



**Jal Shakti Vibhag,
Govt. of Himachal Pradesh, India**

Procurement of Works

- Single-Stage: Two-Envelope Bidding Procedure -

Bidding Document

for

**“Himachal Pradesh Subtropical Horticulture, Irrigation
and Value Addition Project(HP-SHIVA Project)”**

Sep2022

Procurement of Works

Bidding Document For Procurement Of

**Providing Irrigation Facility under HP SHIVA Project for
Kunihar and Nalagarh Block, District Solan (Himachal
Pradesh)– Package- 1**

Issued on: 27-09-2022

Invitation for Bids No.: HPSHIVA-E-tender-CWJ/IRG/SLN-01/2022-23

OCB No: HPSHIVA/OCB-CWJ/IRG/SLN-01/2022-23

Employer: Jal Shakti Vibhag, Govt. of Himachal Pradesh

Country: India

Preface

This Bidding Document for the Procurement of Works has been prepared by Department of Irrigation and Public Health, Himachal Pradesh and is based on the Standard Bidding Document for the Procurement of Works–Small Contracts (**SBD - 1S2E**) issued by the Asian Development Bank dated **December 2021**.

ADB's **SBD -1S2E** has the structure and the provisions of the Master Procurement Document entitled "Bidding Documents for the Procurement of Works–Small Contracts", prepared by multilateral development banks and other public international financial institutions except where ADB-specific considerations have required a change.

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Section 1: Instructions to Bidders

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A. General

1. **Scope of Bid**
 - 1.1 In connection with the Invitation for Bids (IFB) indicated in the Bid Data Sheet (BDS), the Employer, as indicated in the BDS, issues this Bidding Document for the procurement of the Works as specified in Section 6 (Employer's Requirements). The name, identification, and number of contracts of this bidding are provided in the BDS.
 - 1.2 Throughout this Bidding Document,
 - (a) the term "in writing" means communicated in written form and delivered against receipt;
 - (b) except where the context requires otherwise, words indicating the singular also include the plural and words indicating the plural also include the singular; and
 - (c) "day" means calendar day.
2. **Source of Funds**
 - 2.1 The Borrower or Recipient (hereinafter called "Borrower") indicated in the BDS has applied for or received financing (hereinafter called "funds") from the Asian Development Bank (hereinafter called "ADB") toward the cost of the project named in the BDS. The Borrower intends to apply a portion of the funds to eligible payments under the contract(s) for which this Bidding Document is issued.
 - 2.2 Payments by ADB will be made only at the request of the Borrower and upon approval by ADB in accordance with the terms and conditions of the Financing Agreement between the Borrower and ADB (hereinafter called "Financing Agreement"), and will be subject in all respects to the terms and conditions of that Financing Agreement. No party other than the Borrower shall derive any rights from the Financing Agreement or have any claim to the funds.
3. **Fraud and Corruption**
 - 3.1 ADB requires Borrowers (including beneficiaries of ADB-financed activity) and their personnel, as well as firms and individuals participating in an ADB-financed activity, including but not limited to, Bidders, Suppliers, and Contractors, agents, subcontractors, subconsultants, service providers, subsuppliers, manufacturers (including their respective officers, directors, employees and personnel) under ADB-financed contracts to observe the highest standard of ethics during the procurement and execution of such contracts in accordance with ADB's Anticorruption Policy (1998, as amended from time to time). In pursuance of this policy, ADB
 - (a) defines, for the purposes of this provision, the terms set forth below as follows:
 - (i) "corrupt practice" means the offering, giving, receiving, or soliciting, directly or indirectly, anything of value to influence improperly the actions of another party;
 - (ii) "fraudulent practice" means any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation;
 - (iii) "coercive practice" means impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party;

- (iv) “collusive practice” means an arrangement between two or more parties designed to achieve an improper purpose, including influencing improperly the actions of another party;
 - (v) “abuse” means theft, waste, or improper use of assets related to ADB-related activity, either committed intentionally or through reckless disregard;
 - (vi) “conflict of interest” means any situation in which a party has interests that could improperly influence that party’s performance of official duties or responsibilities, contractual obligations, or compliance with applicable laws and regulations; and
 - (vii) “integrity violation” is any act, as defined under ADB’s Integrity Principles and Guidelines (2015, as amended from time to time), which violates ADB’s Anticorruption Policy, including (i) to (vi) above and the following: obstructive practice, violations of ADB sanctions, retaliation against whistleblowers or witnesses, and other violations of ADB’s Anticorruption Policy, including failure to adhere to the highest ethical standard.
- (b) will reject a proposal for award if it determines that the Bidder recommended for award or any of its officers, directors, employees, personnel, subconsultants, subcontractors, service providers, suppliers or manufacturers has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices or other integrity violations in competing for the Contract;
 - (c) will cancel the portion of the financing allocated to a contract if it determines at any time that representatives of the Borrower or of a beneficiary of ADB financing engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices or other integrity violations during the procurement or the execution of that contract, without the Borrower having taken timely and appropriate action satisfactory to ADB to remedy the situation, including by failing to inform ADB in a timely manner at the time they knew of the integrity violations;
 - (d) will impose remedial actions on a firm or an individual, at any time, in accordance with ADB’s Anticorruption Policy and Integrity Principles and Guidelines, including declaring ineligible, either indefinitely or for a stated period of time, to participate¹ in ADB-financed, -administered, or -supported activities or to benefit from an ADB-financed, -administered, or -supported contract, financially or otherwise, if it at any time determines that the firm or individual has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices or other integrity violations; and
 - (e) will have the right to require that a provision be included in bidding documents and in contracts financed, administered, or supported by ADB, requiring Bidders, suppliers, and contractors,

¹ Whether as a Contractor, Subcontractor, Consultant, Manufacturer or Supplier, or Service Provider; or in any other capacity (different names are used depending on the particular Bidding Document).

consultants, manufacturers, service providers and other third parties engaged or involved in ADB-related activities, and their respective officers, directors, employees and personnel, to permit ADB or its representative to inspect the site and their assets, accounts and records and other documents relating to the bid submission and contract performance and to have them audited by auditors appointed by ADB.

- 3.2 All Bidders, consultants, contractors, suppliers, manufacturers, service providers, and other third parties engaged or involved in ADB-related activities, and their respective officers, directors, employees and personnel, are obliged to cooperate fully in any investigation when requested by ADB to do so. As determined on a case by case basis by ADB, such cooperation includes, but is not limited to, the following:
- (a) being available to be interviewed and replying fully and truthfully to all questions asked;
 - (b) providing ADB with any items requested that are within the party's control including, but not limited to, documents and other physical objects;
 - (c) upon written request by ADB, authorizing other related entities to release directly to ADB such information that is specifically and materially related, directly or indirectly, to the said entities or issues which are the subject of the investigation;
 - (d) cooperating with all reasonable requests to search or physically inspect their person and/or work areas, including files, electronic databases, and personal property used on ADB activities, or that utilizes ADB's Information and Communications Technology (ICT) resources or systems (including mobile phones, personal electronic devices, and electronic storage devices such as external disk drives);
 - (e) cooperating in any testing requested by ADB, including but not limited to, fingerprint identification, handwriting analysis, and physical examination and analysis; and
 - (f) preserving and protecting confidentiality of all information discussed with, and as required by, ADB.
- 3.3 All Bidders, consultants, contractors and suppliers shall require their officers, directors, employees, personnel, agents to ensure that, in its contracts with its subconsultants, Subcontractors and other third parties engaged or involved in ADB-related activities, such subconsultants, Subcontractors and other third parties similarly are obliged to cooperate fully in any investigation when requested by ADB to do so.
- 3.4 The Employer hereby puts the Bidder on notice that the Bidder or any Joint Venture partner of the Bidder (if any) may not be able to receive any payments under the Contract if the Bidder or any of its Joint Venture partners, as appropriate, is, or is owned (in whole or in part) by a person or entity subject to applicable sanctions.
- 3.5 Furthermore, Bidders shall be aware of the provisions of GCC 28.3 and 73.2 (i).

4. Eligible Bidders

- 4.1 A Bidder may be a natural person, private entity, or government-owned enterprise subject to ITB 4.5 – or any combination of them with a formal intent to enter into an agreement or under an existing agreement in the form of a Joint Venture. In the case of a Joint Venture:
- (a) all partners shall be jointly and severally liable; and
 - (b) the Joint Venture shall nominate a Representative who shall have the authority to conduct all business for and on behalf of any and all the parties of the Joint Venture during the bidding process and, in the event the Joint Venture is awarded the Contract, during contract execution.
- 4.2 A Bidder, and all parties constituting the Bidder, shall have the nationality of an eligible country, in accordance with Section 5 (Eligible Countries). A Bidder shall be deemed to have the nationality of a country if the Bidder is a citizen or is constituted, incorporated, or registered, and operates in conformity with the provisions of the laws of that country. This criterion shall also apply to the determination of the nationality of proposed Subcontractors or Suppliers for any part of the Contract including related services.
- 4.3 A Bidder shall not have a conflict of interest. All Bidders found to have a conflict of interest shall be disqualified. A Bidder may be considered to be in a conflict of interest with one or more parties in this bidding process if any of, including but not limited to, the following apply:
- (a) they have controlling shareholders in common; or
 - (b) they receive or have received any direct or indirect subsidy from any of them; or
 - (c) they have the same legal representative for purposes of this bid; or
 - (d) they have a relationship with each other, directly or through common third parties, that puts them in a position to have access to material information about or improperly influence the Bid of another Bidder, or influence the decisions of the Employer regarding this bidding process; or
 - (e) a Bidder participates in more than one bid in this bidding process, either individually or as a partner in a Joint Venture, except for alternative offers permitted under ITB 13 of the Bidding Document. This will result in the disqualification of all Bids in which it is involved. However, subject to any finding of a conflict of interest in terms of ITB 4.3 (a)-(d) above, this does not limit the participation of a Bidder as a Subcontractor in another Bid or of a firm as a Subcontractor in more than one Bid; or
 - (f) a Bidder, Joint Venture partner, associates, parent company, or any affiliated entity, participated as a Consultant in the preparation of the design or technical specifications of the works that are the subject of the Bid; or
 - (g) a Bidder was affiliated with a firm or entity that has been hired (or is proposed to be hired) by the Employer or Borrower as Engineer for the contract; or

- (h) a Bidder would be providing goods, works, or nonconsulting services resulting from or directly related to consulting services for the preparation or implementation of the project specified in the BDS ITB 2.1 that it provided or were provided by any affiliate that directly or indirectly controls, is controlled by, or is under common control with that firm; or
- (i) a Bidder that has a financial or familial relationship with staff of the Employer including project implementing/executing agency, or of a recipient of a part of the loan who: (i) are directly or indirectly involved in the preparation of the bidding documents or specifications of the contract, and/or the bid evaluation process of such contract; or (ii) would be involved in the implementation or supervision of such contract unless the conflict stemming from such relationship has been resolved in a manner acceptable to ADB throughout the procurement process and execution of the contract.

- 4.4 A firm will not be eligible to participate in any procurement activities under an ADB-financed, -administered, or -supported project while under temporary suspension or debarment by ADB pursuant to its Anticorruption Policy (see ITB 3), whether such debarment was directly imposed by ADB, or enforced by ADB pursuant to the Agreement for Mutual Enforcement of Debarment Decisions. A bid from a temporarily suspended or debarred firm will be rejected and such bid may be in breach of debarment conditions, thereby subject to further ADB's investigation.
- 4.5 Government-owned enterprises in the Employer's country shall be eligible only if they can establish that they (i) are legally and financially autonomous, (ii) operate under commercial law, and (iii) are not a dependent agency of the Employer.
- 4.6 A Bidder shall not be under suspension from Bidding by the Employer as the result of the execution of a Bid-Securing Declaration.
- 4.7 Bidders shall provide such evidence of their continued eligibility satisfactory to the Employer, as the Employer shall reasonably request.
- 4.8 Bidders shall be excluded if, by an act of compliance with a decision of the United Nations Security Council taken under Chapter VII of the Charter of the United Nations, the Borrower's country prohibits any import of goods from, or payments to, a particular country, person or entity in respect of goods or services originating in that country. Where the Borrower's country prohibits payments to a particular person or entity or for particular goods or services by such an act of compliance, that firm shall be excluded.

5. Eligible Materials, Equipment and Services

- 5.1 The materials, equipment, and services to be supplied under the Contract shall have their origin in eligible source countries as defined in ITB 4.2 above and all expenditures under the Contract will be limited to such materials, equipment, and services. At the Employer's request, Bidders may be required to provide evidence of the origin of materials, equipment, and services.

- 5.2 For purposes of ITB 5.1 above, “origin” means the place where the materials and equipment are mined, grown, produced, or manufactured, and from which the services are provided. Materials and equipment are produced when, through manufacturing, processing, or substantial or major assembling of components, a commercially recognized product results that differs substantially in its basic characteristics or in purpose or utility from its components.

B. Contents of Bidding Document

6. Sections of Bidding Document

- 6.1 The Bidding Document consists of Parts I, II, and III, which include all the sections indicated below, and should be read in conjunction with any addenda issued in accordance with ITB 8.

PART I Bidding Procedures

- Section 1 Instructions to Bidders (ITB)
- Section 2 Bid Data Sheet (BDS)
- Section 3 Evaluation and Qualification Criteria (EQC)
- Section 4 Bidding Forms (BDF)
- Section 5 Eligible Countries (ELC)

PART II Requirements

- Section 6 Employer's Requirements (ERQ)

PART III Conditions of Contract and Contract Forms

- Section 7 General Conditions of Contract (GCC)
- Section 8 Particular Conditions of Contract (PCC)
- Section 9 Contract Forms (COF)

- 6.2 The IFB issued by the Employer is not part of the Bidding Document.
- 6.3 The Employer is not responsible for the completeness of the Bidding Document and their Addenda, if they were not obtained directly from the source stated by the Employer in the IFB.
- 6.4 The Bidder is expected to examine all instructions, forms, terms, and specifications in the Bidding Document. Failure to furnish all information or documentation required by the Bidding Document may result in the rejection of the bid.

7. Clarification of Bidding Document, Site Visit, Pre-Bid Meeting

- 7.1 A prospective Bidder requiring any clarification on the Bidding Document shall contact the Employer in writing at the Employer's address indicated in the BDS or raise his inquiries during the pre-bid meeting if provided for in accordance with ITB 7.4. The Employer will respond in writing to any request for clarification, provided that such request is received prior to the deadline for submission of bids, within a period given in the BDS. The Employer shall forward copies of its response to all Bidders who have acquired the Bidding Document in accordance with ITB 6.3, including a description of the inquiry but without identifying its source. Should the Employer deem it necessary to amend the Bidding Document as a result of a request for clarification, it shall do so following the procedure under ITB 8 and ITB 22.2.

- 7.2 The Bidder is advised to visit and examine the Site of Works and its surroundings and obtain for itself, on its own risk and responsibility, all information that may be necessary for preparing the Bid and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the Bidder's own expense.
 - 7.3 The Bidder and any of its personnel or agents will be granted permission by the Employer to enter its premises and lands for the purpose of such visit, but only upon the express condition that the Bidder, its personnel, and agents will release and indemnify the Employer and its personnel and agents from and against all liability in respect thereof, and will be responsible for death or personal injury, loss of or damage to property, and any other loss, damage, costs, and expenses incurred as a result of the inspection.
 - 7.4 The Bidder's designated representative is invited to attend a pre-bid meeting, if provided for in the BDS. The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.
 - 7.5 The Bidder is requested to submit any questions in writing, to reach the Employer not later than 1 week before the meeting.
 - 7.6 Minutes of the pre-bid meeting, including the text of the questions raised, without identifying the source, and the responses given, together with any responses prepared after the meeting, will be transmitted promptly to all Bidders who have acquired the Bidding Document in accordance with ITB 6.3. Any modification to the Bidding Document that may become necessary as a result of the pre-bid meeting shall be made by the Employer exclusively through the issue of an addendum pursuant to ITB 8 and not through the minutes of the pre-bid meeting.
 - 7.7 Nonattendance at the pre-bid meeting will not be a cause for disqualification of a Bidder.
- 8. Amendment of Bidding Document**
- 8.1 At any time prior to the deadline for submission of Bids, the Employer may amend the Bidding Document by issuing addenda.
 - 8.2 Any addendum issued shall be part of the Bidding Document and shall be communicated in writing to all who have obtained the Bidding Document from the Employer in accordance with ITB 6.3.
 - 8.3 To give prospective Bidders reasonable time in which to take an addendum into account in preparing their Bids, the Employer may, at its discretion, extend the deadline for the submission of Bids, pursuant to ITB 22.2.

C. Preparation of Bids

- 9. Cost of Bidding**
- 9.1 The Bidder shall bear all costs associated with the preparation and submission of its Bid, and the Employer shall in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

- 10. Language of Bid**
- 10.1 The Bid, as well as all correspondence and documents relating to the bid exchanged by the Bidder and the Employer, shall be written in the language specified in the BDS. Supporting documents and printed literature that are part of the Bid may be in another language provided they are accompanied by an accurate translation of the relevant passages in the language specified in the BDS, in which case, for purposes of interpretation of the Bid, such translation shall govern.
- 11. Documents Comprising the Bid**
- 11.1 The Bid shall comprise two envelopes submitted simultaneously, one called the Technical Bid containing the documents listed in ITB 11.2 and the other the Price Bid containing the documents listed in ITB 11.3, both envelopes enclosed together in an outer single envelope.
- 11.2 The Technical Bid shall comprise the following:
- (a) Letter of Technical Bid;
 - (b) Bid Security or Bid-Securing Declaration, in accordance with ITB 19;
 - (c) alternative Bids, at Bidder's option and if permissible, in accordance with ITB 13;
 - (d) written confirmation authorizing the signatory of the Bid to commit the Bidder, in accordance with ITB 20.2;
 - (e) documentary evidence in accordance with ITB 17, establishing the Bidder's qualifications to perform the contract;
 - (f) Technical Proposal in accordance with ITB 16;
 - (g) any other document required in the BDS.
- 11.3 The Price Bid shall comprise the following:
- (a) Letter of Price Bid;
 - (b) completed Price Schedules, in accordance with ITB 12 and ITB 14, or as stipulated in the BDS;
 - (c) alternative price Bids, at Bidder's option and if permissible, in accordance with ITB 13;
 - (d) any other document required in the BDS.
- 11.4 In addition to the requirements under ITB 11.2, Bids submitted by a Joint Venture shall include a copy of the Joint Venture Agreement entered into by all partners. Alternatively, a Letter of Intent to execute a Joint Venture Agreement in the event of a successful Bid shall be signed by all partners and submitted with the Bid, together with a copy of the proposed agreement.
- 12. Letters of Bid and Schedules**
- 12.1 The Letters of Technical Bid and Price Bid, and the Schedules, and all documents listed under Clause 11, shall be prepared using the relevant forms furnished in Section 4 (Bidding Forms). The forms must be completed without any alterations to the text, and no substitutes shall be accepted. All blank spaces shall be filled in with the information requested and as required in the BDS.

13. Alternative Bids

- 13.1 Unless otherwise indicated in the BDS, alternative Bids shall not be considered.
- 13.2 When alternative times for completion are explicitly invited, a statement to that effect will be included in the BDS, as will the method of evaluating different times for completion.
- 13.3 When specified in the BDS pursuant to ITB 13.1, and subject to ITB 13.4 below, Bidders wishing to offer technical alternatives to the requirements of the Bidding Document must first price the Employer's design as described in the Bidding Document and shall further provide all information necessary for a complete evaluation of the alternative by the Employer, including drawings, design calculations, technical specifications, breakdown of prices, and proposed construction methodology and other relevant details. Only the technical alternatives, if any, of the lowest evaluated Bidder conforming to the basic technical requirements shall be considered by the Employer.
- 13.4 When specified in the BDS, Bidders are permitted to submit alternative technical solutions for specified parts of the Works. Such parts will be identified in the BDS and described in Section 6 (Employer's Requirements). The method for their evaluation will be stipulated in Section 3 (Evaluation and Qualification Criteria).

14. Bid Prices and Discounts

- 14.1 The prices and discounts quoted by the Bidder in the Letter of Price Bid and in the Schedules shall conform to the requirements specified below.
- 14.2 The Bidder shall submit a bid for the whole of the works described in ITB 1.1 by filling in prices for all items of the Works, as identified in Section 4 (Bidding Forms). In case of admeasurement contracts, the Bidder shall fill in rates and prices for all items of the Works described in the Bill of Quantities. Items against which no rate or price is entered by the Bidder will not be paid for by the Employer when executed and shall be deemed covered by the rates for other items and prices in the Bill of Quantities. Unit rates and prices for all items of the Works described in the Bill of Quantities shall be expressed in positive values. If unit rates and prices are expressed in negative values, the bid will be rejected.
- 14.3 The price to be quoted in the Letter of Price Bid shall be the total price of the Bid, excluding any discounts offered. Absence of the total bid price in the Letter of Price Bid may result in the rejection of the Bid.
- 14.4 The Bidder shall quote any discounts and the methodology for their application in the Letter of Price Bid, in accordance with ITB 12.1.
- 14.5 The prices shall be either fixed or adjustable as specified in the BDS.
- (a) In the case of Fixed Price, prices quoted by the Bidder shall be fixed during the Bidder's performance of the contract and not subject to variation on any account. A Bid submitted with an adjustable price will be treated as nonresponsive and rejected.
 - (b) In the case of Adjustable Price, prices quoted by the Bidder shall be subject to adjustment during performance of the contract to

reflect changes in the cost elements such as labor, material, transport, and contractor's equipment in accordance with the provisions of the Conditions of Contract. A Bid submitted with a fixed price will be treated as nonresponsive and be rejected. The Bidder shall furnish the indexes and weightings for the price adjustment formulas in the Tables of Adjustment Data included in Section 4 (Bidding Forms) and the Employer may require the Bidder to justify its proposed indexes and weightings. Any bid that omits indexes and weightings shall be subject to clarification with the Bidder.

- 14.6 If so indicated in ITB 1.1, bids are being invited for individual contracts or for any combination of contracts (packages). Bidders wishing to offer any price reduction for the award of more than one Contract shall specify in their bid the price reductions applicable to each package, or alternatively, to individual Contracts within the package. Price reductions or discounts shall be submitted in accordance with ITB 14.4, provided the Bids for all contracts are submitted and opened at the same time.
- 14.7 All duties, taxes, and other levies payable by the Contractor under the Contract, or for any other cause, as of the date 28 days prior to the deadline for submission of bids, shall be included in the rates and prices and the total Bid Price submitted by the Bidder.

15. Currencies of Bid and Payment

- 15.1 The currency(ies) of the Bid and payment shall be as specified in the BDS.
- 15.2 Bidders may be required by the Employer to justify, to the Employer's satisfaction, their local and foreign currency requirements, and to substantiate that the amounts included in the prices shown in the appropriate form(s) of Section 4, in which case a detailed breakdown of the foreign currency requirements shall be provided by Bidders.

16. Documents Comprising the Technical Proposal

- 16.1 The Bidder shall furnish a Technical Proposal including a statement of work methods, equipment, personnel, schedule, environmental, health and safety (EHS) management plan commensurate with the proposed scope of works, EHS Code of Conduct, and any other information as stipulated in Section 4 (Bidding Forms), in sufficient detail to demonstrate the adequacy of the Bidders' proposal to meet the work requirements and the completion time.

17. Documents Establishing the Qualifications of the Bidder

- 17.1 To establish its qualifications to perform the Contract in accordance with Section 3 (Evaluation and Qualification Criteria) the Bidder shall provide the information requested in the corresponding information sheets included in Section 4 (Bidding Forms).
- 17.2 Domestic Bidders, individually or in Joint Ventures, applying for eligibility for domestic preference shall supply all information required to satisfy the criteria for eligibility in accordance with ITB 35.

18. Period of Validity of Bids

- 18.1 Bids shall remain valid for the bid validity period specified in the BDS. The bid validity period starts from the date fixed for the bid submission

deadline date prescribed by the Employer in accordance with ITB 22.1. A bid valid for a shorter period shall be rejected by the Employer as nonresponsive.

18.2 In exceptional circumstances, prior to the expiration of the bid validity period, the Employer may request Bidders to extend the period of validity of their Bids. The request and the responses shall be made in writing. If a bid security is requested in accordance with ITB 19, it shall also be extended 28 days beyond the deadline of the extended validity period. A Bidder may refuse the request without forfeiting its bid security. A Bidder granting the request shall not be required or permitted to modify its Bid.

19. Bid Security/Bid-Securing Declaration

19.1 Unless otherwise specified in the BDS, the Bidder shall furnish as part of its Bid, in original form, either a Bid-Securing Declaration or a bid security as specified in the BDS. In the case of a bid security, the amount and currency shall be as specified in the BDS.

19.2 If a Bid-Securing Declaration is required pursuant to ITB 19.1, it shall use the form included in Section 4 (Bidding Forms). The Employer will declare a Bidder ineligible to be awarded a Contract for a specified period of time, as indicated in the BDS, if the Bid-Securing Declaration is executed.

19.3 If a bid security is specified pursuant to ITB 19.1, the bid security shall be, at the Bidder's option, in any of the following forms:

- (a) an unconditional bank guarantee (hard copy of the bank guarantee or in the form of SWIFT message MT760), or
- (b) an irrevocable letter of credit, or
- (c) a cashier's or certified check.

all from a reputable bank from an eligible country as described in Section 5 (Eligible Countries). In the case of a bank guarantee, the bid security shall be submitted either using the Bid Security Form included in Section 4 (Bidding Forms) or another form acceptable to the Employer. The form must include the complete name of the Bidder. The bid security shall be valid for 28 days beyond the original validity period of the bid, or beyond any period of extension if requested under ITB 18.2.

19.4 Unless otherwise specified in the BDS, any Bid not accompanied by a substantially compliant bid security or Bid-Securing Declaration, if one is required in accordance with ITB 19.1, shall be rejected by the Employer as nonresponsive.

19.5 If a bid security is specified pursuant to ITB 19.1, the bid security of substantially nonresponsive Technical Bids shall be returned before opening the Price Bids. The bid security of unsuccessful Bidders at Price Bid evaluation shall be returned promptly upon the successful Bidder's furnishing of the performance security pursuant to ITB 45.

19.6 If a bid security is specified pursuant to ITB 19.1, the bid security of the successful Bidder shall be returned promptly once the successful Bidder has signed the Contract and furnished the required

performance security.

19.7 The bid security may be forfeited or the Bid-Securing Declaration executed, if

- (a) notwithstanding ITB 24.3, a Bidder withdraws its bid during the period of bid validity specified by the Bidder on the Letters of Technical Bid and Price Bid, except as provided in ITB 18.2; or
- (b) the successful Bidder fails to
 - (i) sign the Contract in accordance with ITB 44;
 - (ii) furnish a performance security in accordance with ITB 45;
 - (iii) accept arithmetical corrections in accordance with ITB 34; or
 - (iv) furnish a domestic preference security, if applicable, in accordance with ITB 45.

19.8 If the bid security is required as per ITB 19.1, the bid security of a Joint Venture shall be in the name of the Joint Venture that submits the Bid. If the Joint Venture has not been legally constituted at the time of bidding, the bid security shall be in the name of any or all of the Joint Venture partners. If the Bid-Securing Declaration is required as per ITB 19.1, the Bid-Securing Declaration of a Joint Venture shall be in the name of the Joint Venture that submits the Bid. If the Joint Venture has not been legally constituted at the time of bidding, the Bid-Securing Declaration shall be in the names of all future partners as named in the letter of intent mentioned in ITB 4.1.

20. Format and Signing of Bid

20.1 The Bidder shall prepare one original set of the Technical Bid and one original of the Price Bid comprising the Bid as described in ITB 11 and clearly mark it "ORIGINAL - TECHNICAL BID" and "ORIGINAL - PRICE BID." Alternative Bids, if permitted in accordance with ITB 13, shall be clearly marked "ALTERNATIVE." In addition, the Bidder shall submit copies of the Bid in the number specified in the BDS, and clearly mark each of them "COPY." In the event of any discrepancy between the original and the copies, the original shall prevail.

20.2 The original and all copies of the Bid shall be typed or written in indelible ink and shall be signed by a person duly authorized to sign on behalf of the Bidder. This authorization shall consist of a written confirmation as specified in the BDS and shall be attached to the Bid. The name and position held by each person signing the authorization must be typed or printed below the signature. If a Bidder submits a deficient authorization, the Bid shall not be rejected in the first instance. The Employer shall request the Bidder to submit an acceptable authorization within the number of days as specified in the BDS. Failure to provide an acceptable authorization within the period stated in the Employer's request shall cause the rejection of the Bid. If either the Letter of Technical Bid or Letter of Price Bid or the Bid-Securing Declaration (if applicable) is not signed, the Bid shall be rejected.

20.3 Any amendments such as interlineations, erasures, or overwriting shall be valid only if they are signed or initialed by the person signing the Bid.

D. Submission and Opening of Bids

21. Sealing and Marking of Bids

21.1 Bidders shall submit their Bids as specified in the BDS. Procedures for submission, sealing, and marking are as follows:

- (a) Bidders submitting Bids by mail or by hand shall enclose the original of the Technical Bid, the original of the Price Bid, and each copy of the Technical Bid and each copy of the Price Bid, in separate sealed envelopes, duly marking the envelopes as "ORIGINAL - TECHNICAL BID," "ORIGINAL - PRICE BID," and "COPY NO... - TECHNICAL BID," and "COPY NO.... - PRICE BID." These envelopes, the first containing the originals and the others containing copies, shall then be enclosed in one single envelope per set. If permitted in accordance with ITB 13, alternative Bids shall be similarly sealed, marked and included in the sets. The rest of the procedure shall be in accordance with ITB 21.2 and ITB 21.3.
- (b) Bidders submitting Bids electronically shall follow the electronic bid submission procedures specified in the BDS.

21.2 The inner and outer envelopes shall

- (a) bear the name and address of the Bidder;
- (b) be addressed to the Employer as provided in BDS 22.1; and
- (c) bear the specific identification of this bidding process indicated in the BDS 1.1.

21.3 The outer envelopes and the inner envelopes containing the Technical Bid shall bear a warning not to open before the time and date for the opening of Technical Bid, in accordance with ITB 25.1.

21.4 The inner envelopes containing the Price Bid shall bear a warning not to open until advised by the Employer in accordance with ITB 25.7.

21.5 If all envelopes are not sealed and marked as required, the Employer will assume no responsibility for the misplacement or premature opening of the Bid.

22. Deadline for Submission of Bids

22.1 Bids must be received by the Employer at the address and no later than the date and time indicated in the BDS.

22.2 The Employer may, at its discretion, extend the deadline for the submission of Bids by amending the Bidding Document in accordance with ITB 8, in which case all rights and obligations of the Employer and Bidders previously subject to the deadline shall thereafter be subject to the deadline as extended.

23. Late Bids

23.1 The Employer shall not consider any Bid that arrives after the deadline for submission of bids, in accordance with ITB 22. Any Bid received by the Employer after the deadline for submission of Bids shall be declared late, rejected, and returned unopened to the Bidder.

24. Withdrawal, Substitution, and Modification of Bids

- 24.1 A Bidder may withdraw, substitute, or modify its Bid – Technical or Price – after it has been submitted by sending a written notice, duly signed by an authorized representative, and shall include a copy of the authorization in accordance with ITB 20.2 (except for withdrawal notices, which do not require copies). The corresponding substitution or modification of the Bid must accompany the respective written notice. All notices must be
- (a) prepared and submitted in accordance with ITB 20 and ITB 21 (except for withdrawal notices, which do not require copies), and in addition, the respective envelopes shall be clearly marked “WITHDRAWAL,” “SUBSTITUTION,” “MODIFICATION;” and
 - (b) received by the Employer prior to the deadline prescribed for submission of Bids, in accordance with ITB 22.
- 24.2 Bids requested to be withdrawn in accordance with ITB 24.1 shall be returned unopened to the Bidders.
- 24.3 No Bid may be withdrawn, substituted, or modified in the interval between the deadline for submission of Bids and the expiration of the period of bid validity specified by the Bidder on the Letters of Technical Bid and Price Bid or any extension thereof.

25. Bid Opening

- 25.1 The Employer shall open the Technical Bids in public at the address, on the date, and time specified in the BDS in the presence of Bidders’ designated representatives and anyone who choose to attend. Any specific electronic bid opening procedures required if electronic bidding is permitted in accordance with ITB 21.1, shall be as specified in the BDS. The Price Bids will remain unopened and will be held in custody of the Employer until the specified time of their opening. If the Technical Bid and Price Bid are submitted together in one envelope, the Employer may reject the entire Bid. Alternatively, the Price Bid may be immediately resealed for later evaluation.
- 25.2 First, envelopes marked “WITHDRAWAL” shall be opened and read out and the envelope with the corresponding Bid shall not be opened, but returned to the Bidder. No bid withdrawal shall be permitted unless the corresponding withdrawal notice contains a valid authorization to request the withdrawal and is read out at bid opening.
- 25.3 Second, outer envelopes marked “SUBSTITUTION” shall be opened. The inner envelopes containing the Substitution Technical Bid and/or Substitution Price Bid shall be exchanged for the corresponding envelopes being substituted, which are to be returned to the Bidder unopened. Only the Substitution Technical Bid, if any, shall be opened, read out, and recorded. Substitution Price Bid will remain unopened in accordance with ITB 25.1. No envelope shall be substituted unless the corresponding substitution notice contains a valid authorization to request the substitution and is read out and recorded at bid opening.
- 25.4 Next, outer envelopes marked “MODIFICATION” shall be opened. No Technical Bid and/or Price Bid shall be modified unless the corresponding modification notice contains a valid authorization to request the modification and is read out and recorded at the opening of Technical Bids. Only the Technical Bids, both Original as well as

Modification, are to be opened, read out, and recorded at the opening. Price Bids, both Original and Modification, will remain unopened in accordance with ITB 25.1.

25.5 All other envelopes holding the Technical Bids shall be opened one at a time, and the following read out and recorded:

- (a) the name of the Bidder;
- (b) whether there is a modification or substitution;
- (c) the presence of a bid security or a Bid-Securing Declaration, if required; and
- (d) any other details as the Employer may consider appropriate.

Only Technical Bids and alternative Technical Bids read out and recorded at bid opening shall be considered for evaluation. Unless otherwise specified in the BDS, all pages of the Letter of Technical Bid are to be initialed by at least three representatives of the Employer attending the bid opening. No Bid shall be rejected at the opening of Technical Bids except for late bids, in accordance with ITB 23.1.

25.6 The Employer shall prepare a record of the opening of Technical Bids that shall include, as a minimum, the name of the Bidder and whether there is a withdrawal, substitution, or modification; alternative proposals; and the presence or absence of a bid security or a Bid-Securing Declaration, if one was required. The Bidders' representatives who are present shall be requested to sign the record. The omission of a Bidder's signature on the record shall not invalidate the contents and effect of the record. A copy of the record shall be distributed to all Bidders who submitted Bids on time, and posted online when electronic bidding is permitted.

25.7 At the end of the evaluation of the Technical Bids, the Employer will invite bidders who have submitted substantially responsive Technical Bids and who have been determined as being qualified for award to attend the opening of the Price Bids. The date, time, and location of the opening of Price Bids will be advised in writing by the Employer. Bidders shall be given reasonable notice for the opening of Price Bids.

25.8 The Employer will notify in writing Bidders who have been rejected for submitting nonresponsive Technical Bids and return their Price Bids unopened together with their bid securities, before opening the Price Bids of the substantially responsive Bidders.

25.9 The Employer shall conduct the opening of Price Bids of all Bidders who submitted substantially responsive Technical Bids, in the presence of Bidders' representatives who choose to attend at the address, on the date, and time specified by the Employer. The Bidder's representatives who are present shall be requested to sign a register evidencing their attendance.

25.10 All envelopes containing Price Bids shall be opened one at a time and the following read out and recorded:

- (a) the name of the Bidder;

- (b) whether there is a modification or substitution;
- (c) the Bid Prices, including any discounts and alternative offers; and
- (d) any other details as the Employer may consider appropriate.

Only Price Bids, discounts, and alternative offers read out and recorded during the opening of Price Bids shall be considered for evaluation. Unless otherwise specified in the BDS, all pages of the Letter of Price Bid and Schedules are to be initialed by at least three representatives of the Employer attending the bid opening. No Bid shall be rejected at the opening of Price Bids.

- 25.11 The Employer shall prepare a record of the opening of Price Bids that shall include, as a minimum, the name of the Bidder, the Bid Price (per lot if applicable), any discounts, and alternative offers. The Bidders' representatives who are present shall be requested to sign the record. The omission of a Bidder's signature on the record shall not invalidate the contents and effect of the record. A copy of the record shall be distributed to all Bidders who submitted Bids on time, and posted online when electronic bidding is permitted.

E. Evaluation and Comparison of Bids

26. Confidentiality

- 26.1 Information relating to the examination, evaluation, comparison, and postqualification of Bids and recommendation of contract award, shall not be disclosed to Bidders or any other persons not officially concerned with such process until on the publication of Contract award.
- 26.2 Any attempt by a Bidder to influence the Employer in the evaluation of the Bids or Contract award decisions may result in the rejection of its Bid.
- 26.3 Notwithstanding ITB 26.2, from the time of bid opening to the time of Contract award, if any Bidder wishes to contact the Employer on any matter related to the bidding process, it may do so in writing.

27. Clarification of Bids

- 27.1 To assist in the examination, evaluation, and comparison of the Technical and Price Bids, the Employer may, at its discretion, ask any Bidder for a clarification of its Bid. Any clarification submitted by a Bidder that is not in response to a request by the Employer shall not be considered. The Employer's request for clarification and the response shall be in writing. No change in the substance of the Technical Bid or prices in the Price Bid shall be sought, offered, or permitted, except to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the Price Bids, in accordance with ITB 33.
- 27.2 If a Bidder does not provide clarifications of its Bid by the date and time set in the Employer's request for clarification, its Bid may be rejected.

28. Deviations, Reservations, and Omissions

- 28.1 During the evaluation of bids, the following definitions apply:
- (a) "Deviation" is a departure from the requirements specified in the Bidding Document;
 - (b) "Reservation" is the setting of limiting conditions or withholding

from complete acceptance of the requirements specified in the Bidding Document; and

- (c) "Omission" is the failure to submit part or all of the information or documentation required in the Bidding Document.

29. Examination of Technical Bids

29.1 The Employer shall examine the Technical Bid to confirm that all documents and technical documentation requested in ITB 11.2 have been provided, and to determine the completeness of each document submitted.

29.2 The Employer shall confirm that the following documents and information have been provided in the Technical Bid. If any of these documents or information is missing, the offer shall be rejected.

- (a) Letter of Technical Bid;
- (b) written confirmation of authorization to commit the Bidder;
- (c) Bid Security or Bid-Securing Declaration, if applicable; and
- (d) Technical Proposal in accordance with ITB 16.

30. Responsiveness of Technical Bid

30.1 The Employer's determination of a Bid's responsiveness is to be based on the contents of the Bid itself, as defined in ITB 11.

30.2 A substantially responsive Technical Bid is one that meets the requirements of the Bidding Document without material deviation, reservation, or omission. A material deviation, reservation, or omission is one that,

- (a) if accepted, would:
 - (i) affect in any substantial way the scope, quality, or performance of the Works specified in the Contract; or
 - (ii) limit in any substantial way, inconsistent with the Bidding Document, the Employer's rights or the Bidder's obligations under the proposed Contract; or
- (b) if rectified, would unfairly affect the competitive position of other Bidders presenting substantially responsive Bids.

30.3 The Employer shall examine the technical aspects of the Bid submitted in accordance with ITB 16, Technical Proposal, in particular, to confirm that all requirements of Section 6 (Employer's Requirements) have been met without any material deviation, reservation, or omission.

30.4 If a Bid is not substantially responsive to the requirements of the Bidding Document, it shall be rejected by the Employer and may not subsequently be made responsive by correction of the material deviation, reservation, or omission.

31. Nonmaterial Nonconformities

31.1 Provided that a Bid is substantially responsive, the Employer may waive any nonconformities in the Bid that do not constitute a material deviation, reservation, or omission.

31.2 Provided that a Technical Bid is substantially responsive, the Employer may request that the Bidder submit the necessary information or documentation, within a reasonable period of time, to rectify

nonmaterial nonconformities in the Technical Bid related to documentation requirements. Requesting information or documentation on such nonconformities shall not be related to any aspect of the Price Bid. Failure of the Bidder to comply with the request may result in the rejection of its Bid.

31.3 Provided that a Technical Bid is substantially responsive, the Employer shall rectify quantifiable nonmaterial nonconformities related to the Bid Price. To this effect, the Bid Price shall be adjusted, for comparison purposes only, to reflect the price of a missing or non-conforming item or component. The adjustment shall be made using the method indicated in Section 3 (Evaluation and Qualification Criteria).

32. Qualification of the Bidder

32.1 The Employer shall determine to its satisfaction during the evaluation of Technical Bids whether Bidders meet the qualifying criteria specified in Section 3 (Evaluation and Qualification Criteria).

32.2 The determination shall be based upon an examination of the documentary evidence of the Bidder's qualifications submitted by the Bidder, pursuant to ITB 17.1. Unless permitted in the BDS, the determination shall not take into consideration the qualifications of other firms such as the Bidder's subsidiaries, parent entities, or affiliates.

32.3 An affirmative determination shall be a prerequisite for the opening and evaluation of a Bidder's Price Bid. The Employer reserves the right to reject the bid of any bidder found to be in circumstances described in GCC 73.2(c). A negative determination shall result into the disqualification of the Bid, in which event the Employer shall return the unopened Price Bid to the Bidder.

33. Subcontractors

33.1 Unless otherwise stated in the BDS, the Employer does not intend for the contractor to execute any specific elements of the Works through nominated subcontractors.

33.2 If Subcontractors are proposed for any of the key activities listed in Section 3 (Evaluation and Qualification) Criteria 2.4.2, they shall be considered as "Specialist Subcontractors" and shall meet qualification requirements for the relevant key activities.

34. Correction of Arithmetical Errors

34.1 During the evaluation of Price Bids, the Employer shall correct arithmetical errors on the following basis:

- (a) Only for admeasurement contracts, if there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail and the total price shall be corrected, unless in the opinion of the Employer there is an obvious misplacement of the decimal point in the unit price, in which case the total price as quoted shall govern and the unit price shall be corrected.
- (b) If there is an error in a total corresponding to the addition or subtraction of subtotals, the subtotals shall prevail and the total shall be corrected.
- (c) If there is a discrepancy between the bid price in the Summary of Bill of Quantities and the bid amount in item (c) of the Letter of

Price Bid, the bid price in the Summary of Bill of Quantities will prevail and the bid amount in item (c) of the Letter of Price Bid will be corrected.

- (d) If there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail subject to (a), (b) and (c) above.

34.2 If the Bidder that submitted the lowest evaluated bid does not accept the correction of errors, its Bid shall be disqualified and its bid security may be forfeited or its Bid-Securing Declaration executed.

35. Conversion to Single Currency

35.1 For evaluation and comparison purposes, the currency(ies) of the Bid shall be converted into a single currency as specified in the BDS.

36. Domestic Preference

36.1 Unless otherwise specified in the BDS, domestic preference shall not apply.

37. Evaluation and Comparison of Price Bids

37.1 The Employer shall use the criteria and methodologies listed in this Clause. No other evaluation criteria or methodologies shall be permitted.

37.2 To evaluate the Price Bid, the Employer shall consider the following:

- (a) the bid price, excluding Provisional Sums and the provision, if any, for contingencies in the Summary Bill of Quantities for admeasurement contracts, or Schedule of Prices for lump sum contracts, but including Daywork items, where priced competitively;
- (b) price adjustment for correction of arithmetic errors in accordance with ITB 34.1;
- (c) price adjustment due to discounts offered in accordance with ITB 14.4;
- (d) converting the amount resulting from applying (a) to (c) above, if relevant, to a single currency in accordance with ITB 35;
- (e) adjustment for nonmaterial nonconformities in accordance with ITB 31.3;
- (f) assessment whether the bid is abnormally low in accordance with ITB 38; and
- (g) application of all the evaluation factors indicated in Section 3 (Evaluation and Qualification Criteria).

37.3 The estimated effect of the price adjustment provisions of the Conditions of Contract, applied over the period of execution of the Contract, shall not be taken into account in bid evaluation.

37.4 If this Bidding Document allows Bidders to quote separate prices for different contracts, and to award multiple contracts to a single Bidder, the methodology to determine the lowest evaluated price of the contract combinations, including any discounts offered in the Letter of Price Bid, is specified in Section 3 (Evaluation and Qualification

Criteria).

37.5 The Employer shall compare all substantially responsive Bids to determine the lowest evaluated Bid, in accordance with ITB 37.2.

38. Abnormally Low Bids

38.1 An abnormally low bid is one where the bid price, in combination with other elements of the bid, appears to be so low that it raises concerns as to the capability of the Bidder to perform the contract for the offered bid price.

38.2 When the offered bid price appears to be abnormally low, the Employer shall undertake a three-step review process as follows:

- (a) identify abnormally low costs and unit rates by comparing them with the engineer's estimates, other substantially responsive bids, or recently awarded similar contracts;
- (b) clarify and analyze the bidder's resource inputs and pricing, including overheads, contingencies and profit margins; and
- (c) decide whether to accept or reject the bid.

38.3 With regard to ITB 38.2 (b) above, the Employer will seek a written explanation from the bidder of the reasons for the offered bid price, including a detailed analysis of costs and unit prices, by reference to the scope, proposed methodology, schedule, and allocation of risks and responsibilities. This may also include information regarding the economy of the manufacturing process; the services to be provided, or the construction method to be used; the technical solutions to be adopted; and any exceptionally favorable conditions available to the bidder for the works, equipment or services proposed.

38.4 After examining the explanation given and the detailed the price analyses presented by the bidder, the Employer may:

- (a) accept the bid, if the evidence provided satisfactorily accounts for the low bid price and costs, in which case the bid is not considered abnormally low;
- (b) accept the bid, but require that the amount of the performance security be increased at the expense of the bidder to a level sufficient to protect the Employer against financial loss. The amount of the performance security shall generally be not more than 20% of the contract price; or
- (c) reject the bid if the evidence provided does not satisfactorily account for the low bid price, and make a similar determination for the next ranked bid, if required.

39. Unbalanced or Front-Loaded Bids

39.1 If the Bid, which results in the lowest evaluated Bid Price, is seriously unbalanced or front-loaded in the opinion of the Employer, the Employer may require the Bidder to produce detailed price analyses for any or all items of the Bill of Quantities, to demonstrate the internal consistency of those prices with the construction methods and schedule proposed, as well as the pricing and sources of materials, equipment and labor.

39.2 After the evaluation of the information and detailed price analyses

presented by the Bidder, the Employer may as appropriate:

- (a) accept the Bid; or
- (b) accept the Bid, but require that the total amount of the Performance Security be increased at the expense of the Bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful Bidder under the Contract subject to ITB 45.2; or
- (c) reject the Bid and make a similar determination for the next ranked bid.

40. Employer's Right to Accept Any Bid, and to Reject Any or All Bids

40.1 The Employer reserves the right to accept or reject any Bid, and to annul the bidding process and reject all Bids at any time prior to contract award, without thereby incurring any liability to Bidders. In case of annulment, all Bids submitted and specifically, bid securities, shall be promptly returned to the Bidders.

41. Notice of Intention for Award of Contract

41.1 If Standstill provisions apply as specified in the BDS, the standstill period shall be defined in the BDS to specify the duration subsequent to notification of intention for award of contract (before making the actual contract award) within which any unsuccessful bidder can challenge the proposed award.

F. Award of Contract

42. Award Criteria

42.1 The Employer shall award the Contract to the Bidder whose offer has been determined in line with ITB 35 to ITB 37 above to be the lowest evaluated Bid and is substantially responsive to the Bidding Document, provided further that the Bidder is determined to be qualified to perform the Contract satisfactorily.

43. Notification of Award

43.1 Prior to the expiration of the period of bid validity and upon expiry of the standstill period specified in ITB 40.1, or upon satisfactory resolution of a complaint filed within standstill period, if applicable, the Employer shall transmit the Notification of Award through issuance of Letter of Acceptance using the form included in Section 9 (Contract Forms) to the successful Bidder, in writing, that its Bid has been accepted. At the same time, the Employer shall also notify all other Bidders of the results of the bidding.

43.2 Unless standstill period applies, upon notification of award through issuance of Letter of Acceptance, unsuccessful Bidders may request in writing to the Employer for a debriefing seeking explanations on the grounds on which their Bids were not selected. The Employer shall promptly respond in writing and/or in a debriefing meeting to any unsuccessful Bidder who, after publication of contract award, requests a debriefing.

43.3 Until a formal contract is prepared and executed, the notification of award through issuance of Letter of Acceptance shall constitute a binding Contract.

43.4 Within 2 weeks of the award of contract or expiry of the standstill period, where such period applies, or, if a complaint has been filed within the standstill period, upon receipt of ADB's confirmation of

satisfactory resolution of the complaint, the borrower shall publish in an English language newspaper or widely known and freely accessible website the results identifying the bid and lot or package numbers, as applicable and the following information:

- (a) name of each Bidder who submitted a Bid;
- (b) bid prices as read out at bid opening;
- (c) name and evaluated prices of each Bid that was evaluated;
- (d) name of Bidders whose bids were rejected and the reasons for their rejection; and
- (e) name of the winning Bidder, and the price it offered, as well as the duration and summary scope of the contract awarded.

44. Signing of Contract

44.1 Promptly after notification, the Employer shall send the successful Bidder the Contract Agreement.

44.2 Within 28 days of receipt of the Contract Agreement, the successful Bidder shall sign, date, and return it to the Employer.

45. Performance Security

45.1 Within 28 days of the receipt of notification of award through issuance of Letter of Acceptance from the Employer, the successful Bidder shall furnish the performance security in accordance with the Conditions of Contract, subject to ITB 38 and ITB 39, using for that purpose the Performance Security Form included in Section 9 (Contract Forms), or another form acceptable to the Employer. If the bank issuing performance security is located outside the Employer's country, it shall be counter-guaranteed or encashable by a bank in the Employer's country.

45.2 Failure of the successful Bidder to submit the abovementioned performance security or to sign the Contract Agreement shall constitute sufficient grounds for the annulment of the award and forfeiture of the bid security or execution of the Bid-Securing Declaration. In that event, the Employer may award the Contract to the next lowest evaluated Bidder whose offer is substantially responsive and is determined by the Employer to be qualified to perform the Contract satisfactorily.

45.3 The above provision shall also apply to the furnishing of a domestic preference security, if so required.

46. Bidding-Related Complaints

46.1 The procedures for dealing with Bidding-Related Complaints arising out of this bidding process are specified in the BDS.

Section 2: Bid Data Sheet

A. General

ITB 1.1	The number of the Invitation for Bids (IFB) is: HPSHIVA-E-tender-CWJ/IRG/SLN-01/2022-23
ITB 1.1	The Employer is: Executive Engineer Cum Project Manager, Jal Shakti Vibhag, Division Nalagarh, Himachal Pradesh Tel.: 01795- 223506 Email: enalagarh@yahoo.in
ITB 1.1	The name of the bidding process is: Open Competitive Bidding (OCB) – Single Stage-Two Envelope (1S2E), through electronic procurement system of Government of Himachal Pradesh The identification number of the bidding process is: HPSHIVA/OCB-CWJ/IRG/SLN-01/2022-23 The number and identification of lots comprising this bidding process is: None
ITB 2.1	The Borrower is: Government of India
ITB 2.1	The name of the Project is: Himachal Pradesh Subtropical Horticulture, Irrigation and Value Addition Project (HPSHIVA)

B. Contents of Bidding Documents

ITB 7.1	For <u>clarification purposes</u> only, the Employer's address is: Attention: Sh. Puneet Sharma, Executive Engineer, Cum Project Manager, Jal Shakti Vibhag, Division Nalagarh, Himachal Pradesh Tel.: 01795- 223506 Email: enalagarh@yahoo.in Requests for clarification should be received by the Employer no later than: Prior to the date and time of pre-bid meeting (Refer ITB 7.4)
ITB 7.4	A Pre-Bid meeting shall take place. Date:06-10-2022 Time: 11.30 AM (IST) Place: Office of the Chief Engineer,

	Jal Shakti Vibhag, Zone Shimla, Govt. of Himachal Pradesh Phone: 0177 - 2832996 Email: ce_south@rediffmail.com Prospective bidder may attend pre meeting in person or virtually. The bidder willing to attend the meeting virtually shall request the Employer through e-mail given in ITB 7.1 A site visit shall be organized by the Employer at the following date, time: Date: W.E.F. 28-09-2022 TO 04-10-2022 Time: 11:00 AM TO 04:00PM The "Site" will mean the entire geographical spread where the proposed work/s is/are expected to be executed. However, the bidder is expected to make themselves thoroughly acquainted with the local conditions prevailing at site of implementation by undertaking field inspection and take into consideration all probable likely factors and difficulties involved during execution of the work as per specification, in all respects (e.g. - transportation of materials, communication facilities, Climate conditions, nature of soil, availability of local labour, market rate prevailing in the locality etc) and no claims whatsoever will be entertained on any such grounds in future.

C. Preparation of Bids

ITB 10.1	The language of the Bid is: English
ITB 11.2 (g)	The Bidder shall submit with its Technical Bid the following additional documents: ▪ In case a Bidder is a Joint Venture, the Bidder shall submit a JV Undertaking document, as follows: JV Undertaking, setting out the legal undertaking between the two or more partners as a JV. This document shall be signed by all the partners who are members of the JV, and shall be addressed to the Employer and shall include: (a) each such member's undertaking to be jointly and severally liable to the Employer for the performance of the Contractor's obligations under the Contract; (b) identification and authorisation of the leader of the JV; and (c) identification of the separate scope or part of the Works (if any) to be carried out by each member of the JV. ▪ Environmental, Health and Safety Management Plan (EHSMP) ▪ COVID-19 protocol
ITB 11.3 (b)	In accordance with ITB 12 and ITB 14, the following schedules shall be submitted with the bid, including the priced Bill of Quantities for admeasurement contracts and Activity Schedule for lump sum contracts: The priced Bill of Quantities
ITB 11.3 (d)	The Bidder shall submit with its Price Bid the following additional documents: None

ITB 12.1	The units and rates in figures entered into the Bill of Quantities and Daywork Schedule should be typewritten or if written by hand, must be in print form. Bill of Quantities and Daywork Schedule not presented accordingly may be considered nonresponsive.
ITB 13.1	Alternative bids shall not be permitted.
ITB 13.2	Alternative times for completion shall not be permitted.
ITB 13.4	Alternative technical solutions shall be permitted for the following parts of the Works: Not Applicable
ITB 14.5	The prices quoted by the Bidder shall not be subject to adjustment during the performance of the Contract.
ITB 15.1	The prices shall be quoted by the bidder and shall be paid in: Indian Rupees (INR)
ITB 16.1	Technical Proposal shall also include a Health and Safety COVID-19 Plan (HS-C19 Plan) as part of the Health and Safety Plan (H&S Plan), and in accordance with relevant government regulations and guidelines on COVID-19 prevention and control, or in the absence thereof, to international good practice guidelines such as World Health Organization. 2020. Considerations for public health and social measures in the workplace in the context of COVID-19. Geneva. Available here: https://www.who.int/publications-detail/considerations-for-public-health-and-social-measures-in-the-workplace-in-the-context-of-covid-19 https://www.who.int/publications-detail/considerations-for-public-health-and-social-measures-in-the-workplace-in-the-context-of-covid-19. The Bidder may also refer to the COVID-19 health and safety guidance for the construction workforce in the IEE. Any bid not accompanied by the H&S Plan with the HS-C19 Plan shall be rejected by the Employer as nonresponsive. If a Bidder submits a HS-C19 Plan that does not provide sufficient information in accordance to the required submission information listed in the bidding document by the Employer, the Employer shall issue a clarification to request for further information from the Bidder. The Bidder must submit the requested information within 5 working days of receiving such a request. Failure to provide a satisfactory response to the request for further information within the prescribed period of receiving such a request shall cause the rejection of the Bid.
ITB 18.1	The bid validity period shall be 120 days.
ITB 19.1	The Bidder shall furnish a bid security in the amount of Rs. 52,80,000 (Rupees Fifty Two Lakh Eighty Thousand Only) in form of Bank Guarantee (in the format given in section 4)/ Fixed Deposit Receipt (FDR) pledged in favour of Executive Engineer cum Project Manager, Jal Shakti Vibhag, Division Nalagarh, Himachal Pradesh.
ITB 19.2	The ineligibility period will be: Not Applicable

ITB 19.4	Subject to the succeeding sentences, any bid not accompanied by an irrevocable and callable bid security shall be rejected by the Employer as nonresponsive. If a Bidder submits a bid security that (i) deviates in form, amount, and/or period of validity, or (ii) does not provide sufficient identification of the Bidder (including, without limitation, failure to indicate the name of the Joint Venture or, where the Joint Venture has not yet been constituted, the names of all future Joint Venture Partners), the Employer shall request the Bidder to submit a compliant bid security within 7 days of receiving such a request. Failure to provide a compliant bid security within the prescribed period of receiving such a request shall cause the rejection of the Bid.
ITB 20.1	In addition to the original Bid, the number of copies is: Not Applicable
ITB 20.2	The written confirmation of authorization to sign on behalf of the Bidder shall consist of: The contents of clause 20.2 of ITB shall be replaced as below: The Bidders have to submit their Bids online, encrypt their Bid as per https://hptenders.gov.in portal requirements. The submission of Bid has to be done by submission of Bid Seals (Hashes) of all the envelopes and documents related to the Bid and is required to be uploaded as per time schedule mentioned in the key dates of the Invitation for Bid after signing of the same by the Digital signatures of appropriate authorised representative. The written confirmation of authorization to sign on behalf of the Bidder shall consist of an organizational document, board resolution or its equivalent, or power of attorney specifying the representative's authority to sign the Bid on behalf of, and to legally bind the Bidder. If the Bidder is an intended or an existing Joint Venture, the power of attorney should be signed by all partners and specify the authority of the named representative of the Joint Venture to sign on behalf of, and legally bind the intended or existing Joint Venture. If the Joint Venture has not yet been formed, also include evidence from all proposed Joint Venture partners of their intent to enter into a Joint Venture in the event of a contract award in accordance with ITB 11.2.
ITB 20.2	The Bidder shall submit an acceptable authorization within 7 days.

D. Submission and Opening of Bids

ITB 21.1	Bidders shall submit their Bids electronically.
ITB 21.1 (b)	Electronic bidding submission procedures shall be: In accordance with provisions provided at https://hptenders.gov.in
ITB 22.1	The letter of Technical and Price bid shall be addressed to the following: Attention: Office of: Executive Engineer Cum Project Manager, Jal Shakti Vibhag, Division Nalagarh, Govt. of Himachal Pradesh

	ZIP code: 174101 Country: India The deadline for bid submission is: Date: 27-10-2022 UPTO 11:00AM
ITB 25.1	The opening of the Technical Bid shall take place at: Office of: Executive Engineer Cum Project Manager, Jal Shakti Vibhag, Division Nalagarh, Govt. of Himachal Pradesh ZIP code: 174101 Country: India Date: 27-10-2022 Time: 11:30 AM (IST)
ITB 25.1	Electronic bid opening procedure shall be as follows: The e-Tender will be opened using digital signature certificate of JSV, in accordance with procedures stipulated at www.hptenders.gov.in .
ITB 25.5	Not Applicable
ITB 25.10	Not Applicable

E. Evaluation and Comparison of Bids

ITB 32.2	The qualifications of other firms such as the Bidder's subsidiaries, parent entities, or affiliates shall not be permitted.
ITB 33.1	The Employer does not intend for the contractor to execute any specific elements of the Works through nominated subcontractors.
ITB 35.1	Not applicable.
ITB 36.1	Domestic preference shall not apply.
ITB 41.1	Standstill provisions shall not apply.

F. Award of Contracts

ITB 46.1	The procedures for Bidding-Related Complaints are referenced in the Procurement Regulations for ADB Borrowers (Appendix 7). The Bidder should submit its complaint following these procedures, in writing, to: For the Attention: Chief Engineer, Employer: Jal Shakti Vibhag, Zone Shimla, Govt. of Himachal Pradesh Phone: 0177 - 2832996

	Email: ce_south@rediffmail.com

Section 3: Evaluation and Qualification Criteria

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1. Evaluation

In addition to the criteria listed in ITB 37.2 (a)–(f), other relevant factors are as follows:

1.1 Adequacy of Technical Proposal

Evaluation of the Bidder's Technical Proposal will include an assessment of the Bidder's technical capacity to successfully implement the contract considering its proposed site organization, method statement, mobilization, and construction schedule (to be described by the Bidder in sufficient detail to demonstrate the adequacy of its work methods, scheduling, and material sourcing) including the extent to which they are presented in a consistent manner and comply with requirements stipulated in Section 6 (Employer's Requirements) without material deviation, reservation, or omission.

Noncompliance with equipment and personnel requirements described in Section 6 (Employer's Requirements) shall not normally be a ground for bid rejection, and such noncompliance will be subject to clarification during bid evaluation and rectification prior to contract award.

1.2 Completion Time

An alternative Completion Time, if permitted under ITB 13.2, will be evaluated as follows: **Not Applicable**

1.3 Technical Alternatives

Technical alternatives, if permitted under ITB 13.4, will be evaluated as follows: **Not Applicable**

1.4 Specialist Subcontractors

Only the specific experience of Specialist Subcontractors for key activities specified in criterion 2.4.2 Construction Experience in Key Activities will be considered. The experience of Specialist Subcontractors in contracts of similar size and nature, and their financial resources shall not be added to those of the Bidder for purposes of qualification of the Bidder.

1.5 Quantifiable Nonconformities and Omissions

Subject to ITB 14.2 and ITB 37.2, the evaluated cost of quantifiable nonconformities including omissions, is determined as follows:

"Pursuant to ITB 31.3, the cost of all quantifiable nonmaterial nonconformities shall be evaluated, including omissions in Daywork where competitively priced but excluding omission of prices in the Bill of Quantities. The Employer will make its own assessment of the cost of any nonmaterial nonconformities and omissions for the purpose of ensuring fair comparison of bids."

1.6 Domestic Preference

If domestic preference shall apply under ITB 36.1, the procedure will be as follows as: **Not applicable**

1.7 Other Criteria: Not Applicable

1.7.1 Environmental, Health and Safety Management Plan (EHSMP)

Any bid not accompanied by the EHSMP may be rejected by the Employer as nonresponsive. If a Bidder submits a EHSMP that is not commensurate with the risks and impacts of the proposed works and activities in the bidding document, the Employer shall issue a request for clarification to request for further information from the Bidder. The Bidder must submit the requested information within 7 days of receiving such a request. Failure to provide a satisfactory response to the request for further information within the prescribed period of receiving such a request may cause the rejection of the Bid.

The Employer will take into account the quality of the Health and Safety COVID -19 Plan (HS-C19 Plan) included in the Health and Safety Plan (H&S Plan) attached to the Technical Proposal in its evaluation of the Adequacy of the Technical Proposal.

The bidder should demonstrate in the HS-C19 Plan the health and safety measures they will put in place on site in relation to COVID-19 prevention and controls, including but not limited to, personal protective equipment (PPE) requirements, site set up, training, induction and mobilization of new personnel, equipment and plants cleaning and other hazard management measures while undertaking site work activities, site visitors health and safety protocols, as well as the approach to the monitoring and reporting of the HS-C19 Plan. The HS-C19 Plan should be fit for purpose for the particular construction works of this contract and be aligned with any relevant government regulations and guidelines on COVID-19 prevention and controls, as well as workplace safety requirements, or in the absence thereof, to international good practice guidelines, such as World Health Organization. 2020. Considerations for public health and social measures in the workplace in the context of COVID-19. Geneva. Available here: <https://www.who.int/publications-detail/considerations-for-public-health-and-social-measures-in-the-workplace-in-the-context-of-covid-19>. Also refer to ADB SDCC's advisory in relation to COVID-19 health and safety and international good practices: <https://www.adb.org/publications/safety-well-being-workers-communities-covid-19>. The Bidder may also refer to the COVID-19 health and safety guidance for the construction workforce in the IEE.

1.7.2 Sustainable Procurement

Not Applicable

1.7.3 Life Cycle costs (for Financial Evaluation)

Life cycle costing: shall not apply.

1.7.4 Joint Venture Participation

Joint Venture Representative must be from the Lead Partner. Lead Partner of the Joint Venture must have majority share participation in the JV. Any change in constitution or percentage participation of any JV member shall not be permitted at any stage after the bid submission.

1.8 Multiple Contracts

If works are grouped in multiple contracts and pursuant to ITB 37.4, the Employer shall evaluate and compare Bids on the basis of a contract, or a combination of contracts, or as a total of contracts in

order to arrive at the least-cost combination for the Employer by taking into account discounts offered by Bidders in case of award of multiple contracts. - **Not applicable**

If a Bidder as defined in ITB 4.1 submits several successful (lowest evaluated substantially responsive) bids, the evaluation will also include an assessment of the Bidder's capacity to meet the following aggregated requirements as presented in the bid (as per ITB 42.1)::

- Average annual construction turnover,
- Financial resources,
- Equipment to be allocated, and
- Personnel to be fielded.

2. Qualification

2.1 Eligibility

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	

2.1.1 Nationality

Nationality in accordance with ITB 4.2.	Must meet requirement	Must meet requirement	Must meet requirement	Not applicable	Forms ELI – 1; ELI – 2 with attachments

2.1.2 Conflict of Interest

No conflicts of interest in accordance with ITB 4.3	Must meet requirement	Must meet requirement	Must meet requirement	Not applicable	Letter of Technical Bid

2.1.3 ADB Eligibility

Not having been declared ineligible by ADB, as described in ITB 4.4.	Must meet requirement	Must meet requirement	Must meet requirement	Not applicable	Letter of Technical Bid

2.1.4 Government-Owned Enterprise

Bidder required to meet conditions of ITB 4.5.	Must meet requirement	Must meet requirement	Must meet requirement	Not applicable	Forms ELI - 1, ELI - 2 with attachments

2.1.5 United Nations Eligibility

Not having been excluded by an act of compliance with a United Nations Security Council resolution in accordance with ITB 4.8.	Must meet requirement	Must meet requirement	Must meet requirement	Not applicable	Letter of Technical Bid

2.2 Historical Contract NonPerformance

2.2.1 History of NonPerforming Contracts

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
Non-performance of a contract ^a did not occur as a result of contractor default since 1 st January 2017	Must meet requirement	Must meet requirement	Must meet requirement ^b	Not Applicable	Form CON-1

^a Nonperformance, as decided by the Employer, shall include all contracts where (a) nonperformance was not challenged by the contractor, including through referral to the dispute resolution mechanism under the respective contract, and (b) contracts that were so challenged but fully settled against the contractor. Nonperformance shall not include contracts where Employers decision was overruled by the dispute resolution mechanism. Nonperformance must be based on all information on fully settled disputes or litigation, i.e. dispute or litigation that has been resolved in accordance with the dispute resolution mechanism under the respective contract and where all appeal instances available to the Bidder have been exhausted.

^b This requirement also applies to contracts executed by the Bidder as Joint Venture partner.

2.2.2 Suspension Based on Execution of Bid-Securing Declaration

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
Not under suspension based on execution of a Bid-Securing Declaration pursuant to ITB 4.6.	Must meet requirement	Must meet requirement	Must meet requirement	Not applicable	Letter of Technical Bid

2.2.3 Pending Litigation and Arbitration

Pending litigation and arbitration criterion shall apply.

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
All pending litigation, arbitration, or other material events impacting the net worth and/or liquidity of the bidder, if any, shall be treated as resolved against the Bidder and so shall in total not represent more than . fifty percent (50%) of the Bidder's net worth calculated as the difference between total assets and total liabilities.	Must meet requirement	Not applicable	Must meet requirement	Not applicable	Form CON - 1

2.2.4 Declaration: Environmental, Health and Safety Past Performance

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
Declare any contracts that have been suspended or terminated and/or performance security called by an employer for reasons related to the non-compliance of any environmental, health and safety contractual obligations in the past five years.	Must make the declaration. If the bidder proposes Specialist Sub-contractor/s to meet EQC 2.4.2, those Specialist Sub-contractor/s must also make the declaration	Not applicable	Each partner must make the declaration. If the bidder proposes Specialist Sub-contractor/s to meet EQC 2.4.2, those Specialist Sub-contractor/s must also make the declaration	Not applicable	Form CON-2

2.3 Financial Situation

2.3.1 Historical Financial Performance

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
Submission of audited financial statements or, if not required by the law of the Bidder's country, other financial statements acceptable to the Employer, for the last five years (FY 2016-17, 2017-18, 2018-19, 2019-20 & 2020-2021) to demonstrate the current soundness of the Bidder's financial position. As a minimum, the Bidder's net worth for the last year, calculated as the difference between total assets and total liabilities should be positive .	Must meet requirement	Not applicable	Must meet requirement	Not applicable	Form FIN - 1 with attachments

2.3.2 Average Annual Construction Turnover

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
Minimum average annual construction turnover of INR 35,19,67,000 calculated as total certified payments received for contracts in progress or completed, within the last five years (FY 2016-17, 2017-18, 2018-19, 2019-20 & 2020-2021).	Must meet requirement	Must meet requirement	Must meet 25% of the requirement	Must meet 40% of the requirement	Form FIN - 2

2.3.3 Financial Resources

If the bid evaluation process and the decision for the award of the Contract takes more than 1 year from the date of bid submission, Bidders may be asked to resubmit their current contract commitments and latest information on financial resources supported by latest audited accounts or audited financial statements, or if not required by the law of the Bidder's country, other financial statements acceptable to the Employer, and the Bidders' financial capacity, will be reassessed on this basis.

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
For Single Entities: The Bidder must demonstrate that its financial resources defined in FIN - 3, less its financial obligations for its current contract commitments defined in FIN - 4, meet or exceed the total requirement for the Subject Contract of INR 4,39,96,000	Must meet requirement	Not applicable	Not applicable	Not applicable	Form FIN – 3 and Form FIN – 4
For Joint Ventures: (1) One partner must demonstrate that its financial resources defined in FIN - 3, less its financial obligations for its own current contract commitments defined in FIN - 4, meet or exceed its required share of 40% from the total requirement for the Subject Contract. AND	Not applicable	Not applicable	Not applicable	Must meet requirement	Form FIN – 3 and Form FIN – 4
(2) Each partner must demonstrate that its financial resources defined in FIN - 3, less its financial obligations for its own current contract commitments defined in FIN - 4, meet or exceed its required share of 25% from the total requirement for the Subject Contract. AND	Not applicable	Not applicable	Must meet requirement	Not applicable	Form FIN – 3 and Form FIN – 4
(3) The joint venture must demonstrate that the combined financial resources of all partners defined in FIN - 3, less all the partners' total financial obligations for the current contract commitments defined in FIN - 4, meet or exceed the total requirement for the Subject Contract of INR 4,39,96,000	Not applicable	Must meet requirement	Not applicable	Not applicable	Form FIN – 3 and Form FIN – 4

2.4 Construction Experience

2.4.1 Contracts of Similar Size and Nature

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
Participation as a contractor, Joint Venture partner, or Subcontractor, in at least a minimum number of similar contracts specified below that have been satisfactorily and substantially completed^[1] as a prime contractor, joint venture member, management contractor or sub-contractor within the last Seven [7] years, ending last day of month pervious to the one in which applications are invited and that is similar to the proposed works. The bidder must have completed one similar work costing not less than the amount equal to (INR 21,11,81,000). OR The bidder must have completed two similar works costing each not less than the amount equal to (INR 13,19,88,000). Definition of similar work means "Water Related Project" which includes: ^a 1. Pumping system including all electrical and mechanical components. 2. Piping work or water conveyance system 3. Desilting System/ Water Treatment Plant/ Water storage/ Retaining structure 4. Head work/River intake/ Percolation well/ Jack Well / tube-well/ infiltration gallery. 5. Pump Houses/Building works	Must meet requirement	Must meet requirement as follows: (i) Either one partner must meet requirement Or (ii) any two partners must each demonstrate one (1) satisfactorily and substantially completed contract of similar size and nature	Not applicable ^c	Not applicable	Form EXP - 1 ^d

^[1] Any Contract which is 80% (Physically) complete will be considered Substantially Complete and in that case the value of the completed part of the contract (80%), shall be equal or exceed the minimum value defined in the criteria.

^a For contracts under which the Bidder participated as a Joint Venture partner or Subcontractor, only the Bidder's share, by value, shall be considered to meet this requirement.

^d In addition to the submission requirement Form EXP - 1, the Bidder shall provide the following supporting documents:

[If the Employer will consider a "substantially completed contract" as one in which the works have been completed, insert the following text:

1. Signed Contract Agreement, and
2. Taking-Over Certificate, Certificate of Completion of the Works (or equivalent) or Performance Certificate,

in sufficient detail to verify the contract name, value and completion time (or substantial completion). If the documents are other than in English, an accurate certified translation of these documents in English shall be provided.]

[If the Employer will consider a "substantially completed contract" as one in which the Contractor has completed all its obligations under the contract, insert the following text:

1. Signed Contract Agreement, and
2. Certificate of Completion of the Works (or equivalent) or Performance Certificate,

in sufficient detail to verify the contract name, value and completion time. If the documents are other than in English, an accurate certified translation of these documents in English shall be provided.]

2.4.2 Construction Experience in Key Activities

2.4.2 (a) Must be complied with by the Bidder. In case of a Joint Venture Bidder, the Bidder or at least one of the partners must meet the requirement in the key activity. For contracts under which the Bidder participated as a Joint Venture partner, only the Bidder's designated scope of works under the contracts shall be considered to meet this requirement.

Table A

Criteria	Compliance Requirements		Documents
Requirement	Single Entity	Joint Venture	Submission Requirements
For the above or other contracts executed during the period stipulated in 2.4.1, a minimum construction experience in the following key activities:	Must meet requirement	Must meet requirement	Form EXP – 2
1. Providing, laying and jointing of MS pipeline for water supply or irrigation projects of diameter 100mm or above for minimum pipe length of 7 km in a single contract.	Must meet requirement	Must meet requirement	Form EXP – 2
2. Experience of construction, installation and commissioning of at least one Reinforced Cement Concrete water Storage Tank /OHT/ Water Reservoir in water supply or irrigation projects having a minimum capacity of 100,000 Liters , in a single contract.	Must meet requirement	Must meet requirement	Form EXP – 2

3. Experience of construction, installation and commissioning of check dam/ head weir/ Intake Well in water supply or irrigation projects	Must meet requirement	Must meet requirement	Form EXP – 2

2.4.2. (b) The Employer accepts any of the following activities to be subcontracted. They may be complied with by the Bidder or by its proposed Specialist Subcontractor.

If the key activity is to be undertaken by a Specialist Subcontractor, the Employer shall require evidence of the subcontracting agreement from the Bidder.

Table B

Criteria	Compliance Requirements		Documents
Requirement	Single Entity or Its Specialist Subcontractors	Joint Venture or Its Specialist Subcontractors	Submission Requirements
For the above or other contracts executed during the period stipulated in 2.4.1, a minimum construction experience is required in the following key activities:	Must meet requirement	Must meet requirement	Form EXP – 2
1. Experience of commissioning SCADA system including all mechanical and electrical works in single contract of a water supply or irrigation project, should include water distribution pipeline and water reservoir/OHT/Water Storage.	Must meet requirement	Must meet requirement	Form EXP – 2

2.4.3 Specific Experience in Managing Environmental, Health and Safety Aspects

Not Applicable

2.5 Organizational Environmental, Health and Safety System

2.5.1 Environmental, Health and Safety Certification

Not Applicable

2.5.2 Environmental, Health and Safety Documentation

Criteria	Compliance Requirements		Documents
Requirement	Single Entity or Its Specialist Subcontractors	Joint Venture or Its Specialist Subcontractors	Submission Requirements
Bidder must have Contractor License to procure workers and have Worker compensation Insurance. Availability of in-house policies and procedures for EHS management.	Must meet requirements	One member must meet requirements Or All members must meet requirements	Form EXP – 5

2.5.3 Environmental, Health and Safety Dedicated Personnel

Criteria	Compliance Requirements		Documents
Requirement	Single Entity or Its Specialist Subcontractors	Joint Venture or Its Specialist Subcontractors	Submission Requirements
One in-house personnel dedicated to EHS issues with 3 years of experience in EHS related projects	Must meet requirements	One member must meet requirements Or All members must meet requirements	Form EXP – 6

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Letter of Technical Bid

Note-

The Bidder must accomplish the Letter of Technical Bid on its letterhead clearly showing the Bidder's complete name and address.

Date:

OCB No.:

Invitation for Bid No.:

To: *[insert complete name of the Employer]*

We, the undersigned, declare that:

- (a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (ITB) 8.
- (b) We acknowledge that we have read and understand ADB's Anticorruption Policy (1998) and Integrity Principles and Guidelines (2015), both as amended from time to time.
- (c) We offer to execute in conformity with the Bidding Documents the following Works: **Providing Irrigation Facility under HP SHIVA Project for Kunihar and Nalagarh Blocks, District Solan (Himachal Pradesh) – Package – 1.**
- (d) Our Bid consisting of the Technical Bid and the Price Bid shall be valid for a period of **120 (One Twenty)** days starts from the date fixed for the bid submission deadline in accordance with ITB 22.1, and it shall remain binding upon us and may be accepted at any time before the expiration of that period.
- (e) Our firm, including any Subcontractors or Suppliers for any part of the Contract, have nationalities from eligible countries in accordance with ITB 4.2.
- (f) We, our directors, key officers, key personnel, including any Subcontractors, consultants, subconsultants, manufacturers, service providers or Suppliers for any part of the contract, do not have any conflict of interest in accordance with ITB 4.3.

If there is any conflict of interest, please state details:

- (i) Parties involved in the conflict of interest: _____
- (ii) Details about the conflict of interest: _____
- (g) We are not participating, as a Bidder, either individually or as partner in a Joint Venture, in more than one Bid in this bidding process in accordance with ITB 4.3(e), other than alternative offers submitted in accordance with ITB 13.
- (h) Our firm, Joint Venture partners, our respective direct and indirect shareholders, directors, key officers, key personnel, associates, parent company, affiliates or subsidiaries, including any Subcontractors, consultants, subconsultants, manufacturers, service providers or Suppliers for any part of the contract, are not subject to, or not controlled by any entity or individual that is subject to, a temporary suspension or a debarment imposed by the Asian Development Bank or a debarment imposed by the Asian Development Bank in accordance with the Agreement for Mutual Enforcement of Debarment Decisions between the Asian Development Bank and other development banks.²

² These institutions include African Development Bank, European Bank for Reconstruction and Development (EBRD), Inter-American Development Bank (IADB), and the World Bank Group. According to paragraph 9 of the Agreement, other international financial institutions may join upon the consent of all Participating Institutions and signature of a Letter of Adherence by the international financial institution substantially in the form provided (Annex B to the Agreement). Upon adherence, such international financial institution shall become a Participating Institution for purposes of the Agreement. Bidders are advised to check www.adb.org/integrity for updates.

- (i) Our firm, Joint Venture partners, our respective direct and indirect shareholders, directors, key officers, key personnel, associates, parent company, affiliates or subsidiaries, including any Subcontractors, consultants, subconsultants, manufacturers, service providers or Suppliers for any part of the contract, are not under ongoing investigation and/or sanctions proceedings by the Asian Development Bank or any multilateral development bank.

If under ongoing investigation and/or sanction proceedings by the Asian Development Bank or any multilateral development bank, please state details:

- (i) Name of the multilateral development bank: _____
(ii) Reason for the ongoing investigation / allegations: _____

- (j) Our firm, Joint Venture partners, our respective direct and indirect shareholders, directors, key officers, key personnel, associates, parent company, affiliates or subsidiaries, including any Subcontractors, consultants, subconsultants, manufacturers, service providers or Suppliers for any part of the Contract, are not temporarily suspended, debarred, declared ineligible, or subject to any national and/or international sanctions by any country, any international organization, any multilateral development bank and other donor agency.

If so temporarily suspended, debarred, declared ineligible, or subject to any national and/or international sanctions by any country, any international organization, any multilateral development bank and other donor agency, please state details (as applicable to each Joint Venture partner, their respective direct or indirect shareholders, directors, key officers, key personnel, associate, parent company, affiliate, subsidiaries, Subcontractors, consultants, subconsultants, manufacturers, service providers and/or Suppliers):

- (i) Name of Institution: _____
(ii) Period of the temporary suspension, debarment, ineligibility, or national or international sanction [start and end date]: _____
(iii) Reason for the temporary suspension, debarment, ineligibility, or national or international sanction: _____

- (k) Our firm, Joint Venture partners, associates, parent company affiliates or subsidiaries, including any Subcontractors, consultants, subconsultants, manufacturers, service providers, Suppliers, key officers, directors and key personnel have never been charged or convicted with any criminal offense (including felonies but excluding misdemeanors) or infractions and/or violations of ordinance; nor charged or found liable in any civil or administrative proceedings in the last 10 years; or undergoing investigation for such, or subject to any criminal, civil or administrative orders, monitorship or enforcement actions.

If so charged, convicted/found liable, under ongoing investigation, or subject to orders, monitorship or enforcement actions, please state details:

- (i) Nature of the offense, violation, proceedings, investigation, and/or monitorship or enforcement actions: _____
(ii) Court, area of jurisdiction and/or the enforcement agency: _____
(iii) Resolution [*i.e. dismissed; settled; or convicted/duration of penalty*]: _____
(iv) Other relevant details [*please specify*]: _____

- (l) Our firm, Joint Venture partners, our respective direct and indirect shareholders, directors, key officers, key personnel, associates, affiliates or subsidiaries, including any Subcontractors, consultants, subconsultants, manufacturers, service providers or Suppliers, can make and receive electronic fund transfer payments through the international banking system or otherwise discharge the Employer's obligation upon initiation of wire transfer.

If unable to make or receive funds through the international banking system or otherwise discharge the Employer's obligation upon initiation of wire transfer, please state the details:

- (i) Nature of the restriction: _____
(ii) Jurisdiction of the restriction: _____
(iii) Other relevant details: _____

- (m) Our firm, Joint Venture partners, associates, parent company, affiliates or subsidiaries, including any Subcontractors, consultants, subconsultants, manufacturers, service providers or Suppliers, key officers, directors and key personnel are not from a country which is prohibited to export goods or services to, or receive any payments from the Employer's country and/or are not prohibited to receive

payments for particular goods or services by the Employer's country by an act of compliance with a decision of the United Nations Security Council taken under Chapter VII of the Charter of the United Nations.

- (n) We have paid, or will pay the following commissions, gratuities, or fees with respect to the bidding process or execution of the Contract.³

Name of Recipient	Address	Reason	Amount
.....			
.....			

- (o) We understand that it is our obligation to notify the Employer of any changes in connection with the matters described in paragraphs (f), (h), (i), (j), (k), (l), (m) and (n) of this Letter of Technical Bid.
- (p) [We are not a government-owned enterprise] / [We are a government-owned enterprise but meet the requirements of ITB 4.5]⁴
- (q) We have not been suspended nor declared ineligible by the Employer based on execution of a Bid-Securing Declaration in accordance with ITB 4.6.
- (r) At any time following submission of our Bid, we shall permit, and shall cause our Joint Venture partners, directors, key officers, key personnel, associates, parent company, affiliates or subsidiaries, including any Subcontractors, consultants, subconsultants, manufacturers, service providers or Suppliers for any part of the contract to permit ADB or its representative to inspect our site, assets, accounts and records and other documents relating to the bid submission and to have them audited by auditors appointed by ADB. We understand that failure of this obligation may constitute obstructive practice that may result in debarment and/or contract termination.
- (s) Regardless of whether the contract will be awarded to us, we shall preserve all accounts, records and other documents related to bid submission for at least 3 years from the date of submission of the bid or the period prescribed in applicable law, whichever is longer.
- (t) If we are awarded the contract, we shall preserve all accounts, records and other documents related to the procurement and execution of the contract for at least 5 years after completing the works contemplated in the relevant contracts or the period prescribed in applicable law, whichever is longer.
- (u) If our Bid is accepted, we commit to mobilizing key equipment and personnel in accordance with the requirements set forth in Section 6 (Employer's Requirements) and our technical proposal, or as otherwise agreed with the Employer.
- (v) We certify on behalf of the Bidder, that the information provided in the bid has been fully reviewed, given in good faith, and to the best of our knowledge is true and complete. We understand that it is our obligation to inform the Employer of any changes to the information as and when it becomes known to us. We understand that any misrepresentation that knowingly or recklessly misleads, or attempts to mislead may lead to the automatic rejection of the Bid or cancellation of the contract, if awarded, and may result in remedial actions, in accordance with ADB's Anticorruption Policy (1998, as amended to date) and Integrity Principles and Guidelines (2015, as amended from time to time).

Name

³ If none has been paid or is to be paid, indicate "None".

⁴ Use one of the two options as appropriate.

In the capacity of

Signed

Duly authorized to sign the Bid for and on behalf of

Date

Letter of Price Bid

Note-

The Bidder must accomplish the Letter of Price Bid on its letterhead clearly showing the Bidder's complete name and address.

Date:

OCB No.:

Invitation for Bid No.:

To: *[insert complete name of the Employer]*

We, the undersigned, declare that:

- (a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (ITB) 8.
- (b) We acknowledge that we have read and understand ADB's Anticorruption Policy (1998) and Integrity Principles and Guidelines (2015), both as amended from time to time.
- (c) We offer to execute in conformity with the Bidding Documents the following Works: **Providing Irrigation Facility under HP SHIVA Project for Kunihar and Nalagarh Blocks, District Solan (Himachal Pradesh) – Package – 1**
- (d) The total price of our Bid, excluding any discounts offered in item (d) below is:

[amount of foreign currency in words], [amount in figures], and [amount of local currency in words], [amount in figures]

The total bid price from the Summary of Bill of Quantities for admeasurement contracts or Activity Schedule for lump sum contracts should be entered by the bidder inside this box. Absence of the total bid price in the Letter of Price Bid may result in the rejection of the bid.

- (e) The discounts offered and the methodology for their application are as follows: *[insert discounts and methodology for their application if any]*
- (f) Our Bid shall be valid for a period of 120 days starts from the date fixed for the bid submission deadline in accordance with ITB 22.1, and it shall remain binding upon us and may be accepted at any time before the expiration of that period.
- (g) If our Bid is accepted, we commit to obtain a performance security in accordance with the Bidding Documents.
- (h) We understand that this bid, together with your written acceptance thereof included in your notification of award through the issuance of Letter of Acceptance, shall constitute a binding contract between us, until a formal contract is prepared and executed.
- (i) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive.
- (j) At any time following submission of our Bid, we shall permit, and shall cause our Joint Venture partners, directors, key officers, key personnel, associates, parent company, affiliates or subsidiaries, including any Subcontractors, consultants, subconsultants, manufacturers, service

providers or Suppliers for any part of the contract to permit ADB or its representative to inspect our site, assets, accounts and records and other documents relating to the bid submission and to have them audited by auditors appointed by ADB. We understand that failure of this obligation may constitute obstructive practice that may result in debarment and/or contract termination.

- (k) Regardless of whether the contract will be awarded to us, we shall preserve all accounts, records and other documents related to bid submission for at least 3 years from the date of submission of the bid or the period prescribed in applicable law, whichever is longer.
- (l) If we are awarded the contract, we shall preserve all accounts, records and other documents related to the procurement and execution of the contract for at least 5 years after completing the works contemplated in the relevant contracts or the period prescribed in applicable law, whichever is longer.
- (m) We confirm and stand by our commitments and other declarations made in connection with the submission of our Letter of Technical Bid.
- (n) We certify on behalf of the Bidder, that the information provided in the bid has been fully reviewed, given in good faith, and to the best of our knowledge is true and complete. We understand that it is our obligation to inform the Employer of any changes to the information as and when it becomes known to us. We understand that any misrepresentation that knowingly or recklessly misleads, or attempts to mislead may lead to the automatic rejection of the Bid or cancellation of the contract, if awarded; and may result in remedial actions, in accordance with ADB's Anticorruption Policy (1998, as amended to date) and Integrity Principles and Guidelines (2015, as amended from time to time).

Name

In the capacity of

Signed

Duly authorized to sign the Bid for and on behalf of

Date

Bid Security

Bank Guarantee

[Bank's name, and address of issuing branch or office]⁵

Beneficiary: [Name and address of the Employer]

Date:

Bid Security No.:

We have been informed that [name of the Bidder] (hereinafter called "the Bidder") has submitted to you its bid dated [please specify] (hereinafter called "the Bid") for the execution of [name of contract] under Invitation for Bids No. [please specify] ("the IFB").

Furthermore, we understand that, according to your conditions, bids must be supported by a bid guarantee.

At the request of the Bidder, we [name of bank] hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of [amount in words] [amount in figures] upon receipt by us of your first demand in writing accompanied by a written statement stating that the Bidder is in breach of its obligation(s) under the bid conditions, because the Bidder

- (a) has withdrawn its Bid during the period of bid validity specified by the Bidder in the Letter of Technical Bid and Letter of Price Bid; or
- (b) does not accept the correction of errors in accordance with the Instructions to Bidders (hereinafter "the ITB"); or
- (c) having been notified of the acceptance of its Bid by the Employer during the period of bid validity, (i) fails or refuses to execute the Contract Agreement, or (ii) fails or refuses to furnish the Performance Security, in accordance with the ITB, or (iii) fails or refuses to furnish the domestic preference security, if required.

This guarantee will expire (a) if the Bidder is the successful Bidder, upon our receipt of copies of the Contract Agreement signed by the Bidder and the Performance Security issued to you upon the instruction of the Bidder; and (b) if the Bidder is not the successful Bidder, upon the earlier of (i) our receipt of a copy your notification to the Bidder of the name of the successful Bidder, or (ii) 28 days after the expiration of the Bidder's bid.

Consequently, any demand for payment under this guarantee must be received by us at the office indicated above on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG) 2010 Revisions, ICC Publication No. 758.⁶

[Authorized signature(s) and bank's seal (where appropriate)]

⁵ All italicized text is for use in preparing this form and shall be deleted from the final document.

⁶ Or the employer may use "Uniform Rules for Demand Guarantees (URDG) ICC Publication No. 458" as appropriate.

Bid-Securing Declaration (Not Applicable)

Date: *[insert date (as day, month and year)]*

Bid No.: *[insert number of bidding process]*

Alternative No.: *[insert identification No if this is a bid for an alternative]*

To: *[insert complete name of the Employer]*

We, the undersigned, declare that:

We understand that, according to your conditions, bids must be supported by a Bid-Securing Declaration.

We accept that we will automatically be suspended from being eligible for bidding in any contract with the Borrower for the period of time of *[insert the number of months or years indicated in ITB 19.2 of the BDS]* starting on the date that we receive a notification from the Employer, if we are in breach of our obligation(s) under the bid conditions, because we

- (a) have withdrawn our Bid during the period of bid validity specified in the Letter of Technical Bid and Letter of Price Bid; or
- (b) do not accept the correction of errors in accordance with the Instruction to Bidders (hereinafter "the ITB"); or
- (c) having been notified of the acceptance of our Bid by the Employer during the period of bid validity, (i) fail or refuse to execute the Contract, if required, (ii) fail or refuse to furnish the Performance Security, in accordance with the ITB, or (iii) fail or refuse to furnish the Domestic Preference Security, if required.

We understand this Bid-Securing Declaration shall expire if we are not the successful Bidder, upon the earlier of (i) our receipt of your notification to us of the name of the successful Bidder; or (ii) 28 days after the expiration of our Bid.

Signed: *[insert signature of person whose name and capacity are shown]*

In the capacity of *[insert legal capacity of person signing the Bid-Securing Declaration]*

Name: *[insert complete name of person signing the Bid-Securing Declaration]*

Duly authorized to sign the bid for and on behalf of *[insert complete name of the bidder]*

Dated on _____ day of _____, _____

Corporate Seal *[where appropriate]*

AFFILIATE COMPANY GUARANTEE (NOT APPLICABLE)

Name of Contract/Contract No.: _____

Name and address of Employer: _____

[together with successors and assigns].

We have been informed that [(name of Contractor)] (hereinafter called the "Contractor") is submitting an offer for the above-referenced Contract in response to your invitation, and that the conditions of your invitation require its offer to be supported by an affiliate company guarantee.

In consideration of you, the Employer, awarding the Contract to the Contractor, we [name of affiliated company] irrevocably and unconditionally guarantee to you, as a primary obligation, that (i) throughout the duration of the Contract, we will make available to the Contractor our financial, technical capacity, expertise and resources required for the Contractor's satisfactory performance of the Contract; and (ii) we are fully committed, along with the Contractor, to ensuring a satisfactory performance of the Contract.

If the Contractor fails to so perform its obligations and liabilities and comply with the Contract, we will indemnify the Employer against and from all damages, losses and expenses (including legal fees and expenses) which arise from any such failure for which the Contractor is liable to the Employer under the Contract.

This guarantee shall come into full force and effect when the Contract comes into full force and effect. If the Contract does not come into full force and effect within a year of the date of this guarantee, or if you demonstrate that you do not intend to enter into the Contract with the Contractor, this guarantee shall be void and ineffective. This guarantee shall continue in full force and effect until all the Contractor's obligations and liabilities under the Contract have been discharged, when this guarantee shall expire and shall be returned to us, and our liability hereunder shall be discharged absolutely.

This guarantee shall apply and be supplemental to the Contract as amended or varied by the Employer and the Contractor from time to time. We hereby authorize them to agree on any such amendment or variation, the due performance of which and compliance with which by the Contractor are likewise guaranteed hereunder. Our obligations and liabilities under this guarantee shall not be discharged by any allowance of time or other indulgence whatsoever by the Employer to the Contractor, or by any variation or suspension of the works to be executed under the Contract, or by any amendments to the Contract or to the constitution of the Contractor or the Employer, or by any other matters, whether with or without our knowledge or consent.

This guarantee shall be governed by the law of the same country (or other jurisdiction) that governs the Contract and any dispute under this guarantee shall be finally settled under the [Rules or Arbitration provided in the Contract]. We confirm that the benefit of this guarantee may be assigned subject only to the provisions for assignment of the Contract.

Signed by:.....

[signature]

.....
[name]

.....
[position in parent/subsidiary company]

Date:.....

Signed by:

[signature]

.....
[name]

.....
[position in parent/subsidiary company]

-- Note --

If permitted in accordance with ITB 32.2 of the BDS, the Bidder shall provide the Affiliate Company Guarantee Form filled out and signed by each subsidiary, parent entity, or affiliate that the Bidder submits for consideration of the Employer in determining its qualifications.

Technical Proposal

Personnel

Form PER – 1: Proposed Personnel

Bidder should provide the details of the proposed personnel and their experience record in the relevant Information Forms below for each candidate:

1.	Title of position
	Name
2.	Title of position
	Name
3.	Title of position
	Name
4.	Title of position
	Name
etc.	Title of position
	Name

-- Note --

All titles of positions will be as listed in Section 6 (Employer's Requirements).

Form PER – 2: Resume of Proposed Personnel

The Bidder shall provide all the information requested below. Use one form for each position.

Position		
Personnel information	Full Legal Name	Date of birth
	Known as	Place of Birth
	Nationality	Citizenship
	Type of Government ID	ID number
	Attach a copy of ID to this form	
	Professional qualifications	
Present employment	Name of employer	
	Address of employer	
	Telephone	Contact (manager / personnel officer)
	Fax	E-mail
	Job title	Years with present employer

Summarize professional experience in reverse chronological order. Indicate particular technical and managerial experience relevant to the project.

From	To	Company / Project / Position / Relevant Technical and Management Experience

Equipment

Form EQU: Equipment

The Bidder shall provide adequate information and details to demonstrate clearly that it has the capability to meet the equipment requirements indicated in Section 6 (Employer's Requirements), using the Forms below. A separate Form shall be prepared for each item of equipment listed, or for alternative equipment proposed by the Bidder.

Item of Equipment		
Equipment Information	Name of manufacturer	Model and power rating
	Capacity	Year of manufacture
Current Status	Current location	
	Details of current commitments	
Source	Indicate source of the equipment ☐ Owned ☐ Rented ☐ Leased ☐ Specially manufactured	

Omit the following information for equipment owned by the Bidder.

Owner	Name of owner	
	Address of owner	
	Telephone	Contact name and title
	Fax	Telex
Agreements	Details of rental / lease / manufacture agreements specific to the project	

Site Organization

Method Statement

Mobilization Schedule

Please reflect the no-objection request and approval step for Site Specific Environmental, Health and Safety Management Plan as per Contract Conditions in the Mobilization Schedule.

Construction Schedule

The construction schedule shall include the following key milestones:

Milestones are given in Section 6 of bid document.

Environmental, Health and Safety Management Plan (EHSMP)

The Bidder shall submit an outline Environmental, Health and Safety Management Plan (EHSMP) commensurate with the risks and impacts of the proposed works and activities. These strategies and plans shall describe in detail the actions, materials, equipment, management processes etc. that will be implemented by the Contractor, and its subcontractors.

In developing these strategies and plans, the Bidder shall have regard to the EHS provisions of the contract and EHS risks including those as may be more fully described in Section 6 (Employer's Requirements).

Environmental, Health and Safety Code of Conduct

Environmental, Health and Safety Code of Conduct for Contractor's Personnel Form

Note to Bidder

The minimum content of the EHS Code of Conduct form as set out by the Employer shall not be substantially modified. However, the Bidder may add requirements as appropriate, including to take into account Contract-specific issues/risks.

The Bidder shall initial and submit the EHS Code of Conduct form as part of its bid.

ENVIRONMENTAL, HEALTH AND SAFETY CODE OF CONDUCT FOR CONTRACTOR'S PERSONNEL

We are the Contractor, [enter name of Contractor]. We have signed a contract with [enter name of Employer] for [enter description of the Works]. These Works will be carried out at [enter the Site and other locations where the Works will be carried out]. Our contract requires us to implement measures to address environmental, health and safety risks related to the Works.

This EHS Code of Conduct is part of our measures to deal with environmental, health and safety risks related to the Works. It applies to all our staff, labourers and other employees at the Works Site or other places where the Works are being carried out. It also applies to the personnel of each subcontractor and any other personnel assisting us in the execution of the Works. All such persons are referred to as "**Contractor's Personnel**" and are subject to this EHS Code of Conduct.

This EHS Code of Conduct identifies the behavior that we require from all Contractor's Personnel.

Our workplace is an environment where unsafe, offensive, abusive or violent behavior will not be tolerated and where all persons should feel comfortable raising issues or concerns without fear of retaliation.

REQUIRED CONDUCT

Contractor's Personnel shall:

1. carry out his/her duties competently and diligently;
2. comply with this EHS Code of Conduct and all applicable laws, regulations and other requirements, including requirements to protect the health, safety and well-being of other Contractor's Personnel and any other person;
3. maintain a safe working environment including by:
 - (a) ensuring that workplaces, machinery, equipment and processes under each person's control are safe and without risk to health;
 - (b) wearing required personal protective equipment;
 - (c) using appropriate measures relating to chemical, physical and biological substances and agents; and
 - (d) following applicable emergency operating procedures.
4. report work situations that he/she believes are not safe or healthy and remove himself/herself from a work situation which he/she reasonably believes presents an imminent and serious danger to his/her life or health;
5. treat other people with respect, and not discriminate against specific groups such as women, people with disabilities, migrant workers or children;
6. report violations of this EHS Code of Conduct; and
7. not retaliate against any person who reports violations of this EHS Code of Conduct, whether to us or the Employer, or who makes use of the grievance mechanism for Contractor's Personnel or the project's Grievance Redress Mechanism.

RAISING CONCERNS

If any person observes behavior that he/she believes may represent a violation of this EHS Code of Conduct, or that otherwise concerns him/her, he/she should raise the issue promptly. This can be done by call [] to reach the Contractor's hotline (*if any*) and leave a message.

The person's identity will be kept confidential, unless reporting of allegations is mandated by the country law. Anonymous complaints or allegations may also be submitted and will be given all due and appropriate consideration. We take seriously all reports of possible misconduct and will investigate and take appropriate action. We will provide warm referrals to service providers that may help support the person who experienced the alleged incident, as appropriate.

CONSEQUENCES OF VIOLATING THE ENVIRONMENTAL, HEALTH AND SAFETY CODE OF CONDUCT

Any violation of this EHS Code of Conduct by Contractor's Personnel may result in serious consequences, up to and including termination and possible referral to legal authorities.

FOR CONTRACTOR'S PERSONNEL:

I have received a copy of this EHS Code of Conduct written in a language that I comprehend. I understand that if I have any questions about this EHS Code of Conduct, I can contact [*enter name of Contractor's contact person(s) with relevant experience*] requesting an explanation.

Name of Contractor's Personnel: [*insert name*]

Signature: _____

Date: [*day month year*]: _____

Countersignature of authorized representative of the Contractor:

Signature: _____

Date: [*day month year*]: _____

Bidders Qualification

To establish its qualifications to perform the contract in accordance with Section 3 (Evaluation and Qualification Criteria) the Bidder shall provide the following information requested in the corresponding Information Sheets.

Form ELI - 1: Bidder's Information Sheet

Bidder's Information			
		Information of the Bidder	If the Bidder is a subsidiary or branch, information of any parent company/companies
Names	Full legal name(s)		
	Full trading name(s) (if any)		
Addresses	Registered address(es)		
	Trading address(es)		
	Postal address(es) (if different from trading address)		
Type of organization			
Country of constitution/incorporation/registration			
Year of constitution/incorporation/registration			
Corporate or registration number			
In case of a Joint Venture, legal name of each partner			
Bidder's authorized representative (name, address, telephone number(s), fax number(s), e-mail address)			
Attached are copies of the following documents. 1) In case of a single entity, articles of incorporation or constitution and company incorporation/registration of the legal entity named above, in accordance with ITB 4.1 and ITB 4.2. 2) Authorization to represent the firm or Joint Venture named above, in accordance with ITB 20.2. 3) In case of a Joint Venture, a letter of intent to form a Joint Venture or Joint Venture agreement, in accordance with ITB 4.1. 4) In case of a government-owned enterprise, any additional documents not covered under 1 above required to comply with ITB 4.5.			

Form ELI - 2: Joint Venture Information Sheet

Each partner of the Joint Venture and Specialist Subcontractor must fill out this form separately.

Joint Venture / Specialist Subcontractor Information			
Bidder's legal name			
		Information of Joint Venture Partner or Specialist Subcontractor	If any Joint Venture Partner or Specialist Subcontractor is a subsidiary or branch, information of any parent company/companies
Names	Full legal name(s)		
	Full trading name(s) (if any)		
Address es	Registered address(es)		
	Trading address (es)		
	Postal address (es) (if different from trading address)		
Type of organization			
Country of constitution/incorporation/registration			
Year of constitution/incorporation/registration			
Corporate or registration number			
Joint Venture Partner's or Specialist Subcontractor's authorized representative information (name, address, telephone number(s), fax number(s), e-mail address)			
Attached are copies of the following documents. 1) Articles of incorporation or constitution and company incorporation/registration of the legal entity named above, in accordance with ITB 4.1 and ITB 4.2. 2) Authorization to represent the firm named above, in accordance with ITB 20.2. 3) In the case of a government-owned enterprise, documents establishing legal and financial autonomy and compliance with commercial law, in accordance with ITB 4.5.			

Form CON – 1: Historical Contract Nonperformance

Each Bidder must fill out this form in accordance with Criteria 2.2.1 and 2.2.3 of Section 3 (Evaluation and Qualification Criteria) to describe any history of nonperforming contracts and pending litigation or arbitration formally commenced against it.

In case of a Joint Venture, each Joint Venture Partner must fill out this form separately and provide the Joint Venture Partner's name:

Joint Venture Partner: _____

Table 1: History of Nonperforming Contracts

Choose one of the following:

- ☐ No nonperforming contracts.
- ☐ Below is a description of nonperforming contracts involving the Bidder (or each Joint Venture partner if Bidder is a Joint Venture).

Year	Description	Amount of Nonperformed Portion of Contract (\$ equivalent)	Total Contract Amount (\$ equivalent)
[insert year]	Contract Identification: [indicate complete contract name/ number, and any other identification] Name of Employer: [insert full name] Address of Employer: [insert street/city/country] Reason(s) for nonperformance: [indicate main reason(s)]	[insert amount]	[insert amount]

Table 2: Pending Litigation and Arbitration

Choose one of the following:

- ☐ No pending litigation, arbitration or any other material events impacting the net worth and/or liquidity of the bidder.
- ☐ Below is a description of all pending litigation, arbitration involving the Bidder or any other material events impacting the net worth and/or liquidity of the bidder (or each Joint Venture partner if Bidder is a Joint Venture).

Year	Matter in Dispute	Value of Pending Claim in \$ Equivalent	Value of Pending Claim as a Percentage of Net Worth
[insert year]	Contract Identification, as applicable: [indicate complete contract name/ number, and any other identification] Name of Employer, parties involved in the material events impacting the net worth and/or liquidity of the bidder: [insert full name] Address of Employer, parties involved in the material events impacting the net worth and/or liquidity of the bidder: [insert street/city/country] Matter of Dispute: [indicate full description of dispute] Party who initiated the dispute: [indicate "Employer" or "Contractor"] Status: [indicate status of dispute]	[insert amount]	[insert amount]

Form CON – 2: EHS Performance Declaration

Each Bidder must fill out this form in accordance with Criterion 2.2.4 of Section 3 (Evaluation and Qualification Criteria).

In case of a Joint Venture, each Joint Venture Partner must fill out this form separately and provide the Joint Venture Partner's name:

Joint Venture Partner: _____

In case of a Specialist Subcontractors, each Specialist Subcontractor must fill out this form and provide the Specialist Subcontractor's name:

Specialist Subcontractor: _____

Environmental and Health and Safety Performance Declaration in accordance with Section 3 (Evaluation and Qualification Criteria)			
☐ No suspension or termination of contract: An employer has not suspended or terminated a contract and/or called the performance security for a contract for reasons related to Environmental or Health and Safety performance since the date specified in Section 3 (Evaluation and Qualification Criteria), Criterion 2.5.			
☐ Declaration of suspension or termination of contract: The following contract(s) has/have been suspended or terminated and/or Performance Security called by an employer(s) for reasons related to Environmental or Health and Safety performance since the date specified in Section 3 (Evaluation and Qualification Criteria), Criterion 2.5. Details are described below:			
☐ Declaration of request for replacement of Key Environment, Health and Safety Personnel: The following contract(s) has/have experienced a request by the Employer to replace Environmental, Health and Safety Personnel for reasons related to Environmental or Health and Safety performance since the date specified in Section 3 (Evaluation and Qualification Criteria), Criterion 2.5. Details are described below:			
☐ Declaration of past fatality resulted from EHS issues on site: The following contract(s) has/have experienced a fatality resulted from EHS issues on site since the date specified in Section 3 (Evaluation and Qualification Criteria), Criterion 2.5. Details are described below:			
Year	Suspended or terminated portion of contract	Contract Identification	Total Contract Amount (current value, currency, exchange rate and US\$ equivalent)
[insert year]	[insert amount and percentage]	Contract Identification: [indicate complete contract name/ number, and any other identification] Name of Employer: [insert full name] Address of Employer: [insert street/city/country] Reason(s) for suspension or termination: [indicate main reason(s) e.g. discharge over environmental limit, workers did not have required health and safety permits to undertake high risk work, work carried out was not adhered to approved construction methodology and quality control plan]	[insert amount]
[insert year]	[insert amount and percentage]	Contract Identification: [indicate complete contract name/ number, and any other identification] Name of Employer: [insert full name] Address of Employer: [insert street/city/country] Reason(s) for suspension or termination: [indicate main	[insert amount]

		<i>reason(s)]</i>	
...	...	<i>[list all applicable contracts]</i>	...
Performance Security called by an employer(s) for reasons related to EHS performance			
Year	Contract Identification	Total Contract Amount (current value, currency, exchange rate and US\$ equivalent)	
<i>[insert year]</i>	Contract Identification: <i>[indicate complete contract name/ number, and any other identification]</i> Name of Employer: <i>[insert full name]</i> Address of Employer: <i>[insert street/city/country]</i> Reason(s) for suspension or termination: <i>[indicate main reason(s) e.g. discharge over environmental limit, workers did not have required health and safety permits to undertake high risk work, work carried out was not adhered to approved construction methodology and quality control plan]</i>	<i>[insert amount]</i>	
Key EHS personnel replacement requested by the Employer for reasons related to EHS performance			
Year	Contract Identification and Reasons	Personnel replacement action and results	
<i>[insert year]</i>	Contract Identification: <i>[indicate complete contract name/ number, and any other identification]</i> Name of Employer: <i>[insert full name]</i> Address of Employer: <i>[insert street/city/country]</i> Reason(s) for requesting for replacement: <i>[indicate main reason(s)]</i>	<i>[insert description]</i>	
Fatality due to EHS issues on Site			
Year	Contract Identification	Follow-on actions taken by the contractor	
<i>[insert year]</i>	Contract Identification: <i>[indicate complete contract name/ number, and any other identification]</i> Name of Employer: <i>[insert full name]</i> Address of Employer: <i>[insert street/city/country]</i> Description of fatality event: Causation:	<i>[insert description]</i>	

Form FIN - 1: Historical Financial Performance

Each Bidder must fill out this form.

In case of a Joint Venture, each Joint Venture Partner must fill out this form separately and provide the Joint Venture Partner's name:

Joint Venture Partner: _____

Financial Data for Previous 5 Years [INR Equivalent]				
Year 1:2016-17	Year 2:2017-18	Year 3:2018-19	Year 4: 2019-20	Year: 2020-21

Information from Balance Sheet

Total Assets (TA)					
Total Liabilities (TL)					
Net Worth = TA – TL					
Current Assets (CA)					
Current Liabilities (CL)					
Working Capital = CA - CL					

Most Recent Working Capital		To be obtained for most recent year and carried forward to FIN - 3 Line 1; in case of Joint Ventures, to the corresponding Joint Venture Partner's FIN - 3.

Information from Income Statement

Total Revenues					
Profits Before Taxes					
Profits After Taxes					

- ☐ Attached are copies of financial statements (balance sheets including all related notes, and income statements) for the last **5 (five)** years, as indicated above, complying with the following conditions.
- 1) Unless otherwise required by Section 3 of the Bidding Document, all such documents reflect the standalone financial situation of legal entity or entities comprising the Bidder and not the Bidder's parent companies, subsidiaries, or affiliates.
 - 2) Historical financial statements must be audited by a certified accountant.
 - 3) Historical financial statements must be complete, including all notes to the financial statements.
 - 4) Historical financial statements must correspond to accounting periods already completed and audited (no statements for partial periods shall be requested or accepted).

Form FIN - 2: Average Annual Construction Turnover

Each Bidder must fill out this form.

The information supplied should be the Annual Turnover of the Bidder or each partner of a Joint Venture for the total certified payments received from the clients for contracts in progress or completed, converted to US dollars at the rate of exchange at the end of the period reported.

In case of a Joint Venture, each Joint Venture Partner must fill out this form separately and provide the Joint Venture Partner's name:

Joint Venture Partner: _____

Annual Turnover Data for the Last 5 Years (Construction only)			
Year	Amount Currency	Exchange Rate	INR Equivalent

Average Annual Construction Turnover

Form FIN – 3: Availability of Financial Resources

Bidder must demonstrate sufficient financial resources, usually comprising of Working Capital supplemented by credit line statements or overdraft facilities and others to meet the Bidder's financial requirements for

- (a) its current contract commitments, and
- (b) the subject contract.

In case of a Joint Venture, each Joint Venture Partner must fill out this form separately and provide the Joint Venture Partner's name:

Joint Venture Partner: _____

Financial Resources		
No.	Source of financing	Amount (INR equivalent)
1	Working Capital (to be taken from FIN - 1)	
2	Credit Line ^a	
3	Other Financial Resources	
	Total Available Financial Resources	

^a To be substantiated by a letter from the bank issuing the line of credit.

Form FIN- 4: Financial Resources Requirement

Bidders (or each Joint Venture partner) should provide information on their current commitments on all contracts that have been awarded, or for which a letter of intent or acceptance has been received, or for contracts approaching completion, but for which an unqualified, full completion certificate has yet to be issued.

In case of a Joint Venture, each Joint Venture Partner must fill out this form separately and provide the Joint Venture Partner's name:

Joint Venture Partner: _____

Current Contract Commitments						
No.	Name of Contract	Employer's Contact (Address, Tel, Fax)	Contract Completion Date	Outstanding Contract Value (X) ^a	Remaining Contract Period in months (Y) ^b	Monthly Financial Resources Requirement (X / Y)
1						
2						
3						
4						
Total Monthly Financial Requirements for Current Contract Commitments						\$

^a Remaining outstanding contract values to be calculated from 28 days prior to the bid submission deadline (\$ equivalent based on the foreign exchange rate as of the same date).

^b Remaining contract period to be calculated from 28 days prior to bid submission deadline.

Form FIN - 5: Self-Assessment Tool for Bidder's Compliance to Financial Resources (Criterion 2.3.3 of Section 3)

This form requires the same information submitted in Forms FIN - 3 and FIN - 4. All conditions of "Available Financial Resources Net of CCC $\geq$ Requirement for the Subject Contract" must be satisfied to qualify.

Form FIN - 5A: For Single Entities

For Single Entities: (A)	Total Available Financial Resources from FIN – 3 (B)	Total Monthly Financial Requirement for Current Contract Commitments (CCC) from FIN – 4 (C)	Available Financial Resources Net of CCC $D = (B - C)$	Requirement for the Subject Contract (E)	Results: Yes or No [D must be greater than or equal to E] (F)
_____ (Name of Bidder)					

Form FIN - 5B: For Joint Ventures

For Joint Ventures: (A)	Total Available Financial Resources from FIN – 3 (B)	Total Monthly Financial Requirement for Current Contract Commitments (CCC) from FIN – 4 (C)	Available Financial Resources Net of CCC $D = (B - C)$	Requirement for the Subject Contract (E)	Results: Yes or No [D must be greater than or equal to E] (F)
One Partner:					
_____ (Name of Partner)					
Each Partner:					
_____ (Name of Partner 1)					
_____ (Name of Partner 2)					
_____ (Name of Partner 3)					
All partners combined	$\Sigma D =$ Sum of available financial resources net of current contract commitments for all partners		$\Sigma D =$ _____		

- Note -

Form FIN – 5 is made available for use by the bidder as a self-assessment tool, and by the Employer as an evaluation work sheet, to determine compliance with the financial resources requirement as stated in 2.3.3. Failure to submit Form FIN - 5 by the Bidder shall not lead to bid rejection.

Form EXP – 1: Contracts of Similar Size and Nature

Fill up one (1) form per contract. Each contract shall be supported by documents such as Signed Contract Agreement or Certificate of Completion of the Works.

The exchange rate to be used to calculate the value of the contract for conversion to a specific currency shall be the selling rate of the Borrower's Central bank on the date of the contract.

Contract of Similar Size and Nature		
Contract No of	Contract Identification	
Award Date		Completion Date
Total Contract Amount	INR	
If partner in a Joint Venture or Subcontractor, specify participation of total contract amount	Percent of Total	Amount
Employer's Name Address Telephone/Fax Number E-mail		
Description of the Similarity in Accordance with Criterion 2.4.1 of Section 3 (Evaluation and Qualification Criteria)		

Form EXP - 2: Construction Experience in Key Activities

Fill up one (1) form per contract. Each contract shall be supported by documents such as Signed Contract Agreement or Certificate of Completion of the Works.

Each Bidder must fill out this form.

If complied by Specialist Subcontractor, each Specialist Subcontractor must fill out this form and provide the Specialist Subcontractor's name:

Specialist Subcontractor: _____

Contract with Similar Key Activities		
Contract No of	Contract Identification	
Award Date		Completion Date
Total Contract Amount	INR	
If partner in a Joint Venture or Subcontractor, specify participation of total contract amount	Percent of Total	Amount
Employer's Name Address Telephone Number Fax Number E-mail		
Description of the Key Activities in Accordance with Criterion 2.4.2 of Section 3 (Evaluation and Qualification Criteria)		

Form EXP – 3: Specific Experience in Managing Environmental, Health and Safety Aspects

Not Applicable

Form EXP – 4: Environmental, Health and Safety Certification

Not Applicable

Form EXP – 5: Environmental, Health and Safety Documentation

Please provide the following information:

Availability of in-house policies and procedures acceptable to the Employer for EHS management:

1. Existence of an Ethics Charter.
2. Existence of a system for monitoring compliance with EHS commitments for the Bidder's Subcontractors and all its partners.
3. Existence of official company procedures for the management of the following relevant points:

[Select 3-5 that apply for the worksite from below options- as per Section 2]

- EHS resources and facilities and EHS monitoring system;
- Project Areas management information (base camps, quarries, burrow pits, storage areas);
- Health and Safety on worksites policy and related guidance;
- Local recruitment and EHS trainings of local staff/subcontractors/local partners;
- Community stakeholder engagement practice;
- Traffic management practice;
- Hazardous products management practice;
- Waste management practice;
- Protection of water resources;
- Biodiversity protection practices;
- Site rehabilitation and revegetation practice;
- Local cultural heritage protection practice;
- Erosion and sedimentation practices;
- Control of infectious and communicable diseases (HIV/AIDS, malaria, COVID-19 etc)

Form EXP – 6: Environmental, Health and Safety Dedicated Personnel

Please provide CV {Form PER-2} of the in-house personnel of the main contractor/Joint Venture partners for the EHS positions specified in Section 6 (Employer's Requirements):

- One in-house personnel dedicated to EHS issues with 3 years of experience in EHS related projects

Schedules (NOT APPLICABLE)

Schedule of Payment Currencies

For insert name of Section of the Works

Separate tables may be required if the various sections of the Works (or of the Bill of Quantities) will have substantially different foreign and local currency requirements. In such a case, the Employer should prepare separate tables for each Section of the Works.

	A	B	C	D
Name of Payment Currency	Amount of Currency	Rate of Exchange to Local Currency	Local Currency Equivalent $C = A \times B$	Percentage of Net Bid Price (NBP) $\frac{100 \times C}{NBP}$
Local Currency		1.00		
Foreign Currency #1				
Foreign Currency #2				
Foreign Currency #3				
Net Bid Price				100.00
Provisional Sums Expressed in Local Currency		1.00		
BID PRICE				

-- Note --

The rates of exchange shall be the selling rates 28 days prior to the deadline for submission of bids published by the source specified in BDS 15.

Table(s) of Adjustment Data (Not Applicable)

Table A - Local Currency Payment

To be entered by the Employer				
Index Code	Index Description	Source of Index *	Base Value and Date	Bidder's Proposed Weighting (coefficient)
L: Labor	Nonadjustable	—	—	a: _____
E: Equipment				b: _____
M1: Material 1				c: _____
M2: Material 2				d: _____
...etc...				e: _____
Total				1.00

To be entered by the Bidder. (Employer may prescribed the range. of weighing)

Table B - Foreign Currency Payment (Not Applicable)

Name of Currency:

[Insert name of currency. If the Bidder wishes to quote in more than one foreign currency, this table should be repeated for each foreign currency such as #1, #2 and #3.]

To be entered by the Bidder				
Index Code	Index Description	Source of Index	Base Value and Date	Bidder's Proposed Weighting (coefficient)
L: Labor	Nonadjustable	—	—	a: _____
E: Equipment				b: _____
M1: Material 1				c: _____
M2: Material 2				d: _____
...etc...				e: _____
Total				1.00

To be entered by the Bidder. (Employer may prescribed the range. of weighing)

— Notes —

- "Base Date" means the date 28 days prior to the deadline for submission of bids.
- For a given currency, the "Source of Index" should be issued or published within the country to which the currency relates.
- Tables of Adjustment Data shall only be included if prices are to be quoted as adjustable prices in accordance with ITB 14.5.

Activity Schedule (Not Applicable)

[Schedules of Prices – Lump Sum Contract]

The Employer shall indicate the list of major activities comprising the works and the number of measurement units consistent with the description of works, drawings, and specifications in Section 6 (Employer's Requirements). Each work item shall be described in sufficient detail to provide clear guidance to Bidders with respect to the type of works, their scope and complexity, and compliance with the required standards.

Bidders are required to enter the prices against each work item on a lump sum basis. Work items against which no lump sum price is entered by the Bidder will not be paid by the Employer when executed and shall be deemed covered by other work items against which the lump sum prices were entered. The sum of prices entered against each work item will represent the total bid price.

The whole cost of complying with the provisions of the Contract shall be included in the Items provided in the Activity Schedule, and where no Items are provided, the cost shall be deemed to be distributed among the Amounts for the related Items of Work.

Bill of Quantities

Preamble to Bill of Quantities

1. Introduction

- a. The quantities set out in the Bills of Quantities are the estimated quantities of the Works and are not to be taken as the actual and correct quantities of the works to be executed by the Contractor in fulfilment of his obligations under the Contract.
- b. For the purpose of pricing the Bill of Quantities shall be read in conjunction with the Instructions to Bidders, Conditions of Contract, Employers requirements, Technical Specifications, Drawings and other sections of this Tender Document.
- c. The items set forth in the Bill of Quantities and the Contract Rates therefore shall, except in so far as may be otherwise provided in the Contract, be deemed to cover all the Contractor's liabilities and obligations set forth or implied in the Contract and all costs and expenses which may be required in and for the proper construction, completion of the works described together with all general risks.
- d. The bidder shall interpret the data furnished and carry out any additional survey work, or investigation work required at his own cost.
- e. The prices quoted shall also include the cost of materials utilized for testing.
- f. The bidder should acquaint himself with the site conditions including the access to Work site. The successful bidder shall have to make suitable access to work sites at his own cost.
- g. **The prices shall be quoted inclusive of all taxes (GST), royalties and duties prevailing at the time of submission of the bids.**
- h. Except where an item in the Bill of Quantities clearly indicates to the contrary all quantities are measured net in accordance with the drawings with no allowance of waste, shrinkage etc.
- i. All works shall be carried out as per BIS (with latest revision) and Technical Specifications and with good Engineering practice.
- j. Unless otherwise specified, the method of measurement of completed works for payment shall generally be in accordance with IS 1200 (Part 1 to 28) (latest edition) and other relevant Indian Standards.
- k. Unless stated otherwise, all rates and prices entered in the Bills of Quantities shall be deemed to include the following:
 - Labour and all costs in connection with the execution and maintenance of the work.
 - The supply of materials, goods, storage and all costs in connection therewith including wastage, shrinkage and delivery to Site.
 - Plant, equipment and all costs in connection therewith.
 - Sampling and testing materials and goods, testing workmanship, providing, storing, packing and transporting samples to and from the place of testing.
 - Fixing, erecting, installing or placing of materials and goods in position.
 - Disposing of surplus and unsuitable materials and goods and excavated materials, including stacking, storing, loading, transporting and unloading.
- l. Bidders shall pay for the electricity cost during construction period of the work and will include the cost in their quoted Price.

All Temporary Works:

- Construction and maintenance of temporary access roads within the Site and of any roads required for access to any part of the Site for the purpose of carrying out the Works, taking into account that the access roads under the Contractor's maintenance control will also be used by the Employer and his staff's vehicles.
 - All general obligations, liabilities and risks involved in the execution of the Works set forth or reasonably implied in the documents on which the Tender is based.
 - Establishment charges, overheads and profits.
 - Co-operating with other Contractors.
- m. The prices for transportation included in any of the items in the Bills of Quantities are to include for all labours and equipment required for unpacking, loading, conveying, unloading, storing and multiple handling of all and every item to be transported.
- n. The bidder shall enter rates and prices against all items of the Works described in the Bill of Quantities. Where no rate or price is entered against an item by the bidder no payment will be made and the cost shall be deemed to be covered by the rates for other items and prices in the Bill of Quantities.
- o. The design and construction of pumping station, GSR, OHT, major crossings and Statutory approvals should be taken up on priority with all related design approval for timely completion of the project.
- p. For details of intake, pumphouse, desilting tank, underground/partially reservoir, elevated service reservoir, instrumentation, automation and control, components of LIS, bidder/contractor shall refer data sheets attached as Annexure 9 in Section 6 of tender document along with BOQ, specifications and drawings.
- q. Road resurfacing should be taken up after completion & hydrotesting of pipeline with proper compaction of the backfilled trench with 95% proctor density.
- r. For any road settlement occurred/observed till Defect Liability Period in project area pipelines are laid, the Contractor shall be responsible for making the good the backfilling and road restoration at his own expenses.
- s. All rules and regulations of the labor department, contract labor Laws, provident fund and employee state insurance and connected Laws, and all other Laws of the land are to be complied with by the Bidder within the quoted rates.
- t. The bidder is expected to inspect the Site to investigate the following items before quoting their rates in the tender:
- Nature and type of soil proposed for excavation and safety of excavation;
 - Availability of power for execution;
 - Availability of water for execution;
 - Means of disposal of storm water/bailing out water from the Site;
 - Means of disposal of water due to de-watering at the Site;
 - Nature and type of protection required for neighboring property to ensure full safety during construction activities in progress; and
 - Place for disposal of serviceable / unserviceable material obtained during construction activities in progress.
- u. No land will be provided by the Employer to the Contractor for constructing any structure for his labor, workman and supervisory camps, un-authorized hutments, canteen or teashops at the Site or within the premises. The Contractor shall make his/her own arrangements for the same.

v. Abbreviations used in Bill of Quantities and Rates have the meanings shown below.

m	Metre / Meter
km	Kilometre
Sq.m	Square metre
m ²	Square metre
Cu.m	Cubic metre
m ³	Cubic metre
BOQ	Bill of Quantities
MT	Metric Tonne
RM	Running Metre
No.	Numbers
CI	Cast Iron
CM	Cement Mortar
CC	Cement Concrete
Dia	Diameter
Kg	Kilogram
L.S	Lump sum
RCC	Reinforced Cement Concrete
Wt	Weight
SWG	Standard Wire Gauge
SFRC	Steel Fibre Reinforced Concrete
WBM	Water Bound Macadam road

2. GENERAL

General Basis for Pricing are

- 2.1 The Contractor shall be deemed to have read and examined the Tender Documents before completing the Bill of Quantities and the Schedule of Rates. The Drawings, Specifications, Schedules etc. are to be considered as explanatory of each other and no advantage shall be taken of any omission in tender documents.
- 2.2 The Contractor shall be deemed to be fully conversant with and to have made full allowance in his Tender for the site conditions, the nature and complexity of the work to be undertaken, the other extensive development and construction work currently being or which may be executed on and around the Site and all changes in the nature and condition of the Site from that existing at the time of Tender.
- 2.3 General directions and descriptions of work and materials given in the Specification or shown on the Drawings are not necessarily repeated in the Bill of Quantities and reference is to be made to the Specification and the Drawings for this information.
- 2.4 The Bill of Quantities is an estimate of the quantities of work involved and is to be used as a basis for pricing of the Tender and for valuation of the work executed, in conjunction with instructions to bidders, terms and conditions of Contract, Employers requirement, general, special and technical specifications and drawings.
- 2.5 Due to the nature of the work, all quantities shown in the Bill of Quantities are approximate only and may be subject to variation. The quantities shown should not be considered as limiting or extending the amount of work to be done and material to be supplied by the Contractor. The Contractor shall ascertain the actual quantities of materials required before placing orders.
- 2.6 The rates quoted in the schedule shall be the all-inclusive, for the work described and be deemed to include for all the Contractor's liabilities and obligations and all risks set forth or implied in the document

and all matters and things necessary for the proper construction, of the Works including surveying, setting out, plant, labour, supervisor, materials, erection, maintenance, insurance, profit, taxes and duties together with all general risks liabilities and obligations set out or implied in the Contract. The Charge for any obligation of the Contractor for which apparently no corresponding item is given in the Bills of Quantities shall be deemed to be included in the Contract Rates and Prices entered against the billed items.

- 2.7 Quantities given in the annexed Bill of Quantities for the various items are approximate only and are given to provide a common basis for tendering. The basis of payment will be the actual quantities of work ordered and carried out, as measured by the Employer's Representative and valued at the rates or prices quoted in the Bills of Quantities where applicable, and otherwise at such rates or prices as may be fixed within the terms of the Contract. Variations in the quantities of work in the Schedule shall be executed as per condition of contract.
- 2.8 Extra items of work shall not vitiate the Contract. The Contractor shall be bound to execute extra items of work as directed by the Employer's Representative.
- 2.9 The quantities given here are those upon which the tender cost of the work is based, but they are subject to alterations, omissions, deductions or additions as provided for in the Conditions of Contract and do not necessarily show the actual quantities of work to be done. The unit rates are those governing payment for extras or deductions or omissions according to the conditions of the Contract as per rate analysis to be carried out by Contractor with supporting document to be submitted for approval of Employer's Representative.
- 2.10 It is to be expressly understood that the measured work is to be taken net (notwithstanding any system or practice to the contrary) according to the actual quantities wherein finished according to the Drawings or as may be ordered from time to time by the Employer's Representative and the cost calculated at the respective prices, without any additional charges for any necessary or contingent works connected therewith. The rates quoted are for works in situ and complete in every respect. Unless the Bill of Quantities specially indicates to the contrary, the constructional plant and temporary works will not be measured.
- 2.11 Unless otherwise stated, all items are measured net and no allowance will be made for wastage, working space, bulking or shrinkage, overlaps and the like.
- 2.12 The unit rate should be entered against each item in the Bill of Quantities and shall be written in ink in figures and words. Any item left unpriced will be deemed to be included for elsewhere in the Bill of Quantities, hence the rate for that item will be taken as NIL.
- 2.13 The rate column should be filled in figures and words legibly while the amount column should be filled in figures legibly. If there is any discrepancy in Tendered rates/amount, it shall be resolved in accordance with conditions of contracts.

3. General Work

3.1 Earthworks

- 3.1.1 The item of earthwork in excavation etc., is excluded in the execution of pipe laying, jointing, testing, etc. and will be measured and paid separately as per relevant item for excavation.
- 3.1.2 The rates of works for excavation etc., shall include for all plant, equipment, materials and labour required for excavation in any material and in any location and shall also include for all temporary diversions, support and protection of any existing services and utilities, temporary support and maintenance of the excavation, any additional excavation necessary to provide working space, refilling trenches with materials as required by the Specification or shown on the Drawings, compaction as per drawings and specifications.

3.1.3 All work in connection with excavation as specified shall be valued by measurement only of such items as are set forth in the Bills of Quantities for excavation. All such measurements shall be in cubic meters as shown in drawings and specifications. No payment shall be made for excess excavation in respect of or the backfilling thereof.

3.1.4 Timbering and MS Shuttering for shoring and strutting for excavation is deemed to be included in excavation item.

3.2 DEWATERING

No separate payment will be made for dewatering and cost for the same is deemed to be included in the respective item quoted by bidder.

3.3 UTILITY SHIFTING AND REINSTATEMENT

No separate payment will be made for utility shifting.

3.4 TRAFFIC DIVERSION DURING CONSTRUCTION

No separate item is provided for traffic diversion during construction of pipelines on road. It will be deemed to be considered in quoted price.

3.5 SITE CLEARANACE AFTER CONSTRUCTION

No separate item is provided for site clearance after construction . It will be deemed to be considered in quoted price.

3.6 Concrete

3.6.1 The unit of measurement for concrete, where measured separately shall be in cubic meters.

3.6.2 Concrete bedding to pipe trenches, bed and surrounds to pipelines shall be measured in cubic meters for all depths as mentioned in bill of quantities and as per drawing.

3.6.3 The quantity of concrete shall be computed on the basis of the dimensions shown on the Drawings or as otherwise instructed as specified in bill of quantities. No deduction in the quantity of concrete shall be made for holes each less than 0.15 cubic meters in volume or chamfers and the like each less than 0.005 square meters in cross sectional area.

3.6.4 The rates for concrete shall include for all plant, materials and labour required to achieve the finished concrete shown on the Drawings or as otherwise instructed in full compliance with the Specification, including testing, concrete of any class, screeds that are not included for elsewhere, finishes, compaction and all other works necessary for the satisfactory completion of the work.

3.6.5 Brick Masonry

a) The unit of measurement for manholes shall be numbers complete. Separate items are provided for various type of manholes for various diameters up to specified depths. The depth of the manhole shall be defined as the distance between the top of the manhole cover and the invert of the lowest sewer in manhole.

b) The rates for manholes shall include for all plant, materials and labour required to provide and construct the manhole in position and at the depth shown in the Drawings or as otherwise instructed and in accordance with the Specification including trial holes carried out to locate services crossing or adjacent to the manhole, excavation, concrete, shuttering, Brick masonry work , plaster on both faces, manhole cover (including the cost of SFRC manhole frame and cover), M.S steps (PVC encapsulated) and all other works required to make the manholes complete in accordance with the Drawings and Specification.

3.6.6 Road Reinstatement Works

a) Reinstatement of road works has to be carried out as per specifications, contained in the 'Specifications for Road and Bridge Works' (Latest Revision) published by the Indian Road Congress, on behalf of the

Government of India, MoRTH. Mode of measurements for bituminous road, CC roads and tiles road shall be as per provisions contained in the relevant clauses of the specifications unless otherwise specified. The rates include all the elements of cost and hire charges of all types of plants, machinery and equipment required to complete the work as mentioned in accordance with bill of quantities, Drawings and Specifications. For purpose of Granular course (Like GSB, WBM, WMM etc), width of road shall be considered as top trench width plus 15cm on both sides of trench.

- b) The Contractor shall be responsible to restore all working services to their original conditions and all cost thereof shall be deemed to be included in the quoted rates.

3.7 Arrangements for Water and Electricity

The Contractor shall be responsible to make all the necessary arrangements for water and electricity for carrying out the works (during execution of works) and the cost thereof shall be deemed to be included in the quoted rates.

4. Bill of quantities

1. The items do not generally give a full description of the Construction Documents, Plant and Materials to be supplied and the services to be performed under each item. The entered rates and prices shall be deemed to include all items necessary for full compliance with all provisions of the Contract. Payment Breakup shall be approved by Engineer-in-Charge (Project), Mandi.
2. Items left blank are deemed to have been included in other items. The TOTAL for each component of work and the TOTAL of the Grand Summary shall be deemed to be the total price for executing the Works in complete accordance with the Contract, whether or not each individual item has been priced.
3. The GST shall be governed by State and Central Government rules (as amended up to date).

Bill of Quantities

[Admeasurement Contract]

[The Bill of Quantities is enclosed separately and the bidder shall submit the same separately as part of Price Bid and shall not be included in the Technical Bid]

Section 5: Eligible Countries

This section contains the list of eligible countries.

1.	AFG	Afghanistan	35.	FSM	Micronesia, Federated States of
2.	ARM	Armenia	36.	MON	Mongolia
3.	AUS	Australia	37.	MYA	Myanmar
4.	AUT	Austria	38.	NAU	Nauru
5.	AZE	Azerbaijan	39.	NEP	Nepal
6.	BAN	Bangladesh	40.	NET	The Netherlands
7.	BEL	Belgium	41.	NIU	Niue
8.	BHU	Bhutan	42.	NZL	New Zealand
9.	BRU	Brunei Darussalam	43.	NOR	Norway
10.	CAM	Cambodia	44.	PAK	Pakistan
11.	CAN	Canada	45.	PAL	Palau
12.	PRC	China, People's Republic of	46.	PNG	Papua New Guinea
13.	COO	Cook Islands	47.	PHI	Philippines
14.	DEN	Denmark	48.	POR	Portugal
15.	FIJ	Fiji	49.	SAM	Samoa
16.	FIN	Finland	50.	SIN	Singapore
17.	FRA	France	51.	SOL	Solomon Islands
18.	GEO	Georgia	52.	SPA	Spain
19.	GER	Germany	53.	SRI	Sri Lanka
20.	HKG	Hong Kong, China	54.	SWE	Sweden
21.	IND	India	55.	SWI	Switzerland
22.	INO	Indonesia	56.	TAJ	Tajikistan
23.	IRE	Ireland	57.	TAP	Taipei, China
24.	ITA	Italy	58.	THA	Thailand
25.	JPN	Japan	59.	TIM	Timor-Leste
26.	KAZ	Kazakhstan	60.	TON	Tonga
27.	KIR	Kiribati	61.	TUR	Turkey
28.	KOR	Korea, Republic of	62.	TKM	Turkmenistan
29.	KGZ	Kyrgyz Republic	63.	TUV	Tuvalu
30.	LAO	Lao People's Democratic Republic	64.	UKG	United Kingdom
31.	LUX	Luxembourg	65.	USA	United States
32.	MAL	Malaysia	66.	UZB	Uzbekistan
33.	MLD	Maldives	67.	VAN	Vanuatu
34.	RMI	Marshall Islands	68.	VIE	Viet Nam

Section 6: Employer's Requirements

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ANNEXURES

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1. Project Background and Requirements

1.1. Background to the Project

The Government of Himachal Pradesh in association with Asian Development Bank co-financing the Himachal Pradesh Subtropical Horticulture, Irrigation and Value Addition (HPSHIVA) to "Improve the irrigation infrastructure for farmers, increase the production of sub-tropical horticulture crops by building climate and disaster resilience agricultural systems and increase profitability and farm-gate prices for horticulture farmers through value chain development strategy and cluster focused interventions in targeted horticulture commodities".

This project aims to support 20000 households across 7 districts (Bilaspur, Hamirpur, Kangra, Mandi, Solan, Sirmour and Una) with a focus on targeted horticulture commodities including but not limited to Guava, Sweet lime, Litchi, Plum, Lime, Pomegranate, Orange and Mango to contribute towards generating additional livelihoods and increased income through the project interventions.

The Government of Himachal Pradesh has appointed Department of Horticulture (DOH) as the Executing Agency (EA) for the project. The project will be implemented by jointly by Jal Shakti Vibhag (JSV) formerly known as, Department of Irrigation and Public Health (DIPH) and Department of Horticulture (DoH).

Structure of the project

The project is divided into 7 districts and districts i.e. Bilaspur, Hamirpur, Kangra, Mandi, Solan, Sirmour and Una. The districts are divided into blocks which gets further divided into clusters. The Package wise tendering is being done by Jal Shakti Vibhag (JSV). This tender is for selection of contractor for Package 1, Kunihar and Nalagarh Block, Solan District (CWJ/IRG/BLS-02).

Package 1 - Kunihar and Nalagarh Block, Solan District

S.No.	District Name	Block Name	Cluster Name	Source of Irrigation	Name of Irrigation Scheme
1	Solan	Kunihar	Ser-Delag	Spring	FIS Seri sarla
2	Solan		Sai	Natural Spring	Functional FIS Sai
3	Solan	Kunihar	Jailang	Need to propose Parallel Scheme-Ghumber Khadd	Functional LIS Jaliayana
4	Solan	Kunihar	Datti	Natural Spring	Functional FIS Datti

S.No.	District Name	Block Name	Cluster Name	Source of Irrigation	Name of Irrigation Scheme
5	Solan		Daseran	Ali Khadd	LIS from Ali Khad
6	Solan		Giana	Jadol Nallah	LIS from Jadol Nallah
7	Solan		Pajeena	Pajeena Nallah	LIS from Panjeena Nallah
8	Solan		Chunad	Ghumber Khad	LIS from Gumber
9	Solan	Nalagarh	Doli	Ghamber Khad	Functional LIS Gajedh
10	Solan		Batiakh	Ghamber Khad	Functional LIS Gajedh
11	Solan		Sour	Ghamber Khad	LIS Sour Kulh
12	Solan		Palli	TW	LIS from TW-3
13	Solan		Beli khol 1	TW	LIS from TW-1
14	Solan		Beli khol 2	TW	LIS from TW-2

2. Project Area

2.1. Location and Connectivity

The Development Block Kunihar, lies in district Solan of Himachal Pradesh State. Solan is one of the south-western districts of Himachal Pradesh lies in the Outer and Lesser Himalaya having geographical area of 1936 sq km . The district lies between north latitude 30° 45' 11" to 31° 21' 10" and east longitude 76° 36' 00" to 77° 15' 20" and is covered by Survey of India degree-sheets 53A, 53B, 53E and 53F. The district is bounded by Bilaspur district in north-west and Mandi district in the north, Shimla and Sirmaur districts in east and south-east respectively. District has inter-state boundary in the south and west with State of Haryana and Punjab respectively.

The district is well connected by rail and road network. Solan is the headquarter of the district. It is around 48 km from Shimla and situated between Chandigarh and Shimla on the Kalka-Shimla National Highway. The Kalka-Shimla narrow gauge heritage railway line, built by the British passes through Solan and is recognized World Heritage site. The nearest airports are at Shimla (Jubbal Hatti) and Chandigarh..

2.2. Climate and Rainfall

The climate of the district is sub-tropical in the valley and tends to be temperate on the hilltops. There are four major seasons. The winter season commences from November to February and ends in March; summer season extends from March to June, followed by the monsoon period extending from July to September. Maximum

precipitation occurs during July to September. Annual normal rainfall in the district is about 1306 mm, out of which 80 to 85% rainfall occurs during June to September. In the winter season, precipitation as snowfall also occurs in the higher reaches up to 1000 m elevation and as rainfall in low hills and valleys of the district. Mean maximum and minimum temperature ranges between 32.2°C (May) and 0.6°C (January).

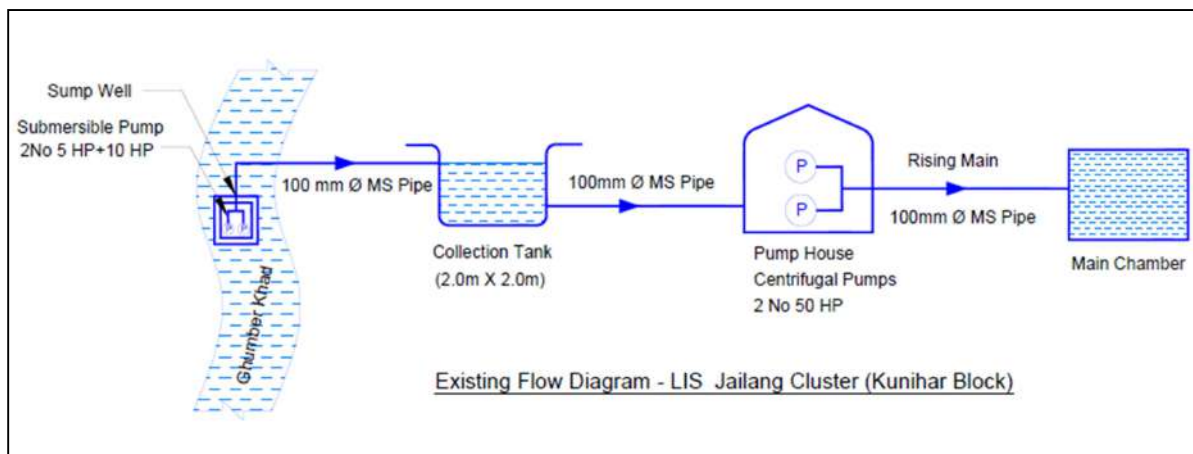
3. Existing Irrigation Schemes

In this package there are total 18 clusters covered in two blocks namely Kunihar and Nalagarh block and details are presented in earlier paras.

3.1 Existing Irrigation Scheme

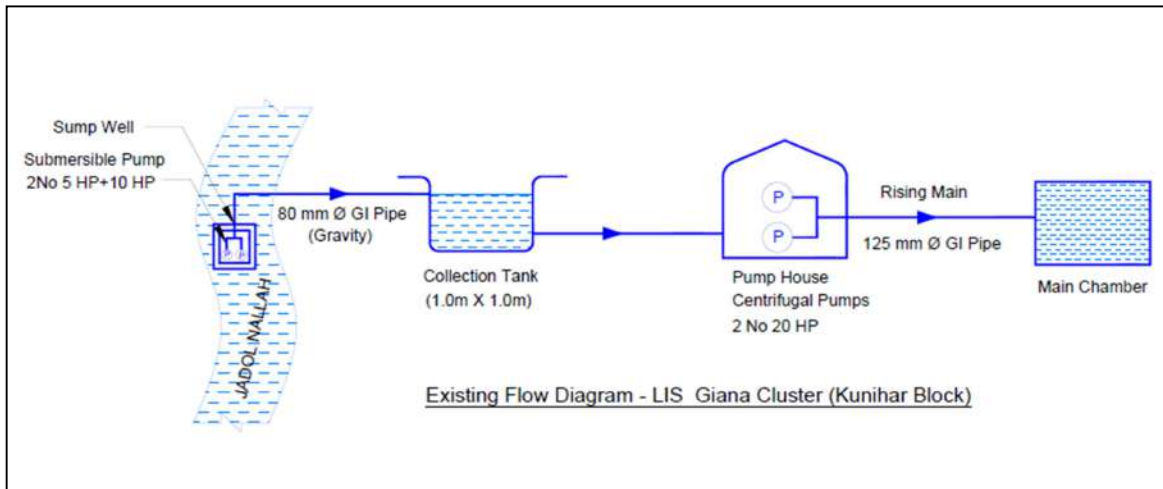
There are two existing schemes at Jailang and Giana cluster. Description of the schemes is provided as below

Existing Scheme- Jailang Cluster - The source for the existing scheme is Ghumber Khad. Water is pumped from sump well through 2 nos submersible pump of 5 HP & 10 HP to collection tank of 2x2m brick masonry. Rectangular Pump house of 8 x 5 m comprises of 2 nos 50 HP centrifugal pumps (Q- 8.58 lps and H-79m), operating at 12 hours daily. Scheme comprises of rising main of MS 150 mm diameter and existing main chamber of 1 x 1 m size:



3.2 Existing Scheme- Giana Cluster

The scheme is constructed for Giana cluster of 27 Ha total command area. The source for the existing scheme is Jadol Nallah. Water gets collected in sump well by gravity khul (Open kuccha channel). The sump/ collection tank (1m X 1m) of is connected from the Khul through GI Pipe – 2 nos (Dia- 80 mm). Rectangular Pump house of 6 x 5 m comprises of 2 nos 20 HP centrifugal pumps (Q- 18m³/hr and H-120m), operating at 12 hours daily. Scheme comprises of rising main of GI 125 mm diameter and existing main chamber of 1 x 1 m size..



4. Scope of Work

The Scope of Work for proposed, check dam, intake well, percolation well, raw water pumphouse, desilting tank, sump, clear water pumphouse, rising main, gravity main, main delivery tank, cluster tank under this contract includes but is not limited to the following in relation to the construction, of the Works,

- Carrying out topographic survey and geotechnical investigation works for the proposed components under the scheme such as check dam, intake, sump, pumphouse, pipeline, tank etc. The list of components to be executed under this package is specified in this document.
- Validate/Prepare hydraulic, structural designs and engineering drawings (construction/working drawings) of all components like Intake, check dam, rising/gravity main, MDT, MBR etc as per the requirements and specifications specified in Section 6 and its annexures. Approval of the detailed designs/drawings by Engineer.
- Approval of the structural designs and drawings from proof checking agency IIT's / NIT/ PEC (The proof checking agency charges shall be paid by Contractor).
- Setting out of the works
- Site Clearing, Excavation, Levelling, Grading and Backfilling Activities
- All preparatory work including clearing and levelling of site, site grading, formation of finished ground level (FGL), provision of internal roads etc., excavation, dewatering as required and disposal of all surplus earth to a suitable location as directed by Engineer
- Construction of check dam, intake well, percolation well, infiltration well, pump house, main delivery tank as per approved drawings, BOQ and specifications. The BOQ and specifications are given in this section of the document.
- Excavation, Laying, Jointing, testing and commissioning of rising main, gravity mains.

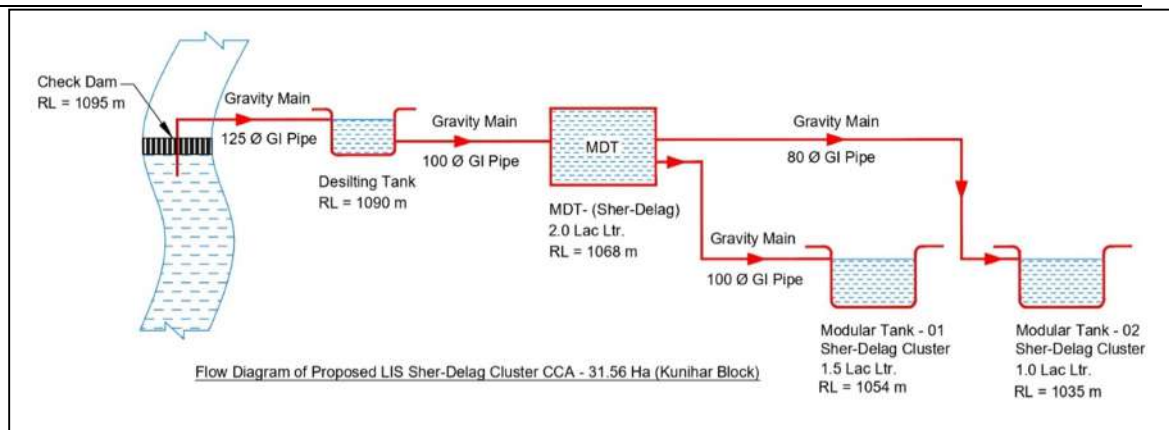
- Construction of anchor blocks and thrust blocks, pipe support for stream/nalla crossings, pipe encasement for road crossing
- Road cutting and restoration works after completion of pipeline crossing works
- Construction of valve chambers and ancillary works
- Placing of order of electro mechanical equipment's such as pumps, motor, valves, specials etc to manufacturers, testing at place of manufacture, inspection by Client/Consultant, supply after painting, packing, transport, delivery, storage
- Procurement, installation, testing, commissioning of pumps, pumping machinery, valves, cranes etc
- The capacities of pumping machinery are indicative only and may vary depending upon the actual requirement. The bidder shall be bound to validate the capacity of pumping machinery, if required, as per project actual requirement, subject to approval from competent authority.
- Procurement, installation, testing commissioning of transformer, panels, etc.
- Supply and Installation testing, commission of Instrumentation Control & Automation (ICA) system along with gateway devices for data communication including necessary coordination for remote monitoring.
- Coordination with Centralized monitoring system implementing contractor.
- Construction of all Civil Structures and Building Works
- Construction of approach road and internal roads
- Construction of compound wall, gate
- Preparation and Submission of As-Built drawings for all Civil, Mechanical, Electrical, Instrumentation, Control & Automation Works
- Providing Training Services to Employer's Personnel

The Scope of Services shall include all technical, managerial, administrative, commercial, environmental, and social interventions as required in accordance with acceptable, prudent construction and management practices. The Scope of Services mentioned above is only indicative and the contractor is required to undertake his own detailed investigation of the Project Facilities to determine the complete Scope of services for successful commission of the schemes.

The components of each LIS schemes to be designed, constructed and commissioned under this package with scope of work described above are as below. The details of the various components under each LIS are tabulated and attached as Annexure 10. The quantities of various components indicated in subsequent paras for individual components are tentative and may vary during execution of project.

4.1. LIS Sher Delag

Flow diagram of the Lift irrigation scheme of Sher Delag is as below:

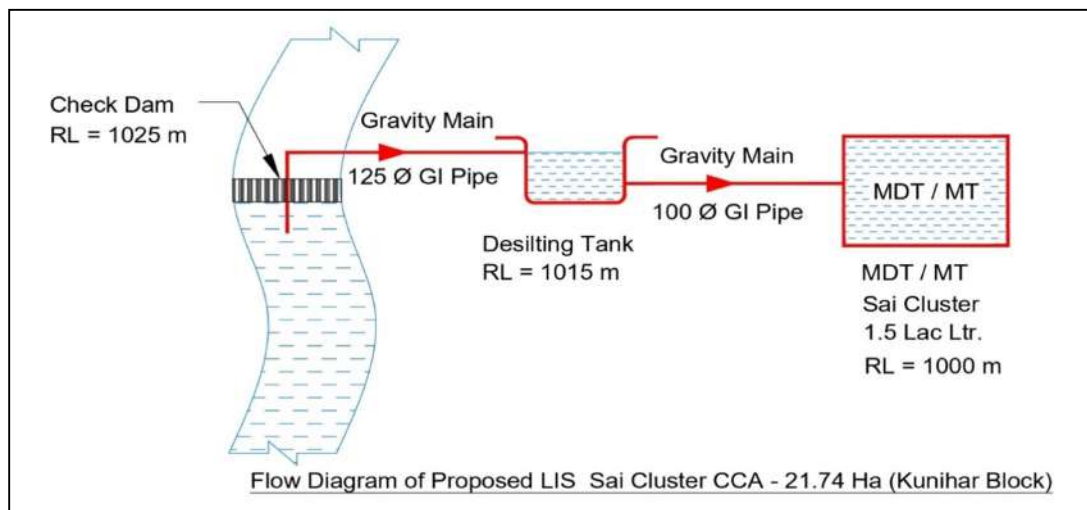


Following components are to be executed:

S.No	Components
1	Check dam
2	Desilting Tank
3	MDT (2 Lakh Litre)
4	MDT to Modular Tanks: Gravity main 80,100 mm dia GI pipe

4.2. LIS Sai –

Flow diagram of Lift irrigation scheme of Sai is as below:

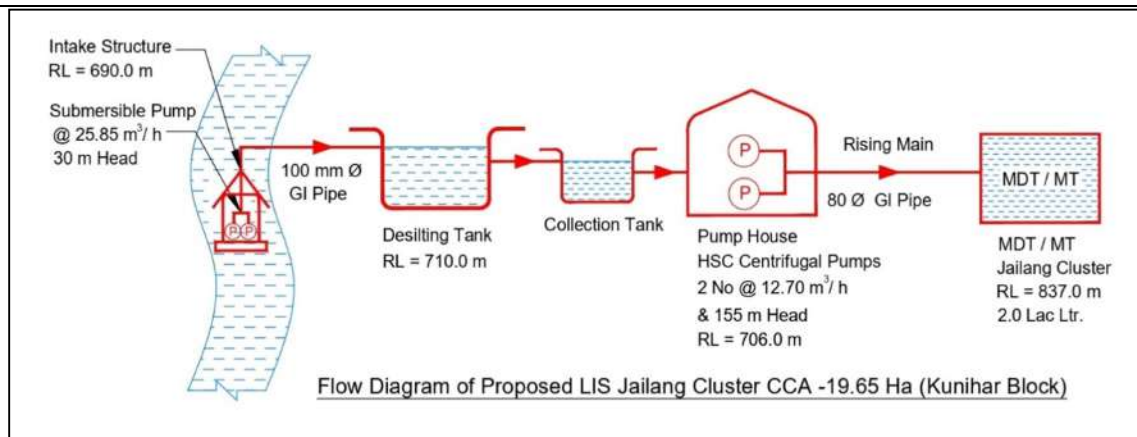


Following components are to be executed:

S.No	Components
2	Check dam
3	Desilting Tank
4	MDT (1.5 Lakh Litre)

4.3. LIS Jailang -

Flow diagram of Lift irrigation scheme of Jailang is as below:

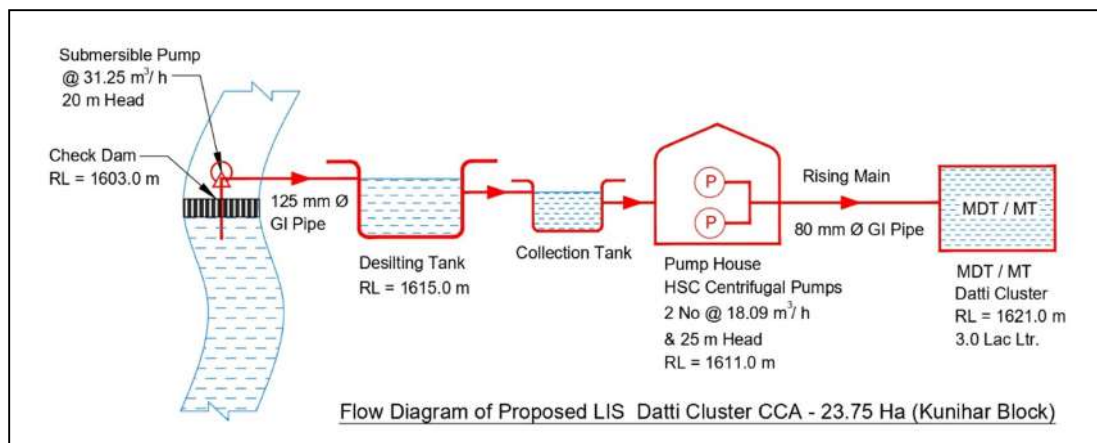


Following components are to be executed

S.No	Components
1	Percolation Well
2	Desilting Tank
3	Collection Tank and Pump House
4	Rising main from Pump house to MDT/MT
5	MDT/ MT (2 Lakh Litre)

4.4. LIS Datti

Flow diagram of Lift irrigation scheme of Datti is as below:

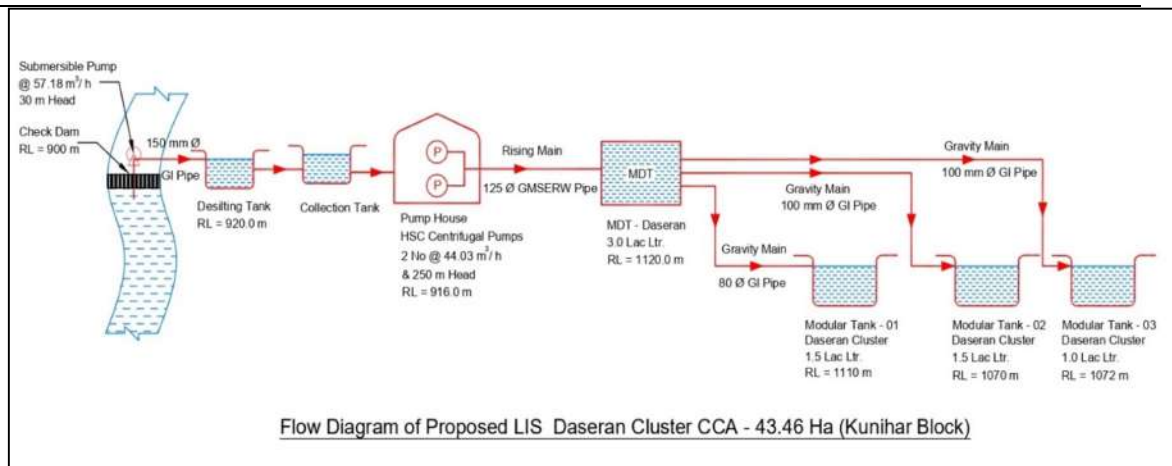


Following components are to be executed

S.No	Components
1	Check dam
2	Desilting Tank
3	Collection Tank and Pump House
4	Rising main from Pump house to MDT/MT
5	MDT (3 Lakh Litre)

4.5. LIS Daseran

Flow diagram of Lift irrigation scheme of Daseran is as below:

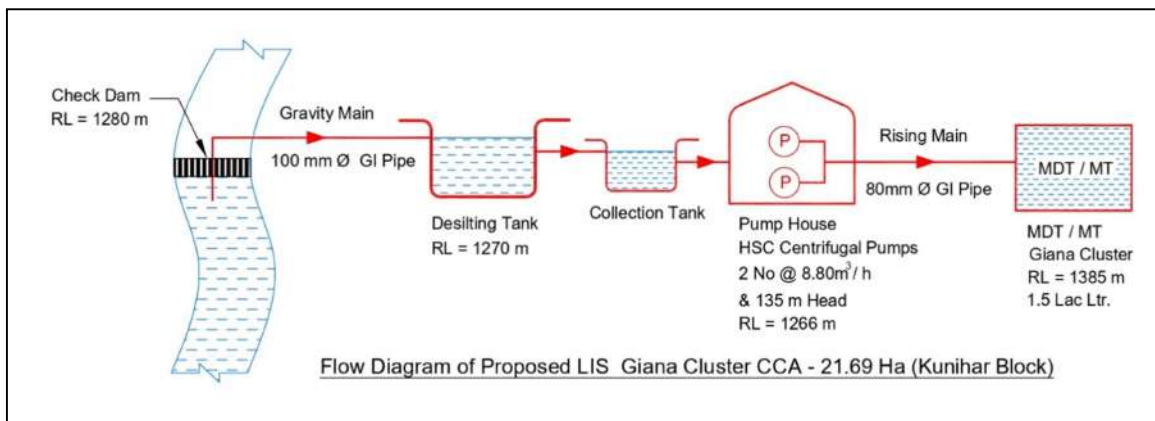


Following components are to be executed :

S.No	Components
1	Check dam
2	Desilting Tank
3	Collection Tank and Pump House
4	Rising main from Pump house to MDT Gravity main from MDT to MT
5	MDT (3 Lakh Litre)

4.6. LIS Giana

Flow diagram of Lift irrigation scheme of Giana is as below:

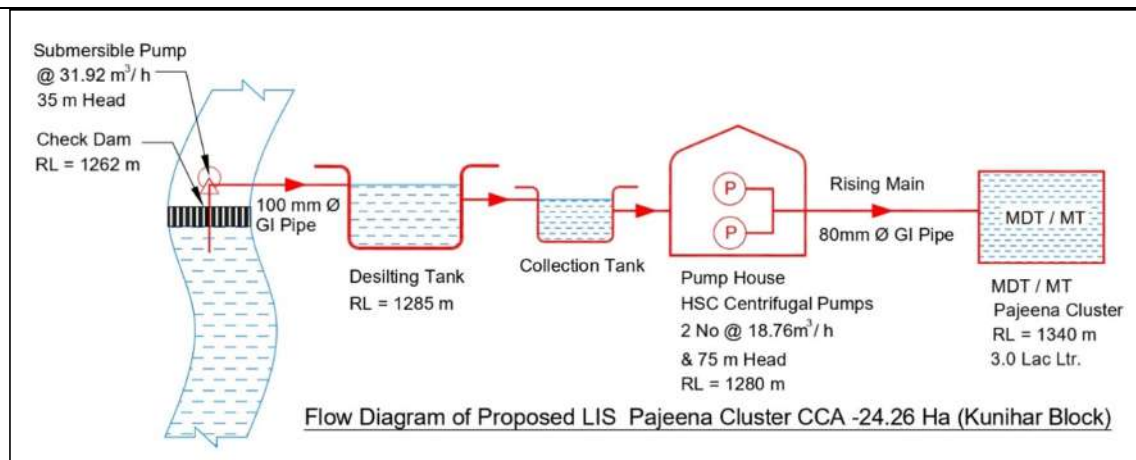


Following components are to be executed :

S.No	Components
1	Check dam
2	Desilting Tank
3	Collection Tank and Pump House
4	Rising main from Pump house to MDT/MT
5	MDT (1.5 Lakh Litre)

4.7. LIS Pajeena

Flow diagram of Lift irrigation scheme of Pajeena is as below:

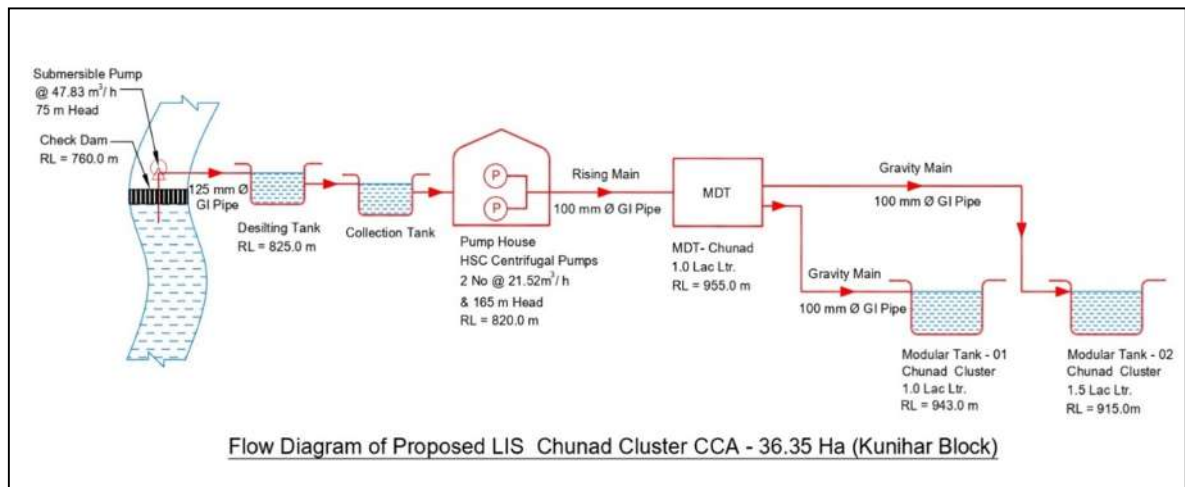


Following components are to be executed:

S.No	Components
1	Check dam
2	Desilting Tank
3	Collection Tank and Pump House
4	Rising main from Pump house to MDT/MT
5	MDT (3 Lakh Litre)

4.8. LIS Chunad

Flow diagram of Lift irrigation scheme of Chunad is as below:

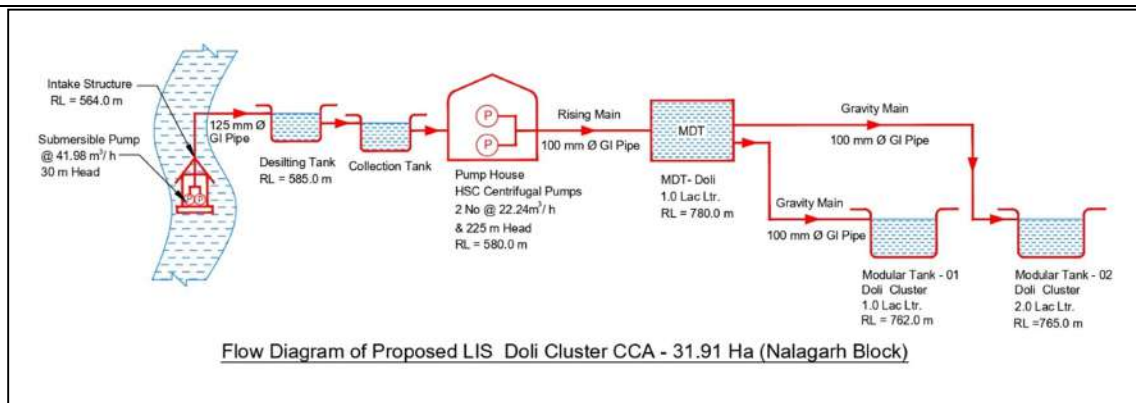


Following components are to be executed :

S.No	Components
1	Check dam
2	Desilting Tank
3	Collection Tank and Pump House
4	Rising main from Pump house to MDT Gravity main from MDT to MT
5	MDT (1 Lakh Litre)

4.9. LIS Doli

Flow diagram of Lift irrigation scheme of Doli is as below:

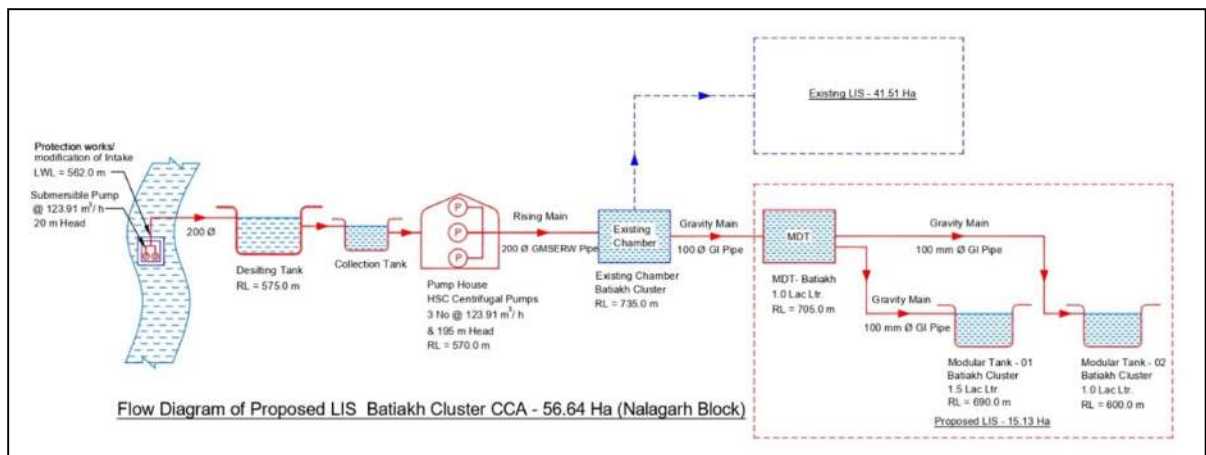


Following components are to be executed :

S.No	Components
1	Intake Structure
2	Desilting Tank
3	Collection Tank and Pump House
4	Rising main from Pump house to MDT Gravity Main from MDT to MT
5	MDT (1.0 Lakh Litre)

4.10. LIS Batiakh

Flow diagram of Lift irrigation scheme of Batiakh is as below:

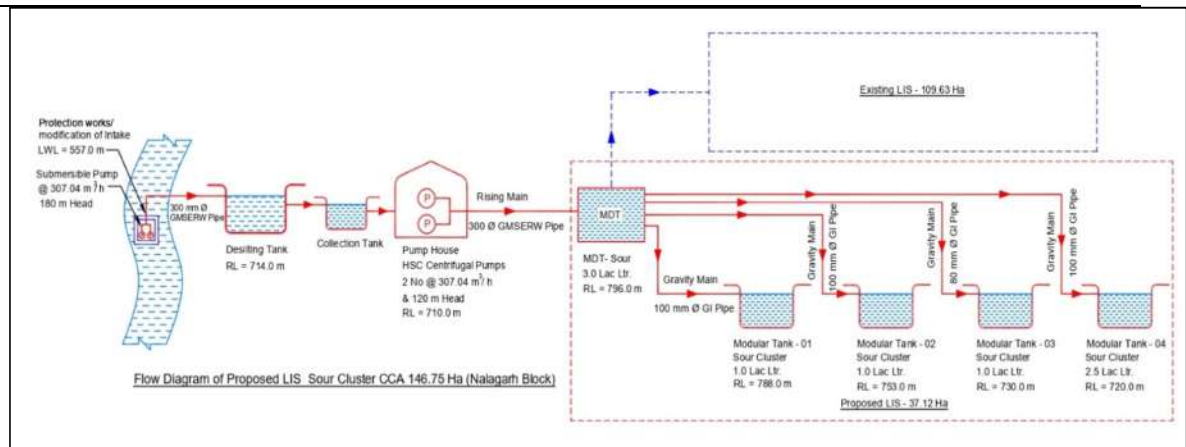


Following components are to be executed :

S.No	Components
1	Desilting Tank
2	Collection Tank and Pump House
3	Rising main from Pump house to Existing Main Chamber Gravity main from Existing Main chamber to MDT and MT
4	MDT (1 Lakh Litre)

4.11. LIS Sour

Flow diagram of Lift irrigation scheme of Sour is as below:

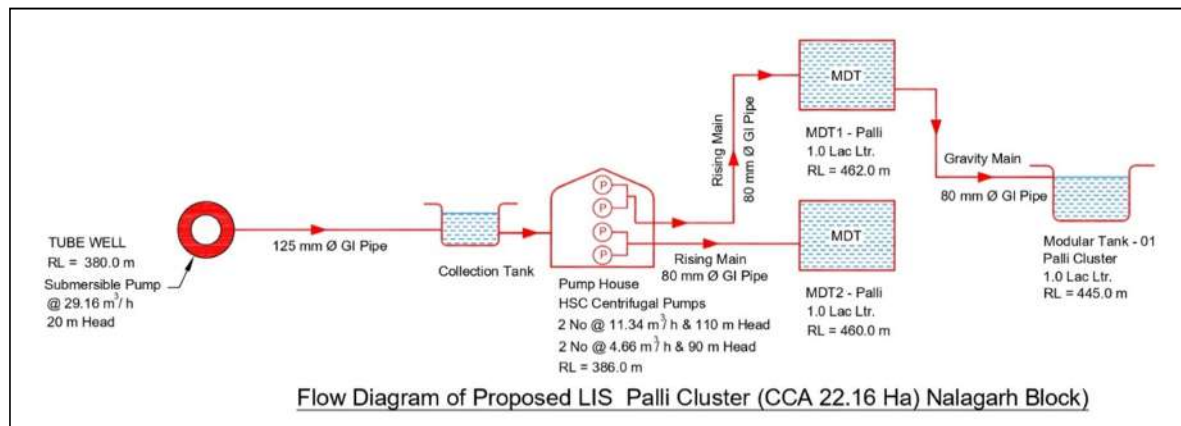


Following components are to be executed :

S.No	Components
1	Desilting Tank
2	Collection Tank and Pump House
3	Rising main from Pump house to MDT Gravity main from MDT to MT
4	MDT (3 Lakh Litre) (Existing chamber replaced)

4.12. LIS Palli

Flow diagram of Lift irrigation scheme of Palli is as below:

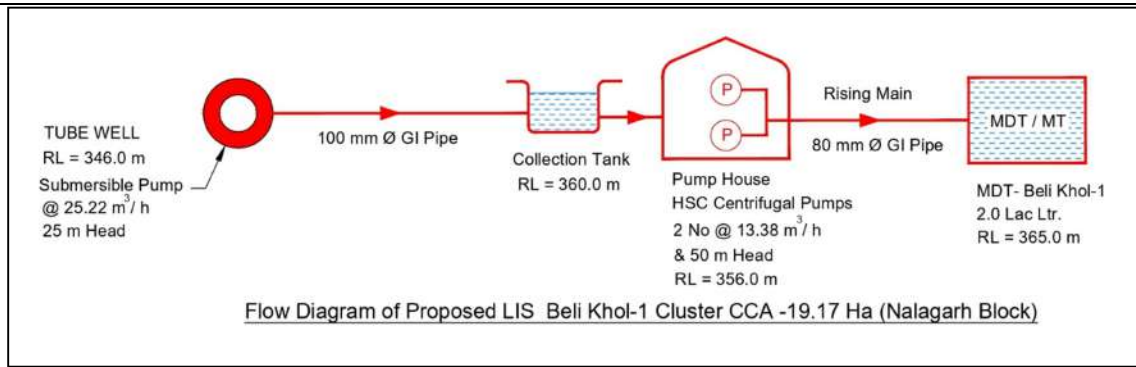


Following components are to be executed :

S.No	Components
2	Tube Well
3	Collection Tank and Pump House
4	Rising main from Pump house to MDT Gravity main from MDT to MT
5	Palli MDT-1 (1 Lakh Litre) Palli MDT-2 (1 Lakh Litre)

4.13. LIS Beli Khol 1

Flow diagram of Lift irrigation scheme of Beli Khol 1 is as below:



Following components are to be executed :

S.No	Components
1	Tube Well
2	Collection Tank and Pump House
3	Rising main from Pump house to MDT/MT
4	MDT (2.0 Lakh Litre)

5. Milestone and Key Time Periods Table

S. No.	Sectional Milestone	Completion Time (days)	Event of start
General			
1	Mobilisation, Topographic survey, Geotechnical investigation, preparation of structural drawings based on GA and sizing of various components	45	Contract signing
2	Construction of all components as specified in the scope of work	500	Approval of design and drawings
3	Testing, commission, Preparation of as built drawings	548	Completion of construction

6. Survey and Geotechnical Data

The data available with the Employer used in formulation of the bid elements shall be used by bidder only as guideline. The data on topographical survey is attached in Tender Drawings. This geotechnical investigation report at proposed location of intake, pumphouse and MDT site will be shared with bidders prior to bid submission for information. Any use of this report or information contained therein shall be solely at the Contractor's own risk. The bidder shall make his own interpretation of this data. The Employer accepts no responsibility whatsoever for, nor guarantee, the accuracy, applicability, or completeness of the Report or information contained therein.

Bidder may carry out the topographical survey, geotechnical investigation and all other details necessary for proper formulation of his price proposal before submission of bid.

After award of contract, Contractor shall carry out independently fresh survey,

geotechnical investigation and all other details necessary for proper planning and detailed design and preparation detailed construction drawings. The Contractor will be required to provide full details of the survey and geotechnical investigations for proposed site for approval of the Employer.

7. Clearances Required for Irrigation System

Following is the list of clearances (not limited to) required during implementation of the subproject:

- a) State Public Works Department (PWD): for road cutting for Laying & Jointing of pipelines
- b) State Telecom Department.: for shifting of telephone posts or shifting of underground telephone cables, if any.
- c) State Water Resource Department (WRD)– For construction of intake in the river/khad, check dam in stream/khad, lifting the required quantum of water from river/khad.

The contractor shall obtain the above required clearances and any other clearances required for execution of project in consultation with Employer.

8. General Design and Drawing Requirements

Designs and Drawings to be submitted by Contractor after award of contract

a) General

The drawings that will be prepared and issued for this Contract shall be to a scale which is suitable for the representation of those details illustrated.

The term Drawing shall be deemed to include all drawings, schedules, lists, software documentation, descriptive text and calculations necessary for the design, construction, of the Works and referred to in this clause.

Drawings and all other submittals required by this contract shall be submitted in editable electronic softcopy format on CD(s) or DVD(s) as well as in hardcopy paper format.

The softcopy format for various items shall be as follows:

- Drawings: AutoCAD
- Text Documents: Microsoft Word
- All programmes and schedules related to the project: Microsoft Project
- Spreadsheets, calculations, tables, technical schedules, prices schedules, and other numerical data: Microsoft Excel
- Databases: Microsoft Access
- All other required information not included in the above: Adobe Portable Document

Format (PDF)

The hardcopy format/sizes for various items shall be as follows:

- Drawings: Standard A1 size paper. The scale for each drawing shall be selected such that the information is presented without any clutter or ambiguity and is clearly and easily legible without the use of magnifying aids other than a reader's normal eye- glasses. Details drawings of critical areas to be prepared at suitable scale, as may be necessary for better clarification and execution.
- All other information: Standard A4 or A3 paper size, except for any pre-printed standard information such as brochures or catalogue information, which may be submitted in the original size and format as required by the client.

b) Drawing Format and Numbering

All drawings shall be prepared using an identical title block format. This shall be approved by the Employer's Representative and shall identify the project, drawing title, the Employer, the Contractor, Sub-contractor, if applicable, and the Employer's Representative.

A formalised drawing numbering system shall be adopted with digits of each number, referencing location, revision, drawing type and size. The numbering format and allocation of drawing number blocks shall be approved by the Employer's Representative.

The Contractor shall provide a sequential numbering system for all Construction

Documents. The drawing number shall not be repeated or duplicated.

All drawings shall be submitted to a formalised checking procedure prior to submission. Drawings not so checked will not be approved.

c) Pre-contract Drawings

The Pre-contract Drawings are those issued to Bidders either with the Bidding Documents for the purpose of illustrating and clarifying the Works described in the Employer's Requirements or later during the bidding period as part of an Addendum to the Contract Documents.

Such drawings shall be deemed to have been issued for the guidance of Bidders and shall, for the purpose of executing the Works, be superseded by the Construction Documents.

d) Details of drawings and calculations to be submitted by the contractor for approval (after award of contract)

Drawings / Calculations for approval shall be submitted by the selected Contractor

after award of the contract in two Phases.

First Phase - Preliminary Drawings / Designs (Basic Engineering Package/BEP)

Second Phase - Detailed Engineering Design phase

The first phase shall be the Preliminary Drawings / Designs. Drawings / Designs submitted during this phase shall be of sufficient detail for the Employer and Employer's representative to understand in outline the Contractor's proposals for the design and construction of the Works. The lists provided below shall not be considered comprehensive. The bidder shall be responsible for including any and all drawings and information for any and all works that may be necessary for full and complete definition or clarification of the design, regardless of whether or not such drawings, information, or works are explicitly included in the lists below or elsewhere in these bid documents.

The Preliminary Drawings / Designs for lift irrigation scheme shall inter alia comprise:

- Detailed Description of the proposed components.
- Detailed schematic diagram indicating entire project features and capacities
- Geo technical investigations at locations for proposed structures
- General layout drawing for all construction activities indicating existing infrastructure,
- proposed buildings, piping alignment, valves, flow meters etc.
- Pipeline alignment feasibility study report for proposed pumping/gravity mains
- Electrical provision feasibility study report
- Detailed Hydraulic Profile of pumping mains and gravity system
- Detailed equipment list/ Sizing with electrical loads for pumping stations & any other facilities
- Electrical Single line diagram of Power Distribution Scheme

The second phase shall be the Detailed Engineering Design phase and shall comprise the submission of the General Arrangement of proposed structures, Detailed Final Hydraulic design of pumping main and distribution mains, Location of pumphouses, , Mechanical/ Electrical/ Instrumentation Control & Automation (ICA) / Structural/ Civil Construction Drawings and structural calculations. These shall be submitted after the approval of the Preliminary Drawings. The lists provided below shall not be considered comprehensive. The bidder shall be responsible for including any and all drawings and information for any and all works that may be necessary for full and complete definition or clarification of the design, regardless of whether or not such drawings, information, or works are explicitly included in the lists below or elsewhere in these bid documents.

The Construction Documents shall be used for the construction of the Works and shall inter alia comprise:

Civil

Site layouts for Desilting tank Sump, pumphouse, GSR, OHT, providing information on levels and detailing the location of:

- General arrangements and main sections of all proposed structures with available land boundaries;
- Location of Desilting tank, sump, Pumphouses, elevations and main sections of all structures and buildings;
- Over Head Tank (OHT) location with working space and piping layout.
- Transformer enclosures
- Access Roadways;
- Buried pipelines;
- Cable routes for direct in ground and ducted systems;

Detail GFC drawings of:

- Check dam
- Desilting tank
- Pumphouse with local ICA system,
- GSR, Over Head Tank with foundation details;
- Valve chambers, Flow meter chambers
- Cable and pipework chambers;
- Buried pipework within headworks;
- Rising main & distribution system Pipework connections;
- Reinforcement drawings;
- Bar bending schedules.

Calculations for:

Detailed Structural Design calculation of all the units/ Structures;

Hydraulic

- Hydraulic drawing indicating ground level, length of pipeline, alignment of pipeline, diameter of pipeline with MoC, velocity, flow direction etc...
- Rising main drawing indicating level of pump, diameter, length, velocity, MoC, location of valves & instruments, L.S drawing with hydraulic gradient line, Pipeline alignment within OHT campus & outside the campus,

Detailed Equipment List

- Major Equipment /Instrument Specifications (with supporting Brochures).
- Major Piping Schedule to include size, material, coating, lining, gauges/thickness, and pressure rating
- Major Valve Schedule to include size, type, material, pressure rating, operator/actuator type, and whether Open/Close or Modulating
- Detailed Electrical Power Consumption Calculations for pumping station

Mechanical

Drawings:

Outline dimensional drawing & Cross section Drawing (with Material of construction) for the following items for rising main, pumphouse, GSR, overhead tank but not

limited to:

1)	Raw water Pump set-submersible; bore well pump, hsc
2)	Sluice valve – motorised
3)	Sluice valve – manually operated
4)	Non-Return valves
5)	Butterfly valve, air valve
6)	Dismantling joints, expansion bellow, flow meter
7)	H.O.T & E.O.T Cranes
Graphs for all major pumps (including but not limited to Raw and clear water Pumps,): Pump Performance Curves: Q vs H, speed, P, Efficiency, and NPSH Iso-efficiency curves of the pump model proposed The details shall contain make and model of energy efficient pumping machinery along with pump characteristic curves indicating there on ~~BHP required for head at duty point, +10% and -15% range of total~~	
	Motor Curve
(i)	Starting Current vs time
(ii)	Characteristics

Electrical Drawings:

- (1) Single Line Diagram of Complete Electrical System for Pumping Station(s), and other facilities.
- (2) Electrical Substation Layout showing HT Two/ Four Pole structure associated switchgears, Transformer, fence and gate etc.
- (3) 11kV Switchgears/ RMU (Where applicable)
 - (a) Dimensional Drawing showing overall dimensions, plan, elevation and cable entry details.
 - (b) Complete assembly` drawings of the Switchgear showing plan, elevation and typical sectional views, details of busbars and location of cable end boxes and control cable terminal blocks for external wiring connections, etc.
 - (c) Foundation plan showing the location of channel sills, anchor bolts and anchors, floor plans and openings.
 - (d) Schematic power and control wiring diagrams along with control & interlock details, complete bill of materials indicating make, type, rating, setting etc of Circuit breakers, relays, contactors, current transformers, potential transformers, instruments, meters, annunciators etc .
- (4) Diesel Generator Set/(s) (Where applicable)
 - (a) GA Drawing showing overall dimensions ,plan, elevation, sectional views, mounting arrangement, layout, make, type ,rating etc of diesel engine, Alternator, Control panel, battery, battery charger etc.

- (b) Single Line & Schematic diagrams showing details of Power & Control, Change over, AMF details, Synchronising details, interlocks, protections annunciations, battery, battery charger etc with make, type, rating, setting etc of various equipment, components etc.
 - (c) Foundation plan showing the location of channel sills, foundation, anchor bolts and anchors, floor plans and openings.
 - (d) Exhaust system with piping layout
 - (e) Day oil tank sizing with mounting arrangement details
 - (f) Fuel bulk storage tank sizing with mounting arrangement details
 - (g) Fuel supply system with pipe arrangement.
- (5) 11kV / 433 kV Transformer/(s)
 - (a) General arrangement drawing of the transformer, showing plan, front elevation and side elevation complete with all accessories and fittings, detailed dimensions, net weights, quantity of oil, clearances between HV terminals, between LV terminals, between HV and LV terminals, between HV & LV terminals and ground etc.
 - (b) Rating, diagram and terminal marking, complete with polarity and vector group.
 - (c) Control wiring diagram for marshalling box.
 - (d) Foundation drawing with position of foundation bolts and depth.
- (6) L.T Switchboards- Power & Motor Control Centers, Lighting & Power Distribution Boards etc..
 - (a) Dimensional Drawing showing overall dimensions, plan, elevation and cable entry details.
 - (b) Complete assembly drawings of the switchboard/ distribution board/ MCC showing plan, elevation and typical sectional views, details of busbars and location of power & control cable terminal blocks for external wiring connections, etc.
 - (c) Foundation plan showing the location of channel sills, anchor bolts and anchors, floor plans and openings.
 - (d) Schematic power and control wiring diagrams along with control & interlock details, complete bill of materials indicating make, type, rating, setting etc of Circuit breakers, relays, contactors, current transformers, potential transformers, instruments, meters, annunciations etc .
 - (e) Feeder Operation and Interlock logic.
- (7) L.T Capacitor bank with Automatic Power Factor Correction Relay
 - (a) Fully dimensioned general arrangement drawings of capacitor and capacitor control panel with elevation, side view, sectional view and foundation details.
 - (b) Justification for number of steps for switching.
 - (c) Complete schematic and wiring diagrams for capacitor control panel.

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- (8) Variable Frequency Drives
 - (a) Dimensional details with mounting arrangement.
 - (b) Schematic power and control wiring diagrams along with control & interlock details, complete bill of materials indicating make, type, rating, setting etc of Circuit breakers, relays, contactors, current transformers, potential transformers, instruments, meters, annunciators etc .
 - (c) Specific details of converter, inverter and harmonic control units.
 - (9) Battery and Battery Charger with D.C. Distribution board
 - (a) Dimensioned general arrangement drawings
 - (b) Fully dimensioned general arrangement drawings of battery and battery charger with elevation, side view, sectional view and foundation details
 - (c) Complete schematic and wiring diagrams
 - (10) Cabling System
 - (a) Make and type of HT& LT Power and Control Cables.
 - (b) Details of Installation of Cables in Trenches, on cable trays, directly buried etc at all locations inside the plant.
 - (c) Cable routing plan and section inside the plant.
 - (d) 11kV Cable termination and mounting Kit Layout drawing.
 - (11) Lighting system
 - (a) Make, type, rating etc of various fixtures, receptacles, switches etc in various premises.
 - (b) Make, type, rating etc of various fixtures, lighting poles etc for street lighting and flood lighting.
 - (c) Detailed Room wise Lighting Layout with Type of fixture details and Circuit diagram showing phase wise load distribution and interconnection between switches, fixtures, Lighting panel, receptacles etc.
 - (d) Internal road Lighting and Area lighting layout with location of poles, details of fixtures and mounting.
 - (e) Street Light pole details with Foundation details.
 - (12) Earthing System
 - (a) Details such as material, sizes, etc. of the earth conductor and electrode pits.
 - (b) Earthing layout drawing showing routing of main grid inside the plant with details of interconnection of equipment earthing to the grid and earth pits.
 - (13) Electrical Equipment and Switchboards & Control Panel Layout.

Schedules:

- (1) Cable schedules & interconnection details

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- (2) Electrical Load and Power consumption schedule
 - (3) Junction box schedule
 - (4) Protection relay setting schedule.

Calculations

- (1) Specific Energy Consumption Calculations.
- (2) Bus bar sizing calculation for 11 KV Switchgears, 415 V Switchgears etc.
- (3) Co-ordinated protection study.
- (4) Fault level and Voltage Dip Calculations.
- (5) Sizing of Capacitor banks.
- (6) Non Segregated Bus Duct
 - (a) Sizing of the bus bars vis-à-vis thermal capability to withstand rated
 - (b) Continuous current and one second short time current.
 - (c) Spacing of the insulators vis-à-vis mechanical strength to withstand forces due to momentary short circuit current.
 - (d) Heat loss and temperature rise calculations for conductor and enclosure. All formulae and other information from which the heat losses have been derived shall be enlisted.
- (7) HT and LT Cable sizing.
- (8) Earthing sizing calculation
- (9) Room wise Lighting Calculation as per Lux level given in the specification.
- (10) Building Lightning Protection and Earthing Sizing Calculation.

Control and Instrumentation Drawings/ Documents

Drawings:

- (1) Power supply distribution single line and schematics diagrams (see note 1 below) for each control panel.
- (2) Internal and external (see note 2 below) general arrangement for each control panel (dimensional).
- (3) RTU/ Control panel wiring diagram, relay logic diagram along with terminal block details.
- (4) System configuration and layout diagram along with bill of material, program listings, block logic diagram and control logic write up for PLC.
- (5) UPS and battery sizing calculations.
- (6) control and instrumentation loop drawings (see note 3 below).
- (7) instrument installation detail drawing (hook up, see note 4 below).
- (8) cable block diagrams.
- (9) cable routing/installation drawings.
- (10) foundation and fixing details and trenches drawings.
- (11) mimic general arrangement (full colour copies shall be provided).

Schedules:

- (1) Cable schedule.
- (2) Cable interconnection schedule.

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- (3) Control and instrumentation load schedule for each control panel.
 - (4) I/O schedule.
 - (5) Junction box schedule.
 - (6) Instrument schedule with tag nos.
 - (7) Instrumentation, process control set point schedule.
 - (8) Instrument data sheets.

Documentation:

- (1) Functional design specification (FDS)(see note 5).
- (2) Factory acceptance test document (FAT).
- (3) Site acceptance test document (SAT).

Notes:

1. Schematic drawings shall include a comprehensive schedule of the components used in each switchboard, MCC and control panel including details of the type, manufacturer, and rating of each component.
2. The external arrangement of each switchboard, MCC and control panel shall show the arrangement of all components including details of panel section, switch, and instrument labels.
3. Control and instrumentation loop drawings shall show on a single drawing the complete circuit associated with an instrument or device including details and location of power supplies, cabling and terminations.
4. Hook up drawings shall detail how an instrument or device is installed.

Electrical control schematics, loop diagrams and schedules shall where practical be A3 size drawings; all other drawings shall be A1 size.

Calculations for:

- System & Equipment sizing.

The Employer's Representative reserves the right to ask for additional Equipment/system information apart from the above to ascertain good system design and proper selection of Equipment.

Submission of Documents and Drawings

The Contractor shall supply to the Employer's Representative 5 (five) hard copies along with softcopies for each of the drawings and design calculations for the process and sizing of all components of the System including architectural, structural, mechanical, electrical and ICA equipment, supported by flow diagrams and general arrangement drawings for approval.

The Employer's Representative may require the Contractor to submit for approval additional drawings if they are necessary to enable him to satisfy himself that the items are well designed, that they comply with the Employer's Requirements and that they are suitable for their intended purpose. These drawings shall form the agreed

basis for the execution of the Works. If an approved drawing is revised, revised copies shall be submitted for approval as above and no such revised drawing shall be used for the purposes of the Contract until it has been approved in place of the earlier issue of the drawing.

The Employer shall arrange to send observations if necessary within 7 (seven) calendar days of submission of the design and drawings for modifications to the Contractor. The Contractor shall incorporate all necessary comments of the Employer's Representative in the above design and drawings, if any, and shall re-submit further 5 (five) copies each of the revised designs and drawings within 10 (ten) days for the final approval of the Employer's Representative. The Contractor shall thereafter submit 8 (eight) copies each of the approved designs and 8 (eight) copies each of the approved drawings together with one copy each of the reproducible tracings. The Employer's Representative will return 2 (two) approved copies to the Contractor and retain 6 (six) for the Employer's Representative's office and field use.

If the submissions require more than one round of revision on account of incomplete compliance from Contractor, the delay will be on account of the Contractor. If new observations are given by the Employer's Representative, the Contractor will be entitled to take an additional 3 (three) days period for compliance. The Employer's Representative will signify his approval or disapproval of the Preliminary Phase Drawings / Construction Documents within 7 (seven) calendar days of each submission.

The structural designs shall be submitted along with STAAD files (input and output).

The Construction Documents are certified Drawings submitted by the Contractor to the Employer or Employer's Representative during the course of the Contract for approval. Construction Documents shall be submitted in accordance with the timetable set down in the Work Programme. Approval of drawings by the Employer's Representative shall not be held to relieve the Contractor of his responsibilities under the Contract.

The construction drawings shall be submitted in A3 / A1 sized drawing papers and to readable scale.

The Employer's Representative will not permit construction to start on a part or section of the Works unless Construction Documents for that part or section have been approved.

Draft As- Built Drawings shall be submitted 30 calendar days prior to the commencement of Tests on Completion. The Employer's Representative will signify his approval or disapproval of the As-Built Drawings within 15 (twenty eight) calendar days of submission. The Final As-Built Drawings shall be submitted prior to the issue of any Taking Over Certificate. To remove doubt the submission dates referred to above shall be the dates on which the drawings and documents are received by the Employer's Representative.

The Drawings prepared by the Employer's Representative, are called Engineer's Drawings. They may be modified or added to as provided by the following clauses.

The proposals shown on the Engineer's Drawings are based on information available prior to preparation of the Tender Documents. All levels indicated or proposed are based on survey information previously available but will need to be revised subject to the results of survey and site investigation carried out by the Contractor.

Working Drawings of the designs carried out by the Contractor shall be submitted by the Contractor to the Employer's Representative. Working Drawings shall include, but not be restricted to, pipeline plans and profiles, reinforcement detail drawings and bending schedules, shop drawings for structural steel and miscellaneous metal work, and drawings for other work for which the Employer's Representative's approval is required.

It shall be the Contractor's own responsibility to prepare such Working Drawings as he may require for the proper setting out and construction of all structures and facilities.

Work shall not commence on an individual structure or facilities until the relevant

Working Drawings have been approved by the Employer's Representative.

All dimensions shall be in metric units and each drawing shall be properly identified by a drawing head and a numbering code in the form prescribed by the Employer's Representative upon commencement of the Works.

Any changes or modifications to the Working Drawings that the Employer's Representative considers necessary shall be made by the Contractor promptly and the drawings resubmitted for approval.

Approval of Working Drawings will be given by the Employer's Representative in the form of a stamp "RELEASED FOR CONSTRUCTION" together with the date and the authorized signature. Only those Working Drawings carrying the signed and dated stamp shall be used for execution.

Copies of all such approved Working Drawings together shall be supplied to the Employer's Representative by the Contractor immediately after approval. The cost of preparing and providing all Working Drawings shall be included in the Contract Rates.

Should it be found at any time after approval has been given by the Employer's Representative to a Working Drawing submitted by the Contractor that the said

Working Drawing does not comply with the terms and conditions of the Contract or that the details do not agree with the Working Drawings previously approved, such alterations and additions as may be deemed necessary by the Employer's Representative shall be made therein by the Contractor and the work carried out accordingly without entitling the Contractor to extra payment on account thereof, except where such alternations and additions are to be made in direct consequence of written order by the Employer's Representative to vary the Works.

No examination by the Employer's Representative of any document submitted by the Contractor or of the Contractor's Working Drawings, nor the approval expressed by the Employer's Representative in regard thereto, either with or without modification, shall absolve the Contractor from any liability imposed upon him by any provision of the Contract. Notwithstanding the Employer's Representative's approval of the Working Drawings the Contractor shall be responsible for any dimensional or other errors.

9. Mobilization Period

During the mobilization period the contractor is required to:

- ☐ Establish a furnished project office
- ☐ Employ/mobilize the staff required for starting the preparatory work
- ☐ Mobilize the survey teams and Investigation team
- ☐ Project management along with connectivity with PIU.
- ☐ Establish Employer Representative office
- ☐ Mobilize vehicles, office (furnished), equipment, communication equipment.

10. Preparatory Period (Preparation of detailed Design and Drawings during preparatory period)

During the Preparatory Period, the Contractor is required to:

- Familiarize himself with the project site condition after required consultation
- Collect data and maps and understand the designs requirements of, Intake, sump, Pump house GSR, OHT, Pump houses etc
- Confirm/ conduct topographic survey to ascertain the levels at the proposed project components
- Carry out geotechnical investigation at proposed components/structure location for design purpose.
- Validate Hydraulic design
- Prepare and get approval of design and detailed construction drawings of various components of Irrigation system

11. Employer's Representative's Site Office

The Contractor shall provide, furnish, equip and maintain, for project completion period, one site offices for the sole use of the Employer's Representative's site staff. The offices shall be located near the Contractor's site offices. Basic construction details and dimensions shall generally be approved by the Employer's Representative.

Site office

Site office at each cluster shall have an internal area of at least 100 sqm each office carpet area, and shall have at least, office room, a conference room, pantry and a toilet. The layout of the site office and the sizes of the individual rooms, shall be agreed upon between the Employer's Representative and the Contractor. The Contractor shall establish Employer's Representative's site office within 14 days of the issue of the Notice to Proceed. The layout of the site office and the sizes of the individual rooms, shall be agreed upon between the Employer's Representative and the Contractor. Each office room in these offices shall be provided with sufficient lighting and well ventilated and shall be so insulated as to provide comfortable working conditions. Contractor may propose porta cabin as site office on approval of Employer.

Site office shall have required furniture/appliances, desktops, printer, required stationary and printing material. Each site office and equipment shall become the property of the Contractor upon completion of the Contract.

The Contractor shall be responsible for the proper maintenance of the offices during the execution period. He shall keep the offices and toilets clean and shall provide adequate cleaning staff for this purpose throughout the Contract period. All electricity, water and telephone charges, relating to the Employer's Representative's offices, shall be paid by the Contractor. If the Employer's Representative feels that office arranged by the contractor is not being maintained properly, Employer's Representative has right to deduct a reasonable amount from that payment.

12. Contractor's Offices, Stores and Services

The Contractor shall provide, erect, construct, maintain and subsequently remove proper offices, stores, workshops, laboratories, storage for his own use. Such facilities shall be sufficiently sized and equipped to enable him to manage his operations and those of his Subcontractors in a professional manner and to enable him to carry out all his obligations under the Contract. Sheds for storage of materials that may deteriorate or corrode if exposed to the weather shall be weatherproof, adequately ventilated and provided with raised floors. No material shall be placed directly on the ground. Within his offices a meeting room shall be available for site meetings with the Employer's Representative and the Employer.

13. Construction Period Milestones

The following milestones shall govern the Construction Period commencing from the date of Letter of Acceptance.

Milestones

Sr No	Construction	Period (in days) from the date of Commencement					
		45	150	250	350	500	548

Sr No	Construction	Period (in days) from the date of Commencement					
1	Mobilisation, survey, investigation and design/drawing	100 %					
2)	LIS Schemes (8 nos)						
a)	Execution of all components		20%	40%	70%	100%	
b)	Testing and commissioning and taking over ,Preparation of As						100%

14. Contractor's personnel and equipment

14.1. Contractor's Personnel

Except as otherwise stated in this Agreement, the Contractor shall make arrangements for the engagement of all the Contractor's Personnel in accordance with Applicable Laws. The Contractor is encouraged, to the extent practicable and reasonable, to employ staff and labour having appropriate qualifications and experience from the State of Himachal Pradesh and within India.

The Contractor shall provide all expertise, staffing and labour necessary for the continuous and efficient performance of Works.

The Contractor shall ensure that its staff possess the necessary qualifications and abilities to undertake their assigned tasks, and shall substitute its staff within three months after being requested by the Employer's Representative.

The Contractor shall pay wages, and observe conditions of labour in accordance with Applicable Laws.

The Contractor shall inform the Contractor's Personnel about their liability to pay personal income taxes in respect of such of their salaries, wages, allowances and any benefits as are subject to tax under the Applicable Laws of India for the time being in force, and the Contractor shall perform such duties in regard to such deductions thereof as may be imposed on it by such Applicable Laws.

The Contractor shall comply with all labour and other Laws applicable to the Contractor's Personnel, including Applicable Laws relating to their employment, health, safety, welfare, immigration and emigration, and shall allow them all their legal rights.

The Contractor shall require the Contractor's Personnel to obey all Applicable Laws, including those concerning safety at work

The Contractor's Personnel shall be appropriately qualified, skilled and experienced

in their respective trades or occupations. The Employer may require the Contractor to remove (or cause to be removed) any person employed under the Contract, who:

- i. persists in any misconduct or lack of care,
- ii. carries out duties incompetently or negligently,
- iii. is determined, based on reasonable evidence to have engaged or be engaging in corrupt, fraudulent or coercive practice during the Agreement,
- iv. fails to conform with any provisions of the Agreement, or
- v. persists in any conduct which is prejudicial to safety, health, or the protection of the environment.

In such a case the Contractor shall then appoint (or cause to be appointed) a suitable replacement person.

The minimum requirements for the Contractor's key personnel shall be following.

Using Form PER-1 and PER-2 in Section 4 (Bidding Forms), the Bidder must demonstrate it has personnel that meet the following requirements:

Personnel Requirement

Position	No s	Minimum Professional /Academic Qualification	Minimum years' (specific) experie n c e	Minimum practical experience
Project Manager	4	Graduate Engineer with Project management Experience	15 (8)	Managing at least one Lift Irrigation project of similar size to the bid. Proven experience in construction management, contract management and quality control in construction of lift irrigation projects preferably in pumping stations, laying and commissioning of pipe lines.
Construction Manager/ Senior Engineer	4	Graduate (Civil) Engineer	10 (5)	Experience in construction of Irrigation schemes of similar size to bid. Proven experience in construction management and quality control
Mechanical engineer	2	Graduate Engineer in the Mechanical engineering	10(5)	Relevant experience in at least one lift irrigation project of similar size
Electrical engineer	2	Graduate Engineer in the Electrical	10(5)	Relevant experience in at least one lift irrigation project of similar size

Position	No s	Minimum Professional /Academic Qualification	Minimum years' (specific) experien ce	Minimum practical experience
		engineering		
Instrumentation engineer	2	Graduate Engineer in the Instrumentation engineering	10(5)	Relevant experience in at least one lift Irrigation project of similar size
Site/QA-QC Engineer	4	Graduate/ Diploma (Civil) Engineer	5(3)	Experience in construction supervision and quality control of Irrigation project
Hydraulic Engineer	2	Graduate Engineer	8 (4)	Experience in modelling design of lift Irrigation scheme in Water-Gems and equivalent
Structural Engineer	2	Graduate Engineer	10 (5)	Experience in structural design of intake, pumphouse, ESR, GSR, anchor blocks/ thrust blocks components in lift Irrigation scheme for at least in 5 schemes
Safety /EHS Officer	4	Degree Environmental, Health and Safety Management or Equivalent	5 (3)	Experience in safety and Hazard Management at site and Knowledge of safety equipment and its use. He shall be available for 90% of time at site
EHS Supervisor	3	Masters in Environment Science	5 (3)	Experience in the field of Environment, health and safety
Supervisors	4	Graduation Degree	5 (3)	For supervision of various components in LIS such as intake, pumphouse, pipeline , tanks.

Note: Contractor shall provide all required manpower for successful commissioning of the project. It shall also include sufficient number of supervisors, drivers, helpers and cleaner etc.

14.2. Contractor's Equipment

The Contractor shall ensure continuous and timely availability all necessary vehicles,

equipment required for ensuring effective and efficient Services during construction Period. The Contractor shall not be eligible for separate payment towards the equipment deployed from time to time.

Replacement of Contractor's Equipment

The Contractor's construction equipment, used for the execution and completion of the works, shall be classified as Contractor's Equipment under GC 1.1.18. For the avoidance of doubt, neither the Employer shall have any right of ownership over Contractor's Equipment. The Contractor shall not be eligible for any additional payment towards the cost of equipment deployed from time to time and all cost of equipment, software, upgrade etc. shall be deemed to be included in contract price.

The minimum equipment required for operations is provided below.

Minimum Equipment to be deployed during construction Period

Sl. No.	Equipment Type and Characteristics	Quantity
1	Excavator	4
4	Field test facilities for testing fineness, consistency, setting time compressive & tensile strength of cement compressive & flexural strength of cement concrete and proof stress, elongation, tensile strength, bending & re-bending of reinforcement steel	4 set
5	Concrete mixer with hopper (1 cum capacity)	4
6	Road roller (tandem/vibratory)	1
7	Needle/ plate vibrator	8
8	Tipper lorries/ Dumper Trucks (not more than 4 cum capacity and hydraulic)	4
9	Crane or Hydra (10 Ton)	2
10	Total station survey equipment set	4
12	Water tanker 2000 litres	4
13	D G Set (20 KVA)	2
14	Pipe welding machine	4

*Note: Above listed equipment's are minimum however contractor shall deploy sufficient number of equipment's for achieving the various milestones defined in this document and successful completion and commissioning of the project within defined timeline in this document.

15. Vendor Approval during Execution Stage

15.1. Materials: general requirements

The term materials shall mean all materials, goods and articles of every kind whether raw, processed or manufactured and equipment and plant of every kind to be supplied by the Contractor for incorporation in the Works.

All materials shall be new and of the kinds and qualities described in the Contract and shall be at least equal to approved samples.

The Contractor shall as far as possible use materials available in India for the completion of the Works, subject to compliance with the Specification.

Substances and products used in the Works which may be applied to or introduced into water which is to be supplied for drinking, washing or cooking shall not contain any matter which could impart taste, odour, colour or toxicity to the water or otherwise be objectionable on health grounds. Only substances and products which have been approved by a national or international regulatory body shall be used.

In case the documentary evidence as required is in a language other than English, the Bidder shall also submit the translation of such document from other language to English duly authenticated by the Indian Embassy in the respective country. In case the documents pertain to a project executed in a country other than India / supply of items from or to a country other than India / any other activity carried out in a country other than India, the Bidder shall submit documents duly attested by the Indian Embassy in the relevant country.

The qualification criteria for the manufacturers of various plants /equipment /products /materials shall be as follows.

15.2. Criteria for selection of makes during execution stage

Following general criteria for evaluation and requirements on selection of Makes shall apply at the time of design / datasheet approval.

- Demonstrate that proposed makes by bidder are reputed makes.
 - The products/goods offered shall be in production for at least 8-10 years.
 - Assured availability of original mandatory spares parts or compatible substitute parts of offered Goods/Product for at least 5 years from the day of supply.
 - Copies of Type Test Certificate not older than 5 years for the items offered.
 - List of Clients to whom already the items have been supplied along with the year of Supply and Value of Orders
 - The Letter from the client (Govt./Semi-Govt./PSU) certifying the number of years of satisfactory performance shall be considered for end user satisfaction
 - Copies of Performance Certificate from the User's for the items in last five years.
 - Copy of latest ISO Certification for the Manufacturer
 - Details of Manufacturing Facilities
 - Turnover of the Manufacturer
 - Manufacturers full contact information
- (1) In addition to above, the goods shall also meet the following criteria:
- Suitable for Indian condition for Voltage and Frequency
 - All the suppliers and manufacturing companies must have a valid ISO 9001

Certificate. The companies shall need to have mandatory continuous ISO 9001

Certification at least up to issue of the Final Contract Completion Certificate.

- The Manufacturer shall not have poor performance record in JSV. The equipment shall also not have poor performance record in JSV

(2) For each Equipment/Goods/Products, the Bidder shall offer/propose preferably

3 reputed Makes and can choose any one of them at the implementation stage subject to JSV approval. Contractor /Employer may suggest any new make

other than above three makes subject to vendor approval procedure.

The submission of documentary evidence as per above criteria shall be required in the execution phase before issuing the approval for procurement/supply.

The end user certificate shall state on the essential information such as name of the Goods, Make and Performance, for verification against the proposed Goods to be supplied under the contract, regardless of whether the certificate was issued in the name of Contractor or Manufacturer.

The Contractor shall ensure that the Plant is safe in use, and that any safety regulations imposed by law or by any authorised body empowered to make such regulations are complied with.

16. Construction Program and Progress of Works

16.1. Construction Program

Contractor shall prepare Construction Program. It shall be in the form of a Critical Path Method (CPM) Diagram showing, sequences, dependencies, durations and dates for execution of all items following the sub- divisions in the Bills of Quantities for the execution of the Works within the periods stated in the Contract. It shall be supported by:

- a. Data of the construction methods
- b. Equipment Utilization Schedule
- c. Manpower Utilization Schedule
- d. Subcontracting Schedule
- e. Mobilization/Demobilization Schedule

The CPM diagram incorporating the above mentioned schedules shall be prepared using Microsoft Project, or similar approved project management software, and shall be presented in hard copy and electronic form to the Employer's Representative

In carrying out the Works due attention shall be paid to all measures which can reasonably be taken in order to diminish the inconvenience which the work may cause to services and access to property.

16.2. Updating, Monitoring and Reporting Progress

The Contractor shall monitor the progress of the Works including information provided by his Sub-contractors and suppliers, as necessary, for purpose of network planning, scheduling and updating and shall confirm the actual progress on each current activity shown on applicable CPM networks. The CPM networks shall form part of the Monthly Progress Report and shall indicate changes of schedule, if any in network activity duration and start/finish imposed dates. It shall also be provided in electronic form.

The Contractor shall prepare written explanatory notes on the particular activities which are overrunning or going to overrun against the schedule. If any such overrunning work is on the critical path, the Contractor shall state what corrective actions will be taken by him to bring it back on the schedule.

16.3. Detailed Fortnightly Program

The contractor shall submit at the end of each working week a detailed bar chart program for the next fortnight. The program shall identify where further drawings or instructions are to be issued by the Employer's Representative to avoid disruption to the progress of the Works.

16.4. Progress Reports

The Contractor shall furnish the Employer's Representative with two copies of Progress Reports at regular monthly intervals (along with softcopy) in a form determined by the Employer's Representative, containing the following information:

- ☐ physical progress for the report month and estimated progress for the next month;
- ☐ CPM networks and explanatory notices as described above in this section
- ☐ updated S-curves for physical progress at different sections of the Works
- ☐ any report which may be specifically requested by the Employer and/or the Employer's Representative.

These monthly progress reports shall be submitted not later than 7 days after the end of the report month.

16.5. Record / Progress Photographs

The Contractor shall arrange each month sufficient number of photographs as Record Photographs of progress of works and shall provide the electronic files. Contractor will include progress photos in the progress reports. Contractor shall capture all the site progress work and site activities photos in video and shall submit with progress report.

17. Standard Operating procedure (SOP) during implementation to be followed by contractor.

- a) **Information Board** showing the name of work, cost of estimate, duration, date of commencement, date of completion and labour wages shall be displayed
- b) **Availability of required Materials & machinery at site** – Contractor to ensure enough quantity of material, equipment and labours availability at site. All vehicles delivering goods to the site shall be covered to avoid spillage of materials and air pollution.
- c) **Environmental and safeguard compliance shall be followed by contractor as per contract.**
- d) Public Notice at the work site informing the people about: Work Schedule, Likely temporary impacts, Signage, Safety advice and mitigation measures, Contact details of Officers in charge and grievance redress mechanism
- e) **Barricading of site** – The excavated portion of trench is to be barricaded with safety reflective ribbon/tapes and portable boards and adequate signage.
- f) The contractor also has to take adequate steps to ensure health and safety of public in project area and the labourers working on the project and will also ensure appointment of a Health and Safety Officer in work site to oversee health and safety aspects. Safety PPE to working personnel and other adequate safety measures to avoid any accident, mishap, etc including sound shoring material, MS sheet piles etc to protect adjacent properties from any damage and structural stability, etc
- g) **Shoring and shuttering** -If depth of trenches exceed 1.5 meter contractor should organize placing of shoring and shuttering in the trenches. Close timbering should be done by completely covering the sides of the trenches.
- h) Disruption to utilities such as water, electricity, telephone cable, etc. needs to be avoided. In the event of any disruption, same shall be set right immediately.
- i) **Pipe bedding** – As per standard specification
- j) **Pipe laying and jointing** - After excavation & bedding contractor to fix the center line in the trench. According to the center line, pipes are to be lowered in the trench. After lowering of pipes in the trench, jointing should be done carefully .After laying & jointing site engineer has to ensure that pipe alignment should be in a straight reach.
- k) **Backfilling with selected excavated material and restoration –**
After successfully completion of the hydrostatic test the site engineer should backfill the trench in layers of 15/20 cm by hand or with mechanical compactor, it should be well compacted without damaging the pipe. The length of compacted layer should be checked & recorded after completion of backfilling the site should be cleared. If any left of surplus earth exists at the site, it should be removed from the site and it has to be dumped at any selected place. The field density should be checked for every layer by sand replacement method or core cutter method.
- l) **Road restoration –**
BT road –
 - Proper Compaction shall be carried out as per standard specifications / drawing Road resurfacing should be taken up after proper

compaction of the backfilled trench.

- GSB/WBM/WMM after achieving proctor density as per standard specification
- BT Road should be restored with BT only.
- Planning of road diversion and providing safety signs
- Arranging the machinery, material
- Protect to footwear and protect to goggles to all workers employed handling asphalt materials, cement, mortar, concrete and crusher operations.
- Cleaning of road, Spraying the water for dust suppression
- Providing road layers as per specification and drawing
- Compaction with road roller and compactor
- Spraying of sand dust for top layer
- Site clearing - after completion of work contractor shall clear debris and all extra material from site within a day.

m) CC road

- Arranging the machinery, material
- Cleaning of road
- Spraying the water for dust suppression
- Providing road diversion and safety signs
- Providing formwork, and necessary reinforcement at construction joint
- Providing road layers as per specification and drawing
- Curing of concrete with sufficient gunny bags or as per direction of Employers representative
- Site clearing
- Repairing of existing drainage where ever required.
- Health and safety
 - i) Ear plugs to workers exposed to high noise levels. ii) Hard hat or Helmets to all workers, supervising staff and inspecting official entering construction site, plant area, quarry and engaged in loading /unloading operations. iii) Protective goggles and clothing to workers engaged in stone breaking activities. iv) Nettings below and on the sides of overhead construction and excavation work to prevent mishaps due to accidental fall of workman and debris. v) Protect to footwear and protect to goggles to all workers employed handling asphalt materials, cement, mortar, concrete and crusher operations. vi) Welder's protective eye-shields and protective footwear to workers engaged in the welding works.

n) Work in rainy season

- No fresh excavation works shall be carried out during rainy season and without prior approval of Employer/ Employers Representative
- During rainy season hard barricading and safety measures should be followed at site for uncompleted works if any. In case of any injury contractor shall be solely responsible for the incidents. Penalty will be liable as per contract conditions.

o) General

- Contractor shall submit bar chart for work plan of entire project for at-least one week prior to start of work. In addition, contractor shall submit microplanning of the works to be carried out in a particular month at least one week prior to start of work in that month.
- Dumping yard information should be provided to the Employer which will be verified by department
- Dewatering pumps, Generator, Safety equipment should available at site.
- Barricading at site shall be provided in all trenches. Type of barricading shall be decided based on depth of trench and as directed by Employers representative.
- Curing to be done of CC road with gunny bag, three times a day and for at- least 15 days.
- Contraction and expansion joint to be filled with ACC Sheet/PVC sheet or any other equivalent material as directed by Employers representative.
- Required machineries and equipment's, including mechanical compactor or roller for patches shall be used.
- Portable drinking water to be made available to the Labour, engineering staff, official staffs during execution of work.
- Mobilization or demobilization of labours should be done with prior intimation to the Employer .
- QAP should be approved.
- Site office with all the basic amenities , facilities such as water, sanitation etc for labour should be arranged by contractor.
- Social improvement camps, Health & safety at site and capacity building camps, workshops to be organized from time to time. Every day before start of work safety instructions shall be given to labors/working staff at site by safety officer & site in charge.

18. Protection of Overhead and Underground Services

The Contractor will be held responsible for any damage to known services (i.e. overhead services that are visible within the Site and as per the survey details if any) and he shall take all necessary measures to protect them. All work or protective measures shall be subject to approval of the Employer's Representative. In the event of a service being damaged he shall inform the Employer's Representative and the authority concerned, the Contractor shall not repair any such service unless instructed to do so.

Contractor will map the underground utilities. Where no underground services are shown on the drawings or scheduled but the possibility of their presence can reasonably be inferred, the Contractor shall, in collaboration with the Employer's Representative, ascertain whether any such services exist within the relevant section of the Site. The Contractor shall complete such an investigation well in advance of the

start of construction work in the said section and he shall submit a report in good time to enable the Employer's Representative to make whatever arrangements as necessary and accordingly Contractor to make the required protection, removal or diversion of the services before any construction activities commences.

As soon as any underground service not shown on the drawings is discovered, it shall be deemed to be a known service and the Contractor will be held responsible for any subsequent damage to it. If such a service is damaged during the course of its discovery, the cost of making good such damage will be met from the provisional sum as approved by Employer unless he establishes that the Contractor did not exercise reasonable diligence and that the damage was avoidable.

Where the authority concerned elects to carry out on its own account any alterations or protective measures, the Contractor shall co-operate with and allow such authority reasonable access and sufficient space and time to carry out the required work.

☐ **Signboards**

Signboards shall be placed at each of the project offices, at important locations, in English, information about the project and Employer, and the names of the Employer's Representative and Contractor in a form and size to be agreed by the Employer's Representative. They shall be of durable construction capable of withstanding the effects of the climate until the end of the construction Period.

The Contractor shall keep the signboards in good repair for the duration of the contract and shall remove them on completion of the Contract.

Besides these signboards the Contractor shall not, except with the written authority of the Employer's Representative, exhibit or permit to be exhibited on the Site any other form of advertisement.

☐ **Site Drainage**

The Contractor shall keep each Section of the Works well drained until the Employer's Representative certifies that it is substantially complete and shall ensure that, so far as is practicable, all work is carried out in the dry. Site areas shall be kept well drained and free from standing water except where this is impracticable having regard to methods of Temporary Works properly adopted by the Contractor.

The Contractor shall provide, operate and maintain in sufficient quantity such pumping equipment, well points, pipes and other equipment as may be necessary to minimize damage, inconvenience and interference and shall construct, operate and maintain all temporary coffer-dams, sumps, ditches, drains and other temporary works as may be necessary to remove water from the Site while construction is in progress. Such Temporary Works and construction equipment shall not be removed without the approval of the Employer's Representative.

Notwithstanding any approval by the Employer's Representative of the Contractor's arrangements for the removal of water, the Contractor shall be responsible for the

sufficiency thereof and for keeping the Works safe at all times and for making good at his own expense any damage to the Works.

The Contractor shall be responsible to keep the Site clear of water at whatever pump rate is found necessary.

The Contractor's site drainage facilities shall not cause pollution in any local watercourses, he shall be responsible for any legal action resulting from pollution events.

☐ **Protection of Adjoining Property and Reinstatement upon Completion**

The Contractor shall be responsible and take all measures in order to protect adjoining property including buildings, electrical and telephone poles, bridges and culverts, retaining walls, compound walls and fences, and other structures. Prior to the commencement of the activities, the Contractor shall assess the probability and extent of unavoidable damages, if any, to the building and properties and submit his assessment to the Employer's Representative. The Employer's Representative may make his own opinion and if required may order arrangements for protection or repair of such likely unavoidable damage in which event the Contractor shall complete the activities.

Temporary facilities shall be provided by the Contractor, only for as long as required after which he shall dismantle and remove the same from their place of use as speedily as possible. Re-usable components shall be safely stored by the Contractor in his yard. The place of use shall be cleared and reinstated immediately to at least the condition existing before the temporary facilities were provided, and to the satisfaction of the Employer's Representative.

☐ **Coordination with Other Authorities**

- **Statutory Services**

As far as possible the Contractor shall acquaint himself with the actual location of all existing public utilities such as water mains, drains, cables for electricity, telephone lines, lighting poles, masts, etc., before commencing any activities likely to affect the existing utilities. The Contractor shall with the assistance of the Employer obtain such information directly from the responsible authorities as early as possible.

- **Notices, Permits**

Well in advance of the programmed start of any work which may affect traffic or any existing utilities the Contractor shall give advance information to the Employer / Employer's Representative indicating the type, the exact location, the programmed starting time and the expected duration of the activities and shall provide whatever particulars may be required by the authorities to issue any required permits and

make all necessary arrangements. The Employer will provide all necessary assistance to Contractor for obtaining the permissions as required.

19. Quality control

19.1. Quality Control Plan and Procedures

The Contractor shall be responsible for establishing and maintaining procedures for quality control that will ensure that all aspects of the Works comply with the requirements of the Contract.

As soon as reasonably practicable prior to the commencement of Works the Contractor shall submit for approval a Quality Control Plan giving detailed proposals for control of quality of all aspects of work on the Site and at suppliers' workshops.

The Quality Control Plan shall include the following: a) a list of the Contractor's staff engaged in quality control b) a list of any outside testing agencies employed by the Contractor for work in connection with quality control c) where a testing laboratory is to be established on Site under the Contract, a list of major items of equipment and a layout of the laboratory, together with details of the tests which will be carried out there d) a list of manufactured items and materials, obtained by the Contractor for the Works, which require inspection at the suppliers' premises, and the proposed procedures for ensuring quality control e) a list of materials and operations to be inspected by the Contractor at the various stages of construction work on Site, together with inspection procedures, test types and frequencies f) sample of proposed quality control records, testing and reporting forms.

Unless the Employer's Representative permits otherwise, the approved Quality Control Plan shall be followed throughout the construction of the Works. Any approval by the Employer's Representative of the Contractor's plan and procedures shall not relieve the Contractor of his obligation to ensure that the Works comply with the requirements of the Contract.

The Contractor shall appoint a suitably qualified member of his staff to be responsible for all aspects of quality control and to maintain effective liaison with the Employer's Representative.

19.2. Sampling and Testing

The Contractor shall provide for the approval of the Employer's Representative, samples of all construction materials and manufactured items required for the Permanent Works. All samples rejected by the Employer's Representative shall be removed from Site. All approved samples shall be stored by the Contractor in a sample room, at a location approved by the Employer's Representative, for the duration of the Contract, and any materials or manufactured items subsequently delivered to Site for incorporation in the Permanent Works shall be of a quality at least equal to the approved sample. The approved samples may only be disposed of with the Employer's Representatives approval.

Samples shall be submitted and tests carried out sufficiently early to enable further samples to be submitted and tested if required by the Employer's Representative. Samples for testing will generally be selected by the Employer's Representative from materials to be utilized in the project and all tests will be under the supervision of, and as directed by, and at such points as may be convenient to the Employer's Representative.

Material requiring testing shall be furnished in sufficient time before intended use so as to allow for testing. No materials represented by tests may be used prior to receipt of written approval of said materials.

The Contractor shall give the Employer's Representative 3 to 7 days' notice in writing of the date on which any of the materials will be ready for testing or inspection at the suppliers' premises or at a laboratory approved by the Employer's Representative and the Employer's Representative/Employer's Representative shall attend at the appointed place and time. The Contractor shall in any case submit to the Employer's Representative within 3 days after every test such number of certified copies of the test readings as the Employer's Representative may require.

Approval by the Employer's Representative as to the placing of orders for materials or as to samples or tests shall not prejudice any of the Employer's Representative's powers under the Contract.

The provisions of this Clause shall also apply to materials supplied under any nominated subcontract.

After all construction at is completed and before applying for taking-over, the Contractor shall perform field tests as called for in the Specifications. The Contractor shall demonstrate to the Employer's Representative the proper operation of the facilities and the satisfactory performance of the individual components. Any improper operation of the system or any improper, or faulty construction shall be repaired or corrected to the satisfaction of the Employer's Representative. The Contractor shall make such changes, adjustments or replacement of equipment as may be required to make the same comply with the Specifications, or replace any defective parts or materials.

In addition to any special provision made herein as to sampling and testing materials by particular methods, samples of materials and workmanship proposed to be employed in the execution of the Works may be called for at any time by the Employer's Representative and these shall be furnished without delay by the Contractor at his own cost. Approved samples will be retained. The Employer's Representative will be at liberty to reject all materials and workmanship that are not equal or better in quality and character than such approved samples.

The tests required for quality control shall include but not be limited to:

- a) tests conducted at the premises of the Contractor, Subcontractor, manufacturer

or supplier which are normally or customarily carried out at such premises for the items or materials being supplied for the Works

- b) tests which are normally or customarily conducted on the items or materials being supplied for the Works by the Contractor, Subcontractor, supplier or manufacturer but which have to be conducted at an approved laboratory because the necessary testing facilities are not available on the premises of the Contractor, Sub-Contractor, supplier and manufacturer
- c) tests on locally obtained materials or items either on the Site or at an approved laboratory for the purpose of obtaining the approval of the Employer's Representative to the classification, use and compliance with the Specifications of such items or materials
- d) routine quality control tests conducted by the Contractor to ensure compliance with the Specifications
- e) regular testing of concrete and other materials as specified in the relevant Chapters of the Technical Specifications
- f) standard shop and Site acceptance tests, including trial assemblies, of Plant.

19.3. Inspection and Acceptance

The Employer's Representative will not inspect any item of fabricated or finished work until such time as the Contractor shall have forwarded to the Employer's Representative the approved Working Drawings covering the items to be inspected, together with copies of the respective orders.

Manufactured items and materials delivered to the Site shall be inspected by the Contractor on arrival. Any defects shall be notified to the Employer's Representative.

Minor defects to surface finishes and the like in manufactured items shall be made good in an approved manner to the satisfaction of the Employer's Representative. Items with more serious defects shall be returned to the suppliers for correction or replacement as appropriate.

19.4. Materials/ Plant Certificates and Inspections

Where certificates are required by the Specifications or relevant Reference Standard, the original and one copy of each such certificate shall be provided by the Contractor.

Certificates shall be clearly identified by serial or reference number and shall include information required by the relevant Reference Standard or Specification clause.

The timing for submittal of certificates shall be as follows:

- a) manufacturer's and supplier's test certificates shall be submitted as soon as the

tests have been completed and in any case not less than 7 calendar days prior to the time that the materials represented by such certificates are needed for incorporation into the Permanent Works

- b) certificates of tests carried out during the construction or on completion of parts of the

Permanent Works shall be submitted within 7 days of the completion of the test.

No materials, articles or items of fabricated or finished work to be supplied by the Contractor or Subcontractors which have been inspected and tested by the Employer's Representative or the inspecting Engineer shall be dispatched unless a Passing Certificate has been requested by the Contractor from the Employer's Representative and subsequently been issued by the Employer's Representative to the effect that the same are approved. Neither the Contractor nor Sub-Contractors shall make use of any materials or articles ordered by them for the purpose of fabrication until a Passing Certificate covering the said materials and articles shall have been issued by the Employer's Representative or inspecting Engineer.

All material under the contract is divided in 3 categories. Drawing in following inspection category means the data sheets, QAP, GAD of equipment, Drawings, etc.

Category A: The Drawing will be approved by the Employer before manufacturing and Testing. The material will be inspected by the Employer or by an Inspecting agency approved by the Employer at the manufacturer's premise before packing and dispatching. **The inspection charges of the agency will be borne by the Employer from provisional sum but initially the contractor has to pay the inspection charges.** The Contractor shall include in their next bill the inspection charges and the same will be reimbursed by the Employer at actual. The Contractor shall provide the necessary equipment and facilities for tests and the cost, thereof, shall be borne by the Contractor. In case of failure of any item during third party inspection, no charges shall be reimbursed to the contractor for the same.

Category B: The drawings of the Equipment will be submitted and to be approved by the Employer prior to manufacture. The material has to be tested by the manufacturer and the manufacturer's test certificates are to be submitted and approved by the Employer before dispatching of the Equipment. Notwithstanding the above, the Employer, after examination of the test certificates, reserves the right to instruct the Contractor for retesting, if required, in the presence of Contractor's representative.

Category C: The material may be manufactured as per standards and delivered to the site.

For material / Equipment under category "A" and "B", the Employer will provide

an authorization for packing and shipping after inspection. The testing, approval for dispatching shall not absolve of the Contractor's obligation for satisfactory performance of the plant. Employer will take the decision on category of inspections.

The testing, approval for dispatching shall not absolve of the Contractor's obligation for satisfactory performance of the plant. Employer will take the decision on category of inspections.

Testing, Approval for Dispatching (Indicative list)

Sr No.	ITEM	Category of inspection
1	All pipes and fittings including	A
2	Pumps-sets, Sluice Valves, NRV, Butterfly valve,	A
3	Level sensors, Pressure transmitter	B
4	Flow meter	A
5	Expansion Bellows/ Dismantling Joints,	A
6	HT Switchboard, LV PCC/ MCC/ Motor starter Panels, Feeder Pillar Panels, Motors, PLC, and	A
7	Power and Control cables, Capacitor, Submersible Cables,	B
8	Earthing system, Lighting system, Local push	C
9	Reinforcement Bars, Bitumen, Cement	C

Note: The above list is indicative and detailed list of inspection category for each equipment and machineries will be provided by the Employer after award of contract.

19.5. Site Records

Daily records of on-site testing and inspection shall be kept on forms of approved format. Test results shall be certified by the responsible member of the Contractor's staff. All test certificates and inspection records (including any from suppliers or other outside testing agencies) shall be clearly identified with the appropriate part of the Works to which they refer, and they shall be submitted to the Employer's Representative together with the respective Passing Certificate.

Once each month, or at such other intervals as the Employer's Representative may require, the Contractor shall submit in an approved form a summary of all quality control inspections and tests performed at Site and elsewhere in the intervening period.

Test results shall be summarized in tabular form or graphically or both in a way that best illustrates the trends, specific results and specification requirements. Where the tests show that the specified requirements were not achieved, the report shall describe the action that was taken.

Each report shall also contain a forecast of quality control work likely to be carried out during the period to be covered by the succeeding report.

The Contractor shall keep detailed and up-to-date inventories in an approved form of goods and materials already approved by the Employer's Representative for which Passing Certificates have been issued as well as of all other goods and materials subject to quality control which are on order, delivered, found faulty, lost during the work or found to be surplus to requirements. The Employer's Representative shall have access to these records at all times.

19.5.1. Daily Log Book

The Contractor shall keep a Daily Log Book at each location where major construction activities are taking place. This Daily Log Book shall be in a form approved by the Employer's Representative and shall contain, but not be limited to, the following major items of information:

- a) name of Contractor and Package No. b) date
- c) weather conditions (max./min., temperature, hours and intensity of rainfall)
- d) work carried out during the day per Section (description, quantities)
- e) major equipment used per section (on contractual work, on extra work ordered, approximate operating time on either)
- f) strength of labour force per Section (on contractual work, on extra work ordered, hours worked on either)
- g) delays (cause, effects such as idle time etc.)
- h) unusual events (earthquakes, floods, fires, storms, accidents, strikes, rallies, etc.)
- i) visitors at Site.

Each daily log shall be signed by the responsible Site Manager of the Contractor and "noted" by the Employer's Representative.

20. Submissions by the Contractor

20.1. Pre-Construction Surveys and Setting Out

The Contractor shall verify all measurements and be responsible for their correctness. Any differences which may be found between actual measurements and the dimensions given in the Contract Documents shall be submitted to the Employer's Representative, in writing, for consideration and directives before proceeding with the Works.

Site bench marks shall be accurately and safely established, maintained and removed upon completion of the Works, all to the satisfaction of the Employer's Representative. The Employer's Representative will indicate the position, co-

ordinates and elevation of bench marks near the works, as shown on the Drawings.

The Contractor shall prepare a plan detailing the location of the bench marks and keep this up-to-date throughout the period of the Contract. Reproducible copies of the plan so prepared shall be supplied to the Employer's Representative, as and when he may require.

The Employer's Representative reserves the right to order levels, considered necessary for the full and proper supervision and measurement of the works, to be taken at any time.

Before the Works, or any part thereof, are commenced, the Contractor and the Employer's Representative shall together make a complete survey, and take levels, of the Site and agree on the dimensions and elevations upon which setting out of the Works shall be based.

These levels shall be related to the bench marks and shall be plotted and drawn up by the Contractor. After agreement of the drawings, which shall be signed by the Employer's Representative and the Contractor, these levels shall form the basis of setting out of the Works.

The Contractor shall be responsible for the true and proper setting out of the Works in relation to reference data given on the Drawings and shall accurately set out the positions, levels and dimensions of all parts of the Works. Any delay or loss resulting from errors in the setting out of the Works shall be the responsibility of the Contractor.

Setting out shall be reviewed by the Employer's Representative before commencing the Works, but any approval shall, in no way, relieve the Contractor of his responsibility for the correct execution of the Work.

20.2. As-Built Drawings

Such approved Working Drawings as have been selected by the Employer's Representative shall be correctly modified for inclusion in the As-Built Drawings incorporating such variations to the Works as have been ordered and executed. Such drawings shall show the actual arrangement of all structures and items of equipment installed under the Contract. The Contractor shall submit 1 (one) soft copy and 3 (three) prints of all As-Built Drawings (in readable form and in scale) clearly named as such to the Employer's Representative for approval before applying for the Taking-Over Certificate for the respective Section of the Works. After approval of the As Built Drawing the Contractor shall supply an electronic copy of the drawing in together with a licensed copy of the drafting software.

During the course of the Works, the Contractor shall maintain a fully detailed record of all changes from the approval to facilitate easy and accurate preparation of the As-Built Drawing.

Irrespective of the other contractual prerequisites no Section of the Works will be considered substantially completed until the respective As-Built Drawings have been approved by the Employer's Representative.

In parallel with the preparation of as-built drawings, the Contractor shall produce GIS data of the constructed works. The contractor conducts all necessary survey work, and shall ensure that vertical and horizontal measurements shall be captured at an accuracy of +/- 0.1m at a 95% confidence level, using the most suitable and cost- effective field data collection technology and methodology. All horizontal and vertical survey measurements will be referenced to the present Survey of India GIS geo reference.

The Contractor will survey the three-dimensional position (x,y,z) of all point and line assets constructed under this project, e.g., check dam, intake, desilting tank, sump, Pump house, rising main, valve chambers, GSR, OHT, cluster tanks,. The Employer's Representative and the Employer may require the Contractor, at no additional cost, to create new attributes to include non-survey data, e.g., model, name of the manufacturer, images or plans, etc. Prior to the field survey, the Contractor shall submit to the Employer's Representative, for approval, the GIS design in terms of themes, feature types and attributes.

The Contractor shall develop a checklist of QC checks for each type of deliverable and will be responsible for ensuring that these QC checks are performed. The Contractor shall assign a GIS quality officer to manage the quality review process. This officer shall be independent of the capture and production teams.

The contractor is required to capture all the assets forming Proposed Scheme along with its attributes, capturing existing and proposed assets. Some of the key assets along with their attributes are listed below. It shall be noted that these listed assets and attributes are not exclusive, it is the responsibility of the contract to include all the assets and additional attributes as directed by the client.

Not all attributes for individual assets may be readily available, however it is the responsibility of the contractor to develop the GIS platform that could be updated as and when the information are available.

Sample Asset Attributes for Irrigation system

S. No.	Sample Asset Attributes

1.	Pipe

Pipe attributes should include, but not limited to:

- ☐ Assets number if specific
- ☐ Pipe diameter (nominal)
- ☐ Pipe diameter (internal)
- ☐ Friction factors
- ☐ Length
- ☐ No. of connections
- ☐ Material/class
- ☐ Age
- ☐ Location

2. Pump

Pump attributes should include, but not limited to::

- ☐ Location
- ☐ Assets number if specific
- ☐ Type
- ☐ Pump Unit motor data
- ☐ Pump Unit Impeller Data
- ☐ System head curves including power & efficiency
- ☐ Performance testing/monitoring data (eg flows, suction and discharge pressure, operating periods)
- ☐ Operational control settings

3. Reservoir/Storage Tank

Reservoir attributes should include, but not limited to:

- ☐ Location
- ☐ Assets number if specific
- ☐ Floor Level
- ☐ Volume
- ☐ Operating Levels
- ☐ Minimum operating level
- ☐ Reserve Storage Level
- ☐ Full service Level
- ☐ Overflow Level

4. Valves, Control Valve and Stop Valves

Control Valves attributes should include, but not limited to:

- ☐ Location
- ☐ Assets number if specific
- ☐ Manufacturer
- ☐ Model
- ☐ Operational setting
- ☐ Design Performance
- ☐ Valve curve

21. Training**21.1. Training of Employer's Staff**

The Contractor shall plan and develop the course content, and implement on-the-job and classroom-based training, for Employer's staff for at least 10-person. The Contractor shall organize training for identified managers from amongst the Employers staff in technical, of Irrigation system to enable the Employer to build sufficient capacity and skills to manage the constructed services after the Contract Completion Date.

The contractor shall develop training program in following manner

-
- ☐ Preliminary training – on site at during design phase;
 - ☐ Assess existing levels of skills and knowledge.
 - ☐ Assess level of skill required.
 - ☐ Define the Training program.
 - ☐ Implement the Training program.
 - ☐ Training methods.

22. Health and safety

22.1. Safety and Security

22.1.1. EHS Officer

The Contractor shall, at all times, have a nominated EHS Officer responsible for safety precautions at the Works. The Contractor shall notify the Employer of the identity of the EHS Officer.

The responsibilities of the EHS Officer shall include:

- (a) safety training
- (b) safety inspections, and
- (c) promoting good safety practice
- (d) Investigation of accidents and health and safety breaches.
- (e) The inspection and maintenance of fixed and portable fire protection equipment.

The Contractor shall:

- i. Ensure that its operating procedures follow good health and safety practice;
- ii. Ensure that the Works is maintained at all times in a safe condition.
- iii. Train all its staff on health and safety issues in accordance with the Health and Safety Manual and the Staff Training Plan;
- iv. Provide for all staff and visitors the necessary protective and safety equipment and clothing.
- v. Provide all necessary safety and first aid equipment.

22.1.2. Security

In order to protect property, materials and facilities against unauthorised entry and trespassing, theft, destruction, damage, sabotage, embezzlement, fraud and other dishonest, illegal or criminal acts during the Operation Service Period, a security program shall be prepared, implemented and maintained. The security plan shall be subject to review and comment by the Employer's Representative.

23. Compliance to ADB safeguards

- 23.1. Within (ex. 28) days from the date of the Letter of Acceptance, the Contractor shall submit a detailed site-specific Environmental, Health and Safety Management Plan (EHSMP) based on the generic environmental management plan (EMP) below. The Contractor will not start any pre-construction and/or construction works until the EHSMP is approved by Project Manager. The EHSMP shall indicate how the Contractor intends to perform all mitigation and monitoring measures to manage environmental impacts as documented in the initial environmental examination (IEE)

and EMP. The Contractor shall familiarize on the information set forth in the project's IEE, which is required under ADB Safeguard Policy Statement of 2009. Work shall not commence on the site until the no objection of site-specific EHSMP has been obtained from the Project Manager.

The Contractor shall comply with all applicable national, provincial, and local environmental laws and regulations. The Contractor shall also comply with all requirements of the national and local authorities responsible for enforcing environmental health and safety controls, such as the following aspects (but not limited to):

1. Biodiversity conservation and sustainable natural resource management
2. Pollution prevention and abatement
3. Health and safety of workers and nearby community people
4. Control of infectious and communicable diseases (HIV/AIDS, malaria, COVID-19 etc)
5. Local cultural conservation
6. Labor codes

The Contractor is responsible for providing site workers with safe and healthy working conditions to minimize occurrence of accidents, injuries, and disease. This includes the establishment of preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks of the construction site work to the health and safety of local communities. An environment, health and safety focal person will be recruited by the Contractor to attend to environment, health and safety requirements.

The Contractor is required to provide all personnel on site including Employer's Personnel and visitors with personal protective equipment in accordance with the site-specific EHSMP. The Contractor should ensure that his Subcontractor(s) comply with the site-specific EHSMP and provide all such necessary equipment to their personnel.

The Contractor shall (a) establish an operational system for managing environmental, health and safety impacts, (b) comply with the measures and requirements relevant to the Contractor set forth in the IEE and the EMP, with the approved site-specific EHSMP, and with any corrective or preventative actions set out in safeguards monitoring reports that the Employer will prepare from time to time to monitor the implementation of the project IEE and EMP through the EHSMP, (c) allocate the budget required to ensure that such measures, requirements and actions are carried out, (d) document mitigation and monitoring measures submit monthly reports on the compliance of such measures to the Project Manager and the Employer.

Where unanticipated health and safety hazards, or environmental risks or impacts become apparent during the Contract, the Contractor is required to update the site-specific EHSMP to outline the potential impacts to site works and associated mitigation measures for the Project Manager's approval.

The Contractor shall be involved on resolving complaints and issues from affected people relevant with the scope of works through grievance redress mechanism of the project.

In the event of a significant injury involving medical treatment or hospitalization and fatal accident the Contractor shall notify the Project Manager immediately by verbal communication and submit a formal report as soon as practicable after its occurrence. For all accidents, whether fatal or not, the Contractor shall also notify the appropriate local authorities in accordance with the Laws of the Country.

During the design, construction of the project, the pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines, World Health Organization's guidelines on ambient air quality and noise level etc., will be applied.

(https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines) These standards contain performance levels and measures that are normally acceptable and applicable to projects. When Government of India regulations differ from these levels and measures, the contractor will achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in ADB SPS

24. Generic Environment Management plan (EMP)

Contractor to create an Environment, Health and Safety Management Plan (EHSMP) based on this.

Generic Environmental, Health and Safety Management Plan (EHSMP) for Irrigation Facility under HPSHIVA Project for Lift Irrigation Scheme, Himachal Pradesh. Contractor will create an EHSMP from this generic plan and findings of the site survey

Potential Environmental Impacts	Mitigation Measures	Reference to laws /guideline	Location	Monitoring indicators (MI)/ Performance Target (PT)	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
	Implementation						Supervision	
Design and preconstruction stage								
Felling of trees on Government land	Feeling of trees from development work (expect Ban/Oak) in non-forest government land in the rural areas which is not forming part of 5ha compact wooded block - permission from Principal Chief Conservator of Forests (PCCF) if deemed found necessary after a proper survey by DFO. No civil work should be carried out until the permission is in place. Cutting trees at the proposed sites will be kept to an absolute minimum and only be permitted when it is obstruction in the planting design and laying of irrigation system.	HP Land Preservation Act, 1978 (Private land not classified as Forest)	Irrigation sites	Environmental Expert at PIU, JSV will prepare documentation and secure permission before the start of civil works	CHPMA recording; Archives to be collected by Environmental Experts at PIU JSV; All data collated at PMU Level	NA	Environmental Experts at PIU level;	Environmental Safeguard at PMU level, Project Director
Procurement of construction materials could lead to vehicular emissions	Contractor to source materials from authorized sources by the government. Use construction vehicles having proper pollution NOCs.	Central Motor Vehicle Act	Project Districts	Pollution Certificates	Submission of Pollution Certificates along with claims on the use of vehicles/ transportation/ machinery	NA	Contractor	PIU Expert, PMU Specialist Finance Specialist
Dust pollution Increased soil erosion;	Minimization of dust pollution by sprinkling water on excavated earth and borrowing pits. This activity should be avoided during the rainy season to avoid	NA	Project clusters Irrigation scheme	Visual site verification	Regular field audits by PIU experts Periodic site	NA	Contractor	PIU Expert, PMU Specialist

Potential Environmental Impacts	Mitigation Measures	Reference to laws /guideline	Location	Monitoring indicators (MI)/ Performance Target (PT)	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
							Implementation	Supervision
and loss of topsoil during the preparation of sites	mudslide conditions;		sites		visits by PMU specialist			
Construction Stage –Construction of Irrigation Schemes								
Land Development (terracing, where needed) Hill cutting could lead to - Dust pollution; Increased soil erosion; and Loss of topsoil;	The new terraces should be protected at their risers and outlets and should be carefully maintained, especially during the first two years. After cutting a terrace, its riser should be shaped and protected using local stones, soil and planted with grass as soon as possible (grass turfing). Sod-forming grasses with extensive rhizomes or rhizome-type grasses are better than those of the tall or bunch-type. The outlet for drainage-type terraces is the point where the run-off leaves the terrace and goes into the waterway or safe outlets. Its gradient is usually steep and should be protected by the sods of earth. A piece of rock, a brick, or a cement block, is sometimes needed to check the water flow on steeper channels. Similar checks on water flow are required for level bench terraces where the water falls from the higher terraces onto those below. A piece of rock should be placed on the lower terrace to dissipate the energy of the flowing water. Grasses should also be established on the area of the bench crossed by the waterway. As much as possible, terracing		Project clusters	Completion certificate to the contractor to be released only after satisfactory closure of site audit(s) finding(s).	PIU Environmental Coordinator to conduct site audits and ensure all protection work has been appropriately implemented;		Contractor to implement; CHPMA facilitators to monitor; DOH to award work contracts according to the season;	PMU Specialist

Potential Environmental Impacts	Mitigation Measures	Reference to laws /guideline	Location	Monitoring indicators (MI)/ Performance Target (PT)	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
							Implementation	Supervision
	activity should be avoided during the rainy season;							
Waste that may get generated if left at the site could lead to land and water pollution;	The contractor should dispose of all such waste away from community land or any valley side that needs protection or compaction with more soil. Such sites should be selected in consultation with the farmer community and should be at least 50m away from the site.	Construction and Demolition waste	Project clusters	Visual site verification	Regular field audits by PIU experts Periodic site visits by PMU specialist	Cost to be borne by the contractor as part of the overall contract	Contractor	PIU Expert, DOH PMU Specialist
Construction of weir / dyke & construction of percolation tank may lead to conflict with downstream water users right	Assess downstream water users carefully and ensure that their rights are protected, also ensure international water rights are not violated. Meaningful consultation with the stakeholders and potentially affected people (AP) will be undertaken on the potential environmental and social impacts.		Project clusters	Grievance Redressal Mechanism	Visual site verification	NA	PIU Expert, JSV	PMU Specialist
Impact on surface water quality during construction of intake well	Select a construction methodology that is least disturbing, and appropriate for the in-situ site condition, and able to complete the construction work in minimum time. Schedule the construction works during the lean period only and ensure that works is completed before onset of monsoon. Erect temporary barriers/ coffer dam to form enclosed construction area with least disturbance. Allow adequate time to settle the solids prior to pumping out water; only clear/clarified water shall be pumped back into the water body/reservoir; any silt	Water (Pollution and Prevention) Act	Irrigation Sites	Visual site verification	Regular field audits by PIU expert from JSV Periodic site visits by PMU specialist	Cost to be borne by the contractor as part of the overall contract	Contractor	PIU Expert, JSV PMU Specialist

Potential Environmental Impacts	Mitigation Measures	Reference to laws /guideline	Location	Monitoring indicators (MI)/ Performance Target (PT)	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
							Implementation	Supervision
	laden water should be pumped to a silt pond only. Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies. Avoid/minimize use of fuels, chemicals and lubricants; ensure no spillage; and have an equipment spill and containment plan on-site.							
Soil Erosion, silt runoff, contamination due to inappropriate transfer, storage, and disposal of petroleum products, chemicals, hazardous materials, liquids and solid waste. spoils from earthwork during construction	Stabilize surface soils where loaders, support equipment and vehicles will operate by using water and maintain surface soils in a stabilized condition. To mitigate soil erosion, contractors should prepare and implement a Soil Erosion Management Plan as part of the contractor site-specific EMP. The EMP should include proper transport and storage requirements for such materials. Measures such as settling ponds or sedimentation basins should be provided to prevent surface runoff; petroleum or other such products to be kept upon the impervious floor with secondary containment.	Water (Pollution and Prevention) Act	Irrigation Sites	Visual site verification	Regular field audits by PIU expert from JSV Periodic site visits by PMU specialist	Cost to be borne by the contractor as part of the overall contract	Contractor	PIU Expert, JSV PMU Specialist
Change in land use and loss of agricultural land, impact on forest area, and settlement areas during construction of MDT and pipe laying activities due	Select government land for construction of Main Delivery Tank to the extent possible. Minimize use of fertile land, forest, private properties, and settlement areas during pipe laying activity. Subprojects with involuntary resettlement will not be eligible for funding. Barricade the construction area using hard barricades on both sides and provide dust/wind screen;	NA	Irrigation Sites	Visual site verification	Regular field audits by PIU expert from JSV Periodic site visits by PMU specialist	Cost to be borne by the contractor as part of the overall contract	Contractor	PIU Expert, JSV PMU Specialist

Potential Environmental Impacts	Mitigation Measures	Reference to laws /guideline	Location	Monitoring indicators (MI)/ Performance Target (PT)	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
							Implementation	Supervision
to laying of rising main	Initiate site clearance and excavation work only after barricading of the site is done; Confine all the material, excavated soil, debris, equipment, machinery (excavators, cranes etc.), to the barricaded area; Limit the stock piling of excavated material at the site; remove the excess soil from the site immediately to the designated disposal area; Undertake the work section wise: 100 – 200 m section should be demarcated and barricaded.							
Degradation in ambient air quality during construction of MDT, hauling of material, material stock piling, pipe- laying activity, land clearance for horticulture area development	Damp down the soil and any stockpiled material on site by water sprinkling; Use tarpaulins to cover the loose material (soil, sand, aggregate etc.) when transported by trucks; Control dust generation while unloading the loose material (particularly aggregate, soil) at the site by sprinkling water and unloading inside the barricaded area; Apply water and maintain soils in a visible damp or crusted condition for temporary stabilization; Apply water prior to levelling or any other earth moving activity to keep the soil moist throughout the process; Avoid open burning during land preparation, weed control, and post-harvest treatments; Check PUC status of construction vehicles and machineries; Prohibit burning of	Air (Pollution and Prevention) Act	Irrigation Sites	Visual site verification	Regular field audits by PIU expert from JSV Periodic site visits by PMU specialist	Cost to be borne by the contractor as part of the overall contract	Contractor	PIU Expert, JSV PMU Specialist

Potential Environmental Impacts	Mitigation Measures	Reference to laws /guideline	Location	Monitoring indicators (MI)/ Performance Target (PT)	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
							Implementation	Supervision
	pesticide-treated agricultural wastes and by-products;							
Occupation Health and Safety	Construction works such as pump house, rising main and MDT may require worker to work at height and therefore there will be risk of slippage from height	Building and Construction worker safety	Irrigation Scheme sites and project clusters	Availability of all PPE kit to workers, especially safety belts and nets	Periodic site visits by PMU specialist	Covered by EPC Contractor	EPC Contractor	PIU JSV
	In the context of the COVID-19, workers may be exposed to occupational hazards that put them at risk of disease The protocols should include requirements on wearing masks PPE, physical distancing, hand washing, disinfection, checking body temperature, ventilation, management of waste, awareness, and morning briefings. Contractor will prepare COVID-19 health and safety plan in reference with WHO's Considerations for public health and social measures in the workplace in the context of COVID-19	WHO Health and Safety Policies and Guidelines	Irrigation Scheme sites and project clusters	Health records of the contractual workers to be maintain by the hiring agency	PIUs collect such records mention by the contractor	Covered by EPC Contractor	EPC Contractor	PIU JSV

25. List of threatened plant and animal species in HP As per Himachal Pradesh State Biodiversity Board

2

THE GAZETTE OF INDIA : EXTRAORDINARY

[PART II—SEC. 3(ii)]

(1)	(2)
2.	संबंधित राज्य जैवविविधता बोर्ड निम्नलिखित अथवा कार्यवाई करेंगे :—
(i)	समग्र जानकारी के लिए, अधिसूचित प्रजातियों के सभी पहलुओं का अध्ययन करना।
(ii)	स्वस्थाने और स्थान बाह्य संरक्षण और पुनःस्थापन के प्रयोजनार्थ, अधिसूचित प्रजातियों का प्रचार; और
(iii)	जागरूकता कार्यक्रम चलाना और वन विभाग के कार्मिकों, जैवविविधता प्रबंधन समितियों, पारिपर्यटन कार्यक्रमों और वनवासियों तथा जनजातियों को अधिसूचित प्रजातियों के संबंध में शैक्षिक सामग्री उपलब्ध करना।

[फा. सं. 28-12/2008-सी एस-III]

ए. के. गोयल, संयुक्त सचिव

MINISTRY OF ENVIRONMENT AND FORESTS NOTIFICATION

New Delhi, the 17th March, 2009

S.O. 783(E).—In exercise of powers conferred by Section 38 of the Biological Diversity Act, 2002 (18 of 2003), the Central Government in consultation with the Government of Himachal Pradesh, hereby notifies the species of plants and animals which are on the verge of extinction, as listed in column (2) of the Table given below, and prohibit or regulate the collection thereof subject to the conditions specified in the Annexure to this notification, for the State of Himachal Pradesh, namely :—

Sl. No.	Name of the species
(1)	(2)
Plants	
1.	<i>Aconitum deinorrhizum</i> Stapf
2.	<i>Aconitum heterophyllum</i> Wall. ex Royle
3.	<i>Aconitum violaceum</i> Jacq. Ex Stapf
4.	<i>Eremostachys superba</i> Royle ex Benth
5.	<i>Jasminum parkeri</i> Dunn
6.	<i>Nardostachys grandiflora</i> DC.
7.	<i>Dactylorrhiza hetegiera</i>
8.	<i>Taxus wallichiana</i>
Animals	
9.	<i>Murina grisea</i> Peters, 1872
10.	<i>Cervus duvaucelli</i> (Cuvier, 1823)

(1)	(2)
11.	<i>Capra falconeri</i> (Wagner)
12.	<i>Moschus chrysogaster</i> (Hodgson, 1839)
13.	<i>Gyps bengalensis</i> (Gmelin, 1788)
14.	<i>Gyps tenuirostris</i> Gray, 1844
15.	<i>Sarcogyps calvus</i> (Scopoli, 1786)
16.	<i>Vanellus gregarious</i> (Pallas, 1771)
17.	<i>Cervus elaphus hanguli</i>
18.	<i>Capricornis sumatraensis</i>

ANNEXURE

Condition No.	Conditions
1.	No plant or animal species as notified above shall be collected in live or dead condition by any except, for purposes mentioned below, with the approval of the concerned State Biodiversity Board; and also in accordance with the provisions of the Indian Forest Act, 1927 (16 of 1927) and the Wild Life (Protection) Act, 1972 (53 of 1972) of the relevant State Forest and Wild Life Legislations, namely :—
	(a) Scientific research;
	(b) Herbarium and museum of scientific and academic institutions;
	(c) Propagation; and
	(d) Any other scientific investigation.
2.	The concerned State Biodiversity Board shall initiate or conduct :—
	(i) studies on all aspects of the notified species for holistic understanding;
	(ii) propagation of the notified species for the purpose of <i>in situ</i> and <i>ex situ</i> conservation and rehabilitation; and
	(iii) awareness programmes and provide educational materials on notified species for forest department personnel, Biodiversity Management Committees, ecotourism programmes, and forest dwellers and tribals.

[F. No. 28-12/2008-CS-III]

A. K. GOYAL, Jt. Secy.

26. Access for Other Contractors

The Contractor shall allow reasonable access to other Contractors if any engaged on the Site or on areas adjoining the Site to carry out their works.

In the event of a dispute over access or priority between Contractors, the Employer's Representative shall be informed in writing. The Employer's Representative shall inform all parties concerned in writing of his decision.

Where any part of the Works is associated with or in physical contact with

plant/system supplied under a separate contract, the Contractor shall satisfy himself that the work carried out by the other contractor is consistent with the correct operation of the Plant. In the event of the Contractor considering any work being carried out or any work already completed to be detrimental to the ultimate operation of the Plant/system, he shall report the matter at once to the Employer's Representative.

If the work of the Contractor is delayed because of any acts or omissions of any other Contractor, the Contractor shall have no claim against the Employer on that account other than for an extension of time.

27. Survey Equipment and Field Assistance to the Employer's Representative

The Contractor shall make available to the Employer's Representative required survey equipment, suitably educated and trained survey assistants and labourers for use on and about the Site in sufficient numbers and at all reasonable times. The above mentioned equipment shall be the property of the Contractor upon the completion of the Contract.

28. Safety Equipment to the Employer's Representative

The Contractor shall provide the Employer's Representative with the safety equipment at each site office. The Contractor shall replace each item after it wears out and becomes unsuitable for use.

28.1. First Aid at Office and work site

The Contractor shall make his own arrangements for treatment of casualties on the Site in such first-aid units as may be thought necessary. The Contractor shall be responsible for the construction of such first-aid units and their management and operation and the removal by ambulance of injured or sick employees to nearby hospitals. The first-aid service shall cover the Contractor's own personnel as well as that of the Employer, the Employer's Representative and all Subcontractors.

28.2. Testing Facilities, Laboratory

Within 14 days of issue of Notice to Proceed, the Contractor shall establish, in the campus of site office, an on-site fully furnished and adequately equipped field laboratory staffed by qualified personnel suitable for construction material testing. Frequency of material testing shall be as per QAQC manual of the project. He will make the facility to test other material in the approved independent material testing

laboratory. The name and qualifications of independent testing laboratories shall be submitted to Employer's Representative for approval no less than thirty calendar days prior to the date the laboratories are to be used. Once approved, dismissal and replacement of the approved independent testing laboratory shall require written authorization by the Employer's Representative. The site laboratory shall be functional till the project completion. Laboratory and equipment shall become the property of the Contractor upon completion of the Contract

If Employer's representative found that Laboratory arranged by the Contractor is not being maintained properly then Employer's representative has right to deduct a reasonable amount from payment. The calibration of the laboratory equipment and instruments shall at the initial stage to be certified by agencies approved by the Employer's Representative. Laboratory equipment shall be properly maintained and calibrated throughout the period of the Contract by the Contractor at his own expense. The Contractor shall notify the Employer's Representative in sufficient advance prior to conducting any tests for the materials and work. The Employer's Representative will also inspect the laboratory and the contractor shall provide adequate facilities to the Employer's Representative for his independent verification of the accuracy and adequacy of the facilities.

The Contractor shall be responsible for the sampling, curing, and transport to the laboratories of all materials for testing, and all testing costs including laboratory fees, and/or all costs in running the on-site laboratory, i.e., chemicals, reagents, and other test consumables, staff, and utilities.

28.3. Site Safety

The Contractor shall at all times in the conduct of his work and that of his Subcontractors adhere to the established rules and regulations concerning all safety matters at as per applicable laws. This is especially important wherever it is necessary to enable the free passage of the public through the Site.

The Contractor's Safety Officer shall have the qualification and the authority to issue instructions to the Contractor's personnel regarding protection measures to prevent accidents.

The Contractor shall provide the public with adequate information on all risks with respect to the construction works. If the general public sustains any kind of bodily injury or death, the Contractor shall be responsible for providing all necessary medical care and compensation.

During construction the Contractor shall erect, maintain and subsequently remove sufficient barricades, guards, lighting, sheeting, shoring, temporary sidewalks and

bridges, danger signals as well as temporary covering of potential accident areas, as approved by the Employer's Representative. .

All open excavations along pipe lines shall be protected sufficiently to keep out livestock, and ensure the safety of workmen and members of the public and be in accordance with the directives of the police and the other local regulations.

The Contractor shall be responsible for ensuring that all persons working in the vicinity of power lines are aware of the relatively large distance that high voltage electricity can "short" to earth when cranes or other large masses of steel are in the vicinity of power lines.

Where work is to be carried out in the proximity of buildings, bridges, tanks or other structures, the Contractor shall take all necessary precautions, including shoring and strutting, where necessary, to ensure the safety of the structures that are at risk.

The Contractor shall be responsible for all damages or injury which may be caused on any property by trespass by the Contractor's or his Subcontractor's employees in the course of their employment, whether the said trespass was committed with or without the consent or knowledge of the Contractor.

29. Equivalency of Standards and Codes

Except where otherwise specified, the Works under this Agreement shall comply with the requirements of the referenced or relevant Indian Standards (IS), British Standards (BS), AWWA standards, ISO standards AWS standards, ASTM standards, etc. Other equivalent national or international standards or similar other organizations may be considered at the sole discretion of the Employer's Representative or as may have been agreed in the Agreement. All standards used shall be the latest versions.

Note: In case of difference or conflict of standard manuals/book/guidelines as listed above, the stringent and superior design value(s)/parameter(s)/specification(s) shall be followed by Contractor for the detailed designs of proposed works.

The Contractor shall obtain at least one copy of each IS, BS, or other approved standards or reference material which are referred to in the specification and a copy of all other standards which apply to materials which are being supplied to, or workmanship executed on the works. These standards and reference material shall be available to the Contractor and the Employer's Representative at all reasonable times.

Where the requirement of any such standard specification or regulation conflict with Employer's Requirements, then the Contractor should refer to the Employer's Representative for clarification before proceeding with construction of the Works.

The Contractor shall carry out the Works based on the Standard Specifications available with the Jal Shakti Vibhag.

In addition to the Standard Specifications prescribed above, the Contract is governed by the Particular Specifications provided in Section 6 of this bid document.

Except as otherwise specified in the above Specifications, the Indian/International Standards and codes of practice in their latest version shall be adhered to for the design, manufacturing, inspection, calibration, installation, field testing, packing, handling and transportation of products. Should any product be offered conforming to other standards, the equipment or products shall be equal to or superior to those specified and the documentary confirmation shall be submitted for the prior approval of the Employer.

All the Materials incorporated in the Works shall be the most suitable for the duty concerned and shall be new and of first-class commercial quality, free from imperfections and selected for long life and minimum maintenance. These may be tested according to relevant Indian Standards (IS) or International Standards Organization (ISO) standards in qualified and govt. approved labs and certificates produced to the satisfaction of the Employer's Representative.

SECTION - 6

ANNEXURE - 1

PARTICULAR CIVIL REQUIREMENTS

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PARTICULAR CIVIL REQUIREMENTS

The “*General Specifications for Civil and Structural Works*” as given in standard specification, set out the specifications that shall be followed for construction of General Works. Specifications for additional specialized items of civil and structural works are as set out in this Particular Technical Specifications, of this Section.

In the event of any discrepancy between the provisions of the General Specifications and the Particular Technical Specifications, the provisions of the Particular Technical Specifications will prevail.

The contractor shall validate/prepare the detailed structural drawings of the various components of the work.

1. Design Submission

Validation report / Complete detailed design calculations of foundations and superstructure together with general arrangement drawings and explanatory sketches shall be submitted by the Contractor to the Employer's Representative. Separate design calculations for foundations or superstructures submitted independent of each other shall be deemed to be incomplete and will not be accepted by the Employer's Representative.

2. Design Philosophy

Following are the details which are to be included in the general design philosophy document submission:

1. Design assumptions/philosophy for Liquid Retaining Structures with various boundary conditions as applicable
2. Design assumptions/philosophy for buildings
3. Design assumptions/philosophy for all other structures
4. Standard General Notes shall include material properties (grade, strength, unit weight etc.), development lengths, lap/splice lengths, Anchorage lengths under tension and compression, clear cover, water proofing specifications, legend used etc.

3. Standard Details

Following typical details shall also be submitted for approval prior to proceeding with detailed design:

1. Reinforcement detail showing the development length at Column/Footing intersection, Column and Roof beam intersections, Walls and Base slab intersections, Walls and cover slab intersections.
2. Detailing of the reinforcement for columns, beams, beam/column intersection, footing/column intersection, and Slabs as per relevant code provisions/requirements depending upon the assumptions made in the design as applicable.
3. Reinforcement detail for cut-outs in slabs and walls with maximum size of cut-outs
4. Reinforcement detail at top of RCC trench walls showing edge/seating angles
5. Pouring sequence of concrete and standard details for construction joints, expansion joints, contraction joints, etc.
6. Details of Opening/Manholes and Rungs to be placed in the tanks
7. Detail for rain water drainage down takes at terrace slab and water proofing at roof/sunken slabs
8. Detail for Roads, plinth protection and entrance ramps to buildings
9. Detail for Handrails and fixing detail of handrail to concrete, Steel Ladders and fixing detail of ladders to Walls/Concrete, Cage ladders, Boundary walls, Fencing and Gates, etc.

4. Submission

Submissions of detailed design calculations and Good for Construction drawings shall include the following as a minimum:

A. Detailed Design Calculations

1. One (1) Copy of a Compact Disc (CD) containing electronic files relevant to the structure's modelling, analysis and design calculations (Microsoft Excel, Staad Pro, etc.). Files submitted shall be in editable format.
2. Print copy (6 Copies) of the contents as submitted in the Compact Disc. B.

Good for Construction Drawings

1. One (1) Copy of a Compact Disc (CD) containing Autocad files (Civil General Arrangement, Structural Dimensions and Reinforcement Details) pertaining to the structure. Files submitted shall be in editable format.
2. Print copy (6 Copies) of the contents as submitted in the Compact Disc. Prints to be submitted on A1 Size Sheet as a minimum or A0 Size Sheet when required by the employer.
3. Bar-bending schedule indicating the number, shape and size of the rebars shall be submitted as part of the Reinforcement Details
4. Detailed drawing showing the location, number and depth of inserts shall be included for any structural steel inserts/Metal inserts in the structure such as

rungs, bolted connections for ladders/railings, etc.

5. Location of Construction Joints and pour sequence shall be included on the drawing for base slabs, walls and top slabs.
6. Revised drawings shall be submitted by clouding at the location with the latest revision number and also show the history of revisions in a table format just above the title block.

The design considerations described hereunder establish the minimum basic requirements of plain and reinforced concrete structures, masonry structures and structural steel works. However, any particular structure shall be designed for the satisfactory performance of the functions for which the same is being constructed. The Contractor shall also take care to check the stability of partly completed structures.

5. Design Standards

All the designs shall be based on the latest Bureau of Indian Standard (BIS) Specifications or Codes of Practice. The design standards adopted shall follow the best modern engineering practice in the field based on any other International Standard or specialist literature subject to such standard reference or extract of such literature in the English language being supplied to and approved by the Employer's Representative. In case of any variation or contradiction between the provisions of the BIS Standards or Codes and the specifications given along with the tender document, the provision given in this Specification shall be followed.

All reinforced concrete structural design shall generally conform to the following publications of the Indian Standards Institution and other relevant Indian Standards (upto latest amendment) & IRC not mentioned in the list:-

- (i) I.S. 456 Code of Practice for plain and reinforced concrete
- (ii) I.S. 875 Code of Practice for design loads for buildings and structures (Part I to V)
- (iii) I.S. 3370 Code of Practice for concrete structures for the storage of liquids (Part I to IV)
- (iv) I.S. 1893 Criteria for earthquake resistant design of structures (Part-1)
- (v) I.S. 2950 Code of Practice for Design & Construction of Raft Foundation
- (vi) I.S. 2974 Code of Practice for design and construction of machine foundations (Part 1 to 4)
- (vi) I.S. 4997 Criteria for Design of Hydraulic Jump Type Stilling Basin with Horizontal & Sloping Apron
- (vii) I.S. 6512 Criteria for Design of Solid Gravity Dams
- (viii) I.S. 11089 Code of Practice for Design and Construction of Ring Foundation
- (ix) I.S. 11223 Guidelines for fixing Spillway Capacity
- (x) I.S. 11682 Criteria for Design of RCC Staging for Overhead Water Tanks
- (xi) I.S. 12169 Criteria for Design of Small Embankment Dams
- (xii) I.S. 13920 Code of Practice for Ductile Design & Detailing of Reinforced Concrete Structures subjected to Seismic Forces.

(xiii) I.S. 4326 : Code of Practice for Earthquake Resistant Design and Construction of Buildings

(xiv) I.S. 1904 : Code of Practice for design and construction of foundations in soils: general Requirement

All structural steel design shall generally conform to the following publications of the Indian Standards Institution:

- (i) I.S. 800 : Code of Practice for general construction in steel
- (ii) I.S. 806 : Code of Practice for use of steel tubes in general building construction

6. Design Life

The Plant components shall be designed and constructed to provide the minimum service life listed below for each component.

Buried Piping	:	30 years
Reinforced Concrete Structures	:	60 years
Other Concrete Structures	:	50 years
Steel Structures	:	50 years

7. Design Loadings

All buildings and structures shall be designed to resist the worst combination of the following loads/stresses under test and working conditions; these include dead load, live load, wind load, seismic load, stresses due to temperature changes, shrinkage and creep in materials, and dynamic loads:

7.1. Dead Load

This shall comprise all permanent construction including walls, floors, roofs, partitions, stairways, fixed service equipment's and other items of machinery. In estimating the loads of process equipment all fixtures and attached piping shall be included, but excluding contents, shall be considered.

The following minimum loads shall be considered in design of structures:

(i)	Weight of water	:	9.81 kN/m ³
(ii)	Weight of soil (irrespective of strata available at site and type of soil used for filling etc). However, for checking stability against uplift, actual weight of soil as determined by field test shall be considered	:	18.00 kN/m ³

(iii)	Weight of concrete	:	24.00 kN/m ³
(iv)	Weight of reinforced concrete	:	25.00 kN/m ³
(v)	Weight of brickwork (exclusive of plaster)	:	20.00 N/m ² per mm thickness of
(vi)	Weight of plaster to masonry surface	:	20.00 N/m ² per
(vii)	Weight of granolithic terrazzo finish or rendering screed, etc.	:	24.00 N/m ² per mm thickness
(viii)	Weight of MS chequered plates	:	78.5 N/m ² per mm thickness of plates

7.2. Live Load

Live Load (LL) shall include the superimposed loads due to the use/occupancy of the structure/building not including dead, wind or earthquake load. Live loads shall be in general as per I.S. 875 Part (II). However, the following minimum loads shall be considered in the design of structures:

(i)	Live load on roofs (Accessible) (Non- Accessible)	: :	1.50 kN/m ² 0.75 kN/m ²
(ii)	Live load on floors supporting Equipment such as pumps, valves etc.	:	10.00 kN/m ²
(iii)	Live load on all other floors walkways, stairways and platforms		5.00 kN/m ²
iv)	Surcharge for underground structures Including channels, sumps, cable & pipe trenches etc		20.00 kN/m ²

In the absence of any suitable provisions for live loads in BIS Codes or as given above for any particular type of floor or structure, assumptions made must receive the approval of the Employer's Representative prior to starting the design work. Apart from the specified live loads or any other load due to material stored, any other equipment load or possible overloading during maintenance or erection/construction shall be considered and shall be partial or full whichever causes the most critical condition.

7.3. Wind Load

Wind loads shall be as per I.S. 875 Part 3.

7.4. Earthquake Load

This shall be computed as per I.S. 1893. An importance factor appropriate to the type of structure shall be considered for design of all the structures. All the civil structures constructed by the bidder shall be earthquake resistant for zone V.

7.5. Dynamic Load

Dynamic loads due to working of items such as pumps, blowers, compressors, switch gears, travelling cranes, etc. shall be considered in the design of structures as per manufacturer's data..

7.6. Wheel Load

For any structure or pipeline below the roads, Class A loading of IRC 6 shall be taken.

8. Joints

Movement joints such as expansion joints, complete contraction joints, partial contraction joints and sliding joints shall be designed to suit the structure. However, contraction joints shall be provided at specified locations spaced not more than 7.5 m in both right angle directions for walls and rafts.

Expansion joints of suitable gap at suitable intervals not more than 30 m shall be provided in walls, floors and roof slabs of liquid retaining structures.

Construction joints shall be provided at right angles to the general direction of the member. The locations of construction joints shall be decided on convenience of construction. To avoid segregation of concrete in walls, horizontal construction joints are normally to be provided at every 2 m height. PVC waterstops of 150 mm width shall be used for walls and 230 mm width for base slabs. Expansion joints for non-liquid retaining structures shall be provided as per IS 3414 (upto latest amendment).

9. Design Criteria for Underground or Partly Underground Liquid Retaining Structures

All underground or partly underground liquid containing structures shall be designed for the following conditions:

- (i) Liquid depth up to full height of wall: no relief due to soil pressure from outside to be considered;
- (ii) Structure empty (i.e., empty of liquid, any material, etc.): full earth pressure and surcharge pressure wherever applicable to be considered .
- (iii) If water table exists, earth pressure to be considered for submerged soil conditions with reference to geotechnical recommendations, approved by the Engineer.
- (iv) Partition wall between dry sump and wet sump : to be designed for full liquid depth up to full height of wall; (if applicable)
- (v) Partition wall between two compartments : to be designed as one compartment empty and other full; (if applicable)

- (vi) Structures shall be designed for uplift in empty conditions with the water table considering at existing ground level or HFL whichever is higher.
- (vii) Walls shall be designed under operating conditions to resist earthquake forces from earth pressure mobilization and dynamic water loads;
- (viii) Underground or partially underground structures shall also be checked against stresses developed due to any combination of full and empty compartments with appropriate ground/uplift pressures from below to base slab. A minimum factor of 1.25 shall be ensured against uplift or floatation.
- (ix) All the liquid retaining structures shall be designed for maximum design crack widths of 0.1mm for direct tension and flexure.
- (x) For general retaining walls and large sized tanks where the walls are designed as retaining walls, sliding check shall also be performed along with over turning checks.

Overtuning: The stability of a structure as a whole against overturning shall be ensured so that the restoring moment shall be not less than the sum of 1.2 times the maximum overturning moment due to the characteristic dead load and 1.4 times the maximum overturning moment due to the characteristic imposed loads. In cases where dead load provides the restoring moment, only 0.9 times the characteristic dead load shall be considered. Restoring moment due to imposed loads shall be ignored.

- (xi) **Sliding:** The structure shall have a factor against sliding of not less than 1.4 under the most adverse combination of the applied characteristic forces. In this case only 0.9 times the characteristic dead load shall be taken into account as per IS codes.
- (xii) In case of Large and Deep Underground Tanks, the analysis can be carried by Finite Element Method using STAAD.Pro or any other equivalent software predominantly used and accepted in the industry.

10. Foundations

- (i) The minimum depth of foundations for all structures, equipment's, buildings and frame foundations and load bearing walls shall be as per IS 1904 but in any case this shall not be less than 1.5 meter in the original/ Virgin soil.
- (ii) Maximum safe bearing capacity of soil strata shall be taken as determined by the Contractor through his own independent investigations subject to approval of Employer's Representative. It may be used by Contractor as part of, in addition to, or in lieu of such investigations at his own risk.

- (iii) Care shall be taken to avoid the foundations of adjacent buildings or structure foundations, either existing or not within the scope of this Contract. Suitable adjustments in depth, location and sizes may have to be made depending on site conditions. No extra claims for such adjustments shall be accepted by the Employer.
- (iv) The Bidder shall ensure the technical feasibility of the offer submitted after visiting the sites and conducting independent investigations. It must be clearly understood by the contractor that he shall be required to design and execute every item(s) of work(s) which are considered required or necessary for the satisfactory completion and functioning of the entire work, commissioning of electro-mechanical equipment , Instrumentation, trial run and any other items required but not specified in the bid document, but are essential to complete the scheme. Nothing extra or additional shall be paid to the contractor on account of his failure of understanding.
- (v) Special attention is drawn to danger of uplift being caused by the ground water table. For design purpose, Ground water table at existing ground level or HFL whichever is higher shall be considered. All underground structural slabs shall be designed for uplift forces due to ground water pressure.
- (vi) Raft foundation as per IS 2950 (Part I) (upto latest amendment) shall be provided wherever applicable to counteract uplift due to water.
- (vii) EGL (Existing ground level) and FGL (Finished ground level) shall be marked on all drawings showing foundation/sub-structure details and related design documents.
- (viii) Machine/static equipment foundations shall be separated from adjoining parts of buildings, other foundations and floor/pavement slabs. Joints at floor/pavement slabs shall be suitably sealed.
- (ix) Foundations and structures for machines subject to vibrations shall be so proportioned that the amplitude and frequency of the foundation/structure are within the permissible limits as per relevant BIS codes (or as required by the machine vendor).
- (x) Machine foundations shall be designed and detailed as per IS: 2974 (upto latest amendment). All appendages to such foundations shall be reinforced suitably to ensure integral action.

11. Design Requirements

The following are the design requirements for all reinforced or plain concrete structures:

- a) All water retaining structures shall use Sulphate resistant cement (SRC) and non-liquid retaining structures shall use Ordinary Portland Cement (OPC)
- b) All blinding and levelling concrete shall be a minimum 100 mm thick in concrete grade

M10.

- c) All liquid retaining reinforced concrete structures, concrete shall be of a minimum M30 grade and Buildings, shall be of a minimum M25 grade (Footings, Plinth Beams, Columns, Slab and beams, etc., i.e. which are other than liquid retaining structures). Further, if there are any liquid retaining RCC tanks coming up with in the buildings, concrete shall be of minimum M30 grade for such RCC tanks also.
- d) The reinforced concrete for Liquid Retaining structures shall have a minimum cement content of 375 kg/m³ for M 30 grade concrete and Buildings shall have 350 kg/m³ with M25 grade concrete. Reinforced concrete shall have maximum slump of 100mm with maximum water cement ratio of 0.48. Cement content not including fly ash and ground granulated blast furnace slag in excess of 450 kg/ m² should not be used unless special consideration has been given in design,
- e) As a design consideration to control crack, though general requirements of IS 3370 shall be followed, All liquid retaining structures shall be designed based on the serviceability crack width limit state (i.e. 0.1 mm crack width) and other limits including the ultimate limit states.
- f) The minimum cover to the main reinforcing bars for different members.

1. **Non-liquid retaining structures** shall be as follows unless stated otherwise: Slab

(Floor, Roof, Canopy, and Staircase)	30 mm
Shell roof for Filter house/Clarifiers	25 mm Beams (Sides,
Bottom & Top)	40 mm
Lintels (all around)	30 mm Columns
	50 mm Pedestals
(in contact with earth)	50 mm Basement
wall, retaining walls	
i) Face in contact with earth	50 mm ii)
Face in contact with liquid	50
mm	
iii) Interior face	40 mm
Foundations	50 mm

NOTE: The minimum clear cover to all reinforcement including stirrups and links shall be 50 mm for all liquid retaining structures.

- g) For reinforced concrete structures, steel in reinforcement shall be HYSD Corrosion Resistant Steel (CRS) of grade Fe 500. All physical and chemical properties of this Fe 500 grade steel shall confirm to IS: 1786-2008. Welded wire fabric shall conform to IS: 1566 as shown or specified on the drawing. The CRS (corrosion resistant steel) index shall be at least 1.35 when tested for Salt Spray test as per “ASTM B 117 – 2009 test

- procedure for 120 hours when compared with the Fe 500 normal reinforcement bars and with same bar diameter. All test results (including physical and chemical properties and salt spray tests) have to be produced for the respective bar diameter for each consignment of steel delivered at site and at a frequency of every 20 Metric Tons.
- h) The amount of reinforcement in each of the two directions at right angles within each surface zone should be provided as per clause 8.1 of IS 3370 (Part 2): 2009 (upto latest amendment). Definition of surface zones is clearly shown in Figure 1 and Figure 2 of IS 3370 (Part 2) (upto latest amendment): 2009. For slabs, minimum of 10 mm dia bars shall be used to avoid any deformation of lesser diameter bars under loads prior to construction.
 - i) All buildings shall have a minimum 1 meter wide, 100 mm thick plinth protection paving in M15 grade concrete or stone slabs/tiles. All plinth protection shall be supported on well compacted strata.
 - j) All pipes and ducts laid below the structural plinth and road works shall be surrounded with concrete of grade M15 having minimum 150 mm thick concrete or $D/4$ (D = outer dia. of pipe) thickness whichever is more.
 - k) Use of pressure relief valves to reduce uplift pressure due to ground water table shall not be allowed.
 - l) Detailing of the reinforcement shall be considered as per latest Indian code of practices and special publications as applicable.
 - m) Sliding layer or slip layer shall be provided between sub base and structural slab (Raft). Polythene sheets of 500 gauge shall be provided as sliding layer as per IS specification.
 - n) Water tightness testing of water retaining structures shall be done in accordance with IS: 3370, Part I (upto latest amendment). It is described in **Clause 2.25**. The depth of water for testing shall be up to the soffit of the covering slab.
 - o) Any structure or pipeline crossing below roads shall be designed for Class A of IRC loading.
 - p) A layer of 450mm thick rubble packing with approved stone, set in regular lines, hand-packed, Evenly placed, filling the interstices with approved small stone chips and sand, consolidating by ramming or compacting with heavy roller after watering including spreading of 12mm layer of stone grit on top shall be carried out for all building works below grade slabs/rafts/footings under water logged conditions/high water table conditions.

The following minimum thicknesses shall be used for different reinforced concrete members, irrespective of design thicknesses:

(i)	Walls for liquid retaining structures	:	250 mm
(ii)	Roof slabs for liquid retaining structures (Other than flat slabs)	:	200 mm
(iii)	Bottom slabs/Raft for liquid retaining structures	:	300 mm
(iv)	Floor slabs including roof slabs, walkways, Canopy slabs	:	125 mm
(v)	Walls of cables / pipe trenches, Underground pits etc.	:	200 mm
(vi)	Column footings	:	300 mm
(vii)	Parapets, chajja	:	100 mm
(viii)	Precast trench cover	:	100 mm
(ix)	Column Dimensions		
	a) Exceptional case (Based on any specific requirement)		
	i) To match with width of block masonry wall	:	200mm
	ii) To match with width of brick masonry wall	:	230mm
	b) In general case	:	300mm
(x)	Beam (To match with width of block masonry wall)	:	200mm
(xi)	Laundry Base Slab/Baffle walls	:	200 mm
(xii)	Laundry Vertical Wall, Baffle Wall, Gutter Slab	:	175 mm
(xiii)	Grade Slabs	:	200 mm

12. Materials in General

The term "materials" shall mean all materials, goods and articles of every kind whether raw, processed or manufactured and equipment and plant of every kind to be supplied by the Contractor for incorporation in the Works.

Except as may be otherwise specified for particular parts of the works the provision of clauses in "Materials and Workmanship" shall apply to materials and workmanship for any part of the works.

All materials shall be new and of the kinds and qualities described in the Contract and shall be at least equal to approved samples.

As soon as practicable after receiving the order to commence the Works, the Contractor shall inform the Employer's Representative of the names of the suppliers from whom he proposes to obtain any materials but he shall not place any order without the approval of the Employer's Representative which may be withheld until samples have been submitted and

satisfactorily tested. The Contractor shall thereafter keep the Employer's Representative informed of orders for and delivery dates of all materials.

Materials shall be transported, handled and stored in such a manner as to prevent deterioration, damage or contamination failing which such damaged materials will be rejected and shall not be used on any part of the Works under this contract.

13. Samples and Tests of Materials

The Contractor shall submit samples of such materials as may be required by the Employer's Representative and shall carry out the specified tests directed by the Employer's Representative at the Site, at the supplier's premises or at a laboratory approved by the Employer's Representative.

Samples shall be submitted and tests carried out sufficiently early to enable further samples to be submitted and tested if required by the Employer's Representative.

The Contractor shall give the Employer's Representative seven days' notice in writing of the date on which any of the materials will be ready for testing or inspection at the supplier's premises or at a laboratory approved by the Employer's Representative. The Employer's Representative shall attend the test at the appointed place within seven days of the said date on which the materials are expected to be ready for testing or inspection according to the Contractor, failing which the test may proceed in his absence unless instructed by the Employer's Representative to carry out such a test on a mutually agreed date in his presence. The Contractor shall in any case submit to Employer's Representative within seven days of every test such number of certified copies (not exceeding six) of the test results as the Employer's Representative may require.

Approval by the Employer's Representative as to the placing of orders for materials or as to samples or tests shall not prejudice any of the Employer Representative's powers under the Contract.

The provisions of this clause shall also apply to materials supplied under any nominated sub- contract.

14. Standards

Materials and workmanship shall comply with the relevant Indian Standards (with amendments) current on the date of submission of the tender.

Where the relevant standard provides for the furnishing of a certificate to the Employer's Representative, at his request, stating that the materials supplied comply in all respects with the standard, the Contractor shall obtain the certificate and forward it to the Employer's Representative.

The specifications, standards and codes listed below are considered to be part of this specification. All standards, specifications, codes of practices referred to herein shall be the latest editions including all applicable official amendments and revisions.

In case of discrepancy between the Specification and the Standards referred to herein, the Specification shall govern.

a) Materials

- IS: 269 - Specification for ordinary Portland cement
- IS: 383 - Specification for coarse and fine aggregates from natural sources for concrete
- IS: 428 - Specification for distemper, oil emulsion, colour as required
- IS: 432 - Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement (Parts 1 & 2)
- IS: 455 - Specification for Portland slag cement
- IS: 458 - Specification for precast concrete pipes (with and without reinforcement)
- IS: 650 - Specification for standard sand for testing of cement
- IS: 651 - Specification for salt glazed stoneware pipes and fittings
- IS: 808 - Specification for dimensions for hot rolled steel beam, column channel and angle sections
- IS: 814 - Specification for covered electrodes for manual metal arc welding of Carbon and Carbon Manganese steel
- IS: 1003 - Specification for timber panelled and glazed shutters (Parts 1 & 2)
- IS: 1038 - Specification for steel doors, windows and ventilators
- IS: 1077 - Specification for common burnt clay building bricks
- IS: 1398 - Specification for packing paper, water proof and bitumen laminated
- IS: 1489 - Specification for Portland pozzolana cement (Parts 1 & 2)
- IS: 1566 - Specification for hard drawn steel wire fabric for concrete reinforcement
- IS: 1580 - Specification for bituminous compounds for water proofing and caulking purposes
- IS: 1786 - Specification for high strength deformed steel bars and wires for concrete reinforcement
- IS: 1852 - Specification for rolling and cutting tolerances for hot rolled steel products
- IS: 1948 - Specification for aluminium doors, windows and ventilators
- IS: 1977 - Specification for structural steel (ordinary quality)
- IS: 2062 - Specification for steel for general structural purposes
- IS: 2185 - Specification for concrete masonry units (Parts 1 & 2)
- IS: 2202 - Specification for wooden flush door shutters (Parts 1 & 2)

- IS: 2645 - Specification for integral cement water proofing compounds
- IS: 2750 - Specification for steel scaffoldings
- IS: 2835 - Specification for flat transparent sheet glass
- IS: 3384 - Specification for bitumen primer for use in waterproofing and damp proofing
- IS: 3502 - Specification for steel chequered plates
- IS: 4021 - Specification for timber door, window and ventilator frames
- IS: 4350 - Specification for concrete porous pipes for under drainage
- IS: 4351 - Specification for steel door frames
- IS: 4990 - Specification for plywood for concrete shuttering work

- IS: 10262 - Recommended guidelines for concrete mix design
- IS: 12330 - Specification for sulphate resisting Portland cement
- IS: 12709 - Glass fibre reinforced plastics (GRP) pipes, joints and fittings for use for potable water supply

b) Tests

- IS: 516 - Method of test for strength of concrete
- IS: 1182 - Recommended practice for radiographic examination of fusion - welded butt joints in steel plates
- IS: 1199 - Methods of sampling and analysis of concrete
- IS: 2386 - Methods of test for aggregates for concrete (Parts 1 to 8)
- IS: 2720 - Methods of test for soils (Parts 1 to 39)
- IS: 3025 - Methods for sampling and test (physical and chemical) for water and wastewater (Parts 1 to 59)
- IS: 3495 - Method of test for burnt clay building bricks (Parts 1 to 4)
- IS: 3613 - Acceptance tests for wire flux combination for submerged arc welding
- IS: 4020 - Methods of tests for wooden flush doors shutters: Type tests
- IS: 4031 - Methods of physical tests for hydraulic cement (Parts 1 to 15)
- IS: 5807 - Method of test for clear finishes for wooden furniture (Parts 1 to 6)
- IS: 7318 - Approval tests for welders when welding procedure approval is not required (Parts 1 and 2)
- IS: 13311 - Methods of Non-destructive testing of Concrete- Part 1 & Part 2

c) Codes of Practice

- IS: 456 - Code of practice for plain and reinforced concrete
- IS: 783 - Code of practice for laying of concrete pipes
- IS: 800 - Code of practice for general construction in steel

- IS: 806 - Code of practice for use of steel tubes in general building construction
- IS: 816 - Code of practice for use of metal arc welding for general construction in mild steel
- IS: 817 - Code of practice for training and testing of metal arc welders
- IS: 875 - Code of practice for design loads (other than earthquake) for building structures (Parts 1 to 5)
- IS: 1081 - Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators
- IS: 1172 - Code of practice for basic requirements for water supply, drainage and sanitation
- IS: 1477 - Code of practice for painting of ferrous metals in buildings (Parts 1 & 2)
- IS: 1597 - Code of practice for construction of stone masonry (Parts 1 & 2)
- IS: 1742 - Code of practice for building drainage
- IS: 1893 - Criteria for earthquake resistant design of structures
- IS: 1904 - Code of Practice for Design and Construction of Foundation in Soils: General Requirements.
- IS: 2065 - Code of practice for water supply in buildings
- IS: 2204 - Code of practice for construction of reinforced concrete shell roof
- IS: 2210 - Code for design of reinforced concrete shell structures and folded plates
- IS: 2212 - Code of practice for brickwork
- IS: 2338 - Code of practice for finishing of wood and wood based materials (Parts 1 & 2)
- IS: 2394 - Code of practice for application of lime plaster finish
- IS: 2395 - Code of practice for painting, concrete, masonry and plaster surfaces (Parts 1 & 2)
- IS: 2470 - Code of practice for installation of septic tanks (Parts 1 & 2)
- IS: 2502 - Code of practice for bending and fixing of bars for concrete reinforcement
- IS: 2571 - Code of practice for laying in-situ cement concrete flooring
- IS: 2595 - Code of practice for radiographic testing
- IS: 2751 - Recommended practice for welding of mild steel plain and deformed bars for reinforced construction
- IS: 2974 - Code of practice for design and construction of machine foundations (Parts 1 to 4)
- IS: 3114 - Code of practice for laying of Cast Iron pipes
- IS: 3370 - Code of practice for concrete structures for the storage of liquids (Parts 1 to 4)
- IS: 3414 - Code of practice for design and installation of joints in buildings
- IS: 3558 - Code of practice for use of immersion vibrators for consolidating concrete
- IS: 3658 - Code of practice for liquid penetrant flaw detection
- IS: 3935 - Code of practice for composite construction

- IS: 4000 - Code of practice for High strength bolts in steel structures
- IS: 4014 - Code of practice for steel tubular scaffolding (Parts 1 & 2)
- IS: 4127 - Code of practice for laying of glazed stoneware pipes
- IS: 4326 - Code of practice for Earthquake Resistant Design and Construction of Buildings
- IS: 4353 - Recommendations for submerged arc welding of mild steel and low alloy steels
- IS: 5329 - Code of practice for sanitary pipe work above ground for buildings
- IS: 5334 - Code of practice for magnetic particle flaw detection of welds
- IS: 5822 - Code of practice for laying of welded steel pipes for water supply
- IS: 7215 - Tolerances for fabrication of steel structures
- IS: 9595 - Recommendations for metal arc welding of carbon and carbon manganese steels
- IS: 10005 - SI units and recommendations for the use of their multiples and of certain other units
- SP: 16 - Design Aids for Reinforced Concrete to IS 456
- SP: 34 - Handbook on Concrete Reinforcement and Detailing
- SP: 38 - Handbook of Typified Design of Structures with Steel Roof Trusses

d) Construction Safety

- IS: 3696 - Safety code for scaffolds and ladder (Parts 1 & 2)
- IS: 3764 - Safety code for Excavation work
- IS: 7205 - Safety code for erection of structural steel work

15. General Arrangement of Plant

The following general guidelines shall be followed in the preparation of general arrangement of Plant:

- Sufficient room shall be allowed between items of plant and adjacent Plant or fixed structures to permit safe and convenient access for operation and maintenance;
- An area adjacent to all mechanical Plant shall be provided as maintenance lay down area;
- fixed runways, lifting eyes or other means shall be provided to permit the removal of Plant that may be required to be removed during the course of its normal operational life for maintenance or any other purpose;

- areas where leakage is likely to occur whether in normal use or during maintenance shall be provided with covered drainage channels which shall direct spillage either to a suitable plant drain or to a sump from where it can be pumped to plant drain;

16. Orientation

The works shall be laid out within the confines of the Site in order to interface to the existing infrastructure of roadways and inlet and outlet pipe work. Underground services requiring to be relocated in order to accommodate the proposed site layout shall, with the approval of the Employer's Representative, be relocated by the Contractor.

17. Buildings and Structures

All the building and structure works shall generally comply with the following Employer's

Requirements unless otherwise specified elsewhere:

- i) All building works shall be of reinforced concrete framework.
- ii) All external walls shall be in brick masonry (1st class) and shall be provided as per IS:2212 (Latest Revision) and shall be 230 mm thick.
- iii) All internal partition walls shall be in brick masonry (1st class) and shall be provided as per IS: 2212 (Latest Revision)..
- iv) (a) Finishes to concrete liquid retaining structures shall be : -
 - F1 - External surfaces, buried
 - F2 - External surfaces exposed and up to 300 mm below ground level
 - F2 - Internal surfaces
- (b) Finishes to other concrete structures shall be :
 - F1 - Buried
 - F1 - Exposed, where plastering is specified
 - F2 - Exposed

SURFACE FINISH TYPE **F1**:

The main requirement is that of dense, well compacted concrete. No treatment is required except repair of defective areas, filling all form tie holes and cleaning up of loose or adhering debris. For surface below grade which will receive waterproofing treatment, the concrete shall be free of surface irregularities which would interfere with proper and effective application of

waterproofing material specified for use.

This finish is formed for surface at construction joints. The surface produced shall be free from voids, honeycombing or other large blemishes, steps, sharps protrusions or local hollows.

SURFACE FINISH TYPE F2

The appearance shall be that of a smooth dense, well compacted concrete showing the slight marks of well fitted shuttering joints. The contractor shall make good any blemishes.

This finish is for surface that are permanently exposed to view. The Surface produced by the formwork shall have smooth finish, free from board marks, voids, honeycombing or other large blemishes. Any small blemishes shall be carefully filled immediately after the removal of the formwork and other marked imperfections such as fins or steps or joints marks shall be smoothed off and made good

- v) All internal masonry surfaces finish shall have 12 mm thick plain faced cement plaster in cement mortar (1:4) with neat cement finish on top. Over this, one coat of primer and two coats of plastic emulsion paint of approved quality and shade shall be provided.
- vi) All external masonry and concrete with rough board finish shall have 20 mm thick sand faced cement plaster in two coats, base coat 12 mm thick in cement mortar 1:4 and finishing coat 8 mm thick in cement mortar 1:4. Waterproofing compound of approved make and quality shall be added to the cement mortar in proportions as specified by the manufacturer.
- vii) All external surfaces above ground level shall have one coat of primer and two coats of waterproof cement based paint of approved quality and shade. A coat of silicone water repellent paint shall also be applied thereon.
- viii) The flooring in the pumping stations, D.G. Room shall be 60mm thick cement flooring with Metallic concrete hardener topping, under layer of 42mm thick cement concrete 1:2:4 (1 cement : 2 coarse : 4 graded stone aggregate 16mm thick nominal size) and top layer of 18mm thick metallic concrete hardener consisting of mix 1:2 (1 cement : 2 stone aggregate 6mm nominal size) by volume & mixed with metallic hardening compound of approved quality @ 3 kg/m². Including cement slurry and rounding off edges.
- ix) The flooring in loading/unloading bay, MCC cum Panel room shall be in 25mm thick Kota stone slab of approved shade and pattern and placed over 20 mm thick base of cement mortar 1:4 to give overall thickness of 45 mm. Half tile skirting shall also be provided in these areas.

All staircases shall have Kota stone for treads and risers of approved make and shade and half tile skirting set in cement mortar in 1:4 to be provided. All concrete stairs shall have aluminium nosing over 2 mm thick rubber strip of width same as

nosing for the full length of the tread. Nosing shall be fixed with countersunk screws.

- x) Stairways shall be provided to permit access between different levels within buildings. Staircase shall be minimum 1000mm wide, minimum Tread = 250 mm, maximum Riser = 175 mm and maximum 15 number of steps per flight unless specified otherwise. Staircases in general shall not be steeper than 40°. Staircases having space constraints may be steeper than 40°. The maximum vertical run for a single flight of stairs shall be 3.0 M.
- xi) All roof tops and overhead tanks shall be made accessible with ladder provision. Vertical step ladders fitted with landing point extensions will be permitted where considered appropriate by the Employer's Representative to access areas not frequently visited. Steel staircases shall be constructed of standard channel stringers with M.S. grating treads 25mm thick with non-skid nosing. Steel Ladders shall be minimum 600mm wide and shall not exceed 6m of straight run. The ladders shall be painted with epoxy paint. PVC encapsulated Cast Iron rungs or step shall be provided on the inner side walls of all the liquid retaining structures at 300mm spacing.
- xii) All hand railing shall be provided with GI, minimum three horizontal rail 32 mm dia and one vertical post 40mm dia. The minimum height of hand railing shall be 1.2m and maximum spacing of verticals shall be 1.5 m- . with a 100 x 2.5 toe plate at the bottom.
- xiii) The reinforced concrete roofs shall be made waterproof by application of an approved roof polythene / bitumen membrane / brick bat coba. The finished roof surface shall have adequate slope to drain quickly the rain water to R.W down take inlet points.
- xiv) All roof floors shall have minimum 900 mm height Brick Masonry parapet wall where accessible is provided and shall have minimum 300 mm height brick masonry parapet wall where accessible is not provided.
- xv) For roofing drainage, uPVC 6kg/sqm rainwater down takes with Bell mouth and uPVC grating at top shall be provided. For roof areas up to 40 sqm minimum two nos. 110 mm diameter down take pipes shall be provided. For every additional area of 40 sqm or part thereof, at least one no. 110 mm dia. down take pipe shall be provided.
- xvi) Top surfaces of chajjas and canopies shall be made waterproof by providing a screed layer of adequate slope or application of an approved roof membrane and sloped to drain the rain water. All chajjas and canopies shall be provided with drip moulding.
- xvii) Building plinth shall be minimum 500 mm above average finished ground level around building or high flood level whichever is more. Damp proof course shall be minimum 75mm thick in RCC M15.
- xviii) All doors, windows, rolling shutters shall have lintels above. Chajja

protection to lintels on external walls shall be such as to prevent the rain water splashing into the building. Chajja projection of minimum 750 mm for rolling shutters, 600 mm for doors and 600 mm for windows shall be provided to prevent the rain water splashing into the building. Chajja shall be projected 150 mm on either sides from size of doors/windows/rolling shutters.

xix) All windows and ventilators shall have 25 mm thick Kota stone sills bedded in cement mortar (1:3).

xx) .All doors and windows shall be painted with two coats of synthetic enamel paint over a priming coat (ready mixed Zinc Chromate Yellow primer of approved brand and manufacturer confirming to I.S.: 127-106, 341 and 340).

xxi) All doors, windows and ventilators shall be made of aluminium confirming to latest version of IS: 1948. All fixtures for doors, windows and ventilators shall also be of aluminium and shall be provided as per IS specifications. Aluminium grills shall be provided in all the windows. Doors shall be in two panel and both panels shall be glazed/unglazed. Minimum weight of aluminium doors & windows shall be as follows

I. Single Glazed Window : (Weights indicated shall be aluminium)

a) Openable

Outer Frame	:	Weight 0.70 kg/Rmt
Shutter Frame	:	Weight 0.97 kg/Rmt
Intermediate Mullion	:	Weight 0.97 kg/Rmt
Beading	:	Weight 0.31 kg/Rmt
Fixing Louvers windows/ventilators		
Outer Frame	:	Weight 0.46 kg/Rmt

II. Double Glazed Window

Outer Frame	:	Weight 0.72 kg/Rmt
Shutter Frame	:	Weight 0.97 kg/Rmt
Intermediate Mullion	:	Weight 0.98 kg/Rmt
Beading	:	Weight 0.31 kg/Rmt

III. Sliding Windows

Bottom & Top Frame	:	Weight 0.70 kg/m
Shutter Frame	:	Weight 0.42 kg/m
Interlocking Section	:	Weight 0.47 kg/m

IV. Aluminium Door

Outer Frame	:	Weight 2.508 kg/Rmt
Shutter Frame	:	Weight 2.508 kg/Rmt
Bottom Stile	:	Weight 2.508 kg/Rmt

Glazing shall be 5.5 mm thick glass , as per IS: 2835 for doors and windows.

Glass louvers shall be provided for ventilators with frame weight of 0.46kg/Rmt

- xxii) Openings of the windows & ventilators shall be minimum 25% of the external wall area.
- xxiii) Ventilator shall be provided where height of floor is more than 3m.
- xxiv) All windows and ventilators shall have wire mesh. Frame of doors, windows and ventilators shall be of aluminium of standard rolled section. Doors, Windows and Ventilators shall be of size as per schedule to be submitted by the Contractor for approval of Employer's Representative. The minimum size shall be as per below:
 - Door of opening size 1.2m x 2.1m
 - Glazed windows of minimum size 1.2m x 1.2m
 - Ventilators of minimum size 0.6m x 0.6m
- xxv) Rolling shutters shall be made of 80 x 1.25 mm MS laths. Rolling shutter shall be of minimum size 3m wide x 3.0m high. Rolling shutter shall be provided at entry and exit of the pump house for access to pumps, motors, valves, panels and as wherever required. Mechanical operated rolling shutter shall be provided up to 3m height and If the height is more than 3m, electrically operated rolling shutter shall be provided.
- xxvi) All structural steel members shall be painted with two coats of enamel paint over one shop and one field coat of red oxide zinc chrome primer. All concrete channels and ducts used for conveying liquid shall have inside finish of type F2. The width of concrete channels shall not be less than 500 mm.
- xxvii) Kerbs to be provided below the hand railing on the catwalks/pathways should be as per relevant sections of Factory Act. It shall not be less than 150mm.
- xxviii) All exposed surfaces of inserts embedded in concrete shall be painted with two coats of enamel paint over one coat of red oxide zinc chrome primer. Surfaces in contact with concrete shall not be painted.
- xxix) All structural steel members shall be painted with two coats of enamel paint over one shop and one field coat of red oxide zinc chrome primer.
- xxx) The design of buildings shall reflect the climatic conditions existing on site..
- xxxi) Emergency exit doorways shall be provided from all buildings in order to comply with local and international regulations .Stairways and paved areas shall be provided at the exit points.
- xxxii) All the walkways shall have minimum 1 m width and shall be secured with Handrails and toe guards.
- xxxiii) For structures containing water, the top of the wall shall be at least 0.5m higher than the maximum water surface level calculated at peak plant flow. The top level of internal plant roads and approaches shall be at least 0.5m above the site Finished ground level.
- xxxiv) In case the High flood level is more than Ground Level, then road shall be constructed on the Earthen Embankments/Engineered Embankment. Earthen

Embankments/ Engineered Embankment shall be constructed with side slope of at least 2 horizontal to 1 vertical. Stone pitching shall be provided at both sides of the embankment as per IS: 8237. Top width of embankment shall be taken as 6.0m. Top level of embankment shall be 1.0 m above high flood level. The excavated earth from the plant can be used for earthen embankment construction if suitable and if required extra earth can be borrowed from the borrow pit as approved by Engineer.

xxxv) Engineered Embankment for plant structure in Swampy/Water logged areas shall be considering in compliance with relevant Geotechnical Investigation Report recommendations as applicable.

xxxvi) All requirements for Engineered Embankment and all other associated works connected to this system (i.e. all controlled filling requirements, type & suitability of materials, methodologies testing, protective system, aprons, proper slopes, stability, specifications, quality control, and all other requirements pertaining to this system of works, etc.) shall be considered in compliance with relevant geotechnical investigation report recommendation as applicable. Also, to enlist the service of an experience and specialized agency for all related design aspect consideration, equipment specifications, and implementation methodology, etc., as an advice for the same.

18. Cable and Pipe work Trenches

Cable and pipework trenches shall generally be constructed in reinforced concrete. However, 500 mm x 500 mm size or smaller trenches, not on fill may be constructed in 200 mm thick solid cement concrete blocks over 150mm thick M 15 PCC base. The trenches will be 20mm thick plastered internally with cement mortar (1:4) and externally in cement mortar (1:3).

Trenches within the pumphouse areas shall be covered with M20 precast R.C.C covers. The trenches shall be suitably sloped to drain rain water. All uncovered openings shall be protected with hand railing.

19. Flood Protection works

An Earthen Embankment with minimum slope of at least 2 horizontal to 1 vertical on both sides has to be constructed as required. Slope of the embankment shall be decided as per the soil properties. Stone pitching shall be provided on the both the sides of the embankment as per IS: 8237. Top width of the embankment shall be at least 3.5m. Top level of the embankment shall be 587.5. Embankment shall be designed as per IS: 12094.

Earth for the embankment & site grading shall be made available from the contract package of the same project. Excavated earth from pumping station

proposed to be constructed as per the contract shall be used for the construction of earthen embankment and site grading. The embankment shall be constructed with the available material as per the standard specification.

GI chain link fencing shall be 2.75 m high above finished ground level with top 0.75 metre of barbed wire confirming to IS 278. The fencing shall include fabric mesh confirming to IS 2721, top and bottom runner wires, vertical posts, GI strap at every vertical post, etc, all as approved by the Engineer.

20. Pipes and Ducts

R.C.C ducts for drainage shall have minimum 1 metre pre-cast cover (M20 concrete, Heavy duty) while laid under roads. Access shafts of size not less than 600 mm x 1000 mm shall be provided.

All drains (except storm water drains adjacent to roads) shall be covered and designed structurally for appropriate loads.

21. Compound wall and Gate

Compound wall shall consist of RC precast slab panels (M25), RC post at regular intervals including plinth beam as supports for the panels and necessary RC foundation system for the same along with barbed wire stretched between MS angles fixing at the top of the precast panels with necessary fixtures etc., or as directed by the Engineer.

All structural designs and Specifications shall confirm to relevant codal provisions.

The OHT premises shall have one main gate to access the plant irrespective of existing gate at the premises of existing plant site. Minimum clear width of main gate shall be 3m. Gates shall have as external framework of GI pipes and internal framework of MS flats. Gate shall be fixed on RCC columns. The design and pattern of gate with drawing shall be submitted for approval of the Engineer. The gate shall have all necessary hinges, locking arrangement, rolling arrangement and painting complete, as approved by the Engineer.

22. Retaining wall

1. Retaining wall shall be RCC with minimum M25 grade of concrete. Wall foundation shall be placed on virgin soil and not on backfill soil. Foundation shall extend to a depth of at least 1.5meter below finished ground level or as per design.
2. Expansion joints shall be provided in the retaining wall.

3. In retaining walls, 100mm dia weep holes shall be provided at 1m vertically and horizontally. The lowest weep hole shall be about 30cm above the ground level. All weep holes shall be surrounded by loose stones and shall have sufficient fall to drain out the water quickly.

23. Hydraulic Testing of Liquid Retaining Structures

In addition to the structural test of structures, the liquid retaining structures shall also be tested for water tightness test at full supply level as described in 10.1.1, 10.1.2 and 10.1.3 of latest revision of IS 3370 (Part I).

On completion of the structure and before its commissioning, the Contractor shall carry out a water tightness test for the maximum water head condition i.e. with the water standing at Full Supply Level (FSL). This test shall be carried out preferably in dry season and prior to internal lining in accordance with the procedure given below:

The water tightness test shall be carried out when the construction of liquid retaining structure is done and when it is possible to fill the structure and ensure that uniform settlement of the structure as a whole or as directed by the Employer's Representative. Before the filling operations are started the structure shall be inspected by the Employer's Representative and the Contractor's Representative and the condition of surfaces of walls, contraction joints shall be noted and it shall be ensured that the jointing material filled in the joint is in position and all openings are closed. The Contractor shall make necessary arrangement for ventilation and lighting of the structure by way of floodlights, circulators etc. for carrying out proper inspection of the surfaces and inner conditions if so desired by the Employer's Representative. Records of leakages starting at different levels of water in the reservoir, if any, shall be kept.

The liquid retaining structure once filled shall be allowed to remain so for a period of seven days before any readings of drop in water level are recorded. The level of the water shall be recorded against the subsequent intervals of 24 hours over a period of seven days. The total drop in surface level over a period of seven days shall be taken as an indication of the water tightness of the structure, which for all practical purposes shall not exceed 20 mm. Also there shall be no indications of the leakages around the opening or on the walls.

If the structure does not satisfy the condition of test and the daily drop in water level is decreasing, the period of test may be extended for a further period of seven days and if the specified limit is then reached the structure may be considered as satisfactory.

The external faces of structure shall not show any signs of leakage and shall remain apparently dry over the period of observation of seven days after allowing a seven day period for absorption after filling.

In case the drop in level exceeds the permissible level limit and signs of leakage with the stipulated period of test, the Contractor shall carry out such additional works and adopt such measures as may be directed by the Employer's Representative to reduce the leakage within the permissible limits. The entire rectification work that shall be carried out in this connection shall be at the Contractor's cost. The water required for subsequent testing shall be supplied to the Contractor free of cost, if the same is available near the site. Contractor shall have to make arrangement for filling emptying the structure at his own cost.

If the test results are unsatisfactory, the Contractor shall ascertain the cause and make all necessary repairs and repeat the water retaining structures test procedures, at his own cost. Should the re-test results still be unsatisfactory after the repairs, the structure will be condemned and the Contractor will dismantle and reconstruct the structure, to the original specification, at his own cost.

During testing and during defect liability period the impression marks created due to seepage shall be rectified and made good.

No separate payment shall be made for water tightness test and the cost thereof shall deem to be covered in the rates quoted of different items of works .

24. Non Destructive Testing of RCC Structures

Non Destructive Testing (NDT) shall be carried out as per latest IS: 13311 codes as per the instruction given by Employer.

Commonly used NDT to find quality, structural integrity and soundness of insitu concrete are:

1. Rebound Hammer Test is a qualitative field test method to measure surface hardness of concrete to find insitu concrete strength.
2. Ultrasonic Pulse Velocity (UPV) Test is a qualitative field test method for determination of discontinuities, cracks and depth of cracks of concrete.
3. Core cutting/Sampling Test is a field cum lab test for assessment of strength, density, texture and permeability of concrete.
4. Radiography Test for taking photographs showing details inside of concrete member, where other NDT methods are not suitable.
5. Impact Echo Test is a field/laboratory test method to detect hidden damage and its extent.

In case there is any distress in concrete during the execution, Engineer can take

decision to go for NDT on the RCC construction before taking any action. Contractor shall conduct NDT tests on his own cost.

25. R.C.C Collection Tank (CT), Main Balancing Reservoir (MBR), and Main delivery tank (MDT): - General Specifications:-

- a) Size, Water depth in container shall be as shown on the drawing..
- b) Shape of container (in plan) shown on drawing shall be adopted, in absence of such information circular shape shall be adopted.
- c) Effect of overlapping of pressure bulbs on soil due nearby structure and proposed sump should be considered.
- d) Care shall be taken that no damage should occur to nearby existing structure. Compensation shall be paid for the same by agency.
- e) The minimum concrete grade for RCC shall be M-30
- f) HYSD Fe 415 / 500 grade reinforcing bars confirming to I.S. 1786 / 1139 shall be considered in design. CRS bars shall be provided.
- g) Minimum size (or thickness) of various components shall be provided as per bid criteria / specifications in absence as per I.S./ Std. practice of JAL SHAKTI VIBHAG.
- h) The safe bearing capacity (SBC) shall be referred from SBC test report. If poor soil is found / water table is met with during excavation SBC shall be scientifically ascertained and design shall be revise. No extra shall be paid for increase in quantity.
- i) CI/DI pipes and special shall only be used if type is not specified in bid/drawings.
- j) The rate shall include cost of dewatering during excavation making all arrangement when water table meets within depth.
- k) The structure shall be designed properly to resist uplift due to water table at ground level.
- l) GI pipes railing shall be provided when sump is more than 2 meter above ground level.
- m) Appearance of structure should be aesthetically good looking acceptable to authority.

Sump

The desilting tank and sump shall be constructed in RCC with concrete design mix of M30 grade and CRS/TMT steel reinforcement of grade Fe 415/500/500 D. The sump shall be watertight. The responsibility of water tightness, structural stability shall be of the Bidder. The sump shall also be provided with the following arrangements:

- a) Inlet arrangement .
- b) Outlet arrangements
- c) Scour arrangement : The sumps shall be provided with scour arrangement at the lowest point in the sumps to empty the tank and the scour pipe arrangement shall be taken to a suitable distance to let out the water into a natural stream or valley or lowest point as directed by Engineer.
- d) Overflow arrangement : The sumps shall be provided with overflow arrangement at MWL with a sufficient lead drain to drain the water into a natural stream or valley or lowest point as directed by Engineer. The overflow pipe will be as per the design Requirement.

- e) **Free Board** The sumps shall be designed with a minimum free board of 0.3 m

The sump shall be covered with Dome / Flat RCC roof slab. Sufficient number of ventilators made up of anticorrosive material shall be provided. Manhole are to be provided with Aluminum/ MS. staircase of minimum width of 900mm with handrail, to enter into the sump. All materials shall be anti-corrosive. Access to sump roof shall also be provided.

25.1. Criteria for preparation of designs:-

Bearing capacity shall be determined by carrying out actual Geotechnical investigation and tests. The testing of samples shall be carried out by a Government laboratory or any other approved laboratory and allowable bearing capacity so arrived shall be taken as the basis of design. The factor of safety adopted in case of actual test shall be as per IS 6403 . For design of components I.S: 3370, IS: 1893 (Part-I and Part-II):2002, IS 875 Part-III 2002, IS 13920, IS 4326 and GSDMA and other relevant IS codes Guidelines shall be followed.

The Bidder shall submit a note on construction methodology adopted after the award of contract. The note should indicate general methodology skills and salient features of structure covering following points.

1. Capacity
2. Shape & type.
3. S.B.C. adopted in the design i.e. S.B.C. of strata based on actual test report and type of foundation proposed with proper justification.
4. Site plan showing location.
5. Line diagram showing dimensional and sectional elevation with important levels.
6. Design parameters proposed to be adopted for detailed design.

25.2. Design Requirements:

Foundation

The foundation shall be designed for actual S.B.C. of strata confirmed by Soil Investigation Report and recommendations provided in report as per I.S 6403 & I.S 1904. The total depth shall not be less than 1.5 m for individual footing. Minimum thickness of 100 mm to be considered for levelling concrete with M15 grade. The free board shall be 300 mm below soffit of roof beam or lowest point of dome and shall be included in the depth of water for design purpose. Maximum actual water depth excluding free board shall not exceed 6.0 m. The design shall be for Seismic Zone as per latest I.S 1893. Structures constructed on the boundary of two Seismic Zone shall be designed for one zone higher as per IS: 1893. Bidder to carry out soil investigation of standing water table for design purpose during monsoon season, retrieve data of last five years from Jal Shakti Vibhag and as per actual site condition during execution and the maximum depth of water table at ground level should be consider for uplift check design purpose. Columns inside container for supporting roof beam/ slab may be provided as per design requirement. However, the size shall not be less than 300 mm dia. No square or rectangular columns shall be allowed. Water density shall be taken as 9.81kN/m³. Age factor for increase in strength shall not be considered for

design. The foundation shall be checked for negative pressure on soil due to combined direct & bending stresses. Negative pressure shall not be allowed on the foundation soil. Corrosion resistant steel / TMT Fe – 415/ 500 for water retaining components and Fe500D CRS for Frame Structure within GSR. Minimum steel: Design requirements as set out in relevant codes in respect of steel shall be fully satisfied. However, following minimum steel should be provided. Minimum cover to reinforcement shall be as per I. S. 456 – 2000 and I. S. 3370 (Latest version). Design shall be based on accepted bases and well-known methods of design as well as the provision of I.S Codes (Latest edition). However, methods based on experimental investigation on models as mentioned in Clause 18.2 3 in I. S. 456 – 2000 shall not be allowed. Similarly, the methods / practice of design having no documented evidence shall not be entertained. Only well defined & well-known methods of design shall be followed.

25.3. Construction requirement:

- a) The Min. concrete grade for RCC shall be M30. Proportion of concrete ingredients shall be as per Mix design using weigh batching.
- b) M.S. ladder shall be provided and fixed for access to roof when height of roof from G.L. is 1.0 m and above.
- c) Water level indicator shall be provided and fixed float type /electronic (as specified)
- d) CI pipes & specials shall only be used,
- e) Effective curing shall be carried out as per specifications

25.4. Auxiliary Items of Work:

- a) Adequate numbers of C. I. Ventilators (as per JAL SHAKTI VIBHAG guidelines) of 100 mm dia shall be provided on top slab of GSR as directed by Engineer.
- b) Adequate number of C.I. Medium class Manhole frame & covers (wt. 53 Kg.) with locking arrangement shall be provided and fixed in the roof slab of as directed by Engineer.
- c) Electronic water level indicator assembly of approved type and make shall be provided & installed as directed by Engineer.
- d) Required number of Brick masonry / R.C.C chambers of suitable size, with C. I. manhole frame & cover shall be provided and constructed at suitable locations for sluice valves and drainage line as directed by Engineer.
- e) Inside and Outside surface of tank, exposed faces of columns, braces, beams, bottom slab and all exposed surfaces of slab be provided with smooth finish and then three coats (one primary coat of white cement and two coats of snowcem) of approved shade of snowcem paint as per colour scheme approved by the Engineer shall be rendered.
- g) Letter indicating capacity of tank, name of scheme, year of construction shall be embossed or engraved on vertical wall of container & shall be painted with suitable shade of oil paint in two coats as directed by Engineer.
- h) On completion of work hydraulic test or water tightness test shall be done as per specification till satisfaction of the Engineer. Water required for testing & construction shall be made available by the Bidder at his cost. If during testing

any damage or leakage or sweating occurs to the structure it will be the responsibility of the Bidder to rectify the same.

- i) Drainage arrangement consisting of RCC NP 3 pipes to carry away overflowed water shall be provided upto nearby Nalla or surface drain.
- j) Plinth protection in PCC M 15 shall be provided all around the structure as directed by Engineer.

25.5. Requirement of Auxiliary items of works:

- a) Aluminum Ladder :- Aluminum ladder 450 mm wide shall be made up of aluminum rectangular section of 65 x 35 mm (3 mm thick) and 25 mm bars as approved by Engineer. Welded as 300 mm center to center. The ladder shall be provided in two flights i.e. first flight from flat slab at top to intermediate landing at 3.5 m depth provided & constructed to container wall and second flight from intermediate landing to bottom slab level. The landing shall be casted homogeneously with the container wall and shall be 1.0 m x 1.0 m size. It should have G. I. pipe railing from two sides.
- b) 7.7.2 M. S. Ladder :- The ladder shall be comprising of 65 mm x 65 mm x 6 mm. M. S. angles placed at 450 mm apart with 16 mm M. S. bars in double rows as steps at 200 mm centre to centre distance. The ladder shall be properly fixed at site as directed and bottom & top shall be properly embedded in 1:2:4 C.C. block. In order to have stiffness to the ladder cross supports or stiffeners at suitable intervals as directed shall be provided of suitable M.S. flats duly embedded in walls and welded to the ladder. The M. S. ladder & supports shall be provided with three coats of anticorrosive paint as directed.
- c) 7.7.3 G. I. Pipe Railing :- Hand railing around the walkway (Balcony), stairs and landing shall be fixed on a side requiring safety. Railing to consist of 25 mm diameter Class B GI pipes in three rows (one at the top and other at equal interval above finished floor level) and 1000 mm high fixed in 150 mm dia R.C.C. vertical post at a maximum distance of 2000 mm centres with all accessories like elbows, tees etc. including welding, threading and fixing in cement concrete floor. Railing shall be painted in three coats of approved oil paint to protect it against corrosion as directed by Engineer.
- d) 7.7.4 Stainless Steel Grating :- 20 mm Dia stainless steel bars welded grating with 100 mm c/c spacing, fixed firmly in the over the outlet pipe and drainpipe.
- e) 7.7.5 Ventilators :- Adequate numbers of C. I. Ventilators (as per IPH DEPARTMENTJAL SHAKTI VIBHAG guidelines) of 150 mm dia shall be provided on top slab of GSR as directed by Engineer.
- f) 7.7.6 Plinth Protection :- Plinth protection all around the structure shall be provided as directed by Engineer. The width of plinth protection shall be 1.5 m and shall have slope towards the edge so that the water is drained out and do not enter the foundation. The plinth protection shall be in M 15 (1:2:4) PCC of 150 mm thick. The overburden or top soil from a depth of 0.3 m shall be removed by excavation & it shall be filled with murrum & boulder in layers. This filling shall be watered and well rammed as directed by Engineer. On this PCC, M 15 grade

shall be provided and finished smoothly. All the piping's like inlet, outlet, and over flow and respective fittings shall be as per approved drawings. The material of all the piping's shall be as per approved drawings.

26. RCC Elevated Service Reservoir (ESR) :-

Conducting site investigations(site survey & soil investigation), designing complying provisions of relevant Indian standards, requirements of Bid technical specifications, obtaining approvals of designs and constructing RCC Elevated Service Reservoir of the specific capacity and staging height , using data of geotechnical investigation and site condition of proposed site , Seismic zone, Wind speed Zone. Including necessary accessories and piping, including necessary hydraulic testing, structural testing; material testing etc.; complete as directed by Employer including: -

- a) Container shape as per tender drawing ,
- b) Staging consisting of column beam bracing trestle (as specified) and
- c) Foundation system. This includes excavation in all types of soil strata(including hard rock) , casting 100 mm thick P.C.C. levelling course in M-15 , Refilling the pit with proper soil and disposing of the surplus stuff within all lead and lift.
- d) This will also include cement plaster in CM 1:3 with approved water proofing compound to inside face of container.
- e) All types of labour & material charges for lowering, laying, erecting / hoisting & joining of pipe assembly of Inlet, Outlet overflow, washout and bye pass arrangement as per hydraulic design.
- f) Providing and fixing accessories(specified) like Aluminum / MS / GI Ladder CI Manhole frame and covers, water level indicator , lightening conductor, GI Pipe railing around walk way, at roof level, at gallery and around landing of inside shaft, Adequate cowl type ventilators with stainless steel jali.
- g) Scope of work includes constructing RCC spiral staircase with adequate tie beams ,staircase beams, staircase footing , and B.B. Masonry chambers for valves. ventilating shaft and ventilators as well as door in shaft. A minimum 2.1m headroom shall be provided at all portion including access from staircase till gallery slab.
- h) Providing and applying three coats of cement paint/snowcem (as specified) to the whole structure.
- i) Satisfactory water tightness test as per relevant I.S. Code and painting name of scheme & capacity on the tank as per direction of engineer in charge.

List of Indian Standards for design of ESR: relevant Indian Standards :

- i) I.S. 3370 part I to IV 2021 1965 or latest revised
- ii) IS 456-2000 or latest revised
- iii) IS 11682- 1985 or latest revised
- iv) IS 1893-2002 Ppart I to V or latest revised
- v) IS 13920-2016/1993, or latest revised
- vi) IS 875 Ppart I to III,1987 or latest revised
- vii) IS 11089- 1987 or latest revised.

26.1. General specifications:-

- a) The Min. concrete grade for RCC shall be M:25: for non-water retaining and M 30 for water retaining elements. Proportion of concrete ingredients shall be as per Mix design using weigh batching
- b) CRS Fe 415/500/500 D confirming to IS 1786/1139 shall be used for Water Retaining Structures & TMT Fe 415/500/500 D grade reinforcing bars confirming to IS 1786/1139 shall be used for Non Water Retaining Structures.
- c) In case of column beam –bracing trestle type staging having more than 6 columns internal horizontal bracing is obligatory. One bracing shall be at Ground level and another at foundation level in case of Individual footings.
- d) Min. size/ thickness of various components shall be provided as per design criteria/specifications.
- e) Minimum dimensions specified for various components in bid data /specifications shall be provided without fail.
- f) The Safe bearing capacity (SBC) /allowable pressure on soil shall be referred from SBC test report. If poor soil strata is met with or ground water table is met with, the SBC shall have to be re ascertained scientifically and scientifically and the design shall be revised.
- g) Maximum spacing between horizontal bracings shall be 3 m (storey height)
- h) The BB Masonry cabin with MS door shall be constructed when spiral staircase is outside the staging.
- i) M.S. ladder shall be provided and fixed for access to roof when height of roof from G.L. is less than 5.0 m. For ESR having more than 5 m height RCC spiral staircase or suitable RC staircase shall be constructed
- j) For ESR-having staging height more than 15 m dog legged staircasethe spiral staircase shall be provided inside the staging with effective tie beams in more than one direction.
- k) Water level indicator shall be provided type /electron.
- l) The rate shall include providing and fixing pipes, specials, and valves required for inlet, outlet ,outlet, wash out, over flow and bye pass arrangement. The scope of work includes constructing supporting RCC pillars, erecting, laying ,fixing and joining and joining pipes and specials etc up to 5m length from face of staging (outer most column).
- m) CI pipes & specials shall only be used
- n) The rate shall include cost of dewatering during execution making all arrangement and any dewatering technique.
- o) The structure shall be designed properly for uplift due to Ground water table specified in data or GWT met with during execution. No extra shall be paid.
- p) Effective curing shall be carried out as per specifications.
- q) Seismic Zone as per latest I.S – 1893. However if the structure falls at the boundary of two Seismic Zones it shall be designed for one zone higher as specified in IS:1893.

26.2. Ventilators:-

A R.C.C. ventilator as shown in the drawing fixed with 24-gauge square mesh of 14 gauge SS wire around the circumference shall be provided at top slab. In addition to these 6 Nos. of C. I. ventilators (J type) of 100 mm dia. shall be provided & fixed in roof slab as directed by Engineer.

26.3. Plinth Protection :-

Plinth protection all around the structure shall be provided as directed by Engineer. The width of plinth protection shall be 1.5 m and shall have slope towards the edge so that the water is drained out and do not enter the foundation. The plinth protection shall be in M 15 (1:2:4) PCC of 150 mm thick. The overburden or top soil from a depth of 0.3 m shall be removed by excavation & it shall be filled with murrum & boulder in layers. This filling shall be watered and well rammed as directed by Engineer. On this PCC, M 15 grade shall be provided and finished smoothly. All the piping's like inlet, outlet, washout and over flow and respective fittings like duck foot bend, bell mouth, crippling flange will be as per approved drawings. The material of all the piping's shall be CI as per approved drawings.

27. Pump house

In typical pumphouse following are the requirements.

Grade of concrete shall be RCC M25 and reinforcement steel shall be TMT FE 415/500/500D. The minimum sizes of the various components specified for various components this document shall be followed.

Sr. No.	Particulars	Specification to be adopted
1.	Type of Structure	RCC framed Structure
2.	Damp Proofing Course	75 mm thick Reinforced Cement Concrete in M15 with water proofing compound
3.	Walls	Brick Masonry Wall in C. M. 1:4 min 230mm thick.
4.	Roofing	RCC / For flat roofs with water proofing treatment
5.	Interior Plaster	Cement Mortar 1:6, 12 mm thick
6.	Exterior Finish	Cement Mortar 1:4, 20 mm thick and water proofing cement paint

Sr. No.	Particulars	Specification to be adopted
7.	Flooring	Concrete
8.	Wall finish	Interior - oil bound washable distemper Exterior - Acrylic Smooth exterior paint
9.	Door, window, ventilators	Aluminum

28. Rising main and Gravity main

Following are the general design criteria for sizing of rising main

Sl. No.	Parameter	Parameter
1	Design Flows	As per demand
2	Pumping hours	16 hrs
3	Minimum Residual Head	3m head of water in the GSR/OHT above maximum water level
4	Hazen Williams C-value for pipes	GI – 120 MSEWR - 140
5	Minor Losses	As per Actual Site Alignment subject to maximum 15% of frictional losses. This is over and above the losses due to pipe friction
6	Velocity	Not less than 0.6 m/sec and not more than 1.8 m/sec; Preferably 1.0 m/sec. for the design purpose
7	Diameter for pipe selection	MSERW
8	Appurtenances	As per L-section shared. Adequate care needs to be exercised during selection of location for valves, anchor blocks and thrust blocks so that there are no obstructions created by construction in the regular access for transport and movement of local populace.

For Gravity main for diameter upto 150mm dia GI pipe and above 150mm dia MSERW pipes are used.

29. Intake Structure

Intake structures i.e. RCC structure should be constructed for collecting ground water / surface water as shown in drawings. The technical specifications has already been covered under RCC chapter with IS Codes

Design Criteria :- The design criteria for the intake system cum pump house shall be as follows :

- a) Inlet ports should be designed and provided at different drawl levels in consideration with high flood level, average flow level and minimum lean period flow level.
- b) Provision of silting chamber shall be made at the bottom of intake well.
- c) Floor level of the pump house shall be kept 1.5 m above HFL.
- d) Provision for Suitable and appropriate de silting arrangement shall be made.
- e) Dimensions of pump house shall be fixed in such a way to accommodate at least two two pumps in a row with clear spacing of 1.5 m in between.
- h) Considering the future requirement and expansion of the system from time to time space for additional row for additional pumps shall be provided.
- i) Clear head room of pump house should not be less than 5m.
- j) Suitable manually operated gantry of minimum 5 MT. Capacity shall be provided in the pump house if required depending upon the size /of pumping machinery.
- k) Design of intake works shall be Bidder's scope and the same shall be approved by client.

SECTION 6

ANNEXURE 2

GENERAL AND PARTICULAR MECHANICAL REQUIREMENTS

GENERAL AND PARTICULAR MECHANICAL REQUIREMENTS

2.1 Submersible Pumps

The scope includes supply, Delivery to site, installation, testing at site, commissioning, finer painting at site for all Mechanical, Electrical machinery related to tube well in different locations. The ratings of the equipments shall be determined on the basis of discharge of the tube well and other parameters.

The machinery offered for each location shall be of best quality, having efficiency within the acceptable limits.

The pumping machinery to be supplied complete with reflux/non-return valve, sluice valves, Pipe work & pipe fittings, dismantling joints, MS clamps, pressure gauges, ventury, insulation sheets, nut bolts & packing and all associated accessories for satisfactory performance of the same.

2.1.1 Specifications of Submersible Tube Well Pumping Sets

- a) The multi-stage submersible pumping sets shall be in accordance with the provisions of IS:
- b) 8034-1989 (specification for submersible Pumping Sets for clear, cold fresh water, latest revision) except for the provisions/ specifications mentioned hereunder'
- c) The electric motor is to operate at 415 V 3 phase 50ds AC supply. The speed shall correspond to 2 pole motor with a synchronous speed of 3000 rpm.
- d) The Pump sets shall be installed in bore wells and should be suitable for conditions existing for ground water generally available in the city' the water to be handled by the Pump sets may have Total dissolved Solids 3000 ppm (max) , Turbidity 50 ppm (Silica Scale) chlorides 1000 ppm (max) and PH value between 6.5 to 8 5
- e) The rotating element (as assembled rotor) of pump should be dynamically balanced at high speed. The impeller shall be dynamically balanced ensuring smooth performance free of vibrations.
- f) The cable shall be water proof PVC insulated and PVC sheathed, flexible, 3 core flat type having copper conductor.
- g) The coupling shall be preferably of mess type rigid sleeves coupling of stainless steel non slip type with matching groove, collar and key way arrangement.
- h) The duty point of the pump shall be located near the peak efficiency and there should not be steep fall in Q v/s H, efficiency curve in the head range of +10% and -25%. This entire range should be on stable portion of the curve.
- i) The thrust bearing should be water lubricated and of hydrodynamic Mitchell type and should be able to take all untoward loads at most unfavorable running conditions. It should have swivelling metallic thrust pad.

Submersible pumps shall be of the single-entry design supplied complete with boltless self-aligning duck-foot assemblies giving automatic connection to the discharge pipe work. Submersible pumps shall be used for Dewatering and Sump drainage applications in Pumping station campus.

Pumps and drives shall be rated for continuous duty and shall be capable of pumping the flow range specified in the specifications without surging, cavitations or excessive vibration to the limits specified. The pump shall meet maximum allowable shut off head. The pumps shall not overload the motors at any point on the maximum pump speed performance characteristic curve and the pump operating range within the limits of stable pump operation. The total head capacity curve shall be continuously rising towards the shut off as flow decreases throughout the entire curve from run out to shut off head with the highest at shut off. Pump shall be compatible for Variable Frequency Drive usage.

Its total head capacity curve shall be continuously rising towards shut off with the highest at shut off, and its capacity shall meet to handle total water volume.

- j) Pumps shall be suitable for single as well as parallel efficient operation at any point in between the maximum and minimum system resistances.
- k) Pumps shall run smooth without undue noise and vibration, cavitations, oil or water leaks over the range of operation. To ensure vibration free operation, all rotative components of pump shall be statically and dynamically balanced to BS ISO 21940-11/as per zones A& B of ISO 10816-1. Vibration levels shall not exceed the levels given in BS ISO 20816-1.
- l) The pump set shall be suitable for starting with discharge valve open and/or closed.
- m) The pump set shall be capable of withstanding the accidental rotation in reverse direction.
- n) The shut off head of pump shall be Minimum 110% to Maximum 130% of the specified head.
- o) The submersible pump set shall be installed in sump with Vertically Guide Pipe with duck foot mounted arrangement.
- p) The total head capacity curve shall be continuously rising towards the shut off with the highest at shut off. Pumps shall run smoothly without undue noise & vibration.

2.1.2 FEATURES OF CONSTRUCTION

- a. Pump shall be centrifugal, vertical spindle, wear resisting, and single stage type.
- b. Pump casing shall be of robust construction. Liquid passages shall be finished smooth and designed as to allow less wear and tear. The volute tongue shall be filed to a smooth rounded edge.
- c. Double Mechanical seals (back to back) shall be provided to protect the motor from ingress of water along the shaft. The preliminary and secondary seals shall be oil-lubricated with tungsten carbide or silicon-carbide faces and they shall be equipped

with an electrical monitoring system for seal failure detection. Seals must be capable of withstanding rotation in either direction. Sensors are to be provided to detect if leakage of liquid into the oil housing is above 30 % concentration.

- d. The Impeller shall be of high efficiency enclosed type with smooth blunt edges and large water ways so as to allow free passage of water. It shall be free from sharp corners and projections.
- e. The critical speed of the rotor shall be at least 30% above the operating speed.
- f. Pump-sets shall have double bearings. Bearings shall be of the anti-friction type. Bearings shall be capable of taking the static weight of the rotating parts and any thrust generated by the operation of the pump. The Solid Shaft shall be supported by heavy duty Ball or Roller bearings grease lubricated with a minimum L10 life of 1,00,000 hours in accordance with BS ISO 281:2007.
- g. For guide pipe installed pump shall be complete with a cast iron delivery connection arrangement for fixing to the concrete floor of the suction well. The joint between the pump discharge flange and the delivery piping shall be made by merely lowering the pump into guide rails from access level. It shall be provided with all necessary fixings for guiding the pumps during lifting/lowering. Each pump shall be provided with a SS 316 lifting chain conforming to BS 1663 and BS EN ISO 9906:2012. Lifting chain shall be provided with engaging the hook of the crane at 1 m interval. All necessary stainless-steel fixtures required for guiding the pumps during lifting / lowering shall be provided. The installation shall facilitate automatic installation and removal of pump without a person entering the sump. The submersible pumps shall be suitable for operation with or without submergence. The pump shall start and stop automatically based on level in the sump.
- h. Each pump shall be provided with an automatic coupling device for attaching the crane hook to the pump at low level, even whilst the pump is submerged, without the need for personnel to enter the well. This automatic coupling device shall easily and automatically couple and uncouple the hoist hook and be complete with necessary accessories. All links and cables shall be multi-stranded stainless steel.
- i. Each pump shall be tested at the manufacturer's premises for the full operating range of the pump to BS EN ISO 9906:2012. Pump performance shall be within the tolerance limits specified in the above said BS.
- (k) Pump parameters are to be achieved at the motor speed corresponding to the frequency of 50 Hz.

The submerged cable shall be a multi-core flexible cord, vulcanized rubber insulated with tough rubber sheath and outer PCP sheath to BS EN 50525.

Where both thermal protective and moisture-sensitive devices are incorporated within the pump, both devices shall be brought out via separate conductors within the motor cable, although one such conductor may be common.

The pumps shall be supplied with all necessary DI flange ends discharge pipe work, including non-return and isolating valves and suitable lifting gear for lowering and removing the pump from the sump. Pumps weighing 40 kg and more shall be lowered in the sump via guide rails

and be located to their respective discharge pipe work with an angle flange connection and self-locating clamps.

Development of tube wells shall be an essential operation for stabilization of tube well immediately after the completion of drilling and lowering of well assembly. It will be done by using dispersive chemicals like Sodium Hexa-Meta-phosphate or any other suitable chemical in case bentonite powder is used during drilling, in order to remove the finer material and opening up the passage in the formation so that water can enter the tube well through screen more freely. The Development will be treated as having been satisfactorily done when:

- ☐ Stabilization of alluvial formation has taken place and there is no further sinking of gravel and discharge is sand free and,
- ☐ Permeability of formation will be increased by removing finer material.
- ☐ Development of the tube wells will be done as per IS 11189: 1985 (Latest Revision) The tube well will be developed to establish maximum rate of usable water yield without sand content. Packing of gravel to fill up the annular space during the development;

The tube well shall be developed with high capacity air compressor of 750 cfm @ 250 psi followed by pump as per requirement suitable at different aquifer zones to achieve sand free clear water having sand content 20 PPM. However the water having sand content more than 50 PPM shall be rejected the gravel if required shall be packed during development. Development shall be done using back washing method.

The development shall be started as far as possible from the bottom of screen. Adequacy of development shall be determined from sand samples collected during drilling.

The verticality of the tube well shall be as conforming to IS 2800 (Part II) 1979. Verticality of the tube well shall have a deviation so as to provide clear cylindrical space not less than the clear cylindrical space available in a hypothetical tube well of the same size but having deviation of 10 cm per 30 m in one direction and in one plane only. The tube well should not be out of alignment and contain kinks, bends or cork screws. The tube well deviation shall be in one direction and in one plane only. The plumb or plunger shall have diameter 6 mm smaller than the well casing. The verticality test report shall be submitted by the contractor in the format approved by the Employer's Representative.

2.2 motor for submersible pump sets

- A. The electric motor is to operate at 3 phase 50c/s A.C. supply of 415 $\pm 10\%$ volts. The preferred speed shall correspond to 2 pole motors [(3000 rpm (synchronous))]. The motor shall be capable of delivering rated output with, a) terminal voltage differing from this rated value by not more than $\pm 6\%$; frequency differing from its rated value by not more than $\pm 3\%$; and c) any combination of a) and b).
- B. The motors are water filled, water lubricated, squirrel cage type with axial thrust bearing as well as radial bearings.

- C. The motor stator body should preferably be shrunk fitted instead of being only press fitted. The stator body should be tightly welded on the stamping assembly and adequate arrangement should be provided for stopping of rotation or shifting of stampings inside the stator body preferably by providing matching grooves in the stamping assembly and the stator body. Metal rings with rounded fingers should be provided on both ends of stamping.
- D. Threaded joints in the motor should be avoided to prevent damage due to rusting. Bearing housing should not be threaded but located on spigot and held by suitable bolts.
- E. The rotor as well as stator should be impregnated under vacuum of air drying and both should be baked repeatedly under controlled conditions to ensure long life of varnish/epoxy and to give a hard finish to the motor surface. The rotor should be dynamically balanced at high speed.
- F. The motor shall be suitable for entire working range of pump from +10% to -25% of the rated head. Motor rating should be higher or equal to higher of the following:
 - ☐ Consumption at + 10% of the duty head of pump
 - ☐ Consumption at - 25% of the duty head of pump
- G. All the material and components for the motors shall be suitable for application in respect of corrosion resistance and mechanical performance continuously under water.

2.2.1 FEATURES OF CONSTRUCTION

- A. All the materials and components for the motors shall be suitable for application in respect of corrosion resistance and mechanical performance continuously under water.
- B. The motor will be of wet type submersible motor which shall be provided with suitable epoxy paint to protect it from corrosion under water.
- C. Thrust bearing shall be provided.
- D. The motor shall be protected by means of cable glands, rubber seals, etc., from ingress of bore well water, sand and other foreign material.
- E. Motor shall be provided with earthing arrangement as per IS 3043 (latest revision) during the time of installation.
- F. The motor shall be of continuous duty (type SI) as per IS 12824 (latest revision).
- G. The class of insulation of the winding shall be F and the temp rise above the ambient temperature shall be restricted to that of class B insulation.

2.3 HORIZONTAL CENTRIFUGAL PUMP

2.3.1 GENERAL

The pumping unit shall consist of a best efficient horizontally split-case, single-stage and double suction type directly connected through a flexible coupling to a horizontal induction motor.

The construction of the pumps shall be such that no damage will occur to the pump, attached motor or controls if reverse rotation takes place. Mechanical brakes or ratchets shall not be permitted.

Each pump casing shall be split along the axis of the shaft to permit the removal of the Impeller and shaft assembly without dismantling the pipe work. Half casings shall be

dowelled to ensure alignment. Jacking screws shall be provided to facilitate dismantling.

All the pumps of same duty shall be of similar characteristic.

The pumps shall be designed for continuous duty at rated parameters and should be capable of pumping the flow ranges specified in Particular Specifications. The rated capacity and head of each pump shall be as specified on relevant datasheets and / or particular specifications. The pumps and associated equipment shall include all necessary provisions to prevent contamination of the drinking water being pumped.

The pumps shall be designed to operate satisfactorily without detrimental surges, vibration, noise, or dynamic imbalance over the required head range.

The pumps shall be capable of reverse rotation up to 125% rated full speed of the drive motor, due to back flow of water, without damage or loosening of threaded components.

Flanges shall be machined on faces and edges and conform to ISO 7005, IS 6392, BS EN 1092 or equivalent International Standards. Back faces of flanges shall where necessary be machined to ensure they are parallel to the front faces and that flange bolts can be fitted flush to the flanges.

There shall be at least two (2) pipe tap connections, one at the bottom of the lower casing as a drain and the other at the top of the upper casing as an air vent. Additional tapped connections shall be provided at any other high points in the upper casing.

The top of the upper casing shall be fitted with a gate valve. Automatic float type air valve with isolating cock shall be fitted at the highest part of the casing to assist priming. The drain shall also be fitted with a gate valve.

The pump casing shall be provided with removable and renewable wearing rings where there are close-running clearances between the impeller and the casing. The casing shall be so constructed that the drains will dewater the entire casing.

All specified accessories and any other standard accessories required for correct and safe operation of the pump shall be furnished with the pumps.

Spare parts supplied with the pump shall be identical to respective pump components and shall be from original pump manufacturer.

Mild steel fabricated coupling guard shall be provided for safeguarding against the open rotating parts of the pump and motor. Guard shall be designed for easy installation and removal, complete with necessary support, accessories and fasteners. All bolts, studs, nuts and washers shall be corrosion resistant.

Flexible pin bush type coupling or any improved design shall be provided by the bidder, duly bored and keyed to the pump and motor shafts. The coupling and the pump shafts shall be designed so that the breaking load of the coupling system is slightly below that of the shaft. The coupling shall be designed to take care of any minor misalignment of pump and motor assembly.

2.3.2 NPSH

The Contractor shall guarantee that adequate required Net Positive Suction Head (NPSH) is available to ensure that pumps can operate without cavitations under the worst operating conditions. The NPSH requirements of pumps, based on the 3% head drop criterion, shall be at least 1m less than the NPSH available at complete pump working range including pump duty conditions at site, at the lowest water level in the sump and maximum ambient temperature and maximum water temperature 45 degree- C.

2.3.3 PARALLEL OPERATION

All pumps in the pumping station must be capable of running satisfactorily in parallel operation of 6 pumps in the system without throttling, and without cavitations or overload under all

operating Conditions within the system resistances indicated.

2.3.4 BALANCING

All rotating parts individually and in assembly shall be statically and dynamically balanced to prevent vibration through a range of normal and reverse speeds.

Rotating assemblies shall be statically and dynamically balanced in accordance with ISO 1940-1 and ISO 21940-11 and designed so that the first critical speed of the pump and its drive is at least 30% higher than the maximum operating speed.

Unbalanced, hydraulic, radial thrust acting upon rotating elements shall be kept being minimum. The unit shall be designed to operate safely at the maximum speed attainable in the reverse direction of rotation due to water returning through the pump at times when the power supply to the motor is interrupted and the Non return valve fails to close.

2.3.5 VIBRATIONS AND NOISE

Pumps shall run smooth without undue noise and vibration. The velocity of vibration shall be within the specified limits 4.5 mm/sec. Combined noise level of pump motor system when 6 pumps are running simultaneously shall be limited to 85 dBA at a distance of 1.86 m.

Pumping Units shall be provided with Vibration switches for Pump Vibration Monitoring. (For details refer part 12 and volume 2).

All the pumping units shall be supplied with machined pads to allow the fitting of portable vibration monitoring transducers. One portable vibration monitoring equipment capable of measuring and recording velocity and vibration shall be supplied for the pumping station. (For details refer, part 12, and volume 2).

2.3.6 IMPELLERS

The impeller shall be the enclosed type and shall be fastened to the shaft in such a manner as to make it readily removable. The water passages of the impeller shall be hand finished to remove rough spots and excessive irregularities. Removable and renewable wearing rings shall be provided on the impeller where there are close running clearances between the impeller and the casing. Hardness of the casing ring shall be 50 BHN lower than the impeller ring. Unless otherwise specified, removable wearing rings shall be provided on the pump casing. Materials and hardness of the casing and impeller wearing rings shall be selected to ensure that they are not susceptible to galling and premature wear.

The impeller shall be at least one size lower diameter than the maximum impeller size that can be fitted in to the pump casing. In other words, by replacing the impeller to the next higher size an increase in discharge of at least 5% more than the specified here should be possible.

2.3.7 BEARINGS

The pump shaft shall be supported by two bearings of anti-friction type, one located on each side of the impeller. The bearings may be of the oil or grease lubricated, ball or roller bearing type depending on the approval of the Engineer. One bearing on the pump shall be of the thrust type, designed to withstand the unbalanced axial hydraulic thrust. Suitable fittings shall be furnished for the type of lubrication provided. Bearings shall have a minimum life L-10 type of 1,00,000 hours of operation. Pockets or pads shall be provided in the pump bearing housings for insertion of portable instruments probes for measuring the bearing temperature.

At initial stage of pump operation, the data of bearing vibration as oscillating wave, and its production number shall be submitted to the Engineer to identify the life cycle or determination

of replacement.

It is desired that bearings be furnished which do not require water for cooling. If the bearings are water cooled, the water shall be taken from the pump discharge and returned to the pump suction. Suitable cooling water supply piping and return drain piping shall be supplied, and a y-type strainer with blow off shall be provided in the cooling water supply piping.

Bearing cooling arrangements if used shall be designed on the closed-circuit principle.

Open discharge of cooling water into the pumping station drainage system is not permissible.

2.3.8 SHAFT SLEEVES AND MECHANICAL SEALS

Replaceable shaft sleeves shall be provided to protect the shaft where it passes through stuffing boxes. Shaft sleeves shall be securely locked or keyed to the shaft to prevent loosening. Shaft and shaft sleeve assembly shall ensure concentric rotation. Minimum surface hardness of shaft sleeves shall be 400 BHN. Water deflectors shall be provided on the shaft to prevent water from passing along the shaft and entering the pump bearings.

Mechanical seals Sic Vs Sic to be provided with self-lubrication arrangements as per API standard 682. Seals shall be provided to prevent loss of lubricant and entrance of moisture and dirt into the bearings.

2.3.9 BASE-PLATES

The pump and motor shall be mounted on a common base frame plate. The pumping unit shall be provided with a fabricated structural steel base-plate. Holes for holding-down bolts shall be included, and all packing for leveling, and all holding-down bolts shall be provided. Steel dowels shall be fitted after final alignment of pump and motor to facilitate dismantling and reassembly.

The base-plates shall be of sufficient size and rigidity to maintain the pump and motor in proper alignment and position. All contact surfaces between the pump and base-plate and between the motor and base-plate shall be machined and shall be provided for transmitting the entire load due to discharge Shut off pressure to the concrete structure. After the unit has been installed and properly aligned, the base-plates will be drilled and reamed for the dowels. The necessary dowels anchor bolts shall be furnished with the pump set. The pocket depth for anchor bolts shall be limited to 600mm. The pump base, or the supporting bracket, shall be drilled in the shop for doweling to the base plate at the Site. The Pump shall be painted with Electro static epoxy (Food grade quality) outside coating for a minimum DFT of 250 Microns.

2.3.10 PUMP PERFORMANCE

Pump performance guarantees shall relate to the flow rate, the total head and the efficiency of the pump as specified in this document shall be verified and confirmed when tested at the manufacturer's works. The same shall be verified and confirmed during site tests on completion.

Pumps shall operate at design duty within the acceptance tolerances for flow and total head laid down in ISO 9906.

Unless otherwise specified, at the time of tender the Contractor shall supply the performance curves for the pumps he is providing. The curves shall show total head, pump efficiency, power absorbed by the pump, and NPSHr plotted against flow rate for the full operating range required. The curves shall be extended to show shut valve conditions, and to show performance at flow rates at least 25% in excess of the maximum flow rate expected in normal operation at site conditions.

Where appropriate, curves shall also be included to show the variations in station losses and internal plant losses plotted against flow rate, to enable the complete pump performance curves to be shown.

If the Employer's estimated system curves for head against flow have been provided, the Contractor's pump curves shall be superimposed on the system curves to show conveniently the expected performance in site conditions.

The contractor shall make necessary arrangements and ensure that each pump shall be tested and verified at manufacturer's factory with the applicable provisions of the American Standards of the Hydraulic Institute, or JIS B8301: 2018, "Rot dynamic Pumps-Hydraulic performance acceptance tests" Grade 2, or ISO 9906 "Rot dynamic Pumps – Hydraulic acceptance tests" Grade 2. Factory performance test reports shall be provided for all pumps.

All the testing and inspecting charges to be borne by the contractor. The inspection/testing shall be carried out as per approved Quality assurance plan after approval from the Employer.

2.4 INDUCTION MOTOR

2.4.1 DESIGN REQUIREMENTS

The motors shall generally conform to IS: 325 or relevant equivalent internationally approved standards. Additionally the specific requirements mentioned in the following clauses shall also be met.

2.4.2 PERFORMANCE AND CHARACTERISTICS

Motors shall be capable of giving rated output without reduction in the expected life span when operated continuously under the following supply conditions:

- Variation in supply voltage + 10%
- Variation in supply frequency + 5%
- Combined voltage and frequency variation $\pm 10\%$

Motors shall be suitable for full voltage direct-on-line starting for motor ratings less than or equal to 5.5kW, motor ratings greater than 5.5kW and less than or equal to 90 kW shall be suitable for Star-Delta starter and for motor ratings above 90 kW shall be suitable Soft starter.

The Power rating of the motor shall be the larger of the following:

- 10% higher than the power input required to the pump at duty point at a speed corresponding to the frequency of 50Hz.
- 5% higher than the maximum power input required to the pump through the entire range of head capacity curve.

2.4.3 INSULATIONS

Any joints in the motor insulation such as at coil connections or between slot and winding sections, shall have strength equivalent to that of slot sections of the coil. The insulation shall be given tropical and fungicidal treatment for successful operation of the motor in hot, humid and tropical climate. The motors shall be provided with class F insulation with temperature rise limited to that of class B insulation.

Motors shall be given power house treatment. This comprises an additional treatment to the winding over and above the normal specified treatment. After the coils are placed in slots and all connections have been made, the entire motor assembly shall be impregnated by completely

submerging in suitable insulating compound or varnish followed by proper baking. At least three such submersions and baking's shall be applied to the assembly.

2.4.4 CONSTRUCTIONAL FEATURES

The motor construction shall be suitable for easy disassembly and reassembly. The enclosure shall be sturdy and shall permit easy removal of any part of the motor for inspection and repair. Motors weighing more than 25 kg shall be provided with eyebolts, lugs or other means to facilitate safe lifting.

The rotor bars shall not be insulated in the slot portion between the iron core laminations for squirrel cage motors.

2.4.5 TERMINAL BOX

Terminal boxes shall be of weather proof construction designed for outdoor service. To eliminate entry to dust and water, gaskets of neoprene or approved equivalent shall be provided at cover joints and between box and motor frame. It shall be suitable for bottom entry of cables. It shall be capable of being turned through 360 degrees in steps of 90 degrees.

The terminals shall be of the stud type with necessary plain washers, spring washers and check-nuts. They shall be designed for the current carrying capacity and shall ensure ample phase to phase and phase to ground clearances. Suitable cable glands and cable lugs shall be supplied to match specified cables.

2.4.6 ACCESSORIES

Two independent earthing points shall be provided on opposite sides of the motor, for bolted connections. These earthing points shall be in addition to earthing stud provided in the terminal box.

2.4.7 MAIN HT MOTORS

Motors shall be capable of starting and accelerating the load with the applicable method of starting, without exceeding acceptable winding temperatures, when the supply voltage is 80% of the rated voltage.

- A. Motors shall be capable of satisfactory operation at full load at a supply voltage of 80% of the rated voltage for 5 minutes, commencing from hot condition.
- B. The locked rotor withstand time under hot conditions at 110% rated voltage shall be more than starting time at minimum permissible voltage by at least two seconds or 15% of the accelerating time whichever is greater. The locked rotor current of motors shall not exceed 600% of full load current of motors which is inclusive of 20% tolerance.
- C. Motors when started with the drive imposing its full starting torque under the specified supply voltage variations shall be capable of withstanding at least two successive starts from cold condition and one start from hot condition without injurious heating of windings. The motors shall also be suitable for three equally spread starts per hour under the above referred supply conditions.

- D. The three phases shall be segregated by metal barriers within both line and neutral Terminal box
- E. The earthing pads shall be of non-corrodible metal, welded/brazed at two locations on opposite sides. The pad size shall be 75 x 65 x 25 mm with two holes drilled at 40mm centers, tapped & provided with suitable bolts and washers for connecting the earthing strip.
- F. At least six resistance type temperature detectors for the stator winding each having D.C. resistance of 100 ohms at 0 degrees Celsius, embedded in the stator winding at locations where highest temperatures may be expected, shall be provided. The material of the RTD's shall be platinum.
- G. At least one vibration detector for the stator winding, embedded in the stator winding at location where vibration may be expected, shall be provided. Compression-type piezoelectric type accelerometers, velocity transducers or proximity transducers shall be applied to the vibration detection system.
- H. Motors shall have space heaters suitable for 240V single phase 50Hz AC supply. These shall be placed in easily accessible position in the lower part of motor frame. Provision shall be made to measure temperature of bearing by inserting hand held temperature measuring device.

2.4.8 L.T. MOTORS

- A. Motors shall be suitable of starting and accelerating the load with the applicable method of starting, without exceeding acceptable winding temperatures, when the supply voltage is 85% of the rated motor voltage.
- B. The locked rotor current of the motor shall not exceed 600% of full load current (Subject to tolerance as per the applicable standard).
- C. Motors shall be designed to withstand 120% of rated speed for two minutes without any mechanical damage, in either direction of rotation.
- D. Stator leads shall be brought to the terminal box as insulated cable through a suitable barrier and terminated in clamp type terminals.

2.5 SUBMERSIBLE PUMPS (NON-CLOG)

2.5.1 GENERAL

The pumps offered shall be non-clog submersible type. The design, manufacture and testing of pumps shall conform to IS: 5600/IS: 8034 with latest amendments or any equivalent international standards. The performance of pumps shall be guaranteed as per IS: 5120 and IS: 9137.

Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. Components of identical pumps shall be interchangeable.

The pumps shall give total discharge against total head, as shall be designed most economically. The pumps shall be offered with minimum 60% efficiency. Characteristic curve for pumps shall be furnished with calculation for power requirement. The HP arrived at end must not be overloading for the required discharge. The direction of rotation shall be clockwise when viewed from motor side. The discharge requirement for sewage pumps have been indicated in

respective units comprising such pumps. The total head for pumps shall be calculated on the basis of levels, distances etc., as per Hydraulic diagram and civil details.

Considering various losses and minimum residual head of 3.0 m the bidder shall prepare system resistance curves for maximum and minimum static head conditions and shall match with them the performance curves of pumps offered. The pumps shall be non-clog single/multi stage vertical centrifugal or submersible type, single delivery to a common discharge manifold.

Pumps and drives shall be rated for continuous duty and shall be capable of pumping the flow range specified in the specifications without surging, cavitations or excessive vibration to the limits specified. The pump shall meet maximum allowable shut off head. The pumps shall not overload the motors at any point on the maximum pump speed performance characteristic curve and the pump operating range within the limits of stable pump operation. The total head capacity curve shall be continuously rising towards the shut off as flow decreases throughout the entire curve from run out to shut off head with the highest at shut off.

Pump motor power rating shall be the larger of the following:

- ☐ 110% of the maximum power required by the pump from zero discharge to duty point total head.
- ☐ 115% of the power required at duty point.

Its total head capacity curve shall be continuously rising towards shut off with the highest at shut off, and its capacity shall be met to handling sludge volume.

- (a) Pumps shall be suitable for single as well as parallel efficient operation at any point in between the maximum and minimum system resistances.
- (c) The pumps shall be designed to handle solid sizes of up to 100 mm for the raw sewage application. Specific gravity of sewage is 1.02.
- (d) Pumps shall run smooth without undue noise and vibration, cavitations, oil or water leaks over the range of operation. To ensure vibration free operation, all rotating components of pump shall be statically and dynamically balanced to BS 6861/.as per zones A& B of ISO 10816 -1
Vibration levels shall not exceed the levels given in BS 4675.
- (f) The pump set shall be suitable for starting with discharge valve open and/or closed.
- (g) The pump set shall be capable of withstanding the accidental rotation in reverse direction.

Pump operation shall be smooth without undue noise and vibration. The velocity of vibration shall be within 4.5 mm/sec. The noise level shall be limited to 80 dB (A) at a distance of 1.0 m for the minimum flow pumps and 90dB (A) at a distance of 1.0m for the peak flow pumps.

2.5.2 Features of Construction

- (a) Pump shall be centrifugal, vertical spindle, with open/semi-open impeller, non-clog, wear resisting, and single stage type.
- (b) Pump casing shall be of robust construction. Liquid passages shall be finished smooth and designed as to allow free passage of solids. The volute tongue shall be filed to a smooth rounded edge.
- (c) Double Mechanical seals (back to back) shall be provided to protect the motor from ingress of sewage along the shaft. The preliminary and secondary seals shall be oil-lubricated with

tungsten carbide or silicon-carbide faces and they shall be equipped with an electrical monitoring system for seal failure detection. . Seals must be capable of withstanding rotation in either direction. A detector shall indicate when moisture is leaking past the first seal.

- (d) Impeller shall be non-clog semi open type, having two vanes with smooth blunt edges and large water ways so as to allow free passage of the large size solids. It shall be free from sharp corners and projections likely to catch and hold rags and stringy materials.
- (e) The critical speed of the rotor shall be at least 30% above the operating speed.
- (f) Pump-sets shall have double bearings. Bearings shall be of the anti-friction type. Bearings shall be capable of taking the static weight of the rotating parts and any thrust generated by the operation of the pump. The bearing life shall be minimum 40,000 hrs of operation.
- (g) Each pump shall be complete with a cast iron delivery connection arrangement for fixing to the concrete floor of the suction well. The joint between the pump discharge flange and the delivery piping shall be made by merely lowering the pump into guide rails / rope from access level. It shall be provided with all necessary fixings for guiding the pumps during lifting/lowering. Each pump shall be provided with a SS 316 lifting chain conforming to BS 1663 and BS 4942.
- (h) Each pump shall be provided with an automatic coupling device for attaching the crane hook to the pump at low level, even whilst the pump is submerged, without the need for personnel to enter the well. This automatic coupling device shall easily and automatically couple and uncouple the hoist hook and be complete with necessary accessories. All links and cables shall be multi-stranded stainless steel.
- (i) The materials of construction for submersible pumps shall be as follows :

S. No.	Component	Material
(i)	Impeller *	Stainless Steel : ASTM A 743 CF8M
(ii)	Casing *	Cast Iron to IS:210 Gr FG 200 with 1.5 to 2% Nickel
(iii)	Mechanical seal (Motor side and Pump side)*	oil-lubricated with tungsten carbide or silicon-carbide faces
(iv)	Shaft*	Stainless Steel : BS:970 Gr 316
(v)	Bush*	Bronze IS 318 Gr. LT B2
(vi)	Guide rail pipe	Stainless Steel : BS:970 Gr 304
(vii)	Lifting Chain	Stainless Steel : AISI 316
(viii)	Fasteners and Foundation Bolts	Stainless Steel AISI 316

* Material test certificates from Government approved metallurgical laboratory shall be furnished by the Contractor

- (j) Each pump shall be tested at the manufacturers premises for the full operating range of the pump to BS 5316 Part 1 .Pump performance shall be within the tolerance limits specified in the above said BS.

2.6 OVALVES

2.6.1 General

- a. Valves shall be as per internationally recognized standards. Flanges shall be machined on faces and edges to ISO 7005, IS 6392, IS1538 or BS EN 1092.
- b. Valves shall be double flanged type and the face shall be parallel to each other and flange face should be at right angles to the valve centerline. Back side of valve flanges shall be machined or spot faced for proper seating of the bolt head and nut.
- c. All the valves buried or installed in underground chamber, where access to a hand wheel would be impractical, shall be operated by means of extension spindle and Head stock arrangement, In case of motorized valve electric actuator shall be mounted on headstock with proper support.
- d. Valve of diameter 300 mm and above shall be provided with lifting eyes and shall have detachable bolted covers for inspection, cleaning and servicing.
- e. Valve shall be suitable for frequent operation as well as operation after long periods of idleness in either open or closed position.
- f. The valve stem, thrust washers, screws, nuts and all other components exposed to the water shall be of a corrosion resistant grade of stainless steel.
- g. Valves shall be free from sharp projections.
- h. Butterfly valve and non-return valve shall be provided with bypass arrangement. This may be integral with valve or connected between pipes.
- i. The entire valve chamber Top of Concrete (TOC) shall be minimum 300 mm, above the Finished Ground level and also above the Road level, to avoid entering of rain water into the valve chambers.

2.6.2 Butter fly valve

- A. The Butterfly Valves shall be double flanged long body, double eccentric type conforming to IS 13095/ BS EN 593. Valve shall be suitable for mounting in any position.
- B. The valve seat shall be of replaceable design. When the valve is fully closed, the seal shall seat firmly so as to prevent leakage. The seat surfaces shall be machined smooth to provide a long life for the seal.
- C. All fasteners shall be set flush so as to offer the least resistance possible to the flow through the valve.
- D. Valve shall be suitable for throttling purpose.
- E. All valve, spindles and hand wheels shall be positioned to give good access for operational personnel. Suitable elevated concrete platform shall be provided on mounting floor for easy access to hand wheel for operation.
- F. Valve of diameter 450 mm and above shall be provided with enclosed gear arrangement for ease of operation. The operation gear shall be such that they can be opened and closed by one man against an unbalanced head 15% in excess of the maximum specified rating. Valve and any gearing shall be such as to permit manual operation in a reasonable time and not

exceed a required rim pull of 400 N.

- G. All hand wheels shall be arranged to turn in a clockwise direction to close the valve, the direction of rotation for opening and closing being indicated on the hand wheels.
- H. All the Butterfly valves buried or installed in underground chamber, shall be operated by means of extension spindle and Head stock arrangement, In case of motorized valve electric actuator shall be mounted on headstock with proper support.
- I. The Valves shall be painted with Electro static epoxy powder (Food grade quality) coating both inside and outside with pocket less body passage for a minimum DFT of 250 Microns.
- J. The contractor shall submit gear box & electrical actuator sizing calculation along with datasheet, QAP and drawings approval.

2.6.3 Electric Actuator

(a) Electric actuators shall consist of followings:

- ☐ AC electric motor
- ☐ Reduction gear unit
- ☐ Torque switch
- ☐ Limit switch
- ☐ Continuous Local Indicator
- ☐ Hand Wheel for manual operation
- ☐ Hand auto lever with locking arrangement

(b) All local controls shall be protected by a lockable cover.

(c) Each actuator shall be adequately sized to suit the application and be continuously rated to suit the modulating control required. The gearbox shall be oil or grease filled, and capable of installation in any position. All operating spindles, gears and headstocks shall be provided with adequate points for lubrication.

(d) The valve actuator shall be capable of producing not less than 1½ times the required valve torque and shall be suitable for at least 15 minutes continuous operation.

(e) The actuator starters shall be integrally housed with the actuator in robustly constructed and totally enclosed weatherproof housing. The motor starter shall be capable of starting the motor under the most severe conditions.

(f) The starter housing shall be fitted with contacts and terminals for power supply, remote control and remote positional indication, and shall also be fitted with internal heaters so as to provide protection against damage due to condensation. Heaters shall be suitable for single phase operation. The heaters shall be switched “ON” when the starters are “OFF” and shall be switched “OFF” when the starters are “ON”.

(g) Each starter shall be equipped as follows :

- 2 Nos. Three phase magnetically operated line contactors with no-volt release and electrical and mechanical interlock.
- 1 No Three phase thermal cut-out device.
- 1 No. Control circuit transformer fully protected by fuses on primary and Secondary circuit.
- 1 No. Set of “Open”, “Close” and “Stop” buttons.
- 1 No. Local- Off-Remote switches with padlocking facilities.
- 1 No. Set of torque and limit switches for “full open” and “full Close” positions.
- 3 No. Sets of auxiliary limit switches in each direction.
- Valve position indicator and hand wheel for manual operation.

(h) **Reduction gear unit:**

Gearbox shall have a life of 1, 00,000 hours, be selected in accordance with AGMA recommendation for horsepower calculation and service factor application.

2.6.4 Sluice valve

- (a) All the Sluice valve shall be of resilient seated, glandless design & metal seated generally confirm to BS 5163/ IS 14846. Face to Face dimension shall be as per IS 14846 only.
- (b) All butterfly valve and Non-return valve bypass arrangement shall be provided with resilient seated, glandless design type sluice valve, Air valve & Pressure relief valve isolation shall also be with resilient seated, glandless design type sluice valve and same shall be for Scour valve arrangement. Individual Suction side of main pump shall be either resilient seated, glandless design or metal seated type based on the availability.
- (c) Flanges shall be machined on faces and edges and drilled to IS 9523/IS 1538/BS EN 1092-1 based on the pipe drilling standard shall be adopted. Sluice valves shall be of non-rising spindle type.
- (d) Valve of 450 mm and above shall be provided with thrust bearing arrangement for ease of operation.
- (e) Valve of 600 mm and above shall be provided with drain and air plug.
- (f) Valve of diameter 450 mm and above shall be provided with enclosed, grease packed spur gear arrangement for ease of operation. The operation gear of all valves shall be such that they can be opened and closed by one man against an unbalanced head 15% in excess of the maximum specified rating. Valve and any gearing shall be such as to permit manual operation in a reasonable time and not exceed a required rim pull of 400 N.
- (g) All valves, spindles and Hand Wheel shall be positioned to give good access for operational personnel. Valve shall be suitable for frequent operation as well as operation after long periods of

idleness in either open or closed position.

- (h) All hand wheels shall be arranged to turn in a clockwise direction to close the valve, the direction of rotation for opening and closing being indicated on the hand wheels.
- (i) Manufacturer is required to give details of proposed gear box i.e. nos. of spur pairs, ratio, efficiency etc. The Employer shall have these tested.
- (j) The valve shall be furnished with a bushing arrangement for replacement of packing without leakage. They shall also have renewable channel and shoe linings. The gap between the shoe and channel shall be limited to 1.5 mm.
- (k) The gate face rings shall be screwed into the gate or alternatively securely pegged over the full circumference.
- (l) The Valves shall be painted with Electro static epoxy powder coating both inside and outside with pocket less body passage for a minimum DFT of 250 Microns.
- (m) Manufacturer is required to give justification with calculation that proposed valve is Operable with the effort parameters specified and no. of turns to ensure the time required to operate the valve from full open to full close is within reasonable limits.

2.6.5 Non return valve

- (a) Type of Valve:

On the individual delivery line of the pump, the following types of non return valves shall be accepted: Tilting Disc/Slanted disc check valve with Internal Dash pot arrangement/Internal damping arrangement/counter lever weight arrangement, the non-slam characteristic shall be achieved by providing suitable combination of door and hydraulic passages without any external clamping arrangements or passages. The angle of sealing and door weight shall be designed to provide the most efficient working with least restriction to flow.

- (b) The valves shall be suitable for mounting on a horizontal pipeline and flow direction shall be clearly embossed on the valve body.
- (c) Valves shall possess high speed closing characteristics and be designed for minimum slam condition when closing.
- (d) Valve of diameter greater than 450 mm shall be provided, in addition to others, supporting feet and jacking screws. Hinge pins / shaft shall preferably be square in section to ensure positive location of flaps and provide for secure fixing.
- (e) The Valves shall be painted with Electro static epoxy powder coating both inside and outside with pocket less body passage for a minimum DFT of 250 Microns.

2.6.6 Tamper Proof Air Valve - Cluster Arrangement

- (a) The Air Valve shall be of tamper Proof triple function Single/Double chamber Kinetic Air Valve.
- (b) The air valve shall be capable of exhausting air from pipe work automatically when being filled. The air being released shall be at a sufficiently high rate to prevent the restriction of the inflow rate. Similarly the valve shall be capable of ventilating pipe work automatically when being emptied, the

air inflow rate being sufficiently high to prevent the development of a vacuum in the pipelines.

- (c) The valve shall also automatically release air accumulating in pipe work during normal working conditions.
- (d) In case the maximum size, as per IS code, is not suitable for the size of pipe line, a cluster of air valves shall be provided.
- (e) Air valve shall be of the double orifice type with a large orifice for air entry into the pipeline and smaller orifice for automatic release of air under normal working pressure. The valve shall be suitable for the maximum working pressures in the systems. All air valves shall be provided with isolating valve and flanged end connections.
- (f) Air valve shall be designed to prevent premature closure prior to all air having been discharged from the line. The orifice shall be positively sealed in the closed position but the float (ball) shall only be raised by the liquid and not by a mixture of air and liquid spray. The seating shall be designed to prevent the floats sticking after long periods in the closed position.
- (g) The Valves shall be painted with Electro static epoxy powder coating both inside and outside with pocket less body passage for a minimum DFT of 250 Microns.
- (h) All Stub piping and cluster piping shall be provided with MS pipe of minimum 10 mm thick and reinforcement pad thickness shall be same as main pipe thickness at the weld joint of pipe. All flange joints bolts & Nuts shall be of SS304 material only.
- (i) The contractor shall provide test certificates for materials and properties shall be in accordance with relevant standards.
- (j) Before carrying out pipeline pressure testing the Contractor shall verify with the supplier of the air valves that the valves have the capacity to sustain the pipeline test pressures. In the event that they do not sustain the pressure the valves shall be removed and the stubs off the pipeline shall be blanked off before pressure testing the pipeline.

2.6.7 Pilot operated Pressure Relief valve

- (a) Pressure relief valves shall be capable of relieving pressure in the system to prevent the system being pressurized in excess of a preset maximum allowable pressure. The valves shall be drop tight under normal operating conditions.
- (b) The valve operation shall be achieved by the interaction of the inlet pressure and an intermediate pressure produced by a pilot valve or relay system acting on the upper side of the main valves.
- (c) The pilot valve System shall be actuated by a diaphragm connected to the inlet pressure on its underside and a constant pressure on its upper side derived either from weight or from a spring.
- (d) All Pressure Relief Valve shall be provided with isolating valve and flanged end connections.
- (e) The Valves shall be painted with Electro static epoxy powder (Food grade quality) coating both inside and outside with pocket less body passage for a minimum DFT of 250 Microns.
- (f) The EPDM rubber & Epoxy coating (EP-P) should be approved by W270. (EP-P)/ WRAS &

NSF.”

- (g) Pilot valve system having Stainless Steel / Brass fittings with spring of SS 302 with all the external control tubing of SS 304 / Copper/ high pressure polypropylene rated PN16, Tightness to DIN EN 12266-1, leakage rate A (or) equivalent and the needle valve/ speed control device should be provided to vary opening speed of the main diaphragm with self-cleaning filter to avoid possibility of dirt build up inside the control tubing. Body test Pressure shall be 1.5 times of the rated pressure.
- (h) All Stub piping shall be provided with MS pipe of minimum 10 mm thick and reinforcement pad thickness shall be same as main pipe thickness at the weld joint of pipe. All flange joints bolts & Nuts shall be of SS304 material only.

2.6.8 Electro-hydraulically operated (Pump Discharge valve) Check valve

The pump discharge Valve shall be provided with electro-hydraulic actuator shall be provided with its own power pack. Each actuator shall consist of a double acting cylinder, control cabinet and accessories to cater for following operational requirements.

In the closed position the valve shall be held closed by a substantial counter weight or by any other mechanical device.

Start-up sequence of pump shall initiate powered opening of butterfly valve hydraulic actuator. The actuator shall be adequately sized to open or close the valve against an unbalance pressure equal to pump shut-off pressure in either direction within the time period as specified. The necessary limit switches shall be provided on the valves so that at a pre-determined position, the pump circuit breaker shall be closed to start the pump.

Valve shall remain open during normal running of the pump. No disc flutter shall take place in the position nor shall there be any creep, in this fully open position.

A limit switch is provided (set at about 3 deg from open position) to sense the creeping. Switch shall start the oil pump and return the valve to the fully open position.

Normal operational shut down shall enable valve to close at a slow closing rate, which shall be adjustable between 30 to 60 seconds.

In case of any fault causing pump motor trip the corresponding butterfly valve shall start closing at a fast rate initially and thereafter at a slow rate. The emergency closing facilities shall be provided with its own solenoid valve in the hydraulic circuit.

Provision for local manual operation shall be made.

The lower part of the cylinders shall have a fixed orifice especially designed to achieve a minimum valve closing time in case of failure of oil pipeline.

A locking device shall be provided so that the valve can be maintained in open shut position during maintenance and inspection.

The hydraulic controls for each valve shall be housed in independent cabinet located on an operating floor near the valve. This shall consist of pumping unit, oil tank, and accumulator of adequate capacity to hold the valve disc at any position and to prevent any surge including disc flutter during valve travel and to fully open position. Accumulator will also have enough capacity for one cycle (open and close operation) of operation without external electric AC power and DC power. The hydraulic power pack will consist of necessary pressure switches, pressure gauges flow regulators at the outlet of oil pump, solenoid valves; transformers, rectifiers etc., for DC power supply for solenoid valves; contactors, relays, fuses, indicating lamps, push buttons etc., for control of solenoid valves and pumping units' throttle valve, filters, non-return valves etc., arranged in a logical circuit to meet operation requirement. A DC motor operated lube oil pump shall be installed in the same base frame for operation in Emergency (During power failure) along with accumulators suitably sized.

All oil pipelines/flexible hoses interconnecting the control cabinet to the valve shall be in bidders responsibility.

The electrical controls for the valve such as relays, contractors and fuses shall be housed in the common control panel (local) for pumps or in a separate panel.

Each butterfly valve shall have four limit switches, each capable of being set- of at any point between full open to full close position to meet the desired functions. In addition, one more extra limit switch to be set at intermediate position shall be provided each limit switch shall have 2 NO and 2NC contacts. Limit switch enclosure shall conform to NEMA 4-x Standrad. Each butterfly valve shall have One No. non-contact type 24 VDC 4-20 mA output position transmitter.

The bidders shall submit with his offer full details of valve operating mechanism and hydraulic diagram with description.

Solo Seal shall be provided at the gland (Self Energizing type) Bulb/Music Note Seal shall be provided for the valve V-Ring Seals shall be provided in the valve bore to avoid Slush & Sand in the Bearing housing By-pass arrangement should be provided, for balanced opening of the valve applicable for higher pressure and size.

2.6.9 Isolating Cocks

For isolation of small bore pipe work tapings for instrumentation equipment etc., and for individual component isolation, the cocks shall be stainless steel, quarter turn ball or plug valve with the operating handle arranged to indicate the open and closed positions. Where specified, means shall be provided for securing the valve body to a front panel or near surface.

2.7 Expansion Bellows:

Expansion bellows of Stainless steel (AISI 304) confirming to EJMA standards which can take radial and axial misalignment of minimum 1 percent of pipe size with tie rods. Bellows shall be of Flange Ends, thickness of the ends shall be same as pipe thickness to match inner and outer diameter of the pipeline. Suitable Mild Steel protection cover shall be provided across the bellows against any external tampering for outdoor installation. It shall have cyclic life more than 1000 cycles and designed at temperature of 50 deg C. Hydro test shall be conducted at

1.5 times that of the design pressure with a holding time of 30 minutes. Painting shall be of 2 coats of Red oxide and 2 coats of Epoxy primer to achieve minimum DFT of 250 microns of suitable shade with prior approval of the Employer's Representative. Calculation confirming to EJMA standards shall be submitted for the selection number of ply and thickness of the bellows.

2.8 Electrically Operated Overhead Travelling Cranes

2.8.1 General

The crane shall be electrically operated, double girder bridge type complete with all accessories including down shop conductor, crane rails and fixtures, and shall conform to IS: 3177 or relevant internationally approved standards.

The span and lift indicated in Particular Specifications are tentative and may change during detailed engineering. The contractor shall verify these details before taking up fabrication. If the offered Pump/motor weight is more than the Crane capacity specified, the Contractor shall offer the Crane capacity higher than the weight of the pump/motor.

A capacity plate showing Name of manufacturer, year of manufacture and related capacity of hoist in figures not less than 150 mm height shall be placed on each side of the crane girder.

Minimum Two pairs of slings and wire ropes, shackles, etc shall be supplied to handle all items of pumping station covered by the hoist. They shall be labeled or marked with the Safe Working Load (SWL) and the purpose for which they are intended.

2.8.2 Crane Bridge

The crane bridge shall consist of double bridge girders on which a wheeled trolley is to run. The bridge trucks and trolley frames shall be fabricated from structural steel of tested quality conforming to ASTM A36 except that, plates more than 20 mm thick shall conform to IS:2062:2011, BS EN 10210-1:2006 or relevant internationally approved standards. Access walkway with safe hand railing as is required along the full span length of the bridge girder. The bridge shall be designed to carry safely the loads specified in IS: 807, BS EN 13001-1:2015 and BS EN 13001-2:2014 or relevant internationally approved standards. All anti-friction bearings for bridge and trolley track wheels, gear boxes and bottom sheaves on hook shall be lubricated manually by hand operated grease pump through respective grease nipples.

The maximum deflection under full load shall not exceed 1/900 of the span as per IS: 807.

2.8.3 End Carriages

Wheel base and structural frame of the wheel mounting of the end carriages shall be designed so as to ensure that the crane remains square and prevent skewness. Bridge and trolley track wheels shall be of forged steel and shall be double flanged type. The wheel diameter and rail sizes shall be suitable for the wheel loads. The crane rails shall be manufactured from wear resistant austenitic manganese steel. Mountings of the wheels shall be designed to facilitate easy removal for maintenance. Walkways shall be at least 500 mm clear inside width with a 6 mm thick non-skid steel plate surface. Steel rail stops to prevent derail from creeping and trolley from running off the bridge shall be abutted against ends of rails and welded to the girders. Bridge and trolley stops to match the wheel radius shall be

provided before the buffer stops.

All exposed couplings, shafts, gear, wheels, pinions and chain drives etc. shall be safely encased and guarded completely to prevent any hazard to persons working around. All bearings and gears shall have a design life as per relevant standards. Electro-magnetic and hydraulic thruster brake shall be provided for the main hoist. One electro-magnetic brake shall be provided for each of the cross travel and long travel motions.

2.8.4 Hook

Hook shall be solid forged, heat treated alloy or carbon steel suitable for the duty service. They shall have swivels and operate on ball thrust bearings with hardened races. The lifting hooks shall comply with the requirements of relevant IS or BS EN 1677-5:2008 or relevant internationally approved standards and shall have a safety latch to prevent rope coming off the hook.

Hoist rope shall be extra flexible, improved plough galvanized steel rope with well lubricated hemp core and having six strands of 36 wires per stand with minimum ultimate tensile strength of 1.6×10^6 kN/m² of Right Hand Ordinary (RHO) lay construction. The ropes shall have a 6:1 safety factor on the specified safe working load, and shall conform to IS: 2266. Rope drums shall be grooved and shall be either cast iron or cast steel or welded steel conforming to IS:3177, BS:466 or relevant internationally approved standards.

Gears shall be cut from solid cast or forged steel blanks or shall be stress relieved welded steel construction. Pinions shall be of forged carbon or heat treated alloy steel. Strength, quality of steel, heat treatment, face, pitch of teeth and design shall conform to BS: 436, IS: 4460 and BS: 721 or relevant internationally approved standards.

2.8.5 Electrical Equipment

All accessory and auxiliary electrical equipment including drive motors, electrically operated brakes, controllers, resistors, conductors, insulators, current collectors, pendant push button station, protective devices, operating devices, cables, conduits, etc. necessary for the safe and satisfactory operation of the crane shall be provided.

Power to the crane shall be provided by down shop conductors manufactured from high conductivity hard drawn copper. Conductors shall be completely shrouded such that they have no exposed current carrying surfaces. Pendant type push button station shall be sheet steel enclosed and shall comprise the following push buttons and indicating lamps:

Start' and `Stop'.

Long travel - `Right' and `Left'.

Cross travel - `To' and `Fro'.

Hook - `Hoist' and `Lower'.

Red indicating lamp for supply `ON' indication.

Pendant type push button shall be supported independently of the electrical cable and shall be earthed separately, independent of the suspension and shall be 1.5 m above pump floor. Automatic reset type of limit switches shall be provided to prevent over travel for each of the following:

For `UP' and `Down' motions of the hook.

Long travel motion

Cross travel motion

Crane structures, motor frames and metal cases of all electrical equipment including metal conduit and cable guards shall be earthed. All motors, brakes, limit switches, panels, drum controllers, resistor unit sets shall be provided with two studs for earthing.

2.8.6 Testing

The crane, and all slings, ropes, shackles and other lifting equipment supplied shall be tested by the manufacturer at his works. The tests shall be carried out at 125% of Safe Working Load, and Test Certificates shall be supplied.

The crane shall be tested for full load and 25% over-load on hoisting and cross traverse motion at factory. Proper clearance, smooth rolling of wheels etc and soundness of fabrication and welding shall also be checked.

2.8.7 The following tests shall be carried out at site before commissioning of crane as per IS 3177

- (a) Insulation Tests (b)
Operation Tests
- (c) Deflection Tests
- (d) Over Load Tests

The crane should comply with relevant safety regulations under the Factory Act and Indian Electricity Rules and other statutory regulations as applicable.

2.9 Manual Hoist

Manual hoists shall be complete with hand-chain, trolley, pulley block, hook, hand and load chains, brake and other accessories. They shall comply with the latest applicable standards, regulations and safety codes in the locality where equipment will be installed.

Each hoist shall be operated on a monorail (I-Beam). The factor of safety shall not be less than 5. The load chain may be heat-treated to give ductility, toughness and conforming to I.S. 3109/ BS 1663. The load wheel is to be made from heavy duty malleable castings. The hand chain is to Conform with BS 6405 and hand chain wheel may be made from pressed sheet steel with roller type guarding. Gears shall be cut from solid cast or forged steel blanks or shall be stress – relieved welded steel construction. Pinions shall be of forged carbon or heat treated alloy steel. Strength, Quality of Steel, heat treatment, face, pitch of teeth and design shall confirm to BS 436, BS 545 and BS 721-1. Spur and helical gears must comply with B.S. 436 and worm with BS 721-1. Bearing must be ball and roller type conforming to B.S.2525-32. Proper lubricating arrangements are to be provided for bearings and pinions. The brake for the lifting gear shall be automatic and always in action.

If the offered weight of intended equipment is more than the hoist capacity specified, the Contractor shall offer the hoist capacity higher than the weight of the equipment.

The proof testing of each chain pulley block is to be carried out as per latest applicable

standards. The safe working load is to be marked in such way that is clearly visible from the operating level.

Name Plate showing the capacity, year of manufacture and rated capacity of hoist in figures not less than 150 mm height shall be placed on each side of the hoist girder.

Minimum Two pairs of slings and wire ropes, shackles, etc shall be supplied to handle all items of pumping station covered by the hoist. They shall be labelled or marked with the Safe Working Load (SWL) and the purpose for which they are intended. The hoist, and all slings, ropes, shackles and other lifting equipment supplied shall be tested by the manufacturer at his works. The tests shall be carried out at 125% of Safe Working Load, and Test Certificates shall be supplied.

2.10 Operated Hoists

Electric hoists shall be complete with hoisting motor, wire rope drum, wire rope, hook, necessary gearing, sheaves, electromagnetic brake for hoisting motion, weather & dust-proof push button station, contractor panel, all wiring, limit switches, etc.

Electric hoists shall conform to IS: 3938 and shall be suitable for outdoor application. All the parts of the hoist shall be designed to withstand surrounding atmospheric conditions without any deterioration.

If the offered Pump/motor/Valves weight is more than the Crane capacity specified, the Contractor shall offer the Crane capacity higher than the weight of the pump/motor/Valves.

Rope drums shall be either cast or welded to sustain concentrated loads resulting from rope pull. Drums shall be machine grooved right and left with grooves of a proper shape for the rope used.

Gears shall be cut from solid cast or forged steel blanks or shall be of stress-relieved welded steel construction or built-up from steel billets and welded together to form a one piece gear section.

Hoist ropes shall be extra flexible, improved plough steel rope with a well lubricated hemp core and having six strands of 36 wires per strand with minimum ultimate tensile strength of 1.6×10^6 KN / Sq. m.

Hooks shall be solid, forged, heat treated alloy or carbon steel of rugged construction of the single hook type and provided with a standard depress type safety latch.

Hoisting motor shall be equipped with electrically released, spring set, friction shoe type brakes having torque capable of holding 125% of the full rated hook load. Brake shall apply when either the motor controller or the main power switch is in 'OFF' position or in the event of power failure.

Drive motors shall be designed for frequent reversal, braking and acceleration and shall be as per IS: 325. Pendant control switch, controllers and resistors, controls, electrical protective devices, cables and conductors, earthing guards etc. shall be as per IS:3938. Limit switches shall be provided for over-hoisting and over-lowering.

Minimum Two pairs of slings and wire ropes, shackles, etc shall be supplied to handle all items of pumping station covered by the hoist. They shall be labelled or marked with the Safe Working Load (SWL) and the purpose for which they are intended.

The electric hoists shall be of Class II duty. 25% overload test, speed tests, limit switch tests

and brake test shall be conducted for the hoist and trolley at manufacturer's works.

2.11 Fire fighting system

The fire extinguishers of 2.0 kg Grip fire carbon dioxide (10 Nos) shall be with ISI mark/ Tariff Advisory Committee's approved make along with following accessories.

The bidder shall supply minimum items listed below as a part of firefighting system along with Fire Extinguishers:

One First Aid Box – 2 Nos

First Aid Chart with Lamination- 2 Nos

Galvanized Iron Hanging buckets- 4 Nos

Rubber Mats- 10 mm thick 1m X 1m- 6 Nos

Hand gloves- 6 Nos

Contractor shall provide adequate fire fighting system for STP and associated buildings as per Fire authority norms.

2.12 Surge Protection System

The Contractor shall carry out comprehensive transient or surge analysis of the complete pumping systems considering full length of pipelines under all operating conditions. The surge analysis shall be carried out using a proven and acceptable computer programme which is being used in water supply industry. The surge analysis report shall be approved by the employer. The surge analysis shall identify the most adverse transient conditions. The analysis shall include but not be limited to the following conditions:

Tripping of all duty/working pumps (running at maximum capacity) due to complete power failure for all operating conditions.

- a) Start up of the pumps under the specified control system
- b) Shut down of the pumps under the specified control system
- c) The objective of the surge analysis is to recommend surge protection devices which ensures maximum and minimum allowable pressures under the operation conditions. After power failure to pumps the following design criteria shall be adopted for assessing the transient pressures:
 - ☐ The maximum transient pressure shall be less than the pipeline design pressure which is about 1.5 times the working pressure.
 - ☐ The negative pressure of the pipeline shall be restricted to 1/3 of atmosphere pressure or less.

The recommended solutions should include sensitivity checks to show that it is still valid with possible variations in system parameters such as wave speed, friction factor and system demands. Proposed surge protection devices i.e. surge vessel / Air vessel, shall be based on the surge analysis results and considering surge tank provided under contract CP-07.

The surge protection devices should include but not be limited to the following recommendations:

- a) Size and details (i.e. Volume) of air vessel (Surge Vessel). b) Details for controlling the air volume in the above vessels.
- c) Details and alarms for monitoring the air volume in the above vessel.
- d) Recommendations for controlling “slam” on the pump delivery non-return valve that may adversely affect the lifetime or operation of the valve and the system.

The Contractor shall provide the required numbers and size of air vessel as per detailed transient / surge analysis result considering minimum numbers and size of vessels specified in the bid document.

In addition to surge vessels of total capacity as arrived by calculations, the Contractor shall install at least one standby surge vessel at the pumping station of the same type and size as the proposed ones. Such standby surge vessel shall be used in case of releasing one of duty vessel for maintenance.

Prior to installation, contractor shall submit the surge analysis report to the employer for approval. The report shall include computer analysis and graphs showing maximum and minimum transient pressure envelopes with and without surge protection devices. The report shall also include time-flow and time pressure plots at critical points with graphs and tables which show surge control requirements shall be met by proposed measures. Surge protection devices shall be air vessel / surge tank, or combination of air vessel, surge tank another devices, but flywheels to add to the pump rotating inertia shall not be used.

Surge Vessels shall be compressed air type, designed, constructed, installed and tested as detailed in the Specification.

Surge vessel(s) shall be installed at practically possible location, to the pumping station with the approval of employer.

The Surge Analysis Study Report shall be wetted and approved technically by institute like IISC, Bangalore, and cost of same shall be deemed in the price bid of bidder.

2.13 Surge/Air Vessels

Pressure vessels shall be suitable to take of water hammer/pressure surges which may occur in the pipeline system. The pressure vessels shall be manufactured out of MS plates as per IS 2002 and shall conform to unfired pressure Vessels Code IS 2825 latest revision. The vessels shall be designed and fabricated for the maximum system pressure with 10% design margin and specified internal pressure and temperature with a minimum corrosion allowance of 3 mm. The vessels in pumped systems shall be designed to 150 per cent of the system rating pressure or the maximum shut off pressure whichever is maximum. The hydro-test pressure shall be one and half times the design pressure multiplied by the ratio of allowable stress of the material used in construction at the design and test temperature.

- a) The vessels designed for air or partial air service shall be tested pneumatically followed by the hydrostatic test. The vessels shall also be tested for full vacuum condition. Unless otherwise specified the ends shall be 2:1 ellipsoidal or torispherical with the inside crown radius equal to the outside diameter and the knuckle radius equal to 10 per cent of the crown radius. A minimum of 2

mm thinning allowance shall be provided on all heads. The heads shall be seamless. If weld joint is inevitable, it shall be 100 per cent radio graphed. The dished ends shall be given a normalizing treatment after forming. Production control coupon/ plates conforming to BS EN 1418 /IS:2002 Gr 2 or Gr 3 representing seams in heads shall be tested to ensure desired tensile/proof, yield stresses, percentage elongation, impact. The nozzles shall be seamless conforming to SA106 Grade B. Flanges upto 250 NB shall be weld neck type of forged quality conforming to SA105.

- b) Strength, hardness etc. in the welds and proper grain structure refinement on heat treatment. All pressure parts of the vessel shall be fabricated with boiler quality materials conforming to BS EN 10028 or equivalent. The nozzle shall be seamless conforming to BS EN 10216-1:2002 and BS EN 10217-1:2002. The seams of fabricated nozzles shall be 100% radio graphed. Flanges and nozzles up to 150 mm diameter shall be of weld neck type of forged quality conforming to ASTM A 105 / IS 2004 Grade. Flanges above 150 mm diameter may be forged or fabricated out of boiler materials. While such forged flanges shall be weld neck or hub bed type, plate flanges shall be of integral type with full penetration welds. The vessels shall be provided with manholes with suitable davit assembly and water outlets at the bottom which shall be connected to the rising mains along with isolating valves and a differential orifice.
- c) During fabrication, procedure and production control test plates shall be prepared to represent 30 % of longitudinal seams, and each welder's performance and tested in accordance with BS EN 1418. At least 10% of the weld joints on the vessel shall be spot radio graphed. 100% of the welded joints, if any on the dish shall be radiographed. Inspection of air vessels shall cover welding qualifications, radiography/UT/MT as applicable, stage/in process inspection and hydro/leak tests.
- d) Inside and outside surfaces of the pressure vessels shall be sand blasted as per BS 7079 and painted as per provision. The internal surface shall be painted for submerged condition, and internal welds shall be dressed smooth.
- e) The paints used shall be established to be non-toxic and free from any odour and shall be certified by a recognised laboratory that the paints used are fit for potable water.
- f) All underground vessels, or portions of vessels, buried underground shall be lined on the outside with 3.5 mm thick fiberglass in isophthalic type polyester resin, after proper preparation of surfaces by sand blasting to BS 7079 specifications. Linings shall be tested with a holiday detector of 10,000 volts output, for acceptance.
- g) Each vessel shall include:
 - I. Saddle supports and legs complete with holding-down bolts;
 - II. Drilled-and-tapped or flanged facings for the following fittings which shall be provided:
 - ☐ Pressure-relief air valve and vacuum breaker valve rated for not less than 150% working pressure and to pass 200% maximum air flow into vessel;
 - ☐ Adequate access to afford inspection of the inside of the vessel;
 - ☐ Calibrated level sight glass of the reflective type covering the full range of Water level in the vessel and having top and bottom shut-off cocks and hinged safety glass, and pressure/level calibrations carried on a substantial engraved plate;

- ☐ Air vent and inlet valves;
 - ☐ 150mm diameter pressure gauge and isolating cock;
 - ☐ Lifting lugs to enable handling of the vessel on Site without damage;
 - ☐ Flanged inlet and outlet branches;
 - ☐ Drain valve;
 - ☐ High and low water level float switch with stilling tube and changeover-Contact micro-switches rated for 220V/420V ac for both high and low level settings.
 - ☐ All necessary pipes, fittings, brackets, fixings and the like required to mount system onto the pumping main.
- III. In accordance with PD 5500:2006, an inspection and regulating authority for the surge equipment shall be appointed/ arranged by the Contractor and shall be submitted for approval to Employer's Representative.
- IV. The name and address of the Authority and extent and details of inspection to be done shall be submitted for approval to Employer's Representative before manufacture commences.

2.14 Air Compressor System

- a) Air compressor shall be electrically driven, multistage, water-cooled, reciprocating, air receiver mounted and non lubricating type. Compressor shall be supplied with V-belt drive and guard, suction air filter, silencer, automatic unloaded and control equipment, safety / pressure relief valves, common bed plate for compressor and motor, high temperature protection by fusible plug in the compressor outlet, low lube oil pressure switch, isolating valve and all necessary accessories required to form a fully-automatic unit supplying compressed air, continuously or intermittently as required, and at the specified rate and pressure. The pipe work and valves shall be arranged so that either of the compressors can be used to supply the compressed air to the surge vessels. The pipe material shall be SS 316 schedule 40S.
- b) Compressors shall be rated for continuous operation at full duty.
- c) The motor shall be suitable for star delta starting with 415 V, 3 Phase, and 50 Hz supply. The power supply to control panel for auto / manual system together with power and control cabling between the panel and compressor and cabling to all accessories associated with antisurge systems such as level switches, pressure / temperature devices and solenoid valves shall be provided.
- d) The following equipment shall be provided:
- (i) A ball plug type valve for connecting air supply to the vessel.
 - (ii) A 600 mm manhole with a door with davit assembly on vessel so arranged that it can be easily handled by man and positioned below the normal operating water level.
 - (iii) Step-irons welded to inside of the vessel to facilitate inspection.
 - (iv) 2 nos. of 20 mm threaded sockets with plugs on anti surge piping for surge test purposes. Sockets and plugs shall be forged steel to A105.
 - (v) A direct reading reflex type heavy duty industrial level indicator for a visible length of approximately diameter of the vessel, with multiple flat glass sections of borosilicate of minimum thickness 20mm with prismatic recesses to reflect water column mark. The body of

the level gauge shall be to SS 316 with Stainless Steel SS 304 fasteners. The integral valves shall also be of Stainless Steel CF8M make. The level indicator shall be complete with drain, vent and isolating valves.

- (vi) An operating platform with suitable 32 mm GI pipe hand rails, with 75mm wide toe plates. The platforms shall be made in equal sized sector shaped grating. All structural shall be hot dip galvanized.

2.15 Propeller Ventilating Fans

The fan should comply with IS 2312. The blades shall be of mild steel and properly balanced so as to avoid noise and vibration. The blade and blade carriers shall be securely fixed so that they do not loosen in operation.

The means provided for securing the fan mounting or fan casing to the wall, partition or window shall be such as to provide a secure fixing without damage to the fan or wall.

Suitably designed guards shall be fitted to the inlet and the outlet side to prevent accidental contact. No flammable material shall be used in the construction of fan. Moulded parts, if used, shall be of such materials as to withstand the maximum temperature attained in the adjacent component parts.

The fan shall have protective insulation or be capable of being earthed. A fan with protective insulation may be of all insulated construction or have either double insulation or reinforced insulation. Each fan should be provided with a 10 sq.mm mesh bird screen. The sheet used for the cowl should be minimum of 14 G.

2.15.1 Noise & vibration

Noise level produced by any rotating equipment individually or collectively shall not exceed 85 dB (A) measured at a distance of 1.5 meters from source in any direction. The over all Vibration level shall be as per zones A and B of ISO 10816-1/ 20816-1: 2016. Balance quality requirements shall be grade G 6.3 conforming to ISO 1940-1/ISO 21940-11.

2.16 Warranty

- a) Comply with the requirements of each type of Equipment and specification mentioned elsewhere in this document.
 - b) Warrant all components to be free of defects in materials or workmanship for 12 months from date of Taking Over Certificate.
 - c) Individual warranties by component manufacturer in lieu of single source responsibility by the main Equipment manufacturer shall not be acceptable.
 - d) Items which fail during the warranty period, excluding expendable items, shall be replaced without cost to the Employer.
- ☐ Provide manufacturer's guarantee and warranty certificates prior to equipment start-up.

2.17 PIPELINES, PIPEWORK AND FITTINGS

2.17.1 Applicable codes

The following codes and standards unless specified herein shall be referred to, or equivalent to the approval of Employer's Representative.

2.17.2 Materials

IS :	210	Specification for grey iron casting
IS :	290	Specification for coal tar black paint
IS:	14948	Paint Coal Tar Epoxy, Two Pack, Black and Brown
IS :	456	Code of practice for plain and reinforced concrete
IS :	458	Specification for pre-cast concrete pipes (with and without reinforcement)
IS :	516	Method of test for strength of concrete
IS :	638	Specification for sheet rubber jointing and rubber insertion jointing
IS :	783	Code of practice for laying of concrete pipes
IS :	816	Code of practice for use of metal arc welding for general construction in mild steel
IS :	1367	Technical supply conditions for threaded steel fasteners
IS :	1387	General requirements for the supply of metallurgical materials
IS :	1500	Method for Brinell hardness test for metallic materials
IS :	1536	Specification for centrifugally cast (spun) iron pressure pipes for water, gas and sewage
IS :	1537	Specification for vertically cast iron pressure pipes for water, gas and sewage
IS :	1538	Specification for cast iron fittings for pressure pipes for water, gas and sewage
IS :	1916	Specification for steel cylinder pipes with concrete lining and coating
IS :	2078	Method for tensile testing of grey cast iron
IS :	3597	Method of tests for concrete pipes
IS :	3658	Code of practice for liquid penetrant flow detection
IS :	5382	Specification for rubber sealing rings for gas mains, water mains and sewers
IS :	5504	Specification for spiral welded pipes
IS :	6587	Specification for spun hemp yarn
IS :	7322	Specification for specials for steel cylinder reinforced concrete pipes

3.17.3 Code of Practice

IS :	783	Code of practice for laying of concrete pipes
IS :	3114	Code of practice for laying of cast iron pipes
IS :	3764	Excavation work - Code of Safety
IS :	4127	Code of practice for laying of glazed stoneware pipes
IS :	5822	Code of practice for laying of electrically welded steel pipes for water supply.
IS :	6530	Code of practice for laying of asbestos cement pressure pipes.

2.17.4 Materials for Pipelines

Each pipeline shall be constructed in a material compatible with the fluid conveyed through that pipeline, i.e. the materials used in the pipes which are or can be in contact with the untreated or treated water, shall not contain any matter which could impart taste or odour or toxicity or otherwise be harmful to health or adversely affect the water conveyed. Nor shall any pipe be adversely affected by the fluid being conveyed through that pipe.

Pipe work and valve materials for the following duties shall be as follows or equivalent to the approval of the Employer's Representative:

Pipe material table is given below.

APPLICATION / LOCATION	MATERIAL
Service water system connection up to overhead Tank.	uPVC /CPVC/HDPE; Minimum 6 Kg/cm ²
Clear Water	All the pipes laid in open i.e. either above ground level or in channels, shall be provided with Mild steel with internal food grade epoxy coating on both inside and outside. All buried pipeline shall be of Mild steel with internal food grade epoxy coating and outside coal tar Enamel coating & wrapping.
Dewatering Pump connections	Flanged end Ductile Iron Pipe and fittings (PN 10)
Bypass Piping for all valves and CACW motor cooling piping	SS 316 Schedule 80S.
Compressed Air piping from (Compressor to Air vessels and Air receivers) & Compressor cooling water Piping	SS 316 Schedule 40S.
Overflow Piping from Clear Water Reservoir up to nearest drain.	Above ground - Mild steel with internal food grade epoxy coating on both inside and outside and Below Ground- RCC NP3.

2.17.5 Ductile Iron Pipes and Fittings

2.17.5.1 Manufacture of Pipe

DI pipes (Class K7 & K9) and fittings (Class K12) shall be in accordance with IS: 8329 and IS:

9523. Pipes and fittings shall be procured from reputed manufacturers with Employers Representative's approval. Employers Representative shall at all reasonable times have free access to the place where the pipes and fittings are manufactured for the purpose of examining and testing the pipes and fittings and for witnessing the test and manufacturing. For the gravity sewers DI pipes of class K7 shall be used and for the

pumping mains for water supply and sewer DI K-9 Class pipes shall be used.

All tests specified either in this specification or in the relevant Indian Standards specified above shall be performed by the supplier/Contractor at his own cost and in presence of Employers Representative if desired. For this, sufficient notice before testing of the pipes and fittings shall be given to Employers Representative.

If the test is found unsatisfactory, Employers Representative may reject any or all pipes and fittings of that lot. The decision of Employers Representative in this matter shall be final and binding on the Contractor and not subject to any arbitration or appeal.

The pipes and fittings shall be stripped, with all precautions necessary to avoid warping or shrinking defects. The pipes and fittings shall be free from defects. Any defect in pipes and fittings in the opinion of Employers Representative shall be rejected and shall be replaced by new one.

In the case of spigot and socket pipes and fittings the socket shall be without the centre ring.

In the case of flanged pipes, the flanges shall be at the right angles to the axis of the pipe and machined on face. The bolt holes shall be drilled and located symmetrically off the centerline. The bolt hole shall be concentric with the bore and bolt holes equally spaced. The flanges shall be integrally cast with the pipes and fittings and the two flanges of the pipe shall be correctly aligned.

The following types of DI fittings shall be manufactured and tested in accordance with IS: 9523 or BS: 4772.

- flanged socket
- flanged spigot
- double socket bends (900, 450, 22 1/2 0, 11 1/4 0)
- double socket branch flanged tee
- all socket tee
- double socket taper
- retrained joints
- All the fittings shall be of class K-12.

Supply

All the DI fittings shall be supplied with one rubber ring for each socket. The rubber ring shall conform to IS: 12820 and IS: 5382. Flanged fittings shall be supplied with one rubber gasket per flange and the required number of nuts and bolts.

Lubricant for ductile iron pipes and specials

General

This section covers the requirements for lubricant for the assembly of Ductile Iron pipes and specials suitable for Tyton push-in rubber ring joints

Specification

The lubricant has to have the following characteristics:

- must have a paste like consistency and be ready for use
- has to adhere to wet and dry surfaces of DI pipes and rubber rings
- to be applied in hot and cold weather; ambient temperature 0 - 50 °C, temperature of exposed pipes up to 70 °C
- must be non toxic
- must be water soluble
- must not affect the properties of the drinking water carried in the pipes
- must not have an objectionable odour
- has to inhibit bacterial growth
- must not be harmful to the skin

- must have a shelf life not less than 2 years Acceptance tests
- They shall be conducted in line with the provisions of the IS 9523

Packing

All the DI fittings shall be properly packed with jute cloth. Rubber rings shall be packed in polyethylene bags. Rubber rings in PE bags and nuts, bolts etc. shall be supplied in separate jute bags.

The fittings should preferably be manufactured by the manufacturer of the pipes. In case they are not, it will be the responsibility of the Contractor to have them manufactured from a reputed manufacturer. The Contractor however shall be responsible for the compatibility and quality of the products.

2.17.5.2 Materials

The materials used in the manufacture of pipes and fittings shall comply with requirements specified in IS: 8329 and IS: 9523.

2.17.5.3 Dimensions and tolerances

The internal diameter, thickness and length of barrel, dimensions of pipes and fittings shall be as per relevant tables of IS: 8329/IS: 9523 for different class of pipes and fittings. Each pipe shall be of uniform thickness throughout its length.

The tolerances for pipes and fittings regarding dimensions, mass, quality and deviations from straight line in case of pipes shall be as per IS: 8329/IS: 9523.

2.17.5.4 Testing of pipes during manufacture

The pipes will be subjected to following tests for acceptance:

- Visual and dimensional check as per Clause 13 and 15 of IS 8329
- Mechanical Test as per Clause 10 of IS 8329
- Hydrostatic Test as per Clause 11 of IS 8329
- The test reports for the rubber gaskets shall be as per acceptance tests of the IS 5832

(a) Mechanical Tests

Mechanical tests shall be carried out during manufacture of pipes and fittings as specified in IS: 8329 / IS: 9523. The frequency and sampling of tests for each batch of pipes shall be in accordance with IS: 8329. The test results so obtained for all the pipes and fittings of different sizes shall be submitted to Employers Representative. The method for tensile tests and the minimum tensile strength requirement for pipes and fittings shall be as per IS: 8329/IS: 9523.

(b) Brinell Hardness Test

For checking the Brinell hardness, the test shall be carried out on the test ring or bars cut from the pipes used for the ring test and tensile test in accordance with IS: 1500. The test shall comply with the requirements specified in IS: 1500/IS: 8329.

(c) Retests

If any test piece representing a lot fails in the first instance, two additional tests shall be made on test pieces selected from two other pipes from the same lot. If both the test results satisfy the specified requirements, the lot shall be accepted. Should either of these additional test pieces fail to pass the test, the lot shall be liable for rejection.

(d) Hydrostatic Test

For hydrostatic test at works, the pipes and fittings shall be kept under test pressure as specified in IS: 8329 / IS: 9523 for a period of minimum 15 seconds, during which the pipes shall be struck moderately with a 700 g hammer for conformation of satisfactory sound. They

shall withstand the pressure test without showing any leakage, sweating or other defect of any kind. The hydrostatic test shall be conducted before surface coating and lining.

2.17.5.5 Laying of the pipe

Laying of DI pipes shall conform to the Code of practice of IS: 12288. Pipes shall be laid underground with a minimum earth cover of 1m. Pipes shall be generally laid in sections of

300 m each. Laying of pipes shall be as per Standard Specifications for Procurement of Project Works. All pipes, fittings and material shall be tested and approved by the Employers Representative before being laid. Any pipes, fittings or material placed before they are tested and approved shall be removed and replaced with tested and approved material. Before laying the pipe, necessary bedding shall be provided wherever required. Polyethylene sleeves wounded pipes shall be used for water logged areas as per specification and as directed by the Employers Representative.

2.17.5.6 Jointing of pipes

(a) General

Jointing of DI pipes and fittings shall be done as per IS: 12288 and manufacturer's recommendations. After jointing, extraneous material, if any, shall be removed from the inside of the pipe. Rubber sealing rings/gaskets used for jointing shall conform to IS: 638, IS: 12820 and IS: 5382.

(b) Spigot and Socket joints

These shall have sockets, which are integral with the pipe and incorporate an elastomeric rubber ring gasket conforming to IS: 12820.

The gaskets/sealant used for joints shall be suitable for water conveyance. In jointing DI pipes and fittings, the Contractor shall take into account the manufacturer's recommendations as to the methods and equipment to be used in assembling the joints. In particular the Contractor shall ensure that the spigot end of the pipe to be jointed is smooth and has been properly chamfered, so that the rubber ring as per IS: 12820 and IS: 5382 is correctly positioned in line, before the joint is made. The rubber rings and any recommended lubricant shall be obtained only through the pipe, supplier or as otherwise directed by the Employers Representative.

(c) Gaskets for Flanges

All gaskets used between flanges of pipes shall be of natural rubber conforming to IS: 638 suitable for sewage and as specified by manufacturer

(d) Flanged joints

These shall comply with dimensions and drilling details as specified in IS: 8329. These shall have isolation gaskets between the flanges, isolation sleeves around all bolts and isolation washers under all bolt heads and nuts. All material shall be supplied by a reputed manufacturer and shall be approved by the Employers Representative.

Each bolt should be tightened a little at a time taking care to tighten diametrically opposite bolts alternatively. The recommended bolting torque to be followed for assembling flanges shall be as specified in manufacturer's instructions. The practice of fully tightening the bolts one after another is highly undesirable. The bolts shall be of mild steel unless otherwise specified. They shall be coated with coal tar epoxy coating after tightening.

2.17.5.7 DI Fittings and Special

DI Fittings shall be as per the provisions of IS 9523 or equivalent International Standard.

The DI Fittings shall be preferably manufactured and supplied by the same pipe manufacturer and/or its subsidiary, manufacturing all the required sizes, to ensure quality and compatibility of the DI Pipes and DI Fittings for better pipeline performance.

In case the DI Pipe manufacturer does not manufacture and supply DI Fittings, it will be the responsibility of the contractor to procure quality DI Fittings from a reputed manufacturer having a valid BIS license after necessary QAP approval and inspection from the Employer's representative before the procurement of the same. Type Tests under Quality Assurance of ISO 2531:2009 (E), states that if fittings are supplied separately from pipes, full reports of the type Tests on these components, and their compatibility with pipes, shall be made available to the Employer by the fitting supplier. The Type Test reports should be carried out inside NABL accredited laboratory. The contractor shall be solely responsible for the compatibility of DI Fittings with Ductile Iron (DI) Pipes.

The manufacturing unit should have ISO 9001 certification.

The company should have fully equipped laboratory with in-house microscope to check nodularity and to check chemical composition along with tensile, hardness & elongation by universal testing machine. The laboratory of the manufacturer should be accredited by NABL.

Since the socket design is not given in the standard the minimum socket thickness of fittings at any point must not be lesser than minimum body thickness given in the standard.

Fittings with Flexible Push-on joint, Flange joint and Mechanical joint are permissible.

➤ **Fittings with Restrained Joints**

DI fittings with restrained joints shall be utilized in underground application where pipelines have to cross roads through existing ducts or in areas with restricted accessibility where the use of concrete anchor blocks is prohibited, or as directed by the Employer's representative. The CONTRACTOR shall submit with his bid with full details of the type of restrained joint he proposes to use.

Whenever in the course of work the CONTRACTOR intends to utilize restrained joints he shall obtain prior approval from the Employer's representative.

Calculation of the number of pipe lengths with restrained joints required on both sides of the fitting shall follow the manufacturer's recommendation and shall be subject to the Employer's representative approval.

Restrained joints shall be designed in accordance with ISO 10804-1. The permissible angular deflection will be as declared by the manufacturer. The performance Type test of this Joint shall be in line with ISO 10804-1/EN545 and has to be established by the manufacturer by getting it witnessed by a NABCB (National Accreditation Board for Certification Bodies) or IAF

(International Accreditation Forum) or EA (European Cooperation for Accreditation) accredited institution / certification agency. The certificate must be produced with the technical bid.

Rubber ring for joints shall be of a type that will not deteriorate when stored under manufacturer's guidelines or during operation. The rubber gasket shall be of EPDM elastomer

2.17.5.8 Coatings

(a) General

Unless otherwise specified, DI pipes and fittings shall be coated with Bitumen in accordance with relevant IS specifications. All buried DI pipes and fittings shall also have factory or site applied polythene sleeving. Coating shall not be applied to pipe and fittings unless its surface is clean, dry and free from rust. Pipe coatings shall be inspected at site and any damage or defective areas shall be made good to the satisfaction of the Employers Representative.

(b) Bitumen coating

Bitumen coating shall be of normal thickness of 75 microns unless otherwise specified. It shall be cold applied compound complying with the requirements of relevant Indian standards, suitable for tropical climates, factory applied in accordance with the manufacturer's instructions.

Damaged areas of coating shall be repainted on site after removing any remaining loose coating and wire brushing any rusted areas of pipe.

(c) Cement mortar lining

All pipes and fittings shall be internally lined with cement mortar in accordance with ISO 4179/IS: 11906. Cement mortar lining shall be applied at the factory in conformance with the above-mentioned standards. The cement used shall be High alumina cement for sewage applications (Gravity/Pumping main). No admixtures in the mortar shall be used without the approval of the Employers Representative.

Pipe linings shall be inspected on site and any damage or defective areas shall be made good to the satisfaction of the Employers Representative.

Lining shall be uniform in thickness all along the pipe. The minimum thickness of factory applied cement mortar lining shall be as per IS: 11906.

(d) Marking

Marking shall be done as per IS: 8329 and IS: 9523 or any other relevant IS codes.

2.17.5.9 Carting & handling

Pipes and fittings/specials shall be transported from the factory to the work sites at places along the alignment of pipeline as approved by Employers Representative in lengths not more than the length of the transporting vehicle. Contractor shall be responsible for the safety of pipes and fittings/specials in transit, loading/unloading. Every care shall be exercised in handling pipes and fittings/specials to avoid damage. While unloading, the pipes and fittings/specials shall not be thrown down from the truck on to hard surfaces. They should be unloaded on timber skids with steadying ropes and / or by any other approved means. Padding shall be provided between coated pipes, fittings/specials and timber skids to avoid damage to the coating. Suitable gaps between pipes should be left at intervals in order to permit access from one side to the other. As far as possible, pipes shall be unloaded on one

side of the trench only. The pipes shall be checked for any visible damage (such as broken edges, cracking or spoiling of pipe) while unloading and shall be sorted out for replacement. Any pipe, which shows damage in the opinion of Employers Representative, shall be discarded and replaced by new one without extra cost. Dragging of pipes and fitting/specials along road or pipeline alignment shall be prohibited.

2.17.5.10 ACCEPTANCE TESTS

I) Check for Obstruction

- a. As soon as a stretch of pipes whether of RCC Pipes or HDPE or DI Pipes has been laid Complete from manhole to manhole, the Contractor shall run through the pipes both backwards and forwards a double disc or solid or closed cylinder 75 mm less in diameter than the internal diameter of the pipes. The open end of an incomplete stretch of pipe line shall be securely closed as may be directed by the Employers Representative to prevent entry of mud or silt etc.
- b. If as a result of the removal of any obstruction the Employers Representative considers that damages may have been caused to the pipe lines, he shall be entitled to order the length to be retested at the expense of the Contractor. Should such retest prove unsatisfactory the Contractor shall at his own expense amend the work and carry out such further tests as are required by the Employers Representative.
- c. It shall also be ascertained by the Contractors that each stretch from manhole to manhole is absolutely clear and without any obstruction by means of visual examination of the interior of the pipe line.

A. Hydraulic Testing of Sewers

Immediately after the test with the double disc or cylinder as mentioned above has been completed and any defects thereby disclosed have been made good, the Contractor shall prove the joints of the stretch of under-ground pipes are water tight.

Each section of sewer shall be tested for water tightness preferably between manholes. To prevent change in alignment and disturbance after the pipes have been laid, it is desirable to backfill the pipes up to the top keeping at least 90 cm length of the pipe open at the joints. However, this may not be feasible in the case of pipes of shorter length, such as stoneware and RCC pipes. With concrete encasement or concrete cradle, partial covering of the pipe is not necessary.

If it is necessary that the pipelines are filled with water before commissioning the application of pressure to allow for the absorption by pipe wall as per relevant IS standards.

The Sewers are tested by plugging the upper end with a provision for an air outlet pipe with stop cock. The water is filled through a funnel connected at the lower end provided with a plug. After the air has been expelled through tile air outlet, the stop cock is closed and water level in the funnel is raised to 1.5 m above the invert at the upper end. Water level in the funnel is noted after 30 minutes and the quantity of water required is measured at an interval of 10 minutes to restore the original water level in the funnel. The pipe line under pressure is then inspected while tile funnel is still in position. There shall not be any leaks in the pipe or the joints (small sweating on tile pipe surface is permitted), any sewer or part there of that

does not meet the test shall be emptied and repaired or re-laid as required and tested again. The leakage or quantity of water to be supplied to maintain the test pressure during the period of 10 minutes shall not exceed 0.2 litres/mm dia, of pipes per kilometre length per day. Water and other accessories required for testing shall be to the account of the contractor. In case of DI pumping/rising mains the hydro testing of the pipes shall be carried out as per IS 8329 provisions.

B. Testing of Manholes

The entire height of the manhole shall be tested for water tightness by closing both the incoming and outgoing ends of the sewer and filling the manhole with water. A drop in water level not more than 50 mm per 24 hours shall be permitted. In case of high sub-soil water, it should be ensured that there is no leakage of ground water into the manhole by observing the manhole for 24 hours after emptying it.

Water and other accessories required for testing shall be arranged by the contractor at his own cost.

C. Air Testing of Sewer

The air test is to be conducted for sewers before back filling. It should not be used for testing after back filling or if the trench is water logged as under those conditions it is possible for a faulty line to be satisfactory.

The requirements of the codes of practice for the air test are that the length of pipe under test should be effectively plugged and air pumped in by suitable means until a pressure of 100 mm of water is indicated in a glass U-tube connected to the system. The air pressure should then not fall to less than 75 mm I during a period of 5 minutes without further pumping, after allowing a suitable time for stabilization of the air temperature. In case the drop is more than 25 mm the leaking joints shall be traced and suitably treated to ensure water tightness. The exact point of leakage can be detected by applying soap solution to all the joints in the line and looking for air bubbles.

2.17.6 HDPE PIPES AND SPECAILS & FITTING

APPLICABLE CODES AND STANDARDS

The manufacturing, testing, supplying, jointing and testing at work site of HDPE pipes and fittings shall comply with all currently applicable statutes, regulations, standards and codes. In particular, the following standards unless otherwise specified herein, shall be referred. In all cases, the latest revision of the codes shall be referred to. If requirements of this specification conflict with the requirements of the codes and standards, this specification shall govern.

Code No.	Title / Specification
IS: 14333	High Density Polyethylene pipes (HDPE) for Sewerage
IS: 7634 Part II	Code of practice for Laying and Jointing of Polyethylene pipes (PE) pipes
IS: 2530	Method of test for polyethylene moulding materials and polyethylene compounds
IS: 7328	High Density Polyethylene material

	for moulding and extrusion
IS: 4905	Method for random sampling

Other codes as approved by Employers Representative but not specifically mentioned here pertaining to the use of HDPE Pipes form part of these specifications.

2.17.6.1 GENERAL

DESIGN

Design of HDPE pipes including material details and the maximum allowable hydrostatic design stress taking into consideration, the temperature and design life of pipes shall be in accordance with the relevant clauses of IS:14333

GRADE OF MATERIAL

The High Density Polyethylene Pipes (HDPE) are proposed to be used for proposed sewerage works in accordance with the Bill of Quantities. Maximum effective length of individual pipes shall be governed by the IS code. The HDPE shall be in the range of 225mm to 355 mm nominal diameter of pressure rating of PN6 on material grade of PE 100 for sewerage applications. Material Grade, Minimum Required Strength and Maximum Allowable Hydrostatic Design Stress shall conform to the relevant clause of IS – 14333.

DESIGNATION

Pipes shall be designated as per IS: 14333 according to the grade of material, followed by pressure rating and nominal diameter, for example, PE 100 PN 6 DN 315 indicates a pipe pertaining to material grade 100 having a pressure rating 0.6 MPa and outside nominal diameter 315mm.

DIAMETER RANGE

- a) Upto 355mm nominal dia: PE 100-PN6 class

2.17.6.2 MANUFACTURING

(i) GENERAL

- a) The method of manufacture of HDPE pipes shall be such that the internal and external surfaces of the pipes shall be smooth, clean and free from grooving and other defects. The ends shall be cleanly cut and shall be square with axis of the pipes.
- b) The Employers Representative shall at all reasonable times have free access to the place where the pipes and fittings are manufactured for the purpose of examining and testing the pipes and fittings and of witnessing the test and manufacturing.
- c) Pipes and fittings shall be manufactured using Virgin material as per relevant IS codes. A sample from the resin used for manufacturing pipes and fittings shall be kept aside in required quantity along with clear description of Batch No. and date of Pipe manufacture
- d) All pipes and fittings shall be tested for physical, chemical, mechanical characteristics/ properties, dimensions and tolerances of pipes and specials as per the IS applicable. All pipes and specials shall be supplied with manufacturer's test certificates and shall bear the relevant IS mark and, as per approved QAP and relevant IS code. Also, on the pipes

and fittings batch no. of manufacture, Project Name (i.e. UUSDIP), town name (Dehradun) and purpose (Sewerage) shall be marked

- e) All tests specified either in this specification or in the relevant Indian standards shall be performed by the supplier/contractor at his own cost and in presence of the Employers Representative if he so desires. For this, sufficient notice before testing of the pipes and fittings shall be given to the Employers Representative.
- f) If the test is found unsatisfactory, the Employers Representative may reject any or all pipes of that lot.
- g) The length of the HDPE sewer pipeline shall be measured between the inner surfaces of consecutive manholes at the invert level of the pipes along the Centre line of pipeline to the nearest centimeter.

(ii) MATERIALS

The material used for the manufacturer of pipes should not constitute toxicity hazard, should not support microbial growth, should not give rise to unpleasant taste or odour, cloudiness or discoloration of water. Pipe manufacturers shall obtain a certificate to this effect from the manufacturers of raw material by any reputed organization as per the satisfaction of the Employers Representative.

Raw Material

- a) Raw material used to manufacture the HDPE pipes shall be 100% virgin PE compound or Natural black PE resin confirming to IS: 14333(latest version), IS: 7328 and ISO: 4427 for this a certification has to be given by the resin manufacturer as per IS: 14333 (latest version). The resin proposed to be used for manufacturing of the pipes should also comply with the following norms as per ISO: 9080.
- b) The resin should have been certified by an independent laboratory of international repute for having passed 10,000 hour long term hydrostatic strength (LTHS) test extrapolated to 50 years to show that the resin has a minimum MRS of over 10MPa. Internal certificate of any resin manufacturer will not be acceptable. The minimum required strength of material should not be lower than 6.30 MPa at 20 deg. Centigrade at 50 years.
- c) Certificate for having passed the full scale rapid crack propagation test as per ISO 13478. High density Polyethylene (HDPE) used for the manufacture of pipes shall conform to designation PEEWA-45-T-006 of IS: 7328. HDPE conforming to designation PEEWA-45- T-012 of IS: 7328 may also be used with the exception that melt flow rate (MFR) shall not exceed 1.10 g/10 min. In addition the material shall also conform to clause 5.6.2 of IS 7328.
- d) The specified base density shall be between 941.0kg/m³ and 946.0kg/m³ (both inclusive) when determined at 27°C according to procedure prescribed in IS: 7328 The value of the density shall also not differ from the nominal value by more than 3kg/m³ as per 5.2.1.1 of IS: 7328. The MFR of the material shall be between 0.41 and 1.10 (both inclusive) when tested at 190°C with nominal load of 5 kgf as determined by method prescribed in IS: 2530. The MFR of the material shall also be within $\pm 20\%$ of the value declared by the manufacturer.
- e) The resin shall be compounded with carbon black. The carbon black content in the material shall be within $2.5 \pm 0.5\%$ and the dispersion of carbon black shall be satisfactory when tested as per IS: 2530.

Anti-Oxidant

The percentage of anti-oxidant used shall not be more than 0.3% by mass of finished resin. The anti-oxidant used shall be physiologically harmless and shall be selected from the list given in IS: 10141.

Maximum Ovality of Pipes

The outside diameter of pipes, tolerance on the same and ovality of pipe shall be as given in IS 14333. Ovality shall be measured as the difference between maximum outside diameter and minimum outside diameter measured at the same cross section of the pipe, at 300 mm away from the cut end.

(iii) DIMENSIONS AND TOLERANCES

The outside diameters of pipes, tolerance on the same and ovality of pipes shall be as given in relevant clause of I.S. 14333(latest version). No negative tolerances are allowed.

b) The minimum & maximum wall thickness of pipe for the given grade of material, namely PE 80/100 and PN6 / PN 8class shall be as given in IS: 14333.

c) The length of straight pipe used shall be 6 m or as agreed by Employers Representative.

2.17.6.3 TESTING

The specimen of pipes for the following tests shall be selected in accordance with relevant clause of IS: 2530 and tests in accordance with the methods described in relevant clause of IS: 14333. Following tests shall be taken in consideration:

- I. Hydrostatic Test
- II. Reversion Test
- III. Density Test
- IV. Melt Flow Test
- V. Carbon Black Content and Dispersion

SAMPLING AND INSPECTION

a) Three samples of the same size and same pressure rating selected at random shall be tested for compliance with the requirements of the type test for Internal Pressure Creep Rupture Test.

b) In case, any of the samples fails in the type test, the testing authority, at its discretion, may call for fresh samples not exceeding the original number and subject them to type test again. In case of the sample fails in the repeat tests, the type of pipe shall not be approved.

c) Acceptance tests are carried out on samples selected from a lot for the purpose of acceptance of the lot.

d) A lot having satisfied dimensional and visual requirements shall be tested for hydraulic characteristics, reversion, density, MFR and Carbon Black content / dispersion requirements. The lot shall be considered to have met the requirements of these tests, if none of the samples tested fails.

2.17.6.4 WORKMANSHIP AND FINISH

Pipes shall be free from all defect including indentations, delaminating, bubbles, pinholes, cracks, pits, blisters, foreign inclusions that due to their nature degree or extent detrimentally affect the strength and serviceability of the pipe. The pipe shall be as uniform as commercially practicable in colour opacity, density and other physical properties as per relevant IS Code or equivalent International Code. The inside surface of each pipe shall be free of scouring, cavities, bulges, dents, ridges and other defects that result in a variation of inside diameter from that obtained on adjacent unaffected portions of the surface. The pipe ends shall be cut clearly and square to the axis of the pipe.

2.17.6.5 CARTING & HANDLING

During handling, transportation, storage and lowering of pipes & fittings, all sections shall be handled by such means and in such a manner that no distortion or damage is done to the section or to the pipes as a whole. Also, unless waived by the Employers Representative, method statements shall be submitted by the Contractor for the approval of the Employers Representative before the handling, transportation and laying of any pipes commences. All pipes shall be handled and stored in compliance with the manufacturer's recommendations. Pipes and fittings /specials shall be transported from the factory to the central pipe store and unloaded there before being transported to Site. At every point of loading or unloading, all pipes and fittings shall be lifted using approved lifting tackle. Unloading by rolling down any form of inclined ramp will not be permitted. Pliable straps or slings shall be used to lift pipes. Rope, wire rope, hooks or chains shall not be allowed to come into contact with any pipe surface. All pipes shall be thoroughly inspected on arrival on site and immediately prior to installation. Any damage to the pipes shall be notified to the Employers Representative for a decision as to the acceptability of the pipes, with or without repairs or remedial work. The final judgement will be taken by the Employers Representative based on his judgement of the suitability of the items for the purpose intended.

The following procedures should be followed so as to eliminate potential damage to pipes & fittings and to maintain maximum safety during unloading, lifting and lowering of pipes:

- a) Pipes must not be stored or transported where they are exposed to heat sources likely to exceed 60°C.
- b) Pipes shall be stored such that they are not in contact with direct sunlight, lubricating or hydraulic oils, petrol, solvents and other aggressive materials.
- c) Scores or scratches to a depth of greater than 10% or more of wall thickness are not permissible; any pipes having such defects should be strictly rejected.
- d) PE pipes should not be subjected to rough handling during loading and unloading operations. Rollers shall be used to move, drag the pipes across any surface.
- e) Only polyester webbing slings should be used to lift heavy PE (>315mm) pipes by crane. Under no circumstances, chains, wire ropes and hooks be used on PE pipes.
- f) Pipes shall not be dropped to avoid impact or bump. If any time during handling or during installation, any damage, such as gouge, crack or fracture occurs, the pipe shall be repaired if so permitted by the competent authority before installation.
- g) Straight lengths should be stored on horizontal racks giving continuous support to prevent the pipe taking on a permanent set.

Pipes manufactured at factory are to be carried to the site of work directly or stacked suitably and neatly along the alignment/road side/elsewhere near by the work site or as directed by the Employers Representative.

- i) Damages during transit, handling, storage will be to the Contractor's account and replacement for such pipes has to be made by the Contractor without any extra cost as directed by the Employers Representative.

2.17.6.6 STORAGE

- a) Black polyethylene pipes may be stored either under cover or in the open. It is suitably protected from ageing due to sunlight by the addition of the appropriate quantity and type of carbon black. .
- b) Straight lengths should be stored on horizontal racks giving continuous support to prevent the pipe taking on a permanent set.

- c) Storage of pipes in heated areas exceeding 27⁰ C should be avoided.

2.17.6.7 MARKING

Each straight length of pipe shall be clearly marked in indelible ink / paint on either end with the following information:

- a) Manufacturer's Name / Trade Name
- b) Designation and nominal diameter of Pipe
- c) Lot Number / Batch Number

2.17.6.8 LAYING AND JOINTING

LAYING

For lowering and laying of pipes, the following points shall be considered:

- a) Each pipe shall be thoroughly checked for any damages before laying and only the pipes which are approved by the Employers Representative shall be laid.
- b) While installing the pipes in trenches, the bed of the trench should be level and free from sharp edged stones. The bedding for HDPE pipes shall be provided as per relevant drawing and as directed by Employers Representative. While laying in rocky areas suitable bed of sand or gravel should be provided. The fill to 15 cm above the pipe should be fine sand or screened excavated material. Where hard rock is met with, 15cm thick sand bed as approved by the Employers Representative shall be provided c) As PE pipes are flexible, long lengths of fusion-jointed pipes having joints made above ground can be rolled or snaked into narrow trenches. Such trenches can be excavated by narrow buckets.
- d) During the pipe laying of continuous fusion jointed systems, due care and allowance should be made for the movements likely to occur due to the thermal expansion/contraction of the material. This effect is most pronounced at end connections to fixed positions (such as valves etc) and at branch connections. Care should be taken in fixing by finishing the connections at a time the length of the pipe is minimal (lower temperature times of the day.)
- e) For summer time installations with two fixed connection points, a slightly longer length of PE pipe may be required to compensate for contraction of the pipe in the cooler trench bottom.
- f) The final tie-in connections should be deferred until the thermal stability of the pipeline is achieved.
- g) The flexibility of polyethylene pipes allows the pipe to be cold bend. The fusion jointed PE pipe is also flexible as the plain Pipe. Thus the total system enables directional changes within the trench without recourse to the provision of special bends or anchor blocks. However, the pipe should not be cold bend to a radius less than 25 times the OD of the pipe.
- h) The Installation of flanged fittings such as connections to sluice / air / gate valves on pumping main requires the use of stub ends (flange adaptors complete with backing rings and gaskets. Care should be taken when tightening these flanges to provide even and balance torque.
- i) Provision should be made at all heavy fittings installation points for supports (such as anchoring of the flange in the soil) for the flange joint to avoid the transfer of valve wheel turning torque on to the PE flange joint.
- j) PE pipe is lighter than water. Hence care should be taken for normal installations where there could be a possibility of flooding of the trench thus the trench shall be kept free of water till the jointing has been properly done
- k) When flooded, some soils may lose cohesiveness, which may allow the PE pipe to float out of the ground. Several design checks are necessary to see if groundwater flotation may be a

concern. Obviously, if the pipeline typically runs full or nearly full of liquid, or if groundwater is always below the pipe, flotation may not be a significant concern.

l) However, weights by way of concrete blocks (anchors) are to be provided so that the PE pipe does not float when suddenly the trench is flooded and the soil surrounding the pipe is washed away. Thus site conditions study is necessary to ensure the avoidance of flotation.

m) Pipe embedment backfill shall be stone-free excavated material placed and compacted to the 95% maximum dry density.

JOINTING

The pipe shall have a jointing system that shall provide for fluid tightness for the intended service conditions. Appropriate jointing for HDPE pipe as per IS: 7634 (Part II) shall be selected considering site and working condition, pressure and flow of liquid. Jointing between the pipes shall be with Electro fusion jointing using superior quality automatic Electro fusion jointing machines which will ensure good quality Electro fusion jointing of HDPE pipes.

Welding Procedure

Jointing between HDPE pipes and specials shall be done as per the latest IS: 7634 part II. Method of jointing between the pipes to pipes and pipes to specials shall be with butt fusion welding using automatic or semi-automatic, hydraulically operated, superior quality butt fusion machines which will ensure good quality butt fusion welding of HDPE pipes.

Fusion Welding

Fusion welding is commonly used in HDPE and is a permanent type of joint. The pipe should be cut square and the face of the pipe should be slightly scraped prior to welding to remove oxidised layer. At the time of welding, levelling of the pipes is essential particularly in case of larger diameter pipes. Welding temperature should be 200 Deg. Centigrade and surface of heating mirror should be 210 +/- 5 deg. Centigrade (heating mirror is a metallic plate heated up to the required temperature either by electrical coil embedded inside or by blow torch). The welding of the pipe should be held in either side of the heating mirror with only contact pressure of about 0.2 kg/cm². When the rim of molten material is found, the pipes are removed from the heating mirror and immediately the joint is made by application of moderate pressure of approximately 1 to 2 Kg/cm² for 2 to 3 seconds. The initial heating time for achieving molten rim, varies from 1 to 5 minutes depending upon the pipe wall thickness and size.

Following precautions shall be taken while fusion welding

- a) It is essential to see that the rim formed is not excessive.
- b) While jointing, the pressure should be maintained until the joint is lukewarm and after the pressure is relieved, the joint allowed to cool completely.
- c) The mirror should be kept exactly around 210 deg. Centigrade which needs about 30 min. time (for electrical mirror). It is also essential to see that the temperature is maintained constant by the proper setting of regulator. For detecting the correct temperature, crayon chalk is used. For example at 210 deg. Centigrade the colour of crayon dot on the mirror changes within 2 seconds. But the dot made should be thin and if not, time taken will be more, indicating a wrong temperature.

A satisfactory butt welded joint of HDPE will have the strength factor of one. Temperature is of primary importance and weld efficiency may decrease if the temperature is more or less than 210°C.

Flanged Joints

These are used for jointing HDPE pipes to valves and metal pipes where strength in tension is required for pumping main. It consists of flanges either loose or welded to the pipe ends. It is recommended that suitable metallic backing plates be used to support the polyethylene flanges to enable them to be bolted together. Injection moulded polyethylene flanges with metal inserts of 6 to 9 mm thickness may also be used. In most cases, sealing is improved by incorporating a natural or synthetic rubber gasket between polyethylene flanges

Cleaning of Pipes

As soon as a stretch of HDPE pipes has been laid complete from manhole to manhole or for a stretch as directed by Employers Representative, Contractor shall remove soil, debris etc and clean the entire stretch to the satisfaction of Employers Representative. The open end of an incomplete stretch of pipe line shall be securely closed as may be directed by Employers Representative to prevent entry of mud or slit etc.

If as a result of the removal of any obstruction, Employers Representative considers that damages may have been caused to the pipe lines, he shall be entitled to order the stretch to be tested immediately. Should such test prove unsatisfactory Contractor shall amend the work and carry out such further tests as are required by Employers Representative.

It shall also be ascertained by Contractor that each stretch from manhole to manhole or the stretch as directed by Employers Representative is absolutely clear and without any obstruction by means of visual examination of the interior of the pipeline suitably enlightened by projected sunlight or otherwise

2.17.6.9 FITTINGS AND SPECIALS

All HDPE fittings/ specials shall be fabricated in accordance with IS: 8360 (Part I & III). PE Injection moulded fittings shall be as per IS: 8008 (Part I to IX). All fittings/specials shall be fabricated or injection moulded at factory only. No fabrication or moulding will be allowed at site, unless specifically permitted by the Employers Representative. Fittings will be butt welded on to the pipes or other fittings by use of heat fusion.

BENDS

HDPE bends shall be plain square ended conforming to IS: 8360 Part I & III Specifications. Bends may be fabricated by jointing several small sections of pipes to reach the required angle.

TEES

HDPE Tees shall be plain square ended conforming to IS: 8360 Part I & II Specifications. Tees may be equal tees or reduced take off tees. Tees may be moulded or fabricated from pipes elements.

2.17.6.10 SITE TESTING

After laying and jointing of HDPE pipes is completed, the pipe line shall be tested. All equipment, material, and labour for testing shall be supplied by the Contractor. Damage during testing shall be contractor's responsibility and shall be rectified by him to the full satisfaction of the Employers Representative. Water for testing of pipeline shall be arranged by the Contractor at his own cost.

After the joints have been checked by the Employers Representative and before backfilling of the trenches, the entire section of the sewer shall be proved by the contractor to be watertight by filling in pipes with water at a constant head of 2.5m above the top of ground level for the highest pipe in the stretch and heading the water up for the period of one hour. The testing apparatus used for the purpose shall normally be fixed on the upstream end and should be

got approved by Employers Representative. Contractor if required by Employers Representative shall dewater the excavated pit and keep it dry during the period of testing. Water used for the test shall be removed from pipes and not discharged to the excavated trenches. Any leakage which causes a drop in the test water level will be visible and the defective part of the work should be removed and made good at his own cost.

The Contractor shall carry out final testing and commissioning of all pipelines to the satisfaction of the Employers Representative.

2.17.7 MDPE PIPES AND SPECIALS & FITTING

APPLICABLE CODES AND STANDARDS

The manufacturing, testing, supplying, jointing and testing at work site of MDPE pipes and fittings shall comply with all currently applicable statutes, regulations, standards and codes. In particular, the following standards unless otherwise specified herein, shall be referred. In all cases, the latest revision of the codes shall be referred to. If requirements of this specification conflict with the requirements of the codes and standards, this specification shall govern.

Code No.	Title / Specification
WIS – 4-32-08	Specification for the fusion jointing of polyethylene pressure pipeline systems using PE80 and PE100 materials.
WIS – 4-32-14	Specification for PE 80 and PE 100 Electrofusion fittings for nominal sizes upto and including 630.
WIS – 4-32-15	Specification for PE80 and PE 100 Spigot Fittings and drawn bends for nominal sizes up to & including 1000.
WIS – 4-32-17	Specification for Polyethylene Pressure Pipes for pressurised water supply and sewerage duties.
ISO-6259-1	Thermoplastics pipes – Determination of tensile properties – Part 1
	General test method
ISO-6259-3	Thermoplastics pipes – Determination of tensile properties – Part 3
	Polyethylene pipes
ISO-4427	Polyethylene (PE) pipes for water supply - specifications
ISO/TR-9080	Thermoplastics pipes for the transport of fluids – Methods of extrapolation of hydrostatic stress rupture data to determine the long-term hydrostatic strength of thermoplastics pipe materials.
ISO-12162	Thermoplastic materials for pipes and fittings for pressure applications – Classification and designation – overall service (design) co-efficient.
ISO-1133	Plastics – determination of the melt flow rate (MFR) and the melt volume flow rate (MVR) of thermoplastics
ISO-1183	Plastics - methods for determining the density of non-cellular plastics – Part 3: Gas Pyknometer method.
ISO-161-1	Thermoplastics pipes for the conveyance of fluids – Nominal outside diameters and nominal pressures.
ISO-4065	Thermoplastics pipes – universal wall thickness table
ISO-11922-1	Thermoplastics pipes for the conveyance of fluids – dimensions & tolerances.
ISO-1167	Thermoplastic pipes for the conveyance of fluids – resistance to internal pressure – test method
ISO-2505-2	Thermoplastic pipes – longitudinal revision – part 2 – determination parameters.
ISO-14236	Compression fittings

Other codes as approved by Employers Representative but not specifically mentioned here pertaining to the use of HDPE Pipes form part of these specifications.

Specification for Polyethylene (PE) Pipes

Polyethylene (PE) Pipes and Fittings

Polyethylene (PE) pipes and fittings for water supply supplied under this specification shall conform to the requirements of the UK Water Industry Specifications WIS 4-32-17: Polythene Pressure Pipes for Pressurised Water Supply and Sewerage Duties, WIS 4-32-14: Specification for PE80 and PE100 Electrofusion Fittings for Nominal Sizes up to and including 630mm and WIS 4-32-15: Specification for PE80 and PE100 Spigot Fittings and Drawn Bends for Nominal Sizes up to and including 1000mm, and in particular ISO 4427, and BS 6572 for pipes up to nominal size 63mm.

Reference to British Standard, Water Industry Standard or International Standard or any other specification applies equally to any equivalent specification.

In all cases, the latest revision of the standards including all applicable official amendments and revisions shall be referred to. In case of discrepancy between this specification and those referred to herein, this specification shall govern.

Material

PE pipe shall be made from a base polymer of polyethylene, or a co-polymer of ethylene and higher olefins in which the higher olefin constituent does not exceed 10% by mass, with a density in the range 930 to 944 kg/m³ in accordance with ISO 4427. The pipe material shall contain anti-oxidants, UV stabilizers and pigments as necessary. Compliance certificates shall be provided for Melt Flow Rate, density, oxidation and induction test, hydrostatic test, pigment dispersion test, and longitudinal reversion test.

PE80 shall have a MRS of 8 Mpa at 50 years at 20°C, RCP resistance, and 1000 hours or more long-term crack resistance, determined using the ISO TR 9080 method of analysis. PE80 pipe shall be used for house service connections up to 50mm diameter in size.

PE100 shall have a MRS of 10 Mpa at 50 years at 20°C, full RCP resistance, and 1000 hours or more long-term crack resistance, determined using the ISO TR 9080 method of analysis.

Blue Pipes and Stripes

The colour for PE pipe shall be light blue for PE80 within the range 18E51 to 18E53 conforming to clause 4.1 of ISO 4427 and dark blue for PE100 within the range 20D44 to 20D45 or 20E53 to 20E56 of ISO 4427.

Thermal Stability

When determined in accordance with ISO/TR 10837, the induction time for materials PE80 and PE100 shall be either at least 20 min when tested at 200°C, or an equivalent period when tested at 210°C, provided the equivalence is supported by a clear correlation between results obtained at 200°C or 210°C, respectively. In case of disputer, the test temperature shall be 200°C.

Reworked Material

The reworked material generated from a manufacture's own production of pipe in accordance with this specification may be used if it is derived from the same resin used for the relevant production.

Effects on Water Quality of Pipes for the Conveyance of Water for Human Consumption

When used under conditions for which they are designed, materials in contact with or likely to come in contact with drinking water shall not constitute a toxic hazard, shall not support microbial growth and shall not give rise to unpleasant taste or odour, cloudiness or discoloration of the water.

PE pipes shall conform to clause 3.5 of ISO 4427 for the conveyance of water for human consumption, and certificates demonstrating compliance with the following parameters shall be provided: odour and flavour of water, appearance of water, growth of micro-organisms, extraction of substances that may be injurious to public health (cyto toxicity), and extraction of metals.

The concentrations of substances, chemicals and biological agents leached from materials in contact with drinking water, and measurement of the relevant organoleptic physical parameters shall not exceed the maximum recommended by the World Health Organisation in its publication "Guidelines for drinking water quality volume 1 recommendations" or as required by the ECE council directive of 15 July 1980 on the water quality intended for human consumption, whichever is the more stringent in each case.

Designation and Classification

The compound shall be designated by the material type (e.g. PE 80) conforming to applicable level of minimum required strength (MRS) specified in **Table 1**, when the lower confidence limit for the compound is determined in accordance with ISO/TR 9080 and this confidence limit is classified in accordance with ISO 12162 to obtain the MRS.

The validity of the designation shall be certified by the compound manufacturer or, in the case of master-batch by the pipe manufacturer.

The design stress σ_s of a pipe shall be obtained by applying a design coefficient of not less than 1.25 to the M value for the material.

Table 1: Designation of Material

Designation of material	MRS at 50 years and 20°C	Maximum allowable hydrostatic stress σ_s
	Mpa	Mpa
PE100	10	8
PE80	8	6.3

The relationship between MRS and σ_s for various design coefficients is given in **Table 2**.

Table 2: Relationship between MRS, σ_s and Design Coefficient C at 20°C

Hydrostatic design stress of pipe, σ_s	Minimum required strength of material				
	10	8	6.3	4	3.2
Mpa	Design coefficient, C				
8	1.25	-	-	-	-
6.3	1.6	1.25	-	-	-

Melt Flow Rate and Density

The pipe manufacture shall provide evidence of the density and the melt flow rate of the raw compound.

When measured in accordance with ISO 1133, the melt flow rate shall conform to the following conditions.

The melt flow of the compound shall not deviate by more than $\pm 20\%$ from the value specified by the manufacture.

The change in MFR caused by processing i.e. the difference between the measured value for material for the pipe and the measured value for the compound, shall not be more than 25%.

The density of the final coloured compound shall be determined in accordance with ISO 1183 Part for both blue and black compounds.

Pressure Classes and Sizes

PE pipes and fittings shall be supplied as SDR11 in two size ranges:

- 20mm to 63mm: shall be PN12.5 bar PE80 (or PN12 for pipes meeting the requirements of BS 6572)
- 75mm to 315mm: shall be PN16 bar PE100

PE80 pipe is referred to as Modified high Density Polyethylene (MDPE) and PE100 pipe is referred to as Higher Performance Polyethylene (HPPE).

PE pipes shall be derated to take account of temperatures above 20°C in accordance with ISO 4427.

Pipes shall conform to the outside diameter and wall thickness in accordance with ISO 161.1 (diameter), ISO – 4065 (Universal Wall thickness) and ISO-11922-1 (tolerances) for the nominal sign for different SDR values as given in **Tables 3 and 4** below:

Table 3: Pressure Rating for Different Materials

SDR	PE80	PE 100
11	PN 12.5	PN 16
17	PN 8	PN 10
26	PN 5	PN 6

Table 4: Pipe Dimensions

Min	Max	Max	Wall Thicknesses for pipe series					
OD	OD	Ovality	SDR 11		SDR 17		SDR 26	
(mm)	(mm)	(mm)	min	max	min	max	min	max
20	20.3	1.2	2.3	2.8	-	-	-	-
25	25.3	1.2	2.3	2.8	-	-	-	-
32	32.3	1.3	3.0	3.4	-	-	-	-
40	40.4	1.4	3.7	4.2	-	-	-	-
50	50.4	1.4	4.6	5.2	-	-	-	-
63	63.4	1.5	5.8	6.5	-	-	-	-
75	75.5	1.6	6.8	7.6	-	-	-	-
90	90.6	1.8	8.2	9.2	5.4	6.1	-	-
110	110.6	2.2	10.0	11.1	6.6	7.4	4.2	4.8
125	125.6	2.5	11.4	12.7	7.4	8.3	4.8	5.4
140	140.9	2.8	12.7	14.1	8.3	9.3	5.4	6.1
160	161.0	3.2	14.6	16.2	9.5	10.6	6.2	7.0
180	181.1	3.6	16.4	18.2	10.7	11.9	6.9	7.7
200	201.2	4.0	18.2	20.2	11.9	13.2	7.7	8.6
225	226.4	4.5	20.5	22.7	13.4	14.9	8.6	9.6
250	251.5	5.0	22.7	25.1	14.8	16.4	9.6	10.7
280	281.7	9.8	25.4	28.1	16.6	18.4	10.7	11.9
315	316.9	11.1	28.6	31.6	18.7	20.7	12.1	13.5
355	357.2	12.5	32.2	35.6	21.1	23.4	13.6	15.1
400	402.4	14.0	36.3	40.1	23.7	26.2	15.3	17.0
450	452.7	15.6	40.9	45.1	26.7	29.5	17.2	19.1
500	503.0	17.5	45.4	50.1	29.7	32.8	19.1	21.2

Min	Max	Max	Wall Thicknesses for pipe series					
OD	OD	Ovality	SDR 11		SDR 17		SDR 26	
(mm)	(mm)	(mm)	min	max	min	max	min	max
560	563.4	19.6	50.8	56.0	33.2	36.7	21.4	23.7
630	633.8	22.1	57.2	63.1	37.4	41.3	24.1	26.7
710	714.0	24.9	-	-	42.1	46.5	27.2	30.1
800	805.0	28.0	-	-	47.4	52.3	30.6	33.8
900	905.0	31.5	-	-	53.3	58.8	34.4	28.3
1000	1005.0	35.0	-	-	59.3	65.4	38.2	42.2
1200	1206.0	42.0	-	-	-	-	45.9	50.6
1400	1406.0	49.0	-	-	-	-	53.5	59
1600	1606.0	56.0	-	-	-	-	61.2	67.5

Ovality

The ovality of pipes up to nominal size 250mm shall not exceed 0.02. The ovality of pipes greater than 250mm shall not exceed 0.035. Ovality is defined as: (maximum individual pipe diameter minus the minimum individual pipe diameter) divided by the mean pipe diameter.

Length of Pipe

Standard pipe lengths shall be 6m, 12m and 18m. PE pipe in the size range 20mm to 180mm may be supplied as coils or on drums. Coils shall be supplied in 25m, 50m, 100m or 150m lengths dependent on diameter.

Hydrostatic Strength

When tested in accordance with ISO 1167, the pipes shall conform to the requirements given in **Table 5** below.

Table 5: Hydrostatic Strength of Pipes

Pipe material	Test stress		
	100 h at 20° C	165 at 80° C	1000 h at 80° C
PE 100	12.4	5.5	5.0
PE 80	9.0	4.6	4.0
PE 63	8.0	3.5	3.2

Retest in Cases of Failure at 80° C

A brittle fracture in less than 165 h shall constitute a failure.

If, in the 165 h test, a test piece fails in a ductile mode in less than 165 h a retest shall be performed at a lower stress. The new test stress, and the new minimum failure time shall be selected from the stress/time points given in **Table 6**.

Table 6: Hydrostatic Strength at 80° C – Retest Requirements

PE 63		PE 80	
Stress	Minimum Failure time	Stress	Minimum Failure time
Mpa	H	Mpa	h
3.5	165	4.6	165
3.4	285	4.5	219
3.3	538	4.4	283
3.2	1000	4.3	394
		4.2	533
		4.1	727
		4.0	1000

Physical Characteristics

Thermal stability of pipes manufactured from PE 80 and PE 100

When determined in accordance with ISO/TR 10837, the induction time for test specimens taken from pipes manufactured from PE 80 and PE 100 shall be either at least 20 min when tested at 200° C or an equivalent period when tested at 210° C, provided the equivalent is supported by a clear correlation between results obtained at 200° C & 210° C respectively. The test specimens shall be taken from the inside surface of the pipe.

Pressure Reduction Factor for PE Pipeline Systems for Temperatures above 20 ° C

Table 7 shall be used for the derivation of reduction factors to apply to operating pressure for elevated temperature operation of PE pipes and fittings. Since these are related to the supply of water and other fluids which do not adversely affect the long-term properties of the PE materials at temperatures up to 40° C. In order to determine the category in which a material lies (i. e. type A, type B and type C).

Table 7: Pressure Reduction Factors at Temperatures up to 40° C, Applicable to a 50 Year Lifetime

Material	Pressure reduction factors at				
	20° C	25° C	30° C	35° C	40° C
Type A	1	0.93	0.87	0.80	0.74
Type B	1	0.90	0.81	0.72	0.62
Type C	1	.82	0.65	0.47	0.30

Longitudinal Reversion

When determined in accordance with ISO 2505-1, method A or B, using one of the following temperatures, for test purposes:

110° C + 2° C for PE 63, PE 80 and PE 100

or

110° C + 2° C for PE 32 and PE 40

and the test times given in ISO 2505 – 2, the value of the longitudinal reversion shall be not greater than 3%.

For pipes with an outside diameter greater than 200 mm, longitudinally cut segments may be used.

Weathering of Non–Black Pipes

To determine to an effect of weathering, pipes shall be exposed to outdoor conditions in accordance with the procedure.

After exposure to a total solar energy of at least 3.5 GJ/m², the pipe shall conform to the following requirements:

- The hydrostatic strength, when determined in accordance with 5.1 at 80° C for at least 165 h, shall be the minimum required
- The elongation at break, when determined in accordance with ISO 6259 – 1 and ISO 6259 – 3, shall not be less than 350%
- The induction time, when measured in accordance with ISO/TR 10837 using a test specimen taken from the outside surface of the pipe shall be at least 10mm at 200°C.

Fusion Compatibility

Pipes manufactured from PE 80 or PE 100 are to be joined by butt fusion or using electro fusion fittings mixing different pipe materials, the joints shall conform to the requirements specification in table 6 (80°C/165h).

Compounds designated PE 63, PE 80 or PE 100 having an MFR (190 °C/5 KG) within the range 0.2g/10 min to 0.3 g/10 min shall be considered compatible for fusion to each other.

Jooints

The UK Water Industry Specification WIS 4-32-08 on site fusion jointing of PE80 and PE100 pipes in size range 63mm and above shall be followed. The manufacturer's recommendation with respect to fusion weld joints shall be followed carefully. The bead that forms around the fusion weld joint shall be kept as small as is consistent with good jointing practice. If, in the opinion of the Engineer, excessively large beads are formed the joint shall be rejected.

Electrofusion joints incorporating an embedded electrical heating element may only be used if directed by the Engineer. Where so allowed, the electrofusion fittings shall comply with WIS 4-32-14.

PE pipes in size range less than 63mm shall be jointed with compression fittings complying with BS 864 Part 5. All fittings shall be Type 1 end load restraining and have internal pipe support. All materials in contact with, or likely to come into contact with, water for public supply shall comply in all aspects with the requirements for potable water quality. Compliance with national or international standards shall be demonstrated by production of appropriate third party certification.

Marking

All pipes shall be indelibly marked at maximum intervals of 1 m.

The word "Water" shall also be included as the pipe is intended for drinking water

The marking of pipe shall remain legible under normal handling, storage and installation procedures and shall show the following:

- ☐ The manufacturer's identification, the polymer classification (PE80 or PE100) together with a code identifying the basic raw material source
- ☐ The nominal size and SDR
- ☐ Continuous pressure rating at 20°C (either PN"x" or "x" bar is acceptable)
- ☐ Along one strip only – the manufacturing codes to identify the production line, date and production shift
- ☐ The word "WATER" shall appear 3 times per metre
- ☐ All coils of pipe greater than 63mm diameter shall have the lead and trailing ends clearly marked with the words "START" and "END", indicating which bands are to be cut first.

All pipes shall be marked at intervals not greater than 1m along two strips on opposite sides of the pipe for diameters greater than 90mm. For diameters 90mm and smaller marking along one strip only shall be sufficient. The marking shall be black in colour. The height of the characters shall be greater than 3mm for pipe sizes less than 125mm and greater than 5mm for sizes 125mm and above.

PE Pipe Supplied as Coils or on Drums

For pipe sizes less than 63mm, coils shall be supplied using shrink-fit, tough plastic film to hold the coil in place. For sizes 63mm and above, all coils shall be securely banded with tough tape that cannot be removed except by cutting.

The following requirements apply to all PE pipes in the size range 90 to 180 supplied as coils or on drums.

The following definitions apply:

- ☐ Coiled pipe: pipe extruded in a multi-layer coiled configuration with the layers strapped together to provide a stable unit without a supporting centre core
- ☐ Drummed pipe: pipe extruded onto a rigid framed reel with a supporting centre core to which the pipe is anchored, with the pipe dispensed from a trailer or low loader

The maximum external diameter and width of any coil shall be 4m and 1m respectively. Coiled pipe shall be constrained in a stable configuration by strapping. The strapping shall permit the removal of one layer of the coil without the remainder of the coil being unravelled.

The strapping arrangement shall ensure that individual layers are clearly discriminated and shall not be impaired by transport and handling. The ends of the coil shall be straight by a distance of at least 2 pipe diameters excluding any anchorage holes. If necessary, re-rounding/straightening tools may be used.

Drums shall be of such construction as to withstand normal site handling. The core diameter of the drum shall be not less than 2.5m. The maximum diameter of any drum shall not exceed 4m. The PE pipe shall not stand proud of the drum outer guard-rail. The maximum weight of the drum plus maximum length of PE pipe shall not exceed 2,500kg. The pipe manufacturer shall declare the maximum length of pipe (for a given diameter and SDR rating) that is compatible with the weight and drum dimension criteria. Where drums are supplied by the manufacturer for direct use from a low loader, these weight limits shall not apply and the system shall incorporate a braking device.

Supply of Straight Pipes

Straight lengths of pipe shall be supplied in crates that are constructed to minimise distortion of, or damage to, the pipes during transit and storage.

All pipes shall be provided with end closures to prevent ingress of contaminants. All swarf shall be removed before fitting end closures.

Fittings

All PE fittings shall conform to the requirements of the UK Water Industry Specifications WIS 4-32-14: Specification for PE80 and PE100 Electrofusion Fittings for Nominal Sizes up to and including 630mm and WIS 4-32-15: Specification for PE80 and PE100 Spigot Fittings and Drawn Bends for Nominal Sizes up to and including 1000mm, and in particular ISO 4427, and BS 6572 for pipes up to nominal size 63mm.

3.17.8 Galvanized Iron Pipes

a. Scope

This Specification covers the requirements for manufacturing, supplying, laying, jointing and testing at works and site of Galvanised Iron pipes used for water supply.

Applicable Codes

The laying GI pipes and fittings / specials shall comply with all currently applicable statutes, regulations, standards and Codes. In particular, the following standards, unless otherwise specified herein, shall be referred. In all cases, the latest revision of the standards / Codes shall be referred to. If requirements of this Specification conflict with the requirements of the standards / Codes, this Specification shall govern.

IS: 1239 (Part-I)	Specification for Medium Grade GI Pipes
IS: 1239 (Part-II)	MS Tubular or Wrought Steel Fittings for GI Pipes
IS: 4736	Specification for Galvanizing
IS: 554.	Specifications for Pipe Threads of Screwed Tubes and Sockets

Others I.S. Codes not specifically mentioned here but pertaining to the use of CI pipes form part of these Specifications.

Manufacture

The pipes shall be Galvanized mild steel hot finished seamless (HFS) or welded ERW, HRIW or HFW

screwed and socketed conforming to IS: 1239 (Part-I) for medium grade. The zinc coating shall be uniform adherent, reasonably smooth and free from imperfections.

All screwed pipes and sockets shall have pipe threads conforming to the requirements of IS: 554. Screwed tubes shall have taper threads while the sockets shall have parallel threads.

Where the pipes have to be cut or threaded, the ends shall be carefully filed out so that no obstruction to bore is offered. The ends of the pipe shall then be carefully threaded conforming to the requirements of IS: 554 with pipe dies and tapes in such a manner that it will not result in slackness of joints when two pieces of pipes are screwed together. The taps and dies shall be used only for straightening screw threads which have become bent or damaged and shall not be used for turning of the threads as to make them slack, as the later procedure may not result in a water tight joint. The screw threads of the pipes and fittings shall be protected from damage until they are fitted.

Dimensions

The dimensions and weights of medium grade GI pipes and sockets and tolerances shall be as prescribed below:

Nominal bore (mm)	Dimension of pipes			Weight of pipe	
	Outside diameter (mm)		Thickness (mm)	Plain end Kg/m	Screwed end socket Kg/m
	Max.	Min.			
6	10.6	9.8	2.0	0.427	0.430
8	14.0	13.2	2.35	0.667	0.681
10	17.5	16.7	2.35	0.886	0.892
15	21.8	21.0	2.65	1.27	1.28
20	27.3	26.5	2.65	1.64	1.65
25	34.2	33.3	3.24	2.51	2.53
32	42.9	42.0	3.25	3.23	3.26
40	48.8	47.9	3.25	3.72	3.76
50	60.8	59.7	3.65	5.24	5.31
65	76.6	75.3	3.65	6.69	6.81
80	89.9	88.0	4.05	8.68	8.85
100	115.0	113.1	4.50	12.40	12.70
125	140.8	138.5	4.85	16.50	17.00
150	166.5	163.9	4.85	19.60	20.20

Tolerance

Tolerance in Thickness

Butt welded medium tubes	+ not limited	- 10.0 %
Seamless tubes	+ not limited	- 12.5 %

Tolerance in Weight

Single tube (irrespective of quantity)	+ 10 %	- 8 %
For quantities of less than 150 m of one size	+ 10 %	- 8 %
For quantities of 150 m and over of one size	+ 4 %	- 4 %

Specials and fittings

The fittings for GI pipes shall be of mild steel tubular or wrought steel fittings conforming to IS: 1239 (Part-II). The fittings shall be designated by the respective nominal bores of the pipes for which they are intended.

Jointing

The pipes shall be cleaned and cleared of all foreign matter before being laid. While jointing the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over with white

lead and a few turns of spun yarn wrapped round the screwed end of the pipe. The end shall then be screwed in the socket, tee etc., with the pipe wrench. Care shall be taken that all pipes and fittings are properly jointed so as to make the joints completely water tight and pipes are kept at all times free from dust and dirt during fixing. Burr from the joint shall be removed after screwing. After laying, the open ends of the pipe shall be plugged with bitumen (between PE pipe and GI pipe) to prevent access of water, soil or any other foreign matter.

2.18 Steel Cylinder Pipes and Specials

2.18.1 Design

In general the design of steel cylinder pipes with internal and external coating shall conform to clause 8 of IS 1916. In addition to above, in case of buried pipe line, the pipe shall also be designed for the Earth load, and traffic load.

2.18.2 Manufacturing

A. General

Steel cylinder pipes and specials with internal food grade epoxy coating and external coal Tar enamel coating shall be systematically checked for any manufacturing defects by experienced supervisors and a very high standard of quality shall be maintained. The pipes and specials shall be inspected by Employer's Representative at site and factory, and defects noticed, if any, such as protrusions, grooves, dents, notches, etc. shall be rectified, if agreed to by the Employer's Representative. Care shall be taken that the resulting wall thickness does not become less than the minimum specified. If the wall thickness becomes less than the minimum specified, as per Table 1 of IS: 1916, the damaged portion should be cut out as cylinder and replaced by an undamaged piece of pipe at no extra cost to the Employer's Representative.

The Employer's Representative shall at all reasonable times have free access to the place where the pipes and specials are manufactured for the purpose of examining, inspection and testing the pipes and specials and for witnessing the test and manufacturing.

All tests specified either in this Engineer Requirement or in the relevant Indian Standards shall be performed by Supplier/Contractor at his own cost and in presence of the Employer's Representative, if desired. For this sufficient notice before testing of the pipes and specials shall be given to the Employer's Representative.

If the test is found unsatisfactory, the Employer's Representative may reject any or all pipes and specials of that lot. The decision of the Employer's Representative in this matter shall be final and binding on the Contractor.

B. Materials

All material shall conform to Clause 7 of IS: 1916.

C. Manufacturing Process

Steel cylinder pipes to be manufactured as per IS 3589 with internal and external coating shall be manufactured as per Clause No.9 of IS: 1916 and specials shall be manufactured as per Clause 7 of IS: 7322. In case of spiral welded pipes, they shall be manufactured as per

Clause 3 of IS: 5504. Internal food grade epoxy coating and external coal tar Enamel shall be up to the full length of the pipes and specials. However, external coating shall be done leaving about 100 mm length of the pipes and specials from their ends. The internal lining and external coating to pipes and specials shall be done at factory. Before coating the surface of pipes and specials shall be thoroughly cleaned. In the event that loose mill scale, tuberculation, or an accumulation of dirt, debris, oil or grease is present, it shall be removed from the surface by hand, by machine or both and given a coating of neat cement slurry.

D. Dimensions

The permissible tolerance for diameter and length of pipe shall be as per Clause 4 of IS: 1916, whereas for diameter, arm length and angular deviation of specials the tolerance limit shall be as per Clause 6 of IS: 7322.

E. Workmanship and Finish

Workmanship and finish of pipe shall conform to Clause 4 of IS: 1916.

F. Testing

Each steel cylinder shall be subjected before coating to a hydrostatic test under a water pressure equivalent to the test pressure in accordance with Clause 10 of IS:1916 and relevant provisions of IS:3597.

Manufacturer's standard specials shall be hydrostatically tested before coating. Where feasible, other specials shall be hydrostatically tested (before coating) at factory. However, when this is not practicable, at the discretion of the Employer's Representative, the unlined specials shall be tested by penetration test as per IS: 3658 or other approved means.

All of results of test and inspection data must be prepared by contractor at site so that the Employer's representative shall make decision of "fail or pass" at once. All cost for the inspection shall be borne by the Contractor.

G. Penetration Test

A suitable liquid penetrant (kerosene oil/Dye) is applied to the surface of the portion under examination and is permitted to remain there for sufficient time to allow the liquid to penetrate into any defects open at the surface. After the penetrant time, the excess penetrant which remains on the surface is removed. Then a light colored powder absorbent called a developer is applied to the surface. This developer acts as a blotter and draws out a portion of the penetrant which had previously seeped into the surface openings. As the penetrant is drawn out it diffuses into the coating of the developer, forming indication of the surface discontinuities or flaws.

H. Marking

The following information shall be clearly marked on each pipe and special:

- ☐ Internal diameter, external diameter and thickness
- ☐ Class of pipe and special with its serial number

- ☐ Date of manufacture and
- ☐ Name of manufacturer or his registered trade mark or both

2.18.3 Jointing

A. General

Jointing of steel cylinder pipes and specials to be done as per the relevant IS. After jointing, extraneous material if any, shall be removed from the inside of the pipes and specials. The welding of joints for pipes and specials at work sites shall comply with IS: 816. Electrodes used for welding shall comply with IS: 814.

B. Butt Welded Joint

After pipes and specials are laid in the trench, the faces of pipes/specials shall first be tack-welded alternately at one or more diametrically opposite pairs of points. After completing tack welding, full welding shall be carried out in suitable runs following a sequence of welding portions of segments diametrically opposite. After jointing the exposed surface of the steel cylinder of pipes and specials shall be coated with internal food grade epoxy coating and outside coal tar enamel coating of sufficient thickness so as to make it flush with the adjoining both inner and outer faces of pipes and specials. The coating shall be done after the field test in the section has been successfully completed.

C. Lap Welded Joint with Slip-in-ends

In the case of pipes with plain or slip-in-ends, swaged end of the steel cylinder may be formed by heating one of its ends and expanding it or rolling it out to the required shape. The minimum depth and maximum clearance between the swaged end and the plain end of pipes for field welding shall be provided as directed by the Employer's representative. Lap welding shall be done from the external face at the junction of pipe and socket. After jointing the exposed surface of the steel cylinder of pipes and specials shall be coated internal food grade epoxy coating and outside coal tar enamel coating of sufficient thickness so as to make it flush with the adjoining both inner and outer faces of pipes and specials. The coating shall be done after the field test in the section has been successfully completed.

D. Flanged Joints

The flanges for steel cylinder pipes and specials shall be as per BS EN 1092-1. Flanges shall be provided at the end of pipes or specials where valves, blank flanges etc. have to be

introduced or flanged joints for the pipes are specified. The flanges shall have necessary bolt holes drilled. It might be necessary for contractor to follow the instructions and specifications given by the valve manufacturer. All bolts, nuts and packing material required for flanged joints shall be provided by the Contractor. Bolts and nuts shall conform to IS: 1367 whereas rubber gasket of required thickness shall conform to IS: 638. The bolts shall be evenly tightened in comply with relevant BS standard. Random inspection shall be carried out by jointly the Employer's representative and the contractor.

2.18.4 Cleaning of pipes and specials

Contractor shall ascertain that each stretch of pipeline is absolutely clear and without any obstruction by means of visual examination of the interior of pipeline suitably lighted by projected sunlight or otherwise. The open end of an incomplete stretch of pipeline shall be securely closed as may be directed by the Employer's representative to prevent entry of mud or silt etc.

If as a result of the removal of any obstructions the Employer's representative considers that damages may have been caused to the pipeline, he shall be entitled to order the stretch to be tested immediately. Should such test prove unsatisfactory, contractor shall amend the work and carry out such further tests as are required by the Employer's representative.

2.18.5 Testing at work site

After laying and jointing of steel cylinder pipes and specials with internal food grade epoxy coating and outside coal tar enamel coating is completed the pipeline shall be tested at work site as per the following Employer's Requirement and as directed by the Employer's representative. All equipment for testing at work site shall be supplied and erected by Contractor. Water for testing of pipes shall be arranged by him. Damage during testing shall be Contractor's responsibility and shall be rectified by him to the full satisfaction of the Employer's representative. Water used for test shall be removed from pipes and not released to the excavated trenches.

Each section of the pipe line shall be slowly filled with clean water and all air shall be expelled from the pipeline. The pressure in the pipeline should then be raised and maintained by means of pump to the test pressure. The test pressure should not be less than 1 1/2 times the working pressure at the lowest point or the static head pressure, whichever is higher. Under the test pressure no leak or sweating shall be visible at the welded joints. The duration of test shall be not less than 24 hours. The exposed joints shall be carefully examined and all such joints showing visible leaks shall be rewelded. Any cracked or defective pipes and specials in consequences of this pressure test shall be removed and replaced by sound material by Contractor and the test shall be repeated to the satisfaction of the Employer's representative.

Proper arrangement of thrust blocks shall be provided during pressure testing or pipe laying works.

2.19 Steel Pipe work

The term "pipe work" means pipe of any description and includes associated flanges, adopters, couplings, jointing materials, fittings, supports, valves, traps and the like which are necessary to complete station pipe work systems associated with Pumping Station.

The Contractor shall design, manufacture, supply, fabricate, and install the pipe work in accordance with the Specification and to satisfy pipe work function of Pump Station. The Contractor's specification for the fabrication of pipe work shall be submitted for the Employer's approval. The information provided shall be, when applicable, as listed below:

- a) Purpose

- b) Contents
- c) Related documents
- d) Definitions
- e) Application standards
- f) Drawings
- g) Materials
- h) Fabrication - general;
 - ☐ tolerance;
 - ☐ preparation;
 - ☐ fit-up;
 - ☐ threading;
 - ☐ bends;
 - ☐ welding;
 - ☐ heat treatment:
 - ☐ after fabrication treatment
 - ☐ inspection
- i) Preparation and protection finishing of surfaces
- j) Marking and coding for identification and matching
- k) Acceptable welder's qualification

All pipes, fittings, bolts, nuts, jointing materials, pipe supports, thrust blocks and appurtenances for piping to be required for execution of the Works shall be manufactured and erected in accordance with the erection plans, specifications to be provided by the Contractor and approved by the Employer. All pipe work and fittings shall be rated to the higher pressure class in excess of the maximum pressure attained in service including any surge pressure. Minimum 2 mm corrosion allowance shall be considered. Buried pipes in addition to above, shall be designed to withstand external loading exerted by soil, water, and live loads as relevant. The external ground water shall be taken at ground level for design purposes. Material of steel pipes and fittings shall conform to IS: 2062. Fabrication and testing shall be in accordance with IS: 3589 for pipes and BS EN 1092 for flanges.

All pipe line shall be marked the flow direction, and print ink the name of liquid to be carried as well as name of the destination of facility.

Underground pipe line must be shown the location by concrete pole that indicates its lay underground depth and its flow direction.

The pipe work installation shall be so arranged to offer ease of dismantling and removal of pumps or other major items of equipment. Stainless steel to Grade AISI 304 expansion bellows which can take radial and axial misalignment of minimum 1 percent of valve nominal size with tie rods shall be included in the suction and delivery pipe work of all pumps as well as on delivery header for easy dismantling, and provision shall be made for a flexible joint arrangement to building structures. All loose flanges shall be secured to fixed flanges by suitable tie-bolts.

All necessary supports, saddles, slings, fixing bolts and foundation bolts shall be supplied to

support the pipe work and its associated equipment in an approved manner. Valves, meters, strainers and other devices mounted in the pipe work shall be supported independently of the pipes to which they connect. All brackets or other forms of support, which can conveniently be so designed, shall be rigidly built up of steel by welding and coated by paint after welding works.

All pipe work shall be adequately supported with purpose-made fittings. When passing through walls, pipe work shall incorporate a puddle flange or other suitable sealing device.

Flange adapters and unions shall be supplied and fitted in pipe work runs, wherever necessary, to permit the simple disconnection of flanges, valves and equipment. The final outlet connection of the pipe work shall match the connecting point of the transmission main.

Flanged joints shall be made with minimum 6 mm thick full face, fabric reinforced rubber gaskets, pierced to take the bolts, and the face of all flanges shall be machined to give a true angle of 90 degree to the centre line of the pipe or fittings. All necessary supports, saddles, slings, fixing bolts and foundation bolts shall be supplied to support the pipe work and its associated equipment in an approved manner. Valves, meters and other devices mounted in the pipe work shall be supported independently of the pipes to which they are connected. Bolts for flange connection must be tightening adequate force in comply with international standards or approved by the Employer's representative.

The whole of the jointing work and materials necessary to fix and connect the pipes, including adequate and efficient pipe support shall be included in the Contract. The Contractor shall be responsible for ensuring that the internal surface of all pipe work is thoroughly clean before and during erection and before commissioning. Cleaning shall include removal of all dirt, rust, scale and welding slag due to Site welding. Before dispatch from the manufacturer's works, the ends of the pipes, branch pipes, etc., shall be suitably capped and covered to prevent any accumulation of dirt or damage. This protection shall not be removed until immediately prior to connecting adjacent pipes, valves or pumps. All small bore pipes shall be blown through with compressed air before connection is made to instruments and other equipment. No point of passage of pipes through floors or walls shall be used as a point of support, except with the approval of the Employer's representative.

Material of construction of pipes and fittings shall confirm to the following specifications:

	Size Mm(NB)	Material Specification	Dimensional Standard
Pipes	Up to 150	IS:1239 PT-1, ERW Black	1239 PT-1 C1 Heavy
	200 & above	IS:2062, Gr. B	IS 3589 – ERW 3589 for dimensions and minimum thickness. Pipe thickness shall be as per IS 2825, Pumping main line thickness as defined in below table

Elbows	Upto 50	ASTM - A 105	ANSI B 16.11 3000 # S.W.
	65 to 300	ASTM - A 234 Gr WPB	ANSI B 16.9 LR. BE. Sch 40
	Above 300 (mitre)	IS : 2062, Gr. B	ANSI B 31-1
Coupling	Upto 50	ASTM - A 105	ANSI B 16.11 3000 # S.W.
Tees	Upto 50 65 to 200	ASTM - A 105	ANSI B 16.11 3000 # S.W
		ASTM - A 234 Gr WPB	ANSI B 16.9 BE, Sch 40
	Above 200	IS:2062, Gr. B	IS : 2825
Reducers	Upto 50	ASTM - A 105	ANSI B 16.11 3000 # S.W.
	65 to 300	ASTM - A 234 Gr WPB	ANSI b 16.9 BE, Sch 40
Reducers	Above 300	IS : 2062, Gr. B	IS: 2825, Thickness matching with that for the higher dia.
Flanges & Blind Flanges	Sizes upto 200	ASTM - A 105	ANSI B 16.5
Flanges & Blind Flanges	Sizes 200 upto 3000	IS : 2062, Gr. B	BS EN:1092-1 SORF

	Size Mm(NB)	Material Specification	Dimensional Standard
Bolts & nuts	All	SS 316	-
Gaskets	MS	IS:638 (Rubber reinforced)	Minimum 6 mm thickness

Facilities shall be provided for draining the pipe system and releasing air.

The pipe work layout within pump stations shall have the approval of the pump manufacturer. Fluid velocities in suction pipe work leading to pumps shall not exceed 1.5 m/s. Fluid velocities in delivery pipe work leading from pumps shall not exceed 2.0 m/s.

The whole of the jointing work and materials necessary to fix and connect the pipes, including adequate and efficient pipe support shall be included in the Contract. The Contractor shall be responsible for ensuring that the internal surface of all pipe work is thoroughly cleaned before and during erection and before commissioning.

Cleaning shall include removal of all dirt, rust, scale and welding slag due to Site welding. Before dispatch from the manufacturer's works, the ends of the pipes, branch pipes, etc., shall be suitably capped and covered to prevent any accumulation of dirt or damage. This protection shall not be removed until immediately prior to connecting adjacent pipes, valves or pumps. All small bore pipes shall be blown through with compressed air before connection is made to instruments and other equipment. No point of passage of pipes through floors or walls shall be used as a point of support, except with the approval of the Employer.

Hydrostatic shop test for pipes and fittings shall be as per code/standard requirement. After erection at site, complete pipes and fittings shall be hydrostatically tested for a pressure of 1.5 times operating pressure.

Flanges, if fabricated in segments shall be fully radio graphed and stress relieved. If fabricated out of billets/bars by cold rolling, welded flanges shall be radio graphed and normalized.

Puddle flanges shall be fitted to pipes where the structure through which they pass is required to take thrust resulting from the pipe. Puddle flanges shall also be fitted where a water barrier is required. All puddle flanges shall be clearly shown on the drawings and the resultant thrust clearly indicated. Puddle flanges shall only be fitted with the prior approval of the Employer.

Buried pipes shall in addition be designed to withstand external loading exerted by soil, water, and live loads as relevant. The external ground water shall be taken at ground level for design purposes.

Saddle type/bracket type support wherever required shall be designed and supplied for the above ground pipe lines.

All pipe joints shall be of the butt welded type. End preparations and fabrication requirements shall generally conform to I.S. 2825. Flanges, if fabricated in segments, shall be fully radio graphed and stress relieved.

Laying of welded steel pipes shall meet the requirements of I.S. 5822.

All pipes, fittings, bolts, nuts, jointing materials and appurtenances for piping to be required for execution of the Works shall be manufactured and erected in accordance with the erection plans, specifications and directives of the Employer's representative. All pipe work and fittings shall be to a class in excess of the maximum pressure attained in service including any surge pressure.

A. PROTECTION

All underground pipe work having a cover less than 1.5 m shall be encased with M 15 concrete of minimum 200 mm thick all around. And any two pipe crossing shall be encased properly such that the load of above pipe shall not be transferred to below pipe.

All the underground buried mild steel piping shall be protected by the application of hot coal tar enamel and fiber glass wrapping. Protection for pipes laid underground shall be by coating and wrapping system giving a final coat thickness of 4.5 mm shall be employed. Such protection shall comprise 1.5 mm of coal tar primer application on a thoroughly cleaned surface, to be followed with fiber glass wraps set in coal tar enamel coats conforming to American Water Works Association specification C/203/57 for a total thickness of 3 mm. Such lining shall meet a spark test to be approved with a holiday detector of 10000 Volts. The Contractor shall indicate on his detailed drawings what thrust blocks are required to anchor

pipe work supplied by him. Particular care shall be taken to ensure that pipe work thrusts are, as far as possible, not transmitted to machinery or other associated apparatus.

All the pipes laid in open i.e. either above ground level or in channels, shall be provided with epoxy painting on both inside and outside. The minimum thickness of epoxy painting shall be 406 microns.

2.19.1 Welded Joints for Steel Pipes

Welding of joints in steel pipes shall be carried out manually by the metal arc welding process complying with AWWA Standard C206.

Before starting the welding of pipe joints in the Works the Contractor shall submit for the Employer's representative's approval details of the plant, methods and materials he proposes to use, including make and size of electrodes, number of runs, current strength and arrangements for air testing of individual joints.

Welding shall only be carried out by welders approved by the Employer's representative and each welder shall identify his work by means of a stenciled mark.

Welded joints other than for closing lengths shall be of the spherical spigot and socket type. For pipes of 675 mm diameter and smaller the pipe joint shall be welded externally. For pipes larger than 675 mm the pipe shall be welded internally and a sealing weld made externally.

All parts to be welded shall have loose scale, slag, rust, paint and other foreign matter removed by means of a wire brush and shall be left clean and dry. All scale and slag shall be removed from each weld run when it is completed. Pipes manufactured with longitudinal or spiral welds shall be lined up before jointing so that these welds are at least 150 apart around the joint circumference.

For pipes larger than 900 mm diameter a triple run convex fillet weld shall be used. For pipes of 900 mm diameter or less a double run convex fillet weld shall be used. The minimum leg length of the fillet as deposited is to be equal to the full thickness of the pipe wall. The actual throat depth shall not be greater than 9/10th and not less than 7/10th of the minimum leg lengths as deposited. The depositing of the weld metal shall be carried out in such a manner as to ensure that all the welds have adequate root fusion and are of good clean metal free from cracks, gas holes, slag inclusions and all other impurities. The surface of the weld shall have an even contour with regular finish and shall indicate proper fusion with the parent metal. All slag shall be thoroughly removed after depositing each run of welding by light hammering with a chipping hammer followed by wire brushing. Any welds showing cracks or other cavities or in which the weld metal tends to overlap on to the parent metal without proper fusion or containing any other defects whatsoever shall be cut out and rewelded to the satisfaction of the Employer's representative at the Contractor's expense.

At closing lengths where two plain ended pipes are to be joined by a welded joint the gap between the two ends shall not exceed 75 mm. An external steel sleeve collar, of a thickness not less than that of the pipe itself and approximately 300 mm in length shall be placed centrally over the two ends to be jointed and the end of each pipe shall then be fillet welded to the sleeve collar in accordance with the above procedure.

No weld or adjacent parts of the pipe shall be painted prior to inspection by the Employer's representative.

2.19.2 Welder Performance Test

The Contractor shall submit for the Employer's representative's approval the names of persons whom he proposes to employ as welders with evidence that, as a minimum preliminary qualification, they have passed the qualifying tests prescribed in Clause 11 of BS 2633 and possessed certificates from an independent testing authority. The Employer's representative may further require any such person to perform satisfactory test welds under Site conditions and on pipes similar to those for use in the Works, before approving his employment as a welder. The Contractor shall maintain an up-to-date list of welders approved by the Employer's representative and if ordered by the Employer's representative he shall remove from the approved list any welder whose workmanship, as demonstrated by the results of air pressure tests on individual welded joints, is below a reasonable standard of quality of consistency in the Employer's representative's opinion.

2.19.3 Testing of Welded Joints

Where directed by the Employer's representative welded joints on pipes larger than 675 mm diameter shall be subject to a nitrogen gas test after welding.

A tapped hole (approximately 6 mm diameter) shall be made in the socket end of each pipe by the Contractor and shall be fitted with a suitable non-return valve. Nitrogen, at 400 kPa pressure, shall then be pumped into the annular space between the spigot and socket and the pump disconnected.

If no drop in pressure occurs over the ensuing period of 30 minutes the test shall be deemed to be successful. If the test pressure cannot be maintained for 30 minutes all defects in the weld shall be cut back and rewelded and the test reapplied until successful. The cost of initial and subsequent testing of defective welds shall be at the Contractor's own expense.

The Contractor shall provide all items necessary for the nitrogen tests including compressor, valves, gauges and tubing.

2.19.4 Hydraulic Losses

The frictional losses due to water flow in pipe work shall be computed, based on the following:

- a) **Straight Pipes:** William-Hazen formula using $C = 140$ (Internal Epoxy painted) & $C=120$ (Cement lined)

$$\begin{aligned} \text{Head loss in mwc/m run of pipe} &= \\ 6.815 \times (V/C)^{1.852} \times (1/D)^{1.167} & \\ \text{Where } V &= \text{flow velocity in m/s} \\ D &= \text{pipe internal diameter in m} \end{aligned}$$

- b) **Valves**

The losses in mwc shall be calculated as

$$\begin{aligned} K \times (V^2/2g), \text{ where } V &= \text{flow velocity through the nominal diameter in m/s} \\ g &= 9.81 \text{ m/sec}^2 \\ K &= \text{Coefficient as noted below;} \end{aligned}$$

$$K - \text{For sluice valves} = 0.2$$

For butterfly valves = 0.3

For non-return valves = 2.0

c) Fittings, specials

For specials like reducers, bell-mouths, tees, elbows, etc, the 'k' values shall be as recommended by the British Hydromechanics Research Association (BHRA), Volume 5, in the BHRA fluid Engineering Series.

2.19.5 Flexibility in Pipework

The Contractor shall provide flexibility in the pipe work at joints in the main structures and shall submit proposals for the approval of the Employer's representative. Flexible joints or collars and cut pipes shall be allowed on all pipe work where necessary to allow for some margin of error in the building work. Wherever possible flexible joints shall be provided with tie bolts or other means to transfer longitudinal thrusts as a whole so that external anchorages may be kept to a minimum. Flexible joints shall also be provided for case of erection and future dismantling. Particular care shall be taken to ensure that pipe work thrusts are not transmitted to machinery or associated apparatus. The Contractor shall indicate on his detailed drawings what thrust blocks are required.

2.19.6 Puddle Flanges

Puddle flanges shall be fitted to pipes where the structure through which they pass is required to take thrust resulting from the pipe. Puddle flanges shall also be fitted where a water barrier is required. All puddle flanges shall be clearly shown on the drawing and the resultant thrust clearly indicated. Puddle flanges shall only be fitted with the Employer's representative prior approval.

2.19.7 Stainless Steel Pipe and Fittings.

Stainless steel pipe shall be 316 stainless steel to ASTM A240 and A778, Gr. TP. Pressure rating shall be up to 1220 kPa maximum pressure. Fabrication shall be seamless Sizing shall conform to ANSI B36.19 as required. Gauge, schedule or plate material shall be used according to the application. Where grooved type couplings are used on gauge material, the material thickness at the ends of the pipe shall be equal to Sch. 10S to suit the grooving/coupling requirement. Threaded couplings shall conform to ASTM A182, A276 and rated for 435 kPa.

Fittings shall conform to ASTM A774, MSS SP43, with smooth flow (pressed type) bends. If mitred bends are used, 90 degree bends shall have five sections and 45 bends three sections. All discharge fittings such as tees, bends, laterals etc shall be reinforced and braced to suit the dynamic forces/pressures accordingly.

The internal diameter of pipes and fittings shall not be less than the connection sizes for valves, equipment etc. All piping and fittings shall be of Number 1 or 2B finish.

2.20 Pipes Identification and Site Testing

2.20.1 Marking

Each pipe and fitting shall have cast, stamped or indelibly painted on it the following appropriate

marks:

- ☐ The nominal diameter
- ☐ Flow direction and line marks for installation
- ☐ Class reference
- ☐ Mass of pipe
- ☐ Date of manufacture and
- ☐ Manufacturer's name, initials or identification mark.
- ☐ Marking shall be done as per relevant IS code.

2.20.2 Flanged Pipes

The gaskets used between flanges of pipes shall be compressed fibre board or natural/synthetic rubber conforming to IS: 638, of thickness 6.0 mm. The fibre board shall be impregnated with chemically neutral mineral oil and shall have a smooth and hard surface. Its weight per square metre shall be not less than 112 g/mm thickness.

Each bolt should be tightened a little at a time taking care to tighten diametrically opposite bolts alternately. The practice of fully tightening the bolts one after another is highly undesirable. The bolts shall be of mild steel unless otherwise specified.

2.20.2 Cleaning of Pipes and Fittings

The Contractor shall ascertain that each stretch of pipeline is absolutely clear and without any obstruction by means of visual examination of the interior of pipeline suitably lighted by projected sunlight or otherwise. The open end of an incomplete stretch of pipeline shall be securely closed as may be directed by the Employer's representative to prevent entry of mud or silt etc.

If as a result of the removal of any obstructions the Employer's representative considers that damages may have been caused to the pipeline, he shall be entitled to order the stretch to be tested immediately. Should such test prove unsatisfactory, contractor shall amend the work and carry out such further tests as are required by the Employer's representative.

2.20.4 Testing at work site

After the pipes and fittings are laid, jointed and the trench partially backfilled except at the joints the stretch of pipe line as directed by Employer's representative shall be subjected to pressure test and leakage test. Where any section of the pipeline is provided with concrete thrust blocks or anchorages, the pressure test shall not be made until at least five days have elapsed after the concrete was cast. If rapid hardening cement has been used in these blocks or anchorages, the tests shall not be made until atleast two days have elapsed.

Each section of the pipe line shall be slowly filled with water and all air shall be expelled from the pipe by tapping at points of highest elevation before the test is made and plugs inserted after the tests have been completed. The specified test pressure based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge shall be applied by means of a pump connected to the pipe as directed by the Employer's representative.

The duration of test shall not be less than 5 minutes. The exposed joints shall be carefully

examined and all such joints showing visible leaks shall be recaulked until water tight. Any cracked or defective pipes and fittings in consequence of this pressure test shall be removed and replaced by sound material by Contractor at no extra cost to the Employer's representative and the test shall be repeated to the satisfaction of the Employer's representative.

After the satisfactory completion of pressure test, the section of pipe line shall be subjected to leakage test. The duration of test shall be 2 hours. No pipe installation shall be accepted until the leakage is less than the number of cm³ /h as determined by the formula:

$$q L = \frac{ND\sqrt{P}}{3.3}$$

Where,

- q L = the allowable leakage in cm³/hr
- N = Number of joints in the length of the pipeline
- D = Diameter in mm, and
- P = the average test pressure during the leakage test in Kg/cm²

Should any test of pipe laid indicate leakage greater than that specified above, the defective joints shall be repaired by Contractor at no extra cost to the Employer until the leakage is within the specified allowance.

Necessary equipment and water used for testing shall be arranged by Contractor at his own cost. Damage during testing shall be Contractor's responsibility and shall be rectified by him at no extra cost to the Employer. Water used for testing shall be removed from the pipe and not released in the excavated trenches.

After the tests mentioned above are completed to the satisfaction of the Employer's representative, the backfilling of trenches shall be done as per the Employer's Requirement specified elsewhere.

2.21 Unplasticised PVC Pipes and Fittings

Unplasticised polyvinyl chloride pipes, fittings and specials shall be to BS 2505 for potable water and BS 4246: Part 1 for fittings.

The pipes shall be of the spigot and socket type with approved gasket type flexible joint. The rubber gaskets shall be to BS 7874, BS EN 681-1 & 2.

Where PVC pipes, fittings and specials are to be connected to Ductile iron, stainless steel or steel pipes, 'Viking Johnson' type flange adaptors or stepped couplings shall be used.

2.22 Polyethylene Pipes

Polyethylene pipes shall comply with BS EN 12201. The welding method shall be adapted to international standard and contractor shall obtain the approval of the Employer's representative before proceeding with such works.

2.23 Rubber Hosing

Rubber hosing shall conform to BS EN ISO 1402. It shall be capable of handling chlorine and sulphur dioxide solutions at a working pressure of 12 bar.

2.24 Copper Tubes and Fittings

Copper tubing and fittings for work above ground level shall comply with BS EN 12449 and BS EN 1254-1 & 2 respectively and be jointed with capillary joints. For underground location the copper pipe shall be to BS 2871: Part 1.

2.25 Flanged Joints

All flanges shall comply with BS EN 1092-1. The nominal pressure rating for particular flanges shall be at least equal to the highest pressure rating of the pipes or fittings to which they are attached, but with a minimum nominal pressure of PN 10. All flanges shall be provided with all necessary nuts, bolts, washers and gaskets. In general, valves shall have flanged body ends.

All flanged joints which are buried or in chambers shall be protected with Densomastic and Dens tape wrapping, applied in accordance with the manufacturer's instructions.

Flanges shall be installed on the pipes in the factory and field welding of flanges shall only be allowed with the approval of the Employer's representative.

Where pipe work outside pumping stations and surge vessel chambers is cathodically protected, an insulated flange shall be incorporated at the first flange inside the structure. These flanges shall be tested to ensure that electrical insulation is achieved.

2.26 Gaskets and Joint Rings

Joint rings shall be manufactured to conform to BS 7874 & BS EN 681-1 and shall be of chloroprene rubber or other approved synthetic material suitable for temperatures up to 80°C.

Gaskets may be inside the bolt circle type and shall comply with BS EN 1514-1. Alternatively the gasket shall be to the full diameter of the flange, drilled to suit the appropriate bolt provisions.

Chloroprene rubber with a hardness of 71 to 80 IRHD shall be used.

Joints shall be made in accordance with manufacturer's instructions or as specified herein.

Until immediately required for incorporation in a joint, each rubber ring or gasket shall be stored in the dark, free from the deleterious effects of heat or cold, and kept flat so as to prevent any part of the rubber being in tension.

Only lubricants recommended by the manufacturer shall be used in connection with rubber rings and these lubricants shall not contain any soluble constituent, shall be suitable for the

climatic conditions at the Site and shall contain an approved bactericide.

After cleaning the flanges the gaskets shall be fitted smoothly to the flange and the joint shall be made by tightening the nuts to finger pressure first. Thereafter the final tightening of the nuts shall be made by gradually and evenly tightening bolts in diametrically opposite positions using standard spanners.

Graphite grease shall be applied to the threads of bolts before joints are made.

2.27 Flexible Couplings and Flange Adaptors

Flexible couplings and flange adaptors shall be of the Viking Johnson or similar approved pattern and be assembled in accordance with the manufacturer's instructions and protected, if buried or in chambers with Densomastic and Densotape wrapping applied in accordance with the manufacturers' instructions. Flexible joints shall be harnessed or tied where necessary.

2.28 Storage & Shipment

2.28.1 Protection of Pipes and Fittings for Shipment

Except where otherwise specified all items shall have received their complete protective coatings before dispatch from the manufacturer's works and shall be additionally protected by approved means for the period of transit, storage and erection, against corrosion and accidental damage.

For the protection of pipe coating and in particular for protecting outer coal tar enamel coatings, protective metal or timber discs shall be fitted over the ends of pipes and fittings. Similar timber protective discs shall be attached to all flanges of pipes and fittings, by means of bolts specifically provided for the purpose and which shall be discarded when the item is incorporated in the Works. The sleeves and flanges of flexible joints shall be wired together in suitable bundles.

2.28.2 Storage of Pipeline Materials

Pipes and fittings shall be stored raised off the ground, and shall be carefully supported, cushioned and wedged. Pipes shall not rest directly on one another and shall not be stacked more than four pipes high or two pipes high in the case of pipes of 500 mm diameter or over. Special care shall be taken to ensure that flexible pipes are cradled and supported in a manner that prevents any distortion of the pipes.

Couplings and joints (and all components thereof) and other similar items shall be stored in dry conditions, raised from the ground in sheds or covered areas.

Storage areas shall be carefully set out to facilitate unloading, and checking of materials with different consignments stacked or stored separately with identification marks clearly visible.

Where items to be stored have a limited shelf life or require special storage arrangements, the method of storage shall be to the approval of the Employer's representative and in accordance with the manufacturer's instructions.

All pipes and fittings supplied as spares shall have end covers which are proof against the entry of sand and vermin. Mortar lined pipes and fittings shall have end covers which form a complete seal, provision being made to accommodate the effects of temperature changes.

Pipes and fittings supplied as spares shall have a temporary white external finish and shall be stored sheltered from the direct rays of the sun.

End covers and protection shall not be removed until incorporation of the pipes and fittings into the Works.

2.28.3 Transportation of Pipes and Fittings

Any vehicle on which pipes are transported shall have a body of such length that the pipes do not overhang. Large pipes shall be placed on cradles and the loads properly secured during transit. The pipes shall be handled in accordance with the manufacturer's recommendations.

Approved slings shall be used and all hooks and dogs and other metal devices shall be well padded. Hooks engaged on the inner wall surface at pipe ends shall not be used. Steadying ropes shall be employed. The positions of lifting slings shall ensure that stresses and tendency towards deformation in the pipes are kept at a minimum.

Pipe handling equipment shall be maintained in good repair and any equipment which in the opinion of the Employer's representative may cause damage to the pipes shall be discarded.

Under no circumstances shall pipes be dropped, be allowed to strike one other, be rolled freely or dragged along the ground.

2.29 Inspection of Pipes and Fittings

Before incorporating into the Works each pipe shall be brushed out and carefully examined for soundness. Damaged pipes which in the opinion of the Employer's representative cannot be satisfactorily repaired shall be rejected and removed from Site.

Damage to pipe coatings shall be repaired to the satisfaction of the Employer's representative.

2.30 Built-in Pipe work and other Plant

The pipes and other Plant in water retaining structures shall, wherever possible, be built in as the work on the structure proceeds. The Contractor shall ensure that delivery of the requisite pipe work and other Plant is in accordance with the requirements of the programme.

Where a pipe subject to thrust passes through a concrete structure or where an external seal is required, a puddle flange shall be used. The puddle flange dimensions shall be to BS EN 1092-1 but shall be undrilled. The exterior of the pipe shall be cement washed symmetrically about the puddle flange by the manufacturer for a length at least equivalent to the thickness of the wall through which it passes.

The Contractor shall be responsible through every stage of the Works for checking the correctness of the setting of built-in Plant and shall satisfy himself they are positioned in accordance with his approved drawings.

2.31 Pipelaying

2.31.1 Carting & Handling

Pipes and fittings /specials shall be transported from the factory to the work sites at places along the alignment of pipeline as directed by the Employer's representative. Contractor shall be responsible for the safety of pipes and fittings/specials in transit, loading/unloading. Every care shall be exercised in handling pipes and fittings/specials to avoid damage. While unloading, the pipes and fittings/specials shall not be thrown down from the truck on to hard surfaces. They should be unloaded on timber skids with steadying ropes or by any other approved means. Padding shall be provided between coated pipes, fittings/specials and timber skids to avoid damage to the coating. Suitable gaps between pipes should be left at intervals in order to permit access from one side to other. In case of spigot socket pipes, care should be taken regarding orientation of pipes while unloading. As far as possible pipes shall be unloaded on one side of the trench only. The pipes shall be checked for any visible damage (such as broken edges, cracking or spalling of pipe) while unloading and shall be sorted out for reclamation. Any pipe which shows sufficient damage to preclude it from being used shall be discarded. Dragging of pipes and fittings/specials along concrete and similar pavement with hard surfaces shall be prohibited.

2.31.2 Storage

Each stack of pipes shall contain only pipes of same class and size, with consignment or batch number marked on it with particulars of suppliers wherever possible. Storage shall be done on firm level and clean ground and wedges shall be provided at the bottom layer to keep the stack stable. The stack shall be in pyramid shape or the pipes laid lengthwise and crosswise in alternate layers. The pyramid stack shall be made for smaller diameter pipes for conserving space in storing them. The height of the stock shall not exceed 1.5 m.

Fittings/Specials shall be stacked under cover and separated from pipes.

Rubber rings shall be stored in a clean, cool store away from windows, boiler, electrical equipment and petrol, oils or other chemicals. Particularly in the field where the rubber rings are being used it is desirable that they are not left out on the ground in the sun or overnight under heavy frost or snow conditions.

2.31.3 Laying

A. Excavation

Before excavating the trench the alignment of pipeline shall be approved by the Employer's representative. The excavation of trenches shall be carried out in accordance with the Employer's Requirement described elsewhere and shall be done such that it does not get far ahead of the laying operation as approved by the Employer's representative.

To protect persons from injury and to avoid damage to property, adequate barricades, construction signs, red lanterns and guards as required shall be placed and maintained during the progress of the construction work and until it is safe for the traffic to use the roadways. The relevant Indian Standards and the rules and regulations of local authorities in regards to safety provisions shall be observed.

Suitable fencing shall be provided along the sides of trenches. The posts of fencing shall be of timber securely fixed in the ground not more than 3 m apart and they shall not be less than 75 mm in diameter or less than 1.2m above surface of the ground. There shall be two rails,

one near the top of the post and the other about 450mm above the ground and each shall be from 50mm to 70mm in diameter and sufficiently long to run from post to post to which they shall be bound with strong rope. The method of projecting rails beyond the post and tying them together where they meet will not be allowed on any account. All along the edges of the excavation trenches a bank of earth about 1.2 m high shall be formed where required by the Employer's representative for further protection.

The road metal and also the rubble packing shall first be stripped off for the whole width of the trench/pit and separately deposited in such place or places as may be determined by the Employer's representative.

During excavation, large stones and rubble shall be separated and removed from the excavated soil and stacked separately. The material from excavation shall be deposited on either side of the trench leaving adequate clear distance from the edges of the trench, or as may be necessary to prevent the sides of the trench pit to slip or fall, or at such a distance and in such a manner as to avoid covering fire hydrants, sluice valves, manholes and covers etc. and so as to avoid abutting the wall or structure or causing inconvenience to the public and other service organizations or otherwise as the Employer's representative may direct.

Contractor shall take into account additional excavation if any as the Employer's representative may require in order locating the position of water pipes or any other works which may be met with, in or about the excavation of trenches while quoting the rates for excavation of trenches while quoting the rates of excavation. Such service lines if met with during excavation shall be properly maintained by Contractor, by means of shoring, strutting, planking over, padding or otherwise as the Employer's representative may direct, and shall be protected by the Contractor from damage during the progress of the work. All precautions shall be taken during excavation and laying operations to guard against possible damage to any existing structure /pipe line of water and other works.

Utmost care shall be taken to see that the width of the trench at the top of pipe is not more than the minimum requirement. In case additional width is required it shall be provided only in the top portion from the ground level up to 300 mm above the top of pipe. If any extra width is provided in the area below this portion, Contractor shall have to provide remedial measures in the form of lime concrete or rubble masonry otherwise at the discretion and to the satisfaction of the Employer's representative. If rock is met with, it shall be removed to 15 cm below the bottom of pipes and fittings/specials and the space resulting shall be refilled with granular materials and properly consolidated. Bottom of trenches shall be saturated with water well rammed wherever the Employer's representative may consider it necessary to do so.

Wherever a socket or collar of pipe or fitting/ special occurs, a grip is to be cut in the bottom of the trench or concrete bed to a depth of at least 75 mm below the bed of the pipe so that the pipe may have a fair bearing on its shaft and does not rest upon its socket. Such grip shall be of sufficient size in every respect to admit the hand all around the socket in order to make the joint and the grip shall be maintained clear until the joint has been approved by the Employer's representative.

When welding is to be carried out with the pipes and specials in the trench, additional excavation of not more than 60cm in depth and 90 cm in length shall be made at joints in order to facilitate welding.

The excess excavated material shall be carried away from site of works to a place up to a distance as directed by the Employer's representative. This shall be done immediately so as not to cause any inconvenience to the public or traffic. If the instructions from Employer's

representative are not implemented within seven days from the date of instructions to cart the materials and to clear the site, the same shall be carried out by the Employer's representative and any claim or dispute shall not be entertained in this respect.

B. Special Foundation in Poor Soil

Where the bottom of the trench and sub grade is found to consist of material which is unstable to such a degree that in the opinion of the Employer's representative, it cannot be removed and replaced with an approved material thoroughly compacted in place to support the pipe properly, a suitable foundation for the pipes, consisting of piling, timbers or other materials, in accordance with relevant drawings to be prepared by the Contractor and as instructed by the Employer's representative shall be constructed.

C. Wooden Shoring

Contractor shall suitably design polling boards, waling and struts to meet different soil conditions that might be encountered in excavating trenches/pits. The horizontal and vertical spacing of struts shall be such that not only the sides of trenches shall be prevented from collapse but also easy lowering of pipe in trenches shall be ensured without creating undue obstructions for the excavation of the work. Any inconvenience and/or delay that might be caused in lowering pipes in trenches as a result of adopting improper spacing of struts by Contractor shall be his sole responsibility. No part of shoring shall at any time be removed by Contractor without obtaining permission from the Employer's representative. While taking out shoring planks the hollows of any form must simultaneously be filled in with soft earth well rammed with rammers and with water.

The Employer's representative may order portions of shoring to be left in the trenches /pits at such places, where it is found absolutely necessary to do so to avoid any damage which may be caused to buildings, cables, gas mains, water mains, sewers etc. in close proximity of the excavation, by pulling out the shoring from the excavations. The Contractor shall not claim, on any reason whatsoever, for the shoring which may have been left in by him at his own discretion.

D. Steel Plate Shoring

Where the subsoil conditions are expected to be of a soft and unstable character in trench/pit excavation, the normal method of timbering may prove insufficient to avoid subsidence of the adjoining road surfaces and other services. In such circumstances, the Contractor will be required to use steel trench sheeting or sheet piling adequately supported by timber struts, waling etc., as per the instructions, manner and method directed by the Employer's representative. Contractor shall supply pitch, drive and subsequently remove trench sheeting or piling in accordance with other items of the Employer's Requirements.

E. Boning Staves and Sight Rails

In laying the pipes and fittings/ specials the centre for each pipeline shall be marked by a peg. Contractor shall dig holes for and set up two posts (about 100 x 100 x 1800 mm) at each junction of pipelines at nearly equal distance from the peg and at sufficient distances there from to be well clear of all intended excavation, so arranged that a sight rail when fixed at a

certain level against the post shall cross the centre line of the pipe lines. The sight rail shall not in any case be more than 30 m apart; intermediate rails shall be put up if directed by the Employer's representative.

Boning staves of 75 mm x 50 mm size shall be prepared by Contractor in various lengths, each length being of a certain whole number of metres and with a fixed tee head and fixed intermediate cross pieces, each about 300 mm long. The top-edge of the cross piece must be fixed below the top-edge of the tee-head at a distance equal to the outside diameter of the pipe or the thickness of the concrete bed to be laid as the case may be. The top of cross pieces shall indicate different levels such as excavation for pipe line, top of concrete bed, top of the pipe etc. as the case may be.

The sight rail of size 250 mm x 40 mm shall be screwed with the top edge resting against the level marks. The center line of the pipe shall be marked on the rail and this mark shall denote also the meeting point of the center lines of any converging pipes. A line drawn from the top edge of one rail to the top edge of the next rail shall be vertically parallel with the bed of the pipe, and the depth of the bed of pipe at any intermediate point may be determined by letting down the selected boning staff until the tee head comes in the line of sight from rail to rail.

The post and rails shall be perfectly square and planed smooth on all sides and edges. The rails shall be painted white on both sides, and the tee-heads and cross-piece of the boning staves shall be painted black.

For the pipes converging to a manhole/chamber at various levels, there shall be a rail fixed for every different level. When a rail comes within 0.60 M of the surface of the ground, a higher sight-rail shall be fixed for use with the rail over the next point.

The posts and rails shall in no case be removed until the trench is excavated, the pipes are laid and the Employer's representative gives permission to proceed with the backfilling.

F. Laying of Pipes and Fittings/Specials

All precautions shall be taken during excavation and laying operations to guard against possible damage to any existing structure/pipeline of water, gas, sewage etc. After excavation of trenches, pipes shall not be lowered unless the dimensions of trenches and bedding work for pipes at the bottom of the trenches are approved and measured by Employer /Employer's representative. Pipes and fittings/specials shall be carefully lowered in the trenches. Special arrangements such as cranes, tripods with chain pulley block for lowering the pipes and fittings/specials shall be made by Contractor. In no case pipes and fittings/specials shall be dropped. Slings of canvas or equally non-abrasive material of suitable width or special attachment to fit the ends of pipes and fittings/specials shall be used to lift and lower the coated pipes and fittings/specials. The pipes and fittings /specials shall be inspected for defects and be rung with a light hammer preferably while suspended to detect cracks. If doubt persists, further confirmation shall be done by pouring a little kerosene/dye on the inside of the pipe at the suspected spot. No sign of kerosene/dye should appear on the outside surface. Pipes and fittings/specials damaged during lowering or aligning shall be rejected by the Employer's representative.

All the pipes are to be laid perfectly true both in alignment and to gradient specified. In case of spigot and socket pipe the socket end of the pipe shall face upstream, except when the pipeline runs uphill in which case the socket ends should face the upgrade. The laying of pipes shall always proceed upgrade of a slope. After placing a pipe in the trench, the spigot end shall be centered in the socket and the pipe forced home and aligned to required

gradient. The pipes shall be secured in place with approved backfill material tamped under it except at the socket. Pipes and fittings/specials which do not allow a sufficient and uniform space for joints shall be removed and replaced with pipes and fittings/specials of proper dimensions to ensure such uniform space. Precautions shall be taken to prevent dirt from entering the jointing space. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the Employer's representative. During the period that the plug is on, the Contractor shall take proper precautions against floating of the pipe owing to entry of water into the trench. Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or where long radius curves are permitted the deflection allowed at joints shall not exceed $2\frac{1}{2}\%$. In case of pipes, with joint to be made with loose collars, the collars shall be slipped on before the next pipe is laid. The pipes shall be laid such that the marking on pipes appears at the top of the pipes.

The cutting of pipe for inserting valves, fittings, or specials shall be done in a neat and workman like manner without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe. For this purpose, pipe cutting machine shall be used.

G. Thrust Blocks

Thrust Blocks shall be provided, to counteract hydraulic thrust, at places wherever directed by the Employer's representative.

H. Jointing

Jointing for pipes and fittings/specials shall be done in accordance with the relevant Employer's Requirement depending upon the type of pipes being used.

I. Testing and Commissioning

Testing and commissioning of pipes shall be done in accordance with the relevant Employer's Requirement.

J. Backfilling

Trenches shall be backfilled with approved selected excavated material only after the successful testing of the pipeline. The tamping around the pipe shall be done by hand or other hand-operated mechanical means. The water content of the soil shall be as near the optimum moisture content as possible. Filling of the trench shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressure does not occur. Backfilling shall be done in layers not exceeding 30 cm. Each layer shall be consolidated by watering, ramming, care being taken to avoid damage to the pipeline. In case of the mild steel pipes/specials, the spiders provided during assembly and welding shall be retained until the trench is refilled and consolidated. Where timbers are placed under the pipeline to aid alignment, these timbers shall be removed before backfilling.

The Contractor is requested to provide the method of Backfilling compaction test and evaluation value and obtain the approval from the Employer's representative.

K. Reinstatement of Road/Footpath

Reinstatement of road/footpath shall be done as per the requirements of local authorities and the Employer's Requirement after completion of work.

L. Clearing of Site

All surplus materials, and all tools and temporary structures shall be removed from the site as directed by the Employer's representative and the construction site left clean to the satisfaction of the Employer's representative.

2.32 Disinfection of Water Mains

The mains intended for potable water supplies should be disinfected before commissioning them for use. Special care should be taken to ensure disinfection of new mains. Among possible sources of contamination are sewer drainage, contaminated soil in the trench, contamination from workmen or their equipment of both and unavoidable foreign material present in the trench during construction.

Education of crew members as to the need for avoiding contamination of the main during construction is fundamental. Contractors and workmen should be thoroughly familiar with all pertinent state and local requirements governing installation of mains. All sewers, water mains and other underground conduits should be located prior to construction relocated, if necessary, to prevent contamination during construction. Pipe should be strung on high ground. At all times when construction is not actually in progress, watertight plugs should be installed in all pipe openings. Gunny sack and rags are not adequate. Provision should be made to pump any other water that might collect in the trench. Special care should be taken to avoid contamination of valves, fittings, and pipe interiors, both before and during construction each of them should be inspected and, if necessary, cleaned before installation.

2.32.1 Continuous Feed

In this method, water from the distribution system or other approved source and the chlorine is fed at constant rate into the new main at a concentration of atleast 20 mg/1. A property adjusted hypochlorite solution injected into the main with a hypo chlorinator, or liquid chlorine injected into the main through a solution feed chlorinator and booster pump may be used. The chlorine residual should be checked at intervals to ensure that the proper level is maintained. Chlorine application should continue until the entire main is filled. All valves, hydrants, etc., along the main should be operated to ensure their proper disinfection. The water should remain in the main for a minimum of 24 hours. Following the 24 hours period no less than 10 mg/1 chlorine residual should remain in the main.

The Contractor is requested to provide photo and take a record the value of chlorine residual at starting point and after 24 hours before completion of work.

The Employer's representative shall jointly check the test at sites. If the value is insufficient, the disinfections work shall be repeated until satisfactory results are achieved.

Waste chlorine residual water must be neutralized before it is discharged to any drainage.

2.32.2 Slug Method

In this method a continuous flow of water is fed with a constant dose of chlorine (as in the

previous method) but with rates proportioned to give a chlorine concentration of at least 300 mg/l. The chlorine is applied continuously for a period of time to provide a column of chlorinated water that contacts all interior surfaces of the main for a period of at least 3 hours. As the slug passes tees, crosses, etc., proper valves shall be operated to ensure their disinfection. This method is used principally for large diameter mains where continuous feed is impractical.

Regardless of the method used, it is necessary to make certain that backflow of the strong chlorine solution into the supplying line does not occur. Following the prescribed contact period, the chlorinated water should be flushed to waste until the remaining water has a chlorine residual approximating that throughout the rest of the system. Bacteriological tests as prescribed by the authorities should be taken, and if the results fail to meet minimum standards, the disinfecting procedure should be repeated and the results again tested before placing the main in service.

If continuous feed method is difficult to apply, Retention Method shall be considered as alternative way.

The area or pipe line to be disinfected shall be fed with chlorine solution from upstream under flowing water condition, and then the area shall be blocked after make sure to reaching more than 20 mg/l. The chlorine solution fed in the pipeline needs to wait for 1 day before starting measurement of residual chlorine. After 3 days later, the chlorine residual value shall be tested at sampling points at upstream and at downstream near to end to check whether the value is in range or not.

The Contractor shall provide photo and take a record the value of chlorine residual at starting point and after 24 hours before completion of work.

The Employer's representative shall jointly check the test at sites. If the value is insufficient, the disinfections work shall be repeated until satisfactory results are achieved.

Waste chlorine residual water must be neutralized before it is discharged to any drainage, as approved by Employer's representative.

A. Surface Preparation

The interior surface of pipe to be lined shall be cleaned to remove all rust, chemical or other deposits, oil, grease and all accumulations of water, dirt, and debris. The cleaning of the surface shall be carried out by the use of suitable chemical or mechanical means to the approval of the Employer's representative. The extent of cleaning shall be to the satisfaction of the Employer's representative.

All loose mill scale, dirt, rust, and accumulation of construction debris shall be removed from the interior of the steel pipeline. The pipeline shall be cleaned by use of power-driven cleaner incorporating revolving brushes on rotating arms.

Immediately prior to the travel of the lining machine through the pipeline, all foreign material shall be removed. This includes sand and loose mortar that might have accumulated since the work of preparation of surfaces was completed.

B. Thickness of coating

Coating shall be uniform in thickness. The coating thickness shall be of minimum 406 microns.

C. Coating Procedure

The coating shall be placed by centrifugal method in one course by a machine travelling through the pipe and discharging the coating over all pipe sections and long radius bends. The rate of travel of the machine and the rate of discharge shall be mechanically regulated so as to produce uniform thickness throughout.

D. Surface Finish

Coating shall be mechanically trowelled except for the places where hand troweling is expressly permitted by the Employer's representative.

The coating machine shall be provided with attachments for mechanically troweling. Both the application and troweling of the coatings shall be such that the freshly placed and trowelled coatings will not be damaged. The trowel attachment shall be such that the pressure applied to the pipe will be uniform and produce a lining of uniform thickness with a smooth and even finished surface free of spiral shoulders. The finished surface of machine-placed and trowelled linings in pipe shall be examined according to the following procedure.

Thickness of lining shall be ascertained frequently during placing of mortar and troweling using an approved non-destructive method.

In the stretch of pipe that has been lined and trowelled in each day's run, ten places shall be selected in straight sections of the pipe by the Employer's representative. In each of the ten places the thickness of the lining shall be re measured by non-destructive means as directed by the Employer's representative.

Defects in coatings including but not restricted to voids, blisters, cracked and dummy areas, and thin spots shall be removed, and the area shall be repaired to the full required thickness of the mortar lining. Defective areas encompassing the full diameter of the pipe shall be replaced by machine. Defective lining rejected at the time of lining shall be removed before initial set of the mortar. Defective lining rejected after initial set shall be replaced or repaired by the most practical method as determined by the Employer's representative.

Hair cracks or cracks up to 0.25 mm width and not over 300 mm in length in finished linings may be considered acceptable at the discretion of the Employer's representative but larger cracks shall be repaired or removed and redone all as directed by the Employer's representative.

E. Hand Application

Coating of bends, specials, areas closely adjacent to valves and other such places where machine placing may not be practical shall be performed by hand. The Employer's representative may order the correction for any defect by hand application.

Coatings for hand work shall be of the same materials as the coatings for machine placed

coatings.

The areas to be coated shall be thoroughly cleaned as specified earlier and, if necessary, shall be moistened with water immediately prior to placing the hand-applied mortar.

Steel finishing trowels shall be used for the hand application of coatings except at bends the outer edges of hand trowelled areas may be brushed in order to reduce the abutting offset.

All hand finishing work in a section of the pipeline shall be completed within 24 hours after completion of the machine application of mortar lining that section. If necessary, application of mortar lining by machine shall be delayed or stopped to assure compliance with this schedule.

Hand placed coatings shall have a uniform and smooth surface with smooth transitions to adjacent machine placed linings.

F. Backfilling

On completion of the pipe laying operations in any section, for a length of about 100 m and while further work is still in progress, refilling of trenches shall be started by the Contractor with a view of restricting the length of open trenches. Pipe laying shall closely follow the progress of trench excavation and the Contractor shall not permit unreasonably excessive lengths of trench excavation to remain open while awaiting testing of the pipeline. If the Employer's representative considers that the Contractor is not complying with any of the foregoing requirements, he may prohibit further trench excavation until he is satisfied with the progress of laying and testing of pipes and refilling of trenches. Filling to a level of 300 mm above the crown of the pipe shall be done in accordance with the requirements of the clause on bedding. Care shall be taken during backfilling, not to injure or disturb the pipes, joints or coating. Filling shall be carried out simultaneously on both sides of the pipes so that unequal pressure does not occur. Walking or working on the completed pipeline shall not be permitted unless the trench has been filled with the instructed bedding and surround material up to height of at least 300 mm over the top of the pipe except as may be necessary for tamping etc., during backfilling work.

The remaining portion of the trench shall be filled in with selected excavated material free from and topsoil, vegetation or boulders and clods of earth larger than 75 mm in size. Filling shall be done in layers not exceeding 150 mm in thickness accompanied by adequate watering, ramming etc., so as to be compacted to 95% of the maximum dry density as per Part 7 of IS: 2720. The water contents of the soil shall be kept as near the optimum moisture content as possible. The trench shall be refilled so as to build up to the original ground level, keeping due allowance for subsequent settlement likely to take place. The surface of the refilled excavations shall be left slightly higher than the adjacent ground and be maintained by the Contractor to a smooth even slope.

The Employer's representative shall, at all times, have powers to decide which portion of the excavated materials shall be used for filling and in which portion of the site and in what manner it shall be so used.

If suitable material for refilling is not available from already excavated material, the Contractor shall import material of approved quality as directed by the Employer's representative.

Regular measurement of the field dry density shall be taken by the Contractor at various levels in the backfilling as required by the Employer's representative.

No mechanical plant other than approved compacting equipment shall run over or operate within the trench until backfilling has reached its final level or the approval for the Employer's representative has been obtained.

Should any subsidence take place either in the filling of the trenches or near about it during the works the Contractor shall make good the same at his own cost.

Surplus excavated material shall be used to fill in any low spots above the pipeline which are identified on the Drawings or are instructed by the Employer's representative. Such material shall be evenly placed and compacted in layers not exceeding 200 mm thick after compaction. The method of compaction employed shall achieve not less than 90% maximum dry density as determined from IS: 2720 (Part 7). Unless approved of by the Employer's representative, the width of areas to be filled shall not exceed 20m.

2.32.3 External Coal Tar Enamel coating

Unless otherwise specified or stated on the drawings the pipeline to be laid underground and the exposed pipeline supported on saddles shall be Coal Tar Enamel coated. Coating shall be in accordance with IS: 1916.

A. Thickness of coating

Detailed proposals of the coating method, materials and apparatus to be used for both factory and site application shall be submitted to and approved by the Employer's representative before work starts. Storage and application shall be in accordance with recommendations of the coating MANUFACTURER, but as a minimum:

- ☐ A visual examination of the surface to be coated shall be carried out and any slivers or similar deposits removed.
- ☐ Prior to blasting all oil and grease shall be removed from the surface to be coated.
- ☐ Preparation of steel surfaces for both factory and site application shall be to a minimum of Sa 2.5 in accordance with BS 7079/ ISO 8501-1:2007 specifications /or as per client specifications and roughness should be 50-75 micron.
- ☐ The surface to be coated shall be dry, clean and free from foreign material and coating shall take place before any surface rusting and at least within 4 hours of blasting.
- ☐ Surface preparation and coating shall not be carried out when the relative humidity exceeds 85% or when the surface to be coated is less than 3 deg C above the dew point.
- ☐ The coating shall have a minimum DFT (Dry Film Thickness) of 406 microns.
- ☐ Coatings shall be used within the pot life specified by the MANUFACTURER.

Pipe coatings shall be inspected on site, and damaged, defective or otherwise unsatisfactory coatings may be condemned. All defective areas shall be made good to the satisfaction of the Employer's representative. Inspection and testing shall be detailed in the contractors Quality Plan and as a minimum undertaken to the following frequencies:

- ☐ Visual Inspection of blasted profile on every pipe to be coated.
- ☐ Visual inspection of finished coating on every pipe.
- ☐ Measurement of coating thickness at four points on each pipe

- ☐ Each completed pipe shall be subjected to holiday detection tests which shall be carried out to the satisfaction of the Employer's representative. The applied voltage shall be those appropriate to the coating under test as recommended by the coating material MANUFACTURER.
- ☐ Peel Test as per Manufacturers standard specification shall also carried out.

B. Surface Preparation

The surface of all pipes to be coated shall be thoroughly cleaned by hand or by sand steel grit blasting if necessary. After cleaning the external surface of pipe shall be given a coat of cement wash.

All oil and greases on the surface of the metal shall be removed thoroughly by flushing and wiping using suitable solvents and clean rags. The use of dirty or oily rags will not be permitted. All other foreign materials shall be removed by buffing or by scrapping and wire brushing. After cleaning, the pipe shall be protected and maintained free of all oil, grease and dirt that might fall upon from whatever source until the pipe has received its cement mortar coating.

If blasting is necessary, all metal surfaces shall be thoroughly blasted to bright metal. Blasted surface which acquire a coat of rust shall be cleaned/reblasted as directed by the Employer's representative.

C. Internal Coating: Solvent Free Food Grade Epoxy Linings

All steel pipes and fittings shall be internally coated with a food grade epoxy approved for contact with potable water under the United Kingdom Water Regulations Advisory Scheme authorized for use under Regulation 31 (4)(a) of the water supply (Water Quality) Regulations 2000 for contact with potable water. The applicable specifications for the coating system shall be in accordance with BS 6920/NACE RP-01-75/AWWA C210-97 or clients specifications.

The coal tar enamel coating system shall be factory coated and shall be of BWSSB approved make only.

All steel pipes shall be lined at the factory. Pipes welded on site shall be coated on site to the same standards as for pipes.

Detailed proposals of the lining method, materials and apparatus to be used for both factory and site application shall be submitted to and approved by the Employer's representative before work starts. Storage and application shall be in accordance with recommendations of the coating MANUFACTURER, but as a minimum:

- ☐ A visual examination of the surface to be coated shall be carried out and any slivers or similar deposits removed.
- ☐ Prior to blasting all oil and grease shall be removed from the surface to be coated.
- ☐ Preparation of steel surfaces for both factory and site application shall be to a minimum of Sa 2.5 accordance with BS 7079/ ISO 8501-1:2007 specifications /or as per client specifications and roughness should be 50-75 micron.
- ☐ The surface to be coated shall be dry, clean and free from foreign material and coating shall take place before any surface rusting and at least within 4 hours of blasting.

- ☐ Surface preparation and coating shall not be carried out when the relative humidity exceeds 85% or when the surface to be coated is less than 3 deg C above the dew point.
- ☐ The coating shall have a minimum DFT (Dry Film Thickness) of 406 microns.
- ☐ Coatings shall be used within the pot life specified by the MANUFACTURER.

Pipe coatings shall be inspected on site, and damaged, defective or otherwise unsatisfactory coatings may be condemned. All defective areas shall be made good to the satisfaction of the Employer's representative. Inspection and testing shall be detailed in the contractors Quality Plan and as a minimum undertaken to the following frequencies:

- ☐ Visual Inspection of blasted profile on every pipe to be coated.
- ☐ Visual inspection of finished coating on every pipe.
- ☐ Measurement of coating thickness at four points on each pipe
- ☐ Each completed pipe shall be subjected to holiday detection tests which shall be carried out to the satisfaction of the Employer's representative. The applied voltage shall be those appropriate to the coating under test as recommended by the coating material MANUFACTURER.
- ☐ Peel Test as per Manufacturers standard specification shall also carried out.

D. Inspection

Pipe coatings shall be inspected prior to transports, to laying site and broken, defective or otherwise unsatisfactory areas may be rejected at any time during construction. All defective areas shall be made good to the satisfaction of the Employer's representative. Coating cracks over 0.25 mm wide or over 500 mm long shall be made good.

2.33 Painting

2.33.1 General

The Contractor shall be responsible for the cleaning, preparation for painting, and priming or otherwise protecting as specified of all parts of the Plant at the place of manufacture prior to packing.

Parts may be cleaned but surface defects may not be filled in before testing at the manufacturer's works. Parts subject to hydraulic test shall be tested before any surface treatment. After test, all surfaces shall be thoroughly cleaned and dried out if necessary by washing with an approved de-watering fluid prior to surface treatment. Except where the Specification provides to the contrary all painting materials shall be applied in strict accordance with the paint manufacturer's instructions.

All protective coatings shall be suitable for use in warm humid climates.

All surfaces shall be rubbed down before the application of a subsequent coat of paint and where possible successive coats shall be of slightly different colors to enable them to be readily distinguishable. No paint shall be applied to dirty, greasy, dusty or damp surfaces.

Where grit blasting is specified this shall be done at the place of manufacture in accordance with BS 7079. The finish shall be between "First Quality" and "Second Quality" given in Table 1 of the above BS and the maximum amplitude of the finished surface shall not exceed 0.1 mm. The first coat of primer shall be applied before the development of any detectable

moisture or corrosion and, in any case, within four hours of completion of the grit blasting.

Galvanizing shall be carried out in accordance with BS EN ISO 1461:2009. Minimum thickness of 120 microns shall be ensured with coating thickness gauge.

2.33.2 Painting at Place of Manufacture

All stages in painting including cleaning and surface treatment in the manufacturer's works shall be available for inspection. Where grit blasting is specified a specimen of steelwork shall be submitted for inspection before work starts as an example of the standard of surface finish to be maintained throughout further work.

The final surface treatment before dispatch and before packing shall be inspected.

a) BRIGHT STEEL PARTS

Bright steel parts and bearing surfaces shall be thoroughly polished and protected from corrosion by the application of an approved rust preventive lacquer or high melting point grease, as approved by the Employer's representative, before the parts are packed. A sufficient quantity of the correct solvent for removal of the protective compound shall be supplied and packed with each particular part.

b) NON-FERROUS PARTS

All surfaces of non-ferrous parts are to be protected from corrosion by the application of approved grease. Individual parts shall be prevented from touching during shipping by wrapping them separately with waterproof paper or tape. Care shall be taken to ensure that galvanic corrosion does not take place due to contact of dissimilar metals.

c) EMBEDDED PARTS

Those parts of an assembly, which will be embedded in concrete shall be thoroughly descaled and cleaned before packing. Before the parts are built in they shall be inspected and any excessive scale removed.

d) EXPOSED FERROUS PARTS OTHER THAN PIPES INSIDE BUILDINGS

All exposed ferrous surfaces which will not be submerged below water or any other liquid or exposed to damp conditions shall be rubbed down, and well cleaned and given one coat of red lead primer to BS 2523 Type C & BS 7956:2000 before packing.

e) STEEL PIPEWORK

All surfaces shall be thoroughly cleaned by grit/sand blasting to BS 7079:2009. The external surfaces shall be protected by approved paint. The internal surfaces shall be painted as follows:

- ☐ Zinc sprays 2 coats, total thickness 75 microns.
- ☐ Coating of "Biturous Solution" applied as primer. Finally the surface to be painted with "Biturous enamel" and tests carried out for taste and odour as stated above. Total thickness

after final painting to be at least 150 Microns.

The Bidder may submit, for approval, any other equivalent paint which shall be free of phenolic compounds and will not impart objectionable tastes and odours when placed with chlorinated or unchlorinated waters for long periods.

f) SUBMERGED STEELWORK

All submerged steel parts or parts exposed to damp conditions shall either be hot dip galvanised (120 microns thick) or be grit blasted and primed with a zinc dust epoxy resin based coating giving a dry film thickness of at least 50 microns.

2.33.3 Painting at Site

Immediately on arrival at the Site all items of Plant shall be examined for damage to the priming coat applied at the manufacturer's works, and any damaged portions shall be cleaned down to the bare metal, all rust being removed, and the priming coat made good with similar paint. Color of finish paint of various items shall be 692 (smoke grey) and 631 (admiralty grey) for indoor and outdoor equipment respectively. The paint shade references are as per IS 5.

After erection and building-in all items of Plant shall be cleaned down and painted as follows to the standard known as Waterworks Finish.

(a) EXPOSED FERROUS PARTS OTHER THAN PIPES INSIDE BUILDINGS

All exposed ferrous surfaces painted with red lead primer shall be given a further priming coat of red lead primer followed by two undercoats and one coat of approved gloss finish.

(b) CAST IRON AND STEEL PIPEWORK INSIDE BUILDINGS

Pipe work supplied with coal tar coatings shall be given two coats of approved metallic sealer followed by an undercoat and one coat of approved gloss finish. Suitable external painting shall be done as indicated above.

(c) GALVANISED PARTS

Galvanized surfaces shall be phosphate using a brush applied wash. The phosphated surface shall be washed and given two coats of either a chlorinated rubber or an epoxy based paint, as appropriate for the service conditions to which it will be subjected. Where phosphating cannot be carried out the pigment in the priming coat shall contain at least 70% of calcium plumbate.

(d) SUBMERGED STEELWORK

Submerged steelwork shall receive one coat of epoxy based heavy coal tar pitch giving a total dry film thickness of at least 8 mils/200 Microns In the case of fabricated steelwork this work shall be done after assembly.

Transformer tank, radiators and conservator shall be shot blasted to remove all scale after degreasing by emulsion application. A two coat stoving primer shall be immediately applied after shot blasting.

Before painting is commenced the Contractor shall submit for the approval of the Employer's representative, full details of the paints he proposes to use together with color charts for the gloss finishes. The Employer's representative will decide the colors for the various pipe runs and items of Plant.

The first in-situ coat shall in all cases be applied immediately after the items of Plant have been erected and built in. Other under-coats shall be applied as soon as practicable after completion of erection and of placing concrete in the area concerned. Finishing coats shall not be applied until the Employer's representative considers that there is negligible risk of subsequent damage by the Contractor or other contractors. All paint and coating thickness shall be measured by approved Elcometer or coating thickness gauge.

Immediately prior to the end of the Period of Maintenance all damaged paint work shall be touched up, except where the damage is due to fair wear and tear.

2.33.4 Painting of Valves

a. PRIOR TO INSPECTION

- ☐ Surface Preparation: Sand Blasting to SA 2 ½ Grade – Near white blast cleaning.
- ☐ Application of Primer Coating after blast cleaning

b. POST INSPECTION

- ☐ **Application of Intermediate Coat:**

One coat of two component high build polyamide crude re-coatable epoxy coating to achieve DFT 150 micron.

- ☐ **Application of Finish Coat:**

One coat of two component aliphatic polyurethane finish to achieve DFT 100 micron.

The Total minimum DFT shall be of 250 microns is to be achieved.

SECTION 6

ANNEXURE 3

GENERAL WORKMANSHIP, MATERIAL REQUIREMENTS

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GENERAL WORKMANSHIP, MATERIAL REQUIREMENTS

3.1 Introduction

This part of the Employer's Requirements sets out the standards of materials, workmanship to be used by the Contractor for Works.

All equipment's used for the Works shall, unless otherwise specified, comply with the provisions of this part.

The names of the manufacturers of materials and equipment proposed for incorporation in the Works together with performance, capacities, certified test reports and other significant information pertaining to the same, shall be furnished when requested for consideration by the Employer's Representative, who shall have power to reject any parts which in his opinion are unsatisfactory or not in compliance with the Specifications and such parts shall be replaced by the Contractor at no extra cost to the Employer.

3.2 Compliance with Standards

The British Standard specifications shall refer to the latest issue or revision of those standards as issued by the British Standards Institution of 2 Park Street, London W1 and the Indian Standard Specifications as issued by the Bureau of Indian Standards. Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110 001 and ASTM standards as issued by the American Society for Testing and Materials, 1916, Race Street, Philadelphia, PA, 19103, U.S.A and ANSI standards as issued by the American National Institute, 1430, Broadway, New York, NY 10018, U.S.A. Equipment conforming to other national or international standards shall be at least equivalent to those specified and shall be subject to approval by the Engineer. Full details of the difference shall be supplied by the Contractor.

Where the design or choice of materials of plants is affected by the Factory Acts, then the materials and plant supplied shall comply with all relevant sections of those Acts even though no particular reference may be made in this Specification.

3.3 Materials General

All materials incorporated in the Works shall be the most suitable for the duty concerned and shall be new and of first class commercial quality, free from imperfections and selected for long life and minimum maintenance.

All submerged moving parts of the equipments, or components such as pins and spindles, for example, of the submerged moving parts or the faces in contact with the parts shall be of corrosion resistant metals and all submerged fasteners, nuts and bolts shall be of SS316. All

parts in direct contact with various chemicals, shall be completely resistant to corrosion, or abrasion by these chemicals, and shall also maintain their properties without aging due to the passage of time, exposure to light or any other cause.

Where "stainless steel" is specified or used it shall have resistance to atmospheric corrosion not less than that provided by B.S.970, Grade 410 S21 for forgings and B.S. 3100, Grade 410-C-21 for castings. Particular attention shall be made to the prevention of seizure by fretting where two corrosion resistant metals are in contact, by the selection of materials of suitable relative hardness and surface finish and the application of lubricants. Where bronze is specified or used it shall be zinc free, to B.S. 1400, Group B- PB1.

Particular attention shall be paid to the prevention of corrosion due to the close proximity of dissimilar metals. Where it is necessary to use dissimilar metals in contact, these shall be selected so that the bimetallic corrosion is as low as possible. The publication by H. M. Stationery Office (in the U.K.) entitled "Corrosion and its Prevention at bimetallic Contacts" shall be used as a guide.

3.4 WORKMANSHIP GENERAL

Workmanship and general finish shall be of first class commercial quality and in accordance with best workshop practice.

All similar items of the Plant and their component parts shall be completely interchangeable. Spare parts shall be manufactured from the same materials as the originals and shall fit all similar items. Machining fits on renewable parts shall be accurate and to specified tolerances so that replacements may be readily installed.

All equipment shall operate without excessive vibration and with a minimum of noise. All revolving parts shall be truly balanced both statically and dynamically so that when running at normal speeds at any load up to the maximum there shall be no vibration due to lack of balance.

All parts which can be worn or damaged by dust shall be totally enclosed in dust proof housings.

3.5 Life of Equipment & Material

All materials and equipment procured under Contract shall have long life and shall be suitable for continuous 24 hour per days operation for prolonged periods with a minimum of maintenance and the Contractor may be called upon to demonstrate this for any component either by the service record of similar equipment elsewhere or by records of extensive type tests.

Routine maintenance and repair shall as far as possible, not require the services of highly

skilled personnel.

Except for consumable items such as rubber bushings, gland packings, carbon brushes etc. which normally require replacement more frequently, no part subject to wear shall have a life from new to replacement or repair of less than three years of continuous normal operation and where major dismantling is required to replace a part, such life shall be not less than ten years.

3.6 WELDING

3.6.1 Design Approval

Welding shall comply with BS EN 1011 code latest Revision. In all welded fabrications, before fabrication commences, the Contractor shall submit to the Engineer detailed drawings of fabrication with sizes of weld and weld preparation together with the details of the application codes. No welding shall be carried out before approval of the details by the Engineer. No alternations shall be made to any previously approved details of weld preparation or size without prior approval of Engineer.

3.6.2 Qualification of Welders and Procedures

Welders shall be qualified in accordance with the requirement of the appropriate section of BS EN ISO 9606-1. The Engineer shall have the right to call for further qualification from time to time from any welder who in the opinion of the Engineer does not produce weld in accordance with the qualification. Each welder shall be assigned a number and letter. Each weld shall clearly be identified as to its welder marking the welder's code adjacent to the welds. A record chart shall be maintained for each welder showing the procedures, for which he has qualified, the date of such qualification, the type of defects produced and their frequency. Engineer shall disqualify the welder whose work requires a disproportionate amount of repairs. All procedures where required shall be qualified as per BS EN ISO 14732:2013.

3.6.3 General Welding Requirements

Inspection and quality of surveillance shall not be limited to the examination of finished welds. All aspects of materials, fabrication procedures and examination procedures shall be subject to the approval of the Engineer's. The equipment used shall be suitable for the quality of work specified. The techniques employed shall be based on methods which are known to produce good results and which have been verified at Site by actual demonstration.

Haphazard striking of the electrodes for establishing arc shall not be permitted. The arc shall be struck either on the joint or on a starting tag. The starting tag shall be of the same material or a material compatible with the base metal being welded. In case of any inadvertent strike on place other than the welding, the area affected shall be ground flushed

and examined by liquid penetration methods.

Generally, a stringer bead technique shall be used with a slight oscillation if necessary to avoid slag and to minimise the number of beads needed to fill the joint. However, the width of the deposited pass shall not exceed 3 times the wire diameter. Vertical welds shall be made in upward direction. For all pipes above 300 mm. dia., welding shall be done whenever possible, by 2 welders working simultaneously both sides of the pipe.

All joint fit ups shall comply with the tolerances specified on the design drawings. All fit ups shall be examined by Engineer before root pass. The root pass shall have less than 1.5 mm internal reinforcement. Defects like icicles burn through and excessive "suck back", etc. shall be cause for rejection of welds.

Final welds shall be suitable for appropriate fabrication of the non-destructive examination of the weld. If grinding is necessary, the weld shall be blended into the parent metal without gouging or thinning of the parent metal in any way. Uneven and excessive grinding may be a cause for rejection. Fillet weld shall preferably be convex and free from undercutting and overlap at the toe of weld. Convexity and concavity shall not exceed 1.5 mm. The leg lengths shall not exceed the specified size by more than 1.5 mm.

All attachments such as lugs, brackets and other non pressure parts shall also be done by qualified welders in accordance with the design details and material specifications. Temporary attachments shall be removed in a manner that will not damage the parent metal. Areas of temporary attachments shall be dressed smooth and examined by ultrasonic or liquid penetration methods. If weld repairs are necessary, they shall be made using qualified procedures and welders and examined by ultrasonic/ liquid penetration methods.

All tack welds shall be made using qualified procedure and welders, the number and size of tack welds shall be kept as small as to consist of adequate strength and joint alignments. All tack welds shall be examined visually for defects and if found defective shall be completely removed. As welding proceeds, tack welds shall be either removed completely or shall be properly prepared by grinding or filing their starting ends so that they may be satisfactorily incorporated in the welds. Unacceptable defects shall be removed by grinding machine or chipping or gouging.

All weld repairs shall be carried out using the approved welding procedures and welders. Preparation of weld repair shall have the prior approval of the Engineer. Re-welded areas shall be re examined by the methods specified for the original weld and repair procedures shall be duly qualified by the Engineer.

All welded components shall be stress relieved prior to matching.

3.6.4 Pre-heating and Post-heating Treatment

Pre-heating and post-heating treatment shall conform to the relevant application codes.

Pre-heating not exceeding 121 deg C for all carbon steel construction above 25 mm. thickness would be mandatory. Such pre-heating would be maintained during flame cutting, flame or arc gouging, welding and repairs and may be done by gas heating by gas torches/gas rings with neutral flame. The temperature shall be checked by temperature indicating crayons. However, such pre-heating will not be necessary for welds less than 6 mm size. In large diameter pipes, fabricated out of plate materials, production control test plates in accordance with the BS EN ISO 14732 to represent 30% of the long seams and each welder's performance would be mandatory.

3.6.5 Electrodes

The brands of electrodes to be used shall be submitted for approval of Engineer. All electrodes shall be stored in their original sealed containers under dry conditions. Electrodes shall remain identified until consumed. All electrodes shall be dried before use. Drying ovens shall be provided in work areas for drying purposes. Electrode withdraw from oven shall be promptly used and excess unused electrodes shall be promptly returned to oven.

3.6.6 Examination/NDT/Radiography

The various stages of examination and types shall be as stipulated in the respective fabrication code. Radiographic examination shall be carried out as per provisions of BS EN ISO 17636-2:2013, ultrasonic tests, where called for, shall be carried out as per provisions of BS EN ISO 17640:2018; magnetic particle tests shall be carried out as per BS EN ISO 9334-1:2006. Liquid penetration tests shall be carried out as per BS EN ISO 3452-1:2013.

3.6.7 Stainless Steel Welding

All welding consumable such as electrodes, filler weirs, argon gas for shielding and purging shall be of high quality and the proposed brand shall be furnished for approval of the Engineer. Weld deposits shall have similar or higher physical properties and similar chemical composition to the members joined.

All electrodes shall be purchased in sealed containers only and stored in their packing intact. The packets opened shall be consumed as early as possible. The electrodes removed from the containers shall be kept in holding ovens at temperatures recommended by electrode manufacturer. Special care shall be taken in avoiding mixing of electrodes in the oven. The electrodes and filling wires shall be free from rust, oil, grease, earth and other foreign matter.

Argon gas with purity 99.5% shall be used for shielding and purging. The purity of gas shall be certified by the gas manufacturers.

Non destructive examination of the welds shall be carried out to ensure quality of weld.

The electric current for welding shall be direct current, straight polarity (electrode negative).

The welding current shall be kept minimum possible to ensure minimum heat affected zone in the parent material. Other side of the weld joint shall be periodically flushed with argon gas.

3.7 Castings

Ductile-iron shall be of standard grey close-grained quality to DI IS 1865 Gr.500/7 or better. The structure of the castings shall be homogeneous and free from non-metallic inclusions and other injurious defects. All surfaces of castings which are not machined shall be smooth and shall be carefully fettled to remove all foundry irregularities.

Minor defects in depth not exceeding 2.5 percent of total metal thickness and which will not ultimately affect the strength and serviceability of the casting may be repaired by approved welding techniques. The Engineer shall be notified of larger defects and no repair welding of such defects shall be carried out without prior approval of the Engineer/his Representative. If the removal of metal for repair should reduce the stress-resisting cross-section of the casting by more than 25 percent, or to such an extent that the computed stress in the remaining metal exceeds the allowable stress by more than 25 percent, then that casting shall be rejected. Test coupons cast simultaneously with the main castings shall be identified by the Engineer/or his Representative to check physical, chemical analysis of casting.

Castings repaired by welding for major defects shall be stress-relieved after such welding. Castings subject to hydraulic pressure shall be pressure tested to 1 1/2 times the rated pressure or, twice the working pressure, whichever is higher and certified copies of test reports shall be forwarded to the Engineer as soon as each test has been completed.

Non-destructive tests as directed by the Engineer will be required for any casting containing defects whose extent cannot otherwise be judged, or to determine whether repair welds have been properly made.

3.8 Forgings

All major stress-bearing forgings shall be made to a standard specification which shall be submitted to the Engineer for approval before work is commenced. Forgings shall be subjected to magnetic particle testing or dye penetration test at the areas of fillets and change in section. The testing shall be conducted after rough machining (10 microns). Any defect which will not machine out during the final machining, will be gouged out fully, inspected by dye penetration or magnetic particle inspection to ensure that the defect is fully removed and repaired using an approved repair procedure. Any indication, which proves to penetrate deeper than 2.5% of the finished thickness of the component, shall be reported to the Engineer giving the details like location, length, width and depth. For the magnetic particle inspection the choice of wet or dry particles shall be at the Contractor's

discretion. All forgings shall be de-magnetised after test and shall be heat treated for the relief of residual stresses. The name of the maker and particulars of the heat treatment proposed for each such forging shall be submitted to the Engineer. The Engineer or the Inspector may inspect such forgings and identify test coupons to check physical and chemical analysis and witness such tests at the place of manufacture with a representative of the Contractor.

3.9 Lubrication

The Contractor shall furnish a complete schedule of recommended oils and other lubricants. The number of different types of lubricants shall be kept to a minimum. The schedule and the name of the supplier of the lubricants shall be submitted to the Engineer for approval before incorporation in the Instruction Manuals. In the case of grease lubricated roller type bearings for electrical motors a lithium base grease is preferred.

Contractors shall indicate indigenously available equivalent lubricants, with complete duty specification, to enable the Engineer to arrange for regular supply.

Where lubrication is effected by means of grease, preference shall be given to a pressure system, which does not require frequent adjustment or recharging. For this purpose, frequent, means more than once in a week and grease system having shorter periods between greasing should be avoided. Where necessary for accessibility grease nipples shall be placed at the end of the extension piping, and, when a number of such points can be grouped conveniently, the nipples shall be brought to a battery plate mounted in a convenient position. 'Hydraulic' button head type nipples, in accordance with IS 4009, shall be used for normal grease. All grease nipples shall be of the same size and type for every part of the Plant. Arrangements shall be provided to prevent bearings being overfilled with either grease or oil.

Where, more than one special grease is required, a grease gun for each special type shall be supplied and permanently labelled.

Oil containers shall be supplied complete with oil level indicators of the sight glass type, or where this is not practicable, with dipsticks. The indicators shall show the level at all temperatures likely to be experienced in service. The levels shall be clearly visible in the sight glass type from the normal access floor to the particular item of Plant and they shall be easily dismantled for cleaning. All sight glasses shall be firmly held and enclosed in metal protection in such manner that they cannot be accidentally dislodged.

All lubrication systems shall be designed so as not to cause a fire or pollution hazard and particular care shall be taken to prevent leakage of lubricants and to avoid leaking lubricants coming into contact with any electrical equipment, heated surfaces or any other potential source of fire or with water in the supply system.

The Contractor shall supply flushing oil for each lubrication system when an item of Plant is ready for preliminary running and a sufficient quantity of the approved lubricants for the

commercial operation of the Plant for two years after the taking-over certificate has been issued.

3.10 Equipment Components

Iron and steel parts shall in general be painted or galvanised as appropriate in accordance with the Specification. Indoor parts may alternatively have chromium or copper-nickel plating or other approved protective finish.

Small iron and steel parts (other than stainless steel) of all instruments and electrical equipment, the poles of electro-magnets and the metal parts of relays and mechanisms shall be chromium or copper- nickel plated or have some other approved finish to prevent rust. Cores, etc., which are built up of laminations or cannot for any other reason be antirust treated, shall have all exposed parts thoroughly cleaned and heavily enamelled, lacquered or compounded.

3.11 Safeguarding of Machinery

The Contractor shall ensure that equipment procured under Contract for which he is responsible is safe. Nothing in this Requirement shall remove the Contractor's obligation from construction drawing the attention of the Employer's Representative to any feature of the Works which is not consistent with safety, or to prevent him making proposals for incorporating equipment or designs which would increase the safety of the overall Tubewell area.

All rotating shafts, couplings, gears, flywheels, belt drives or other moving parts shall be fully guarded. Guards shall be designed to provide ready access to bearings, grease points, thermometer sockets and other check points and to allow safe routine observation and servicing to be executed without the need to dismantle any part of their structure.

3.12 Rating Plates, Nameplates and Labels

All equipment, apparatus shall be clearly labelled or fitted with nameplates and rating plates generally as follows:

3.12.1 Indoor Type Labels

- (a) Labels for the outside of equipment shall be of a rigid type laminated and engraved plastic material, with black block capitals on a white background. The labels shall be fixed by non-rusting screws, or similar approved fixing device.
- (b) Labelling inside equipment shall be as above except that a flexible self-adhesive type labelling may be used if suitable for the ambient temperatures

and if not less than 12 mm in width.

3.12.2 Weatherproof Labels

These labels may be vitreous enamelled or brass. Plastic labels will not be accepted unless proof can be given that the labels can withstand the environmental conditions at Site.

Vitreous enamelled labels shall be secured by brass or non-rusting roundhead screws, with brass and fibre washers in contact with the enamel front and back to prevent damage.

3.12.3 Name and Rating Plates

Each main and auxiliary item of equipment shall have permanently attached to it in a conspicuous position a nameplate and a rating plate. Upon these shall be engraved the manufacturer's name, type and serial number of equipment, details of the loading and duty at which the item of tube well has been designed to operate, and such diagrams as may be required by the Employer's Representative. All indicating and operating devices shall have securely attached to them or marked upon them a designation as to their function and proper manner of use. Provision shall be made to incorporate descriptive numbering codes as indicated on the Record Drawings. Details of proposed plates, labels and inscriptions shall be submitted to the Employer's Representative for approval before manufacture.

3.13 Instruments

Unless otherwise specified, any indicating and recording instruments supplied under the Contract shall be approved by the Employer's Representative. They shall be flush-mounted pattern with dust- and moisture-proof covers and shall be suitable for the environment in which they are installed. Where hinged covers are necessary, they shall be provided with locks.

Indicating instruments shall be of the dial type and shall be provided with a readily accessible zero adjustment.

Dials in general shall be white with black markings and not subject to fading. Scales shall be of such material that no peeling or discoloration will take place with age under humid conditions.

Motor ammeters shall be capable of withstanding the starting current and shall have a compressed overload scale.

Steel screws, when used, shall be zinc, cadmium or chromium-plated, or where plating is not possible due to tolerance limitations, shall be of stainless steel. Instrument screws (except those forming part of a magnetic circuit) shall be of brass or bronze. Springs shall be non-rusting materials, e.g. phosphor-bronze or nickel-silver, as far as possible. Pivots and other parts for which non-ferrous material is unsuitable shall be of stainless steel.

Pressure gauges shall be not less than 150 mm diameter unless otherwise mentioned in bill of quantities or specification. The internal components shall be of stainless steel, bronze or some other corrosion resistant material other than aluminium. The gauges may be mounted directly on the pipe work or side by side on a board or panel. Each pressure gauge shall be fitted with a stop cock immediately adjacent to the gauge, and all pressure gauge piping shall be fitted with an isolating valve at each point of connection to the main system. Where pressure gauges are mounted on panels, the isolating valve shall be suitable for the connection of a test gauge. Stop cocks of gauges shall be clearly identified by means of separate labels of approved type and lettering.

All fixed pipes below 25 mm nominal bore shall be compression jointed heavy gauge copper where this material is suitable. In other cases pipe materials are to be approved by the Employer's Representative.

All pressure gauges shall be fitted with an air release cock and hydraulic pressure snubbers to protect them against shock pressures.

3.14 Noise and Vibration

The noise level produced by any equipment like pump sets, compressor sets and DG sets shall not exceed 85 dBA measured at a distance of 1.86 m from the outline of the equipment. At the time of operation, the mechanical vibration shall not exceed the limits given below, at recommended points of measurement as per ISO 2372-1974 with Amendment 1-1983.

Equipment	Velocity of Vibration mm/sec
All rotating equipment not having reciprocating parts with motor kW less than or equal to 15 kW	1.12
All rotating equipment not having reciprocating parts with motor kW more than 15 kW and less than or equal to 75 KW	1.8
All rotating equipment not having reciprocating parts with motor kW greater than 75 kW	2.8

3.15 Pipe work and Layout

In general all pipes and fittings shall be steel or ductile iron with flanges to IS 1916/ IS 8329/ IS 9523 / BS EN 1092-1/ BS 4504.

Where steel and cast flanges are mated together the steel flange shall be machined over its full face, after welding to its respective pipe is completed.

Flexible joints shall be provided to facilitate installation and removal and/or differential movement of equipment. As and where required, flexible joints shall be provided with tie bolts or other means to transfer longitudinal thrust along the pipe work as a whole.

The pipe work shall be laid out such as to facilitate its erection, painting in situ, dismantling of any section for maintenance and to give a constant and uniform flow of working fluid with a minimum loss in head. Where steel pipe work is used the number of flanges is to be kept to a minimum with the size of each unit of pipe work determined by the ease of handling, installation and general appearance of the completed pipe system. Positions of flanges shall take into account any necessary concrete pipe supports or thrust blocks.

Facilities shall be provided for draining the pipe system. Where a pipe passes through a wall, retaining wall or is subject to thrust it shall incorporate a puddle flange which shall conform to the dimensions stated in BS EN 1092-1/ BS 4504 but remain undrilled.

Unless otherwise specified, nuts, bolts and washers for pipe work shall conform to the requirements of BS EN 1092-1/BS 4504.

Bolts shall be of sufficient length that one thread shall show through the nut when in the fully tightened condition.

3.16 Gaskets and Joint Rings

Joint rings shall be manufactured to conform to BS 2494 / IS 5382 and shall be of chloroprene rubber or other approved synthetic material suitable for temperatures up to 80°C.

Joints shall be made in accordance with manufacturer's instructions or as specified herein.

Until immediately required for incorporation in a joint, each rubber ring or gasket shall be stored in the dark free from the deleterious effects of heat or cold, and kept flat so as to prevent any part of the rubber being in tension.

Only lubricants recommended by the manufacturer shall be used in connection with rubber rings and these lubricants shall not contain any constituent soluble in water of the quality stated in the Requirements, shall be suitable for the climatic conditions at the Site and shall contain an approved bactericide.

After cleaning the flanges, the gaskets shall be fitted smoothly to the flange and the joint made by tightening the nuts to finger pressure first. Thereafter the final tightening of the nuts shall be made by gradually and evenly tightening bolts in diametrically opposite positions using standard spanners.

Graphite grease shall be applied to the threads of bolts before joints are made.

3.17 Steelwork

Any small areas of chequer plating or similar covering that are necessary to cover gaps between items of equipment and the surrounding structure, and any access ladders, platforms and handrails to facilitate operation, inspection or maintenance, shall be supplied and erected by the Contractor.

The Contractor shall include in his Contract for providing adequate means of access to all hand wheels, sight glasses, gauges, lubrication points and any other items to which access is necessary for routine maintenance.

Handrails shall consist of double ball forged steel standards with tubular rails, hot dip galvanised in accordance with BS 729.

Chequer plating shall be of 'Durbur' or other non-slip pattern, not less than 4.5 mm thick (exclusive of pattern) and hot dipped galvanised after fabrication in accordance with BS 729.

Aluminium alloy flooring may be offered as an alternative, manufactured in accordance with BS 1470, material H30 TB.

3.18 Spare parts

The spares shall comprise an adequate stock of the parts likely to be needed as routine replacements together with any major items or components which it may be desirable to hold in order to facilitate or expedite repair during O&M period of five years.

The Contractor shall supply the spare parts required for the continuous operation of the Works for the minimum period of 5 (five) years.

Spare parts shall be new and strictly interchangeable with the parts for which they are intended to be replacements and shall be treated and packed for long storage under the climatic conditions prevailing at the site. Spare parts to be supplied under this contract shall be interchangeable.

Spare parts shall be packed separately from the main equipment in packages or containers designed to preserve the spares from the effects of long term storage under the ambient conditions specified. Any items that cannot be packed in this way must be protected from corrosion by applying temporary protective coatings and shielded from mechanical damage. Each spare part shall be clearly marked or labelled on the outside of its packing with its description and purpose, and when more than one spare is packed in a single case or other

container, a general description of its contents shall be shown on the outside of such case or container and a detailed list enclosed. All cases, containers and other packages shall be marked and numbered in an approved manner for purposes of identification.

All cases, containers or other packages are liable to be opened for such examination as the Employer's Representative may require and packing shall be designed to facilitate opening and thereafter repacking.

The Contractor may use spare parts provided under the Contract to replace failed parts prior to the issue of the Performance Certificate for the Works. However the Contractor shall be responsible for replacing those parts used with identical parts at no cost to the Employer.

The Contractor shall also supply the details of recommended spare parts and quantity required for the continuous and successful operation of the Works and after completion of the O&M contract. At the end of the contract period the Contractor shall handover the recommended spare parts (As agreed during the contract) to the Employer.

"Spares accompanied by technical details/leaflets etc. shall be delivered to site before the start of commissioning tests. Spare parts shall be indicated in the assembly drawings of respective equipment items with clear details of part numbers. Contractor shall also furnish the manufacturers recommendations on spares for respective equipment items."

3.19 Tools and test Equipments

A complete set of necessary special tools and test equipment shall be supplied by the Contractor to enable any erection, dismantling or testing to be carried out on any part of the main equipment, whether of an electrical, mechanical or any other nature during its life period. Brand new tools and equipment shall be supplied at the end of O&M contract at no cost to Employer. The cost of Tools and Test equipment shall deemed be covered under the O&M cost in Contractor's quoted price.

The tools and test equipment shall not be used for the erection of the equipment and except that the Employer's Representative may call upon the Contractor to demonstrate their use or effectiveness, they must be handed over to the Employer in a completely new and unused condition. Should the Contractor require any such tools and test equipment at the site during erection, he shall provide his own.

The tools for each different type of equipment shall be contained in a suitable box clearly marked or labelled with its description. Each tool shall be identified and a list of tools shall be affixed to the inside of the box lid. Each set of tools shall be supplied with the equipment with which it is associated.

The Contractor will be permitted to utilise the overhead gantry cranes supplied under this Contract for the purposes of installing the equipment in his supply. The Contractor shall be responsible for making all arrangements for the electricity supply to operate the cranes and for their service, maintenance and repairs. On completion of the installation and before hand over of the SPS Plant the Contractor shall restore the cranes to an as new condition by the replacement of all worn or defective components.

All special tools and test equipment necessary for overhauling the equipment and testing its performance shall be included and mounted in suitably designed cabinets with lockable doors and shall be stored in maintenance workshop. Racks and clips shall be provided for individual items with outline markings and labels to show where any equipment is missing.

The tools provided shall include clamps, wrenches, lifting lugs, grease guns, gauges test rigs, jigs or extractors which may be required for the life of equipment. All tools and test equipment shall be clearly detailed with size/capacity etc.

The Maintenance workshop shall include all necessary machine tools, welding machines (electric/acetylene gas), lifting equipment/tools/shackles required for carrying out periodic and breakdown maintenance of equipments.

3.20 Protection and Packaging for Transportation

Before any Plant is dispatched from a manufacturer's works it shall be properly prepared and packed. Prior to dispatch all Plant shall be adequately protected by painting or by other approved means for the whole period of, transit storages and erection, against corrosion and incidental damage, including the effects of vermin, sunlight, rain, high temperatures and humid atmospheres. The Contractor shall be held responsible for the Plant being so packed and/or protected as to ensure that it reaches the site intact and undamaged. The Plant shall be packed to withstand rough handling in transit and all packages shall be suitable for storage including possible delays in transit.

The Contractor shall be deemed to have included in the Schedule of Prices for all materials and packing cases necessary for the safe package, conveyance and delivery of the Plant.

The flanges of pipes, valves and fittings shall be protected by wooden discs attached by means of service bolts (which shall not be used at Site) or by other approved means. The sleeves and flanges of flexible couplings shall be bundled by wire. Cases containing rubber rings, bolts and other small items shall not normally weigh more than 500 kg gross.

No one package or bundle shall contain items of Plant intended for incorporation in more than one section of the Works.

All items of Plant shall be clearly marked for identification against the packing list.

Every crate or package shall contain a packing list in a water proof envelope. A duplicate copy of the packing list shall be sent by post to the Engineer at Site.

All crates, packages, etc., shall be clearly marked with a waterproof material to show the weight, and where the slings should be attached, and shall also have an indelible identification mark relating them to the packing lists.

GENERAL & PARTICULAR ELECTRICAL REQUIREMENTS**4.1 Scope of Work****4.1.1 General:**

- (1) The scope of work includes design, engineering, and manufacturing; testing at manufacturer's works, packing, forwarding and delivery to site; unloading and handling at site (shifting from unloading point to the storage area, storage and shifting from the place of storage to the place of installation), assembly, erection, cleaning & touch-up painting; testing & commissioning at site of Electrical Works for Lift Irrigation Schemes complete in all respect.
- (2) List of Equipment & System:
 - (a) Substation.
 - (b) Tariff Metering equipment as per HPERC Net Metering / CERC regulation.
 - (c) Power & Distribution Transformers
 - (d) MV/ LV Switch boards for power distribution
 - (e) MV/LV Motors with suitable starting devices
 - (f) Lighting & aux Power Distribution Boards.
 - (g) All indoor/ outdoor lighting luminaires and its associated wiring/ cabling; and receptacle system with accessories.
 - (h) Cabling System
 - (i) Earthing and Lightning Protection System
 - (j) Miscellaneous statutory equipment.

4.1.2 Power Supply Source/ Distribution Arrangement:

- (1) According to existing power supply code prescribed by HP Electricity Regulatory Commission (HPERC), the standard supply voltage for CONSUMER shall be based on the maximum limits of connected load (kW or MW) and contract demand (kVA or MVA) as under.

Sr. No.	Standard Supply Voltage	Maximum Connected Load	Maximum Contract Demand
1.	Single phase 230 volts or three phase 415 volts or 2.2 kV: (for supplies not involving special category loads)	50kW	50kVA
2.	Three phase 11 kV or 22 kV: (for supplies not involving special category loads)	3 MW	2.2 MVA
3.	Three phase 33 kV	12 MW	10 MVA
4.	Three phase 66 kV	14MW	12 MVA
5.	Three phase 132 kV or 220 kV	No Limit	

- (2) The power supply for the proposed works site shall be provided by power utility/ distribution company (DISCOM) from its nearest substation/ distribution network through an overhead line/(s) at desired voltage level (33/11/0.415kV) with necessary tariff metering arrangement at consumer ends. This work shall be carried out by DISCOM under Deposit Works as per the provisional sums included in the contract.
 - (3) The Power distribution scheme shall be as per SLD enclosed with this specifications or as finalized after award of order during detailed designing stage.
 - (4) During Design Build/ EPC stage, the contractor shall make his own arrangement for power required for the work at his cost. Owner shall not be responsible for construction power supply.
- 4.1.3 Measurement of soil resistivity at site by wenner's four electrode method as per is: 3043 – 2018 and its latest amendments, at minimum two (2) locations per plot shall be carried in the presence of the engineer in-charge and the results/ report shall be certified by govt. authorized laboratories or agencies.
- 4.1.4 Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures, and standard accessories normally provided with such equipment and/ or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the tender unless included in the list of exclusions.
- 4.1.5 All civil works associated with equipment/ system electrical installations like embedment, chipping, punching, making holes, openings in walls, pipe sleeves, fire/ waterproof sealing, concealed conduiting etc.
- 4.1.6 The Contractor shall make all required liaison work with all agencies in respect of release of power connection, CEIG approval and other statutory clearances/ permissions/ NOCs for all electrical installations.
- 4.1.7 It should be clearly understood that the power distribution infrastructure and services have to be carried out strictly in accordance with the prevailing utility norms. Harmonics at the point of common coupling shall be limited to 5% or as per norms of local DISCOM whichever is more stringent. The electrical works shall be carried out through licensed electrical personnel only.
- 4.1.8 List of Submissions:
- (1) Submission of load list cum maximum demand calculations, power distribution philosophy, electrical single line diagram, plant/ equipment's layout drawings/ details, sizing calculations & datasheets etc. for review and approval by DBO Engineer/ TPE before commencement of equipment manufacturing process.
 - (2) Submission of Type test reports not older than five years, carried out at accredited laboratories like ERDA, CPRI or equivalent as per requirements of PURCHASER/ State DISCOM.

- (3) Submission of relevant documents and drawings to the concerned statutory authorities/ agencies and getting clearance and approval for the supplied and installed equipment under this specification is solely the responsibility of the BIDDER.
- (4) Submission of all "As Built" drawings, Data sheets, Calculations etc. after execution and commissioning of the equipment and systems above.

4.1.9 Quality Control Plans:

The quality control plan shall list and define in sequential order all process control activities, inspection and tests proposed to be performed on the equipment/ material starting from component procurement and from testing stages to product dispatch. The quality control plan shall indicate and identify the applicable standards, detailed description with diagram the procedure, acceptance criteria, extent of check and record to be generated.

4.1.10 Inspection:

- (1) The PURCHASER may inspect all the supply components/ equipment/ systems at VENDOR's works. All type test certificates of the bought-out items and internal test certificates shall be furnished at the time of inspection.
- (2) Type/ Routine tests according to relevant standards shall be performed in the presence of PURCHASER.
- (3) All necessary measuring and testing equipment shall be arranged by the VENDOR or its Sub- VENDOR at the time of inspection as well as during commissioning at site without any cost implication to the PURCHASER. All such instruments shall be calibrated from Authorized agencies not older than a year from the date of inspection.

4.2 **General Design Criteria:**

4.2.1 The design standards described herein are generally in compliance with the latest Indian Standards, and code of practices already established in the country. All electrical installations shall conform to the latest Indian Electricity Acts and Rules.

4.2.2 The proposed power distribution system shall be designed to provide:

- (1) Electrical supply to equipment and machinery within the design operating limits.
- (2) Safety to Personnel and equipment during both operation and maintenance.
- (3) Reliability & Continuity of Service.
- (4) Minimal fire risk with fail safe feature.
- (5) Ease & flexibility of maintenance and operation. –
- (6) Adequate provision for future expansion and modification.
- (7) Maximum inter-changeability of equipment.
- (8) Suitability for applicable environmental factors.
- (9) Service Condition.

- 4.2.3 All the components of the power distribution system shall be sized to suit the maximum load under the most severe operating conditions. Accordingly, the maximum simultaneous consumption of power, required by continuously operating loads shall be considered and an additional margin shall be considered for intermittent service loads, if any. The amount of electrical power consumed by each area shall be calculated for its operation at the design capacity.
- 4.2.4 Applicable Codes and Standards: The design, material, construction, manufacture, inspection, installation, testing and performance of electrical equipment's & systems should conform to the latest applicable IS, IEC and IEEE standards, Central Electrical Authority (CEA) regulations, Central PWD (CPWD)/ state PWD Specifications, National Building Code, National and International codes of practice, statutes, regulations and safety codes in the locality where the equipment will be installed.
- 4.2.5 System Design Parameters/ Considerations:
- (1) The electrical system shall be designed as per relevant standards and local regulations with the stringent of the two regulations being the governing parameter. In general, following System Parameter shall be adopted for designing the electrical system:

Nominal Voltage	System	33 kV	11 kV	6.6 kV	0.415 kV
Highest Voltage	System	36 kV	12 kV	7.2 kV	0.456 kV
Lightning Withstand Voltage (1.2/50 microsecond wave)	Impulse Voltage	170 kV _{peak}	75 kV _{peak}	60 kV _{peak}	-
Power Frequency Withstand Voltage for 1 minute	Frequency	70 kV _{rms}	28 kV _{rms}	20 kV _{rms}	3 kV _{rms}
System Earthing	Neutral	Solidly (Effectively) Earthed			
Max Short Circuit Rating		25 kA for 1 sec	18.4 kA for 1sec.		40 kA for 1sec.
Frequency		50 Hz			

- (2) The system shall be suitable for operating satisfactorily under the following service conditions:
- (a) Design Ambient Temperature (Reference Ambient temperature for temperature rise consideration) – 50 °C.

- (b) Relative Humidity – Maximum - 100%
- (3) The system shall be designed taking in to consideration the following system variation:
 - (a) Voltage: +10% to -10%
 - (b) Frequency: +5% to -5%
 - (c) Combined voltage and frequency variation: +10% to -10%.
- (4) The load distribution should be such that the load unbalances does not exceed 5% at the point of commencement of supply.
- (5) The average system power factor shall be at least 0.95 or better as specified by utility.
- (6) In normal operating condition, cumulative voltage drop from Transformer to the last equipment shall not exceed 5% (measured at load end).
- (7) Voltage dip at the Motor terminals during motor starting of the highest rating motor with regular base load shall not exceed 15%.
- (8) Fault level for HT shall be considered as indicated above or actual calculated during detailed design stage by the Contractor, the stringent being applicable.
- (9) The fault level for LT system at transformer terminal shall be calculated based on the transformer rating and its impedance as per relevant standard. However, minimum short circuit rating of switchgear, busbar and cable withstanding capacity at PCC shall be considered as 50kA for 1 sec or as indicated in the single line diagram.
- (10) For Lighting, Air conditioning and other Miscellaneous Power outlets following shall be the parameters to be considered:

Nominal Voltage	240V
Phases	1
Frequency	50Hz
Connection	3 wires (Phase, Neutral & Earth)

4.2.6 **Estimation of Load/ Max Demand:** The following considerations are to be followed to arrive at the maximum electrical demand.

- (1) Demand for pumping stations, plots, housing colonies, mix-used buildings, institutional/ commercial complexes & common facilities like lift/ elevators, park lights & road/ street lights etc shall be calculated based on HP Electricity Supply Code & other applicable guidelines.
- (2) Load Factor

(a)	Main Pump Motor	:	0.9
(b)	Fire Hydrant System	:	0.1
(c)	Auxiliary load (Elevator, Crane/ Hoist, etc.)	:	0.5
(d)	Lighting load	:	1.0
(e)	Plant Watering Pump	:	0.5
(f)	Ventilation System	:	0.7
- (3) Utilization Factor
- (a) Utilization of an individual system shall be considered based on the no of working and stand-by equipment – 50% for one working and one stand-by.
- (b) Utilization of Miscellaneous power outlets shall be considered as 30%.
- (4) Power factor & Efficiency of Motors: As per the Manufacturer's Data sheets
- (5) Overall Diversity for final Demand calculation shall be considered as 1.35 or as per local DISCOM norms'
- (6) A design margin of 10% shall be considered.
- (7) The improved power factor shall be considered as 0.99 lag.

4.2.7 Design Data for `Switchyard Structure

- (1) Design Loads:
- (a) Wind pressure on structures (refer IS 875) – maximum for the area of one face for latticed structures and on single projected area in the case of other structure. Wind pressure on pole structures used in 33/11kV distribution lines may be assumed as 100 kg/ sqm or as per local DISCOM practice.
- (b) Wind Pressure on Conductor – according to area (refer IS 875) on two third projected area.
- (c) Maximum tension of transmission line conductor strung from terminal tower to station structures or strung buses for lines 33 kV and above – 226.8 Kg or as per DISCOM practice.
- (d) Maximum spans adjacent to substation
- i) Lines rated 66kV and above – 152.40 m or as per DISCOM practice
- ii) Lines rated 33kV and above – 60.96 m or as per DISCOM practice
- iii) Lines rated 11kV and below – as per DISCOM practice.
- (2) Working Stresses:

a)	<u>For Steel</u>	
i)	Bending	1265 kg/ sq. cm
ii)	Shear	1265 kg/ sq. cm

b)	<u>For Concrete (1:2:4)</u>	
i)	Bending	52.7 kg/ sq. cm
ii)	Shear	5.27 kg/ sq. cm
iii)	Bend	7.03 kg/ sq. cm

(3) Factor of Safety:

		As per Indian Electricity Rules	Adopted by (TRANSCO/ DISCOM)	Recommended
i)	For Steel	2.0	2.5 based on maximum loading conditions (on elastic limit for tension members and crippling load for compression members)	
ii)	For Reinforced Concrete	2.5	3.5 on ultimate breaking load	
iii)	For Hand Moulded Reinforced Concrete	3.0		

Factor of safety against overturning (for steel- 2.5 and R.C – 2.0)

(4) Slenderness Ratio (L/R) – Ratio of unsupported length (L) to radius of gyration(R) should not exceed;

- (a) 140 for leg members
- (b) 200 for other members having calculated stresses only and 250 for members having nominal stress only.

(5) Minimum Thickness for Steel Members:

- (a) Steel employed for structures- open hearth steel with a high yield point and an ultimate strength of not less than 3867 kg/ sq.cm.
- (b) The following maximum stresses in kg/ sq.cm are assumed for outdoor structures, fabricated out of steel sections manufactured in India:

Tension	18000
Compression	18000 or less (based on slenderness ratio)
Shear on bolts	13500
Bearing on bolts	27000

4.2.8 Transformer Sizing/ Selection:

(1) Criteria 1:

- (a) The capacity of the transformers will be calculated based on the total simultaneous maximum demand (calculated based on the load factors and diversity given above, PF, efficiency).
- (b) Additional 10% contingency shall be considered for deriving transformer sizing.
- (c) Similarly, after consideration of 10% contingency over maximum demand (MD), sizing of the selected transformer shall be such that maximum transformer loading shall not exceed 80% (of the MD +10% Contingency) load.

(2) Criteria 2:

- (a) The adequacy of transformer sizing shall also be proved on the basis of % Voltage dip observed at the motor terminal. % voltage dip at motor terminal shall not exceed 15% i.e., with the use of appropriate starter & considering largest motor starting & base load (all other loads except the highest rating motor are running); the % voltage dip during starting at motor terminal shall not exceed 15%.
 - (b) The Voltage dip and fault level calculations needs to be calculated based on following actual data collected from nearest Substation and Grid.
 - i) The fault level of HV bus from which power supply will be taken to the plant.
 - ii) Impedance of HV Overhead Line Conductor/ HV Cable interconnecting the HV bus of Substation and HV switchboards of the Plant
 - (c) For the per unit calculation purpose, minimum starting current for various types of starter applications shall be considered as following:
 - i) DOL Starter – 6 times the rated current.
 - ii) Star- Delta Starter – 3.5 times the rated current.
 - iii) Soft Starter – 3 times the rated current.
- (3) All pumping schemes having LT motors shall be provided with one transformer. However, the higher capacity pumping schemes having HT motors shall be considered with two transformers (one working + one standby configuration) including all the associated equipment/ accessories. In normal condition, both the transformers shall feed their respective bus sections by keeping bus coupler open & in case of failure of one transformer, the other transformer shall be able to take 100% load with bus coupler in close position.
- (4) The losses of transformer shall be within the values given in relevant IS/ or latest applicable standards.

4.2.9 Switchgear Sizing/ Selection:

- (1) Bus Bar Sizing: The Contractor shall furnish calculations after award of contract, establishing the adequacy of the bus bar sizes to meet the continuous and short time current ratings as calculated. The bus-bars shall be sized considering the following criteria:
 - (a) Sleeving made of insulating material on all bus bars.
 - (b) Design ambient temperature 50°C.
 - (c) Final temperature of the bus-bars complying with requirements of IS 8623 & IEC 60947. Reduced temperature rise limit by 5K (for indoor panels) & 10K (for outdoor panels) to that of mentioned in IS 8623 & IEC 60947 shall be considered to satisfy the final temperature.
 - (d) Bus bars being inside the panel; De-rating for enclosure and ventilation.
 - (e) Bus bars shall withstand the short time rating of the panel for 1 sec duration.
 - (f) Bus bar suitability for carrying rated current continuously. The current density (A/mm²) of the bus bar shall not exceed 0.8 for Aluminium bus and 1.6 for Copper bus.
 - (g) The main bus shall be designed based on the load rating as well as the actual fault level for specified duration at the location of the panel with 10% positive tolerance.
 - (h) Earth bus of the panel shall be sized suitable for the above fault level for the same duration.
- (2) Switchgear shall be sized/ selected considering the following:
 - (a) Rating suitable for carrying full load current of the equipment/ feeder.
 - (b) Suitability for Short Circuit Rating for specified duration.
 - (c) Switchgear for motors shall be suitable for motor duty application with Type – 2 co-ordinations.
 - (d) In panel de-rating of minimum 20% or as provided in Manufacturer's catalogue, whichever is higher shall be considered.
 - (e) Switchgear rating for individual capacitor bank shall be sized at 1.5 times the rated current rating.
 - (f) ACBs shall be considered for switchgear ratings above 630A and MCCBs shall be considered up to 630A. All ACBs and MCCBs shall be rated for Bus fault level with $I_{cs}=I_{cu}=I_{cw}=100\%$ for ACB and $I_{cs}=I_{cu}=100\%$ for MCCBs.
 - (g) Miniature Circuit Breaker (MCB) shall be considered where fault level is below 10kA.
 - (h) All switchboard incomers of 250A & above shall be provided with Microprocessor based overload (O/L), Short circuit (SC) and Earth fault (E/F) releases and incomers of below 250A shall be provided with Thermal Magnetic based overload (O/L), Short circuit (S/C) releases with external earth fault (E/F) module.
 - (i) Multi-function meter for measuring current, voltage, power, frequency, active and reactive power, and harmonics shall be provided for all the incomers (Transformer as well as DG as applicable), Multi-function

meter for measuring current, voltage, power, frequency, active and reactive power for outgoing power / tie feeders. Ammeter shall be provided for other load feeder such as motor feeder, lighting feeder, etc.

(j) In general, Motor starter selection shall be done as follows:

- i) Direct Online (DOL) Starter – For motors rated up to 5.5 kW
- ii) Star- Delta Starter - For motors rated above 5.5 kW up to 30 kW
- iii) Soft starter - For motors rated above 30kW.
- iv) DOL starter shall be provided for the main Fire, Sprinkler Pump & Jockey Pumps, where applicable.

However, it is proposed that all pumping machinery of the schemes shall be provided with soft starters (VFDs) with suitable contactor based bypass arrangement.

(k) Motor feeders shall have the following protection and components:

- i) Motor Protection Circuit Breakers (MPCBs) with inbuilt thermal overload, air break contactors and single phase preventer for motors up to and including 50 kW rating suitable for type 2 co-ordination.
- ii) MCCB with separate thermal overload, air break contactors and single phase preventer for motors above 50kW up to and including 100 kW rating suitable for type 2 co-ordination.
- iii) ACB/ MCCB and composite motor protection relay (a minimum of protections such as over current, short circuit, earth fault, locked rotor, Negative phase sequence, thermal alarm, and single phase preventer etc.) for motors above 100kW rating.
- iv) Motor feeders less than or equal to 5 kW shall have direct connected ammeter in Y phase and motor >5 kW will be provided with one CT and ammeter.

(3) 10% spare capacity shall be considered on each panel for future.

4.2.10 Power Factor Improvement:

- (1) The required capacitor rating shall be calculated based on the system power factor requirement of achieving 0.99 power factor, i.e., 0.85 or actual (whichever is lesser) to be corrected for 0.99 lag.
- (2) APFC Panel conforming to IS 16636-2017 with latest amendment shall be selected considering following design criteria:
 - (a) Optimum no of steps to ensure proper regulation with minimum two (2) nos. of spare steps subject to a maximum of 12 steps
 - (b) Minimum steps of 2 kVAR, 3 kVAR, 5 kVAR, 10 kVAR, 15kVAR and 25 kVAR banks in adequate nos. for fine regulation of power factor at low loads shall be considered.

- (c) Capacitor banks shall be All Poly Propylene (APP), double layer type or MPP type as local norms.

4.2.11 CABLE SIZING: The Contractor shall ensure that cable and wires associated with the power distribution and control systems, plant wiring and all other installations throughout the Works are adequately rated for their use.

- (1) The following main aspects shall also be considered while deciding the final size of the cables-

- (a) Supply voltage and frequency
- (b) All cables shall be selected to carry the corresponding full load current under site conditions.
- (c) Route length and disposition of cables
- (d) Maximum allowable temperature rise under normal full load condition based on the material of cable insulation (XLPE/ PVC).
- (e) Maximum short circuit current duration (fault clearing time) and final temperature of cable during short circuit current flowing through the cable.
- (f) For Cables emerging from ACB outgoing, fault clearing time shall be considered as 0.16 second (for Tie feeders if any it shall be 0.5 second)
- (g) For Cables emerging from MCCB outgoing, fault clearing time shall be considered as 0.01 second
- (h) For the HV incomer cables (metering kiosk to HV switchgear/ transformer) minimum fault clearing time shall be considered as 1 sec.
- (i) For cable from HV panel outgoing to transformer, fault clearing time shall be considered as 0.16 second.
- (j) Cable from transformer secondary to PCC incomer, fault clearing time shall be 1sec
- (k) Contractor to note that, the above fault clearing times are minimum to be considered & fault clearing time shall be considered as per actual relay co-ordination study.
- (l) Appropriate de-rating factors as per cable manufacturer's catalogue and enlisted below shall be considered for sizing the cable:
 - i) Ambient Air Temperature (minimum 50°C).
 - ii) Ambient ground temperature (minimum 40°C to be considered)
 - iii) Laid in Air/ ducts/ directly in ground etc.
 - iv) Depth of cable burial (minimum 750 mm for LT and 900 mm 11kV HV)
 - v) Thermal Resistivity of Soil (minimum 150°C Cm/ W to be considered)
 - vi) No. of cables in a group-touching each other or separated by a distance
 - vii) No. of cable trays in tier

viii) Any other de-rating factors as applicable & as per Manufacturer's catalogue.

- (2) Permissible voltage dips at the time of starting the corresponding motor/ load. Contractor to ensure adherence to the Criteria-2 mentioned above.
- (3) In running condition, cumulative voltage drop (at 100% rated load) shall not exceed 5% (measured at load end) for the LV loads.
- (4) HV cables shall be E/ UE grade (as per system requirement), multi-stranded Al conductor, XLPE insulated, inner/ outer extruded PVC sheath ST2, galvanized steel flat strip armoured cables.
- (5) LV cables shall be 1.1 kV grade, multi-stranded Copper/ Al conductor, XLPE insulated, colour coded, inner and outer extruded PVC sheathed, galvanized steel round wire/ flat strip armoured cables.
- (6) Cables up to & including 4.0 sq.mm shall be Cu multi-stranded conductor with galvanized steel round wire armoured & balance cables shall be Al multi-stranded conductor with galvanized steel round wire/ flat strip armoured.
- (7) Single core cable shall have non-magnetic material armoured.
- (8) Control cables shall be Cu multi-stranded conductor with galvanized steel round wire/ flat strip armoured. For cables above 7 cores, minimum two spare cores shall be considered.

4.2.12 Illumination System:

- (1) Latest version of related IS standards, NBC, and National Lighting Code (NLC) shall be referred for designing Illumination for different areas.
- (2) All lighting design shall be carried out on Dialux latest version or OEM specific software.
- (3) The basis of design shall be based on the following lighting engineering criteria, as per relevant standards or specified herewith:
 - (a) Lighting lux level
 - (b) Luminance distribution
 - (c) Glare restriction
 - (d) Direction of incidence of light and shadow effect
 - (e) Colour appearance and colour rendering of the light source
 - (f) Uniformity
- (4) Selection of Luminaries and Illumination Level: The following luminaries shall be provided for various areas in order to achieve the average luminance as per various relevant lighting standards or those indicated below, which ever be stringent:

Sr. No.	Area	Type of Light Fittings	Appx. Height (m)	Illumination Level (Lux)
i)	Utility Areas like Substation, Switchgears/ MCC and Metering rooms	LED	3.0	200

Sr. No.	Area	Type of Light Fittings	Appx. Height (m)	Illumination Level (Lux)
ii)	Administrative & Operational Area/ Office/ Control Room	LED	2.5	300
iii)	General Process Area/ Pump House	LED	suit to site	200
iv)	Battery Room/ Maintenance Area	LED	3.0	150
v)	Common Area- Entrance/ Staircase/ Corridors/ Passages/ Sanitary Block/ Toilets etc.	LED	2.0/ 2.5	100
vi)	Roads/ Walkways	LED Street Light	6.0	10 -15

- (5) Following factors shall be considered while arriving at the utilization factor to determine the number of fixtures for each area/building:
- (a) Maintenance Factor
 - i) Indoor Area Lighting with LED Luminaire: 0.8
 - ii) Down Outdoor Area Lighting with LED Luminaire: 0.7
 - (b) Reflection factor for Indoor Lighting to be considered are as follows:
 - i) Ceiling : 0.5
 - ii) Walls : 0.3
 - iii) Floors : 0.1
 - (c) However, Reflection factor can be selected based on the Colour of the wall and Ceiling as given below:
 - i) White and very light colours : 0.7
 - ii) Light colours : 0.5
 - iii) Middle tints : 0.3
 - iv) Dark colours : 0.1
 - (d) Room index at applicable surface reflection factors need to be considered.
 - (e) The working plane shall be considered at 0.75 m from the floor level.
 - (f) Uniformity factor shall be considered as per National Lighting code/ NBC/ IS code.
- (6) The power supply for lighting shall be distributed from Lighting Distribution Boards and feeder pillars. All Lighting distribution boards & Feeder Pillars shall be fed from nearest LT switch boards to enlighten the respective building, external area lighting and road lighting etc.

- (7) For street lighting, cabling shall be done with 4C armoured cable such that alternate fixtures are on different phases.
- (8) Light & Power Point Wiring
 - (a) The internal lighting installation shall be installed using single core of 1.5mm², PVC insulated FRLS copper wires enclosed in MS conduit. The MS conduit shall be of minimum 20 mm size. The contractor shall size the required size of conduit considering 70% occupancy by wires. Lighting in external areas shall be installed using multi-core armoured cable of suitable sizes. The wiring shall be using 4C cable such that alternate fixtures are on different phases.
 - (b) The 6A and 16A outlets installation shall be installed using 2.5 mm² and 4.0 mm², PVC insulated FRLS copper wires respectively enclosed in MS conduit. Necessary plug sockets as per requirement and applicable standards shall be provided.

4.2.13 Cables:

- (1) HT cables (where applicable) shall be 33/11/6.6 kV grade, multi-core, stranded and compacted aluminium conductor, extruded XLPE insulated (dry cured), extruded semi conducting compound screen with a layer of non-magnetic metallic tape screen, extruded PVC inner sheath (Type ST-2), armoured and extruded overall sheath with Fire Retardant Low Smoke (FRLS) PVC compound (Type ST-2). These cables shall conform to IS-7098 Part -II.
- (2) LT Cables shall be 1100V grade, single/ multi-core, stranded and compacted aluminium conductor, extruded XLPE insulated, extruded PVC inner sheath (Type ST-2), armoured and extruded overall sheath with Fire Retardant Low Smoke (FRLS) PVC compound (Type ST-2). These cables shall conform to IS 7098, Part I.
- (3) Cables up to & including 6 mm² shall be Copper multi-stranded conductor with PVC insulation galvanized steel round wire armoured & cables beyond 6 mm² shall be Aluminium multi-stranded conductor with XLPE insulation & galvanized steel flat strip armoured. In building application, cables up to & including 16 mm² shall be Copper multi-stranded conductor with PVC insulation galvanized steel round wire/ flat strip armoured as per NBC 2016.
- (4) All control cables shall be 650/ 1100V grade copper conductors FRLS PVC insulated cables conforming to IS 1544- Part I. For cables above 7 cores, minimum two spare cores shall be considered.

- (5) All the cabling and rising mains to the individual floors shall be laid through the electrical ducts provided in the building core with access window on each floor/ staircase landing.
- (6) The following main aspects shall also be considered while deciding the size of the cables/ wires:
- (a) Supply voltage and frequency.
 - (b) Corresponding full load current under site conditions, i.e., necessary de-rating considerations.
 - (c) Route length and method of laying of cables.
 - (d) Maximum allowable temperature rise under normal full load condition based on the material of cable insulation (XLPE/ PVC).
 - (e) Maximum short circuit current duration (fault clearing time) and final temperature of cable during short circuit current flowing through the cable.
 - (f) Following shall be the fault clearing time consideration:
 - i) From HT breaker to Transformer Primary shall be 0.16s.
 - ii) From transformer secondary to Power Control Centre (PCC) incomer shall be 1s.
 - iii) From ACB outgoing of the PCC shall be considered as 0.16s (for Tie feeders if any it shall be 0.5s).
 - iv) For MCCB outgoing it shall be considered as 0.01s.
 - v) CONTRACTOR to note that, the above fault clearing times are minimum to be considered. Actual fault clearing time shall be considered as per actual relay co-ordination.
 - (g) Appropriate de-rating factors as per cable manufacturer's catalogue and enlisted below shall be considered for sizing the cable:
 - i) Ambient Air Temperature (minimum 50°C).
 - ii) Ambient ground temperature (minimum 40°C to be considered).
 - iii) Method of cable laying.
 - iv) Depth of cable burial (minimum 750 mm for LT, 900 mm for 11kV HT & 1050 mm for 33 kV)
 - v) Thermal Resistivity of Soil (minimum 150°C Cm/ W to be considered).
 - vi) No. of cables in a group
 - vii) No. of cable trays in tier.

viii) Any other de-rating factors as applicable & as per Manufacturer's catalogue.

- (h) Bending radius of 12D and 15D shall be provided for LT & Control Cables and HT cables respectively where D is the outer diameter of the cable.
- (i) RCC hume pipes shall be provided where cables need to cross the roads, drives ways. For HT cables, one cable shall be laid in one pipe section of minimum 150 mm internal diameter. LT, control and ICT cables shall be laid in separate pipes.

4.2.14 Earthing & Lightning Protection system:

- (1) Latest version of following standards and codes shall be referred to for designing the Earthing and Lightning protection system:

IS 3043- 2018	:	Code of practice for Safety Earthing
IS/ IEC 62305- 2013	:	Code of Practice for the protection of buildings and allied structures against lightning.
CEA regulations 2010	:	Measures related to safety & electric supply.
IEEE 80-2000-2013	:	IEEE Guide for Safety in AC Substation
CPWD Specifications - 2013	:	General Specifications for Electrical Works Part I - Internal

- (2) Soil Resistivity: The earthing system shall be designed by considering measured soil resistivity during detailed engineering and the earthing calculation shall be done.
- (3) Size of Earthing Conductors: The earthing conductor sizes shall be calculated as per IS 3043.
- (4) Following factors will be considered for sizing the earthing conductor:

Design Ambient Temperature	50°C
Allowable temperature rise for steel welded joints	500°C
Fault clearing time	1.0 s
Overall earthing resistance of the grid	Less than 1Ω

- (5) The maximum values of earth fault current for the design of the earthing system will be considered based on system requirement as follows:

66 kV system	:	31.5kA for 1s
33 kV system	:	25kA for 1s
11kV system	:	18.4kA for 1s
415 V system	:	40kA for 1s

- (6) Equipment Earthing

- (a) The earthing system shall include an earthing network with earth electrodes required for the plant equipment. The earthing systems will comprise of main earth grid along-with suitably placed disconnecting plates to provide multiple earth connections between earth grid and the equipment and for connections between main earth grid and electrodes. Materials used for grid earthing network shall be designed to suit the ground conditions and shall be galvanized steel.
- (b) The earth grid/ conductor network shall be provided, laid buried 600 mm deep in the ground with a clear distance of 300 mm with respect to other utilities and at least 1500 mm from the building plinth connecting all the dedicated Earth electrodes for all equipment's and systems. The quantity of earth pit stations shall be provided as per plant requirement & IS: 3043
- (c) GI pipe electrode as specified in IS 3043 or as per local electricity board, CEIG, CPWD requirements, whichever is stringent, shall be provided for the earthing of non-current carrying parts and enclosures of all electrical equipment such as transformers tank, DG, Motors. HT/LT Switchgears, Lighting Distribution Boards, cable trays, socket outlets, steel structural supports, yard fences etc.
- (d) 2 nos. dedicated copper plate electrode each shall be provided for neutral grounding of both the transformer and the DG set.
- (e) Two dedicated GI pipe electrode shall be provided for metering panel.
- (f) Earthing network shall also be connected/ formed through the cable trays. Double run GI strips shall be laid on the cable tray depending upon whether it will be connected to the earth network ahead. The strips shall be welded to the cable tray at every 10m interval. For multi-tier trays, the strip can be laid in one tray and connected to all at 10 M interval. The minimum size of Galvanized Steel Strip shall be 50x6 mm.
- (g) Earthing requirements for Conduit wiring for Sub main, circuit and point wiring shall be carried out as per CPWD/ state PWD guidelines.
- (h) All electrical equipment will be connected to the earth system by means of a conductor properly rated so as to limit the touch voltage to a value not hazardous for the safety of persons. The electronic units and circuits will be earthed separately..

(7) Lightning Protection:

- (a) The need for lightning protection system shall be established by calculating the risk factor value of each building, structure etc. as per methodology/ procedure prescribed in IS/IEC 62305- 2010. This will be provided for building(s) whose risk factor is exceeding the limiting values. The Risk factor shall be evaluated for Level 3 risk.
- (b) Based on the calculation, if found necessary, air termination system comprising of horizontal roof conductors or finial shall be provided. The horizontal mesh shall be provided as per IEC 62305-2010 above the roof.
- (c) The function of the air-termination systems of a lightning protection system is to prevent that direct lightning strikes damage the volume to

be protected. They must be designed to avoid uncontrolled lightning strikes to the building/ structure to be protected. Air-termination systems can consist of the following components and can be combined with each other as required;

- i) Roof conductor/ rods/ Meshed conductors/ Air termination
 - ii) Down conductors
 - iii) Earth termination
- (d) All connection between the conductors shall be welded/brazed type. Metallic pipe, conduit, structures shall be bonded to lightning protection conductors to prevent the side flashover. But no metallic pipe, conduit, structure shall be used as air termination conductor or down conductor.
- (e) Earth pits provided for down comers of lightning protection will be connected with general earth pits through earth strips below ground to reduce the overall earthing resistance of the grid.

4.2.10 DC System:

DC system shall include one set of 30V or 110V DC, maintenance free rechargeable sealed lead acid / Ni-Cd batteries of adequate AH capacity with 10 years operational life and shall be provided with Float & Float cum Boost charger with integral DC distribution board, indicating lamps and annunciations etc. Alternatively, an industrial grade uninterrupted power supply (UPS) adequately sized to cater ICT & electrical loads shall be provided. It shall have redundant Rectifier units of suitable rating to achieve desired DC output for electrical switchgear controls.

4.3 Equipment Specifications:

4.3.1 Switchyard Equipment:

- (1) The design, material, construction, manufacture and testing of substation equipment shall comply with all currently applicable standards/ statutes, regulations, and safety codes in the locality where the equipment will be installed. In case of conflict between the standards and this specification, this specification shall govern.
- (2) Switchyard structures (to receive incoming power supply from electric supply authority and to extend out required feeders) shall conform to the latest applicable standards, design criteria specified in this specification elsewhere & as under.
 - (a) All the members of switchyard structure shall be hot dipped galvanized.
 - (b) Switchyard structure shall be fabricated to suit incoming line terminations, mounting/ fixing of Isolators, Earth Switches, Lightning Arrestors, Breakers, Voltage & Current Transformers, Strain/ Flexible Busbars & Insulators etc.
 - (c) 66 kV Switchyard Structure - Minimum Thickness for Steel Members:
 - i) Steel employed for structures- open hearth steel with a high yield point and an ultimate strength of not less than 3867 kg/ sq.cm.

- ii) The following maximum stresses in kg/ sq.cm are assumed for outdoor structures, fabricated out of steel sections manufactured in India:

Tension	18000
Compression	18000 or less (based on slenderness ratio)
Shear on bolts	13500
Bearing on bolts	27000

- (d) In general, switchyard structure shall conform to IS:1893 – Criteria for earthquake resistance design of structures. In high intensity seismic zones, switchyard equipment & structure be designed to safely withstand earthquake acceleration force 0.3g both in the vertical & horizontal direction.
- (e) 33/ 11 kV Switchyard Structure- Two/ four pole structure shall be of a rolled steel joist of minimum ISMB 150 (150mm x 75mm)/ steel tubular for 6 meter pole/ ISMB 175 (175 mm x 90 mm)/ steel tubular for 9/ 11 meter pole with 400 mm x 400 mm x 8 mm thick base plate welded at bottom end of all the poles of structure and shall have following fittings & accessories
- i) Mild steel cross members of minimum ISMC 100 mm x 50 mm x 6 mm size channels of 3.5 metre in length as per requirement shall be provided with cross bracing angles of minimum ISA 50 mm x 50 mm x 6 mm size of 4.5 meter in length.
- ii) Side clamps, stay clamps, cleats etc. shall be fabricated from minimum 50 mm x 6 mm size MS flats as per actual requirements. All bolts, nuts, washers, etc. shall be of minimum 15 mm size.
- (f) Excavation of pits even in hard soil shall be done up to a depth of about 1/ 6 the length of pole and refilling the same after erection of structure and concreting work. Compacting the bottom of pits, providing cement concrete to suit at bottom and side of poles up to at-least 150 mm above FGL curing and making it hard as per requirement.
- (g) Erection of RSJ poles and fixing of all structural members as per requirement shall be in line, level and properly facing the incoming and outgoing lines. Cross members shall be firmly tightened.
- (h) All MS parts shall be painted with two coats of red oxide and two coats of aluminium paints.
- (i) Earthing terminals shall be provided by welding 15 mm size bolts or cleats of 50 mm x 6 mm size MS flat shall be welded in each joist with a hole of 15 mm size and galvanized nuts, bolts, washers shall be provided as earthing terminals.
- (j) Necessary stay sets & hardware as required for completeness shall be supplied and erected.

- (k) All drawings/ documents such as GA drawing of substation showing all equipment mounted on the structure, technical particulars & Bill of Material etc shall be prepared and submitted to Purchaser/ Purchaser's representative for approval. Obtaining the approval from CEIG/ IMPD (GOG) and getting power released from supply authority are also included in the scope of work.
- (3) Bus Bars & Insulators – The outdoor bus bars are either of the rigid type or strain type. In the rigid type, pipes supported on pedestal insulators shall be used for bus bars and also for making the connections among the various equipment wherever required. The strain type bus bars shall be an overhead system of ACSR conductors strung between two supporting structures and supported by strain type insulators. The stringing tension may be limited to 500-900 kg depending upon the size of the conductor used. The strain type bus bars shall be preferred as these are suitable for earthquake prone areas. The following materials & sizes for bus bars shall be used.
- (a) In case of strain type bus bars, aluminium conductor steel reinforced shall be used. The sizes of ACSR conductor are commonly used for various voltages are given below.

System Voltage	Conductor	
	Type	Size (No of strands x dia in mm)
12 kV	ACSR (Dog) up to 10 MVA	6 x 4.72 + 7 x 1.76
36 kV	ACSR (Dog) up to 10 MVA	6 x 4.72 + 7 x 1.76
72.5 kV	ACSR (Panther)	30 x 2.79 + 7 x 2.79
145 kV	ACSR	30 x 4.27 + 7 x 4.27
245 kV	ACSR	54 x 3.53 + 7 x 3.53
420 kV	ACSR	54 x 3.53 + 7 x 3.53

- (b) Aluminium conductor steel reinforced shall be hard drawn from 99.5% pure electrolytic aluminium rods. The Contractor shall specify the conductivity.
- (c) Chemical composition of the material shall comply with the requirements of relevant standards.
- (d) The surface of conductor shall be clean and dry and free from any excess grease that may be used in its fabrication. The surface strands shall be smooth and free from burrs and other projections which may be a cause for increasing corona losses.
- (e) The Contractor shall provide necessary treatment for the bus conductor to make it free from corrosion.
- (f) The steel wire strand of conductor and steel conductor shall be hot dip galvanized. Zinc coating shall be evenly and uniformly for heavily coated wires.

- (g) The steel core and inner layer of aluminium wires where more than one aluminium layer exist shall be protected with special grease in order to provide additional protection against corrosion due to salinity. The grease shall fill the whole space between wires within circumscribed cylinder at inner aluminium layer or at steel core if the conductor has only one aluminium layer.
- (h) The grease shall be chemically neutral with respect to aluminium, zinc, and steel. It shall withstand weather conditions given elsewhere and temperature of 85 degree centigrade without alternation of its properties.
- (i) Bare conductor shall be covered in Alkathene pipes of suitable insulation to avoid accidental contact.
- (j) In case of rigid bus bars arrangement, aluminium pipes of Grade 63401 WP conforming to IS: 5082 shall be used. The sizes of pipes commonly used for various voltages are given below

System Voltage	Aluminium Pipes/ IPS Aluminium Tubes	
	Outer Dia (mm)	Internal Dia (mm)
Up to 36 kV	42 mm	36 mm
72.5 kV	60 mm	52 mm
145 kV	80 mm	70 mm
245 kV	114 mm	102 mm
420 kV	127 mm	109 mm

- (k) In case of long span exists in rigid bus bars, expansion joints shall be provided to avoid strain on the supporting insulators due to thermal expansion or contraction of pipes.
- (4) Isolators with Earth Switches:
- (a) Isolators for 11kV & 33 kV nominal system voltage shall conform to IS: 9920 (Part I to IV) and for voltage 66 kV & above as per IS: 9921.
 - (b) Isolators of vertical break type or horizontal break type shall be suitable for the specified site conditions and shall be able to-
 - i) Carry rated current without excessive temperature rise.
 - ii) Withstand the short circuit forces developed during fault.
 - iii) Carry the inrush current of the transformer.
 - iv) Interrupt small inductive and capacitive currents.
 - (c) Isolating switches may be motorized or operated manually. Disconnecting switches rated for 66kV & above are motorized and Earthing switches may be manually operated or motorized. Earth switch is a mechanical switching device for earthing parts of a circuit, capable

of withstanding for a specified time short circuit currents, but not required to carry normal rated currents of the circuit.

- (d) The operating rod shall be extended up to the operating level and shall have a handle with 'lock and key' arrangement. The operating handle shall be at a level of 1.0 meter from finished ground level.
- (e) The operating handles shall be mounted on the base of supporting structure. Guide bearings shall be provided if necessary at appropriate height above ground level. Necessary accessories viz. brackets, angles, guides, guide bearings for attaching the operating mechanism and operating handles to the structure and part of the isolator, rust proof pins, ball or roller type bearings shall be provided and installed. All bearings shall be protected by means of covers and grease retainers. Bearings pressure shall be kept low to ensure long life and ease of operation.
- (f) The operating mechanism design shall be such that, as soon as the moving blades reach the sparking distance during operation of isolator, springs shall take over to give a quick snap action closing so that the isolator closing is independent of manual effort. Similarly the springs must assist during opening operation to give quick breaking feature.
- (g) All copper parts shall be Silver or Tin plated. All ferrous parts shall be hot dipped galvanized to assure long protection against tropicalised weather.
- (h) The contacts shall be of silver faced copper ensuring sufficient contact pressure. The male and female contacts shall be of self-aligning type to ensure trouble free operation during opening and closing of isolator. Mild steel arcing horn capable of breaking the magnetizing current shall be provided. Earth mesh below GOD to be provided.
- (i) Isolator Interlocks:
 - i) For the purpose of making the operation of the isolator dependent upon the position of the associated circuit breaker or other equipment as may be required at site, a suitable electrical interlock arrangement shall be provided.
 - ii) Interlocking arrangement shall be robust, heavy-duty type and sturdy in construction.
 - iii) Besides the electrical interlocks, Isolator/ Earth Switch shall be provided with mechanical interlocks so as to ensure that
 - It should be possible to close the earthing switch only when the isolating switch is in the fully open position or vice versa.
 - Earth switch should not open automatically while attempting to close the isolator. The operation of the earth switch is also interlocked with the CVTs supplies from the transmission lines i.e., it should be possible to close the earth switch only when the line is dead from the feeding end.

- The line isolator should close only when circuit breaker of corresponding bay is open.
- The isolator in bus coupler bay should close when the bus coupler breaker is open.

(j) Isolator Insulators:

- i) The post insulators consist of number of stack units conforming to IS: 2544. The insulators selected shall be suitable for use in the type of normally polluted atmosphere of the area as per relevant IS and made specifically suited to meet the particular requirements of the ultimate torsional strength and cantilever loads which they
- ii) Insulator shall be properly glazed with smooth surface without cracks etc. and dielectric property shall be properly coordinated with isolator voltage class. Porcelain used for the manufacturer of insulator shall be uniform, brown colour, free from blisters, burns and other similar defects. Insulators of the same rating and type shall be interchangeable.
- iii) Porcelain and metal parts shall be assembled in such a manner that any thermal expansion differential between the metal and porcelain parts throughout the range of the temperature variation shall not loosen the parts or create undue internal stresses which may affect the electrical or mechanical strength and rigidity. Each cap and base shall be of high grade cast steel or malleable steel casting, and they shall be machine faced and smoothly galvanized. The cap and base of the insulators shall be interchangeable with each other.

(k) A set of adjustable arcing horns shall be provided mounted on each insulator stack of the isolating switch.

(l) Terminal connectors- Each isolator connected with outgoing lines shall be provided with appropriate number of bimetallic, solderless clamp type of connectors suitable for the line conductor.

(5) Drop Out (DO) Fuse Unit:

- (a) Drop Out Fuse shall be of approved make suitable for 33/ 11 kV supply and shall be mounted on two pole structure complete with 3 fuse elements of required ampere suitable for continuous current rating and shall offer protection against fault level of suitable ampere at 33/ 11 kV.
- (b) The fuse link shall consist of iron channel base to stack insulators per phase, fuse carrier Bakelite tube, heavy duty non-ferrous metal parts and spring loaded phosphor bronze contacts.
- (c) The insulator shall comply with impulse voltage in accordance with relevant IS.

(6) Station Class Lightning Arrestors:

- (a) The design, material, construction, manufacture, inspection and testing of lightning arresters shall comply with all currently applicable statutes, regulations, and safety codes in the locality where the equipment will be installed.
- (b) In case of conflict between the standards and this specification, this specification shall govern.
- (c) The equipment covered in this specification shall conform to the latest edition of the following standards.

IS: 3070 (Part-3) Lightning arresters for AC system – Specification
(Metal Oxide Lightning Arrester without Gaps)

IEC: 60099-4 Metal Oxide surge arresters without gaps for AC
system

(d) Constructional Features:

- i) Lightning arrester shall be station class heavy duty and non-- linear resistance type. The elements shall be in hollow cylindrical form, stacked together. Lightning arrestor shall be of class II, having non – linear voltage – current characteristic and having high discharge capability.
- ii) The entire arrester unit shall be housed in a porcelain insulating casing of high strength, made from brown glazed wet process porcelain, with metallic cover plates and terminal assemblies. The end castings shall be hermetically sealed, and leak tested to protect the unit from moisture or breathing.
- iii) Pressure relief diaphragm, vent pipe, etc. shall be provided on the LA for the escape of gases formed. In the event of failure of L.A., the pressure relief directional aperture should be directed away from adjacent apparatus to prevent damage, due to arc transfer.
- iv) All hardware such as clamps, screws, bolts, nuts, washers etc. shall be electro galvanized.

(e) Insulators:

- i) The porcelain insulators used shall be made from wet process, and shall be homogenous, free from lamination, cavities, and other flaws, which may impair its mechanical or dielectric strength. They shall be thoroughly vitrified, tough and impervious to moisture.
- ii) The glazing of porcelain shall be uniform brown colour, free from blisters, burns, cracks and other defects. The glazing shall cover all the porcelain part of the insulators except that area which serves as support during firing or are unglazed for the purpose of assembly.
- iii) The minimum creepage distance shall be as stipulated in data sheets. The petticoats shall be spaced for natural cleaning action

by wind and rain and avoid concentrated hot spots where local stress can precipitate flashover.

- iv) All live metallic parts shall be suitably painted. All joints shall be fluid – tight and airtight. The design of insulators shall be such, as to produce uniform compression pressure joints.
 - v) All insulators of identical rating shall be interchangeable.
 - vi) Each bushing shall be provided with aluminium/ bimetallic terminal connectors suitable for inter – connection with aluminium tubular Bus bars or ACSR conductor as specified in data sheet.
- (f) Accessories: Each lightning arrester shall be furnished complete with the accessories as listed below:
- i) Anti-contamination and pressure relief diaphragm complete with vent pipe.
 - ii) Two (2) grounding pads.
 - iii) Base plate suitable for mounting on GI/ steel structure or concrete structure.
 - iv) Line side terminal suitable for specified conductor.
 - v) Other standard accessories which are not specifically mentioned but are usually and provided with lightning arrester of similar type and rating for efficient and trouble free operation.
 - vi) Name plates fixed on lightning arresters giving full technical details.
 - vii) The clamps and connectors on arrester terminals for connection to Purchaser's line conductor and the connection between incoming transmission line and LA will be in the Contractors scope.
- (g) Drawings/ documents to be furnished for Purchaser's approval:
- i) Technical Particulars
 - ii) GA drawing of LA indicating weight and overall dimensions
 - iii) GA drawing of insulating base, discharge counter, terminal assembly
 - iv) Bill of Material
 - v) Mounting arrangement (base plate details) on the structure
 - vi) QAP for Lightning Arrester

(7) Chain Link Fencing and Gravel Filling:

- (a) The work of erecting chain link fencing includes excavation, brick wall construction, erection of angle/ channel supports, providing chain link mesh on angle/ pipe frame barbed wire fencing at the top, concreting of support members, painting the complete structure, and whitewashing the walls. All materials, hard wares, labours etc. are in the scope of Contractor.
- (b) Fencing height shall be minimum 2.0 meter & shall be complying with CEA guidelines/ requirements.
- (c) Gate for entry in the fenced compound shall be fabricated from pipes of heavy duty class. Design of gate shall be got approved from the engineer in charge before starting the fabrication work. All necessary hard wares, fittings, stoppers, locking arrangements with brass pad locks of 100 mm size are in the scope of gate works. Gates shall be self-supporting type.
- (d) Gravel Filling

4.3.2 Power / Distribution Transformers:

- (1) Applicable Standards: Transformer shall comply with all currently applicable statutes, regulations, and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable standards and codes of practice specified as under. In case of conflict between the applicable reference standards and this specification, this specification shall govern.

Power transformer	: IS 2026, BS 171, IEC 76, CBIP Pub No. 317
Outdoor oil immersed distribution transformer up to & including 2500 kVA, 33kV.	: IS 1180 - 2014
Fittings & Accessories	: IS 3639
Climate proofing	: IS 3202, BS-CP-1014, IEC 354
Loading of oil immersed	: IS 6600, BS-CP-1010, IEC 296
Oil	: IS 335, BS-148, IEC 137
Bushing for >1000 V, AC	: IS 2099, BS-223, IEC 144
Bushing for <1000 V, AC	: IS 7421, BS-223, IEC 144
Degree of protection	: IS 13947, IEC 76
Tests	: IS 2026, BS-171, IEC 76
Tolerance on guaranteed Particulars	: IS 2026
Buchholz relay	: IS 3637
Electrical insulation classified by thermal stability	: IS 1271, BS 2727, IEC 85
Code of practice for selection, Installation & maintenance of transformer	: IS 10028

- (2) This specification is for complete design, manufacture, testing at manufacturer's works, supply, packing, forwarding and delivery from place of storage/ manufacturer's works to erection site including transit insurance, storage at site, shifting from the place of storage to place of installation, installation, testing and commissioning for two winding, three phase, 50 Hz,

outdoor type, power/ distribution transformer, ONAN cooled, connected in Dyn11 with OCTC/ OLTC on HV winding & other accessories as specified.

- (3) The values of Load- losses and No-load losses shall be as given in relevant IS or as per applicable standard.
- (4) The Purchaser reserves the right to reject the transformer if the same does not meet the specification requirement as follows:
 - (a) No load loss exceeds the guaranteed value by 20% or more.
 - (b) Impedance value differs the guaranteed value by +10% or more (zero negative tolerance)
 - (c) Oil or winding temperature rise exceeds the specified value by 5 deg C
 - (d) Transformer fails on impulse test.
 - (e) Transformer fails on power frequency voltage withstand test.
 - (f) Transformer is proved to have been manufactured not in accordance with the agreed specification.
- (5) The rejected transformers shall be replaced by transformers complying with the requirements of this specification at the Contractor's cost.
- (6) If the commissioning of the project is likely to be delayed by the rejection of a transformer, the Purchaser reserves the right to accept the rejected transformer until the replacement transformer is made available. Transporting the rejected and replacement transformers as well as installation and commissioning of both the transformers shall be at the Contractor's cost
- (7) Transformer Protections: The following protections shall be provided for a distribution transformer:

Over-current protection – Instant (50 / 51)	Trip (Relay in HV Panel)
Earth fault protection – Instant (50N)	Trip (Relay in HV Panel)
Stand by Earth fault protection (51NS) with CT in transformer neutral [For transformer of 1600kVA & above]	Trip (Relay In HV Panel)
Buchholz protection relay (63) [For transformers of 500 kVA & above]	Alarm + Trip
Oil temperature indicator (OTI - 49O)	Alarm + Trip
Winding temperature indicator (WTI - 49W) [for transformer of 500 kVA & above]	Alarm + Trip
Magnetic Oil level gauge (MOG)	Alarm
Oil Surge Relay (OSR) [For transformers with OLTC]	Trip – For OLTC
Pressure relief device (PRD) [For transformer of 800 kVA & above]	Trip

- (8) For the pole mounted transformers (i.e. transformers ≤ 100 kVA rating), suitable orientation of HV porcelain bushings shall be ensured for direct termination of ACSR conductor from HV line Double Pole Structure.
- (9) For transformers above 100 kVA rating, elevated foundation/ plinth of suitable height shall be provided.
- (10) All the Civil works such as, transformer foundation, Oil Soak Pit, burnt oil pit as per CEA regulations & IS 10028 requirements shall be considered in Contractor's scope.
- (11) Ambient temperature of 50°C shall be considered for transformer design. Temperature rise shall be 40°C for oil temperature and 45°C for winding temperature. Hot spot temperature limits shall be complying with IS 2026, IS 6600 & IEC 60076-2:1993 & it shall be limited to 98°C.
- (12) The limits of hot spot temperature mentioned above will have to be satisfied by the manufacturer by carrying out the heat run test at the lowest negative tap. This test shall be carried out by feeding 1.1 times the total losses at 75°C, at highest current tap.
- (13) Neutral of LV winding shall be 50% rated.
- (14) Suitable dial type instruments/ indicator with alarm and trip contacts shall be provided for monitoring of following parameters for the transformer. The settings shall be site adjustable.

Winding Temperature Indicator (WTI)	1 No local + 1 No remote on RTCC
Oil Temperature indicator (OTI)	1 No local + 1 No remote
Magnetic oil level gauge (MOG)	1 No local

- (15) The bushing CT required in neutral connection for back up earth fault protection shall be provided before bifurcation of neutral.
- (16) Accessories listed below shall be provided for the transformer unless noted otherwise.
 - (a) Anti-earthquake clamping device
 - (b) Marshalling Box
 - (c) All interconnection cables, cable accessories for connection between the transformer marshalling box & other devices mounted on the transformer and inter-connection cables for all the associated equipment/ panels including cable termination accessories such as glands, lugs etc.
 - (d) Foundation bolts & hardware, mounting channel & support structures for marshalling boxes, junction boxes etc.
 - (e) All MS components including steel bolts & nuts shall be hot dip galvanized.
 - (f) Automatic self-resetting type pressure relief device with trip contacts wired up to marshalling box.

- (g) Additional neutral bushing.
- (h) Conservator with lifting lugs (for transformers 50 kVA and above with rated voltage up to 11kV, and all rating above 11kV with oil filling hole with cap and a drain plug) shall be complete with plug, sample and drain valve and a shut-off valve on the pipe connection between the transformer tank and conservator to permit removal of the conservator
- (i) Bushing Terminals or cable boxes complete with connectors for the Purchaser's external conductors or cable.
- (j) Neutral bushing terminal complete with connector for earth conductor.
- (k) Four plain rollers in place of fixing channels. The rollers shall be bidirectional, with suitable corrosion-free bearings, suitable for 90 degree rotation & lockable in both directions and of the detachable type.
- (l) Inspection covers (for transformers of 1000 kVA and above).
- (m) Rating and terminal marking plates
- (n) Two earthing terminals for body earthing
- (o) Drain cum sampling valve with plug or cover plate.
- (p) Dehydrating Silica Gel Breather equipped with a silica gel dehydration capsule and oil seal to eliminate constant contact with the atmosphere.
- (q) Thermometer pocket with mercury in glass bulb thermometer.
- (r) Radiator with air release plug, lifting lug, drain valve and with shut off valves.
- (s) Conservator with lifting lugs, oil filling cap & drain plug.
- (t) Prismatic oil level gauge (on conservator) with minimum level marking.
- (u) Jacking Lugs (Transformers weighing above 3000 Kg)
- (v) Filter Valves
- (w) Explosion vent with diaphragm/ pressure relief valve (for transformers 50kVA and above). The device shall be rain-proof after operation. For transformers of 500kVA and above an equalizer pipe connecting the pressure relief device to the conservator shall be supplied
- (x) Base channels for fixing on a platform or plinth
- (y) Lifting lugs for top cover & active part.
- (z) Lifting lugs for lifting complete transformer with oil.
- (aa) Lifting lugs for lifting core & coils.
- (bb) Pocket for O.T.I & W.T.I.
- (cc) Neutral C.T with terminal box.
- (dd) Earthing bar with insulator support.
- (ee) All indicating lamps shall be multichip LED Type.
- (ff) Dial type thermometer (150 mm Dia.) with two contacts for oil temperature 'high' and 'very high' alarms. Each contact shall be electrically independent and brought out to separate terminals, rated 220 VDC; minimum 0.5A.
- (gg) Magnetic oil level gauge (150 mm dia. 240 degree scale) with low oil level alarm contact for transformers fitted with conservator. Contact rating suitable for 220V DC, minimum 0.5A.
- (hh) Gas actuated Buchholz relay, double float type with a valve between the relay and the conservator.
- (ii) Gas sampling device at an accessible height and an air release cock for Buchholz relay.

- (jj) Winding temperature indicator, consisting of:
 - i) Temperature sensing element. Separate PT100 for digital signal shall be provided as temperature sensor
 - ii) Turret mounted CT.
 - iii) Local Winding temperature indicating instrument (150 mm Dia.) with electrically independent contact (potential free contact) brought out to separate terminals for winding temperature 'high' and 'too high' alarms. Contacts shall be suitable for 220V DC, rated minimum 0.5A.
- (kk) All digital outputs for control/ remote annunciation shall be provided with at least two change-over contacts for alarm & two change-over contacts for trip conditions. Auxiliary relays, if required, to provide change-over contacts suitable for Purchaser's equipment are deemed to be included in the Contractor's scope.
- (ll) Valves: Valves shall be of Gun Metal material & of suitable diameter for their intended purpose. Following valves shall be provided for each oil immersed transformer.
 - i) One (1) top filter valve with blanking plate.
 - ii) One (1) bottom filter valve with blanking plate
 - iii) One (1) top sampling valve with blanking plate
 - iv) One (1) bottom drain cum sampling valve with blanking plate for complete Transformer.
 - v) One (1) Drain valve with blanking plate for Conservator
 - vi) Two (2) Shut-Off/ Gate Valve for OLTC Part of Conservator (on both sides of Oil Surge relay)
 - vii) Two (2) Shut-Off/ Gate Valve for Main Conservator (on both sides of Buchholz relay)
 - viii) Radiator shut off valves with blanking plates between radiator head & tank.
 - ix) Oil filling valve with blanking plate for Main & OLTC conservator.
- (17) General Constructional Features of Transformer: All material used shall be of best quality and of the class, most suitable for working-under the conditions specified and shall withstand the variations of temperature and atmospheric conditions, overloads, over-excitation, short-circuits as per specified standards, without distortion or deterioration or the setting up of undue stresses in any part, and also without affecting the strength and suitability of the various parts for the work which they have to perform. The transformer construction shall be suitable for Seismic Data (as per latest edition of IS 1893) or elsewhere in the specification.
 - (a) Tanks:
 - i) The exterior of tank and other steel surfaces exposed to the weather shall be thoroughly cleaned and have a priming coat of zinc chromate applied. The second coat shall be of an oil and

weather-resistant nature, preferably of distinct colour from the prime and finish coats. The final coat shall be of a flossy, oil and weather resisting non-fading paint of specified shade. The interior of the tank shall be cleaned by shot blasting and painting with two coats of heat resistant and oil insoluble paint.

- ii) Steel bolts and nuts exposed to the atmosphere shall be galvanized.
- iii) Vacuum & Pressure Tests
- iv) Various Vacuum & Pressure Tests for tank, conservator, radiator, pipes etc. shall be as per mentioned in the CBIP Manual on Transformer – Publication no. 317: 2013 & latest edition thereof.
- v) The material used for gaskets shall be cork neoprene or approved equivalent.

(b) Core:

- i) The magnetic circuit shall be constructed from high grade cold-rolled non-ageing grain oriented silicon steel laminations and shall be of 'core' type.
- ii) The insulation structure for the core to bolts and core to clamp plates shall be such as to withstand BIL & Lightning Impulse Voltage.
- iii) Each lamination shall be coated with insulation which is unaffected by the temperature attained by the transformer during service.
- iv) Core laminations shall be annealed, and burrs removed after cutting. Cut edges shall be insulated.

(c) Windings:

- i) Windings shall be of electrolytic grade Copper of 99.9% purity unless specifically approved by the Purchaser.
- ii) Windings shall be of insulated Copper wire or Copper strip.
- iii) Windings and insulation shall be so arranged that free circulation of oil is possible between coils, between windings, and between winding and core.
- iv) Winding shall be subjected to a shrinking and seasoning process, so that no further shrinkage occurs during service.
- v) The completed core and coil assembly shall be dried in vacuum and shall be immediately impregnated with oil after the drying process to ensure elimination of air and moisture within the insulation.
- vi) High voltage end-windings shall be suitably braced to withstand short circuit stresses and stresses caused up by surges.
- vii) Materials used in the insulation and assembly of the windings shall be insoluble, non- catalytic and chemically inactive in the hot transformer oil and shall not soften or be otherwise affected under

the operating conditions.

- viii) Varnish application on coil windings may be given only for mechanical protection and not for improvement in dielectric properties. In no case varnish or other adhesive, be used which will seal the coil and prevent evacuations of air and moisture and impregnation by oil.
 - ix) Permanent current carrying joints in the windings and leads shall be welded or brazed. Clamping bolts for current carrying parts inside oil shall be made of oil resistant material which shall not be affected by acidity in the oil. Steel bolts, if used, shall be suitably treated.
 - x) Terminals of all windings, and if stated also of stabilizing windings, shall be Brought out of the tank through bushings for external connections.
 - xi) Windings shall be of copper and the conductors shall be transposed at sufficient intervals in order to minimize eddy currents and equalize the distribution of currents and temperatures along the windings.
 - xii) The sequence and orientation of HV/ LV side phase and neutral bushings shall be as specified in the latest edition of relevant IS.
 - xiii) Transformer shall operate without injurious heating at the rated KVA and at any voltage up to $\pm 10\%$ of the rated voltage of any tap. Transformer shall be designed for 110 % continuous over-fluxing withstands capability.
- (d) Internal Earthing: The framework and clamping arrangement of core and coil shall be securely earthed inside the tank by Copper strap connection to the tank.
- (e) Terminations:
- i) Transformers shall be fitted either with bushing insulators or with air insulated cable boxes/ air insulated cable box with disconnecting chamber, as per requirement based on transformer HV incomer.
 - ii) The neutral of the star-connected winding shall be brought out to a separate bushing terminal. The neutral bushing shall be provided on the tank side to facilitate lead of the earth conductor down to the ground level. For transformers 1000 kVA and above, tank mounted insulators shall be provided for supporting the neutral earthing bar of specified section, along its run from the neutral bushing to ground-level.
- (f) Bushings:
- i) Bushings shall be designed and tested to comply with the applicable standards specified in the specifications.
 - ii) Bushing rated for 400A and above shall have non-ferrous flanges

and hardware.

- iii) Fittings made of steel or malleable iron shall be galvanized.
- iv) Bushings shall be supplied with terminal connector clamp suitable for connecting the bushing terminal to the specified conductor/ cable.

(g) Bushing Current Transformers:

- i) Whenever applicable, bushing shall be supplied with current transformers.
- ii) Secondary leads, including tapping, shall be brought to a weatherproof terminal box near the bushing.
- iii) Bushing CT nameplate shall be mounted on the tank adjacent to the terminal box.

(h) Cable Boxes and Disconnecting Chamber:

- i) The cable boxes, wherever required as per the prescribed criteria, shall be complete with cable joint fittings or sealing ends as required, tinned copper lugs to suit specified cable, compound and all other accessories including compression type glands, armour earth clamps and body earth terminal.
- ii) For Cable type of terminations, disconnecting chamber shall be provided to enable the transformer to be removed without unsealing the cables or draining oil from the main tank. The disconnecting chamber shall be air insulated and complete with seal-off bushings, removable flexible connectors/ links, and removable covers.
- iii) Cable boxes shall be designed to accommodate all cable joint fittings or sealing ends as required, including stress/ cones or other approved means for grading voltage stress on the terminal insulation of cables operating at voltages of 22 kV and above.
- iv) Phase to phase and phase to ground clearances within the chamber shall be such as to enable either the transformer or cable to be subjected separately to HV tests.
- v) Marshalling Box:
- vi) Whenever fittings such as OTI/ WTI, temperature indicators with auxiliary contacts, Buchholz relay, bushing CTs etc. are provided the marshalling box shall be provided to marshal in it all the contacts / terminals of electrical devices mounted on the transformer.
- vii) It shall be in the Contractor's scope to provide interconnection cabling between the marshalling box and the accessory devices by either PVC insulated, FRLS wires in GI conduits and/ or XLPE insulated, inner & outer extruded PVC, armoured cable, and necessary compression type brass cable glands at the marshalling box for the above mentioned cables as well as for

terminating the incoming cables from remote panels.

- viii) The marshalling box shall be tank mounted (at easily accessible location), outdoor type, IP-55 protected, weather-proof, sheet-steel (2.0 mm thick) enclosed, with hinged door having padlocking facility and painted as per paint shade approved by the Purchaser. All doors cover and plates shall be fitted with Neoprene gaskets. Bottom shall be at least 600 mm from floor level and provided with gland plate and cable glands as required. Top surface shall be sloped.
 - ix) The marshalling box shall be provided with glass window so as to make the WTI and the OTI dials visible from the outside without opening the door.
 - x) All contacts for alarm, trip and indication circuits shall each be potential free, wired for auxiliary DC supply as specified and brought out to separate terminals at the terminal blocks in the marshalling-box. Terminals shall be rated for 10A. Wiring shall be 1.1 kV grade, with multi-stranded, copper conductors of sizes not smaller than 1.5 mm² for control and 2.5 mm² for CT circuits. CT terminals shall be provided with shorting facility and earthing.
 - xi) The marshalling box shall house the winding temperature indicator (WTI, 150 mm dial), the oil temperature indicator (OTI, 150 mm dial), terminal block, 60W anti-condensation heater, 6 / 16A industrial type five pin socket and a 10W CFL with fixture, suitable for operating on 240 V AC. Contacts of Buchholz relay, WTI, OTI, magnetic level gauge, PRD, OSR shall be wired up to the terminal block.
- (i) Noise level of transformers shall be as per latest NEMA standard.
 - (j) Oil - Transformers shall be supplied complete with transformer oil. Transformer oil shall be as per IS-335:1993, BS 148 or IEC 296. 10% extra oil shall be supplied with transformer in non-returnable drums.

(18) Maintenance Requirements for Transformers & Associated Equipment:

- (a) The construction of the transformer & location of the accessories like CTs, lower ends of bushings, terminals, tap-changers etc., shall be such as to afford easy access & permit replacement of auxiliaries without removing the tank cover.
- (b) Instruments & wiring in the local marshalling box (cabinet) shall be completely accessible & sufficient working space shall be made available in the cabinet. Instruments, wiring & accessories in the cabinet shall be accessible from the front & the rear as well.
- (c) The rating plate of the transformer shall be supplied as per latest version of IS: 2026.
- (d) Transformer shall be capable of being used with any make of transformer oil complying with IS: 335.
- (e) As far as practicable, transformer & accessories shall be so designed that no special tools are necessary for installation & maintenance.

However, if special tools are required, the Contractor shall supply one complete set of such tools along-with transformer.

(19) Performance Tests:

- (a) In addition to the routine tests specified in the latest edition of IS: 2026, tests listed out shall be carried out on the transformer and these shall be included in the quoted prices.
- (b) The tests shall be carried out in the presence of the Purchaser/ Purchaser's representative. The following tests shall be carried out on the assembled transformer during inspection at the manufacturer's works;
 - i) Measurement of resistance of windings at principal and extreme taps.
 - ii) Ratio at each tap, polarity, and phase relationships
 - iii) Measurement of impedance voltage at principal and extreme taps
 - iv) Measurement of no load current and no load losses at rated frequency and at both the rated voltage and 110% rated voltage
 - v) Measurement of efficiency at $\frac{1}{2}$, $\frac{3}{4}$ and full load
 - vi) Measurement of insulation resistance
 - vii) Induced over voltage withstand test
 - viii) Separate source voltage withstand test
 - ix) Magnetic balance test
 - x) Vacuum & Pressure Test for the tank.
- (c) In addition to the above tests, lightning impulse withstand test shall be carried out on one limb of HV winding of the transformer if impulse test has not been already carried out on transformer of similar or higher capacity in the last five years. Similarly heat run test shall also be carried out if the same has not been already carried out on transformer of similar or higher capacity in the last five years. Type test certificate shall be submitted along with the bid. if such a test has not been already carried out then same has to be carried out & witnessed by third party (such as CPRI) at the Contractor's expense.
 - i) All tests required by the specification including repeated tests and inspection that may be necessary owing to the failure to meet any tests specified, shall be carried out at the Contractor's expense.
 - ii) If the transformer fails to pass the tests specified, the Client shall have the option to reject the unit. Additional tests shall be conducted to locate the failure and after rectification, all tests shall be repeated to prove that the rebuilt transformer meets the specification in all respects, all at the Contractor's expense.

(20) Drawings/ Documents Required: Contractor shall submit the following drawings/ documents for Purchaser's approval:

- (a) General arrangement drawing of the transformer, showing plan, front elevation and side elevation complete with all accessories and fittings, detailed dimensions, net weights, quantity of oil, crane lift for un-tanking, size of lifting lugs and eyes, clearances between HV terminals, between LV terminals, between HV and LV terminals, between HV & LV terminals and ground etc
 - (b) Rating, diagram and terminal marking plates, complete with polarity and vector group
 - (c) Foundation drawing with position of foundation bolts and depth. In case of Soak pit / Burnt oil pit requirements, the same shall also be included.
 - (d) General arrangement of HV cable box with air insulated disconnecting chamber.
 - (e) General arrangement of LV Cable Box or Bus Duct arrangement.
 - (f) General arrangement of marshalling box & wiring diagram.
 - (g) General arrangement of OLTC/ RTCC & wiring diagram
 - (h) Guaranteed Technical Particulars for Transformer
- (21) Off Circuit Tap Changing Mechanism (OCTC) for Transformer ≤ 500 KVA: OCTC shall be with +5%, -10% (or $\pm 7.5\%$) in taps in steps of 2.5% on HV winding of transformer; It shall comprise:
- (a) Operating handle or wheel, accessible from ground level. Tap changer operating switch mounted on the top of the transformer tanks will not be acceptable
 - (b) Tap position indicator.
 - (c) Pad locking arrangement without interfering with visual tap position indicator shall be provided.
 - (d) The tap-changer connections and contacts shall be accessible through an excess hole having a bolted gasketed cover.
- (22) On load Tap Changing Mechanism (OLTC) for Transformer > 500 KVA: OLTC shall be with +5%, -15% (or $\pm 10\%$) taps in steps of 1.25% on HV winding of transformer; It shall have following technical features:
- (a) The OLTC gear shall be designed to complete successfully tap changes for current equal to 120% of current at minimum tap position of the transformer. Also, OLTC over loading capability shall be compatible with that of transformer specified in IS / IEC specification "Guide for loading of oil immersed transformers". Devices shall be incorporated to prevent tap change when the through current is in excess of the safe current that the tap changer can handle. The OLTC gear shall withstand through fault currents without injury.
 - (b) When a tap change has been commenced it shall be completed independently of the operation of the control relays and switches. Necessary safeguard shall be provided to allow for failure of auxiliary power supply or any other contingency which may result in the tap changer movement not being completed once it is commenced.
 - (c) Oil in compartments which contain the making and breaking contacts of the OLTC shall not mix with the oil in other compartments of the OLTC

or with transformer oil. Gases released from these compartments shall be conveyed by a pipe to a separate oil conservator or to a segregated compartment within the main transformer conservator. An oil surge relay shall be installed in the above pipe. The conservator shall be provided with a prismatic oil level gauge.

- (d) Oil, in compartments of OLTC which do not contain the make and break contacts, shall be maintained under conservator head by valved pipe connections. Any gas leaving these compartments shall pass through the oil surge relay before entering the conservator.
- (e) Oil filled compartments shall be provided with filling plug, drain valve with plug, air release vent, oil sampling device, inspection window with view glass.
- (f) OLTC driving mechanism and its associated control equipment shall be mounted in an outdoor, weather proof cabinet conforming to degree of enclosure protection IP55. The finish shall match with that of the transformer on which it is mounted. The cabinet shall include:
 - i) Driving motor (415 V, 3 phase, 50 Hz, AC squirrel cage)
 - ii) Mechanically & electrically interlocked motor starting contactors with thermal overload relay, isolating switch and MCCBs.
 - iii) Duplicate sources of power supply with automatic changeover from the running source to the standby source and vice versa will be provided in transformer marshalling box and one no. outgoing feeder extending to OLTC Driving Motor cabinet, with appropriate provision for receiving the same.
 - iv) Control switch: Raise/ off /lower (spring return to normal type) or independent push buttons.
 - v) Emergency 'OFF' push button (maintained type).
 - vi) Remote/ Local selector switch (maintained contact type).
 - vii) Mechanical tap position indicator.
 - viii) Limit switches to prevent motor over-travel in either direction or final mechanical stops.
 - ix) Appropriate scheme/ device to permit only one tap change at a time on manual operation.
 - x) Emergency manual operating device (hand crank or hand wheel).
 - xi) A five digit operation counter.
 - xii) Space heaters with thermostat and MCB.
 - xiii) Control transformers with MPCB/ MCBs on primary and secondary sides for each supply.
 - xiv) Interior lighting fixture with lamp, door switch/ ON-OFF switch and MCB.
 - xv) Gasketed and hinged door with locking arrangement.
 - xvi) Terminal blocks, internal wiring, earthing terminals and cable glands for power and control cables.
 - xvii) Necessary relays, contactors, current transformers etc.
 - xviii) Transducers or any other appropriate device for remote tap

position indication.

- (g) Control Requirements for OLTC: The following electrical control features shall be provided:
- i) Positive completion of load current transfer, once a tap change has been initiated, without stopping on any intermediate position, even in case of failure of external power supply.
 - ii) Only one tap change from each tap change command even if the command is maintained.
 - iii) Cut-off of electrical control when manual operation is resorted to.
 - iv) Cut-off of a counter impulse for a reverse tap change until the mechanism comes to rest and resets the circuits for a fresh operation.
 - v) Cut-off of electrical control when it tends to operate the tap beyond its extreme position.
- (h) Remote Control Equipment: The OLTC remote control equipment shall be housed in an indoor sheet steel cubicle 2.1 m high & 0.45 m deep to be located in a remote control room. It shall conform to degree of enclosure protection IP42 or better and shall comprise the following:
- i) Control switches; Raise/ Off/ Lower (spring return to normal type) or independent push buttons.
 - ii) If automatic operation is specified, auto/ manual selector switch (maintained contact type) and other items as listed.
 - iii) If parallel operation is specified, Master/ Independent/ Follower selector switch (maintained contact type) with 'out of step' annunciation.
 - iv) Tap position indicator.
 - v) Facia type alarm annunciators with "accept", "lamp test" facilities and hooter/ buzzer for alarms as listed.
 - vi) Necessary auxiliary relays.
 - vii) Lamp indications for:
 - Tap change in progress
 - Lower limit reached
 - Upper limit reached
 - viii) Transformer cooler control apparatus (if applicable)
 - ix) Cable glands for power and control cables.
 - x) 240V rated panel space heater with thermostat.
 - xi) CFL type interior lighting fixture with lamp and door switch.
 - xii) Control MCBs and Terminal blocks.
 - xiii) Internal wiring.
 - xiv) Earthing terminal.
 - xv) Hook up for the remote operation of tap lower and raise operation and contact/ signal for tap position indication to Purchaser's DCS

shall be incorporated in the panel.

- (i) Automatic Control of OLTC: Automatic voltage regulator (AVR) for auto control of OLTC shall include:
 - i) Voltage setting device, Voltage sensing and voltage regulating devices
 - ii) Line drop compensator with adjustable R and X elements.
 - iii) Timer 5-25 seconds for delaying the operation of the tap changer in the first step for every tap change operation.
 - iv) Adjustable dead band for voltage variation.
 - v) Additional features as required when parallel operation with other transformers is specified.
- (j) Alarms: The following alarms shall be provided:
 - i) A.C. supply failure
 - ii) Drive motor auto tripped
 - iii) Other protective purpose considered essential by the Contractor.
 - iv) Out of step operation when paralleled transformers supposed to operate on the same tap are operating at different taps.
 - v) Tap change delayed
 - vi) AVR failure (if AVR is specified)
 - vii) For all specified above an "OLTC trouble" group alarm to be provided in DCS which is located in control room.
 - viii) Others, as specified.
- (k) Tests:
 - i) Routine Tests: Routine tests as per IS: 8468 shall be performed on all OLTC's & Motor drive mechanisms. Over and above, Pressure and Vacuum tests shall be conducted as per IEC: 60214.
 - ii) Type Tests: Type tests as per IS: 8468 shall be carried out on OLTC & Motor drive mechanism when called for. The bidder shall indicate in his price schedule extra price, if any, for carrying out these tests. If type tests are not called for, type test reports for tests conducted (not older than five (5) years) on a similar or higher rating OLTC & Motor drive mechanism shall be submitted for Purchaser's approval.
 - iii) Additional Requirements, if any: Tap position indicators and OLTC control switch shall be supplied loose if Purchaser decides to mount the same in the power transformer control panel.
 - iv) The finish and dimensions of the panel shall be as specified so as to match with the other panels in remote control room.

4.3.3 MV Metal Enclosed Switchgears (where applicable):

- (1) Applicable Standards:

- (a) The design, material, construction, manufacture, inspection and testing of MV Metal Enclosed Switchgear shall conform to the latest applicable standards & comply with all currently applicable statutes, regulations, and safety codes in the locality where the equipment will be installed.
- (b) The equipment shall also conform to the latest standards specified below. In case of conflict between the standards and this specification, this specification shall govern.

Metal Enclosed Switchgear for rated voltage above 1kV up to and including 52 kV	: IS: 3427/ BSEN: 60298/ IEC: 298/ IEC 265
High Voltage AC Circuit Breakers/ Contractors	: IS: 13118/ IEC: 56, 694, 62271, IEC: 60470, 529, 721
Current Transformers	: IS: 2705/ BS: 7626
Voltage Transformers	: IS: 3156/ BS: 7625 / IEC: 186
Arrangement for switchgear bus bars, main connections, and auxiliary wiring	: IS: 5578, 11353
Busbar Support Insulators	: IS: 2544 / BS: 3297/ IEC: 273
Degree of Protection	: IS: 13947 (Part 1)/ IEC: 947-1/ IEC: 60529
Electrical Relays for power system protection	: IS: 3231, 3842/ BS: 142/ IEC: 255
Electrical Indicating Instruments	: IS: 1248 / BS: 89/ IEC: 51
High Voltage Fuses	: IS: 9385/ BS: 2692/ IEC: 282
AC Electricity Meters	: IS: 722, 8530/ BS: 5685/ IEC: 145, 211
Specification for copper rods and bars for electrical purposes	: IS: 613
Code of practice for phosphating iron and steel	: IS: 6005/ BS: 3189
Low Voltage Fuses	: IS: 13703/ BS: 1362/ IEC: 269
Toggle Switches	: IS: 3452/ BS: 3676
Code of practice for selection, installation and maintenance of switchgear and control gear	: IS: 10118
Control Switches	: IS: 6875/ BSEN: 60947/ IEC: 947
HV Cable Termination	: IEC: 62329

- (2) The switchgear shall be metal enclosed, indoor type with vacuum circuit breakers fully draw out. Circuit breakers of same ratings shall be completely inter-changeable with one another. Separate metal enclosed compartments for (a) control, metering & relaying devices, (b) circuit breaker, (c) phase bus bars, (d) Instrument transformers & (e) input/ out power cable terminations and each section shall be in conformance with Loss of Service Continuity LSC 2B.
- (3) The rated capacity of the breaker & switchgear configuration (no. of incomer & outgoing breakers, minimum ratings, protections, indications, annunciations, instruments etc.) shall be as per reference electrical Single Line Diagram & this specification given in table below:

Sr. No.	Description	Rating		
a)	Nominal (Rated) System Voltage	33 kV	11 kV	6.6 kV
b)	Max System Voltage	36 kV	12 kV	7.2 kV
c)	Lightning Impulse Withstand Voltage (1.2/ 50 microsecond)	170 kVp	75 kVp	60 kV _{peak}
d)	Power Frequency Withstand Voltage for 1 minute.	70 kVrms	28 kVrms	20 kV _{rms}
e)	Bus bar rating (A)	*A (As per SLD)		
f)	Short Circuit Rating (kA for 1 sec)	25	18.4	-
g)	Type of breakers	VCB/ SF6	VCB/ SF6	VCB/ SF6
h)	Bus bars material	Electrolytic Copper (Silver plated at Joints)		
i)	Degree of Protection (Indoor / Outdoor)	IP4X/ IP5X (as minimum)		

- (4) Auxiliary relays for multiplication of contacts for following transformer protections shall be provided for oil type transformer feeders:
- (a) Buchholz Relay Alarm & Trip
 - (b) Winding Temperature Alarm & Trip
 - (c) Oil Temperature Alarm & Trip
 - (d) Pressure Relief Device Trip
 - (e) Oil level gauge (MOG) Alarm
 - (f) Oil Surge Relay (OSR) Trip
- (5) The circuit breakers should be able to carry the rated current continuously under site conditions without exceeding the permissible temperature rise for design ambient temperature outside the switchgear cubicle as specified.
- (6) Bus bar material for switchgear panel shall be electrolytic Copper. Bus bars shall be fully insulated, supported on insulators capable of withstanding dynamic stresses due to short circuit. Maximum temperature of the main bus bars and bus bar connections, under operating conditions, when carrying rated normal current at rated frequency shall not exceed 90/ 105°C for non-silver plated/ silver plated joints as per IEC 60694. Bus bar temperature limits shall be adhered to without forced cooling method. The continuous current ratings of the droppers in each switchgear cubicle shall at least be equal to the corresponding breaker rating. However short time current rating shall be same as the short time current rating of the bus-bars.
- (7) The circuit breaker shall be fully drawn out type in horizontal with test, service, and isolated positions. In test position, the circuit breaker shall be capable of being tested for operation without energizing power circuits. Additional 2 (Two) normally open (NO) contacts of test and service positions shall be available for Client's use, after meeting all the interlocks/ permissive.

- (8) Switchgear shall comprise rigid welded structural frame enclosed completely by sheet steel - minimum 2.5 mm thick (hot rolled) or 2.0 mm thick (cold rolled), smooth finished, levelled, and free from flaws. Switchgear cubicles shall be provided with bottom sheet steel plates of 2.5 mm thickness. Cable compartments shall be fitted with removable plates of minimum 2.5 mm thickness for fixing cable glands. Cable gland shall be double compression type. For single core cable, removable plates of non-magnetic material shall be provided.
- (9) The switchgear panel shall be powder coated with shade RAL-7032 with minimum thickness 80 microns with structured finish and height not exceeding 2300 mm.
- (10) For vacuum circuit breakers necessary hardware for surge suppression shall be provided to take care of switching surge.
- (11) Circuit breaker shall be provided with a minimum of 6NO + 6NC contacts per pole exclusively for the Client's use. All spare contacts of the circuit breaker shall be wired up to the terminal block.
- (12) The breaker closing coils, tripping coils, indications, annunciations shall be rated for 30V or 110V DC. The spring charging motor shall be suitable for 240V AC. Space heater, power socket, panel illumination lamp shall be fed from 240V, 50 Hz, 1 phase raw power supply. All lamp test facility shall be provided with push button.
- (13) The current transformers shall be mounted in the fixed portion of the switchgear expansion panel. The CTs shall withstand momentary and short time current ratings of the associated switchgear. CTs & VTs shall be of the cast resin type and completely encapsulated. Adequate space shall be available for termination using heat shrinkable type cable termination in CT compartment.
- (14) The switchgear shall have complete interlocking arrangement at the fully inserted and fully drawn out position of the breaker. Withdrawal of circuit breaker shall not be possible unless it is in open position and operation of circuit breaker shall not be possible unless it is fully in service position or is fully drawn out. Comprehensive interlocking system to prevent any dangerous or inadvertent operation shall be provided. Breaker trolley if required shall be provided with breaker.
- (15) Automatic safety shutters shall cover live parts when the breaker is withdrawn, and all other standard safety features shall be provided.
- (16) All the High Voltage compartments i.e., Circuit Breaker, Bus Bar, and Cable Compartments shall be separated from each other by metallic partitions in line with IEC-62271-100/200. These compartments must have pressure relief flaps for exit of gas due to internal arc to ensure operators safety. All the HV design must ensure conformity to IEC-62271-100/200 and must be type tested for Internal Arc Tests.
- (17) All noncurrent carrying metal work of the switchgear panel shall be effectively bonded to the earth bus. Earth bus-bar shall be extended outside the switchboard at the ends. All hinged doors & bolted joints in the body of switchgear shall be earthed through flexible copper earthing braid of adequate cross section.

- (18) Terminal blocks shall be of stud & nut type, 1100V volts grade, 10 amps rated complete with insulated barriers. Terminal blocks for CTs and VTs shall be provided with test links and isolating facilities and CT terminals with short circuiting and earthing facility. All spare contacts and terminals of cubicle mounted equipment and devices shall be wired to terminal blocks with 20% spare terminals. All terminals of different control voltages shall be separate from each other. Stud type terminals and ring type lugs shall be used for control cables.
- (19) The sizes of wire for CT circuit shall be minimum 2.5 mm² multi-stranded copper conductor PVC insulated and for others minimum 1.5 mm² multi-stranded copper conductors PVC insulated. Ring type lugs suitable for termination of 2.5 sq. mm copper wires shall be used. Colours of the secondary/ auxiliary wiring should conform to IS 375/ 1963 and latest amendments thereof.
- (20) All wiring shall be neatly run, and group of wiring shall be securely fixed with clips so that wiring can be checked without necessity of removing the clamps. Ferrules with number shall be provided on both end of the wiring, i.e. straight + cross ferruling shall be done. Printed ferrules (tubular type- cut to size after printing) white with black lettering shall be provided. Printing shall be done with the indelible ink.
- (21) All protective relays shall be in draw out cases with built in test facilities. All auxiliary relays and timers shall be supplied in non-draw out cases. Externally operated hand reset indicators shall be provided on all electro-mechanical relays and timers. Timers shall be of electromagnetic or electronic type only. All spare contacts of all relays/ timers shall be wired to terminal block. All relays shall be of self-reset type, unless otherwise specified.
- (22) Main Protection relays shall be numerical type and shall be supplied with latest version software without any extra cost. Relays and protection shall be enabled for SCADA with IEC 61850 protocol & Modbus RS-485.
- (23) Breaker control switches shall be of pistol grip type and selector switches shall be oval or knob. Breaker control switches shall be 3 position spring returns to neutral.
- (24) Indicating lamps shall be panel mounting type of the colour specified and of multi-chip/ cluster LED type only.
- (25) Each circuit breaker panel shall be complete with the following:
- (a) T-N-C control switch, spring return to neutral position.
 - (b) Key operated local/ remote selector switch stay put type.
 - (c) Red, green, amber, white and blue coloured clustered type LED indicating lamps for breaker- ON, OFF, auto trip, trip circuit healthy and spring charged and breaker in Test/ Service position shall be provided.
 - (d) Push Button for all lamp test facility.
 - (e) 8 window (for Incomer Panel) or ICOG/ 16 window [for each Outgoing (transformer feeder) panel] annunciator with all associated accessories as per detailed in electrical SLD.
 - (f) Double pole control supply switch with MCB.
 - (g) Electrical anti pumping relay.
 - (h) Interposing relays

- (i) Panel illumination lamp (CFL) with MCB/ switch.
 - (j) Space heater with adjustable thermostat, MCB.
 - (k) 5/ 15A, 1 phase receptacle with MCB.
 - (l) Potential indicating multichip/ clustered type LED lamps (R, Y, and B) for incomer/ ICOG breaker.
 - (m) Components as per electrical SLD.
 - (n) Emergency trip push button (ETPB- Mushroom type, Red coloured latch-able type)
 - (o) Test Terminal Block (TTB)
 - (p) Mechanical trip push button to trip the breaker when control supply is lost. The push button shall be shrouded type. Mechanical close push button provided shall be accessible only after opening of the front door.
 - (q) The panel front of the circuit breaker truck shall have following devices/ indications:
 - i) Mechanical push button for breaker open.
 - ii) Mechanical indications for spring charge/ discharge.
 - iii) Mechanical indications for breaker test/ service position.
 - iv) Mechanical indication for breaker ON/ OFF.
 - v) Operation Counter.
 - vi) Device for manual charging of closing spring
- (26) All analogue indicating meters shall be 96 x 96 mm size taut band with 240° Scale. All indicating meters including Analogue Ammeter & Voltmeter shall be provided as per electrical 'Single Line Diagram'.
- (27) Multi-Function Meter (MFM) shall be micro-processor based electronic meter and shall have facility for online monitoring, reading display of each parameter and shall be provided with RS-485 communication port.
- (28) No extra charges shall be payable to Contractor in the event of any change in the contact configuration of relays i.e. from normally open (NO) to normally closed (NC) and vice versa. All wiring and necessary hardware for the completeness of the schemes shall be included in the scope of Contractor.
- (29) All operating switches shall be accessible without opening the compartment door.
- (30) All transformer outgoing feeders shall be suitable for interrupting transformer magnetizing currents. The breaker shall be electrically interlocked with downstream LV breaker such that if HV breaker trips, LV breaker shall also trip, and LV breaker cannot be closed until HV breaker is closed.
- (31) Withdrawal or engagement of circuit breakers or disconnecting switch shall not be possible unless it is in the open position.
- (32) Operation of circuit breaker or disconnecting switch shall not be possible unless it is fully in service position, or in test position or in fully drawn-out.
- (33) It shall be entirely responsibility of the Contractor to ensure that characteristics of CTs, VTs and all other devices offered by him / her are such as to be suitable for the purpose for which they are intended.
- (34) Switchgear shall be suitable for easy extension on both the sides. It shall be possible at a later stage to add cubicles on both the sides of the switchgear by extending the bus-bars.

- (35) All power and control cables entry shall be from bottom/ top to suit the site condition. The cable compartment shall house all power cable connections along with associated cable terminations.
- (36) All control cabling/ wiring shall be done using 1.1kV grade, multi-stranded, Cu conductor, PVC insulated FRLS cables. Panel wiring shall be securely supported, neatly installed by lacing, and tying, readily accessible and connected to equipment terminals and terminal blocks. All the accessories such as cable troughs, cable ties, covers etc. shall be of fire retardant material.
- (37) Breaker handling trolley shall be provided if required. This shall be complete with all necessary accessories.
- (38) Earthing Switch shall be provided for bus-bar earthing for incomer panel and for cable earthing on the outgoing breaker panel with necessary interlocks. The panel earthing shall be extended up to cable alley for armour earthing.
- (39) Required suitable Cable / extension adopter boxes for power cables shall be a part of HV panel. The termination kit shall be heat shrinkable type only. Cable lugs for all power, control & instrumentation cables connections shall be supplied. The lugs shall be tinned Copper/ Aluminium depending on cable conductor and of solder less crimping type.
- (40) Padlocking facilities shall be provided for locking the shutters positively in closed position in all the panels. All door locks shall be provided with special keys to ensure opening by authorized personal only.
- (41) Caution name plate, "Caution Live Terminal" shall be provided at all the points where the terminals are likely to remain live and isolation is possible only at remote end i.e. incomer to the switchboard.
- (42) Danger notices in three languages (Hindi, English & Local) and in line with the requirements of IS: 2551 shall be riveted & not pasted at appropriate locations of the switchgear.
- (43) Feeder and board name plates to be provided at front and rear of switchboard.
- (44) Panel illumination lamp shall be 9/ 11W LED with fixture & shall be provided with door limit switch.
- (45) Relays:
 - (a) All relays as indicated in electrical 'Single Line Diagram' shall be mounted on the switchgear panels. The relays shall be in draw-out case, flush mounted type.
 - (b) All the unit protection relays such as 50/ 50N, 51/ 51N, 51NS & 27/ 59 shall be numerical type & electro-magnetic relays shall not be used for this purpose.
 - (c) In case the primary protection relays offered by Contractor do not have adequate number of contacts for protection/ interlock schemes. Contractor shall supply suitable contact multiplying auxiliary relays as required. Also, all necessary auxiliary relays as required to meet the Purchaser's final control/ protection/ interlock schemes shall be provided by the Contractor.
 - (d) Relays shall be Numerical type. Test terminal block for testing shall be provided. Relays shall be suitable for 1/ 5A CT secondary rating as indicated in respective Single Line Diagram. Relays shall be suitable for SCADA with IEC 61850 protocol & Modbus RS-485.

- (e) Lockout relay-86 shall be having minimum 6 NO + 6 NC contacts.
- (f) All relays shall have clear identification on the associated panel by well-written inscription plates. Where indications are provided by flag relays or LEDs, these shall also be specifically identified by permanently fixed inscription adjacent to them.
- (g) The final relay ranges of each relay shall be decided at detailed engineering stage, if it is found that the offered relay range is not suitable for the intended application, the Contractor shall change the relay of appropriate range without any commercial/ delivery implications whatsoever. The relay shall be subject to approval of Client's representative.
- (h) Contractor shall furnish recommended relay settings with backup calculations & approval for the same has to be obtained from Purchaser / Consultant. Entire Relay co-ordination shall be carried out in ETAP 12.5 version or latest available during detailed engineering. The Contractor shall obtain all interface data from all concerned.
- (i) All relay/ auxiliary relay coils shall operate satisfactorily between 85% to 115% of rated control voltage.
- (j) It is responsibility of the Contractor to include accessories like auxiliary CTs, VTs and all other necessary devices as required for satisfactory performance of relay and protection scheme even if not indicated in drawings/ data sheets. Testing facilities like test switches / test plugs shall be provided for testing of each individual relays.
- (k) Performance tests shall be conducted at site and also supervised by Contractor for all the equipment's to prove the guarantee.
- (l) Prices quoted shall include the cost of all routine tests specified in relevant standard & as mentioned below. As regards type tests, copies of the earlier test certificates carried out on equipment of similar or higher ratings but not older than five (5) years shall be furnished along with the offer.

(46) Current Transformers: Current transformers shall satisfy following requirements:

- (a) Current transformers for metering & protection shall be cast resin (class of insulation B or better). The CT ratios/ protection class shall be as shown in 'Single Line Diagram'.
- (b) Rated VA burden for metering/ protection CTs shall not be less than 15VA or 120% of total VA burden whichever is higher.
- (c) The accuracy class for metering CT shall be 1.0 or better.
- (d) It shall be responsibility of Contractor to ensure that CTs are suitable for correct and satisfactory operation of the instruments / relays connected across them.
- (e) Short time current rating and momentary withstand rating of CTs shall be as per breaker short time current withstanding capacity.
- (f) All CTs shall have secondary rating of 1A or 5A.

(47) Voltage Transformers: Voltage transformers shall satisfy following requirements:

- (a) Potential transformers for metering/ protection shall be suitable for operation on 11/ 33kV, 50 Hz system. The VT ratios shall be as shown in respective electrical Single Line Diagram.
- (b) Rated VA burden for metering/ protection VTs shall not be less than 100VA or 120% of total VA burden whichever is higher.
- (c) The accuracy class for metering VT shall be Class 1.0/ 3P as required.
- (d) It shall be responsibility of Contractor to ensure that VTs are suitable for correct and satisfactory operation of the instruments connected across them.
- (e) Fuses on primary side shall have rupturing capacity equal to the switchgear rating.
- (f) For VT's MCB shall be provided on secondary. MCB trip contact to be wired up for annunciation.

(48) Maintenance Requirements:

- (a) Contractor shall supply maintenance tools including special tools (if required) for attending to the equipment supplied at no extra cost. As far as practicable, the equipment and accessories shall be so designed that no special tools are necessary for installation and maintenance of the equipment. However, if special tools are required, the Contractor shall supply one complete set for each type of equipment for the purpose.
- (b) Contractor shall include supply of start-up and essential spares.
- (c) Contractor shall furnish detailed inter-panel diagrams, terminal connection wiring diagram, and detailed component layout drawings to carry out maintenance work.
- (d) Contractor shall ensure the use of calibrated test equipment having valid calibration test certificates from standard laboratories traceable to national standard.

(49) Earthing:

- (a) An earthing bus shall be provided at the bottom and extend throughout the length of the switchgear. It shall be bolted / welded to the framework of each unit and each breaker earthing bus.
- (b) All non-current carrying metal work of the switchgear shall be effectively bonded to the earth bus. Hinged doors shall be earthed through flexible earthing braid of adequate size.
- (c) Positive earthing of the circuit breaker frame shall be maintained both in service and test position.

(50) Annunciator:

- (a) Microprocessor based alarm annunciator shall be provided for generating audio visual alarms for each abnormal condition. Facia

annunciator, suitable for operation on 30V or 110V DC (as applicable) shall be provided.

- (b) Each alarm shall initiate the operation of both visual and audible devices equipped with 'Mute', 'Acknowledge' and 'Reset' push buttons common to annunciators on all switchgear aligned together and a 'Lamp test' push button for each annunciator on individual panels.
- (c) Annunciator shall be of facia type with translucent plastic window for each alarm point. Annunciator facia plates shall be engraved in block lettering with respective alarm inscriptions. The inscriptions shall be clearly readable and visible when the respective facia light is lighted provided with two lamps connected in parallel on each facia window with series resistors. Lamps shall be clustered LED type.
- (d) All facia annunciator points shall be suitable to accept external contacts of either 'NO' or 'NC' self or hand reset type for initiating the annunciation sequence.
- (e) Annunciators shall be suitable for accepting fleeting faults of duration as less as 15 milliseconds annunciating subsequent faults with the specified sequence immediately after acknowledging the previous fault.
- (f) Facia Window shall be of minimum size of 35 mm x 50 mm.
- (g) During lamp test, if a fault occurs, the corresponding lamp circuit shall be automatically disconnected from the "lamp test" circuit and shall start flashing.
- (h) The sound intensity of each audible device shall be suitable for the maximum sound level of its environment.
- (i) The sequence of alarm should be user selectable by dip switch. The operation or acceptance of one alarm shall not inhibit the operation of the audible device or the flashing of the appropriate alarm indicator if a future alarm condition occurs
- (j) Annunciator shall be designed for an operating sequence indicated below:

Alarm Condition	Fault Contact	Audible Alarm	Visual Alarm
Normal	Open	Off	Off
Abnormal	Closed	On	Flashing
Acknowledge	Open	Off	Steady on
Reset	Open	Off	Off
Lamp Test	Open	Off	Steady on

(51) Cable Terminations:

- (a) Necessary number of cable glands shall be supplied for terminating auxiliary power and control cables. Glands shall be of heavy duty brass castings, machine finished and complete with check nut, washers, neoprene compression ring.
- (b) Cable lugs for all power and control cable connections shall be supplied. The lugs shall be tinned Copper/ Aluminium depending on cable conductor and of solder less crimping type.

- (c) All necessary materials required for terminating the power cables such as tapes, fillers, binding wires, armour clamps, brass glands etc., shall be supplied.

(52) Tests:

- (a) Routine tests and acceptance tests as per the applicable IS/ IEC standards shall be carried out in the presence of Purchaser / Purchaser's representative.
- (b) Type test certificates for internal arc test, SC withstand & Impulse test shall be furnished with the Bid (not older than five (5) years) from CPRI or other independent agency
- (c) The test equipment, meters, instruments etc. used for testing shall be calibrated at recognized test laboratories at regular intervals and valid certificates shall be made available to the Employer/ Employer's representative at the time of testing. The calibrating instruments used as standards shall be traceable to national/international standards.

(53) Drawings/ Documents Required: The following drawings/ documents to be furnished by the contractor for purchaser's approval

- (a) Technical Data Sheet
- (b) General Arrangement Drawing with Foundation Plan
- (c) Wiring Schematic
- (d) Bill of Quantities
- (e) Quality Assurance Plan

4.3.4 L V Metal Enclosed Switchgear:

- (1) The scope of supply covers design, manufacture, testing and supply of LT Switchboards. The Specification is minimum requirements and should be read in conjunction with relevant latest national & international specification.
- (2) LV PCC/ PMCC shall be CPRI/ Independent international test house tested for all the tests as per IEC61439-1 & 2 and internal arc tests as per IEC 61641 V3, 50kA for 0.3 sec (minimum) at Horizontal bus bar, vertical bus bar and cable chamber.
- (3) Switchboard shall be rated for Impulse withstands capability equal to or greater than the switchgears inside the panel.
- (4) Switchboard shall be certified as Green Premium profile i.e. the PEP (Product Environmental Profile), EoLi (End of Life instruction), REACH etc.
- (5) The metal enclosed switchgear shall be designed to operate continuously with reference to ambient temperature of 50°C without any de-rating.
- (6) The equipment shall be designed and manufactured in accordance with the best engineering practice and shall be such that has been proved to be suitable for the intended purpose.
- (7) Provision for interlocking of LV Incomer breaker with HV side breaker shall be provided such that if the HV breaker trips then the LV breaker will trip, and it shall not be possible to close the LV breaker unless the HV side breaker is closed.

- (8) The switchboard shall be indoor type having incoming section and outgoing switchgears as specified. The design shall be cubical type. The degree of enclosure protection shall be IP 52 for indoor and IP55 for outdoor as per IS: 13947 (Part-I).
- (9) Constructional Requirements:
- (a) All switchboards shall be free standing, metal enclosed, single front, fabricated with 2.0 mm CRCA sheet steel for all doors, partitions and covers and 2.0 mm CRCA sheet steel for load bearing sections including all ACB feeders. A base channel of 75 mm x 40 mm x 5 mm thick shall be provided at the bottom for floor mounted panels.
 - (b) The gasket shall be suitable to withstand all weathers for long tenure of service. All hardware shall be HD Galvanized or stainless steel.
 - (c) For operator safety IP2X (touch proof) protection to be available even after opening the feeder compartment door. The compartmentalization to be achieved by using metal separators, use of PVC sheet / Hylem sheets shall not be allowed.
 - (d) Each door & cover shall have adequate reinforcement of suitable ribs & stiffeners. All such door shall open at min 1050. All feeders and cable alleys shall have hinged type door with panel locks. All bus-bar covers, and other panel covers shall be screw fixed. Cable alleys and bus-bar chamber shall have minimum width of 300mm.
 - (e) All doors shall be with concealed type hinges and captive screws. Rear doors of panels requiring rear access shall be provided with removable hinged doors. Side covers of panels shall be with removable panels.
 - (f) All doors shall be provided with durable and easy fitting locks with special keys to ensure opening by authorized personnel. Rubber grommets shall be provided at the cable entry.
 - (g) All mounting accessories like base channels, cross angles if required, nuts, bolts etc. shall be supplied by the vendor.
 - (h) All the panels shall have uniform height. The operating height of all the panels shall not be less than 300mm and not more than 1900 mm. Switchboards height should not be more than 2375mm.
 - (i) All the switchboards boards shall preferably have cable entry from bottom. Split gland plate of 3 mm thick shall be supplied for termination of power, control and instrumentation cables sized as per the required no. of cables and 20% spare space for future addition.
 - (j) Bus-Bars:
 - i) Bus-bar of the panels shall be rated for Continuous current at site conditions.
 - ii) All bus-bars shall be electrolytic grade copper or aluminium. BIDDER shall specify the purity and conductivity of the bus bar along with the BID.
 - iii) All the bus bars shall be sleeved with heat shrinkable black colour PVC sleeve or better insulation with coloured polyester tapes for phase identification at regular intervals/ locations. Make and Type test reports carried out at accredited laboratory, of such sleeves

shall be submitted during testing.

- iv) BIDDER shall submit all calculations & documental proof of the adequacy of the bus bar sizes to meet the continuous and short time current ratings specified for reference during procurement/manufacturing.
- v) Vertical bus-bars shall have S.C. rating same as main bus bar and shall be suitable for all connected load of vertical section.
- vi) BIDDER shall ensure that incoming feeder shall be suitably designed for terminating the required no. of runs of 1.1kV grade XLPE insulated armoured cables with 20% spare capacity. BIDDER shall consider the necessary arrangement (dummy panel, adapter panel, rear extension etc.) if required, for terminating the cables within the limits specified above.
- vii) The bus-bars shall be designed considering the following criteria:
 - Current density of 0.8A/sq. mm maximum for aluminium and 1.6A/Sq. mm for copper.
 - Sleeves made of insulating material on all bus bars.
 - Bus bars carrying rated current continuously at Design Ambient Temperature shall be considered as 45°C and temperature rise shall be considered as per latest relevant standard.
 - Configuration of bus bars and Proximity effect
 - Bus bars shall withstand the short time rating of the panel.
- viii) Bus bar supports shall only be SMC irrespective of bus bar size. The span between the two insulators shall be as per the approved TYPE TEST REPORT for short time rating. Joint positions and insulators shall be properly adjusted so that they don't interfere. Bus bar bending shall be carried out on appropriate machines designated for the same rather than doing manually.
- ix) Neutral bus-bars of the panel boards shall be rated equal to the size of phase bus.
- x) All bus-bar shall be treated with anti-oxide paste wherever bi-metallic contact is required.
- xi) The material and spacing of the busbar support should be same as per the type tested assembly.

(k) Earthing:

- i) Earth bus bars of Copper or Aluminium material shall be run all along the panel, extended out at both ends of value equal to the rated symmetrical short circuit rating of the associated switchboard/ panel. The same shall be properly supported to withstand stresses induced by the rated symmetrical short circuit current.
- ii) Earthing bus-bar shall be terminated at both ends of the switchgear to suit the connections to earthing conductor. The locations where the bus is protruding out of the panel boards, CONTRACTOR shall ensure that proper ingress protections are

provided at all such locations.

- iii) All doors and detachable components inside the feeder are required to be earthed individually with green (with yellow band) colour PVC insulated multi stranded copper conductor wire of size 4 sq.mm duly crimped with ring type lugs and are to be looped & connected to horizontal earth bus.
- iv) Earthing bus shall be run continuously in panel drawn out suitably considering respective cable entry inside the panel.
- v) Separate AI earth bus shall be provided at each cable alley for all the panels.

(l) Power Wiring (Inside the Feeder):

- i) All power wiring for rating up to and including 63A shall be carried out with 1.1kV grade coloured HFFR/ FRLS PVC insulated, coloured for phase identification, multi stranded copper wires duly crimped with ring type lugs.
- ii) Power connections for rating above 63A shall be done with copper or aluminium bus bars (machine bend for proper profile) insulated with black heat shrinkable sleeves with phase identification coloured tapes duly supported on SMC insulators and placed with required minimum clearance of 25mm between phases and between phase to ground/ neutral. Such bus when brought out of the feeder for cable connections shall be sufficient enough and profiled suitable for termination of the number of LT cables as indicated above.

(m) Control Wiring (For Panel and Feeders):

- i) All panel Control wiring shall be done by 1.1kV grade HFFR/ FRLS PVC insulated multi-stranded copper wire. CT circuit wiring shall be done with minimum 2.5 Sq.mm size wire of above specification. Control and Potential circuits shall be wired with minimum 1.5 sq. mm size wires of above specifications.
- ii) Wires shall be grey coloured with suitable crimp able copper lugs. CT's & PT's wiring shall be colour coded for multi-phase identifications (R-Y-B-N).

(n) General Requirements:

- i) DP MCB shall be provided for all control circuits where the fault level is less than 10kA. Else the control supply shall be tapped through a control transformer of adequate capacity supplied with MCCB/ MPCB/ SFU of adequate short time rating. Independent DP MCBs shall be provided for each circuit such that tripping due to fault in one circuit should not affect other functions adversely.
- ii) Self-explanatory Wiring diagrams with terminal and wire numbers, component numbers shall be provided on the inner face of the

- door of each feeder. Drawing set in the panel shall be laminated.
- iii) All labels for identification of feeders as well as internal and external components as per legends provided shall be on white acrylic sheet with black engraving. These labels shall be fixed by screws/ rivets and shall not be pasted.
 - iv) Aluminium etched 415V Caution boards written in two languages (English, Hindi) shall be riveted on the panel at locations where live bus bars are present and need isolation before any access to it. In case secondary covers have been provided inside the panel, then caution boards shall be also marked on these boards in addition to the external covers. Stickers are not acceptable.
 - v) Selector/control switches shall have an 'Off' position. The 'Off' position shall not be wired in any circuit and shall be utilised to disconnect (or bypass) power supply to control circuit for any maintenance work.
 - vi) All electrical panels (internal components & arrangement) shall have finger touch protection, for human safety viz. working on one component shall not cause shock to the personnel due to any other live component in the panel. Also, the terminal live parts shall not be accessible by fingers (finger cannot come in contact with live parts of the terminals).
 - vii) No openings/ holes meant for fixing hardware shall be left open. All the hardware (esp. screws, nuts, bolts, and washers) shall be in all appropriate positions & properly tightened.
 - viii) Phase separators, shrouds, falling tool barriers shall be suitably provided. Any additional requirements as observed at any stage up to handing-over shall be provided (for safety and ease of maintenance) without any cost implication to the PURCHASER.
 - ix) All PVC/engineering plastic-based items (including but not limited to conduits, casing-capping, trough, trunk, enclosures, covers, plugs, etc) shall be with FR properties.
 - x) Lifting hooks/eyes shall be provided in each shipping section of the equipment and shall be removable type. The equipment shall be given tropical and fungicidal treatment.
 - xi) Insulation mat of suitable standard width shall be provided in front of the HV and LV panels.
 - xii) At least one 230V, 1Ph, Space heater shall be provided for each vertical section of the switchboard. Each Space heater shall be provided with an isolating switch, a thermostat and dedicated MCB protection of appropriate rating. Heater shall be mounted at bottom of the panel with cover to avoid accidental contact of heater with skin.
 - xiii) 230V 1Ph, Panel illumination (11W CFL/ LED fixture with lamp, limit switch and isolation switch) along with 1 no. 5/15A 5 pin socket with switch shall be provided for each vertical section. Bare holder with open lamp is not acceptable.
 - xiv) Adequate space shall be provided for terminating the outgoing

cables.

- xv) For uniformity of appearance, all switchgear and control panels shall have a common appearance and colour.
- xvi) In order to reduce the spares holding to a minimum electrical, control and instrumentation components of a similar type and purpose used throughout the Works shall, unless it can be shown by the Contractor to be impractical, be of the same Manufacturer and type/ series.

(o) Equipment Requirement:

i) MCCB:

- All the panels shall have MCCBs up to 630Amp. All MCCBs shall be rated for 415V, 3 Ph, 50Hz and $I_{cu}=I_{cs}=100\%$.
- MCCB shall have O/C, S/C & E/F protection releases. Where, MCCB is used as incomer it shall be provided with microprocessor based O/C, S/C & E/F protection releases.
- There should be earth fault indication on panel door.
- Rated operational voltage shall be 500V AC.
- For Thermal Magnetic protection the O/L adjustment should be 80% - 100% and for S/C it should be 5 to 10 times. For Microprocessor-based release the adjustment should be 50% - 100% and S/C for 4 to 10 times.
- The incoming MCCBs shall be suitable for remote communication (SCADA / BMS integration).
- All MCCBs shall be with Utilisation Category "A".
- All the MCCBs shall invariably be Current Limiting type, features like Double Break, Positive Isolation functions shall be Integral feature of the device and shall provide a cut off in, <10 ms for prospective currents during faults. All MCCBs shall be provided with rotary handle with door interlock and extension links/ spreaders with proper shrouds. No live part accessible even after opening the front cover.

ii) ACB:

- From 630A onwards ACBs shall normally be used. Air Circuit breakers electrically draw out of suitable $I_{cu}=I_{cs}=I_{cw} = 100\%$ for 1 second ratings, these should have 50 kA Short Circuit Current rating with microprocessor-based overload, short circuit and earth fault protection at 415 volts, 50 Hz.
- The air circuit-breakers (ACBs) used in low-voltage installations shall be designed, built and tested in compliance with the standards of the IEC 947-2 & EN 60947/ IS 19947 (Part-II): 1993.
- Rated operational voltage U_e shall be 690 V.
- The rated insulation voltage shall be equal to or greater than 1000 V.

- Overload protection shall have adjustable setting from 50% to 100% of the ACB's rating.
 - The ACB release shall be self-powered, requiring no external power supply. For it to operate, it is sufficient for one phase to be loaded at 20% of the rated current of the current transformer.
 - Power loss in breakers should also be watched for selection.
 - Utilization category-B
 - Releases are also available with LCD display which displays all three-phase current & neutral current, running voltage, average voltage, and maximum voltage. These releases will also display maintenance date like no. of operations, & fault history (last 10 trips and type of fault). To protect the load and cables from repetitive over temperature protection. In case of BMS connectivity through Ethernet communication, the release shall enable the user ON, OFF, Trip status communication.
 - All ACBs should have built in Zone selective interlocking (ZSI) for logic discrimination to reduce thermal/ electrodynamic stresses in the event of short circuit and earth fault.
 - Individual fault indication LED's (OL, SC & EF) backed by lithium battery to give indications even when the CB is off and electrical fault trip (OL& SC) alarm indication on panel shall be available on trip units for easy & faster identification of cause of fault.
 - ACB with microprocessor-based trip release with adjustable (O/C, S/C & E/F Protection) with adjustable current & time delay & % loading bar graph for each phase.
- iii) For Distinct Fault Indication, required voltage supply shall be derived from the existing control supply by BIDDER. No separate charges shall be asked for later during execution.
 - iv) All instrument transformers shall be cast resin type and shall have insulation of class B or better.
 - v) Indicating lamps shall be of the Multi chip LED type with low watt consumption.
 - vi) Each incomer shall be provided with a Multi-Function Meter displaying all electrical parameters like (but not limited to) current, voltage, kW, kVA, KVA_r, kWh, MD, PF, Hz, (THD measurement only in main PCC incomer) etc. and shall have provision for remote communication with SCADA/ BMS.
 - vii) The switchgear shall be complete with all equipment such as CT, VT, switches etc. duly wired up to terminal blocks. Terminal blocks shall be located at suitable place for easy access. CT shorting, isolating terminals shall be provided for CTs and isolating terminals shall be provided for VT connections. Twenty (20) percent spare terminals shall be provided in each cubicle. Ring type lugs suitable for termination of up to 2.5 sq. mm copper wires

shall be used.

4.3.5 LV Bus Duct- Non-Segregated Phase Type (where applicable):

- (1) The equipment shall be complete with all necessary accessories and components as required as per IS/ IEC standards and requirements for trouble free installation & operation.
- (2) Standard for Compliance- IEC 61439 / BIS 8623 / IEC 62271
- (3) Construction- Bus bars shall be in configuration of 3 Phase + 100% Neutral + 50 % integral ground earth with associated connections, joints and insulating supports confined within a metal enclosure without inter-phase barriers.
- (4) Technical Parameters for Compliance-
 - (a) The busbar shall be of Copper/ Aluminium with silver plated or tin plated at contact (for proper contact resistance).
 - (b) Bus duct shall be designed to withstand short time current (I_{sc}) of 50 kA for one second.
 - (c) Bus bar system shall be designed for an ambient temperature of 50 deg. C and temperature rise restricted to 55 deg. C max. above ambient on bus conductors.
 - (d) Temperature rise of the enclosure 40 deg.C maximum. Temperature rise at terminals 70 deg. C max.
 - (e) Maximum operational voltage(U_e) = 1000 V AC.
 - (f) The bus duct/ busbar trunking housing (IP55) shall be constructed of cold gauge steel and aluminium alloy to reduce hysteresis and eddy current losses and shall be provided with a suitable protective finish of RAL-7032.
 - (g) Bus Duct and Tap off configurations offered shall be CPRI / IEC approved Independent test house tested as per IEC61439-6. Manufacturers who have type tested bus duct/ bus way systems involving components used in projects - such as feeders, elbows, plug-in will only qualify.
- (5) Bus bar system shall be supplied with all accessories such as vertical/ horizontal elbows, copper flexible for end connections, expansion bellows, removable canopy for outdoor section, wall frame assembly & required supporting structure etc. as per site requirement.

4.3.6 LV Bus Duct- Sandwich Type (where applicable):

- (1) Standard for Compliance- IEC-61439-1&6
- (2) Construction- Bus bars shall be in 'Sandwich' construction in configuration of 3 Phase + 100% Neutral + 50 % internal earth + integral ground earth and the conductors shall be individually insulated with 4 layers of insulation film. Inner and outer layer of Polyester Mylar or equivalent reputed make class "B" insulation.
- (3) Technical Parameters for Compliance-

- (a) The busbar shall be of Copper/ Aluminium with silver plated or tin plated at contact (for proper contact resistance).
 - (b) Bus duct will be designed to withstand short circuit current (I_{sc}) of 65 kA for one second.
 - (c) Bus bar system should be designed for an ambient temperature of 40 deg. C and temperature rise restricted to 55 deg. C max. above ambient on conductors.
 - (d) Temperature rise of the enclosure 40 deg. C maximum. Temperature rise at joints/ terminals 70 deg. C max.
 - (e) Maximum operational voltage = 1000 Volts.
 - (f) The busduct/ busbar trunking housing (IP54) shall be constructed of GI sheet steel and shall be provided with a suitable protective finish of RAL-7032.
 - (g) Bus Duct and Tap off configurations offered shall be CPRI/ IEC approved Independent test house tested as per IEC61439-6. Manufacturers who have type tested bus duct/ bus way systems involving components used in projects - such as feeders, elbows, plug-in will only qualify.
- (4) Bus bar system shall be supplied with all accessories such as vertical/ horizontal elbows, copper flexible for end connections, expansion bellows, removable canopy for outdoor section, wall frame assembly & required supporting structure etc. as per site requirement.

4.3.7 Power Factor Improvement Capacitor Banks:

- (1) Power factor improvement (indoor) capacitor Bank, type tested according to IEC 61439-1&2, IEC 61921 including interconnection with LT panel with appropriate size of electric cable for transformer. (Indoor) type panel factory made dust and vermin proof (IP 42) suitable for 1100 V/660 V grade 3 phase 50 HZ AC supply floor mounted in 12 stage with microprocessor along with factory made type panel vermin proof ,fully ventilated both side opening. Fabricated out of MS CRC sheet 2.0 mm thick & frame angle of size 50 mm x 50 mm x 6 mm having bus bar of adequate capacity Aluminium, three phase and one neutral fixed on insulator and bus bar insulated by coloured heats shrinkable sleeve & housed in specified compartment both side openable. Including Powder coating internally externally the entire steel surfaces All the cover shall have with suitable locking arrangements, fully internally wired with suitable size of thimbles .Incoming/ outgoing internal connection with PVC insulated PVC sheathed multistranded copper wire of suitable size all as directed.
- (a) The capacitor banks shall be complete with all parts that are necessary or essential for efficient operation. Such parts shall be deemed to be within the scope of supply whether specifically mentioned or not.
 - (b) The capacitor bank may comprise of suitable number of single-phase units in series parallel combination. However, the number of parallel units in each of the series racks shall be such that failure of one unit

shall not create an overvoltage on the units in parallel with it, which will result in the failure of the parallel units.

- (c) The complete capacitor banks with its accessories shall be metal enclosed (in sheet steel cubicle), indoor floor mounting and free-standing type.
- (d) All sheet steel work shall be thoroughly cleaned of rust, scale, oil, grease, dirt and swarf by pickling, emulsion cleaning etc. The sheet steel shall be phosphate and then painted with two coats of zinc rich primer paint. After application of primer, the final powder coating of paint shall be applied, and the finished paint thickness shall not be less than 80 microns.
- (e) The assembly of the banks shall be such that it provides sufficient ventilation for each unit. Necessary louvers may be provided in the cubicle to ensure proper ventilation.
- (f) Each capacitor unit/bank shall be fitted with directly connected continuously rated, low loss discharge device to discharge the capacitors to reduce the voltage to 50 volts within one minute in accordance with the provisions of the latest edition of IS : 2834.
- (g) All panels of capacitor banks with MCCBs, Contactor, minimum 8 stage automatic power factor correction relay enclosed in IP 42 compliant CRCA Sheet Steel enclosure.
- (h) Capacitors shall be double layer All poly Polypropylene (APP) type having following specifications and conform to IS 13925:
- (i) The capacitors shall have Low Dielectric Loss of ≤ 0.5 W/ kVAR.
- (j) All capacitors shall be provided with 7% de-tuned filter along with all accessories and protections.
- (k) Any change in rated voltage level of the capacitor bank due to the filter or otherwise shall be considered by the Contractor. The indicated rating of capacitor banks are at rated voltage of 415V.
- (l) The banks shall be switched ON and OFF in both Auto as well as Manual mode. An Auto/Manual Switch at the incomer feeder shall be provided.
- (m) All necessary auxiliary contactors of suitable duty along with feeder accessories are included in scope. All power Contactors for capacitor switching shall be of required duty.
- (n) Manual operation shall be done with recess type panel mounted ON/OFF pushbutton with delay timer.
- (o) Minimum current rating under site conditions, of circuit breakers, Contactors, and cables shall be at least 150% of rated capacitor current.
- (p) Capacitors shall be mounted in such a way that heat dissipation is proper and the capacitors are accessible for maintenance and inspections.
- (q) Capacitor switching, and automatic power factor correction panel shall be designed in such a way that power factor of 0.99 lagging shall always be maintained. Timings to cut in capacitors shall be provided in such a manner to facilitate capacitor discharging before next switching and shall also avoid hunting due to temporary fluctuations of load. The timer shall be provided in both auto and manual mode.

- (r) The Automatic power factor correction panel and capacitor panel are integral type, prewired including power connections. Due consideration shall be given for adding/ removal of capacitor or other components and maintenance considerations.
- (s) Each unit shall satisfactorily operate at 130% of rated KVAR including factors of overvoltage, harmonic currents and manufacturing tolerance. The units shall be capable of continuously withstanding satisfactorily any overvoltage up to a maximum of 10% above the rated voltage, excluding transients.

(2) Unit Protection:

- (a) Each capacitor unit shall be individually protected by a MCCB Breaker suitably rated for load current and short circuit capacity, so that a faulty capacitor unit shall be disconnected by the breaker without causing the bank to be disconnected. Thus, the breaker shall disconnect only the faulty unit and shall leave the rest of the units undisturbed.
- (b) The Inputs to the APFC system is Voltage input from two phases and current input from the third phase. Out of two phases of voltage one phase voltage is taken as Reference 0 and other phase voltage as 440 V. APFC need to be installed CT (Current Transformer) on the third phase at main incomer ACB after transformer, which will give signal to the APFC Relay. Based on this input the ASIC (Application Specific Integrated Circuit) OR Call it as Microprocessor internal to the APFC Relay will give output signal to relay outputs which will energize coil of the contactor so that the contactor come in line connecting the capacitor bank in circuit. However, this is step correction means PF is corrected in steps. The Voltage rise due to connection of capacitor banks is marginal. There will be no frequency correction with APFC System.

(3) APFC Panel Accessories:

- (a) Power capacitor and control panel shall be housed in metal enclosed cubicle. Power capacitor shall be housed in the lower compartment and capacitor control panel at top compartment.
- (b) The control equipment including capacitors shall be mounted in a panel of cold rolled sheet steel. The panel shall be of indoor type.
- (c) Bus bars shall be of electrolytic grade copper/ aluminium conductor with high conductivity.
- (d) Isolating switch
- (e) Contactor with overload element
- (f) APFC Relays responsive to current/ voltage/ KVAR/ PF as specified for automatic switching shall be of microprocessor based suitable for state board Electricity with reduced power factor.
- (g) Sequencing devices, timers and auxiliary relays for automatic sequential switching of the capacitors in and out of the circuit.
- (h) Auto-manual selector switches
- (i) Push button for opening and closing the power circuit.

- (j) Red and green cluster LED lights for capacitors ON/OFF indication
- (k) Space heater and cubicle lighting as per the requirements.

4.3.8 Variable Frequency Drives:

(1) General:

- (a) VFD unit shall be 3-Ph, 6/12 pulse Rectifier Bridge, D.C. link with reactor/capacitors, Inverter Bridge, microprocessor based control system. The VFD shall be pulse width modulation (PWM) type with flux vector control. The VFD unit shall have cooling fan, and this shall be controlled based on heat sink temperature. Converter transformer/input reactor and output reactor, if required, shall be integral part of drive panel.
- (b) The unit shall comprise of incoming switchgear, input reactor, three phase diode bridge rectifier acting as the line converter, DC link with capacitor unit, three phase inverter, output contactor, output reactor, by-pass arrangement, etc.

(2) Incoming & Outgoing switchgear:

- (a) The unit shall comprise of an incoming microprocessor based MCCB with suitable over current, short circuit & earth fault releases. The MCCB incomer shall be fully rated having short circuit withstand 50 KA for 1 sec minimum.
- (b) By-pass and output power contactor with AC-4 duty for the applicable loads. Motor protection electronic overload relay as required.

(3) Converter and Inverter Section:

- (a) 3-Ph, 6/12-pulse diode bridge rectifier acting as the line converter with necessary input transformer or reactor, DC link reactor, capacitor unit, dynamic braking facility, etc as required. 3-Ph inverter with IGBT power circuit devices connected with necessary output filters. The VFD shall be pulse width modulation (PWM) type with flux vector control for open loop speed control with manual set points.

(4) Design Criteria:

- (a) Input Supply : 415V (+5%, -5%), TPN, 50KA for 1-sec
- (b) Input frequency : 50 Hz $\pm$ 3%
- (c) Ambient temperature : 50 deg C
- (d) Output Voltage : 0- input Voltage 3 Phase
- (e) Output Frequency : 0- 60 Hz or as required
- (f) Resolution : 0.01 Hz.
- (g) Inputs and Outputs : Digital & Analogue, as required
- (h) Short time Overload Capacity : 150% for 1 min./ every 10 min.(constant torque), 110% for 1 min./ every 10 min. (squared torque) and meet the requirement of the driven equipment
- (i) Switching Frequency : Adjustable to 15kHz.
- (j) Total Harmonic Distortion : As per IEEE-519
- (k) Length of outgoing cables : 150M (approx.)

Note: During momentary voltage dip in the input voltage supply, auxiliary voltage supply, or both, to 80 percent of rated voltage for a duration not exceeding 0.5 second, the VFD shall be able to automatically continue to supply reduced power to the motor and return to set-point speed (if the speed drifted slightly) or reaccelerate if load torque demand resulted in reduced speed.

(5) Features

- (a) The following minimum features shall be available with selected VFD unit:
 - i) Auto tuning
 - ii) Parameter lock
 - iii) Power loss ride through
 - iv) Adjustable acceleration / deceleration time
 - v) Adjustable starting torque
 - vi) Suitable for Constant torque / squared torque application as per requirement.
 - vii) Torque boost at start (adjustable)
 - viii) Adjustable switching frequency
 - ix) Analog inputs/outputs of the converter shall be galvanically isolated type. Digital outputs shall be potential free type.
 - x) Components for the same function and rating shall be of identical

design, make and of modular construction to reduce the inventory.

- (b) The following By-pass features shall be included:
- i) Manual bypass shall provide all the circuitry necessary to transfer the motor from the VFD to the power line, or from the line to the controller while the motor is at zero speed.
 - ii) The bypass circuitry shall fully isolate both the VFD input and output from the line and load sides, providing full speed motor operation.
 - iii) The AC Drive shall include mechanically, and electrically interlocked isolation and bypass contactors complete with thermal overload relay, VFD/OFF/BYPASS switch, and TEST/NORMAL selector switch.
 - iv) Motor overload protection shall be provided in both the controller mode and the bypass mode.
 - v) The operator shall have full control of the bypass starter by operation of the VFD/OFF/BYPASS selector switch.
 - vi) In the AUTOMATIC mode of operation, the isolation and bypass contactors shall be sequenced by the auto start contact from remote.
 - vii) A TEST/NORMAL selector switch shall provide test operation of the power converter while operating the motor in bypass.
 - viii) Indication shall be provided for motor operating in 'Drive' or 'By-pass' mode.
- (c) Control and Indications
- i) All local indications offered for the VFD and supporting systems (e.g., cooling system(s)).
 - ii) All analogue and digital fields I/O shall be electrically isolated from VFD logic-level circuits.
 - iii) The following minimum controls shall be provided at the VFD control panel:
 - START
 - STOP
 - Fault reset
 - Auto and Manual selection
 - Manual set points
 - VFD/OFF/BYPASS
 - iv) The following minimum indications shall be displayed at the VFD control panel:
 - Ready to start
 - Running
 - Motor Running On By-Pass
 - Alarms
 - Tripped
 - Input voltage and frequency
 - Input power
 - Output voltage and frequency
 - Output power

- Output current
 - Control supply ON
 - Cooling failure
- v) All indication lamps shall be long-life light emitting diode (LED) type and shall have a lamp test feature.
- vi) The VFD unit shall have soft / hard wired control system with suitable interfaces for interlocks as well as the required instruments and signals. It also have user-friendly programming software & it shall be capable of at least two level parameter setting with password lock for critical parameters, programming for I/Os, speed search function, copy parameters (upload/download) to other identical unit, tuning to energy saving mode (maximum efficiency), event/ fault recording (last 5 faults in non-volatile memory) & RS485 communication port (MODBUS RTU protocol) with required software.
- vii) Suitable operator panel unit for programming /debugging and control shall be provided for remote parameterisation. Control of set points, display of faults, alarms as well as diagnostic messages shall also be available in plain text on this operator panel on the cubicle door. It shall be sealed type with membrane switches & LCD display unit. This shall be user configurable type.

(d) Protections & annunciations

- i) All required high-speed electronic protections should also be available with unit apart from self-diagnostic features. A few are listed below.
- Over current instantaneous trip
 - Short circuit protection for converter/ inverter
 - Adjustable current limit
 - Earth fault protection
 - Over temperature at heat sink
 - DC bus under voltage & over voltage
 - Control & regulated power supply failure
 - Phase reversal protection
 - Motor winding temperature high
 - Motor On By-Pass
 - By-pass doesn't close
 - By-pass doesn't open

- ii) Abnormal conditions shall initiate alarm and shut down drive based on the nature of the fault.

(e) Metering

- i) Digital Speed Indicator.
- ii) Indicating type Voltmeter
- iii) Indicating type Ammeter
- iv) Ammeter located in LCS near motor necessary CT in outgoing side of VFD panel

(f) Cooling System

- i) Power semiconductor devices shall be mounted on heat sink base which can be individual or common to a number of devices. Adequate provision for clamping and mounting the power semiconductors shall be available.
- ii) Cooling of power semiconductors can either be natural air cooled or forced air cooled. The BIDDER shall recommend the type of cooling. The power semiconductors shall preferably be double side cooled.
- iii) Auxiliary power supply for the forced cooling system shall be derived from VFD incoming power.

(g) EMC, Harmonics, and Filter Systems:

- i) The VFD system shall meet local and national standards for radio frequency emissions and susceptibility.
- ii) Vendor shall calculate the total voltage harmonic distortion based on the power system data provided and the single line diagram for the installation. Particular attention should be paid to the effect that an increase in voltage harmonic distortion may have on existing electrical equipment. The maximum total harmonic distortion shall be approved by the Purchaser.
- iii) Harmonic current distortion values shall be according to IEEE 519 unless other limits are specified. In this Specification, the point of common coupling is defined as the first upstream bus that supplies other loads. Values of total harmonic voltage distortion at the point of common coupling shall be limited as follows:
 - Individual odd harmonics limited to less than 3 percent.
 - Individual even harmonics limited to less than 1.75 percent.

These values shall include any existing background harmonic levels provided by the Purchaser and shall be based on the minimum short-circuit level (maximum source impedance). Values of harmonic voltage as a percentage of fundamental shall be verified by Vendor during site testing of the VFD.

(6) Noise Level

- (a) The VFD system shall meet local and national standards for Noise level and susceptibility.
- (b) Noise level shall be limited to 85dBA when measured at one meter from the edge of the VFD panel.

(7) Construction: The controller should have modular construction to facilitate

maintenance.

(a) Busbars

Power connections shall be of the bolted type and mating surfaces shall be tinned copper. The bus bars running to various converters shall be suitably designed to ensure equal sharing between the parallel strings and prevent mechanical stress on the fuse.

All bus bars shall be adequately insulated for full circuit voltage by insulating tapes and similar insulating material. All cubicles shall have copper earth buses of adequate size running the entire cubicle height along the sides.

(b) Cubicle

Cubicles housing the power semiconductors and drive level control system shall conform to IP 42 degree of protection to enclosures.

Panels shall be free standing, floor mounting type and shall comprise rigid welded structural frames enclosed completely with cold rolled sheet steel of thickness no less than 2.5 mm for front and rear portions and 2.0 mm for sides, top and bottom portions. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation.

All doors, removable covers and panels shall be gasketed all round with neoprene gaskets. Ventilating louvers shall have screens and filters. The screens shall be made of either brass or GI wire mesh.

Design, material selection and workmanship shall be such as to result in a neat appearance inside and outside with no welds, rivets, or bolt heads apparent from outside, with all exterior surfaces true and smooth.

(8) Tropical Protection:

- (a) All equipment, accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects & corrosion.
- (b) Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent the entrance of insects.

(9) Painting:

- (a) All metal surfaces shall be thoroughly cleaned and degreased, pickled, and phosphatised. Thereafter, a coat of phosphate paint and a coat of zinc chromate primer shall be applied. After removing all imperfections, all metal surfaces shall be sprayed with two coats of final paint as per colour shade RAL 7032. Final coat shall be of epoxy based. All unpainted parts shall be plated to prevent corrosion.

(10) Inspection and testing:

- (a) The responsibility for inspection, certification, etc. of all materials, parts lies with the Vendor.
- (b) The Vendor shall specify all of the inspection and testing requirements in the quality plan which shall identify the activities requiring the Owner's approval, review, witnessing etc. Inspection and testing requirements shall be in accordance with this specification, other All Equipment shall be inspected for compliances with:
 - i) Requirement of Owner's specification & correspondence thereafter.
 - ii) Applicable codes, standards, and specifications, which shall also include sub- referenced standards therein.
 - iii) Test and Inspection Plans produced by the vendor.
- (c) Inspectors have the right to request additional inspections or tests to ensure that the equipment complies with the specification and all relevant codes & standards.
- (d) Manufacturer shall furnish valid Type Test Certificates of similar models along with the offer. Fresh type tests for the equipment are not needed, provided the Manufacturer can submit certificates that the equipment complies with all type tests as prescribed by IEC/IS Standard specifying the test requirements for that equipment.
- (e) The routine tests shall include but not necessarily limited to the following:
 - i) Operation under simulated service condition to ensure accuracy of wiring, correctness of control scheme & proper functioning of the equipment.
 - ii) All wiring and current carrying part shall be given appropriate High Voltage test.
 - iii) Primary current and voltage shall be applied to all instrument transformers.
 - iv) Routine test shall be carried out on all equipment such as circuit breakers, instrument transformers, relays, meters etc.
- (f) Routine tests on the equipment shall be carried out as per the relevant IS/IEC. Equipment offered for final inspection shall be complete and ready for shipment, with the possible exception of the final paint finish.
- (g) Routine Test certificates to be submitted for Equipment and it's all auxiliaries. Type test certificate of similar equipment shall be submitted.
- (h) Vendor to furnish required copies of test certificates, Ref Documents, Drawings, and Instruction Manuals before Equipment are dispatched.
- (i) Factory acceptance test (FAT) is required to be done at no extra cost to the Client. The Client or his representative shall be advised of the tentative date for FAT at least 3 weeks in advance prior to the test date.
- (j) Any defects found by the TPI, or the Owner's appointed Inspector shall be rectified in his presence. Where this is not possible or practical, check lists shall be prepared and signed by the Third Party Inspector stating all "pending items". Copies of these lists shall be sent to the Owner to enable their subsequent checking. The equipment shall not leave the Vendor factory before all defects have been rectified and without the written permission of the Owner.

- (k) All spare parts shall be subjected to the same inspection standards and full material certification as the main order.
 - (l) The equipment shall not leave the Vendor / Sub-Vendor's factory before all discovered defects have been rectified and without the written permission of the Owner/Client.
 - (m) Any acceptance or release of equipment following an inspection or test activity shall in no way relieve the Vendor of his contractual responsibility to provide guarantees as to the suitability of the materials, workmanship, and performance of the equipment in accordance with this Specification.
 - (n) Owner/Consultant reserves the right to waive the inspection at any stage. Inspection shall be carried out only on receipt of Vendor's internal test report of the equipment offered and scrutiny of the same. In the event, on receipt of inspection call, the Owner/ Consultant's representative reaches the Vendor's works and finds the material not ready for inspection/incomplete/has short supply, the inspector will return to his base station and all expenses incurred by the inspector including to and from travelling expenses from his base station to place of inspection, boarding and lodging etc shall be reimbursed by Vendor.
- (11) Applicable codes & standards.

IS: 5921	:	Specification for metal clad base materials for printed circuits for use in electronic and telecommunication equipment.
IS: 6297 :	:	Specification of Transformers and Inductors (Power, Audio, Pulse and Switching) for Electronic Equipment
IS: 6619 :	:	Semiconductor rectifier equipment safety code
IS: 7504	:	Specification for printed wiring Board
IEEE: 446 :	:	Recommended practice for emergency and standby power systems for industrial and commercial application
IS: 3700 IEC: 60146	:	Semiconductor devices
IS: 9000	:	Basic climate for mechanical durability tests for electronic components
IS: 5921	:	Specification for metal-clad base materials for printed circuits for use in electronic and communication equipment
IS: 6297	:	Specification for transformers and inductors (Power audio pulse and switching) for electronic equipment
IS: 7405	:	Specification for printed wiring board
IS: 2147 :	:	Degree of protection provided by enclosures for low voltage switch-gears and control gears
IS: 6553 :	:	Environmental requirements of semiconductor devices and integrated circuits
IS: 9676 :	:	Ambient temp. of electronic equipment
IS: 9000	:	Environmental tests for electronic equipment
IS: 4007	:	Terminal for electronic equipment
IS: 3695 BS: 4417	:	Semiconductor rectifier assemblies and THYRISTOR CONVERTERS
IEC: 148	:	
IEC: 60146	:	Semiconductor Converters
IS: 13947	:	Low-voltage switchgear & control gear – General Rules
IEC:61800 :	:	Adjustable speed electrical power drive systems

4.3.9 Diesel Generating Set/ Standby Power Source (where applicable):

- (1) The equipment shall be complete with all necessary accessories and components as required as per relevant IS/ IEC standard and requirements for trouble free installation & operation.
- (2) The generator shall have output rating sufficient to evacuate the output of the engine at rated power factor over complete range of site ambient conditions.
- (3) The DG set shall be supplied with acoustic enclosure with IP55 protection ensuring the noise level shall be limited to 75dB (A) at 1m from enclosure. The DG set with up to 800kW must be compliant to relevant state/ central pollution control board regulations for following emission standards.
 - (a) Gensets with power up to 19 kW

According to CPCB, the emission of oxides of nitrogen and hydrocarbons in a diesel generator with up to 19 kW power should not exceed 7.5g/kW-hr. The emission of carbon monoxide should not exceed 3.5g/kW-hr while that of particulate matter should not exceed 0.3g/kW-hr. The smoke limit for such generators is kept at 0.7 m⁻¹.

(b) Gensets with power between 19 kW and 75 kW

The emission limit for oxides of nitrogen and hydrocarbons for these gensets is 4.7 g/kW-hr. The emission of carbon monoxide should not exceed 3.5 g/kW-hr while that of particulate matter should be under 0.3 g/kW-hr. The smoke limit here is 0.7 m⁻¹.

(c) Gensets with power between 75 kW and 800 kW

The emission of oxides of nitrogen and hydrocarbons by gensets in this range should not exceed 4.0 g/kW-hr. The emission limit for carbon monoxide is 3.5g/kW-hr while that of particulate matter is 0.2g/kW-hr. The smoke emission should either be equal to or less than 0.7 m⁻¹

- (4) The generator shall be capable of satisfactory continuous operation at rated kVA and power factor at any voltage from 90% to 110% and within a frequency range of 47.5 Hz to 52.5 Hz.
- (5) The generator shall have overload capacity as per applicable standards. The generator shall be capable of withstanding a three phase short circuit at generator terminals when operating at rated kVA and power factor, 5% over voltage and with fixed excitation for 3 seconds.
- (6) Earthing
In DG equipment 4-point earthing system are to be considered out of which 2 points are for body earthing with GI strip and 2 point is for alternator neutral earthing with Copper strip.
- (7) Piping
All other associated piping, valves and other item necessary for completeness of equipment shall be supplied by the contractor.
- (8) **Safety Requirements-** Refer CPWD General Specification for Electrical Works Part IV-Substation (2013).

4.3.10 Cables and Cable Carrier System:

(1) Scope

This specification also covers the design, material, construction features, manufacture, inspection and testing at the VENDOR's/his SUB-VENDOR's works and delivery to site of HT Cables and LT Cables, Cabling Accessories, conduits and pipes etc.

(2) Applicable Codes & Standards

The design, construction, manufacture and performance of the equipment/ components shall conform to latest applicable standards as on date of submission of the bid and comply with all currently applicable statutes, regulations and safety codes in the locality where the

equipment/components will be installed. Nothing in this specification shall be construed to relieve the VENDOR of this responsibility.

- (3) Unless otherwise specified, equipment shall conform to the latest applicable standards for cables IS 1554, 7098, 8130, 5831, 3975, IEC 60183, 60227, 60502, 60885, 10418.
- (4) Technical Specification for Cables & Cable termination:
 - (a) The various types of cables covered in this specification shall meet the following requirements:
 - i) **HV XLPE Insulated Power Cables** - The conductors shall be screened by extruded semi-conducting compound and XLPE insulated. The cores shall be screened by extruded semi-conducting compound in combination with non-magnetic metallic tape (copper tape preferred). The inner sheath over laid up cores and outer sheath over the armour shall be extruded black PVC compound type ST-2. Core identification shall be by printed numerals. The construction, performance and testing of the cable shall comply with IS 7098-Part 2 (Cross Linked Polyethylene Insulated PVC Sheathed Cables for working voltages from 3.3kV up to and including 33kV).
 - ii) **1100 V Grade XLPE Insulated Power Cables** - The cable shall be extruded XLPE insulated. The inner sheath over laid up cores and outer sheath over the armour shall be extruded PVC compound type ST-2. Core identification shall be by printed numerals. The construction, performance and testing of the cable shall comply with IS 7098-Part1 (Cross linked polyethylene insulated PVC sheathed cables for working voltages up to and including 1100 V).
 - iii) **1100 V grade PVC insulated Power / control cables** - The cables shall be insulated with extruded PVC compound type C, provided with inner sheath and outer sheath of extruded black PVC compound type ST-2. The construction, performance and testing of the cable shall comply with IS 1554 - Part 1 (PVC insulated heavy duty electric cables for working voltages up to and including 1100 V).
 - iv) **1100 V Grade Lighting/Misc./Light duty unarmoured cables** - Cables shall be insulated with extruded PVC type-C. Outer sheath shall be extruded black PVC type ST-2. The sheathed cables shall be weather proof suitable for indoor/outdoor use. Twin and multicore cables shall be laid up and filled with thermoplastic material, bound by plastic tape and provided with outer sheath.
 - (b) **Cable Installation:**
 - i) In general cable installation works shall be carried out in accordance with IS 1255 – 1983, latest version. At road crossings, the depth of the Pipe shall be minimum 1m else proper concrete

encasing shall be provided.

- ii) For Underground cables, cable marker shall project 150mm above ground and shall be spaced at an interval of 20 metres, and at every change in direction. They shall be located on both sides of road and drain crossings. Top of cable marker/joint marker shall be sloped, to avoid accumulation of water/dust on marker. On finished surface like foot path etc. The marking shall be accomplished with a separate colour tiles/ paver block for highlighting the route of the cable.
- iii) Cable tags shall be provided on all cables both at feeder pillar end as well as on each pole (just before entering the equipment enclosure.
- iv) The installation shall be inclusive of miscellaneous items such as clamps, cleats, cable tags, cable markers etc.

(c) Cable Glands

- i) Double compression type cable glands shall be used for the termination of all the power and control cables. Cable glands shall be brass casting, machine finished and Nickel-plated to avoid corrosion and oxidation. Rubber components used in cable gland shall be of neoprene.
- ii) For single core cables, gland shall be with brass ring.
- iii) Cable glands shall be with metric threads.
- iv) Cable glands shall be conical (& not flange type).

(d) Cable Lugs

- i) Cable lugs shall be of tinned Copper, solder less crimping type for Cu cables & Al lugs for the Al cables.
- ii) The current rating of the lugs shall be same as that of the respective cable conductors. Ring type cable terminations shall be used.
- iii) Insulated lugs are not acceptable for any cable terminations.
- iv) Bi-metal strip/ Bi-metallic lug shall be used whenever two different metals are to be connected together.
- v) Double hole extended neck (long barrel neck) type lugs shall be used in case of cables above 185 sq. mm.
- vi) Fork terminals shall be used for luminaires & decorative switch/ socket. Pin terminals may be acceptable during execution only in case other terminals/ lugs cannot be accommodated.
- vii) Reducer / wire pin terminals shall be avoided for MCB terminations. MCB terminations shall be with long palm terminals.
- viii) All terminations in Feeder Pillars / enclosure for earthing & neutral busbars / terminals shall be with ring type terminals.
- ix) All earthing terminations shall be with ring type lugs only.
- x) All control & interlock cable terminations shall be with ring type lugs.
- xi) Anticorrosion/ anti-oxidation compounds shall be used for crimping lugs [This shall especially be ensured for Al cable

terminations & any bimetallic terminations (Cu cable termination using tinned Copper lugs)].

- xii) If termination is done with crimping tool employing crimping die, then forming dies shall be used to make the sector shaped conductor into a round conductor before crimping the lugs on the conductor. The lug must not be crimped directly on the sector conductor. Before crimping the lug, the conductor shall be thoroughly cleaned, and special jelly applied over it to prevent further oxidation.
- xiii) Cable lugs shall be of tinned Copper, solder less crimping type for Cu cables & Al lugs for the Al cables.
- xiv) The current rating of the lugs shall be same as that of the respective cable conductors.
- xv) Ring type cable terminations shall be used.
- xvi) Insulated lugs are not acceptable for any cable terminations.
- xvii) Bi-metal strip/ Bi-metallic lug shall be used whenever two different metals are to be connected together.
- xviii) Double hole extended neck (long barrel neck) type lugs shall be used in case of cables above 185 sq. mm.
- xix) Fork terminals shall be used for luminaires & decorative switch/ socket. Pin terminals may be acceptable during execution only in case other terminals/ lugs cannot be accommodated.
- xx) Reducer / wire pin terminals shall be avoided for MCB terminations. MCB terminations shall be with 'long palm terminals.
- xxi) All terminations in Feeder Pillars / enclosure for earthing & neutral busbars / terminals shall be with ring type terminals.
- xxii) All earthing terminations shall be with ring type lugs only.
- xxiii) All control & interlock cable terminations shall be with ring type lugs.
- xxiv) Anticorrosion/ anti-oxidation compounds shall be used for crimping lugs [This shall especially be ensured for Aluminium cable terminations & any bimetallic terminations (Copper cable termination using tinned Copper lugs)].
- xxv) If termination is done with crimping tool employing crimping die, then forming dies shall be used to make the sector shaped conductor into a round conductor before crimping the lugs on the conductor. The lug must not be crimped directly on the sector conductor. Before crimping the lug, the conductor shall be thoroughly cleaned, and special jelly applied over it to prevent further oxidation.

(e) **Cable Carrier System:**

- i) The cable carrier system covers the supply of cable racks, cable trays and its supporting accessories hardware and their installation. It shall be the responsibility of the Contractor to complete the cabling system in all respects.
- ii) Cable trays shall be of Galvanized Steel and of perforated type, complete with all necessary coupler plates, elbows, tees, bends, reducers, stiffeners and other accessories and hardware as

required. All hardware (i.e. bolts, nuts, screws, washers, etc.) shall be hot dip galvanized. (galvanization thickness not less than 70 microns).

- iii) Each 2.5 metre section of all types of cable trays and all elbows, tees, crosses, etc. shall be provided with two side coupler plates and associated bolts, nuts and washers.

(5) Requirement of Special Sheath For FRLS Cable:

(a) Tests and Test Equipment

- i) Cables shall be subjected to routine and acceptance tests in accordance with standards specified. Test methods shall conform to IS 10810 (Methods of Test for Cables). Type tests and optional tests according to applicable standards shall be conducted on cables as specified. Contractor shall ensure use of calibrated test equipment having valid calibration test certificates from standard laboratory traceable to National Standards. Outer sheath for FRLS/FS cables shall meet the following test requirements related to flame retardance, low smoke emission, low acid and toxic gas emission. The Contractors shall have proper test apparatus to conduct all the relevant tests as per the applicable Standards mentioned herein.

(b) Test for flame Retardance

- i) Oxygen Index
 - The critical oxygen index value shall be minimum 29 when tested at 27 ± 2 deg.C as per ASTM-D-2863 and the temperature index value shall be minimum 250oC at oxygen index of 21 when tested as per NES 715.
- ii) Flammability
 - Cables shall pass test under fire conditions as per IS-10810-Part-53.
 - Cables shall also pass tests as per IS-10810 Part- 61 & Part-62.
 - Fire survival cables in addition to tests (i) and (ii) above shall pass tests as per IEC-331.

(c) **Test for smoke generation**

The cables shall satisfy the tests conducted to evaluate the percentage obscuration by smoke in an optical system placed in the path of the smoke. The maximum smoke density rating shall not be more than 60% when tested as per ASTM-D-2843.

(d) **Tests for acid gas generation**

The hydrochloric acid generation when tested as per IEC 754-1 shall be less than 20% by weight.

(e) **Tests for Resistance to Ultra Violet Radiation**

This test shall be carried out as per DIN 53387. The retention values of tensile strength and ultimate elongation after the tests shall be minimum 60% of tensile strength and ultimate elongation before test.

(f) **Tests for water absorption**

Outer sheathes shall be subjected to tests for water absorption as per IS 10810. When additional characteristics are required, the tests shall be as agreed to between Employer and VENDOR before the placement of order.

4.3.11 Lighting & Small Power System:

(1) General requirements:

(a) The Lighting system includes the following items.

- i) Lighting fixtures complete with Lamps and accessories (lumen per watt shall be indicated)
- ii) Lighting system equipment (ISI make)
- iii) Light control switches, receptacle units with control Switch units, lighting wires, conduits and other similar items necessary to complete lighting system.
 - Lighting fixture supports, street lighting poles and flood light towers
 - Main Lighting distribution board, lighting panels.
 - Multi core cables for street, boundary, and flood lighting.
 - MS Conduit

(b) Load balancing of lighting system shall be made.

(2) Design:

- (a) The lighting system design shall comply with the acceptable norms and the best engineering practices. The lighting layout shall be designed to provide uniform illumination with minimum glare. The layout design shall meet all the statutory requirement, local rules etc.
- (b) The value of the ratio of spacing (S) to mounting height (H) shall be commensurate with the type of fittings selected and uniformity of illumination.

(3) Applicable Codes & Standards- All standards and codes of practice referred to below shall be the latest edition including all official amendments and revisions.

3 pin plugs & sockets : IS 1293

General safety requirements for luminaires. : IS 1913

Luminaires for street lighting	: IS 10322(Part-5,S 3)
Fitting for rigid steel conduits for electrical wiring	: IS 2667
Code of practice for interior illumination	: IS 3646 & IS 6665
Switches for domestic & similar purposes	: IS 3854
Electric ceiling type fans & regulator	: IS 374
Code of practice for electrical wiring installation (system voltage not exceeding 650 Volts)	: IS 732
General lighting LED and LED Modules	: IS 16101
Self-ballast LED lamps for general lighting services	: IS 16102 (Part-1 & 2)
LED modules for general lighting	: IS 16103(Part-1 & 2)
Safety of lamp control gear	: IS 15885 (Part-2/sec-13)
DC or AC supplied electronic control gear for LED modules	: IS 16104
Method of measurement of lumen maintenance of solid state light (LED) sources	: IS 16105
Method of electrical and photometric) measurements of solid state light (LED) products	: IS 16106
Luminaries performance	: IS 16107 (Part 1 & 2)
Photo biological safety of lamps and lamp system	: IS 16108

(4) LED luminaires

LED luminaires shall be used for internal & outdoor lighting. Luminaires shall be installed to permit ease of maintenance. The Contractor shall provide all equipment necessary to carry out maintenance on the lighting installation and demonstrate its operation to the satisfaction of the Engineer.

MCB + RCCBs (DP for single phase RCCB and 4P for three phase RCCB DB) shall be provided at the incomer of Lighting panels and DP MCB for outgoing feeders.

- (5) Testing of Installation
Refer CPWD General Specification for Electrical Works Part I-Internal (2013).
- (6) Lighting System Installation
Refer CPWD General Specification for Electrical Works Part I-Internal (2013).
- (7) Internal Wiring & Non-metallic conduit wiring system
Refer CPWD General Specification for Electrical Works Part I-Internal (2013).
- (8) Lighting Distribution Board
Refer CPWD General Specification for Electrical Works Part I-Internal (2013).

4.3.12 Street Lighting System:

- (1) General:

Energy Efficient LED lighting system is considered for Outdoor Street Lighting system. The illuminance level for road lighting shall be governed by IS 1944 (Part 1& 2): 1970/ Code of practice for lighting of public thoroughfare. The layout for street lighting system will be planned in such a way that uniformity ratio as required by IS: 1944 is maintained.

- (2) Applicable codes & standards:

Sr. No.	Item	IS/ IEC Code
1.1	Testing procedure of photometric testing for LED luminaires	LM 79
1.2	Testing procedure on the lifespan of LEDs	LM 80
1.3	National Lighting Code	SP72
1.4	Method of Measurement of Lumen Maintenance of Solid-State Light (LED) Sources	IS:16105
1.5	Method of Electrical and Photometric Measurements of Solid-State Lighting (LED) Products	IS:16106
1.6	Limits of Harmonic Current Emissions	IS 14700-3-2
1.7	DC or AC supplied electronic control gear for LED modules performance requirements	IEC 62384
1.8	Lamp control gear: particular requirements for DC or AC supplied electronic control gear for LED modules	IEC 61347-2-13

1.9	Environmental Testing: Test Z- AD: composite temperature/ humidity cyclic test	IEC 60068-2-38
1.10	Electro Magnetic compatibility (EMC)- Limits for Harmonic current emission— (equipment input current ≤ 16 A per phase)	IEC 61000-3-2
1.11	EMC Immunity requirement	IEC 61547
1.12	LED modules for general Lighting-Safety requirements	IEC 62031
1.13	Classification of degree of protections provided by enclosures (IP Codes)	IEC 60529
1.14	Fixed general purpose luminaries	IEC 60598-2-1
1.15	General Lighting - LEDs and LED modules – Terms and Definitions	IS:16101 / IEC TS 62504
1.16	LED Modules for General Lighting Part 1 Safety Requirements	IS:16103 (Part1)
1.17	LED Modules for General Lighting Part 2 Performance Requirements	IS:16103 (Part2)
1.18	Safety of Lamp Control Gear, Part 2 Particular Requirements Section 13 D.C. or A.C. Supplied Electronic Control gear for Led Modules	IS:15885 (Part2/Sec13)

(3) Luminaire Description:

- (a) The Luminaires shall have a sturdy and corrosion resistant high pressure Die cast Aluminium housing with weatherproof gasket for lamp and control gear accessories. The Housing shall be Epoxy coated, without any cracks or thorough holes, made in a single piece of die-cast LM6 aluminium alloy. The luminaries shall be totally enclosed, dust tight and water proof.
- (b) Heat sink used should be aluminium extrusion having high conductivity. The dimensions of luminaries shall be optimum and adequate to permit sufficient heat dissipation, through the body itself, so as to prevent abnormal temperature rise inside the lantern and consequential damage to the cover and gasket materials, LEDs, lenses and electronic drivers. Heat sink must be thermally connected to MCPCB/ LED light source.
- (c) The Luminaire Housing shall be suitable for termination of Cable with Double Compression Cable Glands
- (d) The optical system shall consists of individual PC lenses on high power LEDs designed & tested to achieve typical street lighting distribution from the LED lantern. These lenses provided for individual LEDs are to

be fixed on lens plate in order to have consistent light distribution from luminaires. Luminaires should conform to the photometric Distribution / requirements of Cut-Off / Semi Cut – off light distribution and optics as classified in IS 1944.

- (e) Suitable number of LED lamps shall be used in the luminaries. The manufacturer shall submit the proof of procurement of LEDs from OEMs at the time of testing
- (f) The Luminaires shall be provided with high tensile heat resistant toughened glass of minimum 0.8mm thickness or UV resistant polycarbonate cover fixed with stainless Steel screws.
- (g) An extruded silicon loop gasket shall be provided in the lantern body to ensure a weather proof seal between the cover and the metal housing to exclude the entry of dust, water, insects, etc. Luminaire should conform to degree of protection of IP 65 or above. Felt gasket will not be accepted.
- (h) Year of Manufacture, Batch No., Serial Number or Identification No. Luminaire Manufacturer's Name / Logo, Wattage and Frequency should be embossed on the housing.
- (i) LED luminaires, should conform to the various National / International standards for safety & performance. Manufacturer should provide test reports as per LM 79 & LM80. Lumen maintenance report as per LM 80 guidelines shall be submitted for the LEDs used along with the BID.
- (j) Luminaires should conform to the IS standards for Safety & Performance and test certificates as per IS 16107 should be provided by the manufacturer. In case of luminaires are imported, the BIDDER shall conform to test parameters as per UL or equivalent standards.
- (k) The electrical component of the LED and LED driver must be suitably enclosed in sealed unit to function in environment conditions mentioned earlier.
- (l) All the connecting wires inside the Luminaire shall be low smoke halogen free, fire retardant cable.
- (m) Adequate protection against Overloading, Short Circuit, Over Voltage, Over temperature, Under Voltage, String Open shall be provided within the Luminaire.
- (n) Design of the thermal management shall be done in such a way that it shall not affect the properties of the diffuser.
- (o) The equipment should be compliant to IEC 60598-1, IEC 62031 and IEC/ PAS 62612 depending on the type of luminary.
- (p) All the material used in the luminaries shall not contain any toxic material/ metal like mercury; shall be halogen free and fire retardant confirming to relevant standards.
- (q) The Manufacturer shall have all the relevant testing facilities certified by an accredited laboratory and shall be offered for inspection to the PURCHASER for verification of the required parameters and tests. BIDDER shall confirm the same in the BID.
- (r) The control gear shall comply with the provisions of IEC 61347-2-13, IEC 62031 and IEC 62384 as appropriate.
- (s) The following three types of luminaires are not accepted:

- i) Full glass luminaire: Full glass luminaire is not accepted as toggles/clamps are used which will compromise the IP of the luminaire.
- ii) Chip on board (COB) LED luminaire: COB LEDs are not accepted as there is extremely high per square inch heat generation and the heat sink is too small to take this heat out.
- iii) Double driver luminaire: Where single luminaire is split into two parts and driven by double drivers.

(4) The lighting fixtures offered shall comply with the following requirements;

Sr. No.	Parameter	Requirement / Value
1.	Type	LED Luminaries complete with all accessories for Street Lighting
2.	Rated Voltage	230 V
3.	Expected Frequency	50 Hz +/- 3%
4.	Operating Voltage Range	150 V to 270 V
5.	Power Factor	> 0.95
6.	Operating Temperature Range	0 Deg C to 50 Deg C
7.	Working Humidity	10% - 90% RH
8.	Driver Type	Constant Current based Electronic Driver
9.	Driver Efficiency	> 92%
10.	Protection required in Driver module	
11.	Short Circuit	Yes
12.	Over Voltage	Yes
13.	Over Temperature	Yes
14.	Under Voltage	Yes
15.	String Open Protection	Yes
16.	Luminaire IP Protection	Minimum IP 65 for Outdoor Fixtures
17.	Minimum Surge Protection	>4 KV
18.	THD	≤10%

19.	Rated Minimum LED Life (L70)	50000 Burning Hours
20.	CRI	>75
21.	Junction temperature rise	< 85 Deg C
22.	Solder point temperature	< 70 Deg C
23.	Maximum temperature rise for Driver	<30 Deg C at 45 Deg C ambient
24.	Make of LED	Cree / Nichia/ Philips / Osram
25.	Make of Driver	Cree / Nichia/ Philips / Osram
26.	Operating Hours	Dusk to Dawn (max 12 Hrs.)
27.	Efficacy of Luminaries	>110 lm/W
28.	Colour Temperature	5500K –6500K
29.	Illumination Regulation	<5%
30.	Material used for following	
a)	Housing	Die cast aluminum/ extruded Aluminium body with powder coated finish
b)	Heat Sink	Aluminium extrusion
c)	Clip / Fasteners	Stainless steel.
d)	Diffuser	Toughened glass (0.8mm thick)/ UV stabilized Poly carbonate material
31.	Maximum temperature of Heat sink	<70 Deg C
32.	IK protection of Optic Cover	>IK05
33.	Wires used Inside Luminaries	Cu conductor, low smoke halogen free, fire retardant e-beam cable
34.	Cable gland IP protection	IP 65

35.	Scotopic to Photopic Ratio	>2.15

(5) Testing of Luminaire:

- (a) The Routine test on each of the offered Luminaire shall be carried out by the Contractor before dispatch. Following tests shall be carried out as Routine tests by the BIDDER for the offered Luminaires;
 - i) Visual and Dimensional check
 - ii) Checking of documents of purchase of LED
 - iii) Insulation resistance test
 - iv) HV test
 - v) Reverse polarity
- (b) The Acceptance test shall be carried out by contractor and witness by PURCHASER or PURCHASER's Representative on a sample of the lot offered for Acceptance. The Lot shall be different from the lot from which the Type test samples have been drawn. The cost of the testing shall be borne by the BIDDER. Following tests shall be carried out as Acceptance tests by the BIDDER for the offered Luminaires;
 - i) Visual and Dimensional check
 - ii) Checking of documents of purchase of LED
 - iii) Insulation resistance test
 - iv) HV test
 - v) Over voltage protection
 - vi) Surge protection
 - vii) Reverse polarity
 - viii) Lux measurement
 - ix) Test for IP 65 protection
- (c) Following Type tests reports not older than 5 years shall be provided by the BIDDER for the offered Luminaires along with the BID;

- i) Resistance to humidity
- ii) Insulation resistance test
- iii) HV test
- iv) Over voltage protection
- v) Surge protection
- vi) Reverse polarity
- vii) Temperature rise Test
- viii) Ra (Colour Rendering Index) measurement test
- ix) Lux measurement
- x) Fire retardant Test
- xi) Test for IP 65 protection
- xii) Endurance Test,
- xiii) Life Test
- xiv) Photometric Measurements Test Report (IES LM 79)
- xv) LED Lumen Maintenance Test Report (IES LM 80)
- xvi) Vibration test as per ANSI
- xvii) Drop Test

(6) Galvanized Octagonal Poles:

- (a) All the Poles shall be designed to withstand the maximum wind speed as per IS 875. The top loading .i.e. area and the weight of fixtures are to be considered to calculate maximum deflection of the pole and the same shall meet the requirement of BSEN 40-3:2000, pr EN- 40-3-3.
- (b) All pole shafts shall be provided with the rigid flange plate of suitable thickness with provision for fixing foundation bolts. This base plate shall be fillet welded to the pole shaft at two locations i.e., from inside and outside.
- (c) The pole shall be adequately strengthened at the location of the door to compensate for the loss in section.
- (d) Aesthetic appearance - All the grooves and carvings of the pole unit shall be free from any kind of distortion for a pleasing aesthetic appearance.
- (e) The poles and bracket shall be hot dip galvanized as per IS 2629/ IS 2633/ IS 4759 standard with average coating thickness of 75 micron. The galvanizing shall be done in single dipping.
- (f) Top Mountings -The galvanized mounting bracket shall be supplied along with the Poles for Installation of the luminaries.
- (g) The pole manufacturing & galvanizing unit shall be ISO 9001: 2000 & ISO 14001 certified to ensure consistent quality & environmental protection.
- (h) Electrical connections - Four way connectors shall be provided along with Slide lock suitable for connecting 1.1 kV grade, 4 core Al cable. It shall also in house 1 no. 6 amps DP MCB, 2.5 sq. mm connectors for looping with 2.5 Sq. mm Copper wires for connecting to the luminaire through 1.1 kV grade, 3 core X 2.5 mm² PVC insulated copper conductor flexible un-armoured Cable from the terminal block to the

fixture within the pole. All the cables laid through the pipe shall be without any joint.

- (i) Two nos. Earth Boss shall be provided at the bottom of the pole (diagonally opposite) suitable for connecting 25X6 mm GI earth strip or 6SWG GI wire for earthing of the poles.
- (j) Two nos. 50 mm NB HDPE Sleeves of suitable length shall be provided through the foundation up to the Junction Box for entry of power cable.

4.3.13 Earthing System:

(1) Scope:

- (a) This specification covers supply, design, installation, commissioning & testing of items required for earthing system including grounding conductors, rods, fittings, accessories and hardware to permanently and effectively ground the neutral points of transformers/ Generator Sets, electrical apparatus, electrical equipment frames, conduit, cable trays and all non-current-carrying metal parts, including structural steel and fences.
- (b) The equipment shall be complete with all necessary accessories and components as required as per IS standard and CPWD requirements.

(2) Grounding System – General requirement

- (a) It should provide means to dissipate the current into the earth during fault conditions without exceeding the operating and substation equipment limits and connections.
- (b) The ground grid shall provide least resistance path for grounded neutral circuits.
- (c) The ground grid shall provide means of discharging current carrying parts which are to be handled by personnel.
- (d) Grounding consists of all conductors, ground rods, connectors and all other necessary items to make a complete grounding system.
- (e) The Contractor shall finalize the layout of the grounding system as required for the final equipment dimensions and locations.
- (f) The ground grid shall be designed so as to provide a maximum ground resistance of 1.0 ohm or less.
- (g) Ground grid shall be installed at a minimum depth of 600 mm from ground level.
- (h) Earthing of transformers will be done separately through plate electrodes & further connected to the main collector network using connectors/ risers.
- (i) Where the ground conductor crosses the cable/ pipe trenches, the conductor shall be suitably lowered so as to cross cable trench at least 150 mm below its bottom surface.
- (j) Risers shall be brought out above the ground level for further extension and connection to equipment.

- (k) All conductors in the ground grid shall be welded together at every crossing and at every point where from risers emanate. Continuous lap welding shall be done instead of tack welding.
- (l) The risers from the grid shall be laid to avoid contact with reinforcement to guard against false grounding during resistance tests.
- (m) All non-current carrying metal parts of electrical equipment and apparatus shall be earthed with two separate diametrically/ diagonally opposite connectors. The apparatus shall include:
 - (n) Bodies of electrical machinery, transformers etc.
 - (o) Frames of panels and cubicles
 - (p) Metallic structures of switchgear, casing of cable boxes
 - (q) Shielding of cables and electrical wiring conduits

4.3.14 Lightning Protection System:

- (3) Scope:
The Specification covers for Design, Supply, Installation, Testing and Commissioning of the Lightning material as required. The Lightning Material and Its installation should be strictly as per CPWD.
- (4) General

Supply & installation of Lightning Protection System shall be strictly in accordance with IEC: 62305-2010.
- (5) Zone of Protection

The zone of protection of a lightning conductor defines the space within which a lightning conductor provides protection against a direct lightning strike by diverting the stroke to itself. For a single vertical conductor, this zone is described as a cone with its apex at the highest point of the conductor and with an angle called as protective angle.
- (6) Material and Dimensions
 - (a) The materials of lightning conductor, down conductors, earth termination etc. shall be copper/ GI as per schedule of quantities and shall be protected against corrosion.
 - (b) All air terminations and down conductors shall be of copper/ GI as per schedule of quantities and shall conform to IS/IEC: 62305-2010.
 - (c) **Joints and Bonds** - The lightning protective system shall have as few joints as far as possible. Wherever joints in the conductor are necessary they shall be mechanically and electrically effective and shall be riveted and brazed in case of copper and by welding / bolting in case of GI in an approved manner.
 - (d) **Earth Terminations** - Each down conductor shall have an independent earth termination. All the earth termination shall be inter-connected and shall be capable of isolation for testing.

(7) Earth Electrode:

Earthing with GI earth pipe 3 Mtr long, 40 mm dia or as per IS 3043/ DISCOM/ CEIG will be used.

(8) Down conductor:

- (a) In order to reduce probability of damage it is often necessary to have several parallel current paths. As recommended by IS/IEC: 62305-2010 equal spacing of down conductors, 25 x 6 mm GI external strip, around the building perimeter
- (b) The down conductor must be kept in constant physical contact with the structure via conductive mounting clamps.
- (c) Each down conductor shall be directly connected at the dedicated earthing pit and the dedicated Earth pit shall be connected to the other earth pits in the earthing grid.
- (d) Alternatively, steel reinforcement can be used as down conductor in line with IS/ IEC: 62305-2010. Steelwork within reinforced concrete structures is considered to be electrically continuous, provided that major part of interconnections of vertical & horizontal bars are welded, clamped or overlapped a minimum of 20 times their diameter and bound or otherwise securely connected. While using structural reinforcement as down conductor, preferably outer columns which are straight from terrace up to the ground floor shall be used as down conductor. Steel bars in this column should be welded/ bolted with proper overlapping at every floor to ensure, proper continuity throughout. At ground level steel bars shall be taken out & welded/ bolted to the GI tape, and the tape will be carried out till the earthing pit at ground. Also at terrace level steel bars will be taken out & to the connected to the Air terminal.

4.4 Tests on Completion of Installation:

4.4.1 General:

- (1) The Contractor shall carry out pre-commissioning/ commissioning tests in the presence of the Employer's Representative/ EIC. The evaluation of test results and decision passed by the Employer's Representative/ EIC regarding the test results will be final and binding on the Contractor. Any additional tests or repetition of tests to establish satisfactory operation of any equipment shall be carried out by the Contractor, if so desired by the Employer, at no extra cost.
- (2) The completion checks and commissioning tests to be carried out shall include, but not be limited to, those described in subsequent paragraphs, as applicable to the individual equipment/ system. All checks and tests shall be as per the Manufacturer's drawing manuals, relevant codes of installation and commissioning checklists. Contractor shall ensure to use calibrated test equipment having valid calibration test certificates from standard laboratories

traceable to National Standards / International Standards.

- (3) In general, the following checks shall be carried out on all the equipment/ systems, as applicable.
 - (a) Name plate details according to approved drawings/ specifications
 - (b) Any physical damage or defect and cleanliness
 - (c) Tightness of all bolts, clamps and connections
 - (d) Oil leakages and oil level
 - (e) Condition of accessories and their completeness
 - (f) Clearances
 - (g) Earthing connections
 - (h) Correctness of installation with respect to approved drawings/ specifications
 - (i) Lubrication of moving parts
 - (j) Alignment
 - (k) Correctness and condition of connections

4.4.2 Pre-commissioning/ Commissioning Tests:

The following commissioning tests are to be carried out on all the equipment/ systems, as applicable and as desired by EMPLOYER/ STATUTORY requirements.

- (1) Insulation resistance measurement of equipment, accessories, cabling/ wiring etc. The Contractor shall carry out insulation resistance tests by a megger of following rating:
 - (a) All LT power cables by 1000V megger before & after terminating/ jointing.
 - (b) All HT power cables by 5000V megger before & after terminating/ jointing.
 - (c) Lighting/ Control circuits up to 250 V by 500 V megger
 - (d) Power circuits above 250V & up to 1.1 kV by 1000V megger
- (2) Dielectric tests on equipment, accessories, cabling/ wires etc.
- (3) Phase sequence and polarity
- (4) Continuity tests
- (5) Calibration of indicators, meters, relays, etc.
- (6) Control and interlock checks
- (7) Internal wiring checks, relay settings
- (8) Settings of equipment and accessories
- (9) Checking of accuracy/ error
- (10) Checking of operating characteristics, pick-up voltages and currents, etc.
- (11) Operational and functional tests on equipment, accessories, control schemes, alarm/ trip/ indication circuits, etc.
- (12) Operational Checks for all the equipment's for Auto and Manual mode through SCADA interface.
- (13) Measurement of guaranteed/ approved design values including lighting

- levels, earth resistance measurement, etc.
- (14) Complete commissioning checks of the system

4.4.3 Specific Tests to be carried out on Equipment's are as follows:

- (1) Power/ Distribution Transformer:
- (a) Insulation resistance test HV side, LV side and HV - LV.
 - (b) Magnetizing current test.
 - (c) Winding resistance test.
 - (d) Voltage Ratio & Tap continuity test at all tap.
 - (e) Vector group test.
 - (f) Magnetic Balance Test.
 - (g) Buchholz Relay Test (if any)
 - (h) Neutral CT Test, where applicable
 - (i) Winding Temperature Indicator / Oil Temperature Indicator Test
 - (j) Polarization Index Test
 - (k) Cooling System.
 - (l) No load test and performance observation
 - (m) RTCC Panel: Operational tests & IR values.
 - (n) Local / Remote operations of OLTC
- (2) Diesel Generator Set(s)
- Test on DG set shall be performed as mentioned in Central public works department (CPWD) and as per relevant IS code.
- (3) MV Metal-Clad Switchgears (AIS):
- (a) Check of electrical wiring.
 - (b) IR values of power and control circuits
 - (c) Tests on auxiliary and control circuits.
 - (d) Check of electrical operation of safety (interlocking, automatic changeover, Local / Remote operations in test as well as service position including all electrical interlocks etc.).
 - (e) Check of mechanical operations (insertion and withdrawal of removable parts, locks and interlocks system, operation of safety shutters, Anti pumping device operation etc).
 - (f) Protection system operation stability and sensitivity by primary injection testing method including testing of metering circuits
 - (g) Check of setting of all protective and measurement devices (e.g., protection relays, smart devices, etc).
 - (h) CT testing for polarity, ratio, IR values and magnetization for class PS characteristics
 - (i) PT testing for ratio, IR values
 - (j) Operational test of control circuits to be tested as per schematic drawing.
 - (k) Indications/ Alarm/ Annunciation circuit to be tested as per control schematic drawing.
 - (l) Check for panel space heater and illumination circuits.

(m) Spare contact for customer use

(4) LV Metal-Clad Switchgears:

- (a) Check of electrical wiring.
- (b) IR Values of power circuits & control circuits
- (c) Tests on auxiliary and control circuits.
- (d) Check of electrical operation of safety (interlocking, automatic changeover, Local / Remote operations in test as well as service position including all electrical interlocks etc.)
- (e) Check of mechanical operations (insertion and withdrawal of removable parts, locks and interlocks system, operation of safety shutters, charging - closing - tripping of breaker etc.).
- (f) Check of setting of all protective and measurement devices (e.g. protection relays, smart devices, Secondary injection testing of protective relays/ releases, Trip circuit healthiness and tripping through relays/ releases etc.)
- (g) CT testing for polarity, ratio, IR values and magnetization for class PS characteristics
- (h) PT testing for ratio, IR values
- (i) Operational test of control circuits to be tested as per schematic drawing.
- (j) Indications/Alarm/Annunciation circuit to be tested as per control schematic drawing.
- (k) Check for panel space heater and illumination circuits.
- (l) Spare contact for customer use
- (m) Testing of starter modules for DOL/ Star-Delta/ ATS/ Soft starting or any other starting method as per the schematic drawings applicable.

(5) HV/ LV Power Cable, Control Cable & Cable Accessories:

- (a) IR Values before Hipot
- (b) Hi Pot test for MV & HV cables.
- (c) IR Values after Hipot

(6) Earthing System:

- (a) Earth continuity check.
- (b) Earthing resistance of each electrode
- (c) Overall resistance of earthing installation which shall not be greater than one (1) ohm.

(7) Lighting System:

- (a) Check of electrical wiring.
- (b) Functional tests.
- (c) Lux level measurement for each plant/ facility area.

(8) Induction Motor:

- (a) Measurement of insulation resistance on motor windings, built-in RTDs, anti-condensation heaters and bearing insulation, if any.
- (b) Tests on auxiliary and control circuits-Interlocks and simulation tests Auto/ Manual and local/ remote operations
- (c) Bump start to check direction of rotation to match with driven equipment. Bump start shall be performed with motors uncoupled to prevent damage to equipment by reverse operation.

(9) Elevator/ Escalator (where applicable):

Test on Elevator shall be performed as mentioned in Central public works department (CPWD) and as per relevant IS / IEC code.

- (10) In addition to above, the Employer's representative/ EIC may ask repeat tests for earth continuity tests, earth resistance measurements and other additional tests, which in his opinion are necessary, to prove that the system is in accordance with design, specification, code of practice and CEA Regulations 2010.

SECTION - 6

ANNEXURE - 5

GENERAL & PARTICULAR INSTRUMENTATION
CONTROL & AUTOMATION REQUIREMENTS

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5.1 Introduction

This part covers the general requirements for the design, supply, installation, inspection and testing of the instrumentation, Control and Automation (ICA) consist of all required instrumentation hooked up with PLC based RTU Panel with Human Machine Interface (HMI) for Local Control & Monitoring and a wireless Centralized Monitoring system, associated plant, and materials.

5.2 Reference Standards

Unless otherwise approved, instrumentation shall comply with relevant quality standards test procedures and codes of practice collectively referred to as Reference Standards including those listed below in accordance with the requirements detailed elsewhere in this specification.

BS 89-2:1990, EN 60051-2:1989, IEC 60051-2:1984	Direct acting indicating analogue electrical measuring Instruments and their accessories.
BS 1042 (Various)	Measurement of fluid flow in closed conduits.
BS 1646-1:1979, ISO 3511/I-1977	Symbolic representation for process measurement control Functions and instrumentation. Basic requirements
BS EN 837-1:1998	Pressure gauges. Bourdon tube pressure gauges.
BS EN 60751:1996, IEC 60751:1983	Industrial platinum resistance thermometer sensors
BS 3680 (Various)	Measurement of liquid flow in open channels.
BS 3693:1992	Recommendations for design of scales and indexes on analogue indicating instruments
BS EN 60770-1:1999, IEC 60770-1:1999	Transmitters for use in industrial-process control systems. Methods for performance evaluation
BS 4675-2:1978, ISO 2954-1975	Mechanical vibration in rotating machinery. Requirements for instruments for measuring vibration severity
BS EN 60584-1:1996, IEC 60584-1:1995	Thermocouples. Reference tables
BS 5308 (Various)	Instrumentation cables
BS EN 60529:1992	Specification for degrees of protection provided by enclosures (IP
BS ISO 11631:1998	Measurement of fluid flow. Methods of specifying flowmeter performance
BS 5863-1:1984, IEC 60381-1:1982	Analogue signals for process control systems. Specification for direct current signals
BS 5863-2:1980, IEC 60381-2:1978	Analogue signals for process control systems. Specification for direct voltage signals
BS EN 60654-1:1993, IEC 60654-1:1993	Industrial-process measurement and control equipment. Operating conditions. Climatic conditions
BS 6739:1986	Code of practice for instrumentation in process control systems: installation design and practice

BS EN 60073:2002	Basic and safety principles for man-machine interface, marking and identification. Coding principles for indicators and actuators
BS 1553 (Various)	Specification for graphical symbols for general engineering
ISA-5.1-1984 - (R1992)	Instrumentation Symbols and Identification
ISA-5.4-1991	Instrument Loop Diagrams
ANSI/ISA-7.0.01-1996	Quality Standard for Instrument Air
ANSI/ISA-18.1-1979 - (R1992)	Annunciator Sequences and Specifications
ISA-26-1968	Dynamic Response Testing of Process Control Instrumentation
ISA-37.1-1975 - (R1982)	Electrical Transducer Nomenclature and Terminology
ISA-37.3-1982 - (R1995)	Specifications and Tests for Strain Gage Pressure Transducers
ANSI/ISA-50.00.01-1975 (R2002)	Compatibility of Analog Signals for Electronic Industrial Process Instruments
ANSI/ISA-51.1-1979 - (R1992)	Process Instrumentation Terminology
ISO 9000 and 9004	Quality Systems
IEEE 60587	Power Supply Surge Protection
IEC 61131-3	Programming Languages for Programmable Controllers.
IEC 61158-2	Communication Protocols
ISO 9075 (BS 6964)	Structured Query Language (SQL)
BS 5515	Documentation of Computer Based Systems
BS 7165	Recommendation for Achievement of Quality in Software
BS EN 50081	Electromagnetic Compatibility
ISO 3511	Process measurement control functions - instrumentation symbolic representation.
ISO-OSI	7 Layer Communication Model
IEC-8705101	Modbus Protocol Conversion
IEEE 472-1974	Surge protection.
NEMA	National Electrical Manufacturers Association

5.3 Statement of Compliance

The Contractor shall provide a list of the reference standards used and shall provide a compliance/non-compliance statement during Detail Design submission once the contract has been awarded.

All standards which the Contractor intends to use but which are not part of the above Standards or other listed Reference Standards, shall be submitted to the Employers Representative for consent before any design against that standard proceeds.

5.4 Qualification Criteria for Instrumentation Manufacturer, Automation System Manufacturer, and Automation System Integrator

- 1) ISO 9001 or above accreditation shall be a minimum qualification for all Instrumentation and/or Automation System Manufacturers and all Automation System Integrators (System Integrators).
- 2) The complete Instrumentation, Control, and Automation works in this contract shall be executed by a single System Integrator with a minimum of 5 years of experience in automation projects. The System Integrator shall demonstrate capability and resources for integrating/interfacing control systems from different

- manufacturers as well as coordination with multiple agencies for contract execution.
- 3) The System Integrator shall submit evidence that they employ in excess of 25 personnel, including no less than 15 technical staff to include engineers, programmers, and field technicians. Qualifications and license details for a minimum of three professional engineers in the direct employ of the System Integrator, as well as resumes of all personnel assigned to this contract shall be submitted as part of the Contractor's technical bid.
 - 4) The System Integrator shall be an authorized system integrator for the Automation System Manufacturer(s). Verification certificates shall be submitted directly from the manufacturer(s) of the Automation System. In addition, references shall be provided with the Contractor's technical bid for a minimum of five (5) locations where the proposed manufacturer's Automation System has been successfully installed by the proposed System Integrator within five (5) years prior to the bid date and has been successfully operating for at least two (2) years immediately prior to the bid date. References shall include name, address, and telephone number for the appropriate contact person.
 - 5) The Instrumentation Manufacturer(s) shall have minimum 10 years of experience in India in the field of instrument supply and service and shall have a local service centre in Himachal Pradesh.
 - 6) All hardware and software proposed shall have been successfully used in a similar Treatment Plant application for a period of at least five (5) years and be from established and reputable suppliers.

5.5 Documents to be submitted after award of contract (but not limited to)

- 7) Include a complete Table of Conformance to each reference standards or part of the specifications. Use a chart format with specification part identified, indicate whether each part is complying, a deviation or an exception to the specific part. If an exception or deviation, include a narrative description as to how the deviation or exception can benefit the end-user of the system over that item specified.
- 8) Provide a block diagram of the proposed system showing all major components and their interconnections and interrelationships. Label each diagram and indicate all external power and communications interfaces.
- 9) Provide a written overview of the proposed Centralized Monitoring system, instrumentation system describing the principal functions and capabilities of the system's PC, PLC's, system communications and general system capabilities (maximum number of network nodes, PLC's and I/O points, communication protocols available, etc.).
- 10) Provide an equipment list with descriptive literature for the proposed system. Included on the list shall be all major hardware items. List shall include as a minimum, the manufacturer, the quantity provided, and model numbers for each. Technical schedules for Instruments, PLC & Centralized Monitoring System shall be duly filled in with relevant details.
- 11) Provide an operating system and software applications list with descriptive literature for the proposed system. Include all major software items, supplier name, quantity, and model numbers. Indicate whether any proposed software is proprietary and would not be turned over to the owner. (No proprietary software shall be accepted).
- 12) Information is required for:

-
- a) Name and version of the proposed PC's operating system.
 - b) Name and version of the proposed computer operator graphical user interface software package (Centralized Monitoring System).
 - c) Name and version of the PLC on-line/off-line programming software for all controllers
 - d) Name and version of any required communications software, firmware, etc.
 - e) Name and version of the specified report application software.
 - f) Name and version of the specified maintenance application software if any.
 - g) Describe how system data points are linked from the system database into various applications such as reporting or maintenance. If via DDE (Dynamic Data Exchange) describe specifically the steps required to import data automatically and on-line into the proposed software applications.
 - h) Briefly describe the required procedure for configuration and/or programming of the proposed system to add a simple remote PLC and additional I/O's to the system in the future. Describe in detail, specifically how communications are programmed for the future remote PLC and the necessary changes required at the main controller.
 - i) Provide a description of any non-resident software required to program, troubleshoot, or diagnose any devices in the system.
 - j) Provide a tentative construction schedule for completion of the project within the specified Contract period. Indicate the following activities with milestones: Mobilization, radio communications licensing, submittal preparation, submittal review, equipment procurement, equipment assembly, system configuration and programming, factory testing, system delivery, system installation, start up, field testing and training, and post acceptance routine service intervals.
 - k) Describe the system supplier's provisions for service, technical assistance, and re- placement parts for the proposed system. Include the system supplier's 1-800-toll free number. Identify with resumes, all personnel who will be providing technical support services for the project after it is accepted.

The Contractor shall provide the above required details/documents during the bid submission.

5.6 Submissions of Drawing & Documents

The Contractor shall make submissions to the Employers Representative of all design drawings, schedules and complete documentation on spare parts relating to instrumentation, control and Automation equipment and systems provided under this Contract. These submissions shall include, where relevant, the following:

1) Detail design specification

- a) The Contractor shall submit a complete Detail Design Specification for approval by the Employers Representative within 1 months of the award of contract. This document shall serve as the primary mechanism by which the Employers Representative may confirm that the Contractor possesses an accurate understanding of the system and its control requirements. The Contractor is encouraged to obtain clarifications and to suggest refinements to the control descriptions contained in this Specification.
- b) The Detail Design Specification shall comprise an overall description of the plant, its functioning and control, and a detailed description of each section of the control system covering modes of operation, manual overrides, set point and parameter selection and adjustment. The detailed description shall include a step-by-step control description which defines the function of each piece of equipment and each control action and interlock, including

details of the program in each programmable item. Proposed Centralized Monitoring screens shall form an integral part of detail design specification submissions.

- c) The format of the program details may be chosen by the Contract, however it is suggested that this format be chosen to satisfy the requirements of the software design documentation, if applicable, as described elsewhere.
- d) The detail design specification shall describe the 'fail-safe' features incorporated into the design for the event of failure of a plant item or system, or loss of an input signal affecting a control loop or process sequence.
- e) The detail design specification shall describe control actions taken and monitoring functions which remain available during a power failure, and any automatic controls or sequencing which take place during system start-up and shut- down.
- f) The detail design specification shall be presented in a clear and precise manner and shall include figures or drawings where appropriate.
- g) **The Contractor shall submit and obtain approval of the detail design specification from the Employers Representative before beginning the detailed control system design. The contractor should take note of the importance of this obligation.**

2) Drawings and schedules

- a) Process and instrumentation diagram which shall comply with BS 1646 and BS 1553/equivalent ISA standard.
- b) General arrangement drawings of field-mounted instruments showing installation details.
- c) General arrangement drawings of instrument and control panels, fully dimensioned in plan and elevation views, showing foundation and fixing details, access doors, clearances, cable-entry positions, weight and lifting arrangement.
- d) Layout drawings of panel facias showing instruments, controls, and details of all labels.
- e) Layout drawings of panel interior showing equipment, terminal blocks, and cable ways.
- f) Annunciator arrangement and engraving details.
- g) Internal circuit and wiring diagrams for instrument and control panels.
- h) Schematic control diagrams.
- i) Instrument loop diagrams.
- j) Instrument wiring and piping diagrams.
- k) Interconnection wiring diagrams.
- k) Cable block diagrams, drawings, and schedules.
- l) Instrument system and panel power distribution diagrams.
- m) Programmable-device functional design specifications which shall include hardware details, logic flow charts, ladder diagrams and program listings.
- n) Schedules of inputs to and outputs from programmable controllers and telemetry outstations.
- o) Labelling schedules.
- p) Comprehensive testing schedules for all off-site, on-site, pre-commissioning and commissioning tests and take-over tests.
- q) All other drawings necessary for the provision of ducts, openings, trenches, fixing holes for panels and the like and for the complete understanding of the operation, maintenance and extension of the system including any required for the Purchaser to dismantle, repair, maintain, modify, or extend the Plant.

3) Data and calculations

- a) Manufacturers' catalogues and data sheets.
- b) Calculations to support control system design.
- c) Specification for protective coatings and painting.

4) Certificates

- a) Manufacturers' works tests.
- b) Pre-installation checks.
- c) Pressure-testing schedules.
- d) Instrument loop test check sheets.
- e) Installed instrument performance tests. (f) System tests.
- f) Statutory certificates of compliance (such as hazardous area equipment).

5) Operation and maintenance instructions

- a) Composite manual describing the functional and operation of each piece of equipment.
- b) Composite manual for testing and servicing every system and individual item.

5.7 Design**1) Basic Features**

Instrumentation, Control, Automation system shall be designed, manufactured, and installed to achieve the following basic requirements:

- a) to maintain the highest standards of availability, reliability, and accuracy and to give clear warnings of any deterioration in performance.
- b) to suit the abilities of the staff who will:
 - use the systems.
 - service the systems.
- c) to measure, indicate, process, store and control the relevant parameters, as specified.
- d) to give clear warnings of dangerous and other abnormal conditions and to initiate plant safety procedures, shutdowns and corrective measures as specified to assure the safety of 'operations and maintenance' personnel and plant and to store and collate the data, as required;
- e) to derive, present and utilize, as required, such additional data as required to facilitate:
 - the most efficient operation of the plant.
 - the routine maintenance of the plant

2) Design Requirements for Instrumentation, Controls and Automation Systems

- a) The instrumentation, control, automation installations shall fully comply with design standards, regulations and the material and workmanship requirements of the Specification.
- b) The electrical plant installations associated instrumentation control and automation systems shall also comply with and be tested in accordance with the latest edition of BS 7671 or equivalent Indian standards.
- c) All equipment and materials incorporated in the system shall be selected, designed, and rated to operate under the defined performance duties and specified site conditions and to maintain a high level of operational reliability.
- d) The instrumentation control and monitoring system equipment and materials shall have an operational life of not less than 15 years, unless otherwise approved by the Employers Representative.

5.8 Site Conditions

- 1) **Temperature and Humidity Range.**

The equipment shall be installed in an environment having a temperature range of 0 °C to 55 °C and a maximum relative humidity of 100 % (non-condensing). The Contractor shall use, where required, fans, heaters, and air conditioning units to maintain a correct working temperature for his equipment. All Parts of the equipment shall be constructed of materials or treated to prevent the formation of mould, fungus or any corrosion over the temperature and relative humidity ranges specified.
- 2) **EMI/RFI Noise Immunity.**

The equipment to be provided shall be adequately protected against interference from the use of radio transmitters, at any point external to the equipment housings and no malfunction of the equipment shall result from this cause. Responsibility for the correct and reliable operation of the equipment shall rest with the Contractor, who must ensure that the equipment is adequately protected against the ingress of radiated, mains-borne signal-borne interference.
- 3) **Generated Interference.**

The Contractor shall ensure that the computer, instrumentation, and communications equipment conform to BS EN 50081-1 or equivalent Indian Standard for noise emissions.
- 4) **Coordination.**

The Contractor shall check with other trades to ensure that equipment and material can be installed in space provided. Provide other trades with information necessary for them to execute their work. Details on Drawings, which are specific regarding dimensions and locations, are for information purposes. Coordinate with other trades to ensure work can be installed as indicated.
- 5) **Sequencing.**

The Contractor shall make applications to the local telecommunications Service Provider for provision of communications and coordinate with the sub-contractor responsible for installation of power supply services under this contract. Applications shall be made in time to ensure services are available for installation and commissioning of the telemetry equipment.

5.9 Enclosure/Panel Details

- 1) **Enclosures and mounting boards**
 - a) Enclosures shall be any form of board, cabinet, panel, desk, box, or case used to protect, contain, or group instrumentation, telemetry, or control equipment.
 - b) All equipment in or on enclosures shall be arranged logically and, as far as possible, symmetrically, with projections kept to a minimum. Each enclosure and board shall be designed on ergonomic principles and shall permit in-situ and safe access for any normal adjustment, maintenance, and servicing. The tops of plant-mounted enclosures shall be sloped downwards from front to rear.
 - c) Enclosures mounted inside buildings shall have a minimum rating of protection to IP54.
 - d) Enclosures for use outside buildings or in places where splashing may

occur shall have a minimum rating of protection to IP65 and have tops which project sufficiently to protect the vertical faces of the enclosure and any component mounted thereon from splashing, inclement weather, and direct sunlight. Also, when enclosures for use outside buildings are located where exposure to direct sunlight will give rise to high top- panel surface temperatures such that the internal temperature rises above the manufacturer's recommendation (normally 40°C), the enclosure shall include a sun shield fitted to the top of the enclosure. The sun shield shall prevent direct sunlight from reaching the instrumentation for the full day throughout the year and shall have louvered ventilation.

- e) Fixing arrangements for surface-mounting enclosures shall be external to the enclosure and shall ensure that the rear face of the enclosure is not in contact with the surface to which it is fixed.
- f) Enclosures shall have hinged access doors, fitted with recessed lockable handles. Doors shall be of rigid construction and provided with close-fitting flexible seals in recesses to prevent the ingress of liquids, moisture, dust, and vermin. Hinges shall be of the lift-off pattern and one hinge shall engage before the other for ease of fitting. Wherever necessary, removable access covers secured by quick-release fasteners shall be provided to ensure ease of maintenance for all installed apparatus.
- g) Mounting plates, brackets and racks shall be provided for all other internal equipment which shall be hinged or otherwise arranged with quick-release fasteners or captive screws to give quick and easy access to equipment, securing screws, terminals, and wiring.
- h) Enclosures for two or more devices with electrical circuits shall have gland plates and terminal blocks as specified elsewhere.
- i) Each enclosure shall be designed for the safe testing and servicing of equipment with the power on. Each part which may be live under any circumstances shall be so covered or shielded as to prevent inadvertent contact.

2) Panel design and construction

Unless otherwise specified, all instrument panels, instrument cubicles, control panels, control consoles and desks, associated equipment and terminal racks, telemetry and electronic equipment racks and the like shall be free-standing, floor mounted units and shall conform to the requirements of this part and will hereafter be referred to as panels.

The design and dimensions of control consoles and desks shall be determined according to their intended function and shall be in accordance with the requirements of the Specification. The height shall not exceed 1400mm above the finished floor level. Unless otherwise specified the height of panels shall be not greater than 2130mm overall (excluding lifting devices) above finished floor level.

Controls, switches, and pushbuttons shall be positioned below or adjacent to any associated reading instrument. Panels for use in locations such as pumping stations and machinery rooms shall have anti- vibration mountings.

The clearance between the extremities of apparatus mounted on the internal walls shall allow safe and unobstructed access to all terminals and to parts requiring maintenance.

Panel layout drawings shall normally include a list of all instruments,

accessories and components contained therein. If the drawings have insufficient space for the list, a separate schedule of instruments, accessories and components shall be provided, and the panel drawing shall contain a cross reference to the contents list and an indication of the panel location of each item on the list.

3) Panels - Major

Panels shall be constructed generally as specified in the preceding clause. Panel material shall be prime- quality, cold-rolled and annealed mild steel or zinc-coated mild steel sheet, suitably braced, and stiffened as necessary with flat bar or angle to form a rigid structure.

Panel fronts shall be flat and free from bow or ripple. Exterior corners and edges shall be rounded or welded and ground to give a smooth overall appearance.

Flanged edges shall be straight and smooth.

Materials shall be chosen with due regard to the panel size, number of cut-outs, instrument weight and position of centre of gravity and method of fabrication, with the following minimum thickness:

- instrument bearing surfaces, gland plates and pneumatic distribution plates, 3mm.
- internal mounting plates, 3mm.
- doors covers and filler panels, 2mm.

No design involving the use of externally-visible assembly or fixing bolts and screws or any design resulting in dust or water-collecting crevices will be accepted.

When a panel is constructed in sections, the sections shall be designed for ease of assembly during installation and, in any case, shall not exceed 2m in length. All necessary nuts, bolts, washers, and the like shall be supplied and included in the same shipment as the relevant sections. Sections exceeding 1m in length shall be provided with double doors.

Each panel shall be mounted on a self-draining base frame fabricated from 150mm deep, steel channel section which shall be drilled or provided with clamps for bolting to the floor. The base frame shall be set back from the panel front face to give a toe space of not less than 25mm. The outside of the base frame shall be covered with an approved kicking strip.

Ceiling and other filler panels shall be fabricated from sheet steel and adequately stiffened. Each section shall have 50mm returned edges along all four sides and shall be braced to the main steelwork of the panel.

A chequered plate floor shall be provided inside and above the level of the base frame, having openings suitable for the bottom entry of cables when applicable.

Sufficient removable un-drilled gland plates, in sections convenient for handling, shall be fitted close to the appropriate terminal blocks and not less than 230mm above the panel floor or not less than 230mm below the panel top. The gland plates shall have removable side covers giving access to both sides of the gland

plate and ensuring vermin-proof and dust-proof construction. Gland plates of a surface mounted enclosure may form a part of the base or top.

Panels containing instruments using a fluid as the transmission medium shall have distribution plates with bulkhead unions for the termination of internal and external pipework.

All doors shall open outwards and all doors in one panel assembly shall use the same lock and key combination.

Panel design shall ensure adequate ventilation and air circulation without permitting the entry of vermin or dust. Panels installed in control rooms or other clean condition areas shall have louvers to allow air circulation. Temporary closures shall be provided to prevent the entry of dust and vermin during transit and installation. After commissioning has been completed, all entries except air circulation louvers shall be sealed.

No equipment other than front-of-panel items shall be mounted on panel wall surfaces.

If electrical and non-electrical instruments are mounted in the same panel, the panel shall be subdivided internally to separate the electrical and non-electrical sections.

All connections shall be arranged to ensure that no accidental damage to cabling or electrical components can occur in the event of failure of any non-electrical component or connection.

Provision shall be made for safe and easy handling during transit and installation.

If lifting eyes are provided, they shall be reversible and panel tops shall be reinforced where necessary. Where equipment is specified to be installed at a future date, space shall be allocated, and cut-outs with removable masking plates, brackets, supports, wiring, terminals and piping and the like shall be provided.

Panels shall be finish-coated at the place of manufacture before commencing the installation of apparatus and other fittings.

4) Panels - Minor

Panels for installation on the Plant which contain relatively few items of equipment, or where so specified elsewhere, shall be classed as minor panels, and shall be constructed generally as specified in the preceding clause and comply with this Clause.

Panels shall be fabricated from sheet steel or other approved material less than 2.5mm thick suitably braced to form a robust and rigid structure. Exterior corners and edges shall be rounded to give a smooth overall appearance and assembly bolts; screws or rivets shall not be visible on the front face.

The design shall be such as to ensure adequate ventilation and air circulation where required, without permitting the entry of vermin. Openings for cables shall be made vermin-proof. Doors shall be hinged and shall be provided with close-fitting flexible seals in recesses to prevent the ingress of liquids, moisture, dust, and vermin. Unless otherwise specified, panels shall be suitable for floor

mounting and shall not exceed 2130mm in height. Where surface-mounted panels are provided, the fixing shall prevent the ingress of moisture and the rear of the enclosure shall be not less than 10mm from the wall.

Lifting eyebolts shall be removed, issued to the Purchaser, and subsequently replaced with bolts after installation.

Panels shall be extensible, and symmetrically arranged as far as possible with projections kept to a minimum. Where two or more panels are fitted together, they shall form a flush-fronted continuous panel of uniform height. Front door and top cover dimensions shall match. Instruments, relays, and control devices shall be mounted at a height not more than 2000mm and not less than 300mm from floor level.

The arrangement of equipment within each enclosure shall be such as to permit easy access for installation and maintenance. No instruments, relays or other components shall be mounted on rear access doors or removable covers.

a) Local Control Panel (LCP): -

Local Control Panel shall be provided for each Motor near the drive and shall be Interconnected with MCC. The Local Control Panel shall have the following Provisions.

- 3 Push buttons “START / STOP / EMERGENCY STOP”
- Start / Stop push button operates when the switch on LCP is in “MANUAL” position.
- Emergency Stop push button operates irrespective of the position of the switch.

When the selector switch on LCP is in “LOCAL” position, the motor will be operated by push buttons on LCP and will consider only the specific fail-safe controls of the equipment (electrical protections, low level for a pump). When the selector switch on LCP is in “REMOTE” position the drive will be operated from PLC.

b) Motorized Valves (Field Type): -

Motorized valves will use fully integrated control Actuator. The actuator comes with integrated:

- Selector switch “Remote” / “Local ”
- PB's for: OPEN / CLOSE/ STOP.

Note: -

Necessary Field Indicating devices (Where-ever process Interlocks are applicable) and LED's (Motor's, Actuator's etc., of feedback Indications) shall be provided on LCP's for Manual control operations.

5) Panels – Composite

In situations where space limitations preclude the use of separate instrumentation, control, and automation (ICA) and switchgear panels and, at the sole discretion of the Employers Representative, ICA equipment may be combined within a single enclosure subject to the following conditions:

- a) The observance of all other clauses herein relating to enclosures, mounting boards and minor panels.

- b) The written assurance of each supplier of ICA equipment that the proximity of the switchgear will have no detrimental effect on the life or performance of any ICA component.
- c) The total segregation of ICA equipment and switchgear including the glanding and termination facilities.
- d) The absence of any voltage exceeding 250vac or 50vdc from any compartment containing ICA equipment.
- e) The use of the full height of the panel (excluding the bus bar chamber and Cable space) for any ICA equipment compartment.

6) Panel protection

Adequate facilities for isolation and protection by miniature circuit breaker or fuse for each instrumentation and control circuit and sub-circuit shall be provided and shall be so arranged that any interruption causes minimum disruption of plant, operates the appropriate alarm, and cannot result in any unsafe operating condition.

All fuses shall be of the cartridge pattern and main fuses shall be of the high rupturing capacity type. Fuse and solid-link carriers and bases shall be of plastic moulded insulating material of an approved make. Ceramic materials will not be accepted. Live connections shall be efficiently shrouded, and it shall be possible to change fuses with power on without danger of contact with live metal. The fuses shall be rated to give maximum protection to the equipment in circuit and the rating shall be permanently inscribed on the fuse label and on the fuse carrier. Unless necessary for the protection of particular equipment, miniature circuit breakers used for individual circuits in a panel or control desk shall not trip on over-voltage or under-voltage.

Bases for solid links shall not be interchangeable with those for fuses. Fuses and links in the same circuit shall be mounted opposite each other in separate adjacent rows and shall not alternate in the same row. At least 10% and not less than two unallocated miniature circuit breakers or fuses and links shall be provided in each panel distribution board. Miniature circuit breakers and fuses of similar size and rating shall be of the same make and type.

At least 10%, and not less than two, spare fuses and links of each rating shall be provided and fitted in clips inside the panel.

Each instrument requiring a power supply shall be individually wired and protected so that, in the event of a failure in one circuit, the remainders are unaffected. Power supply circuits shall be of sufficient rating that any protective device may operate without reducing the voltage at the terminals of any other component to an unacceptable level.

7) Panel isolation

Clearly-labelled isolating circuit breakers shall be provided for each incoming power supply. Switches shall be of the quick make-and-break type with spring loaded contacts that close fully without requiring full operation of the handle. The handle and cover shall be interlocked so that the handle cannot be operated when the cover is open, and the cover cannot be opened unless the switch is in the 'off' position. The 'on' and 'off' positions of each switch shall be indicated clearly.

Circuit breakers for panel power supplies shall be mounted near an access point and in positions where they may be operated easily from a standing position.

Plug-in isolating links or devices of an approved type shall be provided in any circuit that may still be live when the power supply isolators are in the 'off' position, as, for example, in circuits controlling equipment whose power supply is independent of the panel. Such links or devices shall be properly screened and, if not incorporated in or adjacent to their associated outgoing terminals, shall be labelled with suitable warning notices.

Any item of panel equipment to which panel internal wiring is connected with a plug and socket instead of terminals shall be wired in flexible cable of adequate rating between the 'free' plug and a socket mounted adjacent to the device.

The power supply connector shall be a socket.

8) Panel terminal blocks

External wiring for panel power supplies shall be terminated on the appropriate isolator. Signal cables from strain gauges, analysers, resistance thermometers, retransmitting slide-wires and thermocouples may be terminated at their appropriate instruments.

A terminal block shall be provided as the interface between the corresponding conductors of each internal and external wire and each internal and external connection except those listed above. The terminal blocks shall be mounted vertically where possible and not nearer than 230mm to the floor or less than 230mm from an incoming cable gland.

Terminal block rows shall be spaced apart by not less than 150mm and arranged to permit convenient access to wires and terminals and to enable ferrule numbers to be read without difficulty.

Other circuits shall be grouped on the terminal blocks according to the classification given in the clause for 'Panel internal wiring' which shall be clearly marked along the corresponding section of each terminal board. Groups of different voltages on the same board shall be separated by insulated barriers.

All connections shall be made from the front of terminal blocks and no live metal shall be exposed at the back. All terminal blocks shall be of the type which clamps the wire securely and without damage between two plates by means of a captive screw and which permits removal of any terminal without disturbance to adjacent terminals. Pinch-screw type terminal blocks will not be accepted. Terminal mouldings shall be in melamine to BS 1322, polyamide or equivalent. Terminal rails shall be hot-dip galvanized. Current bars between the two connection points of each terminal block shall be of copper or brass with tin/lead alloy plating. All steel parts shall be zinc-plated and passivated with a yellow chromate layer. Terminal blocks for input and output analogue signals and for circuits containing volt-free contacts internal or external to the cabinet shall be of the Klippon type SAKC or equivalent which permit the connection of a test milliammeter or continuity meter without disconnecting any wiring. Terminal

blocks for power supplies for equipment external to the panel shall permit the isolation of the item of external equipment without affecting the operation of any other circuit within or outside the panel.

No more than one core of external cables or two internal wires shall be connected to any terminal. If terminal blocks are used as common points for two or more circuits, individual terminals with the appropriate number of permanent cross connections shall be provided. The lengths of exposed cable cores shall be sufficient to reach any terminal in the appropriate row or rows. The cores shall be formed into a neat loom and a separate loom shall be provided for each cable.

Each row of terminal blocks shall contain at least 25% spare terminals over the number required for terminating all cores of external cables in that row. Unless otherwise specified, each external cable shall contain at least 20% spare circuits, with a minimum of one spare circuit.

Terminal blocks shall be numbered consecutively in a sequence different from that used for identifying wiring. The terminal numbers, voltage grouping, and terminal board layout shall correspond precisely with wiring diagrams so that quick and accurate identification of wiring can be made.

All the terminal boards shall be provided with covers of transparent insulating material that does not sustain combustion and shall be sectionalized where possible to give access to groups of terminals without uncovering all boards. Terminals which may be live when the panel is isolated from its main supplies shall be suitably labelled to minimize the risk of accidental contact.

9) Panel internal wiring

a) Panel circuits shall be segregated into the following categories:

Group 1: Power control and very-high-level signal wiring (above 50V):

- ac power supplies.
- dc power supplies.
- ac current signals above 50mA (such as CT circuits).
- 1.4 ac voltage and control signals above 50V (such as PT circuits).

Group 2: High-level signal wiring (6V to 50Vdc):

- signals from conventional electronic transmitters and controllers (such as digital or 4mA to 20mA).
- circuits to alarm annunciators and other solid-state devices
- digital signals.
- emergency shut-down and tripping circuits.
- on/off control circuits.
- intrinsically safe circuits.

Group 3: Low-level signal wiring (5V dc and below):

- signals from thermocouples.
- signals from resistance thermometers and re-transmitting slide-wires;
- signals from analytical equipment and strain gauges.

For Group 3 wiring, internal connections to the instruments shall be made by one of the following methods:

- b) The twisted, screened conductors of the external cable shall be led direct to their appropriate instruments via ducting systems installed for this purpose during construction of the panel;
- c) The conductors of the external cables shall be terminated on terminals segregated from all other categories and the connections to the appropriate instruments shall be made using twisted pairs with individual screening installed for this purpose during construction of the panel.
- d) Internal wiring for all circuits in Group 2 except those sharing a common connection shall be multi- stranded, twisted pair, 0.75mm² minimum copper conductor with HPDE or PVC-insulated cable of adequate grade and rating.
- e) Wiring for circuits in other Groups or sharing a common connection shall be run in stranded, 1.0mm² minimum copper conductor with 250V grade, PVC-insulated cable of adequate grade and rating.
- f) Wiring sheath colours shall be black for ac circuits, and grey for dc circuits (excluding thermocouple circuits) and blue for Group 2.6 circuits. Circuits supplied at 240V, between 240V and 110V dc shall also be physically segregated from each other and from other circuits. Access to wiring and components of circuits having voltages exceeding 240V shall not be possible unless and until the circuit has been isolated.
- g) Separate ducts, trunking, cable looms, tray work and the like shall be provided within the panel for each category with at least 150mm between parallel paths of Group 1 and those of any other Group. Intrinsically- safe circuits and their terminals shall be segregated from other circuits and terminals.
- h) All wiring shall be neatly and securely fixed by insulated cleats, bunched, and secured by approved plastic strapping or run in approved insulated wiring trunking or non-corrodible flexible tubing. Not more than 75% of the capacity of trunking, ducts, looming, or tubing shall be used. Insulated earth wiring shall be so arranged that access to any equipment or connection point or the removal of any item of equipment is unimpeded.
- i) Wiring for future equipment shall be secured and terminated on terminal blocks. Lacing for wiring looms shall be of rot-proof cord or plastic strips. Inter-section wiring in multi-section cabinets shall be via a terminal block in each section.

10) Panel wiring identification and termination

Identification ferrules shall be fitted at both ends of each wire. The numbers or letters used shall correspond with the appropriate wiring diagram. The ferrules shall be of plastic insulating material with permanent black characters on a colour coded background for numbers and on a white background for letters, unaffected by oil or water. They shall be so arranged that they can be read logically from left to right when viewed normally.

The system of wire identification shall be such that wires in the same circuit on opposite sides of a terminal shall have the same reference, and this system shall be continued through all external cabling.

Terminal ferrules (spade, tongue, crimped connections) shall be provided on each conductor.

11) Panel Earthing

A continuous copper earth bar of not less than 25mm x 6mm cross section shall run the full length of each panel and shall be securely fixed and bonded electrically to the main frame. The cable gland-plates and the earth bar shall be provided with suitable brass terminals of not less than 6mm diameter for connecting the metal cladding or armouring of all incoming and outgoing cables to the station earthing system.

A second continuous copper earth bar of not less than 25mm x 6mm cross section, electrically isolated from the steelwork of the panel and metal cladding and armouring of cables, shall be provided for earthing the signal earth connection of each instrumentation and control device and the screen(s) of each instrument cable not earthed elsewhere to the station instrumentation earth plate. The earth bar shall have sufficient brass terminals as specified above for each instrumentation and control device and the screen of every shielded cable plus 25% spare terminals.

In multi-section panels, each earth bar shall be electrically bonded to the corresponding bars in the adjacent section(s).

The earth pit for instrumentation system shall be separate. Electric earth pit shall not be used for earthing of instrumentation equipment. All signal cable screens (analogue and digital) shall be terminated onto the instrument earth bar. Signal cable screens shall be earthed at the control panel end only. Screens at the field end shall be tied back and insulated.

SPDs associated with the control and instrumentation system shall be earthed to the instrument earth in accordance with the SPD manufacturer's recommendations.

12) Panel lighting

Each panel shall be adequately illuminated internally, as evenly and as free from dazzle as possible, by fixed fluorescent lighting controlled from totally enclosed light switches and by totally enclosed door-operated switches positioned so as not to interfere with access. There shall also be one installed inspection

lamp per three metres of panel length or part thereof with adequate flexible connection cable to reach any point in the panel. The control switch for an inspection lamp shall form part of the lamp assembly.

Lighting circuits shall be fused independently of any instrumentation and control circuit and designed to allow lamps to be replaced safely and shall be fed from a distribution board and circuit breaker connected on the live side of the main panel ac supply circuit breaker.

13) Panel ventilation

Each panel shall be provided with ventilation fans as required to ensure that equipment within the panel is maintained within manufacturer's recommendations, with due regard to the environment in which the panel will be mounted. Fans shall be controlled by a suitably labelled enclosed switch mounted internally in an accessible position.

Fans shall be mounted with their axes horizontal and shall be arranged to draw clean air into the panel. Air entries shall have filters which can be renewed from outside the panel and shall be designed to prevent the entry of rain, spray, injurious fluids, sand, or dust.

14) Panel labels

All control gear shall be fully labelled with the KKS code identifying the equipment designation/function, all external and internal components, all rating data, detailed equipment operating data and for danger and hazard warning.

Labels shall be provided for every panel to describe the duty or otherwise identify the panel and its sections, and every instrument, component and item of equipment mounted internally and externally. Where applicable, front-of-panel labels shall be as detailed in the Specification. Wording shall be clear, concise, and unambiguous and shall be subject to review by the Employers Representative before manufacture. Each label shall be permanently secured to the surface near the item to which it refers. Externally fitted labels shall be of Perspex or other approved transparent plastic, with letters and numbers rear-engraved and filled with black.

The rear surface of each Perspex label shall be finished with a coat of paint of the same colour as the panel external finish. Instrument duty labels fitted externally shall be below the item to which they refer. Embossed tape or similar adhesive labels will not be approved.

Laminated materials or rear-engraved and filled plastic shall be used for internally fitted labels, which shall be white with engraved black letters.

Labels conforming to the requirements of the preceding paragraphs or other approved means shall be provided:

- To describe or identify circuits or circuit components.
- To identify dc polarity.
- To warn or remind about dangerous or potentially dangerous circumstances.
- Wherever elsewhere specified.

Unless otherwise specified, all engraving shall be in plain block letters, 4mm high. The minimum practicable number of different sizes shall be used.

Manufacturers' nameplates shall not be fitted on panel external surfaces.

15) Panel finish

For control and instrument panels, desks, and cubicles a hard, smooth, durable finish, free of blemishes, shall be provided. Before painting, all external welds and any rough areas shall be smoothed, and all surfaces shall be thoroughly cleaned and free from scale, contaminates, corrosion or grease. If rust-proof or Zintec steel has not been used in the construction, the panel shall be treated with a passivating agent such as phosphoric acid. All internal surfaces shall have a minimum of three coats of paint of which the first shall be an approved anti-rusting priming coat and the final coat shall be an opaque gloss white enamel. All external surfaces shall have not less than five coats of paint of which the first shall be an approved etch-priming coat, and the second and third suitable undercoats, all of which shall be rubbed smooth when dry before application of

the next coat. The undercoats shall be easily distinguished in shade or colour from the priming and finishing coats. The two final coats shall be of stove enamel paint, gloss, or semi-matt finish, to a colour and finish to be advised by the Employers Representative. Stoving shall be carried out in accordance with the recommendation of the paint manufacturer.

The overall dry film thickness (DFT) shall be between 85 and 120 microns.

Nuts, bolts, washers, and other fixing devices which may have to be removed for transit or maintenance purposes shall be galvanized or otherwise finished to an approved standard.

5.10 Instruments and ancillaries

1) General

All instruments, gauges and control equipment which perform similar duties shall be of uniform type and manufacture throughout the Works in order to facilitate maintenance and the stocking of spare parts.

All equipment shall be fully tropicalised and suitable for the worst environmental operating conditions. Panel-mounted instruments shall be of the electrically operated flush mounted type and shall have damp-proof and dust-proof cases.

Instruments mounted outside instrument panels shall have weatherproof and dustproof cases. Instrument cases shall be of corrosion-resistant material or finish.

Instrument screws (unless forming part of a magnetic circuit) shall be of brass or bronze. Access to terminal compartments of instruments mounted outside panels or other enclosures shall not expose any working part. Moving parts and contacts shall be adequately protected from the ingress of dust. Where applicable instruments shall be easily withdrawable from its housing for maintenance without interrupting its signal.

Unless otherwise specified, instruments shall be finished in the manufacturer's standard colour. Instrument dials shall be of such material that no peeling or discolouration will take place with age under tropical conditions.

Plant-mounted indicators and gauges shall be sized to give full legibility when viewed from a position with convenient and easy access or from the point at which any operation requiring observation of the gauge is performed. The minimum diameter for any gauge shall be 150mm except where forming part of standard instruments and accessories such as air-sets.

Dials and bezels shall be of bronze and internal components shall be of stainless steel, bronze, or other corrosion-resistant material.

Unless otherwise specified, all functions shall be transmitted electrically and all analogue signal-transmission systems shall be in accordance with BS 5863: Part 1 or equivalent and shall use a signal of digital or 4mA to 20mA dc. Where possible, measuring systems shall be designed so that any necessary power supply is taken from the appropriate instrument panel.

Transmitting devices shall have integral indicators to monitor the output signal or connections suitable for use with a portable test meter and shall be capable of meeting the performance requirements specified in the appropriate part of BS EN 60770-1 or equivalent. For the important and critical processes, the transmitting devices, such as pressure, temperature, and level gauges, shall have a reference gauge installed locally for easy reference for the operation and maintenance staff. The transmitters shall be provided with LCD meters.

Equipment mounted in enclosures shall be suitable for continuous operation at the maximum internal temperature possible in service, due account being taken of internally generated heat and heat dissipated by other plant. All components shall be rated adequately, and circuits shall be designed so that change of component characteristics within the manufacturers' tolerances shall not affect the performance of plant. All equipment shall be designed to operate without forced (or fan) cooling.

Equipment provided with anti-condensation heaters shall be capable of operating without damage if the heaters are left on continuously. Unless provided with unalterable factory configured ranges, measuring instruments shall have zero and span adjustment.

Field mounted instruments shall be mounted such that they are easily viewable and easily accessible for maintenance.

Instruments not mounted in panels shall be supplied complete with all brackets, stands, supporting steelwork and weatherproof enclosures (separate from the instrument cases) necessary for securing them in their working positions and affording complete protection at all times including periods of servicing, adjustment, calibration, and maintenance.

Each installation shall incorporate a valve and pipework for obtaining a sample representative of the fluid at the position of the permanent meter and drain. If the measuring and sampling points are remote from each other, the test and sample facilities shall be provided at both points.

In order that maintenance and inspection may be carried out safely and conveniently instruments mounted in elevated and open work areas shall be provided with safety ladders and a sufficiently sized working platform with sun shading.

2) Indicating Instruments and Meters

General

All instruments and meters shall be flush mounted and generally of the same pattern and appearance throughout and those which perform similar duties shall be of uniform type and manufacture.

Indicating instruments shall be fitted with an externally accessible zero adjuster. They shall have no parallax error and their normal maximum reading shall be approximately 60% full scale deflection.

Ammeters in motor starter circuits shall be capable of withstanding the starting current and shall have a compressed overload scale. The ammeter shall have an adjustable and sealable red pointer set to indicate normal full load current. The ammeter physical size shall be in keeping with the size of the starter concerned. The minimum size to be used is 0.25 DIN.

Indicating instruments shall comply with IS 1248, BS 89 or IEC 60051 and shall be of industrial grade accuracy.

a) Panel Mounted Digital Indicators for Field Instruments

Digital panel indicators shall be microprocessor based and modular in design. It

shall accept 4-20mA DC isolated input. The digital panel indicator shall provide an output of 4-20mA DC proportional to input signal for retransmission. It shall have RS485 communication port for connectivity to PLC.

Technical Particulars

Type	:	Microprocessor based.
Mounting	:	Front facia of Instrument Control Panel (ICP)
Display	:	Back-lit LCD or LED
Digit height	:	12.5 mm or higher
No. of digits	:	4
Input	:	4-20mA DC (isolated)
Zero & Span adjustment	:	Required
Engineering units for display	:	As per site requirement
Weather protection class	:	IP-52 of IS 13947
Retransmission output	:	4-20mA proportional to Process
Relay outputs	:	Required 2NO+2NC for high level alarm and 2NO+2NC for low level alarm
Communication port	:	RS-485 (With Modbus protocol)

b) Kilowatt-hour meters.

Kilowatt-hour meters shall comply fully with IS 722 or BS 5685 Class 2 and shall have industrial grade accuracy ($\pm 2.5\%$). Three element units shall be used for 3 phase 4-wire systems. Two element units shall be used for 3 phase, 3-wire systems.

Quantity : 1 No. for each pump and incomers of Switchboard as per approved scheme

Purpose : Power and Energy Monitoring
It shall monitor voltage, current, kW, kVA, power factor and frequency.

Technical Particulars

Data logging: Data storage and it shall be retrieved via RS 485 port

Soft Integration: The meter shall be integrated with Centralized Monitoring system to provide remote display of all measured parameters and meter configurations. The metering shall be via. RS 485 port.

Measurement:

True RMS measurement

Instantaneous phase voltages, line voltages, phase currents and line currents

Frequency

Active, reactive, apparent powers and power factor per phase and line energy parameters

Energy-Import and Export

Maximum demand kVA, kW, kVAR

Password protection for setup parameters

Communications - RS 485

Baud rates minimum 9600

Accuracy Class - 0.5 S

Accuracy Standards- IS-14697:1999

Front Panel Display

Display for all basic power and energy parameters

Password protection for setup parameters

Ratings

Voltage Inputs 50 to 347 VAC

Accuracy VL-N: 0.25% reading

Accuracy Hz: +/- 0.1 Hz

Support 3 phase 3 wire, 3 phase 4 wire connections

Standard screw in terminals

Current Inputs - 5 Amp. Nominal

Accuracy current: 0.25% reading, 20% over range full accuracy

Power Supply - 110 V to 240 VAC & VDC

Environmental Conditions- As per process Requirement- Ambient Temperature.

Humidity: up to 95% non-condensing.

c) **Microprocessor based Alarm Annunciator**

Microprocessor based alarm annunciator shall be provided for generating audio-visual alarms for each abnormal condition. Alarms shall be initiated by the opening and closing of volt-free contacts which shall remain unchanged throughout the periods in which the alarm conditions exist. Alarm circuits shall be capable of conversion from open-healthy to open-alarm or vice versa by a simple configuration after installation requiring no additional parts or special equipment. Each alarm shall initiate the operation of both visual and audible devices. The sound intensity (adjustable) of each audible device shall be suitable for the maximum sound level of its environment.

Each alarm shall initiate a visible and audible indication of the specified condition. Unless otherwise specified, alarm indicators shall be grouped together in annunciator units each having at least 20% spare windows. Each alarm window shall consist of minimum 2 nos. of bulbs having cluster of LEDs and shall have screens engraved with legends approved by the Employers Representative.

When any alarm condition occurs, an audible device common to an alarm annunciator system shall sound and the appropriate indicator shall flash on and off. The flashing rate shall be selectable. Facility for selection of type of sequence shall be provided.

The operation or acceptance of one alarm shall not inhibit the operation of the audible device or the flashing of the appropriate alarm indicator if a future alarm condition occurs.

An integral 'test' pushbutton shall be provided to illuminate each lamp and to operate the audible device but shall not cause a spurious alarm condition.

Alarm circuitry shall be arranged so that spurious or transient alarm states persisting for less than 0.5 seconds adjustable do not initiate any action.

Isolation facility shall be provided for the hooters.

Alarm annunciator/indicator legends or labels shall be arranged with three lines of text as follows:

i.	top line	:	Location
ii.	middle line	:	Parameter

iii.	bottom line	:	Status
e.g.		:	RESERVOIR LEVEL LOW

Alarm annunciator shall have RS-485 communication port (Modbus protocol) for interfacing with the PLC system.

A LED shall be provided to indicate the 'ON' status of the alarm annunciator.

Technical Particulars

Alarm annunciator shall be provided on instrument control panel for annunciation of alarms in control room. The technical particulars of alarm annunciator are as follows:

i.	Type	:	Microprocessor based, split type with alarm windows mounted on the front door and electronic modules inside the panel.
ii.	Mounting	:	Flush with panel
iii.	Construction	:	Modular
iv	Inputs	:	Potential free, NO/NC contacts
v	Size of windows	:	60 mm X 26 mm
vi	Operating	:	First up (user selectable dip switch)
vii	Bulbs per	:	2 (Cluster LEDs)
viii	Push Buttons	:	For Test, Mute, Acknowledge & Reset
ix	Hooter	:	Required, electronic type
x	Power supply	:	24 V DC/240 V AC
xi	Power supply	:	Required
xii	Weather	:	IP-52 of IS 13947
xiii	No. of Windows	:	8 / 12 / 24, As required with 20 % Spare
xiv	Quantity	:	As per process requirement

3) Indicator Lights

Indicator lights shall be not less than 20 mm diameter and shall be panel mounted types with metal bodies adequately fastened so that the lamps shall be capable of replacement from the front of the apparatus without disturbance to the lamp holder or panel wiring. Lamp holders shall be keyed into panels to prevent rotation. Lens colours shall comply with BS EN 60037 as follows:

- power on white*
- running green
- tripped/alarm red
- status (open, closed, etc.) blue
- ready to start blue
- warning (no imminent danger) amber

Note: *white may be used where doubt exists as to which another colour to use.

The lights shall be under-run to give long life either by use of a resistor to limit voltage to 90% normal value or by using higher voltage lamps. The indicating lamps on control panel shall be cluster of LEDs.

4) Pushbuttons

Colours of pushbuttons shall generally comply with IS 6875, BSEN 60947, 60037

or IEC 60073 and in particular shall be as follows:

- stop, emergency stop red
- start green
- jogging/inching black
- reset (when also acting as a stop) blue
- lamp test blue
- override/alarm accept yellow

5) Specification for Junction Boxes:

a) Junction box (instrument)

1	Construction:	3mm sheet steel
2	Protection:	IP65
3	Paint and shade:	One coat of red oxide primer Powder coated light grey as per Shade 631 of IS:5
4	Terminal strip	Elmex type capable of Terminating 0.5 sqmm to 1.5 sqmm Cable din rail mounted
5	No of terminal strips	30/40/70
6	Conduit & cable entry	Lower side
7	Gland plant thickness	3mm
8	Door of JB	Hinged with proper locking Arrangement to avoid entry of Dust & moisture the design of Fixing screws of the lids of the Junction box shall be such that They do not come out of the lids When completely unscrewed (captive screws)
9	Dimension	Vendor to provide most Economic dimension of JB based on the no of Terminal bases and cable Entry
10	Mounting	Frame mounted
11	Earthing	Two no of earthing bolts for JB Earthing separate instrument Earth bus on insulating cleats to be provided
12	Name plates	To be provided material: white Engraved letters on black Anodized aluminium sheet Fixing: stainless steel screws Lettering: black with white engraved

b) Junction box (power & control)

1	Construction:	3mm sheet steel
2	Protection:	IP65
3	Paint and shade:	One coat of red oxide primer Powder coated light grey as per Shade 631 of IS:5
4	Terminal strip	Elmex type capable of Terminating 0.5 sqmm to 1.5 sqmm Cable din rail mounted
5	No of terminal strips	30/40/70
6	Conduit & cable entry	Lower side

7	Gland thickness	3mm
8	Door of JB	Hinged with proper locking Arrangement to avoid entry of Dust & moisture the design of Fixing screws of the lids of the Junction box shall be such that They do not come out of the lids When completely unscrewed (captive screws)
9	Dimension	Vendor to provide most Economic dimension of JB based on the no of Terminal bases and cable Entry
10	Mounting	Frame mounted
11	Earthing	Two no of earthing bolts for JB Earthing separate instrument Earth bus on insulating clits to be provided
12	Name plates	To be provided material: white Engraved letters on black Anodized aluminium sheet Fixing: stainless steel screws Lettering: black with white engraved

5.11 Cabling

1) Instrumentation cabling

Cables from conventional measuring transmitters and analogue process controllers, such as digital or 4mA to 20mA dc output from a constant-current source, (hereinafter referred to as high-level signals) shall be polyethylene or PVC insulated with stranded conductors and laid up as twisted pairs with one twist per 30mm approx. Each cable shall have an overall screen of braided copper or mylar backed aluminium foil giving a minimum coverage of 85%, a steel wire armouring insulated from the screen and from any ducting and an overall PVC sheath. For runs exceeding 30 metres or for all inputs to a data logger, computer or microprocessor, multi-core cables shall have an individual screen of braided copper or mylar-backed aluminium foil for each signal pair. The minimum conductor size shall be 24/0.2mm but shall be of greater cross-sectional area if required for the satisfactory operation of associated plant. Cables for intrinsically safe systems shall comply with BS 5308 and the relevant certificate.

Cables from strain gauges, analysers, and the like, such as 0 to 100mV (hereinafter referred to as low- level signals — see also below) shall be as specified above and shall have an individual screen for each signal pair.

Cables from indicating devices to alarm or tripping circuits shall be as specified above for high-level signals but shall use cables, cable trays, ducts and conduit separate from those for other high-level circuits. Cables for high-level signals, low-level signals, resistance thermometers and thermocouples shall be segregated from each other, and each shall be separated from cables for power, communications, and other electrical services. Other cables run in the vicinity of instrumentation cables shall be twisted at the rate of one twist per 50mm approximately and shall be separated from instrumentation cables by a distance of not less than 300mm.

Initiating devices for plant protection and personnel safety shall be connected by individual cables direct to the tripping or safety device and shall not be routed via any intermediate junction, marshalling box, cabinet, relay or similar. The outer sheaths of such cables shall be coloured orange.

Technical particulars:

Contractor shall include in his scope the supply, laying of cables and associated civil/mechanical work.

Cables shall be capable of satisfactorily withstanding without damage, transportation to site, installation at site, and operation under normal and short circuit conditions of the various systems to which the respective cables are connected when operating under the climatic conditions prevailing at the site as indicated in this specification.

Cable joints in instrument signals and power supply cables shall not be permitted.

Cables shall be capable of satisfactory performance when laid on trays, in trenches, conduits, ducts and when directly buried in the ground.

Cables shall be capable of operating satisfactorily under the specified power supply system voltage and frequency variation.

a) **Cables for analogue signals**

The cables shall comply with the following requirements:

Cables of 1100V grade, multi-pair/multi-triad cable, annealed, tinned, high conductivity, 1.5 sq. mm. stranded copper conductor, extruded PVC insulated two/three cores twisted into pair/triad, laid up collectively, individual pair/triad shielded and overall shielded with aluminium mylar tape, ATC drain wire run continuously in contact with aluminium side of the tape, inner sheathed with extruded PVC, armoured with galvanised steel wire and overall sheathed with extruded PVC conforming to IS 1554, IEC 189 & BS 5308 shall be used for analogue signals.

b) **Cables for digital signals**

The cables shall comply with the following requirements:

Cables of 1100V grade, multi core cables, annealed, tinned, high conductivity, 1.5 sq. mm. stranded copper conductor, extruded PVC, overall shielded with aluminium mylar tape, inner sheathed with extruded PVC, armoured with galvanised steel wire, overall sheathed with extruded PVC conforming to IS 1554, IEC 189 & BS 5308 shall be used for digital signals.

c) **Cables for Instrument/Equipment power supply**

The cables shall comply with the following requirements:

Cables of 1100V grade, multicore cable, annealed, tinned, high conductivity, 2.5 sq. mm. stranded copper conductor, extruded PVC, inner sheathed with extruded PVC, armoured with galvanised steel wire, overall sheathed with extruded PVC conforming to IS 1554, IEC 189 & BS 5308 shall be provided for Instrument/Equipment power supply.

2) **Telemetry cabling**

Telemetry cabling between a master station and an outstation, unless otherwise specified, shall consist of a minimum of 6 signal pairs, of which two pairs shall be allocated to the telemetry system, one pair shall be allocated to a speech circuit and three pairs shall be spare. Each conductor shall be multi-stranded with an equivalent diameter of not less than 0.9mm. Conductors shall be laid up in starquad formation. The dc resistance of any pair of conductors shall not exceed 88 ohms per loop mile at 10°C and the difference between the resistances of the conductors of any pair shall not exceed 0.5% of the loop resistance of that pair.

Telemetry cables shall be designed for burying in water-logged ground.

Conductors shall be plain annealed copper with aluminium/polythene laminate sheath moisture barrier, copper or brass tape pest barrier, single galvanised steel wire armour and overall polythene sheath. The cable shall have a solid filling of petroleum jelly.

The characteristic impedance of each signal circuit shall have a nominal value of 600 ohms at 800Hz and the circuits shall be suitable for signal input levels of between -30dbm to +4dbm (0dbm = 1mW into a load of 600 ohms). The overall attenuation between the terminations of any circuit at the mean frequency of the band width specified elsewhere shall not exceed 20dbm and the attenuation at any two frequencies within this band width shall not differ by more than 6dbm. The transmission time for any two frequencies within the band width specified elsewhere shall not differ by more than $1 / (4 \% B)$ seconds, where B is the transmission speed in bauds, as specified elsewhere.

The signal-to-noise ratio within the bandwidth specified elsewhere shall be better than 12db. The frequency of any received signal shall not differ from the frequency of the corresponding transmitted frequency by more than 1% of the transmission speed in bauds specified elsewhere.

Loading coils as necessary to meet the performance requirements detailed herein shall be supplied and installed at equally spaced points.

a) **Fiber optic cable**

To facilitate the proper and efficient co-ordination of the Works the Contractor shall sublet all Cabling Works to one Sub-Contractor who has proven and successful experience in fiber optic cable installations on projects like the one now proposed.

If cable sizes are not indicated on Drawings or in schedules, determine the correct size based on total end to end signal attenuation not to exceed 40 dB, including all splices and termination losses, and after taking into consideration.

- Type of fiber
- Ambient conditions
- Method of installation
- The disposition of each cable relative to others

All cables and wires shall be suitable for installation and continuous services in the ambient conditions described elsewhere in this document.

Shop Drawings and Product Data shall be submitted for the approval of the Employers Representatives as follows;

- Submit full technical details of each type of cable proposed.
- Submit copy of test certificates from the manufacturer or an independent testing authority confirming that cables comply with the specification.
- Submit exact route of the cable run and relevant Sections in the shop drawings.

Each drum length of cable shall be allotted a distinct and separate reference number. This number shall appear on the test certificate covering the respective length of cable and shall also be clearly marked on the cable drum.

The Contractor shall advise the Employers Representative upon delivery to site of each drum length, quoting the reference number, the test certificates shall be handed to the Employers Representative for examination and approval.

All cables shall be delivered to site with the manufacturer seals, labels, or other proof of origin intact. These labels and seals shall not be removed until the cable is required for use and shall be retained for inspection by the Employers Representative.

The Contractor shall be responsible for the off-loading and handling of the cables on site and shall ensure that cables are delivered to site on drums and properly protected against mechanical damages. Where lengths are cut from cables, the open ends shall be sealed.

The contractor shall be aware of the need to supply and install all cables for this Contract which are most suitable for the special environmental conditions prevailing in this project.

The cable shall comprise 8 fibres, loose tube, two fibres per tube with central 1.5 mm nominal steel central strength member, moisture barrier, steel tape armoured in continuous lengths up to a maximum of 6.0 km or as dictated by cable joint chamber locations and route survey.

Single Mode	
Type of fiber	Single mode, doped silica
Core Diameter	9.0 ± 0.5 micro m
Cladding Dia	125 ± 2.0 micro m
Coating (outer)	250 ± 15 micro m Material UV curable acrylate
Numerical aperture	0.11 micro m
Attenuation	<0.4 dB/km @ 1300 nm <0.2 dB/km @ 1500 nm
Bandwidth	1000 MHz @ 1300 nm
Chromatic Dispersion	3.5 ps/nm x km @ 1300 nm 20 ps/nm x km @
Operating temperature	-30 to +80 deg. C
Crush resistance	>200N/cm
Weight	500 kg/km (maximum)
Tensile strength	2000 N (minimum)
Multi-mode	
Type of fiber	Multi-mode, doped silica
Core Diameter	62.5 ± 3.0 micro m
Cladding Diameter	125 ± 2.0 micro m
Coating (outer) Dia	250 ± 15 micro m Material UV curable acrylate
Numerical aperture	0.275 ± 0.15 micro m
Attenuation	<3.2 dB/km @ 1300 nm <0.9 dB/km @ 1500 nm
Bandwidth	500 Mhz x km @ 1300 nm
Operating temperature	-30 to +80 deg. C
Crush resistance	>200N/cm
Weight	500 kg/km (maximum)
Tensile strength	2000 N (minimum)

3) **Cable termination boxes**

Cable termination boxes shall have double-ended screw terminals with removable links to facilitate core isolation during testing. Each box shall contain sufficient terminals for every conductor plus 20% spare terminals. Cable

termination boxes shall have cable sealing chambers and insulated glands with earthing terminals so that the armouring may be earthed or isolated from earth, as circumstances dictate. Termination boxes for use within buildings shall be of sheet steel with hinged or removable front covers. All other termination boxes shall be cast steel or heavy gauge sheet steel construction giving protection to IP55. All termination boxes shall be hot dip galvanized or approved equivalent finish. Each terminal box shall have a removable, un-drilled gland plate and the Contractor shall supply and fit the requisite number of cable glands.

At each cable termination box, each cable core (including spares) shall be identified by a numbered slip- over type collet. The numbering for a particular cable core shall be the same throughout its length.

Cable joints shall be at points approved by the Employers Representative.

Each cable joint shall be of the straight-through type. The conductors shall be ferrule-jointed with the insulation maintained by heat-shrink sleeving. Joint closure shall be made with epoxy resin and the completed joint shall be impervious to water if submerged or in waterlogged ground. If cast iron joint boxes be used, they shall be provided with cable glands and, after installation and testing, shall be covered with Densomastic HD compound or equal; so that all sharp corners, bolts, and projections are moulded to a smooth surface. Two lapping of Densopol grade ZN 50mm tape, or equal, shall then be applied overall. Jointing shall be carried out on each conductor, including any provided in excess of the minimum quantity specified. All materials and things of every kind required for the cabling jointing shall be provided by the Contractor.

4) **Cable labelling**

At each end of each cable, in a uniform and visible position, a label shall be fixed on the cable to indicate the site cable number and route, and the number and size of conductors. Labels shall be made of brass, aluminium, lead or copper strip, engraved and retained by suitable non-rusting or non-corrodible binding wire passing through two fixing holes, one at either end of the label. If the cable gland is not normally visible, then the label shall be fixed inside the panel by means of screws.

Three-phase power cable cores shall be identified A, B, C or colour-coded red, yellow, blue so that the correct three-phase sequence is preserved throughout the system. Single-phase power cable cores shall be colour-coded red and black.

Control cables shall have individual cores identified by means of suitable permanent ferrules bearing the same number at both ends. Core identification shall occur at every point of termination using an approved system of colour-coded ferrule markers. The size of these ferrule markers shall be such as to match the overall diameter of conductor plus insulation. Numbering shall read from the termination upwards on all cores.

Each cable and core shall bear the same number at both ends of the cable and core respectively.

a) **Power terminations — colour, number, or letter.**

b) **Control terminations — letter or number or both.**

5) **Cable terminations**

All PVC SWAPVC, PVC PVC and XLPE SWAPVC cables shall be terminated with mechanical glands which shall comply with BS 6121. They shall seal the inner and outer cable sheaths against ingress of dirt and moisture and provide

adequate mechanical support. Each cable gland shall be protected by corrosion-resistant moulded PVC hoods, covering the entire assembly from the overall sheath to the gland neck. Glands for armoured cables shall provide a positive armour clamp to the enclosure so that no tension is applied to the termination. The clamp shall also provide a high level of earth continuity and be of adequate size to withstand the full fault current of the system for one second.

All glands shall be provided with an earthing tag. For cables of 4mm² or less, a serrated washer may be used instead for earth continuity.

The cable termination and sealing equipment shall be obtained from the cable manufacturer, or other approved supplier, and shall be purpose-made for the type, size and grade of cable concerned. The application of these materials shall be strictly in accordance with the manufacturer's instructions.

Through joints shall be permitted only on long cable runs outside buildings. Where such joints are necessary; the cables shall be jointed with epoxy or acrylic resin Cold-setting compound which has been pre-measured and pre-packed ready for use.

The boxes shall be of a split moulded plastic type with filling vents for compound.

Bonding straps shall be fitted with armour clamps across the joint and inspected by the Employers Representative prior to filling the box with compound. Wrapped pressure type joints shall not be accepted. Conductor cores shall be jointed number to number or colour to colour.

6) Cable installation-general

Cables which are to be run on walls, ceilings or other building structures shall, unless otherwise agreed by the Employers Representative, be secured on cable trays and ladders, or enclosed in conduit or trunking.

Every cable shall be neatly run vertically or parallel to adjacent walls, beams, or other structural members. Cables shall not be installed in areas of direct sunlight.

Where this is unavoidable, approved sun shields shall be supplied and installed.

Where the building structure incorporates purpose-built covered duct or trench systems for main cables, instrumentation cables shall be segregated and installed on tray work or otherwise secured to the sides of the duct or trench.

Where the structure incorporates general service ducts or trenches containing pipework, chemical lines and other services, all cabling shall be segregated from the other services and shall be run on the walls unless otherwise agreed by the Employers Representative.

Cables shall be spaced to prevent interference between power and signal cables, and to avoid unnecessary crossovers.

The spacing of clips, saddles and cleats shall prevent the sagging of the cables during their installed life. The method of fixing clips and the like shall be by means of non-corrodible screws inserted into approved wall fixings, such as rawlplugs.

Cable hangers, cleats, saddles, brackets, and similar supporting devices shall be of an approved type and of adequate strength for the cables they are supporting. They shall be treated to withstand Site conditions without corroding. Self-locking plastic buckle clips and strapping shall not be used. The arrangement and fixing of each cable shall permit the removal and replacement of any cable without disturbance to any other cable or the fixings thereof.

When cables are terminated in any particular item of equipment, special care

shall be taken to ensure that the cables finally approach the equipment from a common direction and are individually terminated in an orderly and symmetrical fashion.

Submissions which the Contractor shall submit the following in relation to cable installations in addition to submissions detailed elsewhere in the Specification.

7) **Drawings and schedules:**

Block diagrams to show control cabling systems with each cable and terminal equipment being identified as in the cable schedules.

Cable route and layout drawings. For those items which are underground, these drawings shall include the following:

Route plans and sectional views for all cable runs, cable trays, cable ducts and cable trenches;

The position of all marker posts, joints, draw pits and the like.

Cable schedules shall detail the cable number, type, voltage, size, route length and number of cores or pairs. Control-cable schedules shall detail the connected and spare core numbers, diagram number for connected equipment, core ferrule and terminal reference number.

8) **Data and calculations:**

Manufacturers' catalogues and data sheets for all cables and fittings. Cable sizing Calculations.

9) **Test certificates:**

Test certificates for all witnessed and routine tests carried out at the manufacturer's works and at Site (calibration).

10) **Cable trays and ladders**

Cable tray and cable-support ladders shall be of heavy-gauge galvanised steel and with an overall PVC coating when required to the approval of the Employers Representative.

Cable tray and ladder systems shall be installed using factory-made supports, joints, and junction/bend pieces. Wherever tray and ladder sections are cut and shaped on Site, cut edges shall be dressed and painted with at least two coats of cold galvanising compound or lead-based anti-corrosive paint.

Ladder systems shall be secured to walls and ceilings by pre-formed galvanized interlocking channel.

11) **Flexible conduits**

Flexible conduit shall be of the waterproof galvanised type of PVC wire-wound type with cadmium-plated mild steel couplings. Lengths of flexible conduit shall be sufficient to permit withdrawal, adjustment, or movement of the equipment to which it is attached and shall have a minimum length of 300mm. Flexible conduit shall not be used as a means of providing earth continuity. A single earth conductor of adequate size shall be installed external to the conduit complete with earth terminations.

Where conversion from rigid conduit to flexible metallic conduit is to be made, the rigid conduit shall terminate in a trough-type box. The flexible conduit shall extend from this box to the equipment; the earth continuity cable shall be secured to the box and to the piece of equipment. The use of lid facing screws and the like will not be permitted. Adaptors shall incorporate a grub screw or a

gland to prevent the flexible conduit becoming loose.

12) PVC conduit

Where galvanised conduit would be liable to corrosion, PVC conduit shall be installed.

PVC conduit shall be of the oval or round high impact non-flame-propagating type as specified and self-extinguishing, to BS EN 61386-21. Surface and concealed installations shall be generally as described for steel conduit.

PVC conduit fittings shall comply with BS 4607. They shall all be white unless specified otherwise. Jointing shall be carried out using PVC solvent and socketed accessories.

Expansion couplers shall be fitted in straight surface runs every 12m. The free end shall be sealed with non-setting mastic to form a waterproof seal.

Purpose-made bends may be used providing that the cable bending radius is maintained. Cracked or crinkled conduit will be rejected.

The conduit shall be suitable for use in ambient temperatures of between -5°C and $+60^{\circ}\text{C}$ and shall not be installed in areas that receive direct sunlight. A separate protective conductor (earth-continuity conductor) shall be installed.

Adaptable boxes and accessories shall be made from heat-resistant insulating material. The minimum wall thickness of boxes having a nominal internal depth of 16mm or less shall be 1.5mm. For deeper boxes, the minimum wall thickness shall be 2mm. All boxes which are intended to support luminaires or other heat sources shall have either external fixing lugs riveted to the metal inserts or utilise steel insert clips.

5.12 Cable installation methods

1) General

All cabling installation methods shall be subject to the approval of the Employers Representative.

2) Installation directly into the ground

Where cables are buried in the earth, the bottom of the excavated trenches shall be freed of sharp stones and other projections and covered with sand to a depth of 50mm.

Cables shall be unrolled from drums without loops and kinks, and care shall be taken when laying to avoid damage to the outer sheath by drawing over sharp projections.

Cables shall be snaked into the trenches to avoid tension in the cables during backfilling or from subsequent settlement. After laying, cables shall be covered to a minimum depth of 100mm of compacted sand and shall have a layer of protective interlocking concrete cable tiles. The tiles shall be overlaid with marker tape.

When cables of different voltages are laid together at the same depth, vertical cable tiles shall be used to segregate the cables.

ICA and communication cables shall be laid not closer than 1000mm to high voltage cables.

Enough rollers shall be provided so that the cable does not touch the ground or twist during pulling.

3) Installation in underground ducts

Underground ducts shall be constructed of impact-resistant uPVC and laid at a minimum depth of 500mm (to the duct centre), surrounded by at least 75mm of sieved sand. At road crossings, uPVC ducts of minimum diameter 100mm shall be laid at a minimum depth of 1000mm (to the duct centre). The ducts shall be encased by 150mm concrete on all sides.

When installing cables in ducts, the following measures shall be observed:

Cables shall be pulled in a straight line;

Rollers shall be positioned at the edges of draw pits both at the drawing-in and drawing-out points over which the cables shall be drawn;

uPVC pipes and cable sheaths shall be coated with an approved lubricant;

Sufficient draw-in points shall be provided, and adequate room allowed for installation of cables;

The pulling rope shall be guided by rollers.

Only one power cable shall be drawn into each duct.

Whenever a duct is laid in the ground, a draw-wire shall be pulled through with at least 1000mm excess at each end and the draw-wire left in position if the duct is not to be used immediately.

4) Sealing cable entries into buildings

Whenever cables pass through walls below ground level, the point of entry shall be sealed against the ingress of water. This shall be achieved with silicone foam or similar.

All cable entries into a building shall be in ducts and where the cables pass in or out of ducts, together with any spare ducts, the ducts shall be sealed against the ingress of moisture by means of duct stoppers and bituminous compounds or by any other method approved by the Employers Representative. The stopper shall have a fire resistance of at least 30 minutes.

5) Marking of underground cables

The location of all underground cables shall be identified by:

Brass plates fixed to the exterior surface of all walls of buildings 300mm above ground level and directly above the point where cables pass through the wall;

Marker posts in road verges and the like at intervals of not more than 100m and at all junctions and changes of direction along the route.

Marker posts at 10m intervals within an enclosed site and at all junctions and changes of direction along the route.

Marker posts shall be of concrete, not less than 200mm high above ground with an inscribed brass or enamel metal plate. The inscription shall indicate the presence of a cable below, the depth, classification, and voltage rating.

A drawing or sample of a typical marker post shall be submitted for the approval of the Employers Representative.

6) Installation in cable trunking

Cable trunking shall be manufactured from mild steel of not less than 1.25mm and shall be hot dip galvanised.

The Contractor shall ensure that the size of the trunking is adequate for the number of cables to be installed together with 50% spare capacity.

Trunking shall have minimum dimensions of 50mm.

Segregation of cables shall be carried out if required using continuous sheet steel barriers with the bottom edge welded to the trunking.

The trunking shall have two return flanges for rigidity.

Where necessary, additional strengthening straps shall be fitted internally. The cover shall overlap the trunking and be made of the same gauge. Fixing screws for covers shall be recessed and be of the self-retaining quick-fix type.

All bends, tees and intersections shall be of the gusset type and shall, wherever possible, be purpose-made by the manufacturer and of a matching design to the main trunking.

Cables shall be retained in the trunking when the cover is removed by means of straps.

Internal connecting sleeves shall be fitted across joints in the trunking and earth continuity ensured by bonding each section of trunking to a continuous earth wire.

Non-flammable fire barriers shall be inserted where the trunking passes through walls or floors. Conduit connections to trunking shall be made by flanged couplings and male bushes.

Trunking shall be supported at intervals not greater than 2m horizontally or 2.5m vertically. Crossings over expansion joints shall be made in flexible conduit.

Should it be necessary to cut or drill a section of trunking, the bared ends shall immediately be given a coat of zinc-rich cold galvanising paint.

Cable and trunking runs shall be determined by the Contractor and agreed by the Employers Representative before any work is started. The run shall be at least 150mm clear of plumbing and mechanical services.

Trunking systems erected outside a building shall be weatherproof.

7) Installation in troughs and trenches

Where the building structure incorporates purpose-built covered trench systems, power distribution cables may be laid on the floor of the trench. Control and instrumentation cables shall be segregated and installed on supporting steelwork or cable trays secured to the walls of the trench.

Where the building structure incorporates general service trenches containing pipework, chemical lines and other services, all cabling shall be segregated from other services and run on the trench walls. Crossovers shall be kept to a minimum and cabling shall be taken above wet service pipework.

Cable trays shall be of perforated steel with formed flanges and of minimum thickness not less than 1mm for trays up to 100mm width, not less than 1.25mm for trays from 100mm to 150mm width and not less than 1.5mm thickness for trays from 150mm to 300mm width.

Cable-tray supports shall be of sufficient strength to maintain rigid support to the fully-laden cable tray along its entire length. All brackets and tray work shall be suitable for withstanding a temporary weight of 125kg.

Wherever possible, cable trays shall be installed in full lengths without cutting.

Should it be necessary to cut or drill a length of tray, the bared ends shall be dressed and immediately be given a coat of zinc-rich cold galvanising paint. Similarly, for PVC-coated trays, the bared end shall be immediately sprayed using a PVC aerosol.

All cables shall be firmly secured to the tray using purpose-made saddles, as approved by the Employers Representative, together with proprietary cable cleats.

8) Installation in buildings

Cables required to be run on walls, ceilings, or other structures shall be carried

on substantial cleats, either in groups or simply at spacings determined by rating requirements, supported on tray or ladder racks, or enclosed in conduit or trunking.

All cables shall be neatly run vertically or parallel to adjacent walls, beams, or other structural members. The spacing of clips, saddles and cleats shall be such as to prevent the sagging of the cables during their installed life. The method of fixing clips and the like shall be by means of non-corrodible screws inserted into approved wall fixings.

Cable hangers, cleats, saddles, brackets, and similar supporting devices shall be of an approved type and of adequate strength for the cables they are supporting. They shall be treated to withstand site conditions without corroding. Self-locking plastic buckle clips and strapping shall not be used.

Hangers shall be spaced according to recommendations in the IEE Wiring Regulations. Allowance shall be made for expansion and contraction of the cables.

Cables shall be located between 50mm pegs spaced at 40mm centres across a rung so that a 40mm or 80mm space is maintained between cable centres. Cleats shall be used where the ladder racking is vertical.

Cables shall be run at least 150mm clear of plumbing and below heating and hot water pipework.

9) Cable installation in conduits

Conduits shall be either galvanised heavy-gauge steel screwed type or light-gauge steel non-screwed type, steel, or PVC. Accessories shall either be malleable cast iron or pressed steel.

A space factor of 40% shall not be exceeded and, in any case, conduit shall have a minimum diameter of 20mm.

The tubing is to be perfectly smooth inside and out and free from imperfections.

Both ends of every length of tubing shall be reamed and all sharp edges removed before erection.

Where conduits converge, adaptor boxes shall be used. Conduits shall be connected by means of male brass bushes and couplings.

Where conduits are greater than 25mm diameter, straight-through joint boxes shall be of the trough type.

Where conduit or fittings are attached to equipment casings, the material of the casing shall be tapped for a depth of not less than 10mm or male bushes and flanged couplings may be used.

Hexagonal lock nuts shall be used at running joints. They shall seat firmly and evenly on to mating faces. All function boxes, draw-in boxes, and inspection fittings shall be placed so that the cables can be inspected, withdrawn, and re-wired during the life of the installation.

Generally, not more than two bends or offsets or one coupling will be permitted without a suitable inspection accessory. Fish wires shall not be left in conduits during erection. The whole of the installation shall be arranged for a loop-in type of system with joints being carried out at switches, isolators, or appliance fittings. Ends of conduits which are liable to be left open for any length of time during building operations shall be plugged to prevent the ingress of dirt and covers shall be fitted on all boxes.

Generally, conduits shall not cross expansion joints of buildings. Where they cannot be installed in any other manner, a galvanised flexible conduit shall be used across the expansion joint. A total of 150mm movement shall be allowed.

The Contractor shall submit and obtain approval of the DETAIL DESIGN SPECIFICATION from the Employers Representative before beginning the detailed control system design. The contractor should take note of the importance of this obligation.

5.13 Process Instrumentation

1) General

Instrumentation system shall be designed, manufactured, installed, and tested to ensure the high standards of operational reliability. All electronic components shall be adequately rated, and circuits shall be designed so that change of component characteristics shall not affect plant operation.

All instrumentation equipment shall be new, of proven design, reputed make, and shall be suitable for continuous operation. Unless otherwise specified, all instruments shall be tropicalised. The outdoor Equipment shall be designed to withstand tropical rain. Wherever necessary space heaters, dust and waterproof cabinets shall be provided. Instruments offered shall be complete with all the necessary mounting accessories.

Electronic instruments shall utilise solid state electronic components, integrated circuits, microprocessors, etc., and shall be of proven design.

No custom-made hybrid type integrated circuits shall be used.

Unless otherwise stated, overall accuracy of all measurement systems shall be $\pm 1\%$ of measured value, and repeatability shall be $\pm 0.5\%$.

Unless otherwise specified, the normal working range of all indicating instruments shall be between 30% and 80% of the full-scale range.

On resumption of the supply following a power failure the instruments and associated equipment shall start working automatically.

The instruments shall be designed to permit maximum interchangeability of parts and ease of access during inspection and maintenance.

Unless otherwise stated, field mounted electrical and electronic instruments shall be weatherproof to IP-65.

The instruments shall be designed to work at the ambient conditions of temperature, humidity, and chlorine contamination that may prevail but, in any case,, not less stringent than those conditions detailed in the Project Requirements. Instruments shall be resistant to corrosion in the atmosphere in which they are expected to operate.

Lockable enclosures shall be provided for all the field mounted instruments.

All field instruments, and cabinets/panel mounted instruments shall have tag plates/name plates permanently attached to them. Details of proposed inscriptions shall be submitted to the Employer for approval before any labels are manufactured.

All coated parts of sensors shall be made out of non-corrosive material capable of working with chlorine content of 5 ppm.

For all instruments installed in the field, surge protection devices (SPDs) shall be provided at both ends of the connecting cable for protection against static discharges / lightning and electromagnetic interference.

Individual pair screened, overall screened, armoured cables shall be used for analogue signals and armoured, overall screened cable shall be used for digital signal cables.

2) **Flow Measuring Systems**

Flow measuring system shall consist of flow sensor / transducers, flow computer and flow transmitter. Flow transducers shall be rugged in construction and shall be suitable for continuous operation. Flow transducers shall have waterproof construction and shall be suitable for installation in underground/above ground pipelines.

To avoid the effects of disturbances in the velocity profile, a straight and uninterrupted run, upstream as well as downstream from the location of the flow sensor shall be provided in accordance with the requirements of the flowmeter manufacturer.

The flow transmitter shall be suitable for field or panel mounting and shall accept an input from the flow sensor. It shall process the input signal and provide 4-20mA DC output proportional to flow rate. The flow range shall be adjustable.

A zero span adjustment facility shall be provided for flow transmitter and indicator.

Flow measurement shall not be affected by physical properties of sewage viz., temperature, pressure, viscosity, density etc., within given limits. Contractor shall provide compensating electronic circuits if required. The overall accuracy of flow measuring systems shall be at least ± 1.0 % of the measured value unless otherwise stated.

a) **Electromagnetic Flow Meter (Full Bore):**

General

The Electromagnetic Flow Meters shall be installed as per process requirements in RCC chambers / open pits or buried for indication of flow rate and total flow of sewage in pipe work of sewerage system and STP.

The Electromagnetic Flow Meters shall withstand maximum working temperature and working pressure shall be as per process requirement.

Electromagnetic Flow Meter

Full bore electromagnetic flow meters shall be designed, manufactured, and calibrated to ISO standard. The flow meter shall be capable of measuring bi-directional flow.

General Specification

Electromagnetic Flow Meter shall be a velocity sensing electromagnetic type, microprocessor-based signal converter, Flow Integrator and Totalizer sealed housing, flanged tube meter as per working pressure requirement. The meter shall be manufactured to highest standard available for mag-meters.

The accuracy shall be inclusive of linearity, hysteresis, and repeatability, temperature, and pressure effects. The meter assembly shall operate within a range of 0.3 m/sec to 5 m/sec and pressure rating shall be as per process requirement to be constructed as follows

Meter tube shall have a constant nominal inside diameter offering no obstruction to the flow.

Signal Converter shall be pulsed DC coil excitation type with auto zeroing. The signal converter shall be remotely mounted away from the meter.

The converter shall indicate direction of flow and provide a flow rate indication and a total of flow volume for both forward and reverse directions. The converter shall provide an isolated 4-20mA output into minimum 600-ohm load and a frequency output of a maximum of 0-10kHz and a scaled pulse output.

The microprocessor-based signal converter shall have a self-diagnostic test mode and backlit display that continuously displays 'Rate of Flow' and 'Total Volume'.

The converter shall be compatible with Microsoft Windows and other software programs with built in terminal communication capabilities of RS 485, HART, or other protocols for interface.

The converter shall be remotely mounted maximum up to 200 m from the sensor and shall be supplied with all calibration complete for desired requirements.

The converter cum transmitter shall be fully programmable from the front facia. The programming shall be user friendly, self-prompting menu driven.

The length of the sensor shall be strictly as per ISO up to DN 600 mm and for other sizes it shall be as per the manufacturer's standard. Only, one manufacturer shall make all meter size and styles required for this contract.

b) Open Channel Flow meter

Open channel flow measuring systems shall consist of level transducer, flow computer and flow transmitter. The level of the fluid in the flume shall be measured by the ultrasonic level transducer. The level measured shall be used along with the physical characteristics of the flume to compute the flow rate.

The level transducer shall be suitable for flange or bracket mounting as required and shall be environmentally protected as per IP65. It shall have ambient temperature compensation and adjustable datum setting facilities.

The design and application of ultrasonic level meters shall consider the channel construction, the material size, shape, environment, process fluid or material, the presence of foam, granules, size etc.

The installation shall avoid any degradation of performance from spurious reflections, absorption, sound velocity variations, sensor detection area, temperature fluctuations, specific gravity changes and condensation. For application where spurious reflections are unavoidable the control unit shall be provided with facilities for spurious reflection rejection.

The structure required for supporting the level sensor, platform, railings etc. shall be in the Contractor's scope.

3) Level Measuring System

a) Ultrasonic Level Meters

Ultrasonic level measuring devices applied for level measurement shall comprise a transducer, control unit and remote indicator.

The transducer shall be suitable for flange or bracket mounting as required and shall be environmentally protected to IP65. It shall have ambient temperature compensation, adjustable datum setting facilities.

The accuracy of the sensor shall be $\pm 0.25\%$ or better.

It shall be programmable with an integral programming keyboard and provide a digital display of the measured variable. It shall be provided with diagnosis facilities and shall provide an isolated 4 to 20mA dc output signal proportional to the range of measurement.

The design and application of ultrasonic level meters shall consider the vessel or channel construction, the material, size, shape, environment, process fluid or material, the presence of foam, granules, size etc.

The installation shall avoid any degradation of performance from spurious reflections, absorption, sound velocity variations, sensor detection area, temperature fluctuations, specific gravity changes and condensation. For applications where spurious reflections are unavoidable the control unit shall be provided with facilities for spurious reflection rejection.

If turbulence exists, shielding, stilling tubes or other measures shall be provided to avoid effects on the measurement.

b) Conductivity Level Switches

The electrodes used for conductivity level switches shall be stainless steel. Single electrode systems (one electrode per holder) shall be used (except where their use is impractical) with insulated electrodes such that only the tip of each electrode is exposed to the liquid at the operating level.

Relay or control units operating with level electrodes shall have adjustable sensitivity. Electrodes for use in fluids of low or variable conductivity shall be fitted with conductivity discs.

Where relay or control units are not mounted in control panels, they shall be provided with surface mounting enclosures with a degree of protection to IP52 for indoor locations or IP65 for outdoor locations.

4) Pressure gauges and transmitters

Pressure gauges shall comply with BS EN 837-1 or equivalent and have concentric scales. For especially arduous duty where the gauge is subject to pressure pulsations and/or vibration, it shall be provided with a glycerine-filled dial and line snubbers shall be used. Bourdon-tube type differential-pressure gauges shall be capable of withstanding full line pressure on any side with the other side vented to atmosphere without damage to or effect on the calibration. No plastic material shall be used in their construction. Internal parts shall be of stainless steel, bronze, or approved corrosion-resistant material.

The minimum diameter for round pressure gauges shall be 100mm unless specified otherwise or where the gauge forms part of a standard item of equipment.

Unless specified elsewhere the accuracy for pressure gauges shall be 1% of range, for diaphragm gauges

1% of range and for differential gauges 1.5% of range or better.

Where compensation of more than 2% of the instrument span is needed for the difference in level between the instrument and the tapping point, the reading shall be suitably adjusted, and the amount of compensation shall be marked on the dial.

The zero and span of a pressure transmitter shall not change by more than 0.1% of the span per Celsius degree change in ambient temperature. After application for 10 minutes of pressure at 130% of maximum pressure, the change in zero and span shall not exceed 0.1% of the span.

Pressure transmitters shall have an accuracy typically better than 0.1% of span, depending on the application and shall be protected to BS EN 60529: IP65 standard or higher standard. For transmitters installed in meter chambers liable to flooding or underwater applications, they shall be to BS EN 60529: IP68 standard and shall operate up to maximum submergence of 20 metres of water.

Pressure transmitters shall provide a digital or 4mA to 20mA dc output proportional to the pressure range. Pressure gauges and transmitters shall have primary isolating valves, 2 or 3 way valve manifold and vents, in such a way that

it has the facility to calibrate the gauges or transmitters without removal.

5) **Strain-gauge pressure transducers and transmitters**

Strain-gauge pressure transducers shall use thin film sensors without bonding. Each instrument housing shall be of all-welded Grade X 4 CrNiMo 17 12 2 stainless steel or equivalent and hermetically sealed. Non-interacting, zero and span adjustments shall be provided on each transducer. The measuring diaphragm shall be isolated from the process fluid by a non-corrodible barrier diaphragm. The mean time between failure for any model of strain-gauge transducer shall be not less than 15 years, and the performance of the measurement system shall be as given below, or higher performance:

Accuracy: $\pm 0.1\%$ of calibrated span, including linearity hysteresis and repeatability;

Repeatability: $\pm 0.05\%$ at maximum span;

Stability: $\pm 0.1\%$ of upper range limit over 6-month period;

Over-pressure: sustain a 400% over-pressure without damage;

RFI / EMI effect: less than 1% of span with 500MHz at 5W direct contact;

Power-supply variation effect: 0.01% per volt variation.

Load variation effect: $\pm 0.0002\%$ per ohm of loop-resistance variation.

Temperature: -29°C to $+82^{\circ}\text{C}$ range; total thermal error of $\pm 0.75\%$ of span over 0°C to 50°C ;

Protection: IP65

Strain-gauge transducers which do not have terminals for their cable connection, shall have integral sealed-cable assemblies, installed in conduit, and terminated at weatherproof junction boxes, protected to IP65 each mounted near to its associated process transmitter. A digital or 4mA to 20mA dc output signal proportional to the transducer range shall be provided.

Strain-gauge pressure transmitters shall be generally as the transducer except that it shall incorporate a waterproof pressure transmitter producing a digital or 4mA to 20mA output signal.

Provision for transducer venting shall be provided.

6) **Temperature Monitoring System**

Microprocessor Based Multi-Channel Temperature Scanner and Indicators.

Panel mounted microprocessor based multi-channel temperature scanner shall be provided to continuously monitor temperature at different positions in each pump-set. The scanner shall have provision of accepting RTD/ thermocouple inputs. Facility shall be provided for grouping of channels for generating alarm/trip signals. Each scanner shall generate two nos. of potential free contacts for each group. The scanner shall have facility for interfacing with Programmable Logic Controller (PLC).

Technical Particulars:

General:		
Service	:	As per Process requirement
Installation hardware and accessories	:	Required
Type	:	Microprocessor based
Mounting	:	Front facia of Instrument Control
Panel (ICP):		
No. of channels	:	16/24- channels, As required with 20 %

		Spare
Quantity	:	As per Process Requirement.
Input	:	From Temperature measuring sensors
Display	:	Separate LCD/LED displays for channel no. and corresponding temperature
Auxiliary Outputs (Relay's)	:	Two Nos. For each channel
Digit height	:	12.5 mm or higher
No. of digits	:	2 nos. for channel no. 4 nos. (minimum) for process value display
Zero & Span adjustment	:	Required
Engineering units for display	:	Deg. Celsius
Accuracy	:	± 0.2 % of span or better
Weather protection class	:	IP-52 of IS 13947
Relay outputs	:	Required 2NO+2NC for each group
Communication port	:	RS-485 (With Modbus protocol) for interfacing with PLC

5.14 Lift Irrigation Scheme Automation:

1) GENERAL

This section provides instrumentation, control, and automation philosophy for the identified irrigation schemes. To ensure an efficient control & monitoring of irrigation schemes, it is proposed to install PLC based RTU Panel with Human Machine Interface (HMI) with required instrumentation system at water intake with pumping stations, associated rising mains, field level distribution tanks and drip systems. In addition, it is also proposed to install a remote Centralized Monitoring System/ SCADA to have real-time visibility into the operating status of pumps/ motors, valves, flow rate and other parameters of the irrigation systems. The Centralized Monitoring System shall be installed at the central location as identified by Employer/ DoH.

Proposed Centralised Monitoring System/ SCADA will have following advantages.

- Identify water loss between pumping station outlet and Main Distribution Tank (MDT)/ Modular Tank (MT)
- Record each pumping station outlet flow
- Record each MDT/MT inlet/ outlet flow
- Record Level of each Sump/ MDT/ MT
- Record Pressure (Head) of each pumping station outlet and MDT/ MT Inlet
- Record Pump Run Hour
- Record Energy Parameter
- Report Generation of above parameters

2) PROPOSED PHILOSOPHY OF OPERATIONS

a) Water Supply Pumping Station and Distribution Network:

Sump/ Well/ Storage Tank/ Collection Tank AT PUMP HOUSE HAVING LEVEL TRASMITTER.

On **Low** Level of Level Transmitter Reading, Water Supply Pumping Station's Pump Will **Stop** Automatically.

On **High** Level of Level Transmitter Reading, Water Supply Pumping Station's Pump Will **Start** Automatically.

MDT & MT HAVING LEVEL TRANSMITTER.

On **High** Level of Level Transmitter Reading, Water Supply Pumping Station's Pump Will **Stop** Automatically.

On **Low** Level of Level Transmitter Reading, Water Supply Pumping Station's Pump Will **Start** Automatically.

Following **Pump** Feedback displayed on HMI at Pumping station/ Remote Centralized Monitoring System

- Pump Local/ Remote Selected
- Pump Trip
- Pump On
- Pump OFF
- Pump Total **Run Hour**
- Pump Totalized Flow
- Pump Delivery Line Pressure

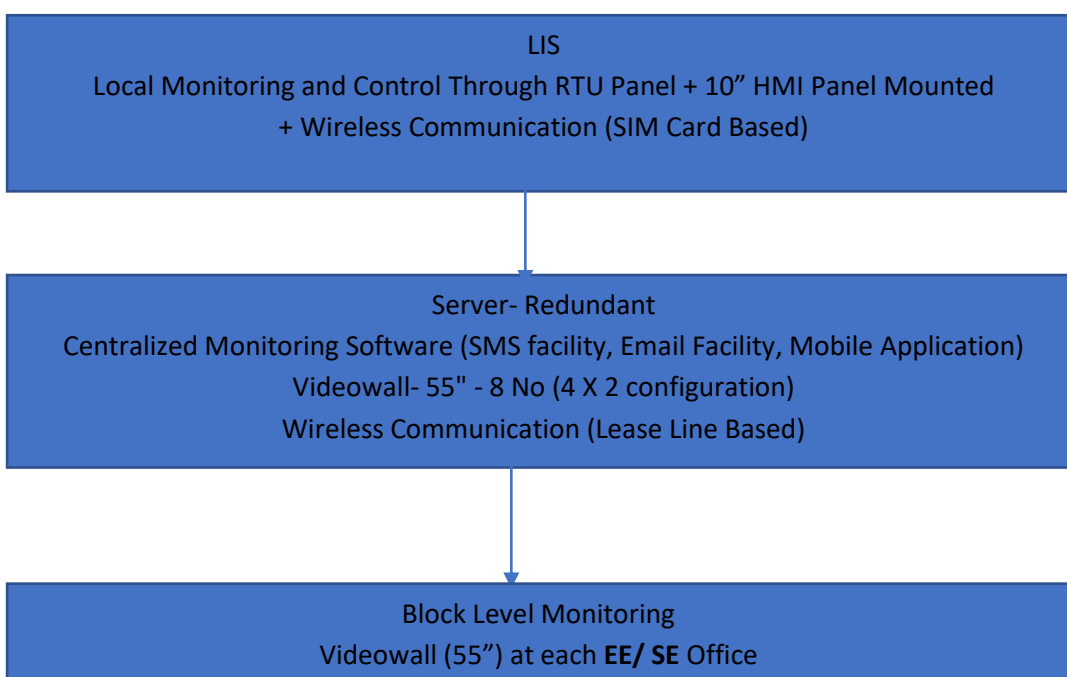
Following **Valve (Actuator)** Feedback displayed on HMI at Pumping station/ Remote Centralized Monitoring System

- Actuator Local/ Remote Selected
- Actuator Open Torque Switch
- Actuator Close Torque Switch
- Actuator Open Limit Switch
- Actuator Close Limit Switch

Following **Instruments** Feedback displayed on HMI at Pumping station/ Remote Centralized Monitoring System

- Totalized Flow at each Pumping Station outlet/ MDT inlet/MT inlet
- Level of Water at each Pumping Station Sump/ MDT/ MT
- Pressure Head at each Pumping Station outlet/ MDT inlet/MT inlet

b) Data Communication:



Facilities:

1. Report Generation
2. SMS Generation and send to assign officer for Daily water Consumption
3. Email Generation and send to assign officer for Monthly Report
4. 392 (28 EE/ SE Office X 14 Engineer) Nos Concurrent connection can view the LIS on Mobile/ Website with assigned username and Password
5. Unlimited users can be added
6. Software is scalable and can add future LIS scheme (Minimum 1 Lacs Tags and Enterprise Application)

3) BASIC REQUIREMENTS OF AUTOMATION EQUIPMENTS:

Sr. No.	Description	Particulars
1	General	
1.1	Item	PLC System
1.2	Service	Plant Automation
1.3	Area Classification	Non-Hazardous
2	PLC System	
2.1	Type of Control system	Programmable Logic Controller (PLC)
2.2	Offered PLC System configuration and PLC system hardware	Latest system available / being supplied in the international market by the manufacturer with proven performance record for the similar type of application
2.3	Operating System windows based	Windows –XP/7 or latest.
2.4	Hierarchical protection for operator & engineer functions	Multi-level security required
2.5	UPS Input-415V/230V AC, 3/1Ø, 50 Hz Output- 230 V AC, 1Ø, 50 Hz	UPS of adequate capacity with battery back-up of min. 1hour (SMF Nickel-Cadmium batteries).
2.6	No of UPS feeders (outgoing)	Bidder to indicate
2.7	UPS sizing	Bidder to indicate. Adequate capacity UPS considering 30 % spare load.
2.8	UPS Battery back-up time	Min. One (1) hour
2.9	Response time (Maximum) for	
2.10	Analog input	250 m sec

Sr. No.	Description	Particulars
2.11	RTD	1 sec
2.12	Digital Input / output	25 - 50 m sec
2.13	Loop cycle time inclusive of controller processing time	250 m sec (Analogue) ; 100 m sec (Digital)
2.14	Auto switchover time to backup/redundant component at a) Processor level b) Communication level c) Power supply level	Not Applicable
2.15	Card changeover, card wiring removal or communication cable change shall be possible on-line (PLC running) without causing any process interruption	PLC Card removal shall be hot swappable.
2.16	Display Call up time in HMI monitor	1 sec or better
2.17	Dynamic update time of parameters in the HMI monitor for measurement and control	1 sec. or better
2.18	Spare capacity required in the control processor considering spare I/O channels and future I/O modules to be located in the spare I/o slots	Minimum 20 %
2.19	Output status on controller failure	LED indication required
2.20	Output status on power supply failure	Not Applicable
2.21	Status indication for each channel in DI / DO card	LED indication required
2.22	Power supply healthiness status in all modules	LED indication required
2.23	Optical Isolation with IPR for DI / DO	Required
2.24	Galvanic isolation for AI / AO	Required
2.25	Fuse Protection for AI / DI modules	Required
2.26	Fused terminals with LED indications for each DO and also for Power supply to PLC	Required
2.27	All I/O module status monitoring (Channel & Module level) in PLC system HMI & shall be from same processor family.	Required
2.28	Self-diagnostics for all PLC modules	Required

Sr. No.	Description	Particulars
2.29	Control processor with floating point arithmetic capability	16/ 32-bit processor
2.30	Capacity of RAM	Minimum 512 KB
2.31	Spare capacity in RAM	Minimum 50 % including spare I/Os
2.32	Processor Redundancy	Not Required.
2.33	Power supply source redundancy with Auto changeover scheme.	Not Required.
2.34	Power supply module redundancy in the PLC panel	Required (SMPS along with O-ring Module)
2.35	Communication module redundancy	Not Required
2.36	Failure of communication module/ data bus/ communication bus/Power supply module shall not lead to change over of Processor/CPU	Not Required
2.37	Network & Network module redundancy	Required (at Server Level)
2.38	Hot redundant connectivity between processor to I/O rack	Not Required
2.39	Primary and secondary indication on controllers	Not Required
2.40	Memory expandability	150% of offered capacity
2.41	RAM with Battery back up	Minimum 72 hr without power.
2.42	Supply of Flash RAM for memory /Program retention	Required
2.43	Closed loop control	Not Applicable
2.44	Open loop control (Logic, protection & interlock)	Non-redundant I/O modules Required
2.45	Maximum number of channels in I/O modules - Analog I/O modules RTD, Thermocouple Digital I/O modules	8 Channels (Differential type) 16 Channels 16 Channels
2.46	Input – Output Philosophy	
2.47	Motor	Digital Input: Local / Remote Selector-1 No Run Feedback- 1 No Stop Feedback- 1 No Overload Feedback- 1 No

Sr. No.	Description	Particulars
		Digital Output: Start Command- 1 No Stop Command-1 No Analog Input: Speed Feedback (Applicable for VFD driven Pump)-1 No Vibration Sensor Feedback (Applicable for MV Motor)- 6 Nos Analog Output: Speed Reference (Applicable for VFD driven Pump)-1 No RTD Input: Windings & DE/NDE Bearings Temperature (Applicable for motor having winding and bearing RTDs)- 8 Nos
2.48	Pump / Blower	Analog Input: Pressure Transmitter- 1 No (wherever continuous Pressure monitoring is required) Flow Transmitter- 1 No (wherever continuous Flow monitoring is required)
2.49	Motorized Valve	Digital Input: Local / Remote Selector-1 No Open Feedback- 1 No Close Feedback- 1 No Open Torque Switch Feedback- 1 No Close Torque Switch Feedback- 1 No Digital Output: Open Command- 1 No Close Command-1 No Stop Command-1 No Analog Input: Position Feedback (Applicable for Modulated Control Valve)-1 No Analog Output: position Reference (Applicable for Modulated Control Valve)-1 No
2.50	Breaker	Digital Input: Local / Remote Selector -1 No ON Feedback- 1 No OFF Feedback- 1 No Master Trip Relay Operated- 1 No Digital Output: ON Command- 1 No OFF Command-1 No

Sr. No.	Description	Particulars
2.51	Transformer	Digital Input: Oil Level Low Alarm-1 No Oil Temperature High-1 No Oil Temperature Very High-1 No Winding Temperature High- 1 No Winding Temperature Very high-1 No Buchholz Alarm-1 No Buchholz Trip-1 No Pressure Relief Device Trip -1 No OLTC Fault-1 No
2.52	Sump / Tank	Digital Input: Level Very High-1 No Level High -1 No Level Low-1 No Level Very Low-1 No Analog Input: Level Transmitter- 1 No (wherever continuous Level monitoring is required)
2.53	Power supply to the field transmitters	Analog input module shall drive the connected field transmitter on 2 wire loops
2.54	Interrogation voltage for Digital signals	24 V DC
2.55	Concept of I/O grouping	a) No two identical / similar equipment shall be grouped in the same I/O module b) I/Os related to equipment and I/Os related to its associated auxiliaries shall be connected to different modules. c) Inputs and outputs shall not be combined in a single module.
2.56	USB ports on Operator station	4 nos.
2.57	DVD R/W drives on Operator Station	One (1)
2.58	Displays on HMI monitor (Panel Mounted 10" HMI)	Process mimic displays, trend displays, system status, alarm displays, logs / reports etc. HMI software shall have minimum 100 pages with unlimited tags.
2.59	Minimum no of plant mimics configurable	100
2.60	Time activated logs	Periodic logs, shift report, daily

Sr. No.	Description	Particulars
		report, status change log, Control system fault log
2.61	Operator Workstation (OWS) At Centralized Monitoring Station (Server and Block Level)	One no. Industrial grade OWS shall be considered. - Intel I5/ I7, Minimum 3.6 GHz processor or latest - 22" LED Monitor - 8 GB RAM min or better - 1 TB HDD - ASCII keyboard - DVD R/W Drive - Workstation model - Original OS & antivirus
2.62	Engineering Workstation cum OWS At Centralized Monitoring Station (Server Level)	One no. industrial grade EWS cum OWS shall be considered. - Intel I5 / I7, Minimum 3.6 GHz processor or latest - 22" LED Monitor - 8 GB RAM min or better - 1TB HDD - DVD R/W Drive - QWERTY Keyboard - Workstation model - Original OS & antivirus
2.63	Annunciation System	Integral to the PLC
2.64	Printers At Centralized Monitoring Station (Server Level)	One A3/A4 size colour laser jet printer (600 DPI resolution) shall be provided
2.65	Hot Spare I/O modules	20 % (wired up & mounted) hot spare modules for each type of I/O module shall be provided in the panel
2.66	Spare Channels in each I/O Module used	20 % (wired up) spare channels over the entire population of each type of module.
2.67	Spare slots in the I/O rack (wired with connector)	20% additional slots/base in each rack shall be provided which shall be wired with connectors for future provision. This is in addition to the required 20 % (wired & mounted) hot spare modules.
2.68	Fuse with led indication for I/O channels	- Individual for analogue signals - Group of max 8 for digital

Sr. No.	Description	Particulars
		channels
2.69	PLC hardware	G2 rated
2.70	SER	Not Applicable
2.71	Interposing Relays	24 V DC with freewheeling diode across the coil – Relay contact rating A at 230 V AC
2.72	Panels / Cabinets	Self-Standing/ Wall Mounted type with maximum height of 2200mm
2.73	Mechanical features	a) 2 mm thick CRCA steel sheet for panel walls. 3mm thick removable gland plate b) 2.5 mm thickness for double doors c) Panel - door switch d) Fans and louvers e) Paint as per RAL 7035 f) Automated panel Illumination by push buttons g) Suitable enclosure protection h) Anti-vibration pad of minimum 15mm thickness.
2.74	Panel Earthing	Safety earth for enclosure and Electronic earth for PLC system.
2.75	Control room at Server Level and Block Level	Air Conditioned.
2.76	Quality Assurance	As per quality plan to be approved by the Purchaser / Engineer
2.77	Inspection Requirements	Factory Acceptance Test & Site Acceptance Test as per procedure approved by the Purchaser / Engineer.
2.78	Communication	The communication shall be Non redundant between the control processors and Panel Mounted HMI as well as across processors and transmission rate shall be minimum 100 MBPS / 1GBPS through multi- port switch having FO ports, ensuring adequate number of spare ports. Also communication between

Sr. No.	Description	Particulars
		control processors and I/O shall be Non redundant. PLC shall be provided with required number of Modbus ports. PLC shall have time synchronisation facility with master clock directly connected to PLC cards.
2.79	Undertaking for Spares & support	OEM's undertaking shall be furnished for Spares & service support for minimum 10 years.
2.80	Make of PLC	Reputed.
	Control Cabinets/ Consoles: at Server Level and Block Level	
2.81	Type & Constructional Features	- Indoor, Self-Standing type with maximum height of 2200 mm - Sheet Steel Thickness - 2.0 mm thick CRCA sheet for panel walls. 3mm thick removable gland plate. - Pant Finish as per RAL- 7032. - Enclosure Protection – IP54 - Anti-vibration pad of minimum 15 mm thickness.
2.82	Accessories	- Panel - door switch - Fans and louvers - Panel Illumination Lamps
2.83	Consoles & Chairs	Consoles for OWS, EOWS & Printers. Two (2) nos. operator chairs (revolving type)
2.84	Software:	
	PLC Development License Software	Required
	Centralised Monitoring System/ SCADA Development License Software	Required
	Centralised Monitoring System/ SCADA Run Time License Software	Required
	Workstation Operating System License Software	Required
2.85	Air Conditioner:	

Sr. No.	Description	Particulars
	Air Conditioner minimum 2 Ton, 5 Star Rating with Copper Tubing, Fittings & Accessories.	Required (Minimum 2 Nos)

5.15 Technical Specification for Centralized Monitoring Station (CMS) Equipment

a) LED Dashboard/ Video wall

Sr. No.	Parameter	Minimum Required Specifications
1	Configuration	Full HD IPS LED/DLP Display, Direct LED Backlight, Display suitable for use in video wall with bezel to bezel distance not more than 3 mm
2	Matrix	4x2 (8 panels)
3	Screen Size	55" or higher
4	Resolution	Full High definition (1920 X 1080) 16:9 Widescreen
5	Contrast Ratio	1200:1 or better
6	Brightness	500 Cd/m2 or better
7	Refresh rate	60 Hz or better
8	Response Time	8 to 12ms
9	Viewing Angle	160 degrees or better
Interface		
1	Standard Inputs	1x Digital DVI-I; 1x Digital DVI-D/HDMI Port or Higher
2	Standard Outputs	1x Digital DVI-D / 1x DP 1.2
3	Control	RS-232/RS-422/IR
Power		
1	Consumption	Not more than 300 Watt per display unit
2	Power Supply	AC 100 -240 V~ (+/-10 %), 50/60 Hz
General		
1	Operating Temperature	0°C - 40°C
2	Certification	UL, CE, FCC, BIS certified at the time of bidding
Accessories		
1	Cables	Dual Link DVI-D /DP cable, power cable for daisy chain, AC cable, Remote Control
2	Display Controller	Video Distributor/ Display controller to control Video wall in a matrix as per requirement with necessary software: Processor specs: Quad core 64-bit, 3.4 GHz CPU or latest RAM: 8 GB DDR3/4 minimum HDD: Min 500 GB Hard Disk (Hard disk Capacity should be upgradable) Network support: Gigabit Ethernet Controller inbuilt, Support for Add on Network adapters. Display: Display multiple source windows in any size,

		anywhere on the wall Accessories: DVD-R, DVD+RW, Keyboard, mouse OS Support: 64-bit Operating Systems Windows / Linux or equivalent industry standard
Video Wall Management Software License		
1	Display & Scaling	Display multiple sources anywhere on display up to any size
2	Input Management	All input sources can be displayed on the video wall in freely resizable and movable windows
3	Scenarios Management	Save and Load desktop layouts from Local or remote machines
4	Layout Management	Support all Layout from Input Sources, Internet Explorer, Desktop and Remote Desktop Application
5	Multi View Option	Multiple view of portions or regions of Desktop Multiple Application Can view from single desktop
6	Other features	• SMTP support, Remote Control over LAN, Alarm management • Remote management, Multiple concurrent client, KVM support
7	Display Management	• Display Health Monitoring • Pop-Up Alert Service • Graphical User Interface

b) Operator Workstation (OWS) / Engineering Cum Operator Workstation (EOWS) System:

OWS/ EOWS System (Computer System)

- OWS/ EOWS shall be provided at central monitoring room.
- OWS/ EOWS shall be designed for 24x 7 operations. It shall be fully modular and easily expandable/ scalable as per the feature requirement.
- OWS/ EOWS shall be suitable for Open interfaces (Ethernet, Serial, and OPC) for Connectivity and Networking.
- OWS/ EOWS shall be of reputed make and supply after prior approval of Client.
- Quantity: 13 Nos- 6 Nos for Centralized monitoring System, 1 No GWIL and 6 Nos for Zone Office
- Technical Particulars- OWS/ EOWS

Description	Particulars
CPU	
System type	64-bit Operating system, x64 based processor, Windows based operating system
Processor	Xeon Processor
Chipset	Intel
Installed Memory (RAM)	16 GB Minimum
Drive controllers	Integrated SATA Controller
Storage/ Hard Disk	2 TB
Graphics Card	On board HD Graphics

Ports	Minimum 4 USB Ports
Power Supply	230 VAC, 24/7 Running Power Supply
Display Port	DVI and DP Port
Monitor	
Type	LED Backlit LCD
Viewable Image area	21.5" minimum or higher
Power	230 VAC, 24/7 Running Power Supply
Keyboard, Mouse & Accessories	
Keyboard	Wired, Required
Mouse	Optical Wired, Required
Interconnecting Cables	Required
Audio Speaker	Required
License Software	
MS Windows/ Equivalent	Win 10 Pro or Latest available/ Equivalent
MS Office/ Equivalent	Microsoft office Home & Business 2019 or Latest available/ Equivalent
Antivirus Software	Required

Contractor has to provide required license software in addition to above for safe, reliable & efficient operation of Workstation/ Operating System proposed by him.

c) Printer:

Printer shall be provided at the central control room.

Technical Particulars (Printer)

Description	Particulars
Type	Laser, Colour, LAN Printer
Print Pages	A3, A4
Black Print Speed	17 Page Per Minute (PPM)
Colour Print Speed	4 PPM
Print Resolution	600 x 600 dpi
Processor	264 MHz
Memory	128 MB
Keypad and Digital Display	Required

LAN Printing/ Time based printing	Required
Power Supply	230 VAC

d) Uninterruptible Power Supply (UPS) for Centralized Monitoring System

UPS quantities shall be considered as per price schedule.

A UPS with 480 minutes backup time shall be provided for the power supply of Instrumentation, Control & Automation system.

The UPS shall have sealed maintenance free batteries and AC distribution board.

The batteries shall be sized such that the maximum recharge time does not exceed 8 hours.

Contractor shall furnish UPS sizing calculations for review and approval.

e) Operator Console:

Operator console with revolving chairs shall be provided for each regional monitoring station and central monitoring station inside the control room.

Technical Particulars (Operator Console)

Description	Particulars
Type	Indoor, Self-Standing type
Height	maximum height of 2200 mm
MOC	CRCA
Thickness of Panel Wall	Minimum 1.5 mm
Thickness of Gland Plate	Minimum 2 mm
Colour	Paint Finish as per RAL- 7032 (follow 7 tank Process)
Enclosure Protection	IP 54
Anti-vibration Pad	Required, minimum 15 mm thickness
Panel Door Switch	Required
Fans & Louvers	Required
Panel Light	Required
Cable Entry	Back Side Bottom
Drawings / Documents	SLD, GA, Power & Control Wiring Diagram & Foundation Details, Routine Test Certificate, FAT/SAT Procedure
Chairs	Two (2) nos. operator chairs (revolving type)

f) Software: Minimum Technical Requirements are as per below.

- Software shall have validity for entire project duration.
- Software shall have capacity to handle data of present as well as future LIS Scheme.
- Tenderer will not pay any additional payment for the software during the entire contract tenure.
- Software should have facility to integrate with 1,000 LIS Scheme.
- Software platform will be use by tenderer for entire O&M Periods and shall allow discovery of all the endpoints of tenderer as and when procured and installed.
- No extra cost shall be paid by tenderer to bidder for software upgradation/updation, patches, bug fixation etc. work during entire contract duration(O&M).
- Software is scalable to cater feature requirement of Tenderer.

- Software shall have facility to demonstrate MAP of State Pipeline Network.
- MAP Shall have zoom in -zoom out facility and able to locate all LIS Scheme/ pumping station.
- Bidder is responsible for procuring google MAP API.
- The location of all LIS Scheme through GPS latitude/longitude will be recorded at the time of installation of Instruments/ RTU Panels and uploaded into the database as a static data point which will be shown on the MAP obtained from Google MAP.
- Note: On MAP Instruments/ RTU Panels related data shall be displayed based on selection.
- Software shall be capable to handle Web Clients- Up to 500 Remote client's concurrent connection and unlimited web client's capability for reports and history viewing at a given point of time.
- Software shall be capable to generate various type of reports.
- Software can be able to generate Flow Meter reading Report- Average Flow, maximum Flow, Minimum Flow
- Flow Meter Reading report in Tabular Form (In this case tenderer can select Individual meter, District wise Meters, Pipe Network Wise Meters, Zone Wise Meters, or all Meters)
- Flow Meter Reading Report on MAP (in this case tenderer can select Individual meter, District wise Meters, Pipe Network Wise Meters, Zone Wise Meters, or all Meters)
- Differential Report between two pumping station (in this case tenderer can select Two Pumping Station or Two Flow meter and software can generate differential reading between two Location)
- Water Audit Report (Sample Example narrated below)
- A= Discharge Flow of Pumping Station A
- B= Received Flow of Pumping Station B
- C= Water Quantity consumed by all on tapping connection between the PS
- D= Non-Revenue Water/ Water Loss= A – (B + C)
- Software can be able to generate Alarm report. - In this report tenderer can select/ sort "Communication Error" Alarm, "Power Failure" Alarm, and "Battery low" Alarm and will get list of RTU with specific alarm.
- Software can be able to generate Trends/ graphs (time vs Flow reading)
- Email and SMS facility is part of centralized monitoring system.
- Software shall be compatible for mobile based application and web-based application.
- Mobile based application is part of software.

Centralised Monitoring Display	Display on Web Site	Display on Mobile Application
Home Page Screen:	Yes	Yes
Password Screen: Consumer shall receive Username and Password	Yes	Yes
Display real time process parameters	Yes	Yes
Alarm/ Faults	Yes	Yes
Representation of LIS- Network & Water Assets on Google Map	Yes	No
GPS Location of LIS - RTU	Yes	No

-
- The solution must be available on an Industry Standard Cloud platform, extendable for further future enhancements, including Hardware and Storage.
 - Software Patches and Upgrades (new versions) are a responsibility of the bidder and should be included in the services to be provided.
 - The platform shall support future scalability for incremental apps and quantity of end customers.
 - The platform must provide robust capabilities for daily backup (or when needed).
 - The platform must provide robust capabilities for restoration in the event of failures.
 - For Extensibility purposes, the solution must provide a platform for developing high-performing applications and/or solutions running on the platform
- g) Basic Technical Requirements Centralized Monitoring Software (Cloud Monitoring Software) are as per below.
- A cloud server hosted solution with an inbuilt Algorithms powered by data analytics. The solution will be hosted in Physical/ Cloud server.
 - Bidder to arrange/responsible for their own server for Centralized Monitoring system.
 - Multiple user logins, up to 500 nos. These user logins must be scalable in future with no extra cost for project duration. The dashboard of Software must be accessible through these logins with security layer compliant to ISO/IEC 27001.
 - Solution must have the facility to integrate legacy/historical data from utility systems/SCADA or flat files (CSV, XML). The solution must have a capability to support future scalability of incremental application and quantity of field devices.
 - The Geographical visualization of the main dashboard for software must be compatible with Google maps/Google Earth or GIS maps.
 - The Geographical visualization must display following information at minimum:
 -
 - Map Zoom in & Zoom out facility
 - GPS coordinates of each field asset
 - Provision for Filter view. The filter view must categorize LIS Scheme according to Size or zone/district or working/nonworking status.
 - Capability to display asset profile during scrolling over the map.
 - Colour codes of different zones/districts based on water consumption. At minimum 3 colour codes must be available for high/medium/low consumption.
 - Two colour codes must be available for RTU/ LIS Scheme to view functional and non-functional RTU/ LIS Scheme in single view.
 - Software-must have facility to create multi-layer user access levels. At the highest access level user must have facility to create or delete water district regions. The user at district/zone level must have the facility to extract following data from the system in CSV/XML format: -
 - LIS Water Balance Chart
 - Region Overview
 - Key Performance Index (KPIs) Graph Data
 - Flow meter readings with time & date stamp
 - Device Alarms with time & date stamp

- The software must have the in-built capability to gather consumption data of flowmeter to report and perform
 - Customer Segmentation
 - Total Volume
 - Comparison of Volume and Revenue Recovery
 - Flow Pattern Analysis and report abnormalities
- Reports (Following reports must be submitted through web software on monthly basis): -
 - Weekly Water Balance Chart of the Scheme
 - Forecasted Water Demand Chart
 - Status Report of RTU/ Process Instruments/ flowmeters (Working & Non-Working)
 - Monthly Device Breakdown with location, reason, and duration.
 - Critical Event/Alarms List in last 30 days with details.
- The Web software must integrate the data of utility Billing server or any other data server, depending on the project management requirement.
- If any meter will not work than Ticket will be generated and after corrective action Ticket will be closed to measure maintenance activity time. The software must assist in Work order management for flow meter installations and replacement where it must record and report the following: -
 - Monitor meter & device installations
 - Create work order and have facility to allocate Work order to other users
 - Work order efficiency
 - Facility for field worker to report status of work order
- For hosting of centralised monitoring system, Bidder will provide required hosting infrastructure at Server Room. Bidder is responsible for providing all the system software like database, OS required for successful functioning of the proposed systems. The System shall work on centralized architecture, in which application and database, both shall be hosted in Server. Bidder is also responsible for internet connectivity, Sim Card Purchase etc. Bidder has to make arrangement of active-active clustered on cloud.
- Bidder has to provide proposed bill of material in the following format in the technical bid. As part of technical bid, the detail BoM requires to be proposed as below:

h) Bill of Material for Hardware

Sr. No.	*Description	vCPU	RAM	HDD Space	Quantity	Remarks, if any

*Description: required Database (DB) servers, app servers, reporting servers or any other server (for production, testing development etc), equipment required for running the application at Server Room; 1 physical core = 2 vCPU

i) Bill of Material for Software

Sr. No.	*Product Description	Unit of Measurement	Licenses quantity for DC	Remarks, if any

*Description: Required all the readymade software including OS and Database, App, Web, BI etc. for Server.

The Bidder shall also be responsible to get application security audited by CERT-In Empanelled application security Auditors at the cost of the Bidder and submit the Security Audit Clearance Certificate issued by CERT-In Empanelled Security Auditors.

Application Development Technology

- Database: **Open source (Enterprise edition) with Enterprise Support**
- Operating System: **Windows/RHEL with enterprise support**
- Central Computing Infrastructure: **Server**

j) **Call Centre Solution:**

Call centre solution is part of centralized monitoring system.

Each LIS Scheme should be assigned with dedicated engineer in charge.

On the receipt of fault message from LIS Scheme at centralized monitoring system, SMS and voice call will send on engineer in charge's mobile number.

Bidder to provide Hands free/ IP Phone to each workstation/ System Operator/ Control room operator.

Interactive Voice Response (IVR) facility shall also be part of Call Centre Solution. IVR is an automated telephony system that interacts with callers and takes necessary inputs from them and accordingly provides options or routes their calls to the recipients.

Bidder to arrange/responsible for any other specific requirement.

Call Centre solution should have facility for only outgoing call.

k) **Air conditioning System:**

A.C. shall be provided at central monitoring room and each monitoring room at Block office.

Type	Split AC with inverter compressor
variable speed compressor which adjusts power depending on heat load	Required
Energy efficient	Required
lowest-noise operation	Required
Capacity	1.5 Ton
Energy Rating	3/ 5 Star
Copper with ocean black protection	Required (Anticorrosive Protection)

(Note- CMS being common for all the Lift Irrigation Schemes and Drip system, it is proposed that this to be implemented under separate package.)

-----End of Document-----

SECTION 6

ANNEXURE 6

INSPECTION, TESTING AND COMMISSIONING REQUIREMENTS

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INSPECTION, TESTING AND COMMISSIONING REQUIREMENTS FOR WATER

6.1 GENERAL

In order to manage pump facilities efficiently over long periods, it is important to have the inspection at manufacturer's premises or workshop of all equipment to conform the performance, dimension, weight, accessory and other auxiliary components for installation of them accurately at pump station as well as the efficiency of maintenance work.

The Contractor shall provide an Inspection and test manual prior to conduct the manufacture's inspection and /or test to obtain the Employers Representative's approval.

All equipment of the plant shall be liable for inspection and testing, at the manufacturer's premises or workshop before their dispatches, as required by the employer or his Employers Representative, who reserve the right to be present in all testing to see that they conform to the specifications. No materials and/or equipment shall be delivered to the site without inspection having been carried out or waived in writing by the Employer or his Employers Representative.

Inspection and testing witnessed by the Employers Representative (termed witnessed testing) shall be carried out at the manufacturer's works in accordance with the relevant clauses of the Conditions of Contract.

The Contractor shall be responsible for all expenses incurred by the Employers Representative or person/s nominated by the Employer in attending inspection and tests of Plant carried out during manufacture within India and abroad. Normally two or three persons from Employer side will witness the inspection and testing said above. No separate payment will be made against to the inspection & testing, and same shall be included in bidder's quoted price.

The factory inspection of all equipments shall be carried out during normal working hours (general Shift) only from 8.00 AM to 6.00 PM, no night inspection is allowed. Contractor shall make all necessary arrangement in this regard and inform the client in advance as per contract clause.

In all factory inspection the authorized contractor person should be available along Employer and third party. Authorized contractor person who is attending inspection shall be a qualified factory inspector based on the type of inspection.

All inspection and testing shall be carried out in accordance with the Specifications, approved drawings, details, QA Plans, relevant Indian Standard or international standard.

After award of contract, Contractor shall furnish Quality Assurance (QA) plan which will be mutually discussed with the Employer and finalized. QA plan shall include test, on incoming supply of raw materials and bought out items, stage inspections and tests on finished products at manufacturer's works / appropriate testing station. QA plan shall clearly indicate tests which are intended to be witnessed by the Contractor alone and those by both Contractor and Employer.

The Employer shall be entitled to attend the aforesaid inspection and/or tests by his own duly authorized and designated Employers Representative.

The Employer and his duly authorized Employers Representative shall have access to the manufacturer's premises at all suitable times to inspect and examine the material and workmanship of the mechanical and electrical plant and equipment during its manufacture there. If part of the plant and equipment is being manufactured on other premises, the Contractor shall obtain permission for the Employer or his duly authorized representative, to inspect as if the plant and equipment was manufactured on the Contractors own premises.

Testing (including testing for chemical analysis and physical properties of materials) shall be carried out by the Contractor and certificates submitted to the Employers Representative who will have the right to witness or inspect the above mentioned inspection /testing at any stage desired by him.

Where inspection or testing is to be carried out at a subcontractor's works, a representative of the Contractor shall be present.

The procedure for the testing and inspection to be carried out during or following the manufacture of the materials to ensure the quality and workmanship of the materials and to further ensure that they conform to the specifications of the Contract shall be as described below:

- (a) The Contractor shall give the Employer at least 21 clear days notice in writing of the date and the place at which any plant or equipment, with report/result on an advance self-imposed manufacture test, will be ready for inspection/testing as provided in the Contract. The Employer or his duly authorized representative shall thereupon at his discretion notify the Contractor of his intention either to release such Part of the plant and equipment upon receipt of works tests certificates or of his intention to inspect.
- (b) The employer shall then give notice in writing to the Contractor and attend at the place so named the said plant and equipment which will be ready for inspection and/or testing. As and when any plant shall have passed the tests referred to in this section, the Employers Representative shall issue to the Contractor a notification to that effect.
- (c) If the equipment is not ready, when the Employers Representative arrive at the manufacturer's or at his sub-supplier works, the Contractor shall have to bear the full costs of subsequent visits of the Employers Representative. For bought out items, the Manufacturers shall have to show to the Employers Representative the test and guarantee certificates of the original materials supplier and furnish photocopies of the same for Employer's records.
- (d) The Contractor shall forward to the Employer 6 duly certified copies of the test certificates and characteristics performance curves for all equipment.
- (e) If the Employers Representative(s) fails to attend the inspection and/or test, or if it is agreed between the parties that the Employers Representative(s) shall not do so, then the Contractor

may proceed with the inspection and/or test in the absence of the Employers Representative and provide the Employer with a certified report of the results thereof as per (c) above.

- (f) If any materials or any part of the works fails to pass any inspection / test, the Contractor shall either rectify or replace such materials or part of the works and shall repeat the inspection and/or test upon giving a notice as per (a) above. Any fault or shortcoming found during any inspection or test shall be rectified to the satisfaction of the Employer before proceeding with further inspection of that item, without any extra claim.
- (g) Where the plant and equipment is a composite unit of several individual pieces manufactured in different places, it shall be assembled and tested as one complete working unit, at the maker's works.
- (h) Neither the execution of an inspection test of materials or any part of the works, nor the attendance by the Employers Representative, or the issue of any test certificate pursuant to (c) above shall relieve the Contractor from his responsibilities under the Contract.
- (i) The test equipment, meters, instruments etc., used for testing shall be calibrated at recognized test laboratories at regular intervals and valid certificates shall be made available to the Engineers at the time of testing. The calibrating instrument used as standards shall be traceable to National/International standards. Calibration certificates or test instruments shall be produced from a recognised/Laboratory for the Employer's consent in advance of testing and if necessary instruments shall be recalibrated or substituted before the commencement of the test.
- (j) Items of plant or control systems not covered by standards shall be tested in accordance with the details and program agreed between the Employer and Contractor. If such materials or works are found to be defective or not conforming to the Contract requirements, due to the fault of the Contractor or his sub-contractors the Contractor shall defray all the expenses of such inspection and/or test and of satisfactory reconstruction.
- (k) Tests shall also be carried out such that due consideration is given to the Site conditions, under which the equipment is required to function. The test certificates shall give all details of such tests.
- (l) Prior to the inspection, the Contractor shall establish and submit a detailed procedure for the inspection of materials or any part of the works to the Employer for approval within the date indicated in the work Program. The detailed procedure shall indicate or specify, without limitation, the following :
 - I. Applicable code, standard, and regulations.
 - II. Fabrication sequence flow chart indicating tests and inspection points.

- III. Detailed tests and inspection method, indicating the measuring apparatus to be used, items to be measured, calculation formula, etc.
 - IV. Acceptance criteria.
 - V. Test report forms and required code certificates and data records.
 - VI. Method of sampling, if any sampling test to be conducted.
 - VII. Contractor's or Employer's witness points.
- (m) The Contractor shall not pack for shipment any part of the Plant until he has obtained written approval from the Employer or his authorized representative to the release of such part for shipment after any tests required by the Contract have been completed to the Employer's satisfaction.
- (n) For Inspection and Testing and its procedures, the contractor shall provide all relevant documents prior to test / inspection, and then it shall be carried out for all the equipment as applicable.
- (o) For all mechanical equipment, the following Inspections/tests of shall be carried out:
- I. Visual Inspection / Structural appearance.
 - II. Performance test / inspection (as fully assembled)
 - Performance test / inspection (Each component/equipment/unit partially assembled)
 - I. Material test /inspection
 - II. (Certificates for all the specified material shall be furnished)
 - III. Welding Qualifications
 - IV. Dimension inspection Painting inspection
 - V. Dynamic balance inspection for all rotating parts
 - VI. Hydrostatic / Leak testing for all pressure parts, and Pneumatic Leak Test wherever applicable
 - VII. Operation inspection
 - VIII. Liquid penetrate tests and/or magnetic particle tests for all machined surfaces of pressure parts.
 - IX. Ultrasonic test for forging materials viz.,
 - Plates of thickness 20mm and above for pressed / formed parts such as heads, etc.
 - Plates, flanges and bars of thickness / dia 40mm and above used for fabrication of pressure and load bearing members and rotating parts.
 - I. Radiographic testing for all but welded parts, as per applicable codes.
 - II. Hardness tests for all Hardened surfaces.
- (p) For obtaining the Employers Representative's approval, the contractor shall provide the table with every kind of evidences and standards prior to conduct the examinations / tests

- (q) The end of inspection and /or test, the Contractor shall provide and maintain the results , test records including Photo with proper identification of all materials used, along with reports for all internal / stage inspection work carried out, based on the specific job requirement and or based on the datasheets / drawings / specifications on the same day of the inspection /test.

The tests mentioned below, but not limited to, shall be carried out, by the contractor and shall be witnessed by a duly authorized representative of the Employer.

6.2 Inspection requirements for Submersible Pumps

The manufacturer shall carry out the following specific tests and inspections to ensure that the equipment furnished lie in strict conformance with the specification and in accordance with codes/ standards and good Engineering practice.

All pumps shall be assembled in the shop to ensure correct fitting of all parts and shall be inspected in assembled condition and shall be match marked before shipment. Static balancing of the Impeller and dynamic balancing of the impeller and pump rotating assembly shall be carried out as per ISO 1940/Gr. 6.3/ VDI 2060.

Pump casings shall be subject to hydrostatic pressure testing as an assembly at 150% of the pump shut-off head or 200% of the pump rated head, whichever is higher. The hydrostatic pressure shall be held for not less than 30 minutes after all leaks have been stopped between attachments.

Clear water pumps shall undergo witnessed performance tests as per IS 9137 / BS 5316 Part 2 Class B/ISO 3555 at the rated speed at the pump manufacturer's Works.

All pumps shall be tested for performance without internal coating and with electric motor being supplied under the Contract.

The pump test shall be carried out in accordance with IS 2800 (Part II): 1991, by installing a vertical turbine with variable speed or submersible pump set and pumping out water. The yield of tube well will depend upon geological formations, data of pumping rates from nearby tube wells and such other factors. The same pump may be used for varied discharge by throttling the valve. Pump has to be operated at three different discharges namely, at the normal expected discharge, 20 % higher discharge and 50 % higher discharge. Draw down in each case will be noted. At each rate of discharge, pumping will have to be done for at least 30 minutes. Sand particles after 20 minutes of pump start in each case should not exceed 20 ppm by volume. At no stage, the sand contents should exceed 50 ppm by volume.

6.2.1 Performance Tests for Submersible Pumps

Each pump shall have to be tested to determine its performance curves. These tests are to be conducted in presence of Employer's representative as per the requirements of Hydraulic Institute Standards, USA / BS: 599 or any other equivalent standard but the tolerances on head, discharge and power shall be as specified in Hydraulic Institute Standard, USA.

Performance tests are to be conducted to cover the entire range of operation of the pumps. These shall be carried out to span 130% of rated capacity up to shut-off condition. A minimum of five combinations of head and capacity are to be achieved during testing to establish the performance curves, including the design capacity point, shut-off point and the two extremities of the range of operation specified. After completion of performance test, all pumps shall be stripped down for inspection of internals.

The following formula shall be taken for computing the pump efficiency:

- For submersible pump

Pump bowl efficiency % $Q \times H / 307.2 \times N$, Where,

Q=Discharge in Cum/hr

H=Bowl head in mwc (Total head + loss in discharge elbow + loss in column pipe)

N=Power in put to motor efficiency-(Thrust bearing and transmission losses)

- For Horizontal Centrifugal pumps

Pump efficiency %: $Q \times H / 367.2 \times N$, Where,

Q-Discharge in Cum/hr

H= Total head in mwc

N= Power in put to motor efficiency

NPSH Tests are to be conducted on one pump of each type at 3% head drop conditions.

Mechanical run test shall be carried out on all pumps to determine the vibration and noise levels etc. at works and at site. However, test value at site shall be used for the acceptance of the equipment.

All instruments and equipment required for such tests shall be provided by the manufacturer and the instruments shall be calibrated and certified by an approved independent testing authority not more than 15 days prior to the test in which they will be used.

Quality assurance programme for each major equipment shall be submitted for the approval of the Employers Representative. The procedure for testing at works for submersible and horizontal pumps shall be submitted to the Employers Representative for approval. Reports and test certificates of

above tests shall be submitted to the Employer for approval. The equipment could be tested by duly authorized third party inspector appointed by the Employer if required and the charges of which shall be borne by the Employer.

6.3 Valves Testing Factory

The inspection and testing procedures, 13.1, (m), is specified. The following tests shall be carried out, but not limited to:

- a) Specification and Quantity Inspection.
- b) Dimensional check for each size of the valve.
- c) Physical & Chemical properties check of each component of the Valve.
- d) Hydrostatic Tests;
- e) Motorized valves shall be tested with their actuators, with a differential head equivalent to their maximum working pressure, to prove that the actuators are capable of opening and closing the valves under maximum unbalanced head condition within the specified opening or closing period.
- f) During testing there shall be no visible evidence of structural damage to any of the valve component.
- g) The tests mentioned below shall be crucial one and are to be witnessed by a duly authorized representative of the Employer:
- h) In testing for valve seat leakage, the up-stream flange is tightly closed for a sluice valve or butterfly valves, the down-stream flange is closed for a check valve, and specified pressure are applied,

Work Test Inspection

- a) Manual Operation:
 - Opening and closing direction of handle of smoothness, and switching manual operation and motor operation
- b) Motor Operation:
 - Proper opening and closing of limit switch, opening and closing time, Voltage and amperes of motor, indication opening of opening angle gauge, operation of torque switch, working amperes of torque switch, confirmation of torque set scale, insulation resistance value, etc.

Gate and valves shall be tested as follows.

- a) Applying 1.5 times the rated torque.
- b) Assemble/dimension inspection,
- c) Structural appearance and dimension inspection,
- d) Non-load operation inspection and load test,
- e) Material/painting inspection,

- f) Bearings/backlash test/inspection on reduction gear.
- g) Magnetic particle tests on body and disc/door,
- h) Dye penetration tests on metal seats,
- i) Ultrasonic tests on shafts.
- j) Overload Torque Test for gear boxes,

A. Butterfly Valves:

The following test shall be carried out for butterfly valves as per test procedure briefed in IS 13095:

- I. Seat leakage test at 1.1 times the rated pressure for a duration of minimum 2 minutes.
- II. Body hydrostatic test at 1.5 times the rated pressure for duration of minimum 5 minutes.
- III. Disc strength test shall be same body test pressure and duration which will be one per size.
- IV. Valve operation with and without actuator.

B. Pump discharge Valve:

The following test shall be carried out for Pump discharge valves as per test procedure briefed in relevant latest IS:

- I. Seat leakage test at 1.1 times the rated pressure for a duration of minimum 2 minutes.
- II. Body hydrostatic test at 1.5 times the rated pressure for duration of minimum 5 minutes.
- III. Disc strength test shall be same body test pressure and duration which will be one per size.
- IV. Valve operation with and without actuator.

C. Sluice Valves:

The following test shall be carried out for sluice valves as per test procedure briefed in IS 14846:

- I. Seat leakage test at rated pressure for a duration of minimum 2 minutes.
- II. Body hydrostatic test at 1.5 times rated pressure for a duration of minimum 5 minutes.
- III. Back seat test at 0.5 times the rated pressure.
- IV. Valve operation with and without actuator

D. Non Return Valves:

The following test shall be carried out for non-return valves as per test procedure briefed in IS 5312:

- I. Seat leakage test at rated pressure for a duration of minimum 2 minutes.
- II. Body hydrostatic test at 1.5 times rated pressure for a duration of minimum 5 minutes.
- III. Operation for door opening and closing for the specified / designed duration.

E. Air Valves:

The following test shall be carried out for Air valves as per test procedure briefed in IS 14845 or Equivalent:

- I. Seat leakage test at rated pressure for a duration of minimum 3 minutes.
- II. Body hydrostatic test at 1.5 times rated pressure for a duration of minimum 5 minutes to check the water tightness of the body.

III. Operation.

F. Pilot operated Pressure Relief Valves:

The following test shall be carried out for Pressure Relief valves as per test procedure briefed in relevant Standard to which it is manufactured:

- I. Body hydrostatic test at 1.5 times rated pressure.
- II. Operation.

G. Expansion Bellows

The inspection and testing shall be conducted as per approved procedures. During testing there shall be no visible evidence of structural damage and no water leakage to any of the valve component.

The following tests shall be carried out, but not limited to:

- I. Specification and Quantity Inspection.
- II. Hydrostatic Tests;
 - Body test pressure, 1.5 times of design pressure, and holding time, more than 3 minutes in testing for bellows seat leakage, which is maximum pressure in use.
- I. Work Test Inspection
 - In testing for bellows for flexibility, and its maximum bending angle / deflection and stroke.

All certificates on the materials physical properties, heat treatments and shop test etc. of valve body, disc, wedge and shaft shall be issued by the manufacturer, which shall be subject to review & approval by Employers Representative/Employer.

Notwithstanding the above requirement for inspection and quality control, the following inspection, tests and quality control measures, but not limited to, shall be carried out by manufacturer:

- I. Assemble/dimension inspection, Non-load operation inspection and load test, material/painting inspection, bearings/backlash test/inspection on reduction gear.
- II. Structural appearance and dimension inspection, Non-load operation inspection, material/paint inspect on coupling
- III. Magnetic particle tests on body and disc/door.
- IV. Dye penetration tests on metal seats.
- V. Ultrasonic tests on shafts.
- VI. Overload Torque Test shall be carried out on the gear boxes of the valves. The test shall be carried out by applying 1.5 times the rated torque.

Even though all the valves are tested at factory premises of manufacturer, Contractor has to establish test set-up at work site to test the valves along with their mating flanges bolted and spool pieces after welding to check the water tightness of the joints (no leakages in joints) and hydro test pressure shall

be same as line pressure at site. After hydro testing the whole Valve assembly along with spools shall be lowered in the valve chamber and same shall be welded along the pipeline.

6.4 EOT Crane & Hoist

The cranes shall be completely assembled in the Contractor's or subcontractor's Works and shall be subjected to the tests as specified in IS 807:2006 / IS 3177 or relevant internationally approved standard. The Contractor shall provide the test weights.

The inspection and testing shall be conducted as per approved procedures. During testing there shall be no visible evidence of structural damage and no any deformation.

The following tests shall be carried out, but not limited to:

- a) Specification and Quantity Inspection.
- b) Structural Appearance Inspection
 - Main pump test and inspection methods applied.
- c) Functional test and Inspection
 - Measurement of deflection;

By slinging down piano weir or scale on the center of beam and also on both ends a right and left and placing trolley at the center, measurement of beam deflection under rate load is taken.

- Traversing and travelling measurement;

Conform travelling and traversing under rate load. When test is not feasible at factory, the contractor shall make a written request, which test is made at site after installation, to the Employers Representative for his approval.

- d) Operation and Speed Measurement;
 - Smoothness of all movement and no abnormal noise, vibration, sliding observed.
 - Each speed during-hoist-up hoist-down, traversing and travelling under rate load is measured.
 - Brake test under sling 125% load, lower at full speed and ascertain brake motion when electric source is cut during motion.
 - Limit switch motion test under hoist-up hoist-down without load and ascertain limit switch motion at upper and lower limit.

e) Voltage and Ampere Measurement;

- No-load and sling rated load and 125% load, hoist up and down, and measure amperes at rated voltage.

f) Insulation Resistance Measurement;

- By using 500V megger, measure insulation between the wiring of partitioned circuit and ground.

g) Parts Inspection;

- Hook; Ultrasonic or magnetic particle inspection is made
- Electrical parts; International test standards are applicable.

h) Materials Test and Inspection;

- The records of material analysis and mechanical test of materials, such as main beam, rail, hook, drum, transmission shaft other parts, based on international accepted test standards executed by material makers are ascertained.
- All of the document provided by manufacture shall be signed by an authorized person and organization.

i) Dimension Inspection

- Span, head, hook approach, hook lift, traversing rail span, crane height bon travelling rail surface, total length of main beam, others.
- Girder, saddle, trolley, walk way, ladder-cabin, high and space of opening on the Crain, handrail on the crane, maintenance step ladder, etc.

j) Paint Inspection

- Main pump test and inspection methods applied.
- Girder, saddle, trolley, walk way, ladder-cabin, high and space of opening on the Crain, handrail on the crane, maintenance step ladder, etc.

6.5 Pressure (Air) vessels & Air Receivers

The inspection and testing shall be conducted as per approved procedures

The following tests shall be carried out, but not limited to:

A. Specification and Quantity Inspection.

B. Appearance inspection.

- Visually check the tank surface and weld bead, beveling, others
- (dent, surface scratch & weld flash, joint at right angle)
- Dimension inspection (distortion, misalignment, total length, diameter, other)
- Welding condition of pipe and flange.
- Gaskets surface and number of bolt hole.

C. Hydrostatic Test

Test pressure and duration for hydrostatic test of surge tank, pipe and fittings, valves shall be as per the test pressure and test duration specified in relevant standards.

D. Material Identification

- Mechanical test of materials based on International accepted standards executed by maker with material test certificates
- Tank, flanges, welding rod.
- Gasket and bolts and nuts.
- Coating

E. Welder Qualification Test**F. Welding Test; Radiography, UT, PT, MT as applicable****G. Dimension Inspection**

The following dimension are measured based on the approval drawings and ascertained.

- Vessel tank; Diameter, thickness, total length, tank head, support and its welded angle.
- Pipe: Outer dimensions, thickness, roundness, degree of bend, length, no proper connection between and equipment.
- Flange diameter, thickness,
- Gasket thickness, bolt hole dimension

H. Paint Inspection

- Main pump test and inspection methods applied

I. Stage / in process inspection

Pressure vessel shall be hydrostatically tested as per requirement of IS 2825, in presence of Employer. For other tests specified, the certificates and shop records shall be duly approved and certified by the manufacturer and these shall be subject to review & approval by Employer.

6.6 COMPRESSOR

The following tests shall be carried out, but not limited to:

- a. Specification and Quantity Inspection.

b. Structural Appearance Inspection

- Air tank test and inspection methods applied.

c. Performance Test and Inspection

- Start test, actuation test and safety/ damage protection equipment.

d. Operation Inspection

- Bearing temperature measurements, vibration measurement, and noise measurement.

e. Outer dimension inspection

f. Fully assembled compressor unit and its common base Paint inspection

- Fully assembled compressor unit and

The following condition shall be tested.

A. Ambient temperature, sea level at manufacturer's works, and convert into condition of construction site to confirm its specification.

B. Out let air temperature.

C. Typical Load test: Pressure measurement at minimum flow and at maximum flow.

D. Items recorded are:

- Revolution speed and direction, output as air flow and pressure, power consumption, compressor ambient temperature, lubricating oil gauge, others
- Protective device functioning test: Protective devices, when attached to the engine, operate at their set value. The temperature switch is checked in freestanding condition.
- Bearing temperature measurement and casing temperature.
- Table of compressor performance curve diagram; the test results are made into a record table and performance curve.
- Measurement of noise level by compressor and outside of room.
- Vibration level.

6.6.1 Materials, Plant, and Equipment

The Contractor shall place orders for the material and the equipment only after approval of the Employer's Representative. The Contractor shall submit the detailed drawings from the approved manufacturer and the procedure of submission, review and revision shall be as specified herein below.

The Contractor shall inform the Employer about the likely dates of manufacturing, testing, and dispatching of any material and equipment to be incorporated into the Permanent Works. The Contractor shall notify the Employer for inspection and testing, at least twenty-eight (28) days prior to packing and shipping and shall supply the manufacturer's test results and quality control certificates. The Employer will decide whether he or his representative (Employer's Representative) will inspect and test the material / equipment or whether he will approve it on the basis of the manufacture's certificate.

The following inspection and test categories shall be applied prior to delivery of the equipment, of various categories as indicated in the technical specifications for each type of the equipment:

Category A: -The drawings have to be approved by the Employer's Representative before manufacture and testing. The material has to be inspected by the Employer's Representative or a third party inspecting agency approved by the Employer at the manufacturer's premise before packing and dispatching. The Contractor shall provide the necessary equipment and facilities for tests and the cost thereof shall be borne by the Contractor.

Category B: - The drawings of the equipment have to be submitted and approved by the Employer's Representative prior to manufacture. The material has to be tested by the manufacturer and the manufacturer's test certificates are to be submitted and approved by the Employer's Representative before dispatching of the equipment. Notwithstanding the above, the Employer, after examination of the test certificates, reserves the right to instruct the Contractor for retesting, if required, in the presence of the Contractor's representative.

Category C: - Samples of the materials and/or equipment shall be submitted to the Employer's Representative for pre-construction review and approval. Following approval by the Employer, the material may be manufactured as per the approved standards and delivered to the Site.

For material/equipment under Category "A" and "B", the Employer will provide an authorization for packing and shipping after inspection.

The testing and approval for dispatching shall not absolve the Contractor from his obligations for satisfactory performance of the plant.

Dispatch Clearance

All mechanical/electrical/instrumentation equipment shall be tested at their respective factory which will be witnessed by tri parties (Contractor, JSV/Consultant inspecting team) in line with approved QAP and Equipment Data sheet.

The test observation sheets, material tests certificates (chemical and mechanical test at laboratory) and joint inspection report shall be signed by the Contractor, JSV/Consultant officials after successfully completion of tests.

Contractor shall forward all original reports to JSV and copy to Consultant for verification and issuances of Dispatch Clearance Certificates as per clause 14.1.1 g (ii). No Dispatch Clearance Certificate will be issued at the factory itself by the inspecting agency.

6.6.2 Factory Acceptance Test (FAT) Document

Thirty (30) days prior to commencement of inspection of each Plant item / equipment the Contractor shall supply a Factory Acceptance Test (FAT) Document for approval. This shall comprise four copies of the following:

- Unpriced copy of the Contractors order for the Plant item / equipment concerned:
- Details of the inspection and test procedures to be carried out.
- Pre-factory test results and its photos.

The FAT Plan shall provide comprehensive details of the tests to be carried out, the purpose of each test, the equipment to be used in carrying out the test and the methods to be adopted in carrying out the tests. The FAT shall provide space within the documentation for results of the tests to be added and for each test and for the FAT as a whole to be signed off by the Contractor and the Employer's Representative.

On completion of the tests the Contractor shall provide four copies of all test certificates, curves etc. for the inspected Plant item. To remove doubt test certificates shall be provided for the Plant item as a whole plus certificate for the relevant component parts such as:

- Motors;
- pumps;
- Instruments;
- Electrical switchgear
- Cranes and Hoists
- Valves
- Pipes
- Expansion/Dismantling Joints.
- Manual Coarse Bar Screen
- EOT Cranes and Hoists

6.6.3 Inspection and Testing Programme

The Contractor shall submit to the Employer's Representative not later than 15 days prior to the commencement of the first inspection and test during manufacture a programme detailing the inspection dates for all Plant. Those items of Plant that the Employer's Representative has specifically identified for witness testing test shall be highlighted in the programme.

The Contractor shall keep the Employer's Representative informed of any changes to the programme.

The Employer's Representative shall not be requested to inspect an item of Plant until the Contractor has satisfied himself that the equipment meets all requirements of the Employer's Requirements.

The Contractor shall inform the Employer's Representative in writing at least 15 days in advance regarding readiness for carrying out inspection of equipment/material etc. at manufacturer's works or at places of inspection. The programme for inspection shall be finalised by the Employer's Representative after the receipt of the above. In case inspection cannot be carried out due to non-readiness of equipment/material etc. a subsequent date shall be finalised for carrying out the inspection in which event all expenses incurred by the Employer for such visits shall be recovered from the Contractor. In case equipment/material etc. is found not to comply with the specification, dates for re-inspection shall be finalised and expenses incurred by the Employer for such visits shall

also be recovered from the Contractor. Contractor's Representatives shall essentially be present during all inspections of Plant items. The following information shall be given in the inspection call letter mentioned above:

- (a) Name of manufacturer/supplier;
- (b) Address of place where inspection is to be carried out;
- (c) Proposed date/s and equipment to be inspected;
- (d) Name/s of contact personnel at manufacturer's/ supplier/s works with their telephone and fax numbers.
- (e) Name of Contractor's Representative who will be present during the inspection.
- (f) Confirmation that internal testing has been completed.

The Contractor shall provide all the necessary instruments, test facility, water / electric power, test piece, samples, Employer's Representative/ workers, all cost and others to carry out the tests after assembly. All instruments used for such tests shall be calibrated and certified by and approved by an independent testing authority not more than one month prior to the tests in which they are used. Calibration certificates with expire date and name of authorization agency for instruments used for such tests shall be produced for the approval of the Employer's Representative and if necessary, instruments shall be recalibrated before the commencement of the tests.

No material shall be delivered to the Site without inspection having been carried out or waived in writing by the Employer's Representative.

If during or after testing, any item of plant fails to achieve its intended duty or otherwise proves defective, it shall be modified or altered as necessary and retested and re-inspected as required by the Employer's Representative.

6.7 Tests at Manufacturer's Premises – Mechanical Equipment

6.7.1 Motors

All motors shall be inspected and tested at manufacturer's works, and they shall be shipped in a good packing condition.

The following tests shall be carried out, but not limited to:

- (a) Specification and Quantity Inspection.
- (b) Inspection Items
 - Structural appearance inspection
 - Mechanical inspection
 - Wound wire resistance inspection
 - Measurement of winding resistance.
 - Insulation test
 - Vibration test
 - No-load test

- Captive test (Blocked rotor test)
 - Phase sequence test
 - Calculation of characteristics
 - Secondary voltage measurement (wound-wire type)
 - Revolution direction inspection
 - Temperature rise inspection test
 - Outer dimension inspection
 - Paint inspection
- (c) Main point for electrical equipment
- Private power generation
 - Panels and related parts
 - Performance test and inspection
 - Independent power generation equipment
 - Panels
- (d) Routine Tests
- All routine tests shall be carried out on all motors as per the latest edition of IS 4029 : 2010
- (e) Acceptance Tests
- Full load test to determine efficiency, power factor and slip shall be conducted on all the motors.
- (f) Type tests
- The following type tests shall be carried out on one motor of each rating above 18.5 kW.
- (1) Isolation resistance test
 - (2) Temperature rise test
 - (3) Momentary overload test
 - (4) Vibration measurement test
 - (5) Noise level test
 - (6) Over speed /over load test
 - (7) Starting current, starting torque, and pull out torque at reduced voltage

6.7.2 Valves

The following tests shall be carried out, but not limited to:

- (a) Specification and Quantity Inspection.
- (b) Dimensional check for each size of the valve.
- (c) Physical & Chemical properties check of each component of the Valve.

- (d) The tests mentioned below shall be crucial one and are to be witnessed by a duly authorized Employers representative.
- (e) During testing there shall be no visible evidence of structural damage to any of the valve component.
- (f) Motorized valves shall be tested with their actuators, with a differential head equivalent to their maximum working pressure, to prove that the actuators are capable of opening and closing the valves under maximum unbalanced head condition within the specified opening or closing period.
- (g) Hydrostatically tested shall be as per relevant IS/BS standard for each type of valve.
- (h) In testing for valve seat leakage, the up-stream flange is tightly closed for a sluice valve or butterfly valves, the down-stream flange is closed for a check valve, and specified pressure are applied, work Test Inspection.
- Manual Operation:
 - Opening and closing direction of handle of smoothness, and switching manual operation and motor operation
 - Motor Operation:
 - Proper opening and closing of limit switch, opening and closing time, Voltage and amperes of motor, indication opening of opening angle gauge, operation of torque switch, working amperes of torque switch, confirmation of torque set scale, insulation resistance value, etc.
- (i) The following test shall be carried out for sluice valves, Knife Gate valves:
- (1) Pressure test
 - (2) Leakage test
 - (3) Seat leakage test.
 - (4) Body hydrostatic test.
 - (5) Valve operation
- (j) The following test shall be carried out for non-return valves:
- (1) Pressure test
 - (2) Leakage test
 - (3) Seat leakage test.
 - (4) Body hydrostatic test.
 - (5) Valve operation
- (k) The following test shall be carried out for Butterfly valves:
- (1) Pressure test
 - (2) Leakage test
 - (3) Seat leakage test.

- (4) Disc strength test.
- (5) Valve operation

(l) The following test shall be carried out for Air valves:

- (1) Seat leakage test.
- (2) Body hydrostatic test.
- (3) Valve operation

(m) The following test shall be carried out for Expansion bellows:

- (1) Leakage test.
- (2) Body hydrostatic test.
- (3) Valve operation
- (4) Pressure test

All certificates on the materials physical properties, heat treatments and shop test etc. of valve body, disc, wedge and shaft shall be issued by the manufacturer, which shall be subject to review & approval by Employers Representative/Employer.

Notwithstanding the above requirement for inspection and quality control, the following inspection, tests and quality control measures, but not limited to, shall be carried out by manufacturer:

- Assemble/dimension inspection, Non-load operation inspection and load test, material/painting inspection, bearings/backlash test/inspection on reduction gear.
- Structural appearance and dimension inspection, Non-load operation inspection, martial/paint inspect on coupling
- Magnetic particle tests on body and disc/door.
- Dye penetration tests on metal seats.
- Ultrasonic tests on shafts.
- Overload Torque Test shall be carried out on the gear boxes of the valves. The test shall be carried out by applying 1.5 times the rated torque.

Even though all the valves are tested at factory premises of manufacturer, Contractor has to establish test set-up at work site to test the valves along with their mating flanges bolted and spool pieces after welding to check the water tightness of the joints (no leakages in joints) and hydro test pressure shall be same as line pressure at site. After hydro testing the whole Valve assembly along with spools shall be lowered in the valve chamber and same shall be welded along the pipeline.

6.7.3 Pipe-work

Testing of pipes and fitting shall be carried out in accordance with relevant Indian Standard and internationally approved standard. Pipes, fittings and expansion bellows shall be hydrostatically tested for 1.5 times the rated pressure. For all the tests specified, the certificates and shop records shall be duly approved and certified by the manufacturer and these shall be subject to review & approval by Employer / Employers Representative.

The welding shall be checked by ultrasonic testing for all length, i.e. 100 % testing at the place of manufacture. Additionally, 10% of the weld joints shall be tested by radiography. All specials shall be tested 100% by radiography.

The following test shall be carried out for pipelines:

- (1) Pressure test
- (2) Leakage test
- (3) Colour check for welding pipeline
- (4) Welding beat check

6.7.4 Crane & Hoists

The cranes shall be completely assembled in the Contractor's or subcontractor's Works and shall be subjected to the tests as specified in IS 807/IS 3177 or relevant internationally approved standard. The Contractor shall provide the test weights.

Hoists and lifting equipment shall be assembled and tested at the place of manufacture in accordance with IS 3938.

Each and every rotating part/assembly/sub-assembly shall be dynamically balanced as per grade G16 of ISO 1940/1 - 1986.

The inspection and testing shall be conducted as per approved procedures. During testing there shall be no visible evidence of structural damage and no any deformation.

The following tests shall be carried out, but not limited to:

- (a) Specification and Quantity Inspection.
- (b) Structural Appearance Inspection
 - Main pump test and inspection methods applied.
- (c) Functional test and Inspection
 - Measurement of deflection;

By slinging down piano weir or scale on the center of beam and also on both ends a right and left and placing trolley at the center, measurement of beam deflection under rate load is taken.

- Traversing and travelling measurement;

Conform travelling and traversing under rate load. When test is not feasible at factory, the contractor shall make a written request, which test is made at site after installation, to the Employers Representative for his approval.

- (d) Operation and Speed Measurement;
 - Smoothness of all movement and no abnormal noise, vibration, sliding observed.

- Each speed during-hoist-up hoist-down, traversing and travelling under rate load is measured.
 - Brake test under sling 125% load, lower at full speed and ascertain brake motion when electric source is cut during motion.
 - Limit switch motion test under hoist-up hoist-down without load and ascertain limit switch motion at upper and lower limit.
- (e) Voltage and Ampere Measurement;
- No-load and sling rated load and 125% load, hoist up and down, and measure amperes at rated voltage.
- (f) Insulation Resistance Measurement;
- By using 500V megger, measure insulation between the wiring of partitioned circuit and ground.
- (g) Parts Inspection;
- Hook; Ultrasonic or magnetic particle inspection is made
 - Electrical parts; International test standards are applicable.
- (h) Materials Test and Inspection;
- The records of material analysis and mechanical test of materials, such as main beam, rail, hook, drum, transmission shaft other parts, based on international accepted test standards executed by material makers are ascertained.
 - All of the document provided by manufacture shall be signed by an authorized person and organization.
- (i) Dimension Inspection
- Span, head, hook approach, hook lift, traversing rail span, crane height bon travelling rail surface, total length of main beam, others.
 - Girder, saddle, trolley, walk way, ladder-cabin, high and space of opening on the Crain, handrail on the crane, maintenance step ladder, etc.
- (j) Paint Inspection
- Main pump test and inspection methods applied.
 - Girder, saddle, trolley, walk way, ladder-cabin, high and space of opening on the Crain, handrail on the crane, maintenance step ladder, etc.

6.8 Tests at Site - Mechanical Equipment

All mechanical equipment shall be tested at site as following items in below,

The test will be verified any damage/missing part, No. of equipment to be installed, material, location as specified in drawing, levelling, centreline, solid installation and condition of installation to be fit in levelling of pipeline and valves.

Testing run will be conducted for verifying rotation direction, vibration, noise, and stability and any leakage, if possible.

The test will be verified to check maintenance space and ease of equipment maintenance work.

The testing shall be performed in full compliance with the latest version of the applicable standard testing protocol. These tests shall be witnessed by Employers Representative per procedures set forth for witnessing elsewhere in this document.

In addition to the progressive supervision and inspection by Employer's Representative, the Contractor shall offer for inspection to Employer's Representative, the completely erected plant/part of Plant on which tests are to be carried out. After such inspection, each equipment/sub-system shall be tested by the Contractor in accordance with the applicable standards in the presence of Employer's Representative. Such tests shall include but not be limited to the tests specified in following clauses.

The Contractor shall possess during the entire working period the Electrical Contractor's licence of appropriate class from the concerned statutory authorities governing the area of work place. The Contractor shall fully comply with the relevant statutory rules and regulations. On completion of the installation or at intermediate stages, if required by the statutory authorities, the Contractor shall arrange for inspection and obtain the approval from the concerned statutory authorities. If any fees are to be paid to statutory authorities for testing, inspection and calibration these shall be paid by the Contractor and shall be included in his erection and commissioning charges.

6.8.1 Pumps, piping and valves

- (a) The erected pipe work shall be subjected to a hydraulic test at 1.5 times the maximum pressure or twice the working pressure whichever is higher to test the soundness of the joints. Provision of the necessary pumps, gauges, blank flanges, tappings etc. for carrying out these tests shall be included in the Contract.
- (b)
- (c) Leakage tests shall be carried out on all erected pipework, pumps and valves immediately after erection and where possible before being built in.
- (d) Operating tests shall be conducted on valves.
- (e) The pump set shall be tested for satisfactory operation. The vibration and noise level shall be checked to be within the specified limits.

6.8.2 Motors

Condition of winding insulation be tested and insulation values shall be restored to required level by suitable heating arrangements locally.

6.8.3 Cranes

The crane and lifting tackle shall be tested to 125 % of the safe working load. The Contractor shall arrange the test load. The contractor shall also arrange for the appropriate certificates from the concerned authorities before regular use of the cranes and other lifting equipment.

SECTION - 6

ANNEXURE - 7

TRAINING REQUIREMENTS

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TRAINING REQUIREMENTS

7.1 General

The Contractor shall provide comprehensive training for the different categories of the Employer's operation and maintenance staff. Training shall fall into two main types which are 'off the job' and 'on the job'. Off the job training shall take place in the class room and on the job training shall be carried out at site.

7.2 Off The Job Training

The Contractor shall prepare formal training documentation for distribution to the trainees. Visual aids shall be used to illustrate the points being made and to make the training programme interesting and enjoyable for the participants.

The off the job training shall comprise the following:

1. Off the Job Training Programme for all Trainees

To provide training:

- a) on the system and principles involved in the operation of the Works;
- b) regarding basic features of the electro-mechanical and instrumentation equipment to be installed
- c) health and safety;
- d) plant safety procedures;

2. Off the Job Training Programme for Operators

To provide training:

- a) on the operation of individual items of plant and sections of the works;
- b) on the day to day operation of the Works and procedures;
- c) on a comprehensive list of 'what if' scenarios dealing with the actions to be taken in the event of potential system problems, alarms, plant failures, overflows, power failures etc.;
- d) on first line mechanical maintenance;
- e) safe work practices;
- f) on safety procedures to be followed in operating, maintaining, and cleaning the plant;

3. Off the Job Training Programme for Electrical Maintenance Staff

To provide training:

- a) on the configuration, construction and operation of the electrical components;
- b) on the electrical maintenance requirements of the Works;
- c) on the switching and safety procedures to be followed;
- d) safe methods of working;
- e) on fault finding and repair procedures.

4. Off the Job Training Programme for Mechanical Maintenance Staff

To provide training:

- a) on the routine mechanical maintenance requirements of the Works;
- b) on lubrication requirements of the Works;
- c) on fault finding, repair and overhaul procedures;
- d) safe methods of working.

7.3 On The Job Training

The Contractor shall utilise the Operation and Maintenance Manuals as the primary training aid in carrying out the on the job training. Shortcomings, omissions and errors identified in the O & M Manuals during the training shall be rectified prior to final acceptance of the O&M Manuals.

1. On the Job Training Programme for all Trainees

To provide training:

- a) plant familiarisation tour;
- b) health and safety;
- c) identify areas where special safety precautions are necessary.

2. On the Job Training Programme for Operators

To provide training:

- a) under operational conditions on the operation of individual items of PS and sections of the Works;
- b) illustrate by example the day to day operation of the Works and procedures;
- c) illustrate by example the actions to be taken in the event of potential system problems, alarms, plant failures overflows, power failures etc. (as identified in the 'what if' scenario off the job training);
- d) illustrate by example the first line mechanical maintenance;
- e) illustrate by example safety procedures to be followed in operation, maintenance and cleaning of the Works.

3. On the Job Training Programme for Electrical Maintenance Staff

To provide training:

- a) illustrate by example the operation of the electrical equipment;
- b) illustrate by example the electrical isolation and maintenance procedures;
- c) illustrate by example fault finding and repair procedures;
- d) illustrate by example switching and safety procedures to be followed;
- e) illustrate by example safe systems of work.

4. On the Job Training Programme for Mechanical Maintenance Staff

To provide training:

- a) illustrate by example the routine mechanical maintenance requirements of the Works;
- b) illustrate by example lubrication procedures;
- c) illustrate by example fault finding, repair and overhaul procedures.
- a) illustrate by example safe systems of work.

7.4 Training Programme

Off the job training shall be carried out prior to Taking Over of the Works or any section of the Works.

Off the Job training shall be carried out prior to On the Job training. On the Job training shall be completed as a condition for acceptance of the Works following completion of the Tests After Completion.

The Contractor shall provide a training plan for each category of staff. The training plan shall detail the content and duration of each course. The training plan shall be submitted for the approval of the Employers Representative at least 30 days prior to the commencement of the Tests on Completion.

The Off the job training period shall be 7 days and on the job training shall be 15 days. The training day shall be assumed to be not less than 8 (eight) hours split into two sessions.

7.5 Training Personnel

The Contractor shall provide suitably qualified trainers to carry out the off the job and on the job training. The Contractor/ system supplier shall conduct training courses for personnel selected by JSV. The Contractor/ system supplier shall make a workbook on each course available to every person taking the courses listed herein. The workbook shall

be of sufficient detail so that, at a later date, a trainee could review in detail the major topics of the course.

The training times shall be scheduled by the Employer in advance with the Contractor.

The training expert shall be fluent in English & Hindi Languages .

SECTION 6

ANNEXURE - 8

**SAFETY CONDITIONS FOR UNDERTAKING SITE WORK
&
CONTRACTOR'S SAFETY AND HEALTH PROGRAMME**

1.0 SCOPE

This document gives broad guidelines to be followed by the CONTRACTOR for ensuring safe working conditions in and around the site.

2.0 SAFETY ORGANISATION

- 2.1) Each CONTRACTOR at site shall establish a Safety organization set up at site consisting of qualified safety officers, safety supervisors and stewards as per requirement. Safety officer who shall be responsible for administering safety functions like planning and implementing site inspections, audits, examination / testing, safety surveys, providing supervision, monitoring safe working conditions at all times for their workers. The Safety Officer shall have a degree or diploma in engineering, and diploma in Industrial Safety from recognised central/state government approved institute and also field experience of minimum 03 years in case of degree in engineering or minimum 05 years in case of diploma in engineering, in the relevant discipline. The safety officer shall also have the authority to stop / suspend the unsafe practices and works taken up in unsafe conditions.
- 2.2) CONTRACTOR shall define the roles and responsibilities of all the personnel at different levels in the safety organization in the CONTRACTOR'S Site Safety Plan.
- 2.3) CONTRACTOR shall take active interest and participate in the development and operation of safety programs at site. His responsibility does not cease with establishment of Safety Group and approval of its various activities. He shall demonstrate his involvement by regular participation in safety meetings, review of safety records and taking corrective action where required, introduction of safety promoting bulletins, posters, suggestions and awards and by setting example by strictly observing safety rules. CONTRACTOR shall remove all waste material and debris from and around the work area and properly clean up the area at the end of each day before leaving the work site.
- 2.4) CONTRACTOR shall take all necessary precautions not only for safe working of his own workmen but also deploy all precautions to ensure safety of structures, equipment and workmen of other agencies in and around his work site.
- 2.5) CONTRACTOR shall ensure that his workmen do not trespass into prohibited/restricted work areas.
- 2.6) EMPLOYER/CONSULTANT shall have the right to inspect at any time, all items of machinery, plant and equipments (owned, borrowed / sub-contracted, leased, rented) brought to site by the CONTRACTOR or his agents or workmen and to prohibit the use on the site of any item, which in the opinion of the EMPLOYER/CONSULTANT is or may be detrimental to the safety of the site.
- 2.7) The exercise of such right or the omission to exercise it in any particular case shall not absolve the CONTRACTOR or his agents or workmen of their responsibility of adhering to the safe working practices.
- 2.8) CONTRACTOR shall execute the work in a manner causing the least possible interference with the business of the EMPLOYER/CONSULTANT, or with the work of any other

CONTRACTOR who may be engaged on the premises and shall at all times co-operate with the other CONTRACTORS working at site.

2.9) CONTRACTOR shall obtain daily work permit from the EMPLOYER/CONSULTANT before start of any work at site. The work permits are issued to prevent the CONTRACTOR from working in unauthorised areas and shall be valid for specific area for a stipulated period.

2.10) CONTRACTOR shall ensure at all times that his workers do not lie down or sleep under or around any machine, equipment, vessel or vehicle in his work area at any time.

2.11) RESPONSIBILITIES OF THE CONTRACTOR'S SAFETY OFFICER

2.12) The duties of a safety officer shall be to advise and assist the CONTRACTOR'S management in the fulfilment of its obligations, statutory or otherwise concerning prevention of personnel injuries and maintaining a safe working environment.

2.13) These duties shall include the following namely:

- a) To advise the building workers in planning and organising measures necessary for effective control of personal injuries.
- b) To advise on safety aspects in a construction work and to carry out detailed safety studies of selected activities.
- c) To check and evaluate the effectiveness of action taken or proposed to be taken to prevent personal injuries.
- d) To advise purchasing and ensuring quality of personal protective equipment confirming to national standards.
- e) To carry out safety inspections of construction work in order to observe the physical conditions of work and the work practices and procedures followed by construction workers and to render advise on measures to be adopted for removing unsafe physical conditions and preventing unsafe actions by construction workers.
- f) To investigate the near misses, incidents and major accidents and submit the detail report to EMPLOYER/CONSULTANT.
- g) To promote the working of safety committees and to act as an advisor to such committees.
- h) To design and conduct, either independently or in collaboration with other agencies, suitable training and educational programmes for prevention of accidents to building workers.
- i) To frame operational control measures, safe rules and safe working practices in consultation with senior officials of the establishment.
- j) Supervise and guide safety precautions to be taken in construction work of the establishment.

- k) Ensure compliance to legal and contractual requirements affecting safety, health, and welfare of his workmen.
- l) Keeping up-to-date with recommended codes of practice and safety literature. Circulating information applicable to each level of employees.
- m) Fostering within the company an understanding that injury prevention and damage control are an integral part of business and operational efficiency.
- n) Attending job progress meetings where safety is a point on the agenda. Report on job safety performance.

3.0 Entry and Exit procedures:

- 3.1) CONTRACTOR must follow Entry / Exit to the project premises for all the project employee and materials will be from the designated entrance / exit point only.
- 3.2) CONTRACTOR must follow entry / exit systems through Photo ID card / bio-metric.
- 3.3) CONTRACTOR must follow Entry to the project premises with mandatory PPE's (safety helmet, shoe & reflective jackets).
- 3.4) The record of Entry / Exit of the personnel will be maintained by the security / time keeper at the gate by CONTRACTOR.
- 3.5) Vehicles of the CONTRACTORS must be parked only at the designated parking lots in the project premises.
- 3.6) General Safety awareness posters to be displayed at the entrance and exit gate points by CONTRACTOR.
- 3.7) CONTRACTOR must provide separate access for pedestrian/vehicles movement at the entry / exit Points.
- 3.8) ID cards should be displayed by all contract workmen at the entry / exit points.
- 3.9) CONTRACTOR must provide one full time ambulance and it must be parked near the Entry gate or at the First aid center manned by an experienced driver.
- 3.10) CONTRACTOR'S Plant and Equipment will be screened at the gate before being deployed at site by Employer/Consultant.
- 3.11) Permission for Entry/Exit of CONTRACTOR's Plant and Equipment into project premises must be through Employer/Consultant.
- 3.12) The CONTRACTOR shall arrange to separate pedestrian and vehicular (including material handling equipment) traffic wherever possible and maintain the routes clear of obstruction. To ensure safety of users' clear painted demarcation is encouraged as a discipline to be enforced.

4.0 STACKING AND STORAGE PRACTICE

- 4.1) All construction materials should be stored in designated areas. The CONTRACTOR shall submit a detailed scheme of construction and other hazardous materials' storage, stacking, dispensing and disposal also considering the physical and chemical properties along with the statutory requirements.
- 4.2) The CONTRACTOR shall ensure stacked material is bonded on a stable and level footing capable of carrying the mass of the stack. Adequate clearances shall be provided between the sides of the stack and top to facilitate unimpeded access to service equipment like overhead wiring, cranes, forklifts and fire fighting equipment, and hoses. Circular items shall be sufficiently choked with wedges not with odd bits of materials. Free-standing stacks of gunny bags and sacks such as cement bags shall be stacked to prescribed safe-stack heights with layers formed for stable bonding, preventing slippage causing accidents. Stacking against walls shall not be permissible.
- 4.3) The CONTRACTOR shall maintain the premises and surrounding areas in clean and clear manner with safe access and egress.

5.0 STORAGE OF HAZARDOUS MATERIALS

- 5.1) CONTRACTOR shall store the Hazardous materials on solid bases. Solid bases shall include compacted earth, pallets, concrete or asphalt platforms or paving. Hazardous materials shall be stored, stacked and secured to prevent toppling, Spillage or other unintended dislodgement. Aisles and clearances shall be detailed as per requirement. Hazardous materials shall be stacked in such a manner that an observer standing in the aisle can read their labels and legend.
- 5.2) CONTRACTOR must provide each hazardous material contained be identified by a legible or legend as per governing statute, code or regulation. The label shall identify the item, quantity and appropriate warnings.
- 5.3) Hazardous materials which if brought in contact with each other could react or pose equal or greater hazard than either material stored alone shall be stored at a distance not lesser than twenty feet apart by CONTRACTOR.
- 5.4) CONTRACTOR shall display/post the Warnings and maintain it in a legible condition at all access points clearly defining the specific hazardous nature of the stored materials such as 'Explosive', 'Compressed Gas', 'Flammable', 'Oxidising', 'Corrosive' or other hazardous nature.
- 5.5) Where hazardous materials are unloaded in the CONTRACTOR's storage maintained at site in a semi-permanent installation, such installations shall be approved by relevant statutory bodies. Copies of licences for storage shall be lodged with the EMPLOYER. The containers and storage shall display quantities stored with name of the hazardous material and the UN hazard classification label in prescribed colour code prominently painted in a conspicuous manner.
- 5.6) The CONTRACTOR shall inspect the hazardous storages and installations on a daily basis

and shall undertake any requisite preventive action necessary to avoid safety risks.

6.0 STORAGE OF FLAMMABLE AND EXPLOSIVE MATERIALS

- 6.1) CONTRACTOR shall secure flammable and or explosive materials against accidental ignition.
- 6.2) CONTRACTOR storage facilities for flammable liquids such as petrol, diesel, kerosene and lubricants as well as the quantities stored shall meet the legal and statutory requirements. These shall be stored in approved fire-resistant rooms with a sump of sufficient volume to contain any spillage.
- 6.3) CONTRACTOR shall provide the electrical fittings with flame proof and follow a strict maintenance schedule. Containers shall be appropriately bonded in receptacles into which low flash point fuel is decanted.

7.0 COMPRESSED GAS CYLINDERS

CONTRACTOR should store the compressed gas cylinders and secure it in the upright position at safe distances shielded from welding and cutting operations/hot work. Compressed gas cylinders in storage shall be shut off and torches, hose and manifolds removed and capped. Cylinders shall be periodically checked for leakages, if any. Compressed gas storages shall be provided with safety relief valves, Safety valves and rupture disc to protect them from overpressures.

8.0 VEHICLES/MACHINERY MOVEMENT IN PROJECT PREMISES

- 8.1) CONTRACTOR vehicles shall have valid registration, insurance, PUC, and road permit in conformance with regulations and always keep copies of valid travelling documents in the vehicle (Driving license, registration, insurance, and identity card and contact details).
- 8.2) CONTRACTOR vehicles (Four Wheelers) shall be equipped with seat belts both in front and rear seats, first aid box, portable fire extinguisher, standard stopper (wheel choke), emergency reflective triangles, etc. The drivers should be trained to use fire extinguishers.
- 8.3) CONTRACTOR vehicles operating on site shall be fitted with reverse horn, rear view mirror and driver shall always be accompanied by trained co-driver / helper.
- 8.4) CONTRACTOR vehicles shall be well maintained and kept in perfect working order and fully equipped with the proper safety gear. Conduct regular checks of the vehicle's condition and report defects immediately. Any defect has to be removed as soon as practicable, before the vehicle is put in use. Toeing of vehicle with the help of Hydra or back push from other vehicle is strictly prohibited on site.
- 8.5) CONTRACTOR shall have driver/operator medical fitness report as per regulation; at least once a year and copy of medical report shall be available with driver/operator.
- 8.6) CONTRACTOR drivers shall have an experience of minimum 5 years and age should be between 25 and 58 years (holding Heavy vehicle license).
- 8.7) All employees including CONTRACTOR shall wear crash helmet and shoes while driving

motorbike. Safety helmets provided for project / site work shall not be worn as crashed helmets, as they are not adequate to withstand the impact caused during accident of vehicle (two-wheeler). Two wheel drivers shall use adequate crash helmets of approved ISI mark.

- 8.8) Any new CONTRACTOR driver before starting driving shall attend authorized training program for safe driving as per regulation.
- 8.9) CONTRACTOR drivers shall have his journey schedule showing expected date and time to complete the journey.
- 8.10) CONTRACTOR drivers shall ensure to take minimum 15 minutes rest for every 4 hrs of continuous journey. Also shall not drive more than 12 hrs in a day.
- 8.11) CONTRACTOR drivers shall operate only those vehicles for which they are trained, authorized and licensed.
- 8.12) Without proper authorization by EMPLOYER/CONSULTANT CONTRACTOR respective drivers/operators shall not operate any vehicle other than they are authorized to operate, even if they are capable of such operation.
- 8.13) CONTRACTOR shall ensure that the person in the driver's seat as well as others in the vehicle shall keep seat belts fastened, while the vehicle is in motion.
- 8.14) CONTRACTOR shall specify and safe speed limits to be observed and maintained at all times.
- 8.15) CONTRACTOR must specify vehicle operating instructions.
- 8.16) CONTRACTOR must ensure safe driving during bad weather conditions (rain showers, winds, snow, etc.) with utmost care.
- 8.17) CONTRACTOR must ensure that, mobile phones are not to be used whilst driving or operating a vehicle.
- 8.18) CONTRACTOR must display that Driving under the influence of alcohol or any sedative drug (including prescribed medication) is strictly prohibited.
- 8.19) CONTRACTOR shall ensure that eating, drinking (even non-alcoholic beverages), etc. during driving inside the project premises be avoided. Such activities increase the risk of accident due to distraction and lack of concentration.
- 8.20) When loading and unloading, the CONTRACTOR shall observe relevant guidelines and requirements to avoid danger to any person or damage to any property.
- 8.21) Drivers/Operators shall not attend to mobile calls/listen to music while driving the vehicles/machinery.

9.0 Excavation

- 9.1) As built drawings of underground services must be referred by the CONTRACTOR before starting the excavation activity.

- 9.2) CONTRACTOR should make detail excavation methodology and submit the Methodology for approval to EMPLOYER/CONSULTANT.
- 9.3) CONTRACTOR must ensure the stability of structure adjoining the workplace or other areas to be excavated by providing safety measures like Sheet piling, shoring or other similar means to support structure.
- 9.4) CONTRACTOR should provide a safe access by providing ladders, staircase or ramps.
- 9.5) CONTRACTOR should ensure at a construction site that any machinery used in excavation is positioned and operated in such a way that such machinery does not endanger the operator of such machinery.
- 9.6) In the event of an excavation or removing a manhole cover, the CONTRACTOR should ensure that any opening, sump or pit caused is securely fenced and covered before leaving the workplace for the day.
- 9.7) Hard barricading should be provided around excavation area by CONTRACTOR.
- 9.8) Excavated earth must be placed 2m away from the excavated area and Suitable warning boards and signs should be put up by CONTRACTOR near excavation work area.

10.0 Scaffolds

- 10.1) Before erecting scaffold at site, CONTRACTOR has to get approved the scaffold design/drawings from EMPLOYER / CONSULTANT.
- 10.2) Scaffold materials must be as per IS standard.
- 10.3) Competent person must be involved in scaffold erection.
- 10.4) CONTRACTOR must use Mandatory scaffold components Base plate, ladders, Steel platform (tied with the scaffold), mid rail, Hand rail, Toe board (150 MM), bracings while erecting the scaffold.
- 10.5) EMPLOYER/CONSULTANT will inspect the CONTRACTOR scaffolding whether erected scaffold is as per the approved design.
- 10.6) SCAFF tag must be followed (Red Tag- Unsafe/Not to use, Green Tag - Safe to use).
- 10.7) CONTRACTOR must ensure usage of mobile scaffold is strictly prohibited.
- 10.8) CONTRACTOR must provide the scaffold with proper fall protection system intact and display the suitable warning boards.
- 10.9) CONTRACTOR must ensure area to be barricaded during erection and dismantling of scaffolds.

11.0 WORKING AT HEIGHTS

- 11.1) CONTRACTOR workmen engaged must undergo medical fitness examination before deploying them for work at heights.
- 11.2) CONTRACTOR workers should wear safety full body harness with double lanyard with hook properly fastened.
- 11.3) CONTRACTOR workmen engaged on work at heights should be experienced in such work.
- 11.4) Steel scaffold staging should be erected as per IS code and the design for Scaffold staging must be submitted to EMPLOYER/CONSULTANT for approval.
- 11.5) Wherever multiple work activities CONTRACTOR must use safety nets beneath the place of work for safety.
- 11.6) CONTRACTOR when working over equipments or tanks, Full body safety harness with double lanyard, safety lifeline and safety nets should always be used whether or not staging and scaffolding is provided.
- 11.7) Safe access to all points of works should be provided in the form of Suitable Ladders /stairways/ boom lifts by CONTRACTOR.
- 11.8) Area around the work place should be barricaded suitably or fenced off to avoid Injuries to personnel passing by. Suitable warning boards and sign should be put up by CONTRACTOR.
- 11.9) Life line and fall protection arrangements should be provided for working at heights by CONTRACTOR
- 11.10) CONTRACTOR must ensure loose materials should be cleared on daily basis from scaffolds.
- 11.11) Man-basket not permitted for height works.

12 Hot Work (Welding / Gas cutting work)

- 12.1) Only qualified welders should be employed at the work site. The CONTRACTOR should organise the qualifying test at site for his welders and the EMPLOYER / CONSULTANT should approve the welders. All welders should have to undergo qualifying test and only on passing the test, they should be allowed to work at site.
- 12.2) CONTRACTOR must organise for all welding work at site, Rectifier / Thyristor sets instead of AC transformer sets. AC transformer sets are banned for welding jobs (both open and closed top type).
- 12.3) CONTRACTOR should get his welding sets certified by the EMPLOYER/CONSULTANT before start of the work. These certificates should have to be renewed every month. A copy of the certificates should be displayed on respective welding sets.

- 12.4) Only cables in good condition and insulated holders should be used. The length of supply cable to welding site should not exceed 8 metres and the welding set body should be properly earthed.
- 12.5) CONTRACTOR welder should not use a building structure, pipeline or railway track etc. as a return path of the current. Adequately rated circuit breaker should be provided in the power circuit for human protection on all power supply points.
- 12.6) Before starting any Hot work like Gas cutting, welding and grinding etc., the CONTRACTOR should obtain hot work permit from the EMPLOYER/CONSULTANT. The permit should be renewed on day-to-day basis.
- 12.7) CONTRACTOR should ensure purging of piping and equipment to make it totally safe before carrying out any hot work.
- 12.8) No combustible material should be stored on or near any source of heat like hot pipes, welding or gas. Before leaving the place of work or the CONTRACTOR'S sheds, the CONTRACTOR'S workmen should ensure that no material or item that could start a fire is left at site. Special attention should be paid to collection and disposal of oil soaked cotton waste or rags. On no account are these to be dropped into corners, pushed below equipment or left hanging on pipes.
- 12.9) CONTRACTOR must use gas cylinders in a safe manner. These should not be dropped from heights or dragged on the floor. Trolley with rubber rimmed wheels should be used for transporting gas cylinders within the site. All cylinders should be kept in upright position. Oxygen cylinders should not be kept near inflammable materials like oil etc.
- 12.10) Standard colour codes for the cylinder must be followed (Oxygen-Black, Acetylene-Maroon) by CONTRACTOR.
- 12.11) CONTRACTOR must provide the gas cutting sets with flash back arrestor at both ends (Cylinder and Torch) and gas cutting rubber tube ends fixed with the clamps.
- 12.12) CONTRACTOR must provide the fire blankets for fire protection and not tarpaulins in the vicinity of welding and gas cutting jobs.
- 12.13) CONTRACTOR must provide charged fire extinguisher of DCP / CO2 type with each welding/gas cutting set.
- 12.14) LPG shall not be used for cutting / heat treatment purpose (strictly prohibited).

13 ERECTION. LIFTING APPLIANCE AND GEAR

- 13.1) CONTRACTOR shall submit detail erection methodology and shall get the same approved by EMPLOYER / CONSULTANT.
- 13.2) CONTRACTOR shall mobilize the lifting appliance and gear in good working condition.
- 13.3) CONTRACTOR shall submit a valid Test Certificate to the EMPLOYER / CONSULTANT, from approved certifying authorities for all of his lifting gear and hoists, slings, chains, wire

ropes, hooks, chain-pulley blocks, winches, hoists and cranes etc. before commencing work.

- 13.4) These third party test shall be carried out at site by the CONTRACTOR
- 13.5) These certificates shall be available at site in the CONTRACTOR office for Inspection as and when required.
- 13.6) Full time mechanic shall be deployed to maintain all the lifting appliance and gear at site.

14 CLEANLINESS

CONTRACTOR must ensure cleanliness as an integral part of plant / project site outlook; the main obstacle to cleanliness in concrete batching plants, hot mix plants, grout mix plants, crushing plants, mine works, is the emission of fugitive dust. This must be fought by special care taken of the following:

- a) Material unloading & handling systems
- b) Equipments and workshops
- c) Unloading / Storage / handling of the materials
- d) Road systems.

It must be emphasized that the proper design and sizing of dust removal / extraction equipments is of utmost importance to ensure cleanliness; adequate & special care while designing & selection of machinery to be taken in the following dust prone areas:

- a) Cement Bag packing area.
- b) Cement Truck loading area.
- c) Adequate sizing of all dust preventing, dust collecting and dust suppression / recovery devices.
- d) Proper design, positioning, use and maintenance of dust control equipment.
- e) Proper design, positioning and maintenance of storage bins like silos, bunkers, screw conveyors etc.

15 MATERIAL HANDLING SYSTEMS

CONTRACTOR shall have Material handling systems such as loading and unloading areas, conveyor belts and transfer points used to handle materials as raw meal, additives, solid fuels, clinker, and cement, these be equipped with dust removal devices. While designing the conveyor systems CONTRACTOR must take special care to minimize transfer points & provide dust suppression to control fugitive emission.

16 EQUIPMENT AND WORKSHOP

CONTRACTOR shall ensure that all dusty work areas such as cement bagging, truck/wagon loading, mixing or weigh hopper landing must be properly ventilated and filtered adequate care of dust suppression to be taken while designing.

Also important to allow for cleaning away dust produced by various types of equipment if they breakdown or are taken apart. This capacity of cleaning must be included in equipment design and selection criteria. It must also be accounted for when designing work-areas.

17 STORAGE OF FINE MATERIALS

CONTRACTOR should ensure that fine materials stored in silos, must be equipped with adequate dust filtering equipment. Storage of fine materials in the open air or open buildings is only accepted at exceptional locations. These storage zones must be protected from the dominant winds either by strategic positioning or through artificial protection (walls, barns). Areas where fine materials are stored in the open must be equipped or designed in such a way that potential runoff from rain/storm water does not contaminate the environment; this means that runoff waters must be collected and settled before release to off- site receiving bodies.

18 SCRAP AND REFUSE BINS-REMOVAL SYSTEM

The CONTRACTOR shall ensure that he has sufficient waste bins that are identified for different wastes and maintained in clearly demarcated areas. Wastes with oily or other ignitable materials such as oily cotton wastes and hand gloves shall be stored separately with covers to prevent fires and shall be made of metal. Different wastes shall be segregated and stored separately and disposed off. These shall be emptied at routine intervals to prevent that they do not overflow with wastes.

18.1) Solid Waste Management

The CONTRACTOR shall ensure that he has sufficient waste collection bins categorised as hazardous and non-hazardous waste with specific names. Non- hazardous waste shall be disposed in environment friendly manner. CONTRACTOR shall maintain adequate records of hazardous waste disposed. The waste collection bins should be covered properly.

18.2) Vehicle Wash bay

The CONTRACTOR shall establish a wash bay near each entrance to the project site. All trucks/vehicles moving outside the site shall have the tyres washed prior to the site leaving the project site. This is to ensure that the roads outside the site are not dirtied / defaced by construction muck. The wash bays shall have submersible pump (1+1 backup) and a hose jet along with recyclable water for washing tyres. Dedicated workers would be manning the wash back at each time. Dump trucks to have lift covers on top to prevent muck/dirt/smell from flowing across roads.

18.3) Sedimentation tank

The CONTRACTOR shall establish that the trade effluent generated as a result of maintenance of concrete batch mixing plant / grout mix plant or washing any residuals of tests conducted on concrete, be properly routed to a designed and approved sedimentation tank. The

CONTRACTOR shall also periodically monitor and ensure the compliance to acceptable limits of the vital parameters of the treated water like pH, oil and chemical contents, BOD, COD, TDS, Turbidity etc or as prescribed under the conditions of consent to operate the plant before discharging.

19 PROTECTION OF WATER

Both surface water and underground water resources must be protected from all possible pollution be it chronic or accidental.

20 NOISE REDUCTION

CONTRACTOR must ensure noise does not represent a nuisance to neighbours, all measures must be taken to reduce emission of noise from equipment (crushers and/or grinders must be enclosed, as well as compressors, diesel generators; care must be taken in selection of low-noise blowers). Noise reducing devices / acoustical enclosures must be installed systematically on the noisiest equipment. CONTRACTOR must follow the statutory legislation for noise levels. Timely preventive and break-down maintenance of the equipment and machinery shall be carried out by CONTRACTOR in order to reduce the noise generation.

21 WASTE MINIMIZATION

CONTRACTOR must avoid or minimize production of waste with an objective to aim towards zero-waste. Production facility must be provided with all the necessary equipment to manage its wastes; storage, sorting, cleaning, preprocessing, and recycling. Temporary waste storage facilities should be designed in such a way as to control emissions to the atmosphere (volatile organics, fugitive dust) and to protect surface and underground water.

22 ASBESTOS

- 22.1) Use of asbestos under any form is strictly forbidden in all construction activities and facilities.
- 22.2) Only CONTRACTOR trained in removal of asbestos should be eligible for asbestos removal. All removal work should be managed and approved by the EMPLOYER / CONSULTANT.

1.0 SAFETY ORGANISATION

1.1 SAFETY AND HEALTH POLICY

The CONTRACTOR'S organisation shall have a written SAFETY AND HEALTH POLICY issued by the Chief Executive of the organisation, appropriate to the scale and nature of the risks involved in the CONTRACT works. A copy of the policy shall be made available to the PURCHASER at the time of the award of the CONTRACT in evidence of the CONTRACTOR's commitment to management of employee's safety & health and compliance to statutory and regulatory requirements. The policy along with its component operation procedures shall be evidenced as working document publicized among the CONTRACTOR's and his SUB-CONTRACTORS' employees through appropriate languages. All the CONTRACTOR'S

employees shall be familiar with the policy and their role and obligations in its implementation. The policy shall meet the relevant statutory and regulatory requirements and other requirements of the PURCHASER/CONSULTANT. The policy shall periodically be reviewed for updating with respect to new and emerging legal and other requirements.

1.2 SITE SPECIFIC SAFETY PLAN

The CONTRACTOR shall make detailed Site-specific Safety Plan which should include the nature of work, time frame, work force involved, hazards and control measures and shall get the same approved by the Employer/consultant. Method statements shall be attached with Site Safety plan and the approved Safety Plan shall be displayed prominently in the Contractor's site office.

1.3 SAFETY OFFICER:

The contractor shall designate a full-time Environment, Health and Safety (EHS) officer at the site. The EHS officer shall supervise, monitor and report on day-to-day compliance to requirements related to workers health and safety as specified in applicable laws, rules and regulations and EMP.

1.3.1) SAFETY OFFICERS QUALIFICATION:

The EHS officer shall be qualified for this responsibility with either Diploma or degree in civil/ environmental engineering with minimum 5 years of experience in construction safety with knowledge of NEBOSH and OSHA and shall have the authority to issue instructions and take protective measures to prevent accidents. Throughout the execution of the Works, the Contractor shall provide whatever is required by this person to exercise this responsibility and authority

1.3.2) The CONTRACTOR shall also nominate in writing competent Safety Appointees from various disciplines to assist the Safety Officer in implementation of safety measures in their routine contract works. The Safety Officer shall have sufficient authority to direct the CONTRACTOR's or his SUB- CONTRACTOR's personnel to meet Safety and Health requirements and to stop performance of work until such requirements are met.

1.4 EMPLOYEE CONSULTATIONS, SAFETY COMMITTEE & COMMUNICATION

1.4.1) The CONTRACTOR shall ensure full involvement of all his employees recognising their right to consultation on Safety, Health and Environment matters. The Safety officer shall be responsible for ensuring employees' involvement through routine Safety inspections, Hazard and Risk assessment in new and any changes in the work and their control. The CONTRACTOR shall maintain appropriate operating procedures to guide these requirements. The contractor shall plan, maintain and implement for entire Project duration, Training / matrix for regular SHE induction, job specific and specialized training programmes for all working levels.

1.4.2) The CONTRACTOR shall also appoint a Safety Committee comprising of the Safety Appointees from the various areas under the chairmanship of the Safety officer. Safety Officer shall report to Authority one level above the Contractor's Project In-charge. The committee

should also include representatives of Subcontractors. The committee shall meet minimum once in month to discuss the status and adequacy of the safety management, and any safety concerns of the employees. The committee shall also formulate and validate the safety procedures incorporating controls to prevent or mitigate hazards and risks before submission for approval by the EMPLOYER/CONSULTANT. Safety Officer shall maintain the records of the meetings and minutes of the Safety Committee meeting shall be submitted to the Employer/CONSULTANT.

- 1.4.3) The CONTRACTOR shall communicate to the employees regularly on job hazards applicable to their tasks in hand and hazards present on Project site. The Safety Appointees shall hold 'Toolbox Talks' or pep talks for this purpose on a routine basis before undertaking any safety critical and/or non-routine activities. Weekly meetings of the CONTRACTOR and his SUBCONTRACTORS attended by the Safety Officer and the Safety Appointee shall include safety as a key item in the agenda to discuss hazards and risk assessments, job safety analysis and control procedures and to review accidents and incidents (Near-miss) for remedial measures to prevent reoccurrence. The minutes of the meeting shall be submitted to the EMPLOYER/CONSULTANT. The Safety Officer shall maintain the records.

1.5 Insurance. Statutory Requirements:

- 1.5.1) CONTRACTOR should obtain Contract Labour License from Inspector of labour/Inspector of factories as per Contract labour act 1970.

- 1.5.2) All the Contractor's workmen should be covered by Site Specific Workmen compensation insurance or Group Workmen compensation insurance with site name endorsed for the project duration (Workmen Compensation Act 1923) or should cover under ESI (If the project location is in ESI Zone).

- 1.5.3) All the Contractor's workmen should be covered under EPF (Employee Provident Fund Act 1952).

- 1.5.4) All CONTRACTORS should comply with local statutory requirement:

- (i) Building and other Construction workers Act, 1996.
- (ii) Environmental protection Act, 1986.
- (iii) Factories Act, 1948.
- (iv) Indian Electricity Act, 2003.
- (v) Indian Boilers Act, 1923.
- (vi) Petroleum Act, 2002.

- 1.5.5) CONTRACTOR shall obtain CAR Policy / ESIC policy for the entire project value / duration.

- 1.5.6) Other Statutory requirements:

- (i) Electrical Equipment's, Scaffold materials, Gas cylinders, mechanical equipment and machineries which are deployed at site are as per IS code.
- (ii) Storage of combustible materials inside the project premises must be as per the allowable limits mentioned in the Petroleum act/Gas cylinder storage act.
- (iii) PPE's must be as per IS standard.
- (iv) CONTRACTOR is accountable for any statutory violations observed by the enforcement/ inspecting govt authorities.
- (v) In case of accidents, inside the project premises, the accountability lies with the CONTRACTOR.

1.6 CONTRACTOR'S MONTHLY SAFETY REPORTS

- 1.6.1) CONTRACTOR shall submit a monthly written report to the EMPLOYER/CONSULTANT, which shall be due on the fifth workday of every month. The Safety and health of all full time, part-time, permanent, temporary, contract employees and any outsourced employee undertaking any part of the CONTRACT works shall be included in the safety report. The report shall include the total number of working hours for the month, the number of recordable accidents and the number of lost-time injury /accidents. A cumulative trend plot of the monthly severity and frequency rate of the reportable incidents/ accidents shall be included in the Monthly safety report.
- 1.6.2) CONTRACTOR shall arrange to display the safety statistics and the cumulative plot of severity and frequency of accidents mentioned above painted on a board prominently displayed, as a means of encouragement and assurance to all interested parties and for publicising the safety achievements.

1.7 CONTRACTOR'S ACCIDENT/INCIDENT REPORTS/PENALTY SYSTEM

- 1.7.1) CONTRACTOR shall report orally, to the EMPLOYER/CONSULTANT regardless of their extent, duration and severity, immediately on occurrence of all incidents/accidents resulting in:
 - (a) Personal injury / Dangerous Occurrences
 - (b) Property damage
 - (c) Near misses
- 1.7.2) CONTRACTOR shall submit the accident / incident report in writing to the EMPLOYER/CONSULTANT within 24 hours of its happening in the form as prescribed by the governing statute or in the absence of which, in the form prescribed by the EMPLOYER/CONSULTANT. The CONTRACTOR shall detail in the 'Accident / Incident Report', the particulars of the dangerous occurrence leading to the accident, lost time of absence due to accident, root cause analysis and the corrective and preventive actions to prevent such recurrence. In addition, the CONTRACTOR shall include his estimate of the

impact of accident on project schedule. Incident including near miss cases shall also be reported in the same manner identifying root cause(s) to eliminate such potential occurrence or risks.

The CONTRACTOR shall ensure that corrective & preventive action is taken so that recurrence of the accident / incidents at one location on site shall not take place at other locations/sites.

1.7.3) Penalty clauses applicable to contractor/ sub contractor against non-compliance of SHE norms, requirements, terms, clauses and instructions given by employer / consultant / applicable statutory laws & requirements.

1.8 FIRST-AID PERSONNEL AND FACILITIES

1.8.1) CONTRACTOR shall ensure first-aiders (person who is well trained and can administer first aid) are available on site. The Contractor shall ensure that adequate numbers of first-aid boxes and or first- aid stations as per statutory requirements. The persons holding current certificates of competency of recognised institutions in prescribed numbers as per any governing statute. First- aiders' names shall be prominently displayed.

1.8.2) The First-aid boxes shall display contents of medical and medicinal articles with quantity maintained, which shall be in accordance with governing statute. Nominated first-aider shall replenish stock of first aid boxes promptly.

1.9 OCCUPATIONAL HEALTH CENTRE

1.9.1) CONTRACTOR should establish and maintain an Occupational Health Centre. (In case, Where the CONTRACTOR out-sources such facility, it shall meet the statutory requirements and shall be approved by the EMPLOYER /CONSULTANT and the statutory body).

1.9.2) Occupational Health Centre shall be served by a full time medical officer holding a medical degree in allopathic medicine with a minimum of five years experience in Occupational Health/Medicine. A male nurse, one dresser/compounder and one sweeper-cum-ward boy who will all be available during working hours.

1.9.3) Occupational Health Centre shall be capable of undertaking emergency care services or emergency treatment facilities which shall include emergency life saving aids and appliances to handle head and spinal injuries, severe fractures, snake bites, burns of all nature, electric shocks, cases of asphyxiation and such other severe injuries as could be reasonably anticipated at the facilities and shall meet provisions of any governing statute.

1.9.4) AMBULANCE ROOM AND AMBULANCE VANS: The CONTRACTOR shall arrange for an ambulance room and an ambulance van directly or outsource the facilities meeting the governing statutory needs for prompt transportation of serious cases of accident and or sickness to the hospital. Such facilities shall be maintained in good repair and equipped with facilities such as dry powder type extinguishers, flashlights, portable oxygen unit, self-contained breathing apparatus etc. as prescribed by the governing statute. Ambulance van shall be available round the clock.

1.10 INDUCTION AND JOB-SAFETY TRAINING

1.10.1) The CONTRACTOR shall maintain a procedure for identification of the training needs and training his employees to create a Safety and Health conscious workforce that will comply with the law and safety requirements of the organisation. He shall also maintain a procedure for safety induction and initial training as well as follow-up training on the job safety for new entrants. All employees shall receive effective training and periodic refresher training on the operation control procedures specific to their tasks designed to control the job-safety risks. A booklet of such operation control procedures and safety rules with need based pictorial illustrations shall be made available to all employees who are to learn and be familiar with such procedures. All training shall be monitored for effectiveness as per established procedures. The CONTRACTOR shall maintain records of all such training.

The induction program shall include the following:

- i) Site Safety and Health policy
- ii) Site entry and access.
- iii) Standard conditions of work in the site.
- iv) Site layout and arrangements such as rest rooms, storage and facilities.
- v) Emergency response procedures and escape routes.
- vi) Incident and near miss reporting.
- vii) Medical and welfare facilities.
- viii) Details of Work permit.

1.10.2) The safety officer shall conduct regular fortnightly or monthly mock-safety drills for different imaginary accident scenarios, in premeditated work areas to provide on-job training such as:

- i) Use of safety appliances such as water monitors, fire hydrants, fire hydrant pumps, fire-hoses, extinguishers, breathing apparatus and safety harness for working at height,
- ii) Response to health and safety emergencies,
- iii) Fighting fires using various equipment and
- iv) First-aid

1.10.3) Participants shall receive training during mock-drills through role-play of their normal expected tasks during emergencies and fire fighting. The degree of demonstrated ability in the chosen tasks during such safety drills shall be recorded as participants' competence level for planning his further training.

1.10.4) The Safety officer shall be trained on a standardised comprehensive advanced training programme covering safety management, legal aspects, techniques of Hazard identification and Risk assessment and specific Job- safety in various disciplines such as Civil, Electrical, Instrumentation and Mechanical plant and equipment of the CONTRACTOR. The training

records shall be maintained subject to audit by the EMPLOYER/CONSULTANT. Training effectiveness shall be assessed and recorded and used as input for further training plans of the employee.

1.11 SAFETY PROMOTION

Safety Posters, Banners and Slogans displayed for safety promotion shall be rotated at frequent intervals at the site locations. The CONTRACTOR is encouraged to have safety promotion as an item in the Safety Committee agenda. The CONTRACTOR is encouraged to include safety promotion programmes such as: safety competitions in slogan and poetry writing on safety, screening of safety films, celebration of National safety and Environmental day, safety suggestion schemes and safety library etc.

1.12 PURCHASE AND PROCUREMENT CONTROL

- 1.12.1) CONTRACTOR shall maintain a procedure for control of his purchases to ensure that all safety requirements are appropriately vetted by the safety personnel during all stages of procurement including planning of specifications, inspection for acceptance and commissioning in order that threats to safety are not overlooked and appropriate attention is paid to the training of personnel in the operation of the Contractor's new or changed machinery and their Operation & control procedures, to prevent/control risks.
- 1.12.2) CONTRACTOR shall exercise due diligence in appointing his SUBCONTRACTORS and outsourcing contract services, that no new safety or Health threats are created. The CONTRACTOR shall ensure personnel of SUBCONTRACTORS and outsourced contract services are competent in Safety, Health and Environmental management to meet the POLICY requirements. They shall be made aware of the safety rules, emergency procedures and any information that will have a bearing on the safety, health and related contractual obligations.

1.13 HAZARD IDENTIFICATION AND RISK ASSESSMENT (HIRA)

- 1.13.1) CONTRACTOR shall ensure that his key personnel and safety personnel are trained to be competent in Hazard identification, Risk assessment and risk control processes. The CONTRACTOR shall on a routine basis identify, evaluate and control all safety & health risks especially in the hazardous work activities and also to validate the previous risk assessments. Elements such as hazard identification, evaluation of risks with existing control measures in place and estimate of tolerability of the residual risks shall be an ongoing process. Any additional/new control measures shall be designed based on this process on need basis.
- 1.13.2) CONTRACTOR shall maintain a Hazard Identification, Risk Analysis and Control Manual (HIRAC) pertaining to all his activities duly updated as detailed above. The HIRAC for activities shall be made available to the EMPLOYER/CONSULTANT during regular inspections and audits.

1.14 WORK PERMITS

The CONTRACTOR shall maintain a work permit procedure. Essential features of the work permit system are as follows:

- 1.14.1) Clear identification of who may authorize particular jobs and who is responsible for specifying the necessary safety precautions.
- 1.14.2) Communication of instructions on the issue and use of permits.
- 1.14.3) Monitoring and auditing to ensure that the system works as intended.
- 1.14.4) The types of jobs requiring the control of a work permit are:
 - (i) Hot work of any type (e.g. Hot metal riveting, gas cutting, brazing, grinding, gouging, gas and electric welding) and Work which may cause uncontrolled hydrocarbon release, including any disconnection or opening of a closed pipeline, vessel or equipment containing flammable material.
 - (ii) Work at height above 1.2m / 4ft or those works at unprotected elevations that demands fall protection to prevent from falling or involving danger of dropped objects.
 - (iii) Work involving electrical isolation or work on live electrical systems and equipment.
 - (iv) Work involving the use of dangerous substance (Radioactive materials).
 - (v) Demolitions and Excavations.
 - (vi) Pressure testing.
 - (vii) Maintenance operations.
 - (viii) Entry into confined spaces.

The work permit issued under the procedure shall be valid for a specified period and shall be issued only after all safety precautions are fulfilled and duly verified by the concerned department engineer and safety officer (EMPLOYER/CONSULTANT). If deemed necessary the same work permit sheet may be revalidated to extent beyond the specified period provided the site conditions and the persons on job remain the same.

1.15 Job Safety Inspection:

- 1.15.1) Employer/Consultant will conduct planned inspections of the contractors work area and activities. The inspections will verify the contractor's safety records. The Contractor safety inspection will cover the safe behaviour of contractor employees, safe work condition of equipment in use and the safety and housekeeping of area where work is carried out.
- 1.15.2) Contractor also shall maintain a procedure for safety inspection at routine intervals to provide assurance that the instituted safety procedures are in place to prevent deviations from established standards that could lead to a safety hazard and consequential risk. The Contractor shall establish appropriate standardised checklist for systematic job safety verification to ensure
 - i) Set standard are followed without deviation.

- ii) Employees are competent to perform as prescribed operational control procedure.
- iii) Monitoring of safety of the various work areas/tasks.
- iv) Adequacy of existing operation reports and proposed remedial measures shall be submitted to the employers/Consultant.

1.16 Safety Audits

- 1.16.1) The Employer/Consultant shall retain their rights to audit the contractor's safety management system either directly by their employees or his nominated representatives for its effectiveness.
- 1.16.2) The contractor shall undertake periodic safety audits to confirm through investigative methods the effectiveness of the measures set out in policy. In order to be effective such safety audit shall be comprehensively covering all aspects detailed in the specification to ensure effective loss-control/accident prevention programme. Safety audits shall take into account the safety inspection records, remedial measures and effectiveness of the safety programme shall be based on the contractor's effective hazard identification and risk assessment processes for design of operational control procedures and on the safety statistics. Audit reports and preventive actions and safety improvement programmes shall be submitted to the Employer/Consultant.

2.0 EQUIPMENT. SUBSTANCES AND PERSONAL SAFEGUARDING

2.1 MECHANICAL SAFETY

- 2.1.1) The CONTRACTOR shall ensure that all his equipments and machinery are safe to use while in motion or working. Operators shall have received training or instruction on operation of the machinery and the regulatory requirements. The CONTRACTOR shall have adequate procedure to ensure the stability and securing of his working machinery during operation. He shall restrict repair and maintenance of the machinery to trained personnel and maintain records of repairs and maintenance. The equipment shall have appropriately designed means of isolating from sources of energy and shall have emergency stop control, which is easily accessible. All controls shall be clearly and uniformly marked. All operation controls, interlocks, sensing devices and guards on tools and equipment shall be functional and their status shall be regularly checked and recorded. The CONTRACTOR shall provide evidence of compliance to these requirements in any contractual write-ups submitted to the EMPLOYER/ CONSULTANT for approval in respect of critical construction/contract works.
- 2.1.2) The CONTRACTOR shall provide only good quality Hand tools and ensure control of condition, storage, routine inspection and use of such hand-tools.

Unsafe tools such as with cracked or broken handles, mushroomed chisels and punches, worn screwdrivers, hardened hammer heads; power tools with unsafe resistance to earth or without safety guards shall be strictly prohibited.
- 2.1.3) All safety ladders, scaffolding and such access equipment shall meet requirements of IS

3696 and IS 4014:1967 and such standards as the EMPLOYER/CONSULTANT may stipulate. The safety work permits shall be issued only after ensuring that all safety requirements of access equipment are complied with. Access equipment shall be inspected on a routine basis to prevent injuries caused by falls. It shall be the responsibility of the Contractor to provide safe work access to all work places.

- 2.1.4) The CONTRACTOR shall ensure safety of all those concerned with lifting and those who may be affected by material hoisting, lifting and handling using various mechanical aids. All lifting equipment such as cranes, hoists, lifting tools and tackles, shackles, hooks chains and links shall be designed as per appropriate international codes of construction. Operators shall have been trained in operation and maintenance of such equipment besides training on standard hand signals to be employed during the hoisting and lifting operations. Safe Working Loads (SWL) shall be marked on equipment prominently. SWL shall be evidenced to have been established by test procedures in accordance with acceptable codes of practices. Medical Examination of Operator & Signaller is mandatory.
- 2.1.5) Riding on construction equipment, forklifts and cranes shall be prohibited unless such vehicles are provided with passenger seats.
- 2.1.6) Pressurized gas and air systems shall be maintained safe in good working order and shall meet the requirements of the Factories Act 1948, The Static and Mobile Pressure Vessels Rules 1984 and the Gas Cylinder Rules 1934 as applicable.
- 2.1.7) The safety relief valves, safety appurtenances and isolation systems shall be compliant with safety code of practices. Any statutory register of pressure vessel records and the code of practices shall be subject to periodic auditing by the EMPLOYER/CONSULTANT. The CONTRACTOR shall ensure the pressurized gas and air systems are periodically tested by competent authority and records are maintained properly.
- 2.1.8) The areas of highly dangerous activities like hoisting, lifting and rock blasting, and radiation, shall be appropriately barricaded to protect personnel and machinery and guided by work permit discipline. Emergency plans shall cater to emergencies arising out of such activities.
- 2.1.9) Signs, barricades, barrier tapes and warning or entry restriction devices or accessories shall be provided to minimise work related risks of accidents and injuries. Signage shall meet all regulatory requirements such as under The Building and Other Construction Workers Act, 1996; Factory Act, 1948; Manufacture, Storage and Import of Hazardous Chemicals Rules under Environmental Protection Act 1986; Indian Explosives Act 1984 and Gas Cylinder Rules, 1981 and Indian Electricity Act, 1910 and Rules there of and any other safety requirements of the EMPLOYER/CONSULTANT.
- 2.1.10) CONTRACTOR shall follow the Environment Act 1986 and Rules framed there under. Devise and adopt appropriate noise control measure to maintain noise level at site reasonably below the acceptable statutory noise levels. Work area monitoring & Ambient Air monitoring for various parameters [i.e. Noise, Dust Water, SPM, SO₂, NO₂ etc.] to be checked through approved laboratory.

2.2 ELECTRICAL SAFETY

- 2.2.1) CONTRACTOR shall provide only such equipment for work that is electrically Safe to work. The CONTRACTOR shall have a procedure to identify and record all his electrical equipment in a register, with provisions to record his periodic inspections of such equipment. Inspection shall cover cables, extension leads, all electrical equipment drawing power from socket outlet. He shall identify and maintain in good working order all electrical installations such as distribution panels and major switchgear ensuring safe accessibility. A clear area shall be maintained around panels and switchgears. The installed equipment shall be periodically inspected by qualified personnel to ensure their continued safe operating condition. Inspection shall include earth polarity checks, continuity checks and earth resistance checks. The CONTRACTOR shall ensure use of flameproof and explosion proof switchgears and lighting fittings where required as per governing codes.
- 2.2.2) Approved earth leakage relays or alternative safety devices to relevant are and International codes shall be used on all portable electrical hand tools. Where possible low-voltage electric power supply shall be used for hand tools, earth leakage units shall protect electrical installations in workshops, kitchens, cafeterias, first-aid rooms, laboratories and offices. Record of regular checks shall be maintained. The CONTRACTOR shall comply with 'Code of Practice for Earthing as per IS: 3043.
- 2.2.3) Safety rubber matting of appropriate voltage rating conforming to IS 5424 entitled 'Rubber Mats for Electrical Purposes' shall be provided in front of all switchgears and power distribution panels for the safety of personnel operating such equipment.
- 2.2.4) CONTRACTOR shall arrange displaying signage under Indian Electricity Act 1910, such as:
- (i) Danger notices as per IS 2551 in conspicuous places on all Low, Medium and High voltages as per Rule 35,
 - (ii) Instruction of restoration of persons suffering from electric shock in English and local languages as per Rule 44 in switchgear rooms, substations and places where electricity is used and
 - (iii) Notice prohibiting unauthorized entry in areas where electrical apparatus are used.
- 2.2.5) All power cables providing construction power to various construction machinery and the connectors shall be in safe and sound condition. Cables shall be routed through cable trays supported on appropriately designed structures, duly clamped, secured and identified. Road crossing cables shall be laid in conduits buried at least 600 mm below the surface to prevent damage due to vehicular traffic. All cables shall be off the floor to avoid damage or tripping hazard. Cables shall be terminated at the switchgear and sockets in a workman like manner to prevent loose contacts and flashover. Only safety receptacles shall be used for providing power connection to hand-tools. All switches and distribution boards shall be clearly marked. All electrical distribution and panel wiring diagrams shall be available with the electrical maintenance personnel. The CONTRACTOR shall maintain a safe electrical isolation/Lockout - Tagout (LOTO) procedure.
- 2.2.6) The CONTRACTOR shall ensure lighting circuits are not used for hand-tools. No electrical

equipment shall be overloaded. Tools and test equipment used on electrical systems shall be insulated.

2.3 SUBSTANCES ABUSE PROGRAMME

2.3.1) The CONTRACTOR is encouraged to have a 'Substance Abuse Programme'. Drinking during working hours shall be strictly prohibited. The CONTRACTOR shall promote through poster and other publicity, awareness on abuse of substances such as alcohol and such depressant drugs that slows the activity of brain and spinal cord on abusive usage endangering the safety and health of users and others affected by their work.

2.3.2) No tobacco in any form shall be allowed in EMPLOYER project premises.

2.4 HAZARDOUS SUBSTANCES CONTROL

2.4.1) CONTRACTOR shall prevent all injuries, illnesses and damage to property or the environment caused by any article or substance, which proves to be hazardous. The code of practices of construction and operation and maintenance and control procedures shall meet required statutory and regulatory requirements. Personnel shall be trained on use, handling, storage, disposal and emergency spillage procedures.

2.4.2) CONTRACTOR shall detail and deploy operational controls to reduce hazardous wastes and their disposal as required by the statute 'Hazardous Waste (Management and Handling) Rules 2000'. Oil wastes, used oils, soil and cotton soaked in oil consequent to handling operations, grease and many class of paints and asbestos sheets and gaskets are typical hazardous wastes.

2.4.3) CONTRACTOR shall identify, contain and control all sources of radiation. Appropriate regulatory approvals shall be obtained before commencement of work involving radiation sources. Radiation protection advisors suitably qualified and experienced shall be appointed whose names shall be submitted to EMPLOYER/CONSULTANT. Surveillance of personnel engaged in such work shall be maintained in accordance with regulatory requirements.

2.4.4) CONTRACTOR shall prominently display Material Safety Data Sheets (MSDS) of all chemical, and hazardous substance used, handled, stored on site, and should ensure that these MSDS are available for reference to all employees at all times and displayed at site (preferably in local language) understandable by the workmen / labour.

3.0 PERSONAL SAFEGUARDING

3.1) PERSONAL PROTECTION EQUIPMENT (PPE)-General

The CONTRACTOR shall provide his employees required PPE meeting the requirements of the stated IS specifications and guidelines or equivalent International Standards as may be prescribed by the EMPLOYER / CONSULTANT from time to time. The CONTRACTOR shall have instituted good working procedures and practices in providing PPEs, maintenance, issue and training on their usages. All PPE shall be periodically checked to ensure worn, damaged equipment are replaced expeditiously.

3.1.1) Control Issue, Use and Maintenance of the PPE

Employees shall be responsible for the PPE issued to them. The CONTRACTOR shall meet requirements of IS 8519 entitled 'Guide for Selection of Industrial Safety Equipment for Body Protection' or any equivalent international specification that the PURCHASER/CONSULTANT may prescribe.

3.1.2) Head Protection

CONTRACTOR shall comply with requirements of IS 2925. Hard hats with chin strip shall be used and worn. Hard hats intended for use by visitors shall have replaceable paper lining.

3.1.3) Eve and Face Protection

Eye protection shall be worn during all operations by operators and people in the vicinity, where there is a danger of flying particles of metal such as generated during use of hand tools such as chisels, grinding, welding and cutting - lathe work on brass and cast iron, acid and alkali splash, high pressure jet cleaning or insulation removal from heights using high pressure jets. The CONTRACTOR shall meet the requirements of IS 8520 entitled 'Guide for Selection of Industrial Safety Equipment for Eye, Face and Ear Protection'.

3.1.4) Footwear

Safety shoes, boots and gumboots fitted with steel toe-caps of approved quality conforming to prescribed Indian or international standards. Wearing of unsafe safety shoes such as jogging shoes, tennis shoes, slippers and sandal etc. are prohibited. The CONTRACTOR shall meet the requirements of IS 10667 entitled 'Guide for Selection of Industrial Safety Equipment for Protection of Foot and Leg'.

3.1.5) Protective Clothing

CONTRACTOR shall prevent hazards of loose clothes worn by workmen getting caught in moving machine parts. Loose and thin garments such as dhoti and pyjamas are prohibited. While the CONTRACTOR shall ensure that all workmen wear long sleeved shirts, jackets or the like with the sleeves rolled down and secured at the cuff, long pants/ trousers extending upto the top of the safety shoes so as to prevent injuries caused by contact with heat, cold abrasive and sharp surfaces shall be strictly enforced. Such protective clothing shall be mandatory in hazardous areas especially during start-up operations involving hot, inflammable, and other chemical hazards, furnaces and boilers and such fired equipment and asphalting plants. Personnel exposed to acids and alkalis hot fluids and steam during such operations shall be provided with appropriate heat or corrosion resistant clothing. The CONTRACTOR shall meet the requirements of IS 8990 entitled 'Maintenance and Care of Industrial Safety Clothing'.

3.1.6) Hand Protection

CONTRACTOR shall provide appropriate hand gloves as per IS 8807 entitled 'Guide for Selection of Industrial Safety Equipment for Protection of Arms and Hands' to prevent injuries to hands during work. The CONTRACTOR shall maintain appropriate inventory of gloves for

different applications like acid and alkali handling, general-purpose work gloves and asbestos or heat resistant hand gloves etc.

3.1.7) Safety Harness

CONTRACTOR shall provide Full body Safety harness with double lanyard to workmen engaged for work in heights such as open-sided floors, open-sided scaffoldings, floor and roof openings, overhead construction works of various nature etc. where there is a falling hazard of two meters or above. Storage, issue, wearing and maintenance of full body safety harness with double lanyard shall be under strict supervision and records shall be maintained. Practices for safety harnesses and fall arrests shall conform to IS 4912, IS 11972 and IS 8519 or equivalent international codes.

3.1.8) Falling Object Protection

Where work is in progress in elevated areas, barricades, barrier tapes, signs and such entry restriction devices shall be used to keep area below clear of personnel to prevent injury due to falling objects. If work is required in the area below elevated work area, it shall be scheduled at a time different from elevated works.

The workmen below shall be protected from falling objects by the debris net or a catch platform with an adequate toe board to prevent material from falling off.

Use of safety net for elevated works shall be considered in the work-permits where appropriate. Where a lift is made above a working area, the area below the path of the lift shall be cleared of personnel during the lift and barricaded and guarded to prevent entry of persons generally in conformity with IS 4912, IS 11972 and IS 13416 for protective barriers in and around building and preventive measures against safety hazards in work places and safety requirements for floor and wall opening, railings and toe- boards.

3.1.9) Respiratory Equipment

CONTRACTOR shall maintain where appropriate, procedures for training and use of Self-Contained Breathing Apparatus (SCBA). The SCBA shall be provided together with lifelines and rescue teams to safeguard personnel working in areas where gases such as carbon monoxide, methane chlorine and such life endangering atmospheres are present. The CONTRACTOR shall meet requirements of IS 9623 for 'Selection, Use and Maintenance of Respiratory Protective Devices'. The CONTRACTOR shall have trained adequate number of personnel including the identified fire fighting teams, hose teams and SAs in the use of the SCBA. The CONTRACTOR shall use the periodic safety drills to demonstrate, train and establish competence of personnel in the use of SCBA.

3.1.10) Hearing Conservation

CONTRACTOR shall ensure reasonable precautions are taken to avoid injury to the hearing of the employees. All noise levels shall be controlled within 85 dBA. The CONTRACTOR shall identify noise areas and display caution boards in such noise areas where noise levels exceed prescribed safe level, the CONTRACTOR shall arrange for appropriate engineering control measures to minimise the noise level in such high noise level areas. Where this is

not feasible, appropriate earmuffs or ear protectors (ear plugs) shall be provided to workmen ensuring these are worn by those exposed to noise levels beyond safe levels. Periodic hearing acuity tests shall be conducted on such persons exposed to high noise levels to ensure that they do not suffer any hearing impairment as per requirements of IS 8520:1977, The contractor shall also maintain records of such medical tests. The CONTRACTOR shall devise training programme for awareness on effects of high noise hazards and control measures for all the employees.

3.2) MANUAL MATERIAL HANDLING AND ERGONOMICS

- 3.2.1) CONTRACTOR shall have procedures to identify risks involved in manual / material handling operation and tasks. The CONTRACTOR shall ensure appropriate training to prevent any possible injury. Full use of mechanical aids shall be made to avoid risks arising out of such manual handling. Employees shall be adequately trained on such manual tasks and related safety precautions to reduce the risk of injury to personnel engaged in such work.
- 3.2.2) CONTRACTOR shall undertake ergonomic study of manual operations to prevent musculoskeletal injury during manual handling, besides visual fatigue and mental stress giving considerations to matters such as seating, lighting and ventilation, etc.

4.1) FIRE PROTECTION AND PREVENTION

- 4.1.1) CONTRACTOR shall arrange to train his personnel meeting the prescribed qualifying competence needs, in requisite numbers in the operation of such fire protection equipment and systems.
- 4.1.2) Risk assessments shall be carried out to identify potentially vulnerable areas to provide sufficient quantities of correct type of extinguishers and ancillary equipment to deal with various types of fire hazards.
- 4.1.3) Where required under the CONTRACT the CONTRACTOR shall provide appropriate type of extinguishers close to areas of fire hazard but not too close they are cut off from use during a fire. Water based extinguishers shall not be positioned close to or used on electrical equipment.
- 4.1.4) Extinguishers shall be marked / labeled and recorded with location particulars in a register. These shall be inspected at monthly intervals to ensure they are in operable sound condition. There shall be a systematic plan for servicing, repairing and recharging fire extinguishers and for recording such dates on the register and equipment.
- 4.1.5) The location of fire fighting equipment shall quickly and easily be identifiable especially in emergencies in a conspicuous manner painted as high as possible to identify the location of the extinguisher to prevent it from being obscured by machinery and goods stacked in front and to return the equipment to its location after emergency use in other locations. In order to ensure this, 'Keep Clear' area shall be demarcated and maintained. Location plans of extinguishers and firefighting equipment shall be prominently displayed when desired by the EMPLOYER/CONSULTANT.

- 4.1.6) Safety Officer / Security shall be trained on fire fighting techniques who shall co-ordinate and control Fire protection and prevention programmes.
- 4.1.7) Where required under the CONTRACT, the CONTRACTOR shall maintain alarm systems powered by mains and by battery for back-up. Where required under the CONTRACT, emergency lighting shall be provided to aid evacuation in poor lighting conditions following the alarm. The alarm system shall be made known to all employees. When the EMPLOYER extends these facilities for use by the CONTRACTOR, he shall provide appropriate training to his personnel in the use of such emergency facilities and duties.
- 4.1.8) A clear written procedure for action in the event of fire should be produced. Fire teams and hose teams shall be identified and their responsibilities during emergencies shall be detailed in writing. Personnel shall be trained on their fire duties and use of fire-fighting equipment. Regular drills shall be conducted to test procedures and to validate them. Fire instructions and emergency procedures shall be displayed throughout the premises. Emergency response procedures are detailed under para 5.0 below.
- 4.1.9) A means of escape shall be provided in all work areas and storages and maintained and kept free from obstruction. All exits shall be clearly marked and kept unlocked whilst the premises are in use. Escape routes shall be protected from fire.
- 4.1.10) When a hot work permit is issued, the CONTRACTOR shall ensure:
- (i) Identification of combustibles such as paper, cardboard and wood and moving away from area where hot work is undertaken using open flame or electric arc.
 - (ii) Determination that flammable vapours and liquids are not present.
 - (iii) Protection of floor and wall openings to keep out sparks.
 - (iv) Determination that sprinkler hydrant and other installed fire fighting systems are functional.
 - (v) Establishing a fire-watch with fully loaded extinguishers or charged Water-hoses throughout the operation and 30 minutes after completion of operation
 - (vi) Adequate ventilation for welders, by means of natural air movement Local exhaust ventilators or air-line respirators as required.
 - (vii) Workmen performing the task are adequately briefed on job safety analysis, hazards and risks and the safeguards against risks.

4.2) SECURITY

- 4.2.1) Where required under the contract, security personnel shall do all that is reasonably practicable to ensure the safety of employees and property of the company in the face of accidents by fighting fires and containing losses due to pilferage, theft, vandalism and industrial espionage both by employees and external elements. Security personnel shall be appropriately competent and receive adequate safety training. Security personnel shall routinely report on a standardized basis on aspects such as violation of fire-protection rules,

use of alcohol and narcotic drugs, condition of security fencing, floodlighting and storages etc.

- 4.2.2) Where the project is located where a number of other companies are in operation, the CONTRACTOR shall plan for mutual assistance /off site programmes in cases of emergencies, as are practiced in the area in conjunction with the EMPLOYER.
- 4.2.3) Where common boundaries exist between companies, the CONTRACTOR in conjunction with the EMPLOYER shall co-ordinate security control over factors common: such as floodlights, fencing, pipelines containing gas, fuel and electricity.
- 4.2.4) Security personnel shall be represented in the Safety Committee through the Safety Appointees nominated from the area.

5.0) EMERGENCY PLANNING / EMERGENCY RESPONSE

- 5.1) CONTRACTOR shall plan to deal with onsite emergencies. An emergency planning/emergency response specific to the job site shall be written and communicated to all employees. The emergency planning/emergency response shall identify for the potential for and responses to incidents and emergency situations and for preventing and mitigating the likely illness and injury that may be associated with them.
- 5.2) CONTRACTOR shall review his emergency preparedness and response plans and procedures in particular after occurrence of incidents or emergency operations.
- 5.3) CONTRACTOR shall designate his emergency team with their duties during emergencies defined, including those of the hose teams, medical personnel, first-aiders and security. The CONTRACTOR shall maintain a procedure as to how his emergency organization shall liaise with the EMPLOYER/CONSULTANT representatives in the emergency planning/emergency response.
- 5.4) CONTRACTOR shall also periodically test such emergency procedures by conducting mock-drills and use the experience for updating the emergency planning/emergency response and for training the employees on the perceived competence needs.
- 5.5) The Emergency Planning/Emergency Response of the CONTRACTOR shall be under the control of the Safety Representative who shall be able to co-ordinate with the EMPLOYER/CONSULTANT for liaising with government agencies, neighboring industries and community.
- 5.6) The Emergency Planning/Emergency Response shall be designed to allow people to work under disaster conditions when normal services such as telephone water, light power, transport and sanitation are not available and first aid and fire fighting facilities are not able to cope with sudden demand on services.
- 5.7) The Telephone numbers of Ambulance, Police, Fire , Hospitals/ medical centers, Managers and the Employers key executives shall be prominently displayed in the identified Emergency Response Centre.

6.0) PREMISES AND HOUSE-KEEPING

6.1) ORDERLY WORK-PLACE

CONTRACTOR shall maintain a well-managed safe working place in sound clean condition. The CONTRACTOR shall ensure that there is a place for everything and everything in its place so that optimum use is made of valuable floor space with commensurate cleanliness and reduced handling time. He shall ensure that his entire infrastructure including temporary and semi- temporary buildings are kept clean and good repair.

6.2) GOOD LIGHTING-NATURAL AND ARTIFICIAL

CONTRACTOR shall provide lighting natural or artificial to enable work Processes are carried out safely. Artificial lighting shall be adequate especially in the nights and emergencies. The lumen levels shall meet the statutory requirements.

6.3) VENTILATION-NATURAL AND ARTIFICIAL

CONTRACTOR shall ensure that workplaces are ventilated with at least prescribed amount of clean or cleaned fresh air of a suitable temperature, especially where toxic or irritating substances are present such as welding, vehicle exhaust fumes, irritating dusts, organic solvents or any other inimical atmosphere creating health hazards or safety.

6.4) WELFARE AND HYGIENE FACILITIES

CONTRACTOR shall provide Welfare facilities to ensure a high standard of cleanliness for all activities and rest. The CONTRACTOR shall provide facilities for his employees such as ablutions, toilets change rooms, kitchens and cafeterias adequate and in a clean and hygienic state.

6.4.1) DRINKING WATER

The Contractor shall make in every place where building or other construction work is in progress, effective arrangements to provide and maintain at suitable points conveniently situated for all persons employed therein, a sufficient supply of wholesome drinking water.

6.4.1.1) All such points shall be legibly marked "Drinking Water" in a language understood by a majority of the persons employed in such place and no such point shall be situated within six meters of any washing place, urinal or latrine.

6.4.1.2) Container used to distribute drinking water shall be hygienic and clearly marked as to the nature of its contents and not used for any other purpose.

6.4.2) SANITATION ARRANGEMENTS.

Latrines or urinals, as the case may be, required to be provided shall be of the types as specified below.

6.4.2.1) Every latrine shall be under cover and so partitioned off as to secure privacy, and shall have a door and fastenings;

6.4.2.2) Where both male and female building workers are employed there shall be displayed outside each block of latrine or urinals a notice containing therein " :

- (i) For Men Only" or "For Women Only", as the case may be, written in the language understood by majority of such workers;
- (ii) Such notice shall also bear the figure of a man or a woman, as the case may be.
- (iii) Every latrine or urinal shall be conveniently situated and accessible to site workers at all the times;
- (iv) Every latrine or urinal shall be adequately lighted and shall be maintained in a clean and sanitary condition at all the times;
- (v) Every latrine or urinal other than those connected with a flush sewage System shall comply with the requirements of public health authorities.
- (vi) Water shall be provided by means of a tap or otherwise so as to be conveniently accessible in or near latrine or urinal;
- (vii) Wall, ceilings and partitions of every latrine or urinal shall be white washed or color washed once in every period of four months.
- (viii) Hand soap or similar cleaning agent shall be provided in each latrine.

6.4.2) CANTEENS:

6.4.2.1) CANTEENS AT LABOUR CAMPS:

- (i) In every place wherein not less than two hundred and fifty building workers are ordinarily employed, contractor of such building workers shall provide an adequate canteen.
- (ii) The canteen shall consist of a dining hall with furniture sufficient to accommodate building workers using such canteen, a kitchen, and store
- (iii) Room, pantry and washing places separately for building workers and for utensils.
- (iv) The canteen shall be sufficiently lighted at all the times when any person has access to it. The floor of canteen shall be made of smooth and impervious material and inside the walls of such canteen shall be lime-washed or colour-washed at least once every six months.
- (v) The precincts of canteen shall be maintained in a clean and sanitary condition;
- (vi) Waste water from canteen shall be carried away in suitable covered drains and shall not be allowed to accumulate in the surrounding of such canteen.
- (vii) Suitable arrangements shall be made for collection and disposal of garbage from canteens.
- (viii) Building of canteen shall be situated at the distance not less than 15.2 metres from any latrine or urinal or any source of dust, smoke obnoxious fumes.

- (ix) Site where workers can not avail canteen facility due some reason and are need to take food close to work place, at such locations contractor shall provide a separate place for food serving facility with sound hygienic principles and shall meet the applicable laws.

6.4.2.2 CANTEEN AT PROJECT PREMISES

- (i) Workers must not cook in the project premises.
- (ii) Workers shall carry the food from labour camps and shall have at designated lunch shed made by the contractor.
- (iii) Contractor should make shed for workers having lunch in designated location approved EMPLOYER/CONSULTANT.
- (iv) Workers having food in open / work location are strictly prohibited.

6.4.3 SAFETY, HEALTH AND WELFARE AT LABOUR CAMPS

- (i) The Contractor shall provide free of charge as near to it as may be possible, temporary living accommodation to all building workers employed by him for such period, as the building or other construction work is in progress.
- (ii) The temporary accommodation provided by the contractor shall have separate cooking place, Bathing, washing & lavatory facilities.
- (iii) As soon as may be, after the building or other construction work is over, the CONTRACTOR shall, at his own cost, cause removal or demolition of the temporary structures erected by him for purpose of providing living accommodation, cooking place or other facilities to the building workers and restore the ground in good level and clean condition.
- (iv) Colony/shelters constructed shall be situated at suitable heights where danger of water (waste or rainy) accumulation does not exists; as water accumulation ultimately leads to breeding ground for mosquitoes.
- (v) Shelters constructed at labour camp shall protect labourer/workers from rain, cold and heat. And shall be so constructed, equipped and maintained, so far a reasonably practicable, as to prevent the entrance or harbour of rodent, insect, and other vermin. A continuing and effective extermination program shall be instituted where their presence is detected.
- (vi) Electric supply shall be provided at labour camps for illumination purpose.
- (vii) Safe and Adequate potable water shall be provided at camps. The quantity of water shall be decided after taking number of persons residing in camp into consideration.
- (viii) Proper access shall be provided to the shelters.
- (ix) Labourers residing at camp shall be encouraged to maintain their camp clean by providing waste bins and waste disposal system.
- (x) Facility shall be created to drain out waste water. Drainage of camps/colony shall be connected

to drainage system or soak tanks to avoid water accumulation.

- (xi) Adequate toilets and washing facilities shall be provided for the labourers inside the camp.
- (xii) Safety & Health related posters shall be placed in the camp to increase safety and health awareness amongst the labourers.
- (xiii) First-aid facility shall be provided in the camp. Also few workers should be trained to render first-aid and fire fighting in case of emergencies.

6.4 POLLUTION TO GROUND, AIR AND WATER

- (i) The CONTRACTOR shall strive to exceed established minimum performance norms in waste and pollution control. All drains shall be identified as clean water and foul water to aid non-armful disposal. The CONTRACTOR shall ensure safe collection and disposal of solid, liquid and other waste, and ensure periodical cleaning of disposal bins, septic tanks and shall maintain the records.
- (ii) The CONTRACTOR shall have a System in place to segregate waste during construction and subsequent reuse or recycling.
- (iii) The CONTRACTOR shall take necessary measures to prevent construction activity pollution by controlling soil erosion and sedimentation as per the National Building Code (NBC) 2016 (amended upto date) guidelines. The Top soil shall be stacked and reused for land scaping, wherever applicable/ reused suitably.
- (iv) The CONTRACTOR shall take necessary measures to control dust generation at site and roads by sprinkling water at regular interval.
- (v) The CONTRACTOR shall conduct periodic ambient air quality monitoring through approved lab to check the pollution levels at the site particularly in areas where batching plant shall be maintained by the CONTRACTOR and produced to EMPLOYER/ CONSULTANT.

6.6 Covid 19 Safety Measures

The contractor shall comply with the covid 19 safety measures and standard operating procedures in accordance with the relevant government regulations and guidelines on COVID-19 prevention and control [or in the absence thereof, to international good practice guidelines such as those from the World Health Organization] and as specified in the Health and Safety COVID-19 Plan (HS-C19 Plan) and the Site-Specific Health and Safety Management Plan (SHMP). All the labours and workers, subcontractors and engineer staff shall wear the mask all the time, maintain social distancing and wash/ sanitize hands regularly.

Annexure -9
DATA SHEET NO.1

DESIGN REQUIREMENTS OF INTAKE STRUCTURE

One intake structure is to be constructed at LIS Jailang and LIS Doli as per the site selection by Senior Hydrogeologist of JSV Department and hydrogeological investigation carried out at site to establish/construct intake structure to meet out requisite water requirement of the project/scheme. The construction of intake structure should be as per site requirement and the top of the well/ floor of the pump house/panel room should be placed in a such way that during highest flood the water of the flooded river do not enter the highest flood level and HFL must be 1.5 mtr below the top the intake well/floor of the panel room/pump house.

SPECIFICATION FOR INTAKE STRUCTURE

1. Based on source feasibility studies X-Section of river covering proposed locations of intake structure are required to be taken. Scouring depth & lean period velocity of flow is required to be measured by the Bidder.
2. Bottom & foundation should be in accordance with enclosed drawing specification.
3. Proposed intake structure should be constructed with the direction of the Employer considering the local site conditions and methodology for construction shall be decided accordingly and Bidder should design the structure.
4. The bottom of the intake shall be cleared of unwanted material before plugging is started. Also, before starting the plugging, the water in the well must be still and up to its normal level.
5. The Bidder shall provide and maintain required decking guard, fencing, roping, planking, sign boards, red lights, etc. required to maintain safe pedestrian and vehicular traffic and for safety of persons and property.
6. A RCC Stair case from the bottom of the intake up to the top of intake
7. The Bidder himself has to arrange for necessary diversion of surface flow for isolating the site of work for construction of Intake Structure cum pump house and other allied works. The bund for diversion should be well formed in such a manner that there may not be any breach during the progress of work and the same should also be maintained in good condition till the work is completed.
8. The Bidder will be personally responsible for any damages caused to the work due to any breach in the diversion formed during the progress of work.
9. The proposed intake structure is to be very closed to water source thereby the entrance velocity is assumed as 0.5 cm/sec which is generally used.

Note: Material & construction shall be in accordance with providing standards, norms and guidelines.

Sr. No.	PARAMETERS	PARTICULARS		
1	Locations	LIS Jailang and LIS Doli (Gumber Khad)		
2	No. of Intake Structure	2 No.		
3	Ground level &Latitude/longitude of intake structure	Ground level	Latitude	Longitude
		690.00 mtr	31°05'51.0"N	76°54'58.0"E
		564.00 mtr	31°10'23.8"N	76°47'38.0"E
4	Total Height of Intake Structure	As per site requirement		
5	Dimension of Intake structure	As per site requirement		
6	Minimum Area of Pump room	12 Sqm.		
6	Type of structure	Rectangular RCC structure		
7	Minimum wall thickness	200 mm		
8	Grade of concrete	M 30		
9	No fine concrete	1:4 (1 Cement :4 aggregate 40mm)		
10	Roofing	RCC slab minimum thickness 150mm		
11	Walkway/passage	RCC stair inside from top to bottom of intake.		
14	Design Methodology	To be submitted by successful bidder duly vetted from NIT Hamirpur, PEC Chandigarh, IIT Delhi, IIT Roorkee and approved by Jal Shakti Vibhag		
15	Steel	Fe 500 as per latest BIS Specifications		
16	Cement	OPC 43 for water retaining structure and OPC 53 for other		

DATA SHEET NO.2

DESIGN REQUIREMENTS OF PERCOLATION WELLS

4 No. Percolation well are to be constructed at **LIS Datti**, at Pajeena Nallah for **LIS Pajeena**, at Gumber Khad for **LIS Chunad** and at Ali Khad for **LIS Daseran** as per the site selection by Senior Hydrogeologist of JSV Department and hydrogeological investigation carried out at site to establish/construct Percolation Wells structure to meet out requisite water requirement of the project/scheme. The construction of Percolation structure should be in a such way that it be 9.00 metre deep and the top of the well/ floor of the pump house/panel room should be placed in a such way that during the maximum water level of the khad do not enter pump house and HFL must be 1.5 mtr below the top the Percolation well/floor of the panel room/pump house. The structure should be RCC Circular in shape with 6 mtr. Internal diameter.

SPECIFICATION FOR PERCOLATION WELL

10. Proposed Percolation wells (4 Nos.) should be constructed with the direction of the Employer considering the local site conditions and methodology for construction shall be decided accordingly and Bidder should design the structure.
11. The Bidder shall provide and maintain required decking guard, fencing, roping, planking, sign boards, red lights, etc. required to maintain safe pedestrian and vehicular traffic and for safety of persons and property.
12. A RCC Stair case from the bottom of the well up to the top of well.
13. The Bidder himself must make all arrange for under water construction on the proposed site in the Ali Khad, Gumber Khad and Pajeena Nallah
14. The Bidder will be personally responsible for any damages caused to the work due to any breach in the diversion formed during the progress of work.

Note: Material & construction shall be in accordance with providing standards, norms and guidelines.

Sr. No.	PARAMETERS	PARTICULARS
1	Locations	At LIS Datti, LIS Daseran, LIS Pajeena and LIS Chunad

2	No. of Percolation well	4 Nos.		
3	Ground level & Latitude/longitude of Percolation wells	Ground level	Latitude	Longitude
		1262.00 mtr (LIS Pajeena)	31°16'03.9"N	76°59'08.5"E
		760.00 mtr (LIS Chunad)	31°15'18.9"N	76°53'54.4"E
		900.00 mtr (LIS Daseran)	31°15'18.9"N	76°53'54.4"E
		1603.00 mtr. (LIS Datti)	31°12'45.9"N	76°56'44.9"E
4	Total Height of Percolation well	10.00 Mtrs.		
5	Dimension of Percolation well	3 mtr. Dia and 9 mtr. Deep		
6	Type of structure	Circular RCC structure		
7	Minimum wall thickness	600 mm		
8	Grade of concrete	M 30		
9	No fine concrete	1:4 (1 Cement :4 aggregate 40mm)		
10	Roofing	Pre-painted steel sheet roofing mounted on steel trusses		
11	Walkway/passage	RCC stair inside from top to bottom of intake.		
12	Design Methodology	To be submitted by successful bidder duly vetted from NIT Hamirpur, PEC Chandigarh, IIT Delhi, IIT Roorkee and approved by Jal Shakti Vibhag		

DATA SHEET NO.3

DESIGN REQUIREMENTS OF PUMP HOUSE FOR CENTRIFUGAL PUMPS AT LIS Jailang, Doli, Datti, Daseran, Giana, Pajeena, Chunad, Palli, Beli Khol-1, Batiakh and Sour.

The plinth area and at above plinth level of Pump house Cum Chowkidar quarter etc. at LIS Jailang, Doli, Datti, Daseran, Giana, Pajeena, Chunad, Palli, Beli Khol-1, Batiakh and Sour. as per NIT. Pump house shall be sufficient for installation of panel board for centrifugal pumping machinery along with storage space T&P etc. The pump house shall be constructed aesthetically and well ventilated as RCC framed structure with Pre painted steel sheet roofing and RCC Roof. The pump house shall be constructed to provide positive suction for pumps, and it shall also have electric overhead gantry for easy movement of pumps and motors and the clear height of gantry girder shall be 4.00 mtr above floor level and head room above gantry shall not be less than 1.50 mtr. The thickness of pre-painted sheet shall be 0.60 mm. Foundation along with anchored bolt of suitable length for pump and motors shall be provided as per manufacture's requirement. Floor of pump house shall have proper arrangement for drainage and various cables running from panel board to motors. All the associated civil works including connections from sump well through inlet pipe, internal electrical wiring and necessary accessories like tube lights, ceiling fan, exhaust fan, LED lamps, furniture for control room & sitting area etc. supporting works to common header shall be done by the bidder/ firm after final approval of department. There should be proper arrangement for water supply, sanitary works along with septic tank as per technical specifications. The pump house shall have properly fenced with M.S. fencing panel fixed in brick masonry pillar in Cement mortar 1:6 and M.S. gate of 5.00 mtr width shall be provided as per drawing design and specification of structure as per provision in the N.I.T. The landscaping of the pump house complex shall be done by the bidder/firm so as to give good aesthetic appearance. Door and window frames, shutter shall be of Anodized Aluminium. The outer door & windows shall be in double shutter. Anodized Aluminium grill shall be provided in all double shutter windows internal wiring shall be properly concealed in P.V.C. conduits conforming to relevant BIS specification, civil structure shall be designed including gantry of required load of 5 M.T. gantry proposed for the pump house. Panel board shall be of standard make and model and shall be got approved by the Employer. Paver shall be provided in the premises of pump house cum chowkidar quarter, and the size, shape, texture and quality of Paver shall be got approved. For proper illumination of the premises 3 Nos LED flood lights fixed on 80mm dia, 6 mtr height above ground, M.S. pole fixed in ground by providing C.C. block in 1:2:4 complete in all respect. The cable trench of size 60x60 cm in S.R. masonry laid in cement mortar 1:5 to accommodate cable from transformer to pumps and automation room complete in all respect including earth work. The trenches shall be covered with removable M.S. grating in a length of 50 mtr or as per actual site of requirement. The rainwater open sub drains of size 30x30 cm in C.C. 1:3:6 shall be provided in a length of 50 mtrs around the pump house building or as per actual site requirement and main drain of size 45x45cm in a length of 15 mtr shall be provided. Foot path of width 1.00 mtr, 10 cm thick in C.C. 1:3:6 over stone soling of 15 cm thick in C.C. 1:3:6 shall be provided. The pump house shall be constructed aesthetically and well ventilated as RCC framed structure (as per site conditions) with RCC slab and should be designed as per seismic point earthquake zone V. The rate for construction of pump house cum chowkidar quarter shall include the provisions for all the items including site development complete in all respect and payment shall be made to the agencies as per the increase or decrease the area in sqm and preface to technical bid. The drawing design and specifications of the structures shall be as per the provision in the N.I.T and subject to final approval of the Dept. before execution of work. Plinth protection work shall also execute along with pump house and is part of BOQ item. There will be no separate payment for the same.

Sr. No.	PARAMETERS	PARTICULARS
1	No of Pump Houses At Jailang, Doli, Datti, Daseran, Giana, Pajeena, Chunad, Palli, Beli Khol-1, Batiakh and Sour.	9 Nos (35 Sqm) 2 Nos (70 Sqm)
2	Height of pump house above plinth (wall height)	5.0 Mtrs.
3	Plinth area of each pump house cum Chowkidar room and toilet	35 Sqm. And 70 Sqm
4	Live load on the pump house floor level (Kg/sqm).	As per relevant IS –875.
5	Live load on the pump house roof (Kg. /sqm).	As per relevant IS –875.
6	Flooring.	Kota Stone of specified size laid in floos.
7	Minimum thickness of outer wall	23 cm.
8	Type of structure.	R.C.C frame structure with Brick Masonry 1st Class) (Grade of Concrete – M-25)
9	Roofing	0.63mm thick pre-painted steel sheet roofing mounted on steel trusses.
10	EOHT (four metre above plinth level)	For 35 sqm. there will no gantry system. For 70 Sqm. Capacity shall be of 5 Tonne capacity.

11	Provision for fire fighting i.e., fire hydrants & fire extinguisher	Job
12	Flood light with complete accessories to the satisfaction of Engineer-in-charge at each pump house	3 No.
13	Steel	Fe 500 as per latest BIS Specifications
14	Cement	OPC 43 for water retaining structure and OPC 53 for other

DATA SHEET NO.4

DESIGN REQUIREMENTS OF DESILTING TANK AT LIS AT LIS Jailang, Doli, Datti, Daseran, Giana, Pajeena, Chunad, Batiakh, Ser-Delag, Sai and Sour.

Storage Reservoir		
Sr. No.	Description	Value
1	Type of reservoir	On the Ground
2	Material	RCC, M30
3	Shape	Conical Circular/ Intze as per approved design/ Intze as per approved design
4	Water Depth (m) and Structural Design and Drawing.	As per design, to be supplied by contractor and approved from the competent authority of HP Jal Shakti Vibhag.
5	Freeboard (m)	0.30
6	Tube Settler	Proper arrangement in the Desilting tank should be done for holding tube settler for removing requisite size of silt particles.
7	Storage Capacity (KL)	
8	Provisions	Verticle Fitting i.e Inlet Pipe, Outlet Pipe, Overflow Pipe, Scour Pipe with Valves and Duckfoot Bends, C/o Chambers with lock and key arrangement, Protection work with drain in and around the periphery of the service storage

		tank.
9	Soil Bearing capacity	To be carried out by agencies/Contractor
10	Size and type of ladder inside & outside of tank	MS/GI Pipe ladder/staircase (With proper steps and railing arrangement with comfortable rise and tread)
11	Design Methodology	As per IS:3370(Part 1 to 4 with Latest amendment) & other relevant BIS standards.
12	Sanitary Protection	1.00m high fencing over Brick masonry wall 1.50 m high ISA 50X50X5 mm posts @ 1.50m c/c with horizontal lines and two diagonals of Galvanised steel Barbed wire as per IS: 278:1962 as per approved design and drawing from the competent authority of HPJal Shakti Vibhag.
13	Manhole Cover	500mm dia SFRC (MC)-2 Nos, with locking arrangement.
14	Railing	MS Railing (Square hollow pipe of at least 1m height with 4 rows) of approved design and make .
15	Site development	PCC/RCC Retaining/Breast wall as per HPPWD/ HPJSV Specifications within battery limits i.e., 3.00 m from the edge of the structure.
16	Min. Depth below GL (m)	1.50m/ Depending upon the strata of site/soil bearing capacity.
17	Min. Inlet Pipe Size/Pipe(mm)	80mm GI.
18	Min. Outlet Pipe Size/Pipe(mm)	80mm GI
19	Min. Overflow Pipe Size/Pipe(mm)	80/MSERW Zinc Coated and shall be connected with distribution system.
20	Scouring arrangement	80 mm/MSERW Zinc Coated Pipe with C.I Sluice valve of approved make and of appropriate rating.
21	Steel	Fe 500 as per latest BIS Specifications
22	Cement	OPC 43 for water retaining structure and OPC 53 for other
23	Particle size	0.002 mm

DATA SHEET NO.5

DESIGN REQUIREMENTS OF RCC STORAGE TANK UNDER KUNIHAR and NALAGARH BLOCK.

Sr. No.	PARAMETERS.	PARTICULARS	
1 (a)	Construction of RCC Storage Tanks	<i>At Chunad, Doli, Batiakh and Palli 100 KL-GL At Sai and Giana 150 KL-GL At Jailang, Ser-Delag and Sour 200 KL-GL At Datti, Daseran and Pajeena 300 KL-GL</i>	
2	Average Ground level of plot.	As per plan	
4	Minimum water depth.	As per design	
5	Free board	0.30 mtr.	
6	Inlet size /type of pipe	80,100,125, 200 and 300 mm	
7	Outlet size/type of pipe.	80,100,125, 200 and 300 mm	
8	Size/type overflow pipe.	80,100,125, 200 and 300 mm	
9	Size/type of scour pipe.	80,100,125, 200 and 300 mm	
10	Type of structure.	R.C.C as per design	
11	Grade of concrete.	M 30	
12	Steel.	Fe 500 as per latest BIS Specifications	
13	Soil bearing capacity.	To be carried out by agencies/ Bidder	
14	Shape of transit tank.	Circular	
15	Mode of ventilation.	Steel cage with CGI Sheet	
16	Size and type of ladder.	Angle iron 50X50X5 mm	

17	Size/type of Sluice Valve	100 mm Leader/ Kirloskar or any equivalent for each tank.	
18	Site Development	As per site requirement	
19	Cement	OPC 43 for water retaining structure and OPC 53 for other	

DATA SHEET NO.6

Remote Monitoring: -

The Automated Water Pumping Stations with SCADA should have the capability to run with minimum manual intervention with inbuilt protection systems and remote access for protection, control, data collection and monitoring the devices from designated Master Stations (with different access levels from Sectional to Zonal Level). The vendor is advised to carry out field survey for finalizing the signal details (monitoring / control / protection), communication media and any other requirement as per his proposed architecture / system.

S.No.	Description	Particulars	To be furnished by the Tenderer
1	General		
1.1	Make	As per approved vendor list	
1.2	Item	PLC System	
1.3	Service	Plant Automation	
1.4	Area Classification	Non-Hazardous	
2	PLC System		
2.1	Type of Control system	Programmable Logic Controller (PLC)	
2.2	Offered PLC System configuration and PLC	Latest system available / being supplied in the international	

	system hardware	market by the manufacturer with proven performance record for the similar type of application	
2.3	Operating System windows based	Windows –11 or latest.	
2.4	Hierarchical protection for operator & engineer functions	Multi-level security required	
2.5	UPS – Input-415V AC, 3Ø, 50 Hz Output- 230 V AC, 1Ø, 50 Hz	UPS of adequate capacity with battery back-up of min. 1hour (SMF Nickel-Cadmium batteries).	
2.6	No of UPS feeders (outgoing)	Bidder to indicate	
2.7	UPS sizing	Bidder to indicate. Adequate capacity UPS considering 30 % spare load.	
2.8	UPS Battery back-up time	Min. One (1) hour	
2.9	Response time (Maximum) for		
2.10	Analog input	250 m sec	
2.11	RTD	1 sec	
2.12	Digital Input / output	25 - 50 m sec	
2.13	Loop cycle time inclusive of controller processing time	250 m sec (Analog) ; 100 m sec (Digital)	
2.14	Auto switchover time to backup/redundant component at a) Processor level b) Communication level c) Power supply level	Instantaneous and bump-less (Bidder to indicate the time)	
2.15	Card changeover, card wiring removal or communication cable change shall be possible	PLC Card removal shall be hot swappable.	

	on-line (PLC running) without causing any process interruption		
2.16	Display Call up time in HMI monitor	1 sec or better	
2.17	Dynamic update time of parameters in the HMI monitor for measurement and control	1 sec. or better	
2.18	Spare capacity required in the control processor considering spare I/O channels and future I/O modules to be located in the spare I/o slots	Minimum 20 %	
2.19	Output status on controller failure	Configurable in engineering station	
2.20	Output status on power supply failure	Configurable for switching to fail safe mode	
2.21	Status indication for each channel in DI / DO card	LED indication required	
2.22	Power supply healthiness status in all modules	LED indication required	
2.23	Optical Isolation with IPR for DI / DO	Required	
2.24	Galvanic isolation for AI / AO	Required	
2.25	Fuse Protection for AI / DI modules	Required	
2.26	Fused terminals with LED indications for each DO and for Power supply to PLC	Required	
2.27	All I/O module status monitoring (Channel & Module level) in PLC system HMI & shall be from same processor family.	Required	

2.28	Self-diagnostics for all PLC modules	Required	
2.29	Control processor with floating point arithmetic capability	64-bit processor	
2.30	Capacity of RAM	2 MB minimum	
2.31	Spare capacity in RAM	Minimum 50 % including spare I/Os	
2.32	Processor Redundancy	Required. Dual redundant hot stand-by, Physical cable connectivity between primary and secondary controllers, loading of programs in primary controller alone.	
2.33	Power supply source redundancy with Auto changeover scheme.	Required. Shall be implemented at each PLC side.	
2.34	Power supply module redundancy in the PLC panel	Required	
2.35	Communication module redundancy	Required	
2.36	Failure of communication module/ data bus/ communication bus/Power supply module shall not lead to change over of Processor/CPU	Required	
2.37	Network & Network module redundancy	Required	
2.38	Hot redundant connectivity between processor to I/O rack	Required	
2.39	Primary and secondary indication on controllers	LED indication & also in MMI required	
2.40	Memory expandability	150% of offered capacity	

2.41	RAM with Battery back up	Minimum 72 hr without power.	
2.42	Supply of Flash RAM for memory /Program retention	Required	
2.43	Closed loop control	Redundant I/O system	
2.44	Open loop control (Logic, protection & interlock)	Non-redundant I/O modules	
2.45	Maximum number of channels in I/O modules - Analog I/O modules RTD, Thermocouple Digital I/O modules	 8 Channels (Differential type) 16 Channels 16 Channels	
2.46	Input – Output Philosophy		
2.47	Pump-Motor	Digital Input: Local / Remote Selector-1 No Run Feedback- 1No Stop Feedback- 1 No Overload Feedback- 1 No Digital Output: Start Command- 1 No Stop Command-1 No	
2.48	Level Transmitter	Digital Input: Level Very High-1 No Level High -1 No Level Low-1 No Level Very Low-1 No Analog Input: Level Transmitter- 1 No (wherever continuous Level monitoring is	

		required)	
2.49	Presseure Transmitter	Analog Input: Feedback: 4 - 20 MA-1 NO) (wherever continuous Pressure monitoring is required)	
2.50	Flow Meter	Analog Input: Feedback: 4 - 20 MA-1 NO) (wherever continuous Flow monitoring is required)	
2.51	Motorized Valve	Digital Input: Local / Remote Selector-1 No Open Feedback- 1 No Close Feedback- 1 No Overload Feedback- 1 No Torque Switch Feedback-1 no Digital Output: Open Command- 1 No Close Command-1 No Analog Input: Position Feedback (Applicable for Modulated Control Valve)-1 No Analog Output: position Reference (Applicable for Modulated Control Valve)-1 No	
2.52	Power supply to the field transmitters	Analog input module shall drive the connected field transmitter on 2 wire loops	
2.53	Interrogation voltage for Digital signals	24 V DC	
2.54	Concept of I/O grouping	a) No two identical / similar equipment shall be grouped in the same I/O module	

		b) I/Os related to equipment and I/Os related to its associated auxiliaries shall be connected to different modules. c) Inputs and outputs shall not be combined in a single module.	
2.55	USB ports on Operator station	4 nos.	
2.56	DVD R/W drives on Operator Station	One (1)	
2.57	Displays on HMI monitor	Process mimic displays, trend displays, system status, alarm displays, logs / reports etc. HMI software shall have minimum 100 pages with unlimited tags.	
2.58	Minimum no of plant mimics configurable	100	
2.59	Time activated logs	Periodic logs, shift report, daily report, status change log, Control system fault log	
2.60	Operator Workstation (OWS)	One no. Industrial grade OWS shall be considered. - Intel I5/ I8, Minimum 3.6 GHz processor or latest - 22" LED Monitor - 8 GB RAM min or better - 1 TB HDD - ASCII keyboard - DVD R/W Drive - Workstation model - Original OS & antivirus	
2.61	Engineering Workstation cum OWS	One no. industrial grade EWS cum OWS shall be considered. - Intel I5 / I8, Minimum 3.6 GHz processor or latest	

		- 22" LED Monitor - 8 GB RAM min or better - 1TB HDD - DVD R/W Drive - QWERTY Keyboard - Workstation model - Original OS & antivirus	
2.62	Annunciation System	Integral to the PLC	
2.63	Printers	One A3/A4 size colour laser jet printer (600 DPI resolution) shall be provided	
2.64	Hot Spare I/O modules	20 % (wired up & mounted) hot spare modules for each type of I/O module shall be provided in the panel	
2.65	Spare Channels in each I/O Module used	20 % (wired up) spare channels over the entire population of each type of module.	
2.66	Spare slots in the I/O rack (wired with connector)	20% additional slots/base in each rack shall be provided which shall be wired with connectors for future provision. This is in addition to the required 20 % (wired & mounted) hot spare modules.	
2.67	Fuse with led indication for I/O channels	- Individual for analog signals - Group of max 8 for digital channels	
2.68	PLC hardware	G3 rated	
2.69	SER	SER in PLC is envisaged for electrical signal only.	
2.70	Interposing Relays	24 V DC with freewheeling diode across the coil – Relay contact rating A at 230 V AC	
2.71	Panels / Cabinets	Self-Standing type with maximum height of 2200mm	

2.72	Mechanical features	a) 2 mm thick CRCA steel sheet for panel walls. 3mm thick removable gland plate b) 2.5 mm thickness for double doors c) Panel - door switch d) Fans and louvers e) Paint as per RAL 7035 f) Automated panel Illumination by push buttons g) Suitable enclosure protection h) Anti-vibration pad of minimum 15mm thickness.	
2.73	Panel Earthing	Safety earth for enclosure and electronic earth for PLC system.	
2.74	Control room	Air Conditioned.	
2.75	Quality Assurance	As per quality plan to be approved by the Purchaser / Engineer	
2.76	Inspection Requirements	Factory Acceptance Test & Site Acceptance Test as per procedure approved by the Purchaser / Engineer.	
2.77	Communication	The communication shall be redundant between the control processors and HMI as well as across processors and transmission rate shall be minimum 100 MBPS / 1GBPS through multi- port switch having FO ports, ensuring adequate number of spare ports. Also communication between control processors and I/O shall be redundant. PLC shall be provided with required number of Modbus ports. PLC shall have time synchronization facility with master clock directly connected to PLC cards.	
2.78	Undertaking for Spares & support	OEM's undertaking shall be furnished for Spares & service	

		support for minimum 15 years.	
2.79	Make of PLC	As per Approved List.	
2.80	Control Cabinets/ Consoles:		
2.81	Type & Constructional Features	- Indoor, Self-Standing type with maximum height of 2200 mm - Sheet Steel Thickness - 2.0 mm thick CRCA sheet for panel walls. 3mm thick removable gland plate. - Pant Finish as per RAL- 7032. - Enclosure Protection – IP54 - Anti-vibration pad of minimum 15 mm thickness.	
2.82	Accessories	- Panel - door switch - Fans and louvers - Panel Illumination Lamps	
	Consoles & Chairs	Consoles for OWS, EOWS & Printers. Two (2) nos. operator chairs (revolving type)	
	Software:		
	PLC Development License Software	Required	
	SCADA Development License Software	Required	
	SCADA Run Time License Software	Required	
	WorkStation Operating System License Software	Required	
	Air Conditioner:	Required	
	Air Conditioner minimum 2 Ton, 5 Star Rating with Copper Tubing, Fittings & Accessories.	Required	

Note: - Vendor/Make shall be got approved from Engineer in Charge before procurement of all the material and equipment.

Package 1 - Kunihar and Nalagarh block (Solan dist.) -Details of Major structures

Sr No	Block	Kunihar					
	Lift Irrigation Schemes	LIS Ser Delag			LIS Sai		
	Major Components	Size	Latitude (deg)	Longitude (deg)	Size	Latitude (deg)	Longitude (deg)
	Type of scheme	Functional			Functional		
1	Check dam		31.164402	76.933752		31.15922	76.872062
2	Percolation well						
3	Intake cum Pump House						
4	Desilting Tank	4mX3mX4			4mX3mX3	-	-
5	Collection Tank	-			-	-	-
6	Pump House				-	-	-
7	Pumping machinery				Submersible and centrifugal pumps as per BOQ		
8	Instrumentation, Control and Automation	-			-		
9	MDT -1	2 Lakh l	31.158311	76.935241	1.5Lac L	31.149427	76.873003
11	Rising main and distribution main						
a)	GI (Medium duty Class B)						
	80mm		1251m	-	-	-	-
	100 mm		879m	-	1901m	-	-
	125 mm		61m	-	28m	-	-
	150 mm		-	-	-	-	-
b)	GMSERW						
	125mm						
	200mm (4.8 mm thk)						
	250mm (4.8 mm thk)						
	300mm (4.8 mm thk)						

Notes:

* The depth of check dam below ground may vary and will depend upon geotechnical investigation works carried out at check dam site by contractor

1

2 For pump configuration of individual scheme refer BOQ,
The coordinates (Latitude/Longitude) of the individual structures mentioned above may vary and will be finalized during execution in consultation with JSV

3

4 Length of rising main and distribution main may vary during execution.

Package 1 - Kunihar and Nalagarh block (Solan dist.) -Details of Major structures

Sr No	Block	Kunihar					
	Lift Irrigation Schemes	LIS Jailang			LIS Datti		
	Major Components	Size	Latitude (deg)	Longitude (deg)	Size	Latitude (deg)	Longitude (deg)
	Type of scheme	New proposed			New proposed		
1	Check dam				Check Dam (L-15 m) & Percolation Well (Dia - 6 m)	31.212747	76.945795
2	Percolation well	-					
3	Intake cum Pump House	Framed Intake Structure	31.097031	76.913529	-		
4	Desilting Tank	3mX3mX3			4 X3 X3	-	-
5	Collection Tank	3mX3mX2			3 X3 X2	-	-
6	Pump House	6m X 4m	31.09774	76.915761	6mX4m	-	-
7	Pumping machinery				Submersible and centrifugal pumps as per BOQ		
8	Instrumentation, Control and Automation				Details as per BOQ		
9	MDT -1	2 Lac L	31.092993	76.914282	3 lac L	31.212468	76.9448
11	Rising main and distribution main						
a)	GI (Medium duty Class B)						
	80mm	1206m	-	-	181m	-	-
	100 mm	24m	-	-	13m	-	-
	125 mm	-	-	-	-	-	-
	150 mm	-	-	-	-	-	-
b)	GMSERW						
	125mm						
	200mm (4.8 mm thk)						
	250mm (4.8 mm thk)						
	300mm (4.8 mm thk)						

Notes:

* The depth of check dam below ground may vary and will depend upon geotechnical investigation works carried out at check dam site by contractor

1

2 For pump configuration of individual scheme refer BOQ,

The coordinates (Latitude/Longitude) of the individual structures mentioned above may vary and will be finalized during execution in consultation with JSV

3

4 Length of rising main and distribution main may vary during execution.

Package 1 - Kunihar and Nalagarh block (Solan dist.) -Details of Major structures

Sr No	Block	Kunihar					
	Lift Irrigation Schemes	LIS Daseran			LIS Giana		
	Major Components	Size	Latitude (deg)	Longitude (deg)	Size	Latitude (deg)	Longitude (deg)
	Type of scheme	New proposed			New proposed		
1	Check dam	Check Dam (L-20 m) & Percolation Well (Dia - 6 m)	31.255244	76.898454	Check dam	31.244797	76.971309
2	Percolation well						
3	Intake cum Pump House	-					
4	Desilting Tank	4mX4mX4	-	-	4 X3 X3		
5	Collection Tank	4 X3 X3	-	-	3 X3 X2		
6	Pump House	6mX4m			6mX4m		
7	Pumping machinery	Submersible and centrifugal pumps as per BOQ			Submersible and centrifugal pumps as per BOQ		
8	Instrumentation, Control and Automation	Details as per BOQ					
9	MDT -1	3 lakh l	31.249473	76.894591	1.5 Lakh L	31.240173	76.974058
11	Rising main and distribution main						
a)	GI (Medium duty Class B)						
	80mm	78	-	-	1205m	-	-
	100 mm	682	-	-	18m	-	-
	125 mm	-	-	-	-	-	-
	150 mm	23m	-	-	-	-	-
b)	GMSEW						
	125mm	2301m					
	200mm (4.8 mm thk)						
	250mm (4.8 mm thk)						
	300mm (4.8 mm thk)						

Notes:

* The depth of check dam below ground may vary and will depend upon geotechnical investigation works carried out at check dam site by contractor

1

2 For pump configuration of individual scheme refer BOQ,

The coordinates (Latitude/Longitude) of the individual structures mentioned above may vary and will be finalized during execution in consultation with JSV

3

4 Length of rising main and distribution main may vary during execution.

Package 1 - Kunihar and Nalagarh block (Solan dist.) -Details of Major structures

Sr No	Block	Kunihar					
	Lift Irrigation Schemes	LIS Panjeena			LIS Chunad		
	Major Components	Size	Latitude (deg)	Longitude (deg)	Size	Latitude (deg)	Longitude (deg)
	Type of scheme	New proposed			New proposed		
1	Check dam	Check Dam (L-20 m) & Percolation Well (Dia - 6 m)	31.267763	76.985687	Check Dam (L-20 m) & Percolation Well (Dia - 6 m)	31.112652	76.929169
2	Percolation well						
3	Intake cum Pump House						
4	Desilting Tank	4 X3 X3			4mX3X4		
5	Collection Tank	3 X3 X2			4mX3mX2		
6	Pump House	6mX4m			6mX4m		
7	Pumping machinery	Submersible and centrifugal pumps as per BOQ			Submersible and centrifugal pumps as per BOQ		
8	Instrumentation, Control and Automation						
9	MDT -1	3 Lac L	31.269976	76.985049	1 Lac L	31.121571	76.923856
11	Rising main and distribution main						
a)	GI (Medium duty Class B)						
	80mm	176m	-	-			
	100 mm	26m	-	-	2138m		
	125 mm	-	-	-	27m		
	150 mm	-	-	-			
b)	GMSEW						
	125mm						
	200mm (4.8 mm thk)						
	250mm (4.8 mm thk)						
	300mm (4.8 mm thk)						

Notes:

* The depth of check dam below ground may vary and will depend upon geotechnical investigation works carried out at check dam site by contractor

1

2 For pump configuration of individual scheme refer BOQ,
The coordinates (Latitude/Longitude) of the individual structures mentioned above may vary and will be finalized during execution in consultation with JSV

3

4 Length of rising main and distribution main may vary during execution.

Package 1 - Kunihar and Nalagarh block (Solan dist.) -Details of Major structures

Sr No	Block	Nalagarh					
	Lift Irrigation Schemes	LIS Doli			LIS Batiakh		
	Major Components	Size	Latitude (deg)	Longitude (deg)	Size	Latitude (deg)	Longitude (deg)
	Type of scheme	New proposed			New proposed		
1	Check dam				Existing Infrastructure "Protection works/ modification of Intake"	31.161782	76.79938
2	Percolation well						
3	Intake cum Pump House	Framed Intake Structure	31.173288	76.793891			
4	Desilting Tank	4mX3mX4			7mX5mX4m		
5	Collection Tank	4mX3mX2			4mX4mX4		
6	Pump House	6mX4m			6mX8m		
7	Pumping machinery	Submersible and centrifugal pumps as per BOQ			Submersible and centrifugal pumps as per BOQ		
8	Instrumentation, Control and Automation						
9	MDT -1	1 Lac L	31.168896	76.786228	1Lac L	31.159885	76.791063
11	Rising main and distribution main						
a)	GI (Medium duty Class B)						
	80mm						
	100 mm	1413m			1613m		
	125 mm	15m					
	150 mm						
b)	GMSERW						
	125mm						
	200mm (4.8 mm thk)				1846m		
	250mm (4.8 mm thk)						
	300mm (4.8 mm thk)						

Notes:

- * The depth of check dam below ground may vary and will depend upon geotechnical investigation works carried out at check dam site by contractor
- 2 For pump configuration of individual scheme refer BOQ, The coordinates (Latitude/Longitude) of the individual structures mentioned above may vary and will be finalized during execution in consultation with JSV
- 4 Length of rising main and distribution main may vary during execution.

Package 1 - Kunihar and Nalagarh block (Solan dist.) -Details of Major structures

Sr No	Block	Nalagarh					
	Lift Irrigation Schemes	LIS Sour			LIS Palli		
	Major Components	Size	Latitude (deg)	Longitude (deg)	Size	Latitude (deg)	Longitude (deg)
	Type of scheme	New proposed			New proposed		
1	Check dam	Existing Infrastructure "Protection works/ modification of Intake"	31.179203	76.789843	Tube well	31.136371	76.692082
2	Percolation well						
3	Intake cum Pump House						
4	Desilting Tank	10mX8mX4m					
5	Collection Tank	7mX6mX4m			3mX3mX2		
6	Pump House	6 m x8 m			6mX8m		
7	Pumping machinery	Submersible and centrifugal pumps as per BOQ			Submersible and centrifugal pumps as per BOQ		
8	Instrumentation, Control and Automation						
9	MDT -1	3 lac l	31.175205	76.809563	1 Lac L	31.146351	76.704374
11	Rising main and distribution main						
a)	GI (Medium duty Class B)						
	80mm	540m			4212m		
	100 mm	2696m					
	125 mm				31m		
	150 mm						
b)	GMSEW						
	125mm						
	200mm (4.8 mm thk)						
	250mm (4.8 mm thk)						
	300mm (4.8 mm thk)	2820m					

Notes:

* The depth of check dam below ground may vary and will depend upon geotechnical investigation works carried out at check dam site by contractor

1

2 For pump configuration of individual scheme refer BOQ,

The coordinates (Latitude/Longitude) of the individual structures mentioned above may vary and will be finalized during execution in consultation with

3 JSV

4 Length of rising main and distribution main may vary during execution.

Package 1 - Kunihar and Nalagarh block (Solan dist.) -Details of Major structures

Sr No	Block	Nalagarh		
	Lift Irrigation Schemes	LIS Beli Khol 1		
	Major Components	Size	Latitude (deg)	Longitude (deg)
	Type of scheme	New proposed		
1	Check dam	Tube well	31.136371	76.692082
2	Percolation well			
3	Intake cum Pump House			
4	Desilting Tank	3mX3mX2		
5	Collection Tank	3mX3mX2		
6	Pump House	6mX4m	31.626333	76.403328
7	Pumping machinery	Submersible and centrifugal pumps as per BOQ		
8	Instrumentation, Control and Automation			
9	MDT -1	2 Lac L	30.986518	76.730188
11	Rising main and distribution main			
a)	GI (Medium duty Class B)			
	80mm	709m		
	100 mm			
	125 mm			
	150 mm			
b)	GMSERW			
	125mm			
	200mm (4.8 mm thk)			
	250mm (4.8 mm thk)			
	300mm (4.8 mm thk)			

Notes:

* The depth of check dam below ground may vary and will depend upon geotechnical investigation works carried out at check dam site by contractor

1

2 For pump configuration of individual scheme refer BOQ,

The coordinates (Latitude/Longitude) of the individual structures mentioned above may vary and will be finalized during execution in consultation with JSV

3

4 Length of rising main and distribution main may vary during execution.

Drawing List - Providing Irrigation Facility under HP SHIVA Project for Kunihar and Nalagarh Block, District Solan (Himachal Pradesh) – Package - 1

S.NO.	DRAWING. NO.	TITLE
1	TCE.12503A-CV-3005-LM-31000	Topographical Survey of Ser-Delag Cluster
2	TCE.12503A-CV-3005-LM-31001	Topographical Survey of Sai Cluster
3	TCE.12503A-CV-3005-LM-31002	Topographical Survey of Jailang Cluster
4	TCE.12503A-CV-3005-LM-31003	Topographical Survey of Datti Cluster
5	TCE.12503A-CV-3005-LM-31004	Topographical Survey of Daseran Cluster
6	TCE.12503A-CV-3005-LM-31005	Topographical Survey of Giana Cluster
7	TCE.12503A-CV-3005-LM-31006	Topographical Survey of Pajeena Cluster
8	TCE.12503A-CV-3005-LM-31007	Topographical Survey of Chunad Cluster
9	TCE.12503A-CV-3005-LM-31008	Topographical Survey of Doli Cluster
10	TCE.12503A-CV-3005-LM-31009	Topographical Survey of Batiakh Cluster
11	TCE.12503A-CV-3005-LM-31010	Topographical Survey of Sour Cluster
12	TCE.12503A-CV-3005-LM-31011	Topographical Survey of Palli Cluster
13	TCE.12503A-CV-3005-LM-31012	Topographical Survey of Kosri Cluster
14	TCE.12503A-CV-3005-LM-31013	Topographical Survey of Baduan Bharmana Cluster
15	TCE.12503A-CV-3005-LM-31014	Topographical Survey of Beli Khol 1 Cluster
16	TCE.12503A-CV-3005-LM-31016	Topographical Survey of Kohla Cluster
17	TCE.12503A-CV-3005-LM-31017	Topographical Survey of Badhal Cluster
18	TCE.12503A-CV-3005-LM-31030	Key plan of Ser-Delag Cluster
19	TCE.12503A-CV-3005-LM-31031	Key plan of Sai Cluster
20	TCE.12503A-CV-3005-LM-31032	Key plan of Jailang Cluster
21	TCE.12503A-CV-3005-LM-31033	Key plan of Datti Cluster
22	TCE.12503A-CV-3005-LM-31034	Key plan of Daseran Cluster
23	TCE.12503A-CV-3005-LM-31035	Key plan of Giana Cluster
24	TCE.12503A-CV-3005-LM-31036	Key plan of Pajeena Cluster
25	TCE.12503A-CV-3005-LM-31037	Key plan of Chunad Cluster
26	TCE.12503A-CV-3005-LM-31038	Key plan of Doli Cluster
27	TCE.12503A-CV-3005-LM-31039	Key plan of Batiakh Cluster
28	TCE.12503A-CV-3005-LM-31040	Key plan of Sour Cluster
29	TCE.12503A-CV-3005-LM-31041	Key plan of Palli Cluster
30	TCE.12503A-CV-3005-LM-31042	Key plan of Kosri Cluster
31	TCE.12503A-CV-3005-LM-31043	Key plan of Baduan Bharmana Cluster

S.NO.	DRAWING. NO.	TITLE
32	TCE.12503A-CV-3005-LM-31044	Key plan of Beli khol 1 Cluster
33	TCE.12503A-CV-3005-LM-31045	Key plan of Kohla Cluster
34	TCE.12503A-CV-3005-LM-31046	Key plan of Badhal Cluster
35	TCE.12503A-CV-3082-FD-31059	Flow Diagram of Existing LIS Giana Cluster
36	TCE.12503A-CV-3082-FD-31060	Flow Diagram of Proposed LIS Ser-Delag Cluster
37	TCE.12503A-CV-3082-FD-31061	Flow Diagram of Proposed LIS Sai Cluster
38	TCE.12503A-CV-3082-FD-31062	Flow Diagram of Proposed LIS Jailang Cluster
39	TCE.12503A-CV-3082-FD-31063	Flow Diagram of Proposed LIS Datti Cluster
40	TCE.12503A-CV-3082-FD-31064	Flow Diagram of Proposed LIS Daseran Cluster
41	TCE.12503A-CV-3082-FD-31065	Flow Diagram of Proposed LIS Giana Cluster
42	TCE.12503A-CV-3082-FD-31066	Flow Diagram of Proposed LIS Pajeena Cluster
43	TCE.12503A-CV-3082-FD-31067	Flow Diagram of Proposed LIS Chunad Cluster
44	TCE.12503A-CV-3082-FD-31068	Flow Diagram of Proposed LIS Doli Cluster
45	TCE.12503A-CV-3082-FD-31069	Flow Diagram of Proposed LIS Batiakh Cluster
46	TCE.12503A-CV-3082-FD-31070	Flow Diagram of Proposed LIS Sour Cluster
47	TCE.12503A-CV-3082-FD-31071	Flow Diagram of Proposed LIS Palli Cluster
48	TCE.12503A-CV-3082-FD-31072	Flow Diagram of Proposed LIS Kosri Cluster
49	TCE.12503A-CV-3082-FD-31073	Flow Diagram of Proposed LIS Baduan Bharmana Cluster
50	TCE.12503A-CV-3082-FD-31074	Flow Diagram of Proposed LIS Beli khol 1 Cluster
51	TCE.12503A-CV-3082-FD-31075	Flow Diagram of Proposed LIS Kohla Cluster
52	TCE.12503A-CV-3082-FD-31076	Flow Diagram of Proposed LIS Badhal Cluster
53	TCE.12503A-CV-3082-FD-31077	Flow Diagram of Existing LIS Sour Cluster
54	TCE.12503A-CV-3082-FD-31078	Flow Diagram of Existing LIS Batiakh Cluster
55	TCE.12503A-CV-3082-FD-31079	Flow Diagram of Existing LIS Jailang Cluster
56	TCE.12503A-CV-3082-WS-31080	Network Drawing of LIS for Ser-Delag Cluster
57	TCE.12503A-CV-3082-WS-31081	Network Drawing of LIS for Sai Cluster
58	TCE.12503A-CV-3082-WS-31082	Network Drawing of LIS for Jailang Cluster
59	TCE.12503A-CV-3082-WS-31083	Network Drawing of LIS for Datti Cluster
60	TCE.12503A-CV-3082-WS-31084	Network Drawing of LIS for Daseran Cluster
61	TCE.12503A-CV-3082-WS-31085	Network Drawing of LIS for Giana Cluster
62	TCE.12503A-CV-3082-WS-31086	Network Drawing of LIS for Pajeena Cluster

S.NO.	DRAWING. NO.	TITLE
63	TCE.12503A-CV-3082-WS-31087	Network Drawing of LIS for Chunad Cluster
64	TCE.12503A-CV-3082-WS-31088	Network Drawing of LIS for Doli Cluster
65	TCE.12503A-CV-3082-WS-31089	Network Drawing of LIS for Batiakh Cluster
66	TCE.12503A-CV-3082-WS-31090	Network Drawing of LIS for Sour Cluster
67	TCE.12503A-CV-3082-WS-31091	Network Drawing of LIS for Palli Cluster
68	TCE.12503A-CV-3082-WS-31092	Network Drawing of LIS for Kosri Cluster
69	TCE.12503A-CV-3082-WS-31093	Network Drawing of LIS for Baduan Bharmana Cluster
70	TCE.12503A-CV-3082-WS-31094	Network Drawing of LIS for Beli Khol 1 Cluster
71	TCE.12503A-CV-3082-WS-31095	Network Drawing of LIS for Kohla Cluster
72	TCE.12503A-CV-3082-WS-31096	Network Drawing of LIS for Badhal Cluster
73	TCE.12503A-CV -3082-WS-31141	Proposed L-Section - LIS for Ser-Delag Cluster (Sheet 01 of 02)
74	TCE.12503A-CV -3082-WS-31142	Proposed L-Section - LIS for Ser-Delag Cluster (Sheet 02 of 02)
75	TCE.12503A-CV -3082-WS-31143	Proposed L-Section - LIS for Sai Cluster
76	TCE.12503A-CV -3082-WS-31144	Proposed L-Section - LIS for Jailang Cluster
77	TCE.12503A-CV -3082-WS-31145	Proposed L-Section - LIS for Datti Cluster
78	TCE.12503A-CV -3082-WS-31146	Proposed L-Section - LIS for Daseran Cluster (Sheet 01 of 03)
79	TCE.12503A-CV -3082-WS-31147	Proposed L-Section - LIS for Daseran Cluster (Sheet 02 of 03)
80	TCE.12503A-CV -3082-WS-31148	Proposed L-Section - LIS for Daseran Cluster (Sheet 03 of 03)
81	TCE.12503A-CV -3082-WS-31149	Proposed L-Section - LIS for Giana Cluster
82	TCE.12503A-CV -3082-WS-31150	Proposed L-Section - LIS for Pajeena Cluster
83	TCE.12503A-CV -3082-WS-31151	Proposed L-Section - LIS for Chunad Cluster (Sheet 01 of 03)
84	TCE.12503A-CV -3082-WS-31152	Proposed L-Section - LIS for Chunad Cluster (Sheet 02 of 03)
85	TCE.12503A-CV -3082-WS-31153	Proposed L-Section - LIS for Chunad Cluster (Sheet 03 of 03)
86	TCE.12503A-CV -3082-WS-31154	Proposed L-Section - LIS for Doli Cluster (Sheet 01 of 03)
87	TCE.12503A-CV -3082-WS-31155	Proposed L-Section - LIS for Doli Cluster (Sheet 02 of 03)
88	TCE.12503A-CV -3082-WS-31156	Proposed L-Section - LIS for Doli Cluster (Sheet 03 of 03)
89	TCE.12503A-CV -3082-WS-31157	Proposed L-Section - LIS for Batiakh Cluster (Sheet 01 of 03)
90	TCE.12503A-CV -3082-WS-31158	Proposed L-Section - LIS for Batiakh Cluster (Sheet 02 of 03)
91	TCE.12503A-CV -3082-WS-31159	Proposed L-Section - LIS for Batiakh Cluster (Sheet 03 of 03)
92	TCE.12503A-CV -3082-WS-31160	Proposed L-Section - LIS for Sour Cluster (Sheet 01 of 05)
93	TCE.12503A-CV -3082-WS-31161	Proposed L-Section - LIS for Sour Cluster (Sheet 02 of 05)
94	TCE.12503A-CV -3082-WS-31162	Proposed L-Section - LIS for Sour Cluster (Sheet 03 of 05)
95	TCE.12503A-CV -3082-WS-31163	Proposed L-Section - LIS for Sour Cluster (Sheet 04 of 05)

S.NO.	DRAWING. NO.	TITLE
96	TCE.12503A-CV -3082-WS-31164	Proposed L-Section - LIS for Sour Cluster (Sheet 05 of 05)
97	TCE.12503A-CV -3082-WS-31165	Proposed L-Section - LIS for Palli Cluster (Sheet 01 of 03)
98	TCE.12503A-CV -3082-WS-31166	Proposed L-Section - LIS for Palli Cluster (Sheet 02 of 03)
99	TCE.12503A-CV -3082-WS-31167	Proposed L-Section - LIS for Palli Cluster (Sheet 03 of 03)
100	TCE.12503A-CV -3082-WS-31168	Proposed L-Section - LIS for Kosri Cluster (Sheet 01 of 03)
101	TCE.12503A-CV -3082-WS-31169	Proposed L-Section - LIS for Kosri Cluster (Sheet 02 of 03)
102	TCE.12503A-CV -3082-WS-31170	Proposed L-Section - LIS for Kosri Cluster (Sheet 03 of 03)
103	TCE.12503A-CV -3082-WS-31171	Proposed L-Section - LIS for Baduan Bharmana Cluster (Sheet 01 of 03)
104	TCE.12503A-CV -3082-WS-31172	Proposed L-Section - LIS for Baduan Bharmana Cluster (Sheet 02 of 03)
105	TCE.12503A-CV -3082-WS-31173	Proposed L-Section - LIS for Baduan Bharmana Cluster (Sheet 03 of 03)
106	TCE.12503A-CV -3082-WS-31174	Proposed L-Section - LIS for Beli Khol 1 Cluster
107	TCE.12503A-CV -3082-WS-31175	Proposed L-Section - LIS for Kohla Cluster
108	TCE.12503A-CV -3082-WS-31176	Proposed L-Section - LIS for Badhal Cluster
109	TCE.12503A-CV-3082-WS-30581	Typical Sluice Valve Chamber Details
110	TCE.12503A-CV-3082-WS-30582	Typical Details for Thrust Block
111	TCE.12503A-CV-3082-RC-30583	Typical Details for Saddle Support
112	TCE.12503A-CV-3082-GA-30584	Typical GLSR Details (100000, 150000, 200000, 250000 Litre Capacity)
113	TCE.12503A-CV-3082-WS-30585	Typical Details for Scour Valve and Air Valve Chamber
114	TCE.12503A-CV-3082-GA-30586	Typical Details for Pump House
115	TCE.12503A-CV-3082-GA-30587	General Arrangement for Intake Well
116	TCE.12503A-CV-3082-WS-30588	Typical Details for Bedding And Trench
117	TCE.12503A-CV-3082-GA-30589	General Arrangement for Check Dam
118	TCE.12503A-CV-3082-GA-30590	Typical Detail for Desilting Tank
119	TCE.12503A-CV-3082-GA-30591	Typical details for ELSR
120	TCE.12503A-CV-3082-GA-30592	Typical details of Percolation Well
121	TCE.12503A-EL-4002-AU-40001	Typical SLD for LIS Pumping Station with 1W+1S units & LT Metering
122	TCE.12503A-EL-4002-AU-40002	Typical SLD for LIS Pumping Station with 1W+1S units & HT Metering
123	TCE.12503A-EL-4002-AU-40003	Typical SLD for LIS Pumping Station with 2W+1S units & HT Metering
124	TCE.12503A-EL-4002-AU-40004	Typical SLD for LIS Pumping Station having LT/ HT Motor Loads - General Notes & Legends

Draft Initial Environmental Examination

Project No: 53189-002

April 2022

IND: Himachal Pradesh Subtropical Horticulture Irrigation and Value Chain Addition Project (HPSHIVA)

Prepared by Department of Horticulture for the Asian Development Bank

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Currency Equivalents

Currency unit	–	Indian Rupee (₹)
₹1.00	=	\$0.0133
\$1.00	=	₹75.00

ABBREVIATIONS

ADB	–	Asian Development Bank
BOQ	–	Bill of Quantities
CC	–	Cluster Coordinator
CCF	–	Chief Conservator of Forests
CGWA	–	Central Ground Water Authority
CHPMA	–	Community Horticulture Production and Marketing Association
COVID-19	–	Coronavirus disease
DFO	–	Divisional Forest Officer
DG	–	Diesel Generator
DoH	–	Department of Horticulture
EARF	–	Environmental Assessment Review Framework
EIA	–	Environmental Impact Assessment
FPO	–	Farmer Producer Organization
GoHP	–	Government of Himachal Pradesh
GOI	–	Government of India
GRM	–	Grievance Redress Mechanism
ha	–	Hectare
HPSHIVA	–	Himachal Pradesh Subtropical Horticulture, Irrigation and Value Addition
IEE	–	Initial Environmental Examination
IUCN	–	International Union for Conservation of Nature
JSV	–	Jal Shakti Vibhag
LIS	–	Lift Irrigation Scheme
MSL	–	Mean Sea Level
MT	–	Metric Tonnes
NABARD	–	National Bank for Agriculture and Rural Development
NHM	–	National Horticulture Mission
NOC	–	No Objection Certificate
PCCF	–	Principal Chief Conservator of Forests
PIU	–	Project Implementation Unit
PMU	–	Project Monitoring Unit
PRF	–	Project Readiness Financing
REA	–	Rapid Environmental Assessment
SC	–	Scheduled Caste
SCEP	–	Stakeholder Consultation and Engagement Plan
SPCB	–	State Pollution Control Board
SPP	–	Strategic Procurement Plan
SPS	–	Safeguards Policy Statement
ST	–	Scheduled Tribe
WUA	–	Water User Association

NOTE

- (i) In this report, “\$” refers to United States dollars.

1. Executive Summary

- i. The proposed project, the Himachal Pradesh Subtropical Horticulture, Irrigation & Value Addition (HPSHIVA) Project (hereinafter called the “Project”) aims to showcase how systematic development of climate resilient horticulture plantation, complemented with climate compatible irrigation facilities, can facilitate enhancing farmers’ income, and return to agriculture sector to contribute to food security for the State and country.
- ii. The Project targets to increase income of at least 20,000 farmer households within seven districts of Bilaspur, Hamirpur, Kangra, Mandi, Sirmaur, Solan and Una (Project district) in subtropical areas of Himachal Pradesh (HP) by:
 1. bringing 8,000 ha of land under climate resilient horticulture production,
 2. expand climate-proofed irrigation facilities in a coordinated manner with the horticultural needs for 8,000 ha, and
 3. establish market access through value chain development of targeted crops.
- iii. The three key outputs of the project are:
 1. **Output 1 - Irrigated area expanded and sustainably operated** – under this component, it is aimed to extend irrigation facilities to 8,000 ha horticulture plantations (termed as horticulture clusters) being developed under Output 2 of this project.
 2. **Output 2 – Climate resilient subtropical horticultural production systems adopted** – about 8,000 ha of agricultural land will be transformed to horticulture plantation (clusters) of targeted crops.
 3. **Output 3 - Market access for subtropical horticulture farmers developed** – farmers will be supported with new collection centres, upgraded (existing) and new processing units, incubation and training centres and other management systems to raise farmers’ profitability and farm gate price of the produce.
- iv. The Project is being implemented in two parts – (i) HPSHIVA Project Readiness Financing (HPSHIVA- PRF): December 2020 – November 2022 and (ii) HPSHIVA ensuing loan: December 2022 - November 2029. The ensuing loan will be implemented in two phases, where in Phase I – about 4,000 ha of horticulture plantation is being developed and in Phase II – another 4,000 ha of horticulture plantation will be developed. The irrigation schemes are being identified in sync with the horticulture clusters.
- v. This IEE covers only the Phase 1 activities.
- vi. Therefore, following are the proposed interventions that will be implemented:
 1. **Horticulture Fields Development including Solar-powered GI fences and Drip Irrigation** - develop climate resilient high-density horticulture fields irrigated through lift irrigation schemes (LIS) connected drip irrigation systems. The fruits that have been identified for horticultural plantation include sweet orange, guava, litchi, mango, pomegranate, persimmon, plum and pecan nut. The Project also allows farmers to undertake intercropping of other water-resilient crops and green pasture of a given hybrid as well as beekeeping. However, intercropping and beekeeping are not part of project funding – it is on farmer’s cost. There are about 580 clusters that have been identified covering 4,000 ha (as Phase 1).
 2. **Drip Irrigation** – Installation of drip irrigation system that includes drip lines fitted with emitters/drippers at appropriate length as per plant spacing, and supply of water to the soil at the root zone level of crops in low rates (2-20 litres/hour).
 3. **Rehabilitation of Existing and Development of New Irrigation Facilities-** LIS of surface water is being proposed as main source of irrigation water under HPSHIVA. The River Satluj and River Beas, and their tributaries are the main perennial sources of surface water for the subtropical region of the State. These rivers are fed by Himalayan glaciers. Other than these, small rivulets, natural canals, and springs are the next best surface water sources for the State. In some of the clusters, in absence of any nearby

surface water source, tube well has been proposed. To irrigate 4,000 ha of horticulture land under Phase I, about 194 LIS schemes will be developed. Out of 194 total schemes, 56 are operational schemes, 30 are existing schemes, but are currently non-operational, and rest 108 are new schemes.

- vii. **Baseline Environment:** The project districts are located in the subtropical region of State. The climate of the subtropical consist of foothills and valley areas from 350 to 650 metres above mean sea level. There are four major seasons. Winter season lasts from November to February and ends in March; the summer season extends from March to June, followed by the monsoon period extending from July to September. The maximum precipitation occurs during July to September.
- viii. The target irrigation sites are at remote areas, besides river banks and Khads (rivulet). Thus, the ambient air quality and noise level are similar to that of rural areas. Similarly, the horticulture fields are at different villages, wherein the main activities are agriculture. Thus, the ambient air quality and noise levels are that of rural areas.
- ix. The subtropical region of the state is richly endowed with hilly terrain having an enormous volume of water for the catchment areas of Satluj (which covers 30.69% of the state), the Beas (24.5%). As per the Climate Change Risk and Vulnerability Assessment (CRVA) report, indicates projected increase in water availability in near future but leading reduced availability in the long-term period (by 2050). Thus, irrigation schemes being developed under project HPSHIVA are less likely to experience low/ no water availability from river sources; though they may get exposed to extensive flooding.
- x. The areas in absence of piped water source depends heavily on either groundwater or springs for both domestic and irrigation usage. The recent assessment of groundwater availability the Central Ground Water Board (CGWB) suggest slight improvement in availability from past overexploitation status. However, the ephemeral sources being tapped by the project has risk of low availability during no rainfall periods, primarily during winter months. Detailed Hydrological Assessment has been carried out of each source and the results of the same has been presented in the Screening Reports of the clusters.
- xi. The clusters are located in agricultural field hence only domesticated animals such as cows and buffalo are seen around the sites, primarily owned by the farmers who own land within cluster. The sites are also frequented by monkeys (Rhesus Macaque), a native primate in Himachal Pradesh. MoEFCC, through vide notification No. 804, dated 14 February 2019, declared Rhesus Macaque species of monkeys as vermin (pest animals) for a period of a year in 10 districts of Himachal Pradesh which includes all project districts. Consultation with the farmers also suggest presence of Indian Peafowl (*Pavo cristatus*). Indian peafowl is included in Schedule-I of Wildlife Protection Act 1972, indicates the high conservation value of species. Thus, the solar fencing in project will stop human and animal conflict and allow conservation of species.
- xii. The project districts are predominantly covered under forest (45%), extending about 2578.66 sq. km. The list of National Parks and Wildlife Sanctuaries in the state has been attached in Annexure 5. Since none of the clusters are within forest area, there is no apparent conflict between farmers and wildlife. In general, the vegetation found in the target sites are bamboo, Chir Pine, Oak, Deodar, Kail, Fir and Spruce in private lands.
- xiii. **Impacts.** The supportive plantation of horticulture plants will lead to soil conservation of the areas, turning many barren lands to cultivable lands, thus protecting them from erosions, surface runoff, and lead to increase infiltration of rain water. The project would also positively lead to creation of enhanced carbon sink. Solar fencing will avoid human and animal conflicts and save crops.
- xiv. The significance of impacts during construction and operation will be low to moderate, temporary and short-termed. Project may lead to reduction in water availability in abundant at the downstream during dry spells, especially during winter months when the region experienced low to no rainfall days. Operation of the developed plantation may increase application of fertilizers and pesticides. During construction period, other than local noise and air pollution from generation of dust and construction waste, there are risk of workers' safety working at heights; especially during laying of the rising mains. With the EMP in place, the potential impacts will either be eliminated or minimized to insignificant levels.

- xv. **Mitigation Measures.** The project is unlikely to cause adverse impacts that are irreversible, diverse or unprecedented. The environmental management plan will mitigate all anticipated environment impacts during pre-construction, construction, and operation stages for the project components. There will be no biodiversity and habitat related impacts on the natural landscape. Department of Horticulture will be responsible for environmental monitoring as a central level monitoring agency – the project management unit. Also, Jal Shakti Vibhag (JSV) will be responsible for monitoring all irrigation related activities as a project implementation unit. The semi-annual monitoring reports will be uploaded in the ADB website.
- xvi. **Public Consultation.** Consultations held as part of the project preparation, including safeguards documents, saw large-scale participation from the communities, and the disadvantaged and vulnerable groups. All responses were positive and the beneficiaries welcomed the support of the government and ADB.
- xvii. **Conclusion.** The HPSIHA Project will bring benefits to the local farmers and other people in the locality from the extended irrigation benefits. Based on the initial environmental examination (IEE) findings, there are no significant impacts, and the classification of the project as Category B per ADB Safeguard Policy Statement (SPS, 2009). The significance of impacts during construction and operation will be low to moderate, temporary and short-termed. With the EMP in place, the potential impacts will either be eliminated or minimized to insignificant levels. IEE will be updated when unanticipated impacts occur during the project implementation. EMPs will be updated as well based on the specific conditions of areas when beneficiaries and actual sites are defined. Throughout the implementation, environmental safeguard requirements of ADB SPS (2009) and relevant government policies will be complied by the project through the PMU and PIUs with the support from PISC.

2. INTRODUCTION

A. Project Description

1. About 90% of the population in Himachal Pradesh (hereinafter referred to as State) reside in rural areas and more than 60% of the population are engaged in agriculture¹. But the contribution of agriculture sector to the State's gross value added is only 15%. This has been mainly due to farmers moving away from farming as a result of low financial returns across the agriculture sector, especially in the subtropical region. The subtropical region in the State faces multiple challenges in terms of climate change (i.e., increasing temperature and rainfall uncertainties), developmental issues (i.e., lack of irrigation facilities), and damages caused by wild and stray animals.
2. The proposed project, the Himachal Pradesh Subtropical Horticulture, Irrigation & Value Addition (HPSHIVA) Project (hereinafter called the "Project") aims to showcase how systematic development of climate resilient horticulture plantation, complemented with climate compatible irrigation facilities, can facilitate enhancing farmers' income, and return to agriculture sector to contribute to food security for the State and country.
3. The Project targets to increase income of at least 20,000 farmer households within seven districts of Bilaspur, Hamirpur, Kangra, Mandi, Sirmaur, Solan and Una in subtropical areas of Himachal Pradesh by:
 - i) bringing 8,000 ha of land under climate resilient horticulture production,
 - ii) expand climate-proofed irrigation facilities in a coordinated manner with the horticultural needs for 8,000 ha, and
 - iii) establish market access through value chain development of targeted crops.

Figure 1: Districts covered under the Project



4. The three key outputs of the project are:
 4. **Output 1 - Irrigated area expanded and sustainably operated** – under this component, it is aimed to extend irrigation facilities to 8,000 ha horticulture plantations (termed as horticulture clusters) being developed under Output 2 of this project.

¹ Statistical abstract of HP 2019-20

5. **Output 2 – Climate resilient subtropical horticultural production systems adopted** – about 8,000 ha of agricultural land will be transformed to horticulture plantation (clusters) of targeted crops.
6. **Output 3 - Market access for subtropical horticulture farmers developed** – farmers will be supported with new collection centres, upgraded (existing) and new processing units, incubation and training centres and other management systems to raise farmers' profitability and farm gate price of the produce.
5. The Project is being implemented in two parts – (i) HPSHIVA Project Readiness Financing (HPSHIVA- PRF): December 2020 – November 2022 and (ii) HPSHIVA ensuing loan: December 2022 - November 2029. The ensuing loan will be implemented in two phases, where in Phase I – about 4,000 ha of horticulture plantation is being developed and in Phase II – another 4,000 ha of horticulture plantation will be developed. !. The irrigation schemes are being identified in sync with the horticulture clusters.

B. Outputs 1 and 2

6. **Cluster-based Approach** - Under the cluster-based approach, willing farmers in villages having adjoining fields can voluntarily agree to integrate land and convert their agricultural fields to horticultural plantations. As per baseline study conducted by the Project, it has been found that, of the land contributed by the farmers for the Project, about 16% is currently barren, as farmers are not able to cope with animal invasions and unmanageable climatic impacts. The rest 84% of the land is rain-fed farmland, wherein the farmers generally cultivate wheat, paddy, and maize, mostly for self-consumption. Only a few can manage commercial production – especially those with large parcel of lands (large farmers).
7. After agreeing to form clustered lands, farmers formally form a body identified as Community Horticulture Production and Marketing Association (CHPMA) and select common horticulture crop that they agree to grow, maintain, harvest and market collectively. For irrigation support, the Government of Himachal Pradesh either extends already existing irrigation schemes to clustered lands or develops new schemes to support farmers' water needs. Rain-fed agricultural fields and barren land (as observed from the Baseline survey), form part of the Project.
8. Activities undertaken to develop clusters and connect them to the irrigation schemes can be broadly divided into two categories:
 - i) Horticulture Fields Development – comprising of sub activities - a) fencing of clusters by solar-powered galvanized iron (GI) fences, b) field preparation, c) plantation, and d) installation of drip-irrigation system at fields.
 - ii) Rehabilitation of Existing and Development of New Irrigation Facilities and connecting them to the horticulture fields.
9. **Horticulture Fields Development** - the Department of Horticulture (DOH) continues to identify and assist at least 20,000 farm households to invest and develop climate resilient high-density horticulture fields irrigated through lift irrigation schemes (LIS) connected drip irrigation systems. The fruits that have been identified for horticultural plantation include sweet orange, guava, litchi, mango, pomegranate, persimmon, plum and pecan nut. The Project also allows intercropping of other water-resilient crops and green pasture (of a given hybrid), such as Mung bean, Wild Marigold, Ashwagandha, Turmeric, Urd, Peas, etc., between plantation rows. There are about 580 clusters that have been identified covering 8,000 ha. The 580 clusters will also be fenced by composite solar powered fences to protect the crops from wild and stray animals.
10. **Solar-powered GI fences** - At first, farmers collectively identify contiguous parcels of land (preferably not less than 10 ha). Such area is marked as cluster and later barricaded with solar-powered GI fences, which helps in protecting the cultivation from animal invasions.

Figure 2: Solar Powered Animal Proof Composite fencing



Source: Cluster site visits

11. **Field preparation** - Land is prepared by clearing the ground of any hurdles such as trees, bushes, stones, bricks, structures, etc. Thereafter, rows of raised beds as per given spacing are developed using soil from the same field. Then pits are dug within the rows of raised beds for plantation of crops' saplings. The farmers procure saplings from nurseries being developed and managed under HPSHIVA initiatives.

Figure 3: Field Preparation



Source: Department of Horticulture, Himachal Pradesh

12. **Crop Selection** – Crops of a given variety have been selected based on certain ecological parameters, i.e., altitude of the land, terrain aspects (flat, hilly, and direction against sun-facing), soil characteristics (type, pH, EC, drainage capacity), and climatic factors (temperature range, average rainfall, and frost). The ecological parameters considered were identified in consultation with the sector experts and the local horticulture university. Also, packages of practices have been developed for the farmers to follow and cultivate the crops free from pests/ diseases. Crops of the following varieties have been selected for cultivation.

Table 1: Selected Crops and their variety

Crop Name	Varieties
Citrus	Valencia, Hamlin, Natal, Pera, Westin, Jaffa, Blood Red, Mosambi
Guava	Shweta, VNR Bihi, Lalit, Hisar Safeda, Thai Pink
Litchi	Dehradun, Calcuttia
Pomegranate	Bhagwa
Persimmon	Fuyu, Jiro, Hachiya
Plum	Black-Amber
Mango	Mallika, Pusa Arunima, Chausa, Ambika
Pecan Nut	Mahan, Nellis

13. **Plantation** - Every cluster is supplied with the required variety and quantity of planting materials. To support future needs for planting materials under the Project, nursery development is also planned to be strengthened within the State.

Figure 4: Procurement of plant material from nurseries



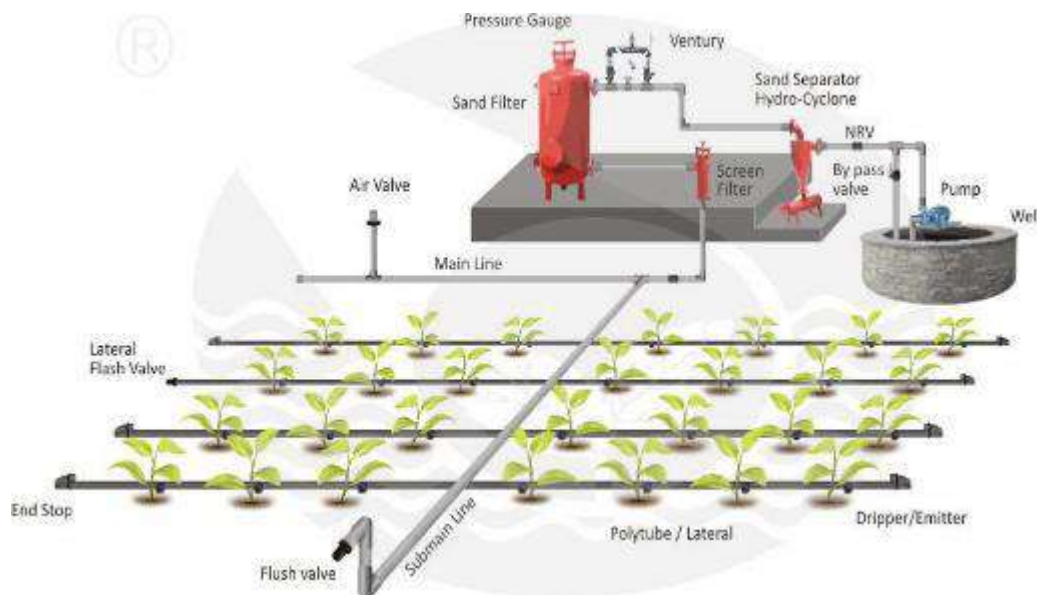
Source: Visit to nursery at Bhota & Neri, Hamirpur

14. **Water requirement for main-crop** – Factors influencing water requirement of crops are species and its variety, soil characteristics and climatic conditions (temperature and rainfall). All these have been mapped per cluster to arrive at total water requirement for the cluster. It is estimated that if a 10-ha land will be cultivated with selected crop varieties (at its maximum demand), it will require 100,000 litre/day of water storage tank at cluster level.
15. **Drip Irrigation** – Through drip lines fitted with emitters/drippers at appropriate length as per plant spacing, this system involves supply of water to the soil at the root zone level of crops in low rates (2-20 litres/hour). The amount of irrigation depends on water percolation rate, soil and crop requirements. Frequency of application of water is adjusted as per crop requirement and season of the year. Major components of drip irrigation system are as follows:

Table 2: Major components of Drip Irrigation system

1	Water Storage Tank	6	By-pass Assembly
2	Pump Station	7	De-silting Tank
3	Control Valves	8	Pressure Regulator
4	Fertilizer tank /Venturi	9	Laterals
5	Mains / Sub-mains	10	Emitters/Micro-tubes

Figure 5: Drip Irrigation system



16. **Mulching** – After installation of drip irrigation, plastic sheets are spread over the ground around plants to cover soil, and specially to protect roots of plants from heat (excessive evaporation) or cold, to keep soil moisture, and control weed growth.

Figure 6: Mulch laying in cluster



17. **Intercropping and Beekeeping:** Since productions of horticultural crops are expected to start after three years of plantation, farmers may require additional source of livelihoods during this period. Hence, to create alternatives for farm income and livelihood for project beneficiaries, concepts of intercropping and beekeeping are introduced. Crops such as onion, ginger, turmeric, wild marigold, pea, cowpea, cabbage, urd, etc. have been recommended by experts, after consultation with DOH. Similarly, beekeeping, also known as apiculture, ensures better pollination by intercrops. Farmers in the project clusters are allowed to carry-out beekeeping for additional source of income. Investment related to intercropping and beekeeping will be carried out by the farmers on their own and does not involve project loan. During growth of intercrops, water will be required for irrigation, which can be provided without any additional provision, as the irrigation infrastructure will already be in place for the main fruit crop.
18. **Rehabilitation of Existing and Development of New Irrigation Facilities (Output 1)** – LIS of surface water is being proposed as main source of irrigation water under HPSHIVA. The River Satluj and River Beas, and their tributaries are the main perennial sources of surface

water for the subtropical region of the State. These rivers are fed by Himalayan glaciers. Other than these, small rivulets, natural canals, and springs are the next best surface water sources for the State. In some of the clusters, in absence of any nearby surface water source, tube well has been proposed. To irrigate 4,000 ha of horticulture land under Phase I, about 194 LIS schemes will be developed. Out of 194 total schemes, 56 are operational schemes, 30 are existing schemes, but are currently non-operational, and rest 108 are new schemes.

- i. **Operational/ Functional schemes** - Functional schemes are those which are in working condition and in which water has reached up to delivery tank and some minor repair/ replacement of infrastructure components are envisaged.
 - ii. **Existing/ Non-functional schemes** - Non-functional schemes are those which are not in working condition and some of the components such as pumps, repair/rehabilitation/augmentation of source, rising main replacement are required. The degree of rehabilitation is scheme specific.
 - iii. **New Schemes** - In new scheme, entire irrigation system needs to be planned and designed from source to the main distribution tank located at/ near the cluster.
19. **Source Sustainability of Irrigation Water** – The source sustainability of water resources is estimated based on net availability in a water balance – (a) total rainfall in the catchment, (b) evapo-transpiration rate, (c) existing and future water demands in upstream and downstream riparian rights or, in absence of actual data, considered 80% of the flow, (d) water requirement for all clusters taken as 20 m³/day/ha, and (e) environmental flow and future demand at each source are taken as 15% and 20% yield respectively. Based on this, surplus or deficit has been calculated.
20. For sustainable operations and maintenance of irrigation schemes being rehabilitated and/or developed, a farmer-based association called Water User Associations (WUA) is being formalised at each cluster. The WUA will be governed through Water User Act for the State – being enacted as part of the project. The irrigation components of the project are being executed by Jal Shakti Vibhag (JSV) of the State.

C. Output 3

21. **Development of Post-Harvest Facilities** – These include design and construction of value chain infrastructures required for farmers' marketing organizations, such as collection centres, upgrading existing and building new processing units, establishing incubation and training centres and other capacity building activities. These infrastructures will be developed by CHPMA through grant support from HPSHIVA. Currently, no land or design requirements have been finalized, thus these are outside the purview of the IEE.

D. Other Project Information

22. **Project Proponent** – The Department of Horticulture (DOH), GOHP will be the Executing Agency, whereas both DOH and Jal Shakti Vibhag (JSV), GOHP will be the two implementing agencies for the project. A project management unit (PMU) has been established by DOH, led by the Project Director from DOH, who is being supported by one deputy director each from DOH and JSV.
23. **Environmental Categorization** – As first step of identifying environmental impacts, screening of project sites at the district level for environmental sustainability is carried out. This commenced with filling-up the ADB's Rapid Environmental Assessment (REA) checklist for irrigation sector, as maximum adverse impacts of the project are envisaged from civil works for rehabilitation and development of irrigation schemes. Refer to the accomplished checklist under Annexure 1.
24. As concluded from screening exercise, civil works for development of irrigation schemes are likely to cause potential site-specific environmental impacts, but none that have significant adverse environmental impacts, that are irreversible, diverse, or unprecedented in nature. Also, the impacts can be mitigated by applying appropriate design measures and by following the best environmental practices during construction. The activities to be undertaken for the development of horticulture fields including the laying of drip-irrigation

systems are likely to cause minimal environmental impacts. **Hence, the project has been categorized as an environmental “Category B” project.**

25. From the point of view of environmental assessment, neither the project nor any of the activities proposed in the project attract provisions of the Environment Impact Assessment Notification (2006), and none require any prior environmental clearance either from the Union or from the State Government regulators.

E. Purpose of this Report

26. This Initial Environmental Examination (IEE) report follows the requirement of ADB's Safeguard Policy Statement (SPS) of 2009 and its relevant annexures (i.e., Appendix 1 – Safeguard Requirements 1: Environment).
27. **Scope of IEE:** This IEE covers about 4,000 ha of horticulture fields and the associated irrigation schemes, those that have been designed under Phase I of the ensuing loan. For the upcoming 4,000 ha, an environmental assessment and review framework (EARF) has been developed and same should be followed for safeguard screening and assessment of forthcoming subprojects. The subproject selection will be in accordance with the environmental project selection criteria, as outlined in this EARF. For assessment of associated structures to the ensuing loan, a separate Due Diligence Report has been prepared for the performance of PRF Clusters, i.e., clusters developed under PRF funding.
28. This IEE captures the environmental setting of all the proposed project sites (for 4,000 ha in Phase I) including physical, biological, and socioeconomic conditions and the national and local legal setting, as well as international environmental agreements that are relevant to the project.
29. Based on these, the IEE further identifies and analyses potential direct, indirect, cumulative, and induced impacts and risks to physical, biological, socioeconomic, and cultural resources, in context to project's area of influence. The area, at the radius of 500 m surrounding the target sites, has been considered as the project area of influence. It then suggests mitigation measures including occupation and community health and safety measures (including precautions for COVID-19 infection).
30. **Limitations** – Preliminary engineering designs, the proposed technology, and Bill of Materials (BOM), among others, were provided to the safeguard team to document the sub-projects' descriptions. However, the information of the actual designs, technological specifications and final cost estimates will be completed by the engineering, procurement, and construction (EPC) contractors. Thus, where applicable, the team has utilized the secondary information of the sub-project areas gathered from site visits, consultations, review of relevant ongoing projects in the State^{2,3} and elsewhere in India, and professional experiences in similar projects.

² Himachal Pradesh Horticulture Development Project - P151744, Department of Horticulture, Himachal Pradesh, World Bank Funded;

³ Integrated Project for Source Sustainability and Climate Resilient Rain-fed Agriculture in Himachal Pradesh, World Bank-funded, Project Concept Stage;

3. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

31. The implementation of the project's environment safeguards will be governed by relevant national laws and state's environmental rules, regulations, and standards, and social rules as well. These regulations impose restrictions on activities to minimize and mitigate likely impacts on the environment and community and setting standards to regulate the disturbances due to the proposed Project's schemes. Compliance is required in all stages of the project's implementation including design, construction, and maintenance phases. The IEE report has greatly considered the ADB's Safeguards Policy Statement (SPS) 2009 requirements. Provided that the project complies with the national and ADB SPS 2009 requirements, the potential environmental and social implications and risks will be mitigated during the implementation of the project activities.

A. Applicable National Regulatory Laws and Notifications

32. The Ministry of Environment, Forest and Climate Change, Government of India (MoEFCC) has the overall responsibility to set policy and standards for the protection of environment along with the Central Pollution Control Board. Their policies cover air, noise, and water quality standards, and the requirements for preparing environmental impact assessment statements for development projects (if applicable). These standards are of significance for the proposed Project. Salient features of relevant environmental and labour laws and regulations, including their applicability to the sub-projects are detailed below. The following table shows the summary of the regulatory laws.

Table 3: Applicability of environmental and labour laws and regulations

Law/Act	Description	Applicability/ Compliance
The Environmental (Protection) Act, 1986, and the Environmental (Protection) Rules, 1987-2002 (various amendments)	Umbrella Act. Protection and improvement of the environment. Establishes the standards for emission and discharge of parameters in the atmosphere. All environmental notifications, rules and schedules are issued under this act	In this Act, unless the context otherwise requires, defines unit "environment" that includes water, air and land and the inter- relationship and further provision the need for Air, Water, Noise and Waste Management Acts. As the project is envisaged to cause air, water, noise pollution and waste generation, hence this Act is relevant to the project.
The EIA Notification, 14th September 2006 and subsequent amendments	To accord environmental clearance to new development activities listed in schedule of EIA notification.	The proposed activities under the project are part of minor irrigation schemes with less than 10 ha CCA, thus prior EC is not required as per Draft EIA notification 2020 ⁴ . Hence this notification is not relevant to the project.
Forest (Conservation) Act, 1980 and Forest Conservation Rules, 2003 as amended	To check deforestation by restricting conversion of forested areas into non-forested areas	Risk of encroachment as many of the proposed clusters are adjacent to forest areas. Permission from Divisional Forest Officer will be required, if trees from protected category will be cut/ felled. Some of the clusters such as Ghattewal, Bassi, and Dulhet (Dhalet) (under Bilaspur Package) are located at the periphery of the Naina Devi Conservation Reserve. However, no major construction activities will be carried out in these clusters as LIS Changer is an existing irrigation scheme. Hence, only a notification to the forest authority about the project is required. For new subprojects, if identified to pass through forest area (gravity main) then forest clearance would be

⁴ http://environmentclearance.nic.in/writereaddata/Draft_EIA_2020.pdf

Law/Act	Description	Applicability/ Compliance																	
		required.																	
National Forest Policy 1952 (Revised) 1988 & Biological Diversity Act, 2002	To maintain ecological stability through conservation and restoration of biological diversity. Keeping the forest area intact in the Himalayan States- This policy implies to maintain the 66.7% of land under forest area in HP.	There are 14 wildlife sanctuaries (2 in Bilaspur, 2 in Kangra, 3 in Mandi, 4 in Solan and 3 in Sirmaur) under the project districts. Clusters Ghattewal, Bassi, and Dulhet (Dhalet) (under Bilaspur Package) are located at the periphery of the Naina Devi Conservation Reserve. However, as no major construction activities will be carried out in these clusters as LIS Changer is an existing irrigation scheme. Hence, there will be no adverse impact to the biodiversity of the area .																	
Himachal Pradesh Fisheries Rules 2020	This rule protects the Trout Species, as same is being cultured by the state, and identifies those stretches of rivers or streams where trout fish is being developed. Hence, no intake points for irrigation water is allowed from these water.	Trout waters to be avoided for irrigation are: - Tirthan streams and its tributaries above its confluence with river Beas in Kullu and Mandi District. - River Uhl and its tributaries in Mandi and Kangra District, including balancing reservoir and feeder channels at Barot. - Neugal stream and its tributaries up streams Mainjha bridge and 10 kms stretch of Baner Khad up stream suspension bridge at Tikker Doli in Kangra District None of the current clusters are tapping water from the Trout waters.																	
Water (Prevention and Control of Pollution) Act, 1974	Aims to prevent and control water pollution and to maintain/restore the wholesomeness of water by establishing Central and State Pollution Control Boards to monitor and enforce these regulations.	This Act is not applicable to minor irrigation schemes as project like this do not cause pollution to the waters. However, as best horticulture practices, the framers should use water wisely and undertake all measures to avoid water contamination from use of pesticides.																	
Air (Prevention and Control of Pollution) Act, 1981	To reduce air pollution by controlling emission of air Pollutants as per the prescribed standards.	The project will involve only minor construction activities at water intake sites, for rising main and field preparation at field level that may led to fugitive emissions. Clusters those that are near to ecological sensitive areas would therefore require to monitor air quality during such construction activities. The standards are provided in section B of this chapter. As mitigation measure the sites should spray water periodically during construction time to prevent air pollution.																	
Noise Pollution (Regulation and Control) rules 2000, Amendment up to 2010	Rule 3 of the act specifies the ambient noise standard with respect to day and night noise for different zones /areas. This act will be applicable to ensure all noise producing activities during the civil works to maintain the applicable standards and necessary protection measure need to be considered in design.	Project activities may lead to minor generation of noise due to construction activities. The project needs to maintain the following level of decibel depending on the area: <table border="1"> <thead> <tr> <th rowspan="2">Area Category</th><th colspan="2">Limits in dB(A) L equivalent</th></tr> <tr> <th>Day Time</th><th>Night Time</th></tr> </thead> <tbody> <tr> <td>Residential Area</td><td>55</td><td>45</td></tr> <tr> <td>Silence Zone</td><td>50</td><td>40</td></tr> <tr> <td>Commercial Area</td><td>65</td><td>55</td></tr> <tr> <td>Industrial Area</td><td>75</td><td>70</td></tr> </tbody> </table>	Area Category	Limits in dB(A) L equivalent		Day Time	Night Time	Residential Area	55	45	Silence Zone	50	40	Commercial Area	65	55	Industrial Area	75	70
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	Day Time	Night Time																	
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Industrial Area	75	70																	

Law/Act	Description	Applicability/ Compliance
HP Land Preservation Act, 1978 (Private land not classified as Forest)	An Act to provide for the better preservation and protection of certain portions of the territories of Himachal Pradesh.	For felling of trees, no permission is required up to 5 trees in one financial year in case of broad leave species including Chil (<i>Pinus roxburghii</i>) and Ban Oak (<i>Quercus leucotrichophora</i>), 3 trees in case of coniferous species, up to 10 trees with the written permission of the Range Officer and more than 10 trees with the written permission from Divisional Forest Officer (DFO) Felling of trees other than Chil, Bak Oak and coniferous species: up to 50 - permission from Divisional Forest Officer (DFO), up to 100 – Chief Conservator of Forests (CCF), up to 200 – Principal Chief Conservator of Forests (PCCF), HP. Felling of exempted species that require no permission – Indian Siris (<i>Albizia lebbbeck</i>), Poplar (<i>Populus</i>), Bauhinia (<i>Bauhinia</i>), Eucalyptus (<i>Eucalyptus</i>), Mulberry (<i>Morus alba</i>), Bamboo species (<i>Bambusoideae</i>), Japanese Shahtoot (<i>Morus nigra</i>).
National Agriculture Policy 2000	National Agriculture Policy seeks to capture the actual growth potential of Indian Agriculture, strengthen rural infrastructure to support faster agricultural development, promote value addition, accelerate the growth of agro-business, create employment in rural areas, secure a fair standard of living for farmers and agricultural workers and their families, discourage migration to urban areas and face the challenges arising out of economic liberalization and globalization.	The project aims to improve agricultural productivity and farm incomes by integrating technology, institutions and market innovations.
National Water Policy 2002	To ensure that planning, development, and management of water resources are governed by national perspectives	As project activities will involve development of new minor irrigation systems as well as renovation and augmentation of existing infrastructure.
National Horticulture Mission (NHM) 2005	The NHM's key objective is to develop horticulture to the maximum potential available in the State and to augment production of all horticultural products in the State.	Applicable as the objective of the project is increase in subtropical horticulture crop production.
National Policy for Farmers 2007	Sets goals such as: (i) improve economic viability of farming by substantially increasing the net income of farmers and to ensure that agricultural progress is measured by advances made in this income. (ii) protect and improve land, water, biodiversity and genetic resources essential for sustained increase in the productivity, profitability and stability of major farming systems by creating an economic stake in conservation. (iii) develop support services including provision for seeds, irrigation, power, machinery and	Applicable as project would comprise many of the features enunciated in the policy such as increasing farmers income, develop support services including provision for seeds, irrigation, power, machinery and implements, fertilizers and credit at affordable prices in adequate quantity for farmers., etc.

Law/Act	Description	Applicability/ Compliance
	implements, fertilizers and credit at affordable prices in adequate quantity for farmers., etc.	
The Building and Other Construction Workers (regulation of employment and conditions of service) Act, 1996	To regulate the employment and conditions of construction workers and to provide for their safety, health and welfare measure and for other matter incidental thereto	A large number of construction workers (skilled, semiskilled or unskilled) will be employed temporarily during construction phase of the project
Hazardous Wastes (Management, Handling and Trans boundary Movement) Rules, 2016	Protection to the general public against improper handling and disposal of hazardous wastes	Hazardous wastes such as used oil, batteries, paint residues, etc. will be generated during the project. - Such waste should be recorded in terms of type and quantity generated; - The contractor should store such waste as a dedicated area having appropriate signage of danger; - The waste thus generated to be disposed safely to the government dedicated sites or handed over authorized incinerators; - Open burning of solid wastes, whether hazardous or nonhazardous, is not considered good practice and should be avoided, as the generation of polluting emissions from this type of source cannot be controlled effectively.
Construction and demolition Waste Management Rules, 2016	Rules to manage construction waste resulting from construction, re-modelling, repair and demolition of any civil structure. Rules define C and D waste as waste comprising of building materials, debris resulting from construction, re-modelling, repair and demolition of any civil structure.	Construction and demolition waste generated from augmentation and renovation of existing infrastructure shall be managed and disposed of as per the rules to the dedicated sites earmarked by the government. Appendix 9 provides with more detailed guidelines.
Plant Quarantine (Regulation of Import into India) Order (2003)	To ensure and regulate the import of plants, root stocks, genetically modified species and its quarantine in India.	The project will involve import and multiplication of root stocks and cultivars, which will be quarantined in govt. owned nurseries being developed under HPSHIVA. - Permits for import of plants and plant products to be obtained; - No consignment of plants and plant products, if found infested or infected with a quarantine pest or contaminated with noxious weed species shall be permitted to be imported; - All nurseries to be registered under DOH; - Head, Division of Plant Pathology, Dr. Y.S. Parmar University of Horticulture and Forestry, Solan, is the dedicated Inspection Authorities for Certification of Post entry quarantine facilities and inspection of growing plants; - Section IV of the Plant Quarantine (Regulation of Import into India) Order (2003), every application for certification of post-entry quarantine facilities shall be submitted to the inspection authority in

Law/Act	Description	Applicability/ Compliance
		Form PQ 18. The inspection authority, if satisfied after necessary inspection and verification of facilities, shall issue a certificate in Form PQ 19.
Protection of Plant Varieties and Farmers' Rights Act (2001)	This act provides the establishment of an effective system for protection of plant varieties, the rights of farmers and plant breeders, and to encourage the development and cultivation of new varieties of plants.	Such protection is likely to facilitate the growth of the seed industry, which will ensure the availability of high-quality seeds and planting material to the farmers.
Insecticide Act 1968; Insecticide Rules 1971; Insecticide (Control) Order 1985; Fertilizer Control Order 1985; Fertilizer Movement Control Order 1973; Essential Commodities Act (Amended - 1986)	The Government of India (GOI) has notified various Acts for the control and Prevention of pollution due to pesticides and fertilizers.	As project investments are likely to involve use of pesticides, fertilizers and insecticides, provisions of some of these would be relevant. The banned list of pesticides is given in Annexure 4.
Himachal Pradesh Fruit Plant Nurseries Regulation and Amendment Act (2015)	An Act to provide for the registration of fruit nurseries in Himachal Pradesh	Nursery owners shall not engage in the production and sale of nursery plants or plant material without getting himself or his firm registered with the competent authority and without obtaining a license.
Environment Master Plan, Himachal Pradesh (2013)	Protection of environment in the State, ensure the sustainability of environmental heritage and natural resources and to develop a long-term perspective of achieving environmentally sustainable Development.	Agriculture and Horticulture sectors are covered under Natural resource management.
Himachal Pradesh Non-Biodegradable Garbage (Control) Act (1995)	Ban on non-biodegradable garbage, including plastics	The project may use nonbiodegradable material for crates and packing material, however these will be reused in its life cycle and their applicability for use will also be assessed during project implementation phase.
Occupational Safety, Health And Working Conditions Code, 2020 & Employees State Insurance (ESI) Act 1948	Occupational safety and health and working conditions of the persons employed in an establishment including construction site.	This will be applicable to PMU, PIUs and Contractors employing people for implementation of HPSHIVA project. The daily work hour limit to a maximum of eight hours; Defines an inter-state migrant worker as someone who has come on his/her own from one state and received employment in another state and earns up to INR. 18000 per month; Empowers women to be employed in all kinds of establishments and at night (between 7 PM and 6 AM) subject to their consent and safety; Obligatory for contractors recruiting 50 or more workers; No charge is levied on any employee for maintenance of safety and health at the workplace including the conduct of medical examination and investigation for the purpose of detecting occupational diseases; The ESI Act 1948, encompasses certain health related

Law/Act	Description	Applicability/ Compliance
		eventualities that the workers are generally exposed to; such as sickness, maternity, temporary or permanent disablement, Occupational disease or death due to employment injury, resulting in loss of wages or earning capacity-total or partial.
Central Motor Vehicle Act 1988 and Central Motor Vehicle Rules 1989;	The Act and the Rules provides in detail the legislative provisions regarding licensing of drivers/conductors, registration of motor vehicles, control of motor vehicles through permits, special provisions relating to state transport undertakings, traffic regulation, insurance, liability, offences and penalties, etc.	This is an act and rules are applicable as the project will use many vehicles directly or indirectly for project purpose. All vehicles under the project should have appropriate No Objection Certificate.

B. National Environmental Standards

B.1. Water Quality Standards for Irrigation Purpose

33. Generally, salinity, sodicity and toxicity of specific ions are considered for assessing suitability of waters used for irrigation purposes. Use of waters exceeding the maximum permissible limits of these parameters will affect the soil structure and decrease the yield of the crops grown. Based on above considerations, Bureau of Indian Standards (BIS) has prescribed the following concentration ranges for irrigation waters:

Table 4: Water Quality Standard for Irrigation Purpose (BIS)

S. No.	Parameters	Prescribed limits		Probable effects
		Desirable	Permissible	
1	Salinity/EC in Mmhos/cm at 25°C	Sensitive crops <1500 Semi-tolerant 1500-3000 Tolerant >3000		Plant growth is retarded with stunted fruits, leaves and stem in high salinity
2	SODICITY/SAR	SAR<10 10-18 18-26 >26	Excellent Good Medium Bad	Causes deflocculation of soil, restricting free movement of water
3	R.S.C meq/l	<1.25 1.25-2.5 >2.5	Excellent Good Bad	Result in increase of Sodium causing adverse effects.
4	BORON,(B) mg/l	Sensitive crops <1.0 Semi-tolerant 1.0-2.0 Tolerant 2.0-4.0 Unsatisfactory for most crops>4.0		An essential plant nutrient at low concentration but high conc. are toxic to plant

B.2. Air Quality Standards

34. The revised National Ambient Air Quality Standards, 2009, specifies 24 hours and annual ambient air quality standards. Since the project construction works are minor in nature and neither the operations of horticulture fields will lead to annual emissions, hence 24 hours standards are applicable to the project.

Table 5: Ambient Air Quality Standards for Rural and Ecosensitive Zone

Pollutant	Concentration in Ambient Air		
	Industrial, Residential, Rural and Other Area	Ecologically Sensitive Area (government notified)	Methods of Measurement
SO ₂ , µg/m ³	80	80	Improved West and Gaeke

			Ultraviolet fluorescence
NO ₂ , µg/m ³	80	80	Modified Jacob & Hochheiser (Na-Arsenite) Chemiluminescence
PM ₁₀ , µg/m ³	100	100	Gravimetric
PM _{2.5} , µg/m ³	60	60	TOEM Beta attenuation
O ₃ , µg/m ³	100 (8 hours) 180 (1 hour)	100 (8 hours) 180 (1 hour)	UV photometric Chemiluminescence Chemical Method
Lead (Pb), µg/m ³	1	1	AAS/ICP method after sampling on EMP 2000 or equivalent filter paper ED-XRF using Teflon filter
CO, mg/m ³	2 (8 hours) 4 (1 hour)	2 (8 hours) 4 (1 hour)	Non Dispersive Infra Red (NDIR) spectroscopy
Ammonia (NH ₃) µg/m ³	400	400	Chemiluminescence Indophenol blue method

B.3. Noise Level Standards

35. 34. Following Noise (Ambient) Quality Standards to be followed by the project. However, project is not expected to cause any significant noise pollution.

Table 6: Noise (Ambient Air Quality) Monitoring Standards

Area Category	Limits in dB(A) L equivalent	
	Day Time	Night Time
Residential Area	55	45
Silence Zone	50	40
Commercial Area	65	55
Industrial Area	75	70

C. Water User Act for the State

D. International Treaties

36. In addition to national and state rules and regulations, international conventions such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Convention on Migratory Species of Wild Animals (CMS), and the Ramsar Convention on Wetlands of International Importance are applicable for selection and screening of subprojects under restricted/sensitive areas. India is a party to these conventions. Relevance of the international agreements to the project is explained in the following.
37. **International Union for Conservation of Nature (IUCN).** The IUCN Red List of threatened species (also known as the IUCN red list or red data list), founded in 1963, is a comprehensive inventory of the global conservation status of plant and animal species. A series of regional red lists are produced by countries or organizations, which assess the risk of extinction to species within a political management unit. As per Section 38 of the Biological Diversity Act, The Ministry of Environment & Forests and Climate Change, Govt. of India in consultation with the Govt. of Himachal Pradesh, has notified eight species of plants and ten species of animals which are on the verge of extinction in the Gazette notification dated 17th March, 2009. The notification on threatened plant and animal species for the state is given in Annexure 11.
38. **Ramsar Convention on Wetlands of International Importance, 1971.** The Convention on Wetlands of International Importance is another intergovernmental treaty that provides framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. According to the Ramsar List of Wetlands of International Importance, there are 25 designated wetlands in India which must be protected, among which, there are three Ramsar sites in the State of Himachal Pradesh (2 under

project districts – Pong Dam in Kangra and Renuka in Sirmaur). None of the clusters are within 10kms radius of the wetland area.

E. ADB SPS 2009

39. The key ADB policy guiding environmental safeguards is the ADB Safeguard Policy Statement of June 2009.⁵ ADB requires the consideration of environmental issues in all aspects of ADB's operations, and the requirements for environmental assessment are described in ADB SPS, 2009. The statement document requires environmental assessment of all ADB investments. The objective of ADB SPS 2009 is to "ensure the environmental soundness and sustainability of projects and to support the integration of environmental considerations into the project decision-making process." ADB SPS 2009 defines the requirements to be followed with regards to project screening and classification, information disclosure, consultation, and participation, monitoring and reporting, and grievance redress mechanisms. The discussion of the requirements is shown in the following.
40. **Screening and Categorization** - ADB has classified projects under four categories depending on the most environmentally sensitive component, including direct, indirect, cumulative and induced impacts in the project's area of influence. The categories are:
 - (i) Category A – where projects are likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. The impacts may affect an area larger than the sites or facilities subject to physical works. Such projects require an EIA;
 - (ii) Category B - where potential adverse impacts are less than those of Category A. Impacts are generally site specific, few if any are irreversible, and in most cases mitigation measures can be designed more readily than for Category A projects. Such projects require an IEE;
 - (iii) Category C, which incurs minimal or no adverse environmental impact and thus does not require environmental assessment, although environmental implications need to be reviewed. Environmental Due Diligence will be adequate for such projects; and
 - (iv) Category FI refers to projects that involve investment of ADB funds through a financial intermediary and is not applicable to the present Project.
41. ADB's policy on Environment Safeguards (2012) states that "A project's category is determined by the category of its most environmentally sensitive component, including direct, indirect, cumulative, and induced impacts in the project's area of influence" and the policy requires that "environmental impact assessments evaluate transboundary and cumulative impacts of ADB projects or programs".
42. **Environmental assessment.** Category A projects require environmental impact assessment or EIA. Category B projects required initial environmental examination or IEE. Category C projects do not require environmental assessment, but environmental implications are reviewed. Environmental assessment report is required for all environment category A and B projects. Its level of detail and comprehensiveness is commensurate with the significance of potential environmental impacts and risks. A typical outline of an EIA report and IEE⁶ is shown in Appendix C.
43. When the project involves existing activities or facilities, environmental audits will be performed to determine the existence of any areas where the subproject may cause or is causing environmental risks or impacts. If the subproject does not foresee any new major expansion, the audit constitutes the environmental assessment. A typical environmental audit report includes the following major elements: (i) executive summary; (ii) facilities description, including both past and current activities; (iii) summary of national, local, and any other applicable environmental laws, regulations, and standards; (iv) audit and site investigation procedure; (v) findings and areas of concern; and (vi) corrective action plan that

⁵ <https://www.adb.org/sites/default/files/institutional-document/32056/safeguard-policy-statement-june2009.pdf>

⁶ May have a narrower scope than EIA report depending on the nature of the 2nd Phase.

provides the appropriate corrective actions⁷ for each area of concern, including costs and schedule. The audit report (including corrective action plan, if any) will be made available to the public in accordance with the information disclosure requirements of ADB SPS.

44. **Environmental Management Plan (EMP).** The project will prepare EMP that addresses potential impacts and risks identified by the environmental assessment. The level of detail and complexity of the EMP and the priority of the identified measures and actions will be commensurate with the project's impact and risks.
45. **Information disclosure.** Information about environmental safeguard issues are to be made available in a timely manner, in an accessible place, and in a form and language(s) understandable to affected people and to other stakeholders, including the public, so they can provide meaningful inputs into project design and implementation. For illiterate people, suitable communication methods are to be used.
46. **Consultation and participation.** Communities, groups, or people affected by proposed projects, and civil society are to be engaged through information disclosure, consultation, and informed participation in a manner commensurate with the risks to and impacts on affected communities. There will be meaningful consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation. Meaningful consultation is a process that:
 - (i) begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle;
 - (ii) provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people;
 - (iii) is undertaken in an atmosphere free of intimidation or coercion;
 - (iv) is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and
 - (v) enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues.
47. **Monitoring and reporting.** Procedures are to be established and followed to monitor the implementation of environmental management plans, verify compliance with safeguard measures and progress toward intended safeguard outcomes; and prepare and disclose periodic environmental monitoring reports.
48. **Grievance Redress Mechanisms (GRM).** Projects are to develop and maintain a GRM to receive and facilitate resolution of affected peoples' concerns and grievances on environmental and social performance. The GRM is to address concerns and complaints promptly, using understandable and transparent processes that are gender responsive, culturally appropriate, readily accessible to all segments of the affected people, and that do not impede access to the national judicial or administrative remedies.
49. **Unanticipated Environmental Impacts.** Where unanticipated environmental impacts become apparent during project implementation, the PMU will update the environmental assessment and EMP or prepare a new environmental assessment and EMP to assess the potential impacts, evaluate the alternatives, and outline mitigation measures and resources to address those impacts.
50. **Biodiversity Conservation and Sustainable Natural Resource Management.** The PMU will assess the significance of project impacts and risks on biodiversity and natural resources as an integral part of the environmental assessment process. The assessment will focus on the major threats to biodiversity, which include destruction of habitat and introduction of invasive alien species, and on the use of natural resources in an unsustainable manner. The PMU will identify measures to avoid, minimize, or mitigate potentially adverse impacts and

⁷ Where noncompliance is identified, a corrective action plan will be agreed on by ADB and PMO. The plan will define necessary remedial actions, the budget for such actions, and the time frame for resolution of noncompliance.

risks and, as a last resort, propose compensatory measures, such as biodiversity offsets, to achieve no net loss or a net gain of the affected biodiversity.

51. **Pollution prevention and abatement.** ADB SPS requires the PMU to apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's (i) General Environment, Health and Safety (EHS) Guidelines (ii) Irrigation (ii) Waste Management, and other as may be applicable. These standards contain performance levels and measures that are normally acceptable and applicable to projects. When Government of India regulations differ from these levels and measures, PMU will achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the PMU will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in ADB SPS and EHS Guidelines.
52. **Occupational Health and Safety.** The PMU will provide workers with a safe and healthy working environment, taking into account risks inherent to the particular sector and specific classes of hazards in the work areas, including physical, chemical, biological, and radiological hazards. The PMU will take steps to prevent accidents, injury, and disease arising from, associated with, or occurring during the course of work, and apply preventive and protective measures consistent with international good practice such as International Finance Corporation (IFC) EHS Guidelines on Occupational Health and Safety⁸.
53. **Community Health and Safety.** The PMU will identify and assess the risks to, and potential impacts on, the safety of affected communities during the design, construction, operation, and decommissioning of the project, and will establish preventive measures and plans to address them in a manner commensurate with the identified risks and impacts. These measures will favor the prevention or avoidance of risks and impacts over their minimization and reduction. Consideration will be given to potential exposure to both accidental and natural hazards, especially where the structural elements of the project are accessible to members of the affected community or where their failure could result in injury to the community.
54. **Physical Cultural Resources (PCR).** The PMU is responsible for siting and designing the project to avoid significant damage to PCR⁹. Such resources likely to be affected by the project will be identified, and qualified and experienced experts will assess the project's potential impacts on these resources using field-based surveys as an integral part of the environmental assessment process.

⁸ This can be downloaded from International Finance Corporation (IFC), World Bank Groups. [General EHS Guidelines: Occupational Health and Safety](#).

⁹ Defined as movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings and may be above or below ground or under water. Their cultural interest may be at the local, provincial, national, or international level.

4. DESCRIPTION OF THE PROJECT

A. Rationale

55. In Himachal Pradesh, Agriculture & Allied Sector supports about 60% of the population. It accounted for 13.61% of State domestic product 2021-22 with a negative growth rate of 8.6%, majorly due to the impact of COVID-19. Horticulture sector is proving helpful in strengthening the economic state of the people by generating various sources of income. Out of the total geographical area of the State (55.7 lakh ha.), the area of operational holdings is about 955,000 ha, operated by 961,000 farmers. The average holding size is about 1.00 ha. Distribution of land holdings shows that 87.95 % of the total holding belongs to small and marginal farmers. The State's agriculture is largely dominated by high value horticultural commodities such as apples, which account for about 49% of the total area under fruit crops and 79% of the total fruit production. The horticulture sector annually contributes approximately INR 3000 crore to INR 5000 crore to the State's economy.
56. While crop diversification is increasing in Himachal Pradesh, for fruits and vegetables, this is mostly concentrated in districts of the mid-hills and high hills and dry temperate zone, leaving a substantial income gap between temperate and sub-temperate producers and those producing sub-tropical crops. The sub-tropical region (Bilaspur, Hamirpur, Kangra, Mandi, Sirmour, Solan, and Una districts) in the State faces multiple challenges in terms of climate change, rainfall uncertainties, water availability and low productivity of horticulture produce and income disparity. The average agriculture income in the State is INR 12,153 per month and is above the national average of INR 10,218 per month as per NSS 2019 data. However, the agriculture income of sub-tropical farmers is lower than the tropical farmers which was further validated by the baseline survey of the project area, i.e., INR 1,693 per month (INR 20,316.94 per year for 0.39 Ha average landholding offered by farmers towards Project for plantation).
57. The Project beneficiaries are marginal and small farmers with limited capacity to invest in irrigation schemes as well as preliminary plantation, hence, government support by way of fiscal assistance and subsidy is important. Assistance by way of support in marketing and other capacity building is also required at the project level.
58. The State has also developed a Vision 2030 document, namely, "Drishti Himachal Pradesh 2030: Sustainable Development Goals". Key highlights herein in the context of the agriculture and allied sector include:
 - Targeted increase in vegetable related productivity from 21 MT/ha to 27 MT/ha and fruits related productivity from 5 MT/ha to 25 MT/ha by 2030.
 - Increasing cropping area under organic cultivation from 17,000 ha to 30,000 ha.
 - Increase area under protected cultivation from 15 lakh ha to 23 lakh ha
 - Reduce % of water losses in the irrigation sector from 35% to 15%
59. ! A Project Readiness Financing (PRF) loan was approved by ADB on 8th December 2020 for an amount of INR 75 crore (US\$ 10 million) to be implemented over a period of two years from December 2020 to November 2022. Department of Horticulture, Government of Himachal Pradesh (DOH) and Jal Shakti Vibhag (JSV) are the implementing agencies for the project where DOH acts as the nodal agency. The funds under the PRF facilities were supported to undertake advanced solutions which created an environment for subtropical horticulture development in the State.
60. The PRF has been successfully implemented. The main activities included demonstrating the Project concept in 17 Clusters in 12 Blocks of 4 Districts, covering a total area of approx. 200 ha with assured irrigation and 1081 farmers for pilot testing of four fruits namely Citrus, Guava, Litchi, and Pomegranate. The envisaged outputs of the PRF are mentioned in Table 3 below:

Table 7: PRF Outputs

Sr. No.	Envisaged Outputs
1	Irrigation infrastructure and farmer management systems established
2	Subtropical horticulture production technology and marketing systems demonstrated
3	Enabling environment, tools, and capacity for promoting irrigated subtropical horticulture provided
4	Ensuing investment project and its implementation readiness prepared

61. The various outcomes of PRF are summarised below:

- **Concept of “One Crop, One Cluster”** successfully implemented.
- **46,000-meter length** of fencing laid.
- **17 Community Horticulture Production and Marketing Associations (CHPMAs) formed and registered** under the Himachal Pradesh Cooperative Act of 1968.
- **Additional income for farmers generated.**
- **Beekeeping florals identified for the Ensuing Loan project.**
- **16 irrigation schemes** (7 functional, 4 non-functional rehabilitated, and 5 new schemes) implemented with CCA of 300 ha
- **17 Water User Association (WUAs) established and capacitated.**
- **Intercropping models** proactively adopted due to the availability of fenced areas that protects the cultivated crops from animal menace.
- **GIS and MIS introduced and initiated** to practice timely monitoring of the ongoing activities within the Clusters.

B. Cluster Selection and Details

62. Willing farmers having adjoining fields can voluntarily integrate lands and convert into horticultural plantations. The project follows a cluster-based approach for adoption of high-density plantation with active involvement of the community, meeting the following criteria:

- a. Cluster selection criteria (General):
 1. Minimum 10 ha of private land with unit size of minimum 5 ha. each, in case of more than one unit and in near vicinity for combined operation.
 2. At least ten (10) no. of household farmers involved in the Cluster. Out of the total number of farmers in every cluster, 80% are small and marginal growers with gender equality. Future scope of expansion of plantation (preferred).
 3. Easy accessibility with presence of a perennial water source for development of new irrigation schemes / renovation of existing functional / defunct schemes of Jal Shakti Vibhag or any other Departments (Agriculture, Horticulture, Rural Development, PMKSY)
 4. Land should not be in flood line and free of unwanted trees, bushes, and weeds, etc. before the start of project activities.
 5. Beneficiaries should be voluntarily ready to organize themselves in CHPMAs and WUAs and willing to participate and take care of their own plants / plantation / other infrastructure, etc.
 6. Soil status, soil testing, aspect, altitude etc. should meet crop selection criteria. Selection of fruit crops should be on basis of recommendations of technical advisory committee based on feasibility report in consultation with beneficiary farmers.

- b. Cluster selection criteria (Irrigational factors: by the end of project period, following requirements to be met):
 - 1. 60% of schemes to be existing/rehabilitation works.
 - 2. Approximately 45% of irrigation schemes should be gravity fed, 30% low lift and only 25% other schemes including high-lift schemes.
 - 3. Satisfactory analysis of the hydrology of the selected schemes, ensuring adequate and reliable supply for the scheme taking account of climate change impacts and downstream water commitments.
- 63. Based on the above-mentioned criteria, 278 clusters, covering about 4,000 ha (Phase I) have been mapped to 194 irrigation schemes, across 28 blocks in the 7 project districts. Out of 194 schemes, 56 schemes are functional, 30 schemes are non-functional, and 108 schemes are new. The details of the irrigation schemes have been given in Table 4 below.
- 64. **Location Details** – The Latitude and Longitude details of each cluster and its mapped irrigation scheme have been presented in the Annexure – 2.

Table 8: Clusters and their mapped irrigation scheme

#	District	Block	No. of Clusters	District wise CCA (ha)	Block wise CCA (ha)	Crop	Irrigation Schemes	Functional		Non-Functional		New	
								Nos.	Area (ha)	Nos.	Area (ha)	Nos.	Area (ha)
1	Solan	Kunihar	8	266.78	122.47	Citrus, Guava, Pomegranate	8	2	28.30			6	94.17
		Nalagarh	10		144.31	Guava	10					10	144.31
2	Sirmour	Nahan	10	197.92	113.96	Guava, Litchi, Mango	8					8	113.96
		Ponta Sahib	6		83.96	Guava	6	2	28.49			4	55.47
3	Hamirpur	Bamsan	2	644.48	26.19	Citrus, Pomegranate	2	1	8.68	1	17.5		
		Bhoranj	6		128.91	Guava	6					6	128.91
		Bijhar	5		64.54	Pomegranate	5			3	39.1	2	25.48
		Hamirpur	5		82.36	Citrus	4			4	82.4		
		Nadaun	19		250.28	Citrus	12	1	21.17	6	91.7	5	137.42
		Sujanpur	8		92.20	Citrus, Guava, Pomegranate	6			5	74.0	1	18.21
4	Bilaspur	Ghumarwin	21	618.57	230.02	Citrus, Guava, Litchi	16	4	75.65	4	62.55	8	91.82
		Jhandutta	8		191.97	Citrus, Guava, Pomegranate	7			3	80.36	4	111.60
		Sadar-Bilaspur	7		126.25	Citrus, Guava	4	1	14.23	1	11.43	2	100.60
		Swarghat	3		70.32	Citrus	1	1	70.32				
5	Mandi	Chauntara	6	1121.75	101.29	Citrus, Guava, Litchi	6					6	101.29
		Dharampur	68		680.48	Citrus, Guava, Plum	16	10	342.73	2	33.11	4	304.65
		Drang	2		2.35	Guava	1	1	2.35				
		Gohar/Balh	8		137.77	Guava, Persimmon, Plum	8	8	137.77				
		Gopalpur	13		120.23	Citrus, Guava, Pomegranate	13	7	51.91			6	68.32
		Sadar	2		25.06	Citrus, Litchi	2	2	25.06				
		Sundarnagar	4		54.57	Citrus, Plum	4	3	44.41			1	10.15
6	Kangra	Baijnath	6	922.36	49.34	Guava, Pecan Nut	6					6	49.34
		Bhawarna	7		102.76	Citrus, Guava, Litchi	7	4	38.91			3	63.85
		Dehra	7		512.99	Citrus	4	1	13.90		23.49	3	475.60
		Lambagoan	6		48.94	Citrus	5	3	33.01			2	15.92
		Panchrukhi	10		88.44	Citrus, Litchi	10	1	8.22			9	80.22
		Sullah	6		119.90	Citrus, Litchi	5	1	34.28			4	85.63
7	Una	Bangana	15	277.97	277.97	Guava, Pomegranate	12	3	88.80	1	11.85	8	177.33
Total		28	278	4050	4050		194	56	1068	30	527	108	2454

C. Proposed Interventions

65. The proposed interventions include the various irrigation schemes (Functional, Non-functional, and New) and Solar powered GI fence.
66. **Functional Schemes** – Functional schemes are those which are in working condition and in which water for irrigation has reached up to delivery tank and some minor repair or replacement of infrastructure components are envisaged. Additionally, following to be installed:
- **Main delivery tank (MDT) near cluster** – The capacity of the tank was decided based on daily water requirement for each plant within the cluster during peak period. MDT are in RCC M30 grade concrete with inlet, outlet, overflow pipe.
 - **Pipeline from MDT to cluster** – The pipelines from MDT to cluster are of GI or HDPE material.
 - **Valves on the rising main/gravity main feeding water to MDT** – For controlling the flow into the tank
67. **Non-functional Schemes** – Non-functional schemes are those which are not in working condition and some of the components such as pumps, repair/rehabilitation/augmentation of source, rising main replacement is required.
- **Repair/replacement of pumping machinery** – The pumping machinery details, such as duty point of pump (discharge, head) required for making the scheme functional/working have been worked out and cost for the same is calculated.
 - **Repair/replacement of pipeline** – The details of existing rising main/gravity main such as material, diameter etc. to be replaced are finalized and cost for the same have been worked out.
 - **Replacement of valves, flow meters, etc.** – The details of valves/flow meter on the delivery side of pumping main are collected and cost of the same has worked out.
 - **Augmentation of source of water, such as providing check dam, construction of dyke, etc.** – For existing scheme based on the hydrological study if storage is required, a check dam is proposed on the khad/stream. Similarly for the proposed scheme at source location, if storage is required a check dam is proposed and cost of the same has been worked. Check dam is normally constructed in plum concrete and suitable energy dissipation arrangement on downstream side is proposed.
 - **MDT, pipeline from MDT to cluster tanks and valves to be additionally installed.**
68. **New Schemes** – New schemes are those in which the entire irrigation system needs to be planned and designed from source to cluster tank near the cluster. Due to addition of cluster's area on the existing scheme, there will be additional water requirement on the proposed scheme. The sustainability of source for this additional water requirement was also checked. In order to validate sustainability of the source, a hydrological study of the source of water was carried out.
- **Check dam** – As per the hydrological study, if the storage is required on the khad/stream, a check dam of suitable height for storage of required quantity of water has been proposed. Check dam is in plum concrete with energy dissipation arrangement.
 - **Percolation well, Infiltration well** – For tapping subsurface water, especially during lean period percolation well, infiltration wells have been proposed.
 - **Raw water Pump house, rising main** – For lifting of water from river/ khad/stream submersible pumps have been proposed. Based on discharge, head, length etc. economical diameter of the rising main has been worked out. For rising main Galvanised Mild Steel pipes have been proposed
 - **Sedimentation tank** - For horticulture DRIP irrigation system has been proposed. In order that Drippers shall not clog due to silt/sediment particles in the water, same needs to be removed. In order to achieve this, sedimentation tank of suitable size has been proposed. Sedimentation tank is in proposed to be constructed in concrete.

- **Sump and clear water pump house** – The clear water from sedimentation tank is stored into sump. From sump, water is pumped with the help of centrifugal/HSC pump to the main delivery tank.
 - **Gravity main** – For Gravity main, upto 150 mm dia GI pipes and above 150 mm dia GMS pipes have been proposed.
69. **Solar powered GI fence** – The loss of agricultural produce due to menace of monkeys and wild animals is a major issue and needs to be handled scientifically, without harming the animals. In order to help the farmers in resolving this issue, an innovative solution of Solar Powered Electric Fencing has been proposed. In this modern non-conventional fencing, wires are used to fence the area which carry low voltage current generated by solar equipment which is non-fatal to any animal coming in its contact. Current flowing through these wires act as deterrent for any animal and hence the fenced area gets protected from animal damage. The current does not cause any harm to the animal but acts as a psychological barrier for the animal from intruding into the field and helps in preventing losses.
70. The Solar Fencing consists of Energizer, solar panel, battery, insulation material, poles, high tensile conducting wire and Interlink Galvanized Steel chain mesh. The electric impulse is generated by the energizer, which produces high voltage impulses of approximately 8 KV once every 0.9 to 1.2 seconds. The impulse lasts for about 300 millionths of a second to 0.1 second with a current of up to 10 mA. The detailed section drawing of fencing is mentioned below. The major benefit of solar fencing is to protect the crop loss and re-activate the growers in such affected Cluster areas for various agricultural activities. Besides this, the final produce of farmer will increase thus resulting in higher income. Another supplementary benefit is that the provision of fencing will reduce the farmer's mental and physical stress due to constant need of guarding the field, which will lead to improved health and financial well-being.

D. Crop Selection

71. Since the selection and identification of horticultural crops is essential for achieving the desired goals of the Project, a scientific baseline study was conducted to determine the feasibility of different subtropical crops with respect to the climatic conditions. The selection of different fruit crops was done based on the Cluster ecological parameters, learnings from PRF, recommendations by experts hired by PMU and in consultation with PMU.
72. The parameters considered for crop selection included availability of the land, interest of farmers, various soil parameters such as physical and chemical characteristics of soil, nutrient status, water requirement, availability of irrigation facilities, environment and climate risk assessment, orchard management practices, production, and marketing facilities, etc. Climatic conditions of an area play a major role in deciding any agriculture activity, both at macro and micro-level. Hence, all parameters on scientific lines involving all stake holders were taken into consideration while selecting a Cluster and the fruit crop. Most of the selected area is rain-fed and has sub-tropical climatic conditions. The selected fruit crops have been decided on the basis of the agro-climatic suitability of an area. The parameters taken into consideration are summarized below:

!

Crop	Preferred traits for growth					Plantation Plants/ha	Avg. Yield (MT/ha)
	Altitude (m) amsl ¹⁰	Avg. annual rainfall (mm)	Soil Type	Soil pH	Spacing (m x m)		
Citrus (Sweet Orange)	Up to 900	500 - 775	Deep sandy loam or alluvial	5.5 to 7.5	3 x 3	1111	40-50
Guava	410 - 1200	500 - 1000	Loamy	5 to 7	3 x 3	1111	35-40
Litchi	300 to 900	1000	Deep Loamy	5 to 7	4 x 4	625	60-70
Pomegranate	Up to 1800	1000	Deep Alluvial or Sandy to Sandy Loam	6.5 to 7	3 x 3	1111	40-45
Persimmon	900 - 2000	1500-2500	Sandy loam or Loamy	6.5 to 7.5	4 x 4	625	70-80
Mango	Up to 1000	750 - 3750	Loamy or Deep Alluvial	5.5 to 7.5	3 x 3	833	50
Pecan Nut	1000-2000	800 - 1500	Deep sandy loam	6.2 to 6.5	6 x 6	278	25
Plum	1000-4000	1000-1250	Sandy loam	6.5	4 x 4	625	75

Table 9: Parameters for crop selection

E. District-wise Package Details

73. Herein Package-wise details in regard to cluster location, coverage area, irrigation scheme, type of crop to be planted and water demand have been presented. The detailed design of irrigation scheme through flow-diagrams of each cluster has been presented in Annexure – 3.

74. Each of the irrigation schemes will have following components: - a check dam / dyke wherever needed, submersible pumps at intake points, followed by a desilting tank to settle down the silt and store water to maintain continuous flow, a pump house with pumps to lift the water through rising main, a main distribution tank (MDT) at the cluster head and modular tanks within the cluster which are then connected with drip-irrigation system.

Package 1 – Solan District – Cluster and Scheme Details

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Crop	Water Demand (cu. m. per day)
Kunihar	Sai	6.74	Functional FIS Sai	Natural Spring	Guava	134.80

¹⁰ AMSL – average mean sea level

	Ser-Delag	21.56	FIS Seri sarla	Spring	Guava	431.20
	Chunad	15.64	LIS from Gumber	Ghumber Khad	Guava	312.80
	Daseran	32.90	LIS from Ali Khad	Ali Khad	Citrus	658.00
	Datti	13.75	Functional FIS Datti	Natural Spring	Pomegranate	275.00
	Giana	6.69	LIS from Jadol Nallah	Jadol Nallah	Pomegranate	133.80
	Jailang	9.65	Functional LIS Jaliyana	parallel scheme – Ghumber Khad	Guava	193.00
	Pajeena	13.70	LIS from Panjeena Nallah	Pajeena Nallah	Citrus	274.00
Nalagarh	Badhal	6.42	LIS from Perennial Nallah	Perennial Nallah	Guava	128.40
	Baduan Bharmana	17.35	LIS from Halyara Khad	Halyara Khad / Nallah	Guava	347.00
	Batiakh	14.42	Functional LIS Gajedh	Ghumber Khad	Guava	288.40
	Beli khol 1	10.17	LIS from TW-1	TW	Guava	203.40
	Beli khol 2	1.44	LIS from TW-2	TW	Guava	28.80
	Doli	16.20	Functional LIS Gajedh	Ghumber Khad	Guava	324.00
	Kohla	6.26	LIS from Swarghat Nallah	Swarghat Nallah	Guava	125.20
	Kosri	21.38	LIS from Kosri Nallah	Kosri Nallah	Guava	427.60
	Palli	10.02	LIS from TW-3	TW	Guava	200.40
	Sour	36.41	LIS Sour Kulh	Ghumber Khad	Guava	728.20

Package 2 – Sirmaur District – Cluster and Scheme Details

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Crop	Water Demand (cu. m. per day)
Nahan	Dungi Sher	9.68	LIS from Jalal Khadd	Jalal Khadd	Guava	193.60
	Bajari (1 & 2)	13.99	LIS Jungla Bhood	Ruhn Khadd	Litchi	279.80
	Rama	6.88	LIS from Doghat Khad	Doghat Khadd	Guava	137.60
	Bhogpur	8.49	Check dam / LIS on Ruhn Khadd	Ruhn Khadd	Guava	169.80
	Simbalwala	9.99	Check dam / LIS on Ruhn Khadd	Ruhn Khadd	Guava	199.80
	Kherichandan 1	14.41	LIS on Jalal Khadd	Jalal Khadd	Guava	288.20
	Kherichandan 2	13.81	LIS on Jalal Khadd	Jalal Khadd	Guava	276.20
	Judag	12.61	LIS from Judag Nallah	Judag Nallah	Guava	252.20
	Goant	8.00	LIS from Goant Dam	Existing DAM Goant	Guava	160.00
	Budriyon	16.10	LIS from Tubewell	Tubewell 2	Guava	322.00
Paonta Sahib	Fatehpur	6.61	LIS Fatehpur	Percolation well, Edge of Bata River	Guava	132.20
	Killour	21.88	LIS Killour	Tons River	Guava	437.60
	Upper Bhuddi	21.72	LIS from Tubewell	Tubewell 3	Guava	434.40
	Khara	8.95	LIS Khara Nallah	Khara Nallah	Guava	179.00

	Puruwala	13.93	LIS from Tubewell	Tubewell 4	Guava	278.60
	Gyayaniwala	10.87	LIS from Tubewell	Tubewell 5	Guava	217.40

Package 3 – Hamirpur District – Cluster and Scheme Details

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Crop	Water Demand (cu. m. per day)
Bamsan	Sachuin	8.68	LIS Sachuhi	Beas River	Pomegranate	173.60
	Parol	17.51	LIS Dera Parol	Kunah Khadd	Citrus	350.20
Bhoranj	Balor-Sangrawar	33.45	LIS Balor Nallah	Balor Nallah	Guava	669.00
	Jol	19.72	LIS Jol Nallah	Jol Nallah	Guava	394.40
	Lagmanwin	6.90	LIS Lagmanwin Nallah	Lagmanwin Nallah	Guava	138.00
	Lambagram/Palasi	18.17	LIS JICA dam, Plassi Nallah	JICA dam, Plassi Nallah	Guava	363.40
	Mundkhar tushi	27.99	LIS Balor Nallah	Balor Nallah	Guava	559.80
	Samlog	22.69	LIS Samlog Nallah	Samlog Nallah	Guava	453.80
Bijhar	Bhalat	11.52	Existing LIS Bhalat Nallah	Bhalat Nallah	Pomegranate	230.40
	Lafran	13.96	LIS over New Source	New Proposed	Pomegranate	279.20
	Ghangot	8.42	Existing LIS Ghangot Nallah	Ghangot Nallah	Pomegranate	168.40
	Kalwal	15.75	LIS Kalwal	Rihal Nallah	Pomegranate	315.00
	Seri-Bhakredi	14.88	LIS Bhakreri	Existing check dam on Nallah	Pomegranate	297.60

Package 4 – Hamirpur District – Cluster and Scheme Details

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Crop	Water Demand (cu. m. per day)
Hamirpur	Branda	7.90	LIS Nalti Branda	Kunah Khad	Citrus	158.00
	Bakarti-I	29.97	LIS Bakarti	Kunah Khad	Citrus	599.40
	Jangal Ropa	22.20	LIS Jangal Ropa	Kunah Khad	Citrus	444.00
	Haar	14.90	LIS Jangal Ropa Haar	Kunah Khad	Citrus	298.00
	Neri	7.44	LIS Neri	Kunah Khad	Citrus	148.80
Nadaun	Sadhwan	8.80	MIP Nadaun	MIP Nadaun	Citrus	176.00
	Rail-I	6.20	MIP Nadaun	MIP Nadaun	Citrus	124.00
	Baag Bharmoti	6.10	MIP Nadaun	MIP Nadaun	Citrus	122.00
	Kushiar-I	15.80	LIS Khusiyar Galol	Maan Khadd	Citrus	316.00
	Bhabran 1	11.22	LIS Bhabran	LIS Bhabran	Citrus	224.40
	Bhabran 2	13.90	LIS Bhabran	LIS Bhabran	Citrus	278.00
	Kaloor	9.74	LIS Kola	Maan Khadd	Citrus	194.80
	Kashmir	6.70	LIS Kashmir	LIS Kashmir	Citrus	134.00
	Phal Palsi	28.20	LIS Palsi	LIS Palsi	Citrus	564.00
	Choru (Bhoo-I)	6.20	LIS Bhoo	LIS Bhoo	Citrus	124.00
	Manjot	7.90	LIS Salasi Nallah	Salasi Nallah	Citrus	158.00
	Manjot 2	1.50	LIS Salasi Nallah	Salasi Nallah	Citrus	30.00
	Tung (Baloh)	14.10	LIS Maan	Maan	Citrus	282.00

			Khadd	Khadd		
	Loharda	5.00	MIP Nadaun Right Bank	MIP Nadaun	Citrus	100.00
	Sai Lower	19.00	MIP Nadaun Left Bank	MIP Nadaun	Citrus	380.00
	Pansai 1	32.20	LIS Pansai	LIS Pansai	Citrus	644.00
	Pansai 2	24.20	LIS Pansai	LIS Pansai	Citrus	484.00
Sujanpur	Kheri	12.80	LIS Kheri	LIS Kheri	Pomegranate	256.00
	Beri-1	9.30	LIS Kudana Beri	LIS Kudana Beri	Pomegranate	186.00
	Beri-2	12.40	LIS Kudana Beri	LIS Kudana Beri	Pomegranate	248.00
	Bhahru (Pour)	7.10	LIS Bhahru Jatour	LIS Bhahru Jatour	Pomegranate	142.00
	Bir Baghera	7.00	LIS Pour	LIS Pour	Pomegranate	140.00
	Kudana	7.90	LIS Bhahru Jatour	LIS Bhahru Jatour	Citrus	158.00
	Bhalana Rei	18.21	LIS Pung Khad	LIS Pung Khad	Guava	364.20

Package 5 – Bilaspur District – Cluster and Scheme Details

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Crop	Water Demand (cu. m. per day)
Ghumarwin	Dehra	17.90	IPH Scheme	Seer Khad	Citrus	358.00
	Kathalag droun	20.57	IPH Scheme	Seer Khad	Guava	411.40
	Lower Lanjhta	11.61	IPH Scheme – Seer Khad	Seer Khad	Litchi	232.20
	Thandora	7.41	IPH Scheme – Seer Khad	Seer Khad	Litchi	148.20
	Upper Talwara	9.35	LIS Talwara	Khad	Citrus	187.00
	Talwara Lower	1.91	LIS Talwara	Khad	Citrus	38.20
	Talwara Phase-2	6.91	LIS Talwara	Khad	Citrus	138.20
	Kasol	20.53	LIS Kasohal	Seer Khad	Citrus	410.60
	Kasol Balh	8.84	LIS Kasohal	Seer Khad	Citrus	176.80
	Kasol Kanjeen	6.20	LIS Kasohal	Seer Khad	Citrus	124.00
	Mehri Kathla	14.46	LIS Mehri Kathla	Bajrauli Khad	Citrus	289.20
	Nalti Parnal	8.77	LIS Parnal	Seer Khad	Citrus	175.40
	Gwal Muthani (Nanawan)	3.75	LIS Nanawan	Madhi Khad	Guava	75.00
	Chharal Daloli	19.29	New Check Dam	Over LIS Talwara	Citrus	385.80
	Feori (Kothi)	8.67	New Scheme Borewell proposed	Borewell	Citrus	173.40
	Sandhiar (Chhat)	18.97	New Scheme Check Dam proposed	Existing DAM – Nearby Nallah - Sandhiar	Guava	379.40
	Bhadrog (Seu)	8.88	New Scheme IPH Scheme	Seer Khad	Citrus	177.60
	Bhapral	7.11	New LIS	Seer Khad	Guava	142.20
	Samsai	5.34	New scheme Check Dam / Bore	Borewell	Guava	106.80
	Massour / Maloh	6.57	New Check Dam	Seer Khad	Citrus	131.40
	Chhiber	16.99	New Scheme Check Dam existing and proposed	Nearby Nallah	Citrus	339.80
Sadar - Bilaspur	Kotlu	14.23	New scheme to be developed	Ali Khad	Guava	284.60
	Dugga Har	11.43	Kuhl	Kuhl	Citrus	228.60

	(Manjher)					
	Loharda	23.02	Kuhl	Ali Khad	Citrus	460.40
	Kainthal	6.38	Kuhl	Ali Khad	Citrus	127.60
	Khod ka kyar	21.49	IPH Kuhl	Ali Khad	Citrus	429.80
	Karot	21.92	Existing Kuhl	Ali Khad	Citrus	438.40
	Salnu	27.79	New Scheme	Sutlej River	Citrus	555.80

Package 6 – Bilaspur District – Cluster and Scheme Details

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Crop	Water Demand (cu. m. per day)
Jhandutta	Balh Sinha	32.14	LIS from JICA check dam	JICA dam	Litchi	642.80
	Kosarian-I	30.03	New scheme Perennial Nala	Kosari Nall	Citrus	600.60
	Lehar	24.51	New scheme Perennial Nala	Neri Dam	Guava	490.20
	Tikari Kotlu	22.94	New scheme Perennial Nala	Seer khad	Guava	458.80
	Fagog	22.28	LIS Seerkhad	JICA dam	Citrus	445.60
	Fagog Banjholi	11.77	Sukar Khad	JICA dam	Citrus	235.40
	Jhandu	15.35	Defunct Scheme of MHWDP Perennial Nala	JICA dam	Guava	307.00
	Tihri	29.15	LIS Tihri	LIS Tihri	Pomegranate	583.00
Swarghat	Bassi	12.44	LIS Changer	BBMB Canal	Citrus	248.80
	Dulhet 3	29.62	LIS Changer	BBMB Canal	Citrus	592.40
	Ghattewal	28.26	LIS Changer	BBMB Canal	Citrus	565.20

Package 7 – Mandi District – Cluster and Scheme Details

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Crop	Water Demand (cu. m. per day)
Chauntara	Golwan	17.19	LIS Golwan	Ropdi Khad	Guava	343.80
	Kothi – I (Balh)	9.3	LIS from TW 1	Tubewell	Guava	186.00
	Kothi - II	8.3	LIS from TW 2	Tubewell	Citrus	166.00
	Dhelu (Dhog)	9.97	LIS Dhelu	Tubewell	Guava	199.40
	Dol	33.29	LIS from TW 3	Tubewell	Litchi	665.80
	Khadiyal	23.24	LIS from TW 4	Tubewell	Litchi	464.80
Gopalpur	Sulpur	7.5	LIS Sulpur Bahi	Percollation well, Seer Khad	Pomegranate	150.00
	Dhar	10.16	LIS Basantpur	Beas River	Guava	203.20
	Barchwar	10.82		River Beas	Guava	216.40
	Ghadhyani	7.24		River Beas	Guava	144.80
	Kharoh (Kalerka)	17.11		Beas River	Guava	342.20
	Bhadarwar Khobla	9.02	LIS Bhadharwaar, Bhudroli Khad	Rissa Khad	Guava	180.40
	Bahi	8.71	LIS Percollation-Seer Khad	Percollation well, Seer Khad	Guava	174.20
	Bhambhla-I	14.15	LIS from Seer Khad	Seer Khad	Citrus	283.00
	Thouna/Dhalait	8.18	FIS Thouna Kuhl	Local Nallah	Guava	163.60
	Rasher	10.95	LIS Son Khadd	Son Khad	Citrus	219.00
	Batail 2	9.13	LIS from TW 5	Tubewell	Citrus	182.60
	Batal 1	19.7			Plum	394.00
	Bag-chuhku	12.86	LIS from TW 6	Tubewell	Citrus	257.20
	Mataur Tanda	13.05	LIS Infiltration-	Seer Khad	Pomegranate	261.00

			Seer Khad			
Dharampur	Richhli	12.81	LIS Bari Marhi Dhwali	Beas River	Citrus	256.20
	Mannu Dhar (Joh)	13.68			Citrus	273.60
	Haryanal	12.55			Guava	251.00
	Satrehar	12.52			Citrus	250.40
	Ghanswai	8.3			Guava	166.00
	Aarli Paryal	9.87			Citrus	197.40
	Richhali / Dhwali	5.75			Guava	115.00
	Tarohla	8			Guava	160.00
	Taroon	9.26			Citrus	185.20
	Chhapanu	8.38			Citrus	167.60
	Banwaar Kalaan	13.16			Citrus	263.20
	Dhardi-1	2.67			Citrus	53.40
	Baratpur	7.49			Citrus	149.80
	Balhara 1	1.46			Citrus	29.20
	Balhara 2	2.45			Citrus	49.00
	Dhardi 2	3.55			Citrus	71.00
	Lalana	4.27			Citrus	85.40
	Parli Paryal	1.7			Citrus	34.00
	Sakran Dhar	5.36			Citrus	107.20
	Sherpur	1.24			Guava	24.80
	Chakyana	3.72			Citrus	74.40
	Chunighat	14.14			Citrus	282.80
	Gorat	12.25			Citrus	245.00
	Pakhdol	4.39			Citrus	87.80
	Tourjajar	9.74			Citrus	194.80
	Galloo (Chanouta)	6.19	LIS Baroti- Mandap-Joddan	Beas River	Citrus	123.80
	Siram(Sarskan)	7.05			Citrus	141.00
	Trembala	6.06			Citrus	121.20
	Hiun	3.96			Citrus	79.20
	Kumarhda 2	10.22			Plum	204.40
	Didnu	5.2			Citrus	104.00
	Banerti-2	10.44			Plum	208.80
	Pehad-2	10.04			Plum	200.80
	Chhater	10.86			Guava	217.20
	Drumman	30.76			Citrus	615.20
	Kumahrda	13.84			Plum	276.80
	Giun	27.8			Citrus	556.00
	Cheh	8.67			Guava	173.40
	Bahn	5.63			Citrus	112.60
	Chatroun (Lower)	11.26	LIS Kothua Dhallara	Beas River	Guava	225.20
	Dhalara 1	9.35			Citrus	187.00
	Dhalara 2	8.7			Citrus	174.00
	Lower Balh	6.24			Citrus	124.80
	Single Kuhat	3.7	LIS Sandhole	Beas River	Citrus	74.00
	Kanohi	1.32			Guava	26.40
	Lahsani	1.35			Guava	27.00
	Churu ra Balh	20.88	LIS Churu Balh	Nald Khad	Citrus	417.60
	Seoh II	27.49	LIS Seoh	Beas River	Citrus	549.80
	Seoh (Balh) Nichla Ropa	18.74		Beas River	Citrus	374.80
	Lower (Nichali) Bairi	9.13	LIS Bairi	Beas River	Citrus	182.60
	Upper Bairi	23.98			Citrus	479.60
	Barota	4.37	LIS Brang	Soan Khad	Guava	87.40
	Manyoh- Lambri	20.14	LIS Tihra	Beas River	Guava	402.80
	Thanna (Ropari)	8.18			Citrus	163.60
	Patti (Kot)	6.9			Guava	138.00
	Darwaar	9.27			Guava	185.40
	Digho-Baglana (Karyal)	7.28			Guava	145.60
	Skohta	1.82			Citrus	36.40
	Khajurti	5.76			Guava	115.20
	Bandal	10.71			Guava	214.20

	Chandpur	11.98			Citrus	239.60
	Tikri	14.51			Plum	290.20
	Dyol	5.59			Litchi	111.80

Package 8 – Mandi District – Cluster and Scheme Details

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Crop	Water Demand (cu. m. per day)
Drang	Baragaon – I & II	14.32	LIS Baragaon	Baragaon nalla	Guava	286.40
Gohar/Balh	Dharwahan-II (Sehal)	17.39	New LIS 10 Behl-Ksarla	BSL Canal	Guava	347.80
	Sawla	17.46	IPH Chamber	IPH Chamber	Persimmon	349.20
	Bagga Chalog	8.63	New LIS – Bagga Chalog	Jiuni Khad	Plum	172.60
	Latogali I	26.97	New LIS – Kuklah to Latogali	Bakhli Khad	Persimmon	539.40
	Brikhmani	16.76	FIS Anu Darbehad	Brikhmani Nalla	Plum	335.20
	Darvehad	12.33	LIS Zone no. 5 Balbehli	BSL Canal	Plum	246.60
	Manjhog Dhaniut	9.66	FIS Majhog Dhanyot	Dhaniut nalla	Plum	193.20
	Manjhagan Chudara	28.56	LIS – Manjhagan Chudara	Jiuni Khad	Plum	571.20
Sadar	Dhaniyara	17.85	LIS Dhanyara	Arnodi Khad	Litchi	357.00
	Binol	7.21	LIS Binol Neeyul	Beas River	Citrus	144.20
Sundernagar	Palhota	17.11	Functional Lift Irrigation Scheme, Nehra, Palhota (Kansa Khad)	Kansa Khad	Citrus	342.20
	Kuthain	15.45	Piped Irrigation Scheme Chirdi Boudhal Dhar	Kansa Khad	Citrus	309.00
	Bhantraed	11.85	Functional Lift Irrigation Scheme, Bhantrred (Bhantrred Khad)	Bhantrred Khad	Citrus	237.00
	Khagron	10.15	New LIS from Kiyargi Nallah	Kiyargi Nalla source	Plum	203.00

Package 9 – Kangra District – Cluster and Scheme Details

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Crop	Water Demand (cu. m. per day)
Baijnath	Langhu – 1	6.20	LIS on Binwa Khad	Binwa Khad	Guava	124.00
	Langhu – 2	7.25			Guava	145.00
	Upper Bhet	8.42			Guava	168.40
	Manghota	6.00	LIS Manghota Cluster	Binwa Khad	Guava	120.00
	Kudail	16.61	LIS Kudail Cluster	Dea Nallah	Guava	332.20
	Utrala	4.85	Binwa River / Tundal Kholi Nala	Binwa River / Tundal Kholi Nala	Pecan nut	97.00
Bhawarna	Thandol – 1	16.95	LIS Thandol	Mol Khad	Guava	339.00

			Cluster			
	Ghar	8.21	LIS Ghar Cluster	Mand Khad	Citrus	164.20
	Malahu II	8.46	LIS on Mol Khad	Mol Khad	Litchi	169.20
	Malahu I	5.29			Citrus	105.80
	Sidhpur	30.09	LIS Sidhpur Cluster	Nugal Khad	Citrus	601.80
	Chartkhola	18.67	LIS on Tahl Khad	Tahl Khad	Citrus	373.40
	Ludhran 1 & 2	15.09	LIS on Tahl Khad	Tahl Khad	Litchi	301.80
Lambagaon	Maldoan	10.59	Existing Functional LIS Alampur Extension	Nugal Khad	Citrus	211.80
	Jangal	9.15	LIS Alampur Extension	Nugal Khad	Citrus	183.00
	Odri	8.76	LIS Bandhui Extension	Mol Khad	Citrus	175.20
	Kotlu	4.52	LIS Bandhui Extension	Mol Khad	Citrus	90.40
	Kathla	7.59	LIS Kathla Cluster	Beas River	Citrus	151.80
	Thanpal / Chambi	8.34	LIS Thanpal / Chambi Cluster	Beas River	Citrus	166.80
Panchrukhi	Trehal	8.22	LIS Trehal Cluster	Tubewell	Guava	164.40
	Agozar	7.03	LIS Agozar Cluster	Tubewell	Citrus	140.60
	Rajhot 1	17.27	LIS Rajhot – 1 & 2 Cluster	Awah Khad	Citrus	345.40
	Ladoh 1	17.21	LIS Ladoh-1 Cluster	Tubewell	Litchi	344.20
	Ladoh 2	5.53	LIS Ladoh-2 Cluster	Alang Nallah	Litchi	110.60
	Banuri	7.73	LIS Banuri Cluster	Gharuhal Khul	Citrus	154.60
	Tatehal	3.44	LIS Tatehal Cluster	Tubewell	Citrus	68.80
	Saliana	7.33	LIS Saliana Cluster	Nai Khul	Citrus	146.60
	Molichak	6.15	LIS Molichak Cluster	Tubewell	Citrus	123.00
	Jandpur	8.54	LIS Jandpur Cluster	Tubewell	Citrus	170.80
Sullah	Dheera 1 & 2	23.47	LIS Dheera – 1 & 2 Cluster	Nugal Khad	Citrus	469.40
	Dheera 3	10.81	LIS Dheera – 3 Cluster	Nugal Khad	Citrus	216.20
	Chainchadi – Kuthera	10.19	LIS Chainchadi – Kuthera Cluster	Mand Khad	Citrus	203.80
	Purba	15.36	LIS Purba Cluster	Nugal Khad	Citrus	307.20
	Chandar	36.60	LIS Chandar Cluster	Mol Khad	Litchi	732.00
	Gagal Khas	23.47	LIS Gagal Khas Cluster	Tal Khad	Litchi	469.40

Package 10 – Kangra District – Cluster and Scheme Details

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Crop	Water Demand (cu. m. per day)
Dehra	Jakhota	226.98	New Proposed	Beas River	Citrus	4539.60
	Dhanot	205.66	New Proposed	Beas River	Citrus	4113.20
	Bhatoli	10.88	LIS Dibber Rour	Banner Khad	Citrus	217.60

	Phakasian		(F)	(rivulet)		
	Bhatera Bassa	13.90	LIS Bhatera Bassa (F)	Banner Khad (rivulet)	Citrus	278.00
	Lalwada	29.85	New Proposed	Beas River	Citrus	597.00
	Chamba Khas	11.07	LIS Chamba Khas (N/F)	Beas River	Citrus	221.40
	Kuhna	11.31	New Proposed	Beas River	Citrus	226.20

Package 11 – Una District – Cluster and Scheme Details

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Crop	Water Demand (cu. m. per day)
Bangana	Boul – 1	19.32	LIS from RWHS Samoor	RWH	Guava	386.40
	Boul – 2	24.55	LIS from RWHS Samoor	RWH	Guava	491.00
	Dulehri Rajputa	9.11	Dulheri Rajputa and Thana Khurd	Nallah	Pomegranate	182.20
	Sanhal	13.58	LIS from RWHS Samoor	RWH	Guava	271.60
	Thana Khurd	22.24	Dulheri Rajputa and Thana Khurd	Nallah	Pomegranate	444.80
	Balh	14.02	LIS over Check dam	Check Dam	Pomegranate	280.40
	Chadoli	26.75	LIS over RWH-1	RWH	Guava	535.00
	Dumkhar	10.75	RWHS upstream of Khad	RWH	Pomegranate	215.00
	Hatli	6.38	LIS over RWH-2	RWH	Guava	127.60
	Kathoh	11.90	LIS over RWH-3	RWH	Guava	238.00
	Muchali 1 & 2	21.26	LIS over RWH	RWH	Guava	425.20
	Nalwari	36.52	RWHS upstream of Khad	RWH	Pomegranate	730.40
	Tureta	13.46	LIS over Nallah-1	Nallah	Guava	269.20
	Baral	36.26	LIS over Nallah-2	Nallah / Check dam	Guava	725.20
	Handola	11.84	LIS Handola	River Satluj	Guava	236.80
	Dobad	8.70	LIS over RWH	Check dam	Pomegranate	174.00

F. Timeline of Project Implementation

75. The component-wise Project implementation timeline is as mentioned in the table below:

Table 10: Project Implementation Timeline

Sr. No.	Project Components	2022 - 2023				2023 - 2024				2024 - 2025				2025 - 2026				2026 - 2027				2027 - 2028				2028 - 2029			
		Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
1	Output 1																												
1.1	Rehabilitate and Construct Irrigation Scheme																												
1.1.1	Functional																												
1.1.2	Non-Functional																												
1.1.3	New Scheme																												
1.1.4	SCADA (50 schemes)																												
1.1.5	Functional Scheme (Next Phase)																												
1.2	Capacity Building of JSV																												
1.3	Capacity Building of WUA																												
2	Output 2																												
2.1	Horticulture Plantation																												
2.1.1	Land Preparation																												
2.1.2	Planting Material																												
2.1.3	Mulching																												
2.1.4	Drip Irrigation & System																												
2.1.5	Horticulture Input																												
2.1.6	Horticulture Tools																												
2.1.7	Solar Fencing																												
2.2	GIS Land Mapping																												
2.3	Digital Agri Services																												
2.4	Capacity Building of DOH																												
2.5	Capacity Building of CHPMA farmers																												
2.6	IEC Material																												
2.7	Capacity Building on Safeguards																												
2.8	Training on Intercropping & Beekeeping																												
2.9	Support for establishing Organic Fertilizer																												
2.10	Nursery Development																												
2.11	Revolving Fund																												
2.12	Consultancy for research on crops & carbon credit																												
3	Output 3																												
3.1	Value Chain Infrastructure																												
3.1.1	Collection Centre																												
3.1.2	Integrated Facility Centre																												
3.1.3	Upgrading Processing Unit																												
3.1.4	New Processing Unit																												
3.2	Building Institutional capacity of CHPMA & Apex Body																												
3.3	Market Development and Promotion																												
3.4	Incubation and Training Centre																												
3.5	Value Chain Accelerator Consultancy																												
4	Project Management																												

Sr. No.	Project Components	2022 - 2023				2023 - 2024				2024 - 2025				2025 - 2026				2026 - 2027				2027 - 2028				2028 - 2029			
		Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
4.1	PMU Administrative Cost																												
4.2	Consultancy Service for Design & Implementation																												

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G. Project Implementation Arrangements

76. The Nodal agency of the HPSHIVA Project is Department of Horticulture (DOH). A Project Management Unit (PMU) at the State level has been established under DOH. Two separate Project Implementation Units (PIUs) are established in DOH and Jal Shakti Vibhag (JSV) for implementation of respective project components. The roles and responsibilities of PMU and PIUs are as follows:

PMU (DOH):

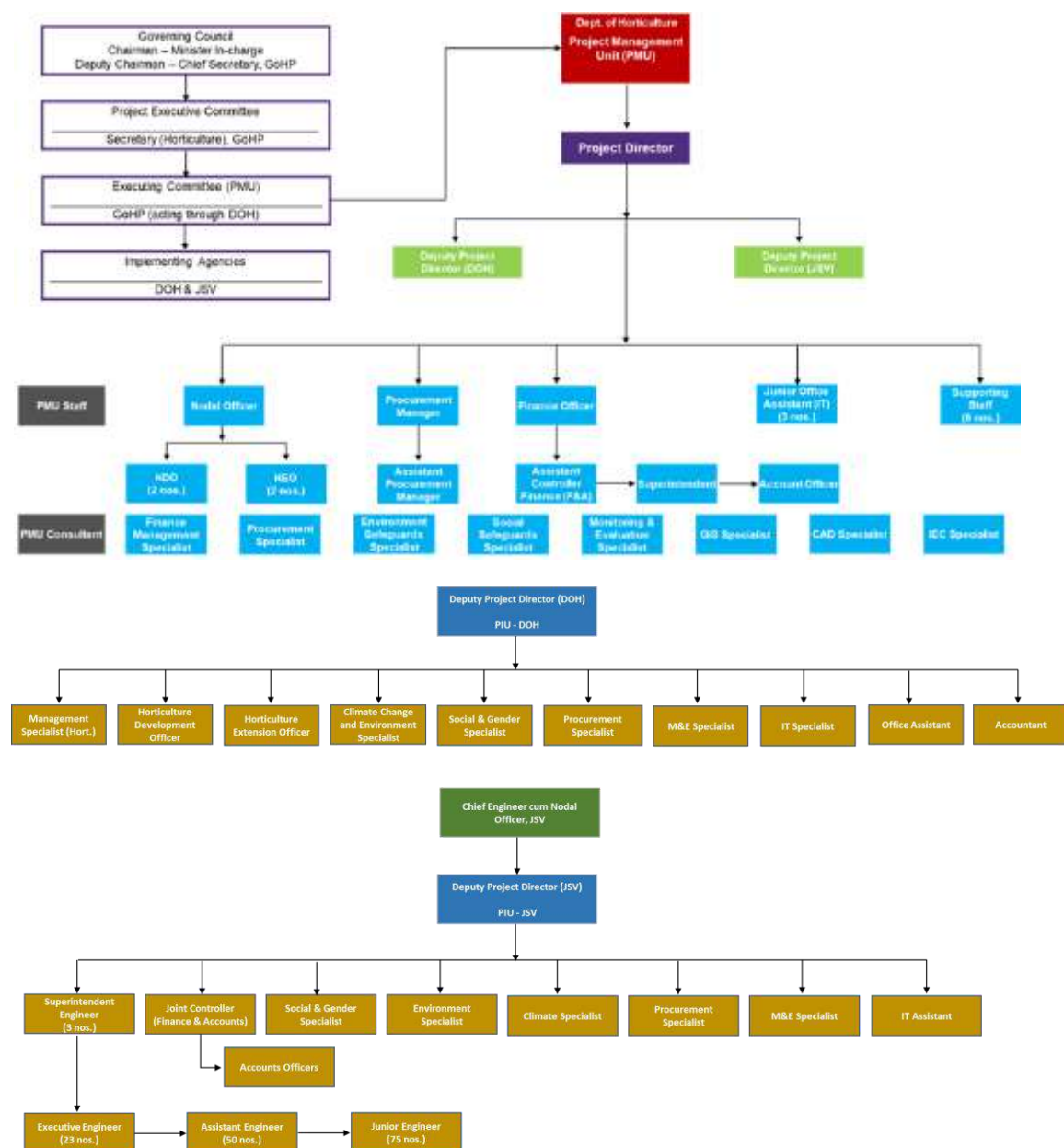
- Overall Project execution, supervision, and management,
- Oversee and monitor Project implementation as well as the adequacy of overall Project funding,
- Project account management by establishing and maintaining Project account, submitting withdrawal applications and administer statement-of-expenditure and maintain supporting documents,
- Complete loan financial records,
- Monitor and periodically provide updated procurement plan to ADB,
- Oversee procurement of Goods, Works, Consulting services and non-consulting services,
- Project progress reports, and
- Final approval of contract awards, based on recommendations of PIUs (as may be the case).

PIUs (DOH and JSV):

- Overall Project execution, supervision, and management,
- Oversee and monitor Project implementation as well as the adequacy of overall Project funding,
- Project account management by establishing and maintaining Project account, submitting withdrawal applications and administer statement-of-expenditure and maintain supporting documents,
- Complete loan financial records,
- Monitor and periodically provide updated procurement plan to ADB,
- Oversee procurement of Goods, Works, Consulting services and non-consulting services,
- Project progress reports, and
- Final approval of contract awards, based on recommendations of PIUs (as may be the case).

77. The procurement strategy to be adopted for the HPSHIVA project is being currently formulated as part of the Strategic Procurement Plan (SPP) that will form the basic planning document for developing the Detailed Procurement Plan for the project. The project shall be implemented over a period of 7 years, i.e., from 2022-23 to 2028-29. The following is the structure of PMU, followed by structure at PIUs.

Figure 7: Structure of PMU



78. The PMU will be supported by an Environmental Safeguards Specialist, who will be responsible for overall implementation of environmental safeguards activities. The specialist will be responsible for compiling and preparing all reports for purpose of ADB requirements as well as for any regulatory requirement applicable to the project. The PMU specialist will be supported by Environmental Safeguard Experts at PIU level (both at DoH and JSV). The PIU level experts will be responsible for ensuring implementation of Environmental Management and Monitoring Plans as delineated in this IEE and guidelines indicated in the EARF. The PIU level experts will be responsible for collating and preparing all field level information and report to PMU.

79. Training and Capacity Building: Various training and capacity building programmes related to environmental safeguards will be held as delineated below:

Table 11: Environmental Safeguards Training Detail

Training Detail	Stakeholders	Trainer	Timeline
- Applicable Laws, regulations, policies including ADB's Safeguard policies those that are triggered by the project activities and exclusion list, - Implementation of Environment Management Plan and Monitoring, - Monitoring and reporting format, - Institutional arrangements and Grievance Redressal Mechanism	PIU Experts	PMU Environmental Safeguard Specialist	Within 1 month of Phase I implementation start date
ADB reporting requirements	PMU and PIU experts	ADB Project team	Within 1 month of Phase I implementation start date
Training to the EPC Contractor on Environmental Safeguards Requirement including ADB SPS, 2009 requirement;	ECP Contractor	PMU Environmental Safeguard Specialist PIU Experts, DOH, JSV	Within 1 month of contract awarding
Building Institutional capacity of CHPMA & Apex Body on Environmental Safeguards matters	CHPMA & Apex Body	PMU Environmental Safeguard Specialist PIU Expert, DOH	To be completed covering all CHPMA within 1 year from the start date of Phase I implementation
Building Institutional capacity of WUA on Environmental Safeguards matters	CHPMA & Apex Body	PMU Environmental Safeguard Specialist PIU Expert, JSV	To be completed covering all CHPMA within 1 year from the start date of Phase I implementation
Screening process and how to screen sub-projects for Phase II project selection	PIU Experts	PMU Environmental Safeguard Specialist	Within 6 months of Phase I implementation start date
Handling and management of Fertilizer, Pesticides and other horticulture plantation material;	CHPMA members	PMU Environmental Safeguard Specialist PIU Expert, DOH With support from external agency as deem fit;	To be completed covering all CHPMA within 1 year from the start date of Phase I implementation

5. DESCRIPTION OF THE ENVIRONMENT

A. Physical Environment

80. Location of the districts

- a. Bilaspur district is located in the southwestern part of Himachal Pradesh. The district has a geographical area of 1,167 sq.km and covers 2.1% area of the State. The district lies between the north latitudes 31° 12' 30" and 31° 35' 45" and east longitude 76° 23' 30" and 76° 55' 40". It is bounded on the north by Hamirpur district, on the north-east and east by Mandi district, on the south-east by Solan district, on the west by Una district and towards south-west by the State of Punjab. The district is predominantly located on the lower basin of the Satluj river.
- b. Hamirpur district is a sparsely populated district that lies in the south-west part of the state and constitutes the central micro region of Himachal Pradesh. The district has a total geographical area of 1,118 km² and covers 1.97 % of the state. The terrain of the district is hilly and occupied by Siwalik Group of rocks. The district lies between 31° 23' 00" and 31° 53' 00" north latitude and 76° 20' 00" and 77° 45' 00" east longitude. It is bounded on the east by Mandi district, on the northwest by Kangra district, on the south & southwest by Bilaspur and Una districts respectively.
- c. Kangra district is located in the Siwaliks Hills. The district lies in the western part of Himachal Pradesh and located between latitudes 31° 41' 00" and 32° 28' 05" and longitudes 75° 35' 34" and 77° 04' 46" in the low foothills of the Himalayas. The area of the district is 5,739 sq. km, which constitutes 10.31% of geographical area of the state.
- d. Mandi district is a densely populated and centrally located district of Himachal Pradesh. The district is entirely hilly, except a few isolated patches of small and fertile valleys. The district, with its headquarter at Mandi town, lies between 31° 13' 50" and 32° 04' 30" north latitudes and 76° 37' 20" and 77° 23' 15" east longitudes. The district is bounded by Kangra district on the northwest, Kullu district on the east, Shimla and Solan districts on the south and southwest respectively, Bilaspur and Hamirpur districts on the southwest. The district has a total geographical area of 3,950 sq. km, which constitutes 7.10% of the State.
- e. Sirmaur is the southernmost district of Himachal Pradesh, having 2,825 sq km geographical area. The district has hilly and mountainous topography with intermontane valleys, prominent being the Paonta valley. The district has its headquarter at Nahan and lies between North latitude 30° 22' 30" to 31° 01' 20" and East longitude 77° 01' 12" to 77° 49' 40". The district is bounded by Shimla district towards north & Solan district towards northwest. The district has an inter-state boundary in the west and south with State of Haryana and with Uttarakhand to the east.
- f. Solan is one of the south-western districts of Himachal Pradesh, lying in the Outer and Lesser Himalaya and having geographical area of 1,936 sq. km. The district lies between the north latitudes 30° 45' 11" and 31° 21' 10" and east longitude 76° 36' 00" and 77° 15' 20". The district is bounded by Bilaspur district in north-west, Mandi district in the north, Shimla and Sirmaur districts in east and south-east respectively.
- g. Una district lies in the south-west part of the State and is located between the north latitudes 31° 18' 00" and 31° 55' 40" and east longitude 75° 55' 00" and 76° 28' 00". Una shares its border with the Hoshiarpur and Rupnagar districts of Punjab, and Kangra, Hamirpur and Bilaspur districts of Himachal Pradesh. The district has a total geographical area of 1,540 sq.km. and covers 2.8% of the State.

Figure 8: Districts of Himachal Pradesh¹¹

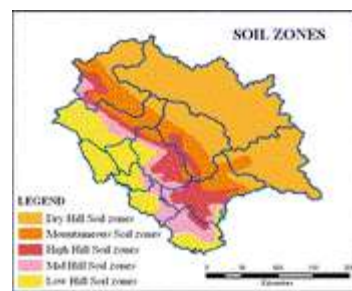
81. Geology

- a. Bilaspur District is mainly located on the Siwalik ranges and forms a part of the lesser Himalayas. Bilaspur is predominantly a mountainous region in the State, with a diverse landscape of hills and valleys. This part of the State has a rugged and undulating terrain with an elevation ranging from 320 m to 6,975 m. Major physiographic units in the district are structural hills, denudation hills and valley fills. The drainage pattern in the region is generally dendritic.
- b. Hamirpur district has a mostly hilly and undulating terrain. The surface elevation ranges from 400 m to 600 m above MSL along the Beas river and in lower reaches of Kunah Khad in the northern part of the district. The elevation is more than 900 m above MSL in the eastern part of the district. The altitudinal variation, in general, ranges between 600 m to 900 m above MSL.
- c. Kangra District presents an intricate mosaic of mountain ranges, hills, and valleys. It is primarily a hilly district, with altitudes ranging from 350 m above Mean Sea Level (MSL) to 4,880 m above MSL in the hills of Dhauladhar. Physiographically, the district can be divided into six units, i.e., (i) high hills, which cover almost 60% of the district, (ii) Fluvio glacial outwash terraces, which is located in the north eastern part of the district, (iii) structural terraces, in the central part, (iv) valley fills, (v) piedmont plain, and (vi) floodplain.
- d. Mandi district is primarily a hilly district with altitudes ranging from 550 m near Sandhole where the Beas River leaves the district, to about 3960 m above MSL near Kullu border. There is a general increase in elevation from west to east and from south to north. Master slope is south- westerly. The southwestern part consists of Siwalik ranges having scarp slopes. There are few small intermontane valleys; prominent among them is the Balh valley, located in the lesser Himalayan ranges, having an average altitude of about

¹¹ Source: <https://www.mapsofindia.com/maps/himachalpradesh/himachalpradesh.htm>

790 m amsl and have a general slope towards NNE. The valley floor is undulating and is marked by low hillocks and terraces fringing the hills and intervening low alluvial plain.

- e. Sirmaur district presents an intricate mosaic of high mountain ranges, hills and valleys with altitude ranging from 300 to 3000 m above MSL. There is general increase in elevation from south to north and from east to west. In general tranc, Giri terrain exhibits highly rugged mountain terrain. The highest peaks in Chaur dhar remain snow bound throughout the year. Low denuded hill ranges of Siwalik represent the southwestern part of the district. In the areas underlain by high hill ranges of Himalayas, the valleys are narrow and deep with steep slopes. The terrain is moderately to highly dissected with steep slopes. Paonta valley, trending NWSE, has an area of about 276 sq. km and lies between the main Himalayan ranges on the north and outer Siwaliks hill range in the south.
 - f. Solan District has a range of mountains, hills and valleys with altitudes ranging from 300 to 3,000 m above msl. The altitude of the hill ranges is higher in northern parts, whereas the south-western part of the district is represented by low denudational/structural hill ranges of Siwalik. In the areas underlain by high hill ranges of Himalayas, the valleys are narrow and deep with steep slopes trending in NW-SE direction. The terrain is moderate to highly dissected with steep slopes.
 - g. Una District nestles between Siwalik ranges and forms a part of the lesser Himalayas. It has a diverse landscape of hills, valleys with piedmont zone, and terraces. The elevations of the land surface in the district vary from 320 m in the south-eastern part to 1,041 m above msl in the eastern part of the district. There are four hill ranges in Una district – Chamukha Dhar, Solah Singhi Dhar, Dhionsar Dhar, and Ramgarh Dhar with an elevation of 1041 m, 1063 m, 950 m, and 997 m above MSL respectively.
82. **Soil** - As presented in the figure below, the project districts are in soil zone Low hill, Mid hill and High hill. The soil characterises of these zones are as follow¹².
- a. Low hill soil – Covers entire districts of Una and Hamirpur and parts of Bilaspur, Kangra, Mandi, Sirmour, and Solan. The texture of the soil is sandy loam, embedded with pebbles, stones and boulders. Soil colour is light grey to brown. The soil reaction is mostly neutral and the carbon to nitrogen ratio is 10:1. It is suitable for stone fruits like mango, litchi, guava, citrus varieties, etc.
 - b. Mid hill soil – Covers parts of Bilaspur, Kangra, Mandi, Sirmour, and Solan. The texture of the soil varies between loam to silt-loam. Soil colour is greenish to brown. The soil reaction is slightly acidic and the carbon to nitrogen ratio widens compared to low hill soil. It is suitable for stone fruits like peach, plum, apricot, persimmon, pomegranate, etc.
 - c. High hill soil - Covers a few parts of Kangra and Mandi. The texture of the soil varies between silt-loam to clay loam. Soil colour is light to dark brown. Fertility of the soil type is quite high as compared to low and mid hills. The soil reaction is slightly acidic and the carbon to nitrogen ratio widens compared to mid hill soil. It is suitable for walnut, chestnuts, cherry, etc.
83. **Physiography** – The four general physiographic divisions from south to north are:
- **The outer Himalayas (Shivaliks):** Shivaliks range consists of lower hills (600 m above sea level). The hills of the region are composed of highly unconsolidated deposits which results in high rates of erosion and deforestation.
 - **The lesser Himalayas (central zone):** The lesser Himalayas have a gradual elevation towards the Dhauladhar and the Pir Panjal ranges. The rise is more rapid in the Shimla hills, to the south of which is the high peak of Churdhar (3647 m). North of the river Sutlej, the rise is steady. The Kangra valley is a longitudinal trough which is at the foot of



¹² Source: HP Biodiversity Board, <https://hpbiodiversity.gov.in/Pdf/Soil%20types%20of%20HP.pdf>

the Dhauladhar range. Dhauladhar (which means the 'White Peak') has a mean elevation of nearly 4,550 m. It has a rapid rise of 3,600 m above the Kangra valley.

- **The Great Himalayas (northern zone):** The Great Himalayan range (5,000 to 6,000 metres) runs along the eastern boundary and is slashed across by the Sutlej.
- **Zaskar range (Shilla Peak (6,132 m) in kinnaur, Pangl in Chamba):** The Zaskar Range, the easternmost range, separates Kinnaur and Spiti from Tibet and Pangl Chamba from Leh Ladakh UT. It has peaks up to 6816 m high.

84. **Seismicity** - As per the Bureau of Indian Standards (BIS) seismic zonation map, Himachal Pradesh falls in Zone IV (High Damage Risk Zone) and V (Very High Damage Risk Zone), making it more susceptible to landslides. Table 10 list the project districts in order of their vulnerability to an earthquake. As per events of occurrence, the districts of Kangra and Mandi stand out to be highly prone to earthquakes and of higher magnitude.

Table 12: District-wise area under Seismic Zones V and IV

District	Area under Zone V (%)	Area under Zone IV (%)	Occurrence between 1800-2008	
			Numbers (<=4)	magnitude (Richter scale) ¹³
Kangra	98.80	01.20	39	4 – 7.8
Mandi	97.40	02.60	53	4 – 6
Hamirpur	90.90	09.10	2	4–5
Una	37.00	73.00	0	<=4
Bilaspur	25.30	74.70	1	4–5
Solan	01.06	98.94	4	5–6
Sirmaur	Nil	100	8	4–7

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B. Climate and Meteorology

85. The climate of Bilaspur district is temperate to sub-tropical. The summer is invariably hot. The winter season starts from November and continues till mid-March. The minimum and maximum temperature varies from 1.3 °C in January to 34.7 °C in May. For three months in winter, a thick mist surrounds the Sutlej. The places situated at higher elevations such as Swarghat and Nambhol have a bracing climate, while the hills and valleys along the khads are quite dry in summer. In rainy season, the humidity increases, and the weather becomes hot and sultry. The area receives rainfall during the monsoon period extending from June to September and during the non-monsoon period (winter). The average annual rainfall in the district is about 1,200 mm and about 81.5% rainfall occurs during the monsoon period.
86. The climate of Hamirpur district depends primarily on the elevation, which varies from less than 200 meters to more than 1000 meters above mean sea level. The climate can broadly be divided into three broad seasons viz., winters from October to March, summer season from April to June and monsoon season from July to September. The district receives moderate rainfall and bulk of it is received during the months of July and August. The normal annual rainfall in the district is 1361 mm, out of which 82% occurs during June to Sept.
87. The climate of Kangra district is classified as warm and temperate. The average annual temperature is 21.8 °C and the average annual rainfall is 2500 mm. The climate of the districts varies from sub-tropical to sub-humid. Winter extends from December to February and summer extends from March to June while July to September are the rainy months. The average annual rainfall of the district is 1,751 mm, out of which 83% occurs during June to Sept. Snow fall is received in the higher reaches of Dhauladhar ranges. The landscape of the district during monsoon period becomes fresh/green and the small water channels in the beds of hill streams begins to swell which had dried up in the summer.
88. The climate of Mandi district is sub-tropical in the valleys and tends to be temperate near the hilltops. In the higher region, the climate remains cold throughout the year. In winter, snow often comes down to 1300 m above MSL. Normally, it starts melting from the end of March from places lying below 3300 m. In summer, the whole Balh valley and other low altitudes

¹³ As per Hazard Vulnerability & Risk Analysis Atlas of HP, powered by TARU Leading Edge Pvt. Ltd.

are quite hot. The winter starts from the middle of November and continues till the middle of March. Thereafter, the mercury continues to rise till the onset of the monsoon, which starts from the last week of June or early July and continues till the middle of September. During October and November, the nights are pleasant, whereas the days are a little bit hot. Average minimum and maximum temperature in the district vary from 3.1° C in January to 37.6° C in June. The district receives precipitation in the form of rainfall, mainly during the monsoon period from July to September. The annual normal rainfall of the district is 1442 mm. Annual average rainfall is highly variable from place to place in the district and ranges from 700 to more than 2000 mm at Jogindernagar. During winters, snow fall often occurs down to elevation of 1300 m above MSL.

89. The climate of the Sirmaur district is sub-tropical to temperate, depending upon the elevation. The three major seasons are the winter season from November to February; summer season from March to June followed by the monsoon period extending from July to September end. Maximum precipitation in the form of rain occurs during July to September. Annual normal rainfall in the district is about 1626 mm, out of which 90% occurs during monsoon season. In the non-monsoon season, precipitation as snowfall also occurs in the higher reaches. During winter period, rainfall also occurs in lower hills and valleys parts. Mean maximum and minimum temperature of 30°C and 0°C respectively.
90. The climate of the Solan district is sub-tropical in the valley and tend to be temperate on the hilltops. There are four major seasons. Winter season lasts from November to February and ends in March; the summer season extends from March to June, followed by the monsoon period extending from July to September. The maximum precipitation occurs during July to September. Annual normal rainfall in the district is about 1306 mm, of which 80 to 85% rainfall occurs during June to September. In the winter season, precipitation in the form of snowfall occurs in the higher reaches up to 1,000 m elevation, and in the form of rainfall in the low hills and valleys of the district. The mean maximum and minimum temperature ranges between 32.2 °C (May) and 0.6 °C (January).
91. The climate of Una district is tropical to temperate in nature, as the terrain varies from plains to high hills. Temperature varies from a minimum of 4 °C in winter to a maximum of 46 °C in summer. The area receives rainfall during the monsoon period, extending from June to September and during the non-monsoon period (winter). The average annual rainfall in the area is about 1051 mm, with about 55 average rainy days. The winter season starts from November and continues till mid-March. Thereafter, the summer months last till end of June, after which the monsoon season lasts till mid-September.
92. Figure 9, illustrates the trend analysis of observed average annual mean temperature between 1901 to 2020 and Figure10 illustrates the trend analysis of observed average annual rainfall between 1901 to 2020

Figure 9: Observed Average Annual Mean Temperature, 1901-2020

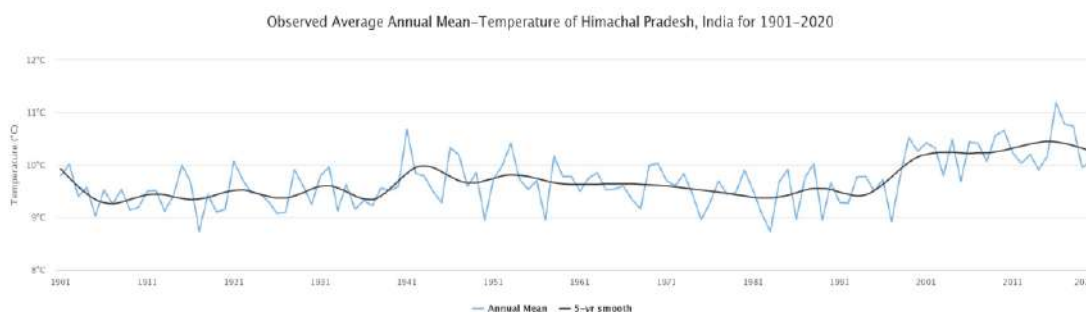
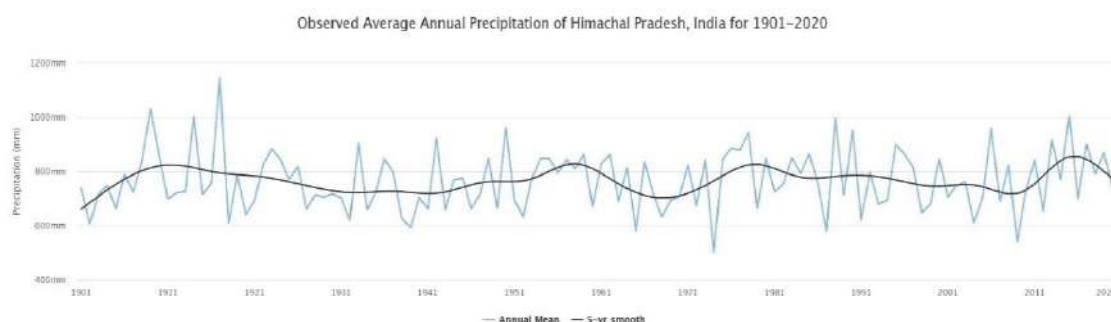


Figure 10: Observed Average Annual Mean Precipitation (1901 - 20202)



C. Ambient Air Quality and Noise Level

93. The target irrigation sites are at remote areas, besides river banks and Khads (rivulet). Thus, the ambient air quality and noise level are similar to that of rural areas. Similarly, the horticulture fields are at different villages, wherein the main activities are agriculture. Thus, the ambient air quality and noise levels are that of rural areas.
94. Himachal Pradesh State Pollution Control Board regularly conducts ambient noise monitoring for different areas / zones at 87 selected locations in the State on weekly basis. Those locations where ambient noise has exceeded the prescribed limit up to 5 times (day/night) during the year are not treated as hot spots from ambient noise pollution point of view. It is noted from the report¹⁴ that the rural areas are within the prescribed limit of noise level for residential zone – 55 dB (A) day time and 45 dB (A) night time – standard prescribed limit. However, in the Project district of Bilaspur, for one residential zone location, 06 values in day time and 07 values in night time were found to be above the standard prescribed limits.
95. Ambient air quality is also monitored in 10 towns/cities at Shimla, Parwanoo, Jassur, Paonta Sahib, Kala Amb, Baddi, Nalagarh, Sunder Nagar, Manali and Una under National Ambient Air Quality Monitoring Program. Air quality standards are fixed for 24 hours average and the annual average standard for residential and eco-sensitive area is estimated. According to the latest report of the Himachal Pradesh State Pollution Control Board, the ambient air quality in the residential places is within the prescribed limit, as follows:

Table 13: Ambient air quality in Himachal Pradesh

Standard for	Particulate Matter (PM10) (size less than 10 micron) ($\mu\text{g}/\text{m}^3$)	Particulate Matter (PM2.5) (size less than 2.5 micron) ($\mu\text{g}/\text{m}^3$)	Carbon Monoxide (CO) (mg/m^3)	Sulphur Dioxide ($\mu\text{g}/\text{m}^3$)	Nitrogen Dioxide ($\mu\text{g}/\text{m}^3$)
Residential	100 (24 hrs)	40 (annual)	4 (1 hour)	80 (24 hrs)	80 (24 hrs)
Eco-sensitive	100 (24 hrs)	40 (annual)	4 (1 hour)	80 (24 hrs)	80 (24 hrs)

D. Water Resources

D.1. River Discharge

96. The state is richly endowed with hilly terrain having an enormous volume of water for the catchment areas of Satluj (which covers 30.69% of the state), the Beas (24.5%), the Chenab (14.2%), the Yamuna (10.6%), the Ravi (9.9%) and the Indus (2.6%). For project districts, the catchment areas of rivers Beas and Satluj is of importance.
97. Satluj one of the main tributaries of Indus enters Himachal Pradesh at Shipki (altitude of 6,608 metres) and flows in the south-westerly direction through Kinnaur, Shimla, Kullu, Solan, Mandi and Bilaspur districts. Its total catchment area in Himachal Pradesh is 20,000

¹⁴ Report on findings of Noise monitoring conducted by HP State Pollution Control Board for the year 2021 - <http://hppcb.nic.in/NMR.pdf>

sq. km. Satluj river is fed by the glacier melt, snowmelt and rain. The important tributaries of the Satluj River at Himachal Pradesh are the Soel khud, Alseed khud, Ali khud, Gamrola khud, Ghambhar khud, Seer khud, Sukhar khud, Sarhali khud, and Lunkar khud. The world's largest dam, Bhakhra Dam, has been constructed on the Sutlej River. The Beas rises in the Pir Panjal glacial range near the Rohtang Pass and flows some 256km in Himachal through Kullu, Mandi, Kangra, and Hamirpur districts. The tributaries that form River Beas are Parbati, Spin, Hurla, Malna, Chakki, Sainj, Uhl, Phung, Binwa, Banganga and Man khud. The northern and eastern tributaries of the Beas are snow-fed and perennial, while the southern affluent are seasonal.

98. The Alseed khud, Ali khud, Gamrola khud, Ghambhar khud, Seer khud of Satluj and Binwa Khud of River Beas and River Beas itself are few of the sources of project's irrigation water.

99. As per the Climate Change Risk and Vulnerability Assessment (CRVA) report, indicates projected increase in water availability in near future but leading reduced availability in the long-term period (by 2050). Thus, irrigation schemes being developed under project HPSHIVA are less likely to experience low/ no water availability from river sources; though they may get exposed to extensive flooding. The report recommends that the design of the schemes should consider longer return periods and the alignment of the intake structure, the pumping main and the gravity canal system and the number of lifts and pumps be planned judiciously.

D.2. Groundwater Table

100. Most of the areas of Himachal Pradesh are hilly except for some intermountain valleys and groundwater occurs under unconfined to confined conditions in these intermountain valleys and submontane tract. Areas in absence of piped water source depends heavily on either groundwater or springs for both domestic and irrigation usage.

101. The Central Ground Water Board (CGWB) assess the availability of groundwater every year across each state. The recent assessment (i.e., 2020), compares with the past assessment (2017) (refer to Table 3) showing slight improvement in availability. This is because of the action taken by the State to move from groundwater sources to surface water by enhancing minor and medium irrigation schemes at the khuds as well as using water from the River Beas and River Sutlej.

Figure 11: Assessment of Ground Water - Central Ground Water Board (Year 2020, 2017)

S. No	Name of District	Name of Assessment Unit	Stage of Ground Water Extraction (%) in 2017	Categorization 2017	Name of District	Name of Assessment Unit	Stage of Ground Water Extraction (%) in 2020	Categorization 2020	Remark
Improved									
1	Kangra	Indaura Valley	119.00	Over-Exploited	Kangra	Nurpur Indaura Valley	29.27	Safe	Improved
2	Sirmour	Kala Amb Valley	385.11	Over-Exploited	Sirmour	Kala Amb Valley	27.51	Safe	Improved
3	Nalagarh Valley	Solan	110.80	Over-Exploited	Nalagarh Valley	Solan	58.41	Safe	Improved
4	Una Valley	Una	108.37	Over-Exploited	Una Valley	Una	60.99	Safe	Improved
3	Hum valley	Una	75.50	Semi-Critical	Hum valley	Una	58.12	Safe	Improved

102. All past assessments of CGWBs¹⁵ shows overexploitation of the sources and a few of them are identified at the Critical stage as well. The State has been working on artificial recharging initiatives as well. The Departments of Agriculture and Rural Development is constructing concrete check dams in some tributary creeks to improve groundwater recharge¹⁶.

103. The annual measurement of groundwater table by CGWB concludes as follow:

- b. Annual Water Level Fluctuation for May 2019 to May 2020 (post-monsoon level) shows fall in water level in majority of monitoring areas. Fall of 0-2m is shown in Kangra-Palampur valley of Kangra & Kullu district, major part of Nurpur and Indaura Valley and some pockets of Una Valley. Fall >4 m is noticed in some pockets of Nurpur valley and

¹⁵ <http://cgwb.gov.in/Dynamic-GW-Resources.html>

¹⁶ Climate change adaptation in Himachal Pradesh: Sustainable strategies for water resources, ADB, 2010

Indaura Valley. Rise in water level is noticed in a few pockets of Kangra Palampur valley, Una valley, northern part of Kullu valley and southern of part of Balh valley.

- c. Annual fluctuation of water level post monsoon (November 2019 - November 2020) indicates, out of the 101 stations, only 10 stations (9.90%) have shown rise in water level ranging from 0.08m (Kangra district) to 1.72 m (Una district) whereas 90 stations (89.10%) have shown fall ranging from 0.02 m (Kangra and Mandi district) to 3.19 m (Solan district).
- d. Decadal Variation indicates (average of May (2010 - 2019) with May 2020) reveals fall less than 2m, in all the valleys of Kullu district, Mandi district & Una district except at some places in Indaura valley, Balh valley & Kangra-Palampur valley and Nurpur valley. A fall is 2-4m and >4 m is shown in Nurpur valley, central part of Kullu valley.

104. Rainwater is the main source of replenishment and a very small percentage is contributed through infiltration from spring water. However, since the project districts are in subtropical region having mixed of plains and hilly areas with significantly lumpy and rocky surfaces, a larger percentage of the precipitation flows away as runoff. This results in less water getting infiltrated from subsurface to groundwater bodies. Additionally, since climate change projections suggest heavy and concentrated rainfall with increased surface run-off, groundwater sources are a less sustainable source with the chance of getting overexploited very soon.

D.3. Water Quality

105. Water quality has been tested by established laboratories of JSV, one at each district. The water quality has been tested against drinking water quality standard as followed by JSV for drinking water supply. In most the cluster the water is slightly alkaline and within limit for irrigation purpose. Some of the clusters have traces of high nitrate and sulphate, however within tolerance limits of the horticulture plants. Water quality is periodically tested by JSV as same water sources are also tapped for drinking water purpose. Sample test reports are presented in Annex 12.

Assessment of Groundwater Quality

106. The latest assessment of GW quality by CGWB suggests that the following districts are above the safe limits of either nitrate or arsenic contain or both. Thus, it is concluded that GW resources may not be a sustainable and safe alternative source for purpose of horticulture use.

Pollutants	Nitrate (above 1.5mg/l)	Arsenic (above 0.01mg/l)
Districts	Una, Solan, Hamirpur, Kangra, Mandi	Kangra

E. Hydrology

107. For source water sustainability analysis (estimation at 75% dependable yield), following exercise have been carried out:

- Estimation of Crop Water Demand – standardised at 20 m³/day/ha
- Analysis of hydro-meteorological data extending to recent 30 years
 - Observed rainfall stations near and within the Cluster area.
 - Observed discharges at the gauging stations on different khads.
 - Evaporation data that is representative of the Cluster area.
- Estimation of existing and future water demand along the source.
- Catchment area analysis
- Pumping test carried out to determine the yield from open well or bore well or tube well.

108. Following are the conclusions for respective sources:

Package 01 – Solan district

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Source Sustainability
Kunihar	Sai	6.74	Sai	Natural Spring	From analysis, it is concluded that the gross demand can satisfactorily be made by the source with surplus quantity available throughout the year,
	Ser-Delag	21.56	Seri Sarla	Spring	

					except for the months of May, November and December.
	Chunad	15.64	New Proposed	Ghumber Khad	The clusters proposed on Ghumber and Ali Khads have perennial water source. The structures proposed are Percolation well on Ghumber khad and Check dam on Ali khad. The expected discharge of the percolation well is around 15 to 25 lps. The water source of remaining clusters requires detailed hydrological study since the khads/nallahs seem to be ephemeral and not perennial.
	Daseran	32.90	New Proposed	Ali Khad	
	Datti	13.75	New Proposed	Natural Spring	
	Giana	6.69	New Proposed	Jadol Nallah	
	Jailang	9.65	New Proposed	Ghumber Khad	
	Pajeena	13.70	New Proposed	Pajeena Nallah	
Nalagarh	Badhal	6.42	New Proposed	Perennial Nallah	The clusters require detailed hydrological study as both the clusters have a small catchment area. Therefore, opinion of Hydrologist is mandatory.
	Kohla	6.26	New Proposed	Swarghat Nallah	
	Baduan Bharmana	17.35	New Proposed	Halyara Khad / Nallah	
	Kosri	21.38	New Proposed	Kosri Nallah	Both the khads/nallahs seem to be ephemeral khads/nallahs. After hydrological study, check dams can be constructed at suitable locations to meet the water requirement
	Batiakh	14.42	New Proposed	Ghamber Khad	The khad is perennial in nature and has sufficient catchment area. The khad has good discharge in lower reaches and is adequate to meet the water requirement.
	Doli	16.20	New Proposed	Ghamber Khad	
	Sour	36.41	New Proposed	Ghamber Khad	
	Beli khol 1	10.17	New Proposed	Tubewell	The source of the clusters is ground water. Two sites have been identified for the construction of tubewells to meet the irrigation demand.
	Beli khol 2	1.44	New Proposed	Tubewell	
	Palli	10.02	New Proposed	Tubewell	

Package 02 – Sirmaur district

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Source Sustainability
	Dungi Sher	9.68	LIS from Jalal Khadd	Jalal Khadd	Water demand of Dungi Sher and Kherichandan 1 & 2 clusters is presently satisfied from the available water in Jalal Khad and excess water is likely to be available as per the scenarios considered
	Kherichandan 1	14.41	LIS on Jalal Khadd	Jalal Khadd	
	Kherichandan 2	13.81	LIS on Jalal Khadd	Jalal Khadd	
	Bajari (1 & 2)	13.99	LIS Jungla Bhood	Ruhn Khadd	Maximum shortage / excess is noticed majority of times in November and May followed by single event in May. Maximum shortage of 0.0080 Mm3 is noticed for Bhogpur & Simbalwala cluster having catchment area of 75.47 km2 while serving irrigation area of 13.99 ha. Minimum shortage of 0.0009 Mm3 is noticed for Khara cluster having catchment area of 8.705 km2 while watering irrigation area of 8.95 ha.
	Rama	6.88	LIS from Doghat Khad	Doghat Khadd	
	Bhogpur	8.49	Check dam / LIS on Ruhn Khadd	Ruhn Khadd	
	Simbalwala	9.99	Check dam / LIS on Ruhn Khadd	Ruhn Khadd	
	Judag	12.61	LIS from Judag Nallah	Judag Nallah	
	Goant	8.00	LIS from Goant Dam	Existing DAM Goant	
	Budriyon	16.10	LIS from Tubewell	Tubewell 2	
Paonta Sahib	Fatehpur	6.61	LIS Fatehpur	Percolation well, Edge of Bata River	Storage structures with capacity ranging from 0.0015 Mm3 at Khara cluster to 0.0120 Mm3 at Bhogpur Simbalwala clusters are proposed to make these clusters workable with water available in proposed source.
	Killour	21.88	LIS Killour	Tons River	
	Upper Bhuddi	21.72	LIS from Tubewell	Tubewell 3	
	Khara	8.95	LIS Khara Nallah	Khara Nallah	
	Puruwala	13.93	LIS from Tubewell	Tubewell 4	
	Gyayaniwala	10.87	LIS from Tubewell	Tubewell 5	

Package 03 – Hamirpur district

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Source Sustainability
Bamsan	Sachuin	8.68	LIS Sachuhi	Beas River	Maximum shortage / excess is noticed majority of times in December, followed by October and one single event each in April and November. All clusters in Package P3 have shortages.
	Parol	17.51	LIS Dera Parol	Kunah Khadd	
Bhoranj	Balor-Sangrawar	33.45	LIS Balor Nallah	Balor Nallah	
	Jol	19.72	LIS Jol Nallah	Jol Nallah	
	Lagmanwin	6.90	LIS Lagmanwin Nallah	Lagmanwin Nallah	Maximum shortage of 0.0207 mm ³ is noticed for Balor-Sangrawar cluster in Bhoranj block having catchment area of 4.65 km ² while serving irrigation for an area of 33.45 ha. Minimum shortage of 0.0040 mm ³ is noticed for Bhalat cluster in Bijhar block having catchment area of 9.0970 km ² while watering irrigation area of 11.52 ha.
	Lambagram / Palasi	18.17	LIS JICA dam, Plassi Nallah	JICA dam, Plassi Nallah	
	Mundkhar tuls	27.99	LIS Balor Nallah	Balor Nallah	
	Samlog	22.69	LIS Samlog Nallah	Samlog Nallah	
Bijhar	Bhalat	11.52	Existing LIS Bhalat Nallah	Bhalat Nallah	Storage structures with capacity ranging from 0.0060 to 0.0315 mm ³ are proposed to make these clusters workable with water available in proposed source.
	Lafran	13.96	LIS over New Source	New Proposed	
	Ghangot	8.42	Existing LIS Ghangot Nallah	Ghangot Nallah	
	Kalwal	15.75	LIS Kalwal	Rihal Nallah	
	Seri-Bhakredi	14.88	LIS Bhakreri	Existing check dam on Nallah	

Package 04 – Hamirpur district

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Source Sustainability
Hamirpur	Branda	7.90	LIS Nalti Branda	Kunah Khad	Maximum shortage / excess is noticed majority of times in November, followed by October. Except for Manjot / Manjot 2 cluster that has excess storage, shortage is noticed for other clusters.
	Bakarti-I	29.97	LIS Bakarti	Kunah Khad	
	Jangal Ropa	22.20	LIS Jangal Ropa	Kunah Khad	
	Haar	14.90	LIS Jangal Ropa Haar	Kunah Khad	
	Neri	7.44	LIS Neri	Kunah Khad	
Nadaun	Sadhwan	8.80	MIP Nadaun	MIP Nadaun	Maximum shortage of 0.0163 mm ³ is noticed for Jangal Ropa cluster in Hamirpur block having catchment area of 182.94 km ² while serving irrigation for an area of 22.20 ha. Minimum shortage of 0.0026 mm ³ is noticed for Bakarti cluster in Hamirpur block having catchment area of 148.90 km ² while watering irrigation area of 29.90 ha and Kashmir cluster with irrigation area of 6.70 ha and catchment area of 14.65 km ² in Nadaun Block.
	Rail-I	6.20	MIP Nadaun	MIP Nadaun	
	Baag Bharmoti	6.10	MIP Nadaun	MIP Nadaun	
	Kushiar-I	15.80	LIS Khusiyar Galol	Maan Khadd	
	Bhabran 1	11.22	LIS Bhabran	LIS Bhabran	
	Bhabran 2	13.90	LIS Bhabran	LIS Bhabran	
	Kaloor	9.74	LIS Kola	Maan Khadd	
	Kashmir	6.70	LIS Kashmir	LIS Kashmir	
	Phal Palsi	28.20	LIS Palsi	LIS Palsi	
	Choru (Bhoo-I)	6.20	LIS Bhoo	LIS Bhoo	
	Manjot	7.90	LIS Salasi Nallah	Salasi Nallah	
	Manjot 2	1.50	LIS Salasi Nallah	Salasi Nallah	
	Tung (Baloh)	14.10	LIS Maan Khadd	Maan Khadd	
	Loharda	5.00	MIP Nadaun Right Bank	MIP Nadaun	
	Sai Lower	19.00	MIP Nadaun Left Bank	MIP Nadaun	
	Pansai 1	32.20	LIS Pansai	LIS Pansai	
	Pansai 2	24.20	LIS Pansai	LIS Pansai	
Sujanpur	Kheri	12.80	LIS Kheri	LIS Kheri	Storage structures with capacity ranging from 0.0040 to 0.0455 mm ³ are proposed to make these clusters workable with water available in proposed source.
	Beri-1	9.30	LIS Kudana Beri	LIS Kudana Beri	
	Beri-2	12.40	LIS Kudana Beri	LIS Kudana Beri	
	Bhahru (Pour)	7.10	LIS Bhahru Jatour	LIS Bhahru Jatour	
	Bir	7.00	LIS Pour	LIS Pour	

	Baghera				
	Kudana	7.90	LIS Bhahru Jatour	LIS Bhahru Jatour	
	Bhalana Rei	18.21	LIS Pung Khad	LIS Pung Khad	

Package 05 – Bilaspur district

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Source Sustainability
Ghumarwin	Dehra	17.90	IPH Scheme	Seer Khad	Source of the khads indicates shortages in supplying water to irrigated area. Storage structures with capacity ranging from 0.0050 Mm ³ at Talwara cluster to 0.0750 Mm ³ at Kasol and Bhadrog cluster are proposed to make these clusters workable with water available in proposed source.
	Kathalag droun	20.57	IPH Scheme	Seer Khad	
	Lower Lanjhta	11.61	IPH Scheme	Seer Khad	
	Thandora	7.41	IPH Scheme	Seer Khad	
	Upper Talwara	9.35	LIS Talwara	Khad	
	Talwara Lower	1.91	LIS Talwara	Khad	
	Talwara Phase-2	6.91	LIS Talwara	Khad	
	Kasol	20.53	LIS Kasohal	Seer Khad	
	Kasol Balh	8.84	LIS Kasohal	Seer Khad	
	Kasol Kanjeen	6.20	LIS Kasohal	Seer Khad	
	Mehri Kathla	14.46	Mehri Kathla	Bajrauli Khad	
	Nalti Parnal	8.77	LIS Parnal	Seer Khad	
	Gwal Muthani (Nanawan)	3.75	LIS Nanawan	Madhi Khad	
	Chharal Daloli	19.29	New Check Dam	Over LIS Talwara	The source is based on surface water of Seer khad and other local nallahs, therefore, hydrological study of Seer khad and local nallahs is crucial and the recommendation of Hydrologist is mandatory for sustainable development of the resource in the area. It is further added that hydrological study of Seer khad is utmost important as the discharge of Seer khad is falling every year, particularly in the upper reaches
	Sandhiar (Chhat)	18.97	New Scheme Check Dam proposed	Existing DAM – Nearby Nallah - Sandhiar	
	Bhadrog (Seu)	8.88	New Scheme IPH Scheme	Seer Khad	
	Bhapral	7.11	New LIS	Seer Khad	
	Massour / Maloh	6.57	New Check Dam	Seer Khad	
	Chhiber	16.99	New Scheme Check Dam existing and proposed	Nearby Nallah	The source is based on ground water. Hydrogeological conditions in the area of these clusters are not conducive for large drawl ground water development as indicated above. Hence, not recommended for drilling and alternate suitable source for both the clusters be investigated accordingly for successful functioning of New Schemes.
	Samsai	5.34	New scheme Check Dam / Bore	Borewell	
	Feori (Kothi)	8.67	New Scheme Borewell proposed	Borewell	
Sadar - Bilaspur	Kotlu	14.23	New scheme	Ali Khad	Water demand is presently satisfied from the available water in Ali Khad and excess water is likely to be available as per the scenarios considered.
	Karot	21.92	Existing Kuhl	Ali Khad	
	Dugga Har (Manjher)	11.43	Kuhl	Kuhl	The source of these clusters is single borewell. Based on existing hydrogeological conditions at/or near the surrounding area of these clusters, it is not feasible for construction of borewell to provide discharge/water to these clusters. Therefore, the source identified by the JSV
	Loharda	23.02	Kuhl	Ali Khad	
	Kainthal	6.38	Kuhl	Ali Khad	
	Khod ka kyar	21.49	IPH Kuhl	Ali Khad	

					shall be reviewed and rainwater harvesting structure/or any suitable structure nearby these clusters be considered/identified for successful functioning of the scheme. Opinion of Hydrologist is mandatory.
	Salnu	27.79	New Scheme	Sutlej River	Source is hydrologically assessed feasible for providing LIS to cluster Salnu.

Package 06 – Bilaspur district

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Source Sustainability
Jhandutta	Balh Sinha	32.14	New Proposed	JICA Dam	The source is sustainable for all months, except for shortages in January and December, with shortage volume ranging from a maximum of 0.0193 mm ³ for Balh Sinha cluster with catchment area of 303 ha to a minimum of 0.0096 mm ³ for Jhandu with catchment area of 170 ha. Storage structures with capacity ranging from 0.015 to 0.030 mm ³ are proposed to make the clusters workable.
	Kosarian-I	30.03	New Proposed	Kosari Nalla	
	Jhandu	15.35	Defunct scheme of MHWDP Perennial Nallah (NF)	JICA Dam	
	Tihri	29.15	LIS Tihri (NF)	LIS Tihri	
	Lehar	24.51	New Proposed	Neri Dam	
	Tikkari Kotlu	22.94	New Proposed	Seer Khad	
	Fagog	22.28	LIS Seer khad (NF)	JICA Dam	Water demand is likely to be satisfied from the available water and excess water is likely to be available.
	Fagog Banjholi	11.17	Sukar Khad (NF)	JICA Dam	
Swarghat	Bassi	12.44	BBMB Canal	Anand Sahib Hydel Channel (ASHC)	Govt of Punjab agreed to release 25 Cusec of water regularly from ASHC for irrigation and drinking water purpose. Separate gravity main to be proposed from existing Zone 1B and Zone 2B tank to connect the proposed cluster tanks
	Dulhet 3	29.62			
	Ghattewal	28.26			

Package 07 – Mandi district

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Source Sustainability
Chauntara	Golwan	17.19	LIS Golwan	Ropdi Khad	The source of Golwan cluster, i.e., Ropdi Khad does not have an adequate catchment area. Thus, hydrological study and recommendation of Hydrologist is mandatory.
	Kothi – I (Balh)	9.3	TW 1	Tubewell	The borewells lie on the Govt. land along the right bank of Beas river. However, the source of these five clusters is also feasible from surface water of Beas river.
	Kothi - II	8.3	TW 2	Tubewell	
	Dhelu (Dhog)	9.97	LIS Dhelu	Tubewell	
	Dol	33.29	TW 3	Tubewell	

	Khadiyal	23.24	TW 4	Tubewell	The borewells have been taken as source, because the area has already been explored as no. of borewells have been drilled in the vicinity.
Gopalpur	Sulpur	7.5	LIS Sulpur Bahi	Seer Khad	The Sulpur cluster have their source from functional scheme. The hydrogeological set up of the Seer khad is not conducive for construction of tubewells. Therefore, to tap base flow of Seer khad 4 Infiltration Galleries are recommended across the Seer khad at suitable locations identified / suggested by the Hydrogeologist
	Bhambhla-I	14.15	Seer Khad	Seer Khad	
	Batail 2	9.13	TW 5	Tubewell	
	Mataur Tanda	13.05	LIS Infiltration-Seer Khad	Seer Khad	The Beas River is perennial in nature
	Dhar	10.16	LIS Basantpur	Beas River	
	Barchwar	10.82		River Beas	
	Ghadhyani	7.24		River Beas	
	Kharoh (Kalerka)	17.11		Beas River	
	Bhadarwar Khobla	9.02	LIS Bhadharwaar, Bhudroli Khad	Rissa Khad	Source is perennial in nature
	Bahi	8.71	LIS Percollation-Seer Khad	Percollation well, Seer Khad	Functional scheme; to improve the health of the source i.e., Pwell for cluster Bahi, subsurface dyke cum check dam of height 1 to 2 m d/s of Pwell is recommended for long term sustainable development of the resource.
	Thouna/Dhalait	8.18	FIS Thouna Kuhal	Local Nallah	It is observed that the catchment area of the nallah is not adequate. Therefore, hydrological study and opinion of hydrologist is mandatory.
	Rasher	10.95	LIS Son Khadd	Rissa Khad	Source is perennial in nature
	Batial 1	19.7	TW 5	Tubewell	Infiltration galleries are recommended across the Seer Khad
	Bag-chuhku	12.86	TW 6	Tubewell	
Dharampur	Richhli	12.81	LIS Bari Marhi Dhwali	Beas River	The Beas River is perennial in nature and is having sufficient discharge
	Mannu Dhar (Joh)	13.68			
	Haryanal	12.55			
	Satrehar	12.52			
	Ghanswai	8.3			
	Aarli Paryal	9.87			
	Richhali / Dhwali	5.75			
	Tarohla	8			
	Taroon	9.26			
	Chhapanu	8.38			
	Banwaar Kalaan	13.16			
	Dhardi-1	2.67			
	Baratpur	7.49			
	Balhara 1	1.46			
	Balhara 2	2.45			
	Dhardi 2	3.55			
	Lalana	4.27			
	Parli Paryal	1.7			
	Sakran Dhar	5.36			
	Sherpur	1.24			
	Chakyana	3.72			
	Chunighat	14.14			
	Gorat	12.25			
	Pakhdol	4.39			
	Tourjajar	9.74	LIS Baroti-Mandap-Joddan	Beas River	
	Galloo (Chanouta)	6.19			
	Siram(Sarskan)	7.05			
	Trembala	6.06			
	Hiun	3.96			
	Kumarhda 2	10.22			
	Didnu	5.2			
	Banerti-2	10.44			

	Pehad-2	10.04			
	Chhater	10.86			
	Drumman	30.76			
	Kumahrda	13.84			
	Giun	27.8			
	Cheh	8.67			
	Bahn	5.63	LIS Kothua Dhallara	Beas River	
	Chatroun (Lower)	11.26			
	Dhalara 1	9.35			
	Dhalara 2	8.7			
	Lower Balh	6.24			
	Single Kuhat	3.7			
	Kanohi	1.32	LIS Sandhole	Beas River	
	Lahsani	1.35			
	Churu ra Balh	20.88	LIS Churu Balh	Nald Khad	The behaviour of the khad is ephemeral
	Seoh II	27.49	LIS Seoh	Beas River	The Beas River is perennial in nature and is having sufficient discharge
	Seoh (Balh) Nichla Ropa	18.74		Beas River	
	Lower (Nichali) Bairi	9.13	LIS Bairi	Beas River	
	Upper Bairi	23.98			
	Barota	4.37	LIS Brang	Soan Khad	The khad goes dry during lean period
	Manyoh- Lambri	20.14	LIS Tihra	Beas River	The Beas River is perennial in nature and is having sufficient discharge
	Thanna (Ropari)	8.18			
	Patti (Kot)	6.9			
	Darwaar	9.27			
	Digho-Baglana (Karyal)	7.28			
	Skohta	1.82			
	Khajurti	5.76			
Bandal	10.71				
Chandpur	11.98				
Tikri	14.51				
Dvol	5.59				

Package 08 – Mandi district

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Source Water Sustainability
Drang	Baragaon – I & II	14.32	LIS Baragaon	Baragaon nalla	Maximum shortage / excess is noticed majority of times in October and December, followed by February. Except for Baragaon, Latogali and Khargaon clusters, rest have shortage.
Gohar/Balh	Dharwahan-II (Sehal)	17.39	New LIS 10 Behl-Ksarla	BSL Canal	
	Sawla	17.46	IPH Chamber	IPH Chamber	Maximum shortage of 0.0119 mm ³ is noticed for Palhota cluster in Sundernagar block having catchment area of 42.073 km ² while serving irrigation for an area of 17.11 ha. Minimum shortage of 0.0008 mm ³ is noticed for Manjhagan Chudara cluster in Gohar Block having catchment area of 178.18 km ² while watering irrigation area of 37.19 ha.
	Bagga Chalog	8.63	New LIS – Bagga Chalog	Jiuni Khad	
	Latogali I	26.97	New LIS – Kuklah to Latogali	Bakhli Khad	
	Brikhmani	16.76	FIS Anu Darbehad	Brikhmani Nalla	
	Darvehad	12.33	LIS Zone no. 5 Balbehli	BSL Canal	Storage structures with capacity ranging from 0.0180 to 0.0012 mm ³ are proposed to make these clusters workable with water available in proposed source.
	Manjhog Dhaniut	9.66	FIS Majhog Dhanyot	Dhaniut nalla	
	Manjhagan Chudara	28.56	LIS – Manjhagan Chudara	Jiuni Khad	Two clusters on BSL Canal (Sundernagar Hydel Channel) have water demand of less than 1% of design discharge of canal. Therefore, water demand of both the clusters
Sadar	Dhaniyara	17.85	LIS Dhanyara	Arnodi Khad	
	Binol	7.21	LIS Binol Neeyul	Beas River	

Sundernagar	Palhota	17.11	Functional Lift Irrigation Scheme, Nehra, Palhota	Kansa Khad	is likely to be sustainable except for the period of canal closure.
	Kuthain	15.45	Piped Irrigation Scheme Chirdi Boudhal Dhar	Kansa Khad	
	Bhantraed	11.85	Bhantred Khad	Bhantred Khad	
	Khagron	10.15	New LIS from Kiyargi Nallah	Kiyargi Nalla source	

Package 09 – Kangra district

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Source Water Sustainability	
Baijnath	Langhu – 1	6.20	LIS on Binwa Khad	Binwa Khad	Except for Manghota cluster, rest have shortage.	
	Langhu – 2	7.25				
	Upper Bhet	8.42				
	Manghota	6.00	LIS Manghota Cluster	Binwa Khad	Maximum shortage of 0.03022 mm ³ is noticed for Jangal Malodha cluster in Lambagaon block having catchment area of 379.541 km ² while serving irrigation for an area of 19.7346 ha. Minimum shortage of 0.0062 mm ³ is noticed for Malahu 1 & 2 cluster in Bhawarna Block having catchment area of 20.947 km ² while watering irrigation area of 13.75 ha as well as Chainchadi Kuthera cluster in Sullah Block having catchment area of 50.125 km ² while watering irrigation area of 10.19 ha.	
	Kudail	16.61	LIS Kudail Cluster	Dea Nallah		
	Utrala	4.85	Binwa River / Tundal Kholi Nala	Binwa River / Tundal Kholi Nala		
Bhawarna	Thandol – 1	16.95	LIS Thandol Cluster	Mol Khad		Storage structures with capacity ranging from 0.0065 to 0.0455 Mm3 are proposed to make these clusters workable with water available in proposed source.
	Ghar	8.21	LIS Ghar Cluster	Mand Khad		
	Malahu II	8.46	LIS on Mol Khad	Mol Khad		
	Malahu I	5.29				
	Sidhpur	30.09	LIS Sidhpur Cluster	Nugal Khad		
	Chartkhola	18.67	LIS on Tahl Khad	Tahl Khad		
	Ludhran 1 & 2	15.09	LIS on Tahl Khad	Tahl Khad		
Lambagaon	Maldoan	10.59	Existing Functional LIS Alampur Extension	Nugal Khad	The Beas River is perennial in nature and is having sufficient discharge	
	Jangal	9.15	LIS Alampur Extension	Nugal Khad		
	Odri	8.76	LIS Bandhui Extension	Mol Khad		
	Kotlu	4.52	LIS Bandhui Extension	Mol Khad		
	Kathla	7.59	LIS Kathla Cluster	Beas River		
	Thanpal / Chambi	8.34	LIS Thanpal / Chambi Cluster	Beas River		
Panchrukhi	Trehal	8.22	LIS Trehal Cluster	Tubewell		
	Agozar	7.03	LIS Agozar Cluster	Tubewell		
	Rajhot 1	17.27	LIS Rajhot – 1 & 2 Cluster	Awah Khad		
	Ladoh 1	17.21				
	Ladoh 2	5.53	LIS Ladoh-2 Cluster	Alang Nallah		
	Banuri	7.73	LIS Banuri Cluster	Gharuhal Khul		
	Tatehal	3.44	LIS Tatehal Cluster	Tubewell		
	Saliana	7.33	LIS Saliana Cluster	Nai Khul		
	Molichak	6.15	LIS Molichak Cluster	Tubewell		
	Jandpur	8.54	LIS Jandpur Cluster	Tubewell		
Sullah	Dheera 1 & 2	23.47	LIS Dheera – 1 & 2 Cluster	Nugal Khad		
	Dheera 3	10.81				LIS Dheera – 3 Cluster
	Chainchadi – Kuthera	10.19	LIS Chainchadi – Kuthera Cluster	Mand Khad		
	Purba	15.36	LIS Purba Cluster	Nugal Khad		
	Chandar	36.60	LIS Chandar Cluster	Mol Khad		
	Gagal Khas	23.47	LIS Gagal Khas Cluster	Tal Khad		

Package 10 – Kangra district

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Source Sustainability
Dehra	Lalwada	30.41	New Proposed	Beas River	The total demand of Jhakota, Dhanot and Lalwada clusters together with 20% for environmental releases and 15% for future demands would be $1.35 \times 0.031 \sim 0.042 \text{ m}^3/\text{s}$. This demand is about 1.3% of the minimum release during low flow season viz $3.12 \text{ m}^3/\text{s}$. Thus, it can be concluded that the proposed source on river Beas would be sustainable under post project scenario.
	Jakhota	227.54	New Proposed	Beas River	
	Dhanot	206.21	New Proposed	Beas River	
	Bhatoli Phakasian	11.44	LIS Dibber Rour (F)	Banner Khad (rivulet)	From analysis, it is concluded that the gross demand can satisfactorily be made by the source with surplus quantity available throughout the year, except for the months of May, November and December. Thus, storage capacity of 0.03 mm^3 is proposed.
	Bhatera Bassa	13.9	LIS Bhatera Bassa (F)	Banner Khad (rivulet)	From analysis, it is concluded that the gross demand can be satisfactorily be made by the source with surplus quantity available throughout the year, except for the months of May, November and December. Thus, storage capacity of 0.05 mm^3 is proposed.
Paragpur	Chamba Khas	10.44	LIS Chamba Khas (N/F)	Beas River	The intake structures for Kuhna and Chamba Khas Clusters are situated about 24.5 km and 28.778 km downstream of proposed dam site for Dhaulasidh HEP. Few of tributaries join river Beas downstream of Dhaulasidh dam that would add to the release. Study of HEP project water release suggest that even at 10% release, there will be surplus water available for the horticulture clusters after maintaining environmental flow.
	Kuhna	11.86	New Proposed	Beas River	

Package 11 – Una district

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Source Sustainability
Bangana	Boul-1	19.32	RWHS Samoor (F)	Samoor Khad	The estimation of yield from surface water of khads/nallahs as the source has been carried out using 12-year rainfall data. The annual yield from 75% dependable rainfall is estimated. The estimated yield on monthly time steps and assumed data on demands indicate adequacy of surface water from Khads/nallahs as source to meet these demands after providing storages with adequate capacity to meet future demands in fair weather season. The results indicate a maximum shortage of 0.0453 mm^3 in the month of January.
	Boul-2	24.55	RWHS Samoor (F)	Samoor Khad	
	Dulehri Rajputa	9.11	Dulheri Rajputa & Thana Khurd	Dulheri Nallah	
	Sanhal	13.58	LIS from RWHS Samoor (F)	Samoor Khad	
	Thana Khurd	22.24	Dulheri Rajputa & Thana Khurd	Dulheri Nallah	
	Balh	14.02	New Proposed	Balh Khad	
	Chadoli	26.75	New Proposed	Chplah Khad	
	Dumkhar	10.75	New Proposed	Chplah Khad	
	Hatli	6.38	New Proposed	Rit Sthrukha Khad	
	Kathoh	11.90	New Proposed	Kathoh Khad	
	Muchali 1 & 2	21.26	New Proposed	Muchali Nallah	
	Nalwari	36.52	New Proposed	Chplah Khad	
	Tureta	13.46	New Proposed	Kolhri Tureta Nallah	
	Baral	36.26	New Proposed	Baral Nallah	
	Handola	11.84	LIS Handola (NF)	River Satluj	Water availability would be dependent on releases from Bhakra dam and is likely to be available majority of the time.

F. Biological Environment

109. **Fauna** - The clusters are located in agricultural field hence only domesticated animals such as cows and buffalo are seen around the sites, primarily owned by the farmers who own land within cluster. The sites are also frequented by monkeys (*Rhesus Macaque*), a native primate in Himachal Pradesh. MoEFCC, through vide notification No. 804, dated 14 February 2019, declared *Rhesus Macaque* species of monkeys as vermin (pest animals) for a period of a year in 10 districts of Himachal Pradesh (which includes project districts of Kangra, Bilaspur, Una, Sirmour, Solan, Mandi, Hamirpur)¹⁷ for necessary balance of local population of the species and mitigate damage to human life, crops, and other properties of State while conserving wildlife. The notification has been further extended for two years. As a measure the state government has been sterilizing the species to reduce their population.
110. Consultation with the farmers also suggest presence of Indian Peafowl (*Pavo cristatus*). Indian peafowl is included in Schedule-I of Wildlife Protection Act 1972, indicates the high conservation value of species. Thus, the solar fencing in project will stop human and animal conflict and allow conservation of species.
111. **Forest and Wildlife Protected Areas** – The project districts are predominantly covered under forest (45%), extending about 2578.66 sq. km. The list of National Parks and Wildlife Sanctuaries in the state has been attached in Annexure 5. Since none of the clusters are within forest area, there is no apparent conflict between farmers and wildlife.
112. **Aquatic fauna** - A variety of fish such as Mahaseer, Katla, Rahoo, Mirgal, Malli, Singhara, Carps, Mirror Carps, etc. are found in the lake and its tributaries. A total of 27 fish species belonging to five families have been recorded in the project districts. However, none of the sites fall under protected water or trout water.
113. **Vegetation on private lands** – In general, the vegetation found in the target sites are bamboo, Chir Pine, Oak, Deodar, Kail, Fir and Spruce in private lands.
 - a. Many of the clusters at Solan recorded Khair trees (*Acacia catechu*) that are counted as Non-Forest Timber Products and their harvesting is regulated by the forest department (noted during field discussions).
 - b. Sal (*Shorea robusta*) is the dominant species found in Una and Sirmaur districts.
 - c. In Bilaspur - The natural vegetation consists of Sal (*S. robusta*), Toona (*Cedra toona*), Eucalyptus (*E. glohulus*), Babool (*Acacia arabica*), Dhaman (*Ghrewia optiva*) and Mango (*Mangifera indica*), mostly found on lower slopes. On steep slopes, Forest species like Pine: (*pinus roxburghii*) and bushes are dominant (noted during field discussion).
 - d. At Hamirpur, project area comprises of tree species of Khair (*Acacia catechu*), Siris (*Albizia lebbeck*), Shisham (*Dalbergia sissoo*), Mulberry (*Morus alba*), etc. are found planted along the boundary of the agricultural lands and along the road sides (noted during field visits).
 - e. Mandi – Bel (*Aegle marmelos*), Peepal (*Ficus religiosa*), Arjuna (*Terminalia arjuna*), Bahera (*Terminalia bellerica*), Bahera Kinu (*Diospyros Chloroxylon*), Babool (*Acacia nilotica*), Neem (*Azadirachta indica*), Sagon (*Tectona grandis*), Mahwa (*Madhuca indica*) Shisham (*Dalbergia sissoo*), Shimbali (*Bombax ceiba*), Mango (*M. indica*) (noted during field visits)
 - f. Kangra - Shisham (*D. sissoo*), Shimbali (*Bombax ceiba*), Mango (*M. indica*), Bel (*Aegle marmelos*), Peepal (*Ficus religiosa*), Arjuna (*Terminalia arjuna*), Bahera (*Terminalia bellerica*), Bahera Kinu (*Diospyros Chloroxylon*), Babool (*Acacia nilotica*), Neem (*Azadirachta indica*), Sagon (*Tectona grandis*) and Mahwa (*Madhuca indica*)

¹⁷ https://hpforest.nic.in/files/Notification_Himachal_1.pdf

G. Socio-Economic Profile

114. Bilaspur District consists of 4 Sub-Divisions, 4 Tehsils, 3 Sub-Tehsils and 4 Development Blocks. As per the 2011 census, Bilaspur district has a population of 381,956 persons, with a population density of 327 persons per sq. km. The sex ratio is 981 females per thousand males. The rural and urban population in the district is 356,827 and 25,129 respectively.
115. Hamirpur district is divided into 5 Sub-Divisions, 8 Tehsils, 2 Sub-Tehsils and 6 Development Blocks. As per 2011 census, the district has a population of 4,54,768 persons with a population density of 407 persons per sq. km. The male and female population in the district is 2,17,070 and 2,37,698 respectively, with a sex ratio of 1,095 females per 1,000 males.
116. As per 2011 census, the Kangra District has a population of 15,10,075 persons with a population density of 263 persons per sq. km. Population wise it ranks first in the state. The male and female population in the district is 7,50,591 and 7,59,484 respectively, with a sex ratio of 1,012 females per 1,000 males. The schedule caste population in the district is 21.15 % and the schedule tribe population is 5.6%. There are 3,908 villages in the district. The district has been divided into 14 Sub-divisions, 19 Tehsils, 15 Sub-Tehsil and 16 Development Blocks.
117. Mandi district has been divided into 12 Sub-divisions, 17 tehsils, 14 sub-tehsils and 13 Development Blocks. As per 2011 census, the district has a population of 9,99,777 persons with a population density of 253 persons per sq. km. The male and female population in the district is 4,98,065 and 5,01,712 respectively, with a sex ratio of 1007 females per 1000 males.
118. Sirmaur district has been divided into 7 Sub- divisions, 9 Tehsils, 5 Sub-Tehsils and 7 Development Blocks. As per 2011 census, the district has a population of 5,29,855 persons with a population density of 188 persons per sq. km. The male and female population in the district is 2,76,289 and 2,53,566 respectively, with a sex ratio of 918 females per 1000 males.
119. Solan District has been divided into 4 Sub-divisions, 7 Tehsils, 5 Sub-Tehsils and 5 development blocks. There are 2,614 villages and 240 Gram Panchayats in the district. It is well developed in the industrial sector due to close proximity to Punjab State. As per 2011 census, the district has a population of 580,320 persons with a population density of 300 persons per sq. km. The male and female population in the district is 308,754 and 271,566 respectively, with a sex ratio of 880 females per 1,000 males. The rural and urban population is 81.78% and 18.22% respectively.
120. Una District is divided into 5 Sub-Divisions, 5 Tehsils, 7 Sub-Tehsils and 5 development blocks. There are 5 towns, 866 villages and 245 Gram Panchayats in the district. As per 2011 census, the population of Una district is 521,173 persons with a population density of 338 persons per sq. km. The sex ratio is 976 females per thousand males.
121. On the basis of data collected from the 1,016 farmers surveyed as a part of the baseline survey, it was found that the contribution of agricultural income from the parcel of land that the farmer is willing to part with for the project, was substantially less (6%) as compared to the family income from other sources (94%). One of the main reasons for this difference is that the agricultural income is meagre and not sufficient for the farmer to manage his/her regular family expenses.
122. On the basis of the survey¹⁸, it was estimated that 67.5% and 22.2% of the surveyed farmers are marginal and small farmers, respectively. In other words, an overwhelming majority (almost 90%) of the farmers are small and marginal. Also of the 1,016 farmers surveyed, 25 farmers (2.5%) are such who are parting with 100% of their agricultural land holding and have no other source of family income. Of the 25 farmers, 24 belong to the marginal category and 1 belongs to the small category, as per farmer land holding.
123. It was observed that wheat is the most cultivated crop in the region, with more than 80% households cultivating the crop. Wheat is followed by maize and paddy, in terms of number

¹⁸ Baseline survey conducted in January – February 2022 (1016 farmers surveyed across all 28 blocks in the 7 Project districts)

of households cultivating a particular crop. The survey data is in line with the assumptions, given that Wheat, Maize and Paddy form a major part of the staple diet in the region.

124. Only 4% of Himachal Pradesh's population is classified as scheduled tribes, according to the 2011 census, a mere 5% Indigenous People (IP) population was recorded during the baseline. Moreover, scheduled tribes in Himachal Pradesh are not distinct tribal groups but are mainstreamed considering the culture, language, economic activities, and source of livelihood. These groups may not be considered Indigenous Peoples as per the ADB SPS. They have access to infrastructure facilities such as roads, electricity, schools, and hospitals. No particular impact or discrimination is expected on minorities. Instead, the IP farmers part of the CHPMA and WUAs (if any) participating in the project activities will benefit- this benefit will be related to improved knowledge and skills on post-harvest practices, increased production, and improved income, and better access to markets.

H. Cultural and Archaeological Resources

125. No that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significant resource has been found within the project sites.

6. ANTICIPATED ENVIRONMENTAL IMPACTS

127. Environmental assessment is required to consider all potential direct, indirect, cumulative and induced impacts and risks to physical, biological, socioeconomic (including impacts on livelihoods through environmental media, health and safety, vulnerable groups and gender issues), and physical cultural resources in the project's area of influence.
128. As the project will involve civil works for expansion, rehabilitation and development of new scheme irrigation, it is anticipated that impacts will be site-specific, temporary in nature and of short duration. Project environmental screening checklist has been developed to screen the project activities and identify any significant environmental impacts during implementation of subproject and site selection. Careful site selection and engineering design of project components, coupled with clearly defined construction, operation and maintenance procedures can avoid and reduce environmental impacts to a minimal level. The table below list out the environmental impacts against the project activities and recommends mitigation measures to avoid, reduce and mitigate impacts.

A. Impacts found in PRF implementation

129. Following impacts found in PRF Implementation

- Felling of tress were not duly archived; however, farmers were found to be aware of tree felling regulation of the state and assured same has been followed during the field preparation; DOH agreed to record feeling of tree henceforth by type and number;
- Construction wastes were found unmanaged in few of the sites;
- Few of the sites did not have adequate water head pressure from MDT to modular tank and from modular tank to end of the field. Thus, even after all system in place water could not reach to the fields and farmers continued to be in distress;
- Water quality is not being monitored in regular basis and communicated to farmers;
- Some of the sites were observed to be on flood prone zones (Mator Tanda);
- Schedule cleaning of RCC tank and other machinery and safe disposal of waste have not been thought through;
- In some of the clusters solar fencing was found none functional due to solar panel not placed at right position;

B. Positive Environmental Impacts

130. Following are the positive environmental impacts envisaged from the project:

- The planation of horticulture crops will lead to conservation of soil and turning many of the barren land into cultivable land;
- The plantation will lead to creation of carbon sink, prevent soil erosion, and surface runoff and increase infiltration of rain water;
- Solar fencing will avoid human and animal conflicts;

C. Analysis of Degree of Impact

131. The assessment has been made on site basis and based on local condition. While it is difficult to ascertain degree of impact, however, severity of anthropogenic disturbances of the environment is assessed on the following parameters - Spatial scale; Temporal Scale and Intensity. All these parameters can be combined and rated under the scale of – high, medium and low; and define as follow:

- Negligible/ no impact (N) - Environmental changes are within the existing limits of natural variations, temporary in nature and is site-specific;
- Low (L) - Environmental changes exceed the existing limits of natural variation, however is temporary in nature and is site-specific;

- Medium (M) - Environmental changes exceed the existing limits of natural variations and result in damage to any of the environmental components, but remains self-recoverable;
- High (H) - Environmental changes result in significant disturbance to environmental components and ecosystems. Certain environmental components lose self-recovering ability.
- Similarly, for positive impact, High (Hp), Medium (Mp) and Low (Lp) reflects same degree of positivity.

D. Installation of Solar Fencing

Table 14: List of anticipated impacts from Installation of Solar Fencing

Activities	Additional Explanation	Potential Impacts (positive or negative)	Degree of Impact (H,M,L) (Hp, Mp, Lp)
Design of the fencing posts, roads, and seeking the necessary approvals and licenses	Final designing of the post (nos. & positioning), fencing (wire), positioning of solar panels, battery, electric wiring, warning sign boards, earthing system, etc.	Installation of solar-power fencing has positive impacts on the cluster members as it will protect both horticulture and other produce through intercropping	Hp
	Informing farmers and panchayat (village administration) on the construction activities and benefits of solar-power fencing.	No environmental impact	N
Assembling and sourcing of materials;	The key materials to be sourced are GI posts, GI wire mesh, solar panels, lithium batteries, electrical wires, cement, sand and aggregates;	Indirect adverse impacts of air pollution due to vehicular movements;	L
Clearing of vegetation for about a 1m wide strip at the periphery of the cluster including the uprooting of rank vegetation, grass, brushwood, saplings etc.	The fencing will be laid out at the periphery of plantations.	Loss of vegetation could lead to loss of topsoil	L
		If work is carried out in the rainy season, it may trigger local erosion	L
		May come across threatened plant species	L
		Occupational health and safety risks	N
Excavation of earth up to for installation of GI post	Earth needs to be excavated for the installation of GI posts (corner posts, support posts and intermediate posts) of various diameters.	Dust pollution	L
		Increased soil erosion	L
		Loss of topsoil	L
		Occupational health and safety risks	N
Grouting of GI posts with PCC cement sand & stone ballast	Use of plain concrete cement, sand and stone ballast for fixing the GI posts in their dedicated position.	Dust and land pollution from the mixing of concrete and from the use of sand & stone ballast	L
		Occupational health and safety risks due to dust pollution	L

Activities	Additional Explanation	Potential Impacts (positive or negative)	Degree of Impact (H,M,L) (Hp, Mp, Lp)
Installing wires and strainers	Installation of pre-tested standard aluminium conductor steel-reinforced (ACSR) cable for high tensile (HT) electric conduction up to 15kV. 05 Nos through each post supported through Polypropylene (PP) insulators (UV Stabilized) on each post. The electric shock is completely safe and non-lethal for humans and animals. As the current is pulsating (not live) and passing every 1 to 1.2 seconds and only for a 0.3 millisecond (1000th of second) of time, the animal gets enough time to get away from the fence. The pulsating current will not grab the animal which generally happens in the continuous current.	Accidental shock to animals, birds and humans in case the safety systems fail to act.	M
		On failure of the solar power system, if farmers energize the wires through live and continuous current – any living being coming in contact with the wire will be electrocuted leading to contraction of muscles/cramps and preventing the body from moving away from the fence	M
		Occupational health and safety risks for probable shock;	M
Installing Solar-panels with lithium battery storage and energizers	An appropriate location for the solar panel to get abundant sunlight can ensure the successful working of the fencing. This project is using a very little amount of non-renewable resources and the lifetime of the panels and batteries is for 5 year. Battery should always be kept in upright position.	Generation of e-waste;	L
		Indirect impact of the use of non-renewable resources such as Silicon and Lithium.	L
		Occupational health and safety risks	L
Disposal of construction waste	Construction waste such as concrete, aggregates, electrical wires, e-waste, etc. are likely to be generated and needs a disposal plan.	The waste that may get generated if left at the site could lead to land and water pollution;	M
		Occupational health and safety risks	L
Operation of solar fences	Solar fencing will be operated by the farmers on regular basis;	Fencing may increase the animal menace in the neighbouring fields	L
Annual maintenance and skill development among cluster members	The EPC contractor will train the trainer on the operation and maintenance of the entire system, especially on the aspects of health and safety, maintenance of solar panels from dust, routine checks on energizers, hotter alarm, shock stop, lightning	This will have positive impacts on the participating farmers as follow: - -development of new skill sets; -development of a sense of ownership, leading to	H

Activities	Additional Explanation	Potential Impacts (positive or negative)	Degree of Impact (H,M,L) (Hp, Mp, Lp)
	diverters, etc.	responsible behaviour; -training and convincing other farmers to participate; -protection of horticulture produces and other intercropping produces;	
		Generation of e-waste;	N
		Occupational health and safety risks from handling of lithium battery;	L

E. Field Preparation and Horticulture Plantation

Table 15: List of anticipated impacts from Field Preparation for Horticulture Plantation

Activities	Additional Explanation	Potential Impacts (positive or negative)	Degree of Impact (H,M,L) (Hp, Mp, Lp)
Planning of layouts the plantation	Each crop has a different set of spacing and bed requirements, drawn out as per the type of soil, humidity range, sun aspects and annual temperature range. As HPSHIVA aims for high-density plantation, the position of the plants is to be specified on the ground specifically at: i) point where plant to be planted, and ii) at the mid of the rows on two sides	Planning of the plantation plots has positive impacts such as: -enhance the efficiency of drip irrigation and soil drainage; -allow usage of mini-agro machinery; -enhance farmers' productivity; -reduce soil erosion;	Hp
Site Clearance	Trees, shrubs, rank vegetation, grass, brushwood, roots of trees and saplings of girth up to 30cm measured at a height of 1m above ground level to be cleared. The roots of trees and saplings shall be removed to a depth of 60cm below ground level or 30 cm below formation level or 15 cm below subgrade level, whichever is lower.	Loss of vegetation could lead to loss of topsoil	L
		If work is carried out in the rainy season, it may trigger local erosion	L
		May come across threatened plant species	L
		Muck generation, mainly plant and stone waste	N
		Occupational health and safety risks	N

Activities	Additional Explanation	Potential Impacts (positive or negative)	Degree of Impact (H,M,L) (Hp, Mp, Lp)
Land Development (terracing, where needed)	In case of slanty terrain, terraces would need to be created such that crops can be planted at raised beds and beds are protected from erosion; It should be noted that subtropical region of the State is expected to experience more torrential rains concentrated in a few days.	Dust pollution	L
		Increased soil erosion due to loss of vegetation cover	L
		Loss of topsoil	L
		Occupational health and safety risks from dust pollution	L
Dressing with bed-making	Preparing raised bed along plant rows of width 1.20m and height 0.3 m above natural ground level by way of excavating the top orchard soil along the planting row.	Local dust pollution from handling of soil	L
		Occupational health and safety risks	N
Pit digging	Digging of pits at the planting site as per dimensions and spacing.	Generation of additional soil	L
		Occupational health and safety risks	N
Disposal of waste	Additional soil, stones, shrubs and herbs as waste will be generated from site clearance and land development activities.	The waste that may get generated if left at the site could lead to land degradation, increased soil erosion and water pollution	L
Cultivation activities and maintenance of the plantation	DOH along with the support from the CHPMA facilitator should train the farmers on how to maintain the field, carry out mulching, weeding, and intercropping between the beds.	This will have positive impacts on the participating farmers as follow: - -development of new skill sets; -development of a sense of ownership, leading to responsible behaviour; -training and convincing other farmers to participate; - increased production of horticulture and other intercropping produces;	Hp
		Land and soil pollution from use of pesticides/ insecticides	M
		Occupational health and safety risks from use of pesticides/ insecticides	M

F. Rehabilitation/ Development of new Irrigation Schemes

Activities	Additional Explanation	Potential Impacts (positive or negative)	Degree of Impact (H,M,L) (Hp,Mp, Lp)
Planning the layout of the irrigation scheme	Final designs of intake wells, siting of control structures and rising main alignments will be completed after taking into account the provisions of the environmental management plan.	Positive impact	Hp
Site Clearance	Sites preparation for intake well, desilting tank, pump-house, rising main and main distribution tank (MDT) will have to be cleared before start of construction; Some of the clusters are in the buffer zones of eco-sensitive zone (refer to the detail checklist of the packages). For those sites, Forest and Wildlife state authorities should be duly informed before starting any activity. There no formal clearance required.	Impacts to surface water quality may include increased siltation and turbidity from site preparatory work.	M
		Impact on aquatic life – flowing surface water will be temporarily diverted from the bank side where intake wells will be constructed.	L
		Clearing project sites may cause permanent or temporary disturbance to vegetation, although no known protected flora species have been identified on the project sites.	L
		Occupational health and safety risk from snake/ insect bites. Although no poisonous species have been noted in project sites;	L
Installation of submersible pump	Two numbers of submersible pumps will be installed at the intake well.	Impact on surface water quality from soil erosion, leading to more siltation and water quality deterioration	L
		Occupational health and safety risks due to spillage from height	M
Construction of de-silting tank	One number of desilting tanks will be installed at each scheme to help settle the silt in river water. This will help in prolonging the life of the pumps which may get clogged otherwise.	Impact on air and noise quality at the site	L
		Occupational health and safety risks due to spillage from height	M
Construction of pumping station	One number of pumping station has been designed at each scheme level, such that water can be lifted from the desilting tank to the main distribution tanks through raising main.	Soil erosion and silt run-off	L
		Contamination due to inappropriate transfer, storage and disposal of petroleum products, chemicals, hazardous materials, liquids and solid waste.	L
		Spoils from earthwork during construction	L
		Occupational health and safety risks due to spillage from height	M
Laying of rising main	GI pipes of various sizes will be used. Pipes are proposed with welded joints instead of flanged joints to take care of.	Change in land use and loss of agricultural land, impact on forest area, and settlement areas during construction of MDT and pipe laying activities	M

Activities	Additional Explanation	Potential Impacts (positive or negative)	Degree of Impact (H,M,L) (Hp,Mp, Lp)
		May cause landslide if poorly managed, undertaken during heavy rainfall or strong winds.	M
		Laying of distribution system has the potential to increase erosion and nutrient loss if poorly managed, undertaken during heavy rainfall or strong winds.	H
		Dust generated by excavation and dust from aggregate preparation has the potential to impact local air quality	M
		Occupational health and safety risk of slippage from height for the construction workers;	H
Construction of reinforced concrete (RCC) MDT	The tank will be either ground storage reservoir (GSR) or Elevated service reservoir (ESR) as per the topography of the cluster. It will be circular RCC tank in M30 grade concrete and will be a pre-fabricated structure.	Degradation in ambient air quality during construction of MDT, hauling of materials, material stock piling, pipe-laying activity, land clearance for horticulture area development	L
		Occupational health and safety risk of slippage from height for the construction workers;	L
Use of machinery and vehicles		Dust generated hauling, loading, and unloading; movement of vehicles and heavy machinery on unpaved access and haul roads has the potential to impact local air quality.	L
		Heavy machinery operation has the potential to result in noise impacts. Noise volume of construction machinery is generally between 80 dB and 110 dB, while vehicle noise intensity is generally about 90 dB. As some of the construction areas may be adjacent to villages, noise will have some impacts on nearby residents.	L
		Occupational health and safety risk from accidental injury from use of machinery and vehicles	L
Generation of construction and demolition wastes		Disposal of excavated materials will lead to air, water and soil pollution	L
		Occupational health and safety risk	N

G. Installation and Operation of Drip Irrigation System

Activities	Additional Explanation	Potential Impacts (positive or negative)	Degree of Impact (H,M,L) (Hp,Mp, Lp)
Planning the layout of the drip irrigation system	- The main components of the drip irrigation system are: - Screen filter - Sand filter - Fertigation tank with assembly - Ventury and manifold - Pipes - Valves - Water solar-power pumps with an electric motor To ensure all plants receive adequate water and excess water is drained out properly without contamination of any source - Survey, planning, designing and installation including trench work is carried out	Positive impact	Hp
Installation of Drip irrigation system along with solar pumps	Installation and testing of the system and training of the farmers to be carried out by the system provider	This could lead to the generation of solid waste such as leftover pipes and other materials;	L
	Solid waste is often generated from this activity;	Occupational health and safety risk	N
Operation of drip irrigation system	Operation of irrigation system by the farmers and periodic maintenance	Soil contamination from unmanaged use of fertilizer through fertigation system	M
		Unmanaged disposal of sand filters, screen filters could lead to soil contamination	L
		Clogging of emitters/ dripper with soil leading to inefficient use of water	L
		Occupational health and safety risk	N

7. ANALYSIS OF ALTERNATIVES

132. The State also enjoys a rich diversity of agroclimatic conditions, topographical variations, and altitudinal differences, which favours the cultivation of temperate to sub-tropical fruits and exotic vegetables. Among the temperate fruits, the State produces apples, peaches, plums, pears, citrus, kiwi fruits and apricots along with many other exotic fruits. The State also produces a range of sub-tropical fruits, including citrus, pomegranate, litchi, guava, mango, etc. Majority of agricultural activities in the State are dependent on rainfall with 80% of the area under rain-fed. Even though there is a large volume of water available in the State, only a part of its cultivated area is irrigated because of physiographic constraints. While crop diversification is increasing in the State, for fruits and vegetables, this is mostly concentrated in districts of the mid-hills and high hills and valley zone, leaving a substantial income gap between temperate and sub-temperate producers and those producing sub-tropical crops. The sub-tropical region (Bilaspur, Hamirpur, Kangra, Mandi, Sirmour, Solan, and Una districts) in the State face multiple challenges in terms of climate change, rainfall uncertainties, water availability and low productivity of horticulture produce and income disparity, etc. Thus, project alternative with no support of developed and rehabilitated minor irrigation scheme would not have met the objectives of HPSHIVA.
133. There are different methods to supply water in farmlands for crop yield - such as surface irrigation (which is currently being practiced in few of the project cluster by taking water from khul; sprinklers, or drip irrigation). Surface irrigation/ flood irrigation – a) is unsuitable for horticulture crops as standing water can destroy their root system; b) it is an inefficient way of irrigation, leading to methane generation from the fields. Sprinklers are also not suitable for horticulture crops as when they would attain mature height sprinklers would not be able to reach to every end. Hence drip irrigation is the only suitable method of irrigation.
134. Drip irrigation is a smart and innovative solution for the horticulture plantation. It is significantly proven to be effective in case of hilly areas and for small farmers. It can increase the production by 50% and limits topsoil erosion, pest infestation and evaporation from the soil surface. The advantages of the drip irrigation system are as follows:
- Improves quality and ensure early maturity of the crops.
 - Water Saving up to 40% – 70%.
 - Controls weed growth, saving of fertilizer (30%) and labour cost (10%).
 - High Water Use Efficiency
 - Reduces greenhouse emission
135. Fencing of horticulture fields - To help the farmers in resolving the issue of animal predation, an innovative solution of Solar Powered Electric Fencing has been proposed. In this modern, non-conventional fencing, wires carry solar energy produced current, delivering a fierce but non-fatal shock to an animal coming in its contact, causing a suitable deterrent effect on the animal. The current does not cause any harm to the animal, but it acts as a psychological barrier for the animal from intruding into the field and helps in preventing losses. Thus, without this component project would not have been successful.
136. Crop selection was carried out based on various research studies carried out under the TA activities of HPSHIVA. Crop mapping for every identified Cluster is a pre-requisite to identify the suitable crop. For the said purpose Cluster matrix for each crop was developed on the basis of ecological parameters needed for optimal yield and good production. The parameters included altitude and slope of the land, soil and climatic factors. Similarly, for each Cluster soil testing was conducted to gather information regarding the Cluster parameters. Based on the parameters, the best fit crops (1-3 nos.) were mapped for the Cluster. Hence, the most suitable crops for the given clusters have been selected.

8. ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

137. The principal purpose of an EMP is to provide a guide in the formulation of appropriate management systems, plans and procedures to ensure compliance with national and ADB safeguards requirements. The requirements set out in this section should be included within contractual documentation with the relevant parties, as appropriate, to ensure there is clarity and commitment regarding contractor obligations related to environmental, health and safety management of the Project.
138. The EMP contains the arrangements on the implementation of mitigation measures, monitoring program, cost estimates, and institutional set-up to ensure that no significant adverse impacts results from the proposed projects. The plan covers the pre-construction, construction and operations stages. The basic objectives of the EMP are to:
- establish the roles and responsibilities of all parties involved in the project's environmental management;
 - ensure implementation of recommended actions aimed at environmental management and its enhancement; and
 - ensure that the environment and its surrounding areas are protected and developed to meet the needs of the local communities including other stakeholders and safeguard and the interests of the common people.
139. Mitigation measures required to address the impacts identified by this IEE have been consolidated in the following EMP.

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Table 16: EMP for the Facilities Proposed for Expansion and or Modernization

Potential Environmental Impacts	Mitigation Measures	Reference to laws /guideline	Location	Monitoring indicators (MI)/ Performance Target (PT)	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
							Implementation	Supervision
Design and preconstruction stage								
Solar fencing may increase animal menace in neighbouring fields	DoH and CHPMA facilitators to actively encourage other farmers to participate in HPSHIVA initiative such that this kind of conflict can be minimized. !	NA	Clusters	Recorded through the Grievance Redressal Mechanism (GRM) Recorded in the monthly meetings of the CHPMA members	GRM recording and resolution	NA	Environmental Experts at PIU level	Environmental Safeguard at PMU level Project Director
Clearing vegetation for about a 1m wide strip at the periphery of and within the cluster including the uprooting of trees, rank vegetation, grass, brushwood, saplings etc.	Farmer should not uproot any endangered tree species as listed in Annexure 6. Farmer should not uproot more trees than permitted under the HP Land Preservation Act, 1978. For any additional requirements farmer, with support of PIU, to seek permission as per the rule. No civil work should be carried out until the permission is in place.	HP Land Preservation Act, 1978 (Private land not classified as Forest)	Clusters	CHPMA to record during field preparation how many trees and species per farmer have been felled; The farmer felling tree will give an undertaking that all regulations under HP Land Preservation Act, 1978 (Private land not classified as Forest), have been followed; Farmer to submit NOC as and when required;	CHPMA recording during field; Archives to be collected by Environmental Experts at PIU DOH; All data collated at PMU Level	NA	By the farmers at their cost	Environmental Safeguard at PMU level, Project Director
Felling of trees on Government land	Feeling of trees from development work (expect Ban/Oak) in non-forest government land in the rural areas which is not forming part of 5ha compact wooded block - permission from Principal Chief Conservator of	HP Land Preservation Act, 1978 (Private land not classified as Forest)	Irrigation sites	Environmental Expert at PIU, JSV will prepare documentation and secure permission before the start of	CHPMA recording; Archives to be collected by Environmental	NA	Environmental Experts at PIU level;	Environmental Safeguard at PMU level, Project Director

Potential Environmental Impacts	Mitigation Measures	Reference to laws /guideline	Location	Monitoring indicators (MI)/ Performance Target (PT)	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
							Implementation	Supervision
	Forests (PCCF) if deemed found necessary after a proper survey by DFO. No civil work should be carried out until the permission is in place. Cutting trees at the proposed sites will be kept to an absolute minimum and only be permitted when it is obstruction in the planting design and laying of irrigation system.			civil works	Experts at PIU JSV; All data collated at PMU Level			
Procurement of construction materials could lead to vehicular emissions	Contractor to source materials from authorized sources by the government. Use construction vehicles having proper pollution NOCs.	! Central Motor Vehicle Act	Project Districts	Pollution Certificates	Submission of Pollution Certificates along with claims on the use of vehicles/ transportation/ machinery	NA	Contractor	PIU Expert, PMU Specialist Finance Specialist
Dust pollution Increased soil erosion; and loss of topsoil during the preparation of sites	Minimization of dust pollution by sprinkling water on excavated earth and borrowing pits. This activity should be avoided during the rainy season to avoid mudslide conditions;	NA	Project clusters Irrigation scheme sites	Visual site verification	Regular field audits by PIU experts Periodic site visits by PMU specialist	NA	Contractor	PIU Expert, PMU Specialist
Construction Stage (Solar Fencing)								
Dust and land pollution from the mixing of concrete and from the use of sand and stone ballast	Cover construction materials with tarpaulin sheet while not in use. Mixing of concrete must be done at least 500 meters away from household area and source of water. Ensure no spillage fencing materials on the field and avoid soil contamination and killing of plants.	Construction and Demolition Waste	Project clusters;	Visual site verification	Regular field audits by PIU experts Periodic site visits by PMU specialist	Cost to be borne by the contractor as part of the overall contract	Contractor	PIU Expert, DOH PMU Specialist

Potential Environmental Impacts	Mitigation Measures	Reference to laws /guideline	Location	Monitoring indicators (MI)/ Performance Target (PT)	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
							Implementation	Supervision
	For solar fencing, the entire laying of GI pipes and fencing should be completed in a day's time and topsoil be compacted;							
Generation of E-waste;	All E-waste generated at sites should be collected and disposed of E-Waste (Management) Amendment Rules, 2018 Farmers should be trained to maintain the solar panels and batteries such that the lifetime of the equipment can be enhanced and disposed of in an adequate manner as per rules.	e waste management rules 2016	Project clusters	Maintenance registered to be maintained by CHPMA on handling, management and disposal of solar-based electric fencing	Audit of maintenance register	NA	CHPMA	PIU Expert to audit
Construction Stage – Horticulture Field Preparation, Construction of Irrigation Schemes and Installation of Drip Irrigation								
Land Development (terracing, where needed) Hill cutting could lead to - Dust pollution; Increased soil erosion; and Loss of topsoil;	The new terraces should be protected at their risers and outlets and should be carefully maintained, especially during the first two years. After cutting a terrace, its riser should be shaped and protected using local stones, soil and planted with grass as soon as possible (grass turfing). Sod-forming grasses with extensive rhizomes or rhizome-type grasses are better than those of the tall or bunch-type. The outlet for drainage-type terraces is the point where the run-off leaves the terrace and goes into the waterway or safe outlets. Its gradient is usually steep and should be protected by the sods of earth. A piece of rock, a brick, or a cement block, is sometimes needed to check the water flow on steeper channels. Similar checks on water flow are required for level bench terraces where the water falls from the higher terraces onto those below. A piece of rock should be placed on the lower		Project clusters	Completion certificate to the contractor to be released only after satisfactory closure of site audit(s) finding(s).	PIU Environmental Coordinator to conduct site audits and ensure all protection work has been appropriately implemented;		Contractor to implement; CHPMA facilitators to monitor; DOH to award work contracts according to the season;	PMU Specialist

Potential Environmental Impacts	Mitigation Measures	Reference to laws /guideline	Location	Monitoring indicators (MI)/ Performance Target (PT)	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
							Implementation	Supervision
	terrace to dissipate the energy of the flowing water. Grasses should also be established on the area of the bench crossed by the waterway. This activity should be avoided during the rainy season;							
The waste that may get generated if left at the site could lead to land and water pollution;	The contractor should dispose of all such waste to community land or any valley side that needs protection or compaction with more soil; Such sites should be selected in consultation with the farmer community and should be at least 50m away from the site;	Construction and Demolition waste	Project clusters	Visual site verification	Regular field audits by PIU experts Periodic site visits by PMU specialist	Cost to be borne by the contractor as part of the overall contract	Contractor	PIU Expert, DOH PMU Specialist
Construction of weir / dyke & Construction of percolation tank may lead to Conflict with downstream water users right	Assess downstream water users carefully and ensure that their rights are protected, also ensure international water rights are not violated. Meaningful consultation with the stakeholders and potentially affected people (AP) will be undertaken on the potential environmental and social impacts.	PS	Project clusters	Grievance Redressal Mechanism	Visual site verification	NA	PIU Expert, JSV	PMU Specialist
Impact on surface water quality during construction of intake well	Select a construction methodology that is least disturbing, and appropriate for the in-situ site condition, and able to complete the construction work in minimum time. Schedule the construction works during the lean period only and ensure that works is completed before onset of monsoon. Erect temporary barriers/ coffer dam to form enclosed construction area with least disturbance. Allow adequate time to settle the solids prior to pumping out water; only clear/clarified water shall be pumped back into the water body/reservoir; any silt laden water should be pumped to a silt pond only. Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies;	Water (Pollution and Prevention) Act	Irrigation Sites	Visual site verification	Regular field audits by PIU expert from JSV Periodic site visits by PMU specialist	Cost to be borne by the contractor as part of the overall contract	Contractor	PIU Expert, JSV PMU Specialist

Potential Environmental Impacts	Mitigation Measures	Reference to laws /guideline	Location	Monitoring indicators (MI)/ Performance Target (PT)	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
							Implementation	Supervision
	Avoid/minimize use of fuels, chemicals and lubricants; ensure no spillage; and have an equipment spill and containment plan on-site.							
Soil Erosion, silt runoff, contamination due to inappropriate transfer, storage, and disposal of petroleum products, chemicals, hazardous materials, liquids and solid waste. spoils from earthwork during construction from the construction of pumping station	Stabilize surface soils where loaders, support equipment and vehicles will operate by using water and maintain surface soils in a stabilized condition; To mitigate soil erosion, contractors should prepare and implement a Soil Erosion Management Plan as part of the contractor site-specific EMP. The EMP should include proper transport and storage requirements for such materials. Measures such as settling ponds or sedimentation basins should be provided to prevent surface runoff; petroleum or other such products to be kept upon the impervious floor with secondary containment.	Water (Pollution and Prevention) Act	Irrigation Sites	Visual site verification	Regular field audits by PIU expert from JSV Periodic site visits by PMU specialist	Cost to be borne by the contractor as part of the overall contract	Contractor	PIU Expert, JSV PMU Specialist
Change in land use and loss of agricultural land, impact on forest area, and settlement areas during construction of MDT and pipe laying activities due to laying of rising main	Select government land for construction of Main Delivery Tank to the extent possible. Minimize use of fertile land, forest, private properties, and settlement areas during pipe laying activity. Subprojects with involuntary resettlement will not be eligible for funding. Barricade the construction area using hard barricades on both sides and provide dust/wind screen; Initiate site clearance and excavation work only after barricading of the site is done; Confine all the material, excavated soil, debris, equipment, machinery (excavators, cranes etc.), to the barricaded area; Limit the stock piling of excavated material at the site; remove the excess soil from the site immediately to the designated disposal area; Undertake the work	NA	Irrigation Sites	Visual site verification	Regular field audits by PIU expert from JSV Periodic site visits by PMU specialist	Cost to be borne by the contractor as part of the overall contract	Contractor	PIU Expert, JSV PMU Specialist

Potential Environmental Impacts	Mitigation Measures	Reference to laws /guideline	Location	Monitoring indicators (MI)/ Performance Target (PT)	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
							Implementation	Supervision
	section wise: 100 – 200 m section should be demarcated and barricaded.							
Degradation in ambient air quality during construction of MDT, hauling of material, material stock piling, pipe- laying activity, land clearance for horticulture area development	Damp down the soil and any stockpiled material on site by water sprinkling; Use tarpaulins to cover the loose material (soil, sand, aggregate etc.) when transported by trucks; Control dust generation while unloading the loose material (particularly aggregate, soil) at the site by sprinkling water and unloading inside the barricaded area; Apply water and maintain soils in a visible damp or crusted condition for temporary stabilization; Apply water prior to levelling or any other earth moving activity to keep the soil moist throughout the process; Avoid open burning during land preparation, weed control, and post-harvest treatments; Check PUC status of construction vehicles and machineries; Prohibit burning of pesticide-treated agricultural wastes and by-products;	Air (Pollution and Prevention) Act	Irrigation Sites	Visual site verification	Regular field audits by PIU expert from JSV Periodic site visits by PMU specialist	Cost to be borne by the contractor as part of the overall contract	Contractor	PIU Expert, JSV PMU Specialist
Occupation Health and Safety	Construction works such as pump house, rising main and MDT may require worker to work at height and therefore there will be risk of slippage from height	Building and Construction worker safety	Irrigation Scheme sites and project clusters	Availability of all PPE kit to workers, especially safety belts and nets	Periodic site visits by PMU specialist	Covered by EPC Contractor	EPC Contractor	PIU JSV
	In the context of the COVID-19, workers may be exposed to occupational hazards that put them at risk of disease The protocols should include requirements on wearing masks PPE, physical distancing, hand washing, disinfection, checking body temperature, ventilation, management of waste, awareness,	WHO Health and Safety Policies and Guidelines	Irrigation Scheme sites and project clusters	Health records of the contractual workers to be maintained by the hiring agency	PIUs collect such records mentioned by the contractor	Covered by EPC Contractor	EPC Contractor	PIU JSV

Potential Environmental Impacts	Mitigation Measures	Reference to laws /guideline	Location	Monitoring indicators (MI)/ Performance Target (PT)	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
							Implementation	Supervision
	and morning briefings.							
Operation Phase								
Accidental shock to animals, birds and humans in case the safety systems fail to act	Following safety units to be installed; Shock stops should be coupled to the energizer to enable maintenance staff to switch the fence off during any event and on during maintenance. They are to be mounted on a panel located in an energizer house; Fencing alarm: solar house to have an in-built hooter system of 118 decibel (DB) that will get triggered when any animal, bird or human gets trapped in the fencing; Lightning Diverters: V-shaped, water-proofed lightning diverters to be installed between wires and earthing system; Earthing: 3 for each panel & one at every 200m to be installed. These should be at least 10m from any water supply, earthing rods, underground telephone or power cable. Warning Boards: of size 30cm x 18cm, with yellow background and black writing to be installed at every 50	ADB Community Health and Safety – SPS, 2009; Occupational Health and Safety Code, 2020	Project clusters;	Completion certificate to the contractor to be released only after satisfactory closure of safety audit(s) finding(s).	PIU Environmental Coordinator to conduct a safety audit of the installed system and confirm total safety performance;	Cost to be borne by the contractor as part of the overall contract	Contractor to implement and demonstrate to the farmers, CHPMA facilitators and PIUs and PMU representatives on how the safety systems works, what measures needs to be taken during any accidental events, what are the dos and don'ts; CHPMA facilitators to monitor and ensure each farmer is trained in the cluster on safety measures;	PIU Expert, DOH PMU Specialist
Declining/ shortage of water in the ephemeral sources such as khuds and springs	PIU JSV, CHPMA members, and Water User Association will ensure compliance with government policies on the use of water for drip irrigation systems. CHPMA to report any leaks or damage on the drip irrigation to PIU	National Water Policy	Project clusters	Visual site verification	Regular field audits by PIU experts Periodic site visits by PMU specialist	NA	Contractor	PIU Expert, DOH PMU Specialist

Potential Environmental Impacts	Mitigation Measures	Reference to laws /guideline	Location	Monitoring indicators (MI)/ Performance Target (PT)	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
							Implementation	Supervision
	PIU JSV will perform periodic monitoring and maintenance of the drip irrigation system; Provide soil and water management periodic orientations to the CHPMAs.							
Contamination of land and water due to use of pesticides	Training on Handling and management of Fertilizer, Pesticides and other horticulture plantation material to CHPMA members	Hazardous Waste Management Rules, 2016	Project Clusters	Training to a CHPMAs to be completed within 1 year from the implementation start date	Training records	INR 5,00,000	PIU Expert, DOH With support from external agency as deem fit; To be completed covering all CHPMA within 1 year from the start date of Phase I implementation	PMU Environmental Safeguard Specialist

A. Environmental Monitoring Plan

140. Since no major civil work will be carried out, ambient air quality and noise level will not be required to be monitored. However, the PIUs should keep checking the following:

- a) For clusters near to the eco-sensitive zones, informs the relevant forest/ wildlife authority before starting any activities in those clusters/ sites;
- b) CHPMA are properly trained on water and soil conservation, proper handling, management and disposal of insecticides/ pesticides containers;
- c) EPC Contractor provides safe working environment to all workers and migrant work be registered with the state;

A. Budgetary Cost Provision of EMP Implementation

141. The budgetary cost for the implementation of EMP is as follows:

Table 17: Budgetary costs for implementation of EMP

Sr. No.	Environmental Management Measure	Cost/Expenditure INR	
		Recurring/per annum	One Time (Initial)
1	Environmental Safeguard Staff	Has been included as project management cost	
2.	Training and capacity building	5,00,000	3,00,000 (ADB first implementation mission)
3.	Site Audits	5,00,000	
4.	Monitoring and Reporting	2,00,000	
5.	Screening and site audits for Phase II 4000 ha		5,00,000
6.	Miscellaneous		2,00,000
	TOTAL	12,00,000	10,00,000
	Total Environmental Safeguard Budget		12,00,000 * 11 = 132,00,000 10,00,000 = INR 142,00,000

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9. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

142. The Project engaged with multiple and variety of stakeholders for different activities under the project components through the approach of Stakeholder Consultation and Engagement Plan (SCEP). It outlines general principles and collaborative strategy to identify stakeholders for all outputs under the Project, identify appropriate modes of engagement and prepare plans for engagement and meaningful consultation throughout the project cycle, while ensuring transparency. The goal is to improve and facilitate decision-making and create an atmosphere of understanding that actively involves project beneficiaries and other stakeholders promptly and that these groups are provided sufficient opportunity to voice their opinions and concerns that may influence Project decisions. The SCEP will act as a guiding tool and framework for managing communications and engagement between DOH and its stakeholders for the Project. The SCEP has been adapted to the nature and scale of the Project and its potential environmental and social risks and impacts and considers the existing institutional and regulatory frameworks/acts of the Government of India (GOI) and the Government of Himachal Pradesh (GoHP).
143. The SCEP includes multiple channels and mechanisms of engaging with the stakeholders, including website, telephone, public consultations and meetings, participatory assessments and surveys, participatory planning, and existing channels of citizen engagement of the GoHP. Differentiated measures will be adopted to engage with vulnerable and disadvantaged households, including focus group discussions, inclusive beneficiary identification in the cluster, and inclusion amongst beneficiary groups. Other project-related information will be shared with the primary stakeholders in locally understood languages, where necessary. All safeguards related plans and documents will be disclosed on the project's websites. The details of SCEP framework have been mentioned in Annexure 7.

A. Stakeholder Consultations during Project Preparation

144. The Project Preparation Team and the DoH teams engaged in extensive consultations with all relevant stakeholders during each visit in the project preparation process, including the Department of Forest, Irrigation (now JSV), Public Works, and National Bank for Agriculture and Rural Development (NABARD). The objective of these consultations was to understand the scope of stakeholder's participation and sectoral interventions under the Project, and the potential social and environmental risks and issues involved. Since the focus of the Project is on marginalized communities, the Project also consulted the disadvantaged and vulnerable people: (i) small and marginal farmers, (ii) scheduled caste households, (iii) scheduled tribes, (iv) women-headed households as well as (v) households designated below the poverty line. These households are more constrained than others to access benefits from the Project and participate more fully in the planning and consultations. Consultations held as part of the project preparation, including safeguards documents, saw large-scale participation from the communities and these disadvantaged and vulnerable groups.
145. Before the consultations, relevant information in the local language is shared with the communities to give them information on the project objectives/activities and seek their feedback and concerns/issues related to project components.
146. As part of stakeholder consultations, a number of meetings and discussions were carried out with farmers and other stakeholders. Additionally, a baseline survey was also carried out to estimate the income and demographic profile of the cluster sites. The details of the same have been attached in Annexure 8.

B. Information Disclosure and Engagement Methods

147. The final draft of the IEE and EARF will be disclosed on the project's website and shared with all the District and Block Development Offices and the targeted clusters/CHPMA. All updated versions will also be re-posted on the project portal. HPSHIVA will use various engagement methods that the implementing agencies will operate as part of their

continuous interaction with the stakeholders. The method of engagement will be constantly reviewed for its appropriateness, outreach, impact, and inclusivity.

C. Grievance Redress Mechanism (GRM)

148. Grievance redressal is another critical component of effective stakeholder engagement. The purpose of GRM is to provide a forum for the internal and external stakeholders to voice their concerns, queries, and issues with the Project. Such a mechanism would give the stakeholders one project personnel or one channel through which their questions will be channelled, and this process will ensure timely responses to each query. This will allow for trust to be built amongst the stakeholders and prevent the culmination of minor issues into significant community unrest. The GRM will be accessible and understandable for all stakeholders and the entire Project. The GRM will be communicated to all relevant stakeholders and applicable to any contractor who will occupy and/or use land during the construction and operations phase.
149. ADB standards require Grievance Mechanisms to provide a structured way of receiving and resolving grievances. Complaints should be addressed promptly using an understandable and transparent process that is culturally appropriate and readily acceptable to all segments of affected communities and is at no cost and without retribution. The mechanism should apply to the scale of impacts and risks presented by a project and benefit both the company and stakeholders. The tool must not impede access to other judicial or administrative remedies.
150. The DoH has constituted a Grievances Redressal Mechanism (GRM) under the PRF to support the environmental and social safeguards of the HPSHIVA project; the exact mechanism shall be functional under the sovereign Project. The GRM shall be accessible to aggrieved farmers before or post involvement with the project GRM, which will receive, evaluate and facilitate the resolution of impacted people's feedback, including concerns, complaints, and grievances about the social and environmental performance of the level of the Project. The GRM will aim to provide a time-bound and transparent mechanism to voice suggestions and appreciation and resolve social and environmental concerns linked to the Project. The Project-specific GRM is not intended to bypass the government's redress process; instead, it is designed to promptly address stakeholders' concerns and complaints, making it readily accessible to all community segments, and is scaled to the risks and impacts of the Project. A complainant may access the formal legal system at any time.

10. CONCLUSION

151. The IEE study of the proposed infrastructural interventions under HPSHIVA Project has minimal environmental impact with respect to air, water, land, biodiversity and waste management. Most of the adverse impacts predicted are of low significance, short term and localized. All expected adverse impacts could be mitigated with appropriate measures suggested in this report.
152. It is expected that there will be an overall positive cumulative environmental effect of the project if it succeeds in creating efficient value chain linkages between the agricultural commodity producer and the consumer. The beneficial impacts will be manifold. Following are the overall long-term impacts from the project:
 - a. The farmers' income in the subtropical region of the state will increase,
 - b. There will be reduction in water losses that occur due to poor infrastructure facilities and flood irrigation,
 - c. There will be improvement in the overall environment of production areas and handling of harvested produce, and
 - d. The employment opportunities of both temporary and permanent nature will get generated for local population.
153. Due to increase in employment opportunities, trade, business and agricultural income, a considerable amount of money may be channelled to the local economy in the area. This will increase the income level of the individual households and the local community of the area.
154. This IEE and EMP may need to be further updated by the PMU of HPSHIVA during the implementation stage. However, all the recommended mitigation measures and environmental monitoring plan should be followed.

Annexure 1: RAPID ENVIRONMENTAL IMPACT ASSESSMENT CHECKLIST

Questionnaire

Instructions:

This checklist is to be prepared to support the environmental classification of a project. It is to be attached to the environmental categorization form that is to be prepared and submitted to the Chief Compliance Officer of the Regional and Sustainable Development Department.

This checklist is to be completed with the assistance of an Environment Specialist in a Regional Department.

This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB checklists and handbooks on

(i) involuntary resettlement,

(ii) indigenous peoples planning, (iii) poverty reduction, (iv) participation, and (v) gender and development.

Answer the questions assuming the “without mitigation” case. The purpose is to identify potential impacts. Use the “remarks” section to discuss any anticipated mitigation measures.

For Package # 01 – Solan District - PACKAGE-01 (CWJ/IRG/SLN-01) of SOLAN DISTRICT

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Crop	Water Demand (cu. m. per day)
Kunihar	Sai	6.74	Functional FIS Sai	Natural Spring	Guava	134.80
	Ser-Delag	21.56	FIS Seri sarla	Spring	Guava	431.20
	Chunad	15.64	LIS from Gumber	Ghumber Khad	Guava	312.80
	Daseran	32.90	LIS from Ali Khad	Ali Khad	Citrus	658.00
	Datti	13.75	Functional FIS Datti	Natural Spring	Pomegranate	275.00
	Giana	6.69	LIS from Jadol Nallah	Jadol Nallah	Pomegranate	133.80
	Jailang	9.65	Functional LIS Jaliayana	parallel scheme – Ghumber Khad	Guava	193.00
	Pajeena	13.70	LIS from Panjeena Nallah	Pajeena Nallah	Citrus	274.00
Nalagarh	Badhal	6.42	LIS from Perennial Nallah	Perennial Nallah	Guava	128.40
	Baduan Bharmana	17.35	LIS from Halyara Khad	Halyara Khad / Nallah	Guava	347.00
	Batiakh	14.42	Functional LIS Gajedh	Ghamber Khad	Guava	288.40
	Beli khol 1	10.17	LIS from TW-1	Tube Well	Guava	203.40
	Beli khol 2	1.44	LIS from TW-2	Tube Well	Guava	28.80
	Doli	16.20	Functional LIS Gajedh	Ghamber Khad	Guava	324.00
	Kohla	6.26	LIS from Swarghat Nallah	Swarghat Nallah	Guava	125.20
	Kosri	21.38	LIS from Kosri Nallah	Kosri Nallah	Guava	427.60
	Palli	10.02	LIS from TW-3	TW	Guava	200.40
	Sour	36.41	LIS Sour Kulh	Ghamber Khad	Guava	728.20

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Siting Is the Project area adjacent to or within any of the following environmentally sensitive areas?			The proposed sub-project sites/ clusters are located under Kunihar and Nalagarh blocks in Solan district in Himachal Pradesh. There are no environmentally sensitive areas nearby to project sites. The Chail Wildlife Sanctuary is about 15km away.
▪ Protected Area		√	
▪ Wetland		√	
▪ Mangrove		√	
▪ Estuarine		√	
▪ Buffer zone of protected area		√	
▪ Special area for protecting biodiversity		√	

B. Potential Environmental Impacts Will the Project cause...			
loss of precious ecological values (e.g. the result of encroachment into forests/swamplands or historical/cultural buildings/areas, disruption of hydrology of natural waterways, regional flooding, and drainage hazards)?		√	Most of the sites are undergoing augmentation of capacity. The intake points have an existing system however very old hence rehabilitation is possible. Thus, no additional impact is expected.
conflicts in water supply rights and related social conflicts?		√	As per the hydrological assessment of the sources, the project sites are expected to experience water shortages during the winter months (Oct to Feb) due to a lack of rainfall during the period. The shortages have been estimated on the net availability after deducting the following environmental flows (E-flow) – - data on existing and future water demand on upstream and downstream riparian rights – in absence of actual data considered 80% of the flow; - water requirement for all clusters is taken as 20 m3/day/ha; - E-flow and future demand at each source were taken as 15% and 20% yield respectively of net available; - There is a shortage of water at all source locations. The majority of sources have a small catchment area as compared to irrigation and other demands due to the location being very close to the origin of the stream. (detail is given at the end of the assessment). Except for sources on Ghamber Khad, all other sources on other khads/ nallas indicate shortages in supplying water to irrigated area. However, since the calculation has considered E-flows and Future consumption as well as 80% for upstream and downstream consumption, it is expected that there will be no conflict in water supply rights and related social conflicts due to project activities. Additionally, the CHPMA and WUA members will be adequately trained to be able to manage water in a sustainable manner.
impediments to movements of people and animals?	√		Temporary disruption of the movement of people and animals is anticipated during the construction phase only. Appropriate work scheduling and temporary access arrangements will be discussed and agreed upon with local communities during the construction phase.
potential ecological problems due to increased soil erosion and siltation, leading to decreased stream capacity?		√	Not anticipated.
Insufficient drainage leading to salinity intrusion?		√	Not anticipated.
Over-pumping of groundwater, leading to salinization and ground subsidence?		√	Groundwater will be abstracted at three sites namely – Palli and Beli Khol 1 & 2. These are existing tube wells.
impairment of downstream water quality and therefore, impairment of downstream beneficial uses of water?		√	A detailed hydrological study has been carried out considering the catchment area, historical rainfall data, population growth and water demand in the area and discharge data. A 15% environmental flow has also been considered to maintain the downstream water supply. It is concluded that during the peak demand period, most of the sites are likely to face shortages. Thus, CHPMA and WUA members will be trained to maintain downstream flow and sustainably manage available water.

▪ Disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		√	Not anticipated.
▪ dislocation or involuntary resettlement of people?		√	The project will not cause any displacement of people.
▪ potential social conflicts arising from land tenure and land use issues?		√	No private land will be involved for the project purpose.
▪ soil erosion before compaction and lining of canals?	√		Protection of embankment will be included in the design option to avoid soil erosion. Measures such as temporary silt rap, stoking of soil away from water course, etc. will be adopted during construction phase.
▪ noise from construction equipment?	√		A temporary increase in noise level is anticipated during the construction phase only. All the construction machinery employed will comply with the noise standards of the Central Pollution Control Board (CPCB). Consultation will be held with local communities for work scheduling at sensitive areas (school, health centers, etc.)
▪ dust from construction?	√		Temporary increase in dust generation is anticipated during construction phase due to movement of vehicles, hauling of materials and earth. Dust suppression measures such as water sprinkling, covering all trucks/ dumpers carrying dispersible etc. will be employed.
▪ labor-related social problems especially if workers from different areas are hired?		√	No such social conflict is anticipated as maximum number of local labors will be employed during construction phase only. Only few outside skilled labors will be temporarily deployed for specific job.
▪ waterlogging and soil salinization due to inadequate drainage and farm management?		√	The clusters are located on natural slope, no waterlogging is anticipated during farming. Natural drainage pattern will not be altered.
▪ leaching of soil nutrients and changes in soil characteristics due to excessive application of irrigation water?	√		Measures such as training farmers for rational usage of water resources will be ensured during implementation.
▪ reduction of downstream water supply during peak seasons?		√	A detailed hydrological study has been carried out considering the catchment area, historical rainfall data, population growth and water demand in the area and discharge data. A 15% environmental flow has also been considered to maintain the downstream water supply. It is concluded that during the peak demand period, most of the sites are likely to face shortages. Thus, CHPMA and WUA members will be trained to maintain downstream flow and sustainably manage available water.
▪ soil pollution, polluted farm runoff and groundwater, and public health risks due to excessive application of fertilizers and pesticides?	√		Contamination to groundwater and soil is anticipated due to excessive application of fertilizers and pesticides. Measures for safe handling, storage and usage of fertilizers and pesticides will be followed.
▪ soil erosion (furrow, surface)?		√	Construction work during monsoon shall be carried out with due care so that silt runoff due to construction operation is prevented. No construction will be allowed during rains.
▪ scouring of canals?		√	Regular maintenance activities such as removal of sediments and clogging will be involved.
▪ logging of canals by sediments?		√	Construction work during monsoon shall be carried out with due care so that silt run off due to construction operation is prevented. No construction will be allowed during rains.
▪ clogging of canals by weeds?		√	Regular cleaning activities will be involved.

▪ seawater intrusion into downstream freshwater systems?		√	Not Applicable
▪ introduction of increase in incidence of waterborne or water related diseases?		√	No such probable incidence is anticipated.
▪ dangers to a safe and healthy working environment due to physical, chemical and biological hazards during project construction and operation?	√		Occupational health and safety issues will not be significant. These will be managed through EMPs per subproject and environmental clauses in the construction contract.
▪ social conflicts if workers from other regions or countries are hired?		√	Not anticipated.
▪ large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		√	Local labour is to be recruited as much as possible.
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?	√		The proposed project is unlikely to result in significant risks. The specific provision in the contracts together with monitoring of EMP implementation will ensure minimizing such risks.
▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project (e.g., irrigation dams) are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		√	The proposed project is unlikely to result in significant risks. The specific provision in the contracts together with monitoring of EMP implementation will ensure minimizing such risks.

Water Shortage Calculation

S No	Name of Cluster	Catchment Area km ²	Catchment Area ha	Proposed Irrigation Area ha	Minimum Excess / Maximum Shortage Vol (Mm ³)	Month of Occurrence
1	Pajeena	1.054	105.4	14.26	-0.0082	Oct
2	Giana	5.236	523.6	06.69	-0.0010	Oct
3	Ser-Delang	2.955	295.5	21.56	-0.0116	Oct
4	Sai	0.542	542.0	6.74	-0.0041	Dec
5	Jailang	0.18	18.0	9.65	-0.0060	Dec
6	Daseran	2.161	216.1	33.46	-0.0206	Dec
7	Chunad	4.311	431.1	16.35	-0.0063	Nov
8	Kosri	1.890	189.0	21.87	-0.0132	Mar
9	Baduan Bharmana	8.39	839.0	17.00	-0.0098	Apr
10	Kohla	1.74	174.0	6.26	-0.0036	Dec
11	Badhal	0.14	14.0	6.00	-0.0037	Mar
12	Batiakh	536.64	53664.0	15.00	+0.0763	Nov
13	Doli	544.20	54420.0	16.91	+0.0662	Nov
14	Sour	551.02	55102.0	25.00	+0.0512	Nov

For Package # 02 – Sirmaur District - PACKAGE-02 (CWJ/IRG/SMR-01) of SIRMAUR DISTRICT

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Crop	Water Demand (cu. m. per day)
Nahan	Dungi Sher	9.68	LIS from Jalal Khadd	Jalal Khadd	Guava	193.60
	Bajari (1 & 2)	13.99	LIS Jungla Bhood	Ruhn Khadd	Litchi	279.80
	Rama	6.88	LIS from Doghat Khad	Doghat Khadd	Guava	137.60
	Bhogpur	8.49	Check dam / LIS on Ruhn Khadd	Ruhn Khadd	Guava	169.80
	Simbalwala	9.99	Check dam / LIS on Ruhn Khadd	Ruhn Khadd	Guava	199.80
	Kherichandan 1	14.41	LIS on Jalal Khadd	Jalal Khadd	Guava	288.20
	Kherichandan 2	13.81	LIS on Jalal Khadd	Jalal Khadd	Guava	276.20
	Judag	12.61	LIS from Judag Nallah	Judag Nallah	Guava	252.20
	Goant	8.00	LIS from Goant Dam	Existing DAM Goant	Guava	160.00
	Budriyon	16.10	LIS from Tubewell	Tubewell 2	Guava	322.00
Paonta Sahib	Fatehpur	6.61	LIS Fatehpur	Percolation well, Edge of Bata River	Guava	132.20
	Killour	21.88	LIS Killour	Tons River	Guava	437.60
	Upper Bhuddi	21.72	LIS from Tubewell	Tubewell 3	Guava	434.40
	Khara	8.95	LIS Khara Nallah	Khara Nallah	Guava	179.00
	Puruwala	13.93	LIS from Tubewell	Tubewell 4	Guava	278.60
	Gyayaniwala	10.87	LIS from Tubewell	Tubewell 5	Guava	217.40

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Siting Is the Project area adjacent to or within any of the following environmentally sensitive areas?			The proposed sub-project sites/ clusters are located under Nahan and Paonta Sahib blocks in Sirmaur district in Himachal Pradesh.
▪ Protected Area		√	The Simbalbara National Park, Churdhar Wildlife Sanctuary and Renuka Wildlife Sanctuary are located in the Sirmaur district. The Simbalbara National Park is located in the Paonta valley. The project sites in Paonta Sahib block are located in the buffer zone of the conservation area. The National Park is covered with Sal trees and grassy glades. The commonly found animals include Goral, Sambhar, Spotted Deer, Chittal, Himalayan black bear, Hanuman langurs, and Indian muntjacs. Renuka Wildlife Sanctuary is more than 30 km away from the project sites, while Churdhar Wildlife Sanctuary is more than 100 km away from the project sites.
▪ Wetland		√	
▪ Mangrove		√	
▪ Estuarine		√	
▪ Buffer zone of protected area	√		
▪ Special area for protecting biodiversity		√	
B. Potential Environmental Impacts Will the Project cause...			
▪ loss of precious ecological values (e.g., result of encroachment into forests/swamplands or historical/cultural buildings/areas, disruption of hydrology of natural waterways, regional flooding, and drainage hazards)?		√	Under this package, there are 2 functional (existing) and 14 new irrigation schemes that will be developed. Of the 10 clusters in Nahan block, one cluster (Budriyon) has its source based on tubewell. Of the remaining 9 clusters, 6 clusters have their source from surface water of various khads/nallahs, while 3 clusters have their source from already constructed check dam. Of the 6 clusters in Paonta Sahib block, 2 clusters are taken under functional scheme and 4 clusters are covered under new proposed scheme. The sources for the functional schemes are well developed. 3 of the 4 new schemes will have tubewells as their source while for cluster Khara, the source is surface water of Khara nallah.

			Thus, there will be no disruption of waterways or regional flooding expected.
conflicts in water supply rights and related social conflicts?		√	Estimation of annual yield from surface water of khads / nallahs as the source has been carried out for 15 khads / nallahs using available rainfall data of 12 years. Except for Dungi Sher and Kherichandan 1 & 2 clusters with source on Jalal Khad, sources of all other khads indicate shortages in supplying water to irrigated area. Storage structures with capacity ranging from 0.0015 Mm³ at Khara cluster to 0.0120 Mm³ at Bhogpur Simbalwala clusters are proposed to make these clusters workable with water available in proposed source. Thus, it is expected that there will be no conflict in water supply rights and related social conflicts due to project activities. Additionally, the CHPMA and WUA members will be adequately trained to be able to manage water in a sustainable manner.
impediments to movements of people and animals?	√		Temporary disruption of the movement of people and animals is anticipated during the construction phase only. Appropriate work scheduling and temporary access arrangements will be discussed and agreed upon with local communities during the construction phase.
potential ecological problems due to increased soil erosion and siltation, leading to decreased stream capacity?		√	Not anticipated
Insufficient drainage leading to salinity intrusion?		√	Not anticipated.
Over-pumping of groundwater, leading to salinization and ground subsidence?		√	In Nahan block, of the 10 clusters under new proposed schemes, Budriyon cluster has its source based on tubewell. The tubewell lies in Kala Amb valley, where the stage ground water development is under safe category. Hydrogeological conditions are assessed conducive for construction of tubewell. In Paonta Sahib block, of the 4 clusters proposed under new scheme, JSV has proposed tubewells for 3 clusters. The tubewells proposed for 2 clusters, Puruwala and Gyayanwala, are assessed hydrogeologically feasible for construction, however, the tubewell proposed for cluster Upper Bhuddi lies on the periphery of Paonta valley, where the hydrogeological conditions are not conducive for large drawl ground water extraction.
Impairment of downstream water quality and therefore, impairment of downstream beneficial uses of water?		√	The net yield has been estimated after deducting upstream and downstream demands from monthly yield values. Additionally, CHPMA and WUA members will be trained to maintain downstream flow and sustainably manage available water.
Dislocation or involuntary resettlement of people?		√	The project will not cause any displacement of people.
potential social conflicts arising from land tenure and land use issues?		√	No private land will be involved for the project purpose.
soil erosion before compaction and lining of canals?	√		Protection of embankment will be included in the design option to avoid soil erosion. Measures such as temporary silt rap, stoking of soil away from water course, etc. will be adopted during the construction phase.

▪ noise from construction equipment?	√		Temporary increase in noise level is anticipated during construction phase only. All the construction machineries employed will comply with noise emission standards of Central Pollution Control Board (CPCB). Consultation will be held with local communities for work scheduling at sensitive areas (school, health centers, etc.).
▪ dust?	√		Temporary increase in dust generation is anticipated during construction phase due to movement of vehicles, hauling of materials and earth. Dust suppression measures such as water sprinkling, covering all trucks/ dumpers carrying dispersible, etc. will be employed.
▪ labor-related social problems especially if workers from different areas are hired?		√	No such social conflict is anticipated as maximum number of local labors will be employed during construction phase only. Only few outside skilled labors will be temporarily deployed for specific job.
▪ waterlogging and soil salinization due to inadequate drainage and farm management?		√	The clusters are located on natural slope, no waterlogging is anticipated during farming. Natural drainage pattern will not be altered.
▪ leaching of soil nutrients and changes in soil characteristics due to excessive application of irrigation water?	√		Measures such as training of farmers for rational usage of water resource will be ensured during implementation.
▪ reduction of downstream water supply during peak seasons?		√	A detailed hydrological study has been carried out considering the catchment area, historical rainfall data, population growth and water demand in the area and discharge data. Downstream demands have been accounted for while calculating the net yield. It is concluded that during the peak demand period, most of the sites are likely to face shortages. Thus, CHPMA and WUA members will be trained to maintain downstream flow and sustainably manage available water.
▪ soil pollution, polluted farm runoff and groundwater, and public health risks due to excessive application of fertilizers and pesticides?	√		Contamination to ground water and soil are anticipated due to excessive application of fertilizers and pesticides. Measures for safe handling, storage and usage of fertilizers and pesticides will be followed.
▪ soil erosion (furrow, surface)?		√	Construction work during monsoon shall be carried out with due care so that silt run off due to construction operation is prevented. No construction will be allowed during rains.
▪ scouring of canals?		√	Regular maintenance activities such as removal of sediments and clogging will be involved.
▪ logging of canals by sediments?		√	Construction work during monsoon shall be carried out with due care so that silt run off due to construction operation is prevented. No construction will be allowed during rains.
▪ clogging of canals by weeds?		√	Regular cleaning activities will be involved.
▪ seawater intrusion into downstream freshwater systems?		√	Not Applicable
▪ introduction of increase in incidence of waterborne or water related diseases?		√	No such probable incidence is anticipated.
▪ dangers to a safe and healthy working environment due to physical, chemical and biological hazards during project construction and operation?		√	Occupational health and safety issues will not be significant. These will be managed through EMPs per subproject and environmental clauses in the construction contract.
▪ social conflicts if workers from other regions or countries are hired?		√	Not anticipated.

▪ large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		√	Local labor is to be recruited as much as possible.
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?		√	The proposed project is unlikely to result in significant risks. Specific provision in the contracts together with monitoring of EMP implementation will ensure minimizing such risks.
▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project (e.g., irrigation dams) are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		√	The proposed project is unlikely to result in significant risks. Specific provision in the contracts together with monitoring of EMP implementation will ensure minimizing such risks.

Water Shortage Calculation

Block Name	Irrigation Scheme	Cluster Name	Catchment Area (km ²)	Proposed Irrigation Area (ha)	Minimum Excess / Maximum Shortage Vol (mm ³)	Month of Occurrence
Nahan	LIS from Jalal Khadd	Dungi Sher	147.168	9.68	0.0331	Nov
	LIS Jungla Bhood	Bajari (1 & 2)	73.57	13.99	-0.0053	May
	LIS from Doghat Khad	Rama	3.65	6.88	-0.0027	Nov
	Check dam / LIS on Ruhn Khadd	Bhogpur & Simbalwala	75.47	18.48	-0.0080	May
	LIS on Jalal Khadd	Kherichandan 1 & 2	170.30	28.22	0.0108	Nov
	LIS from Judag Nallah	Judag	2992	12.61		
	LIS from Goant Dam	Goant	18.13	8.00	-0.0041	May
	LIS from Tubewell	Budriyon	N/A	16.10		
Paonta Sahib	LIS Fatehpur	Fatehpur	N/A	6.61		
	LIS Killour	Killour	3065.17	21.88		
	LIS from Tubewell	Upper Bhuddi	N/A	21.72		
	LIS Khara Nallah	Khara	8.705	8.95	-0.0009	Feb
	LIS from Tubewell	Puruwala	N/A	13.93		
	LIS from Tubewell	Gyayaniwala	N/A	10.87		

For Package # 03 – Hamirpur District - PACKAGE-03 (CWJ/IRG/HMR-01) of HAMIRPUR DISTRICT

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Crop	Water Demand (cu. m. per day)
Bamsan	Sachuin	8.68	LIS Sachuhi	Beas River	Pomegranate	173.60
	Parol	17.51	LIS Dera Parol	Kunah Khadd	Citrus	350.20
Bhoranj	Balor-Sangrawar	33.45	LIS Balor Nallah	Balor Nallah	Guava	669.00
	Jol	19.72	LIS Jol Nallah	Jol Nallah	Guava	394.40
	Lagmanwin	6.90	LIS Lagmanwin Nallah	Lagmanwin Nallah	Guava	138.00
	Lambagram/P alasi	18.17	LIS JICA dam, Plassi Nallah	JICA dam, Plassi Nallah	Guava	363.40
	Mundkhar tuisi	27.99	LIS Balor Nallah	Balor Nallah	Guava	559.80
	Samlog	22.69	LIS Samlog Nallah	Samlog Nallah	Guava	453.80
Bijhar	Bhalat	11.52	Existing LIS	Bhalat	Pomegranate	230.40

			Bhalat Nallah	Nallah		
	Lafran	13.96	LIS over New Source	New Proposed	Pomegranate	279.20
	Ghangot	8.42	Existing LIS Ghangot Nallah	Ghangot Nallah	Pomegranate	168.40
	Kalwal	15.75	LIS Kalwal	Rihal Nallah	Pomegranate	315.00
	Seri-Bhakredi	14.88	LIS Bhakreri	Existing check dam on Nallah	Pomegranate	297.60

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Siting			The proposed sub-project sites/ clusters are located under Bamsan, Bhoranj, and Bijhar blocks in Hamirpur district in Himachal Pradesh. There are no Wildlife Sanctuaries or National Parks located in Hamirpur district. Hence, the Project sites are not adjacent to or within any environmentally sensitive area.
Is the Project area adjacent to or within any of the following environmentally sensitive areas?			
▪ Protected Area		√	
▪ Wetland		√	
▪ Mangrove		√	
▪ Estuarine		√	
▪ Buffer zone of protected area		√	
▪ Special area for protecting biodiversity		√	
B. Potential Environmental Impacts			
Will the Project cause...			
▪ loss of precious ecological values (e.g., result of encroachment into forests/swamplands or historical/cultural buildings/areas, disruption of hydrology of natural waterways, regional flooding, and drainage hazards)?		√	Under this package, there are 1 functional, 4 non-functional (defunct) and 8 new irrigation schemes that will be developed. For the functional scheme, the source has been assessed as hydrologically feasible for LIS Sachuhi. For the non-functional schemes, the sources are based on the local nallahs, where check dams have already been constructed as intake to the irrigation schemes. For the new schemes, check dams have already been constructed across the respective nallahs. For Lafran cluster, the proposed site has been found to be not conducive for construction of percolation well. Thus, a suitable rainwater harvesting structure will be constructed for LIS Lafran. Any loss of precious ecological values is not anticipated.
▪ conflicts in water supply rights and related social conflicts?		√	Estimation of annual yield from surface water of khads / nallahs as the source has been carried out for 12 khads / nallahs using available rainfall data of 12 years. All khads indicate shortages in supplying water to irrigated area. Maximum shortage of 0.0207 mm³ is noticed for Balor-Sangrawar cluster in Bhoranj block, while minimum shortage of 0.0040 mm³ is noticed for Bhalat cluster in Bijhar block. Storage structures with capacity ranging from 0.0060 to 0.0315 mm³ are proposed to make these clusters workable with water available in proposed source. Thus, it is expected that there will be no conflict in water supply rights and related social conflicts due to project activities. Additionally, the CHPMA and WUA members

			will be adequately trained to be able to manage water in a sustainable manner.
▪ impediments to movements of people and animals?	√		Temporary disruption of the movement of people and animals is anticipated during the construction phase only. Appropriate work scheduling and temporary access arrangements will be discussed and agreed upon with local communities during the construction phase.
▪ potential ecological problems due to increased soil erosion and siltation, leading to decreased stream capacity?		√	Not anticipated
▪ Insufficient drainage leading to salinity intrusion?		√	Not anticipated.
▪ Over-pumping of groundwater, leading to salinization and ground subsidence?		√	In Bamsan block, the cluster Parol has its source on surface water of Kunah khad. Kunah khad near the source is not perennial in nature and thus, hydrological study of the Kunah khad is essential and recommendations of Hydrologist are mandatory. In Bhoranj block, the catchment area and CCA of every cluster does not commensurate. Since these clusters are covered under New Proposed Schemes, detailed hydrological study of each cluster is necessary and recommendations of Hydrologist are mandatory. In Bijhar block, for Lafran cluster, percolation well has been proposed by JSV. The hydrogeological conditions assessed in the area are not conducive for construction of percolation well for LIS Lafran. Therefore, the proposed site is not recommended for construction of percolation well. It has been agreed that a suitable rainwater harvesting structure will be constructed for LIS Lafran. The detailed study reveals that the catchment area as well as CCA of every cluster does not commensurate, except Lafran to some extent. Therefore, detailed hydrological study of each cluster is requisite for smooth functioning of irrigation schemes to be constructed and recommendations of Hydrologist are mandatory.
▪ Impairment of downstream water quality and therefore, impairment of downstream beneficial uses of water?		√	The net yield has been estimated after deducting upstream and downstream demands from monthly yield values. Additionally, CHPMA and WUA members will be trained to maintain downstream flow and sustainably manage available water.
▪ Dislocation or involuntary resettlement of people?		√	The project will not cause any displacement of people.
▪ potential social conflicts arising from land tenure and land use issues?		√	No private land will be involved for the project purpose.
▪ soil erosion before compaction and lining of canals?	√		Protection of embankment will be included in the design option to avoid soil erosion. Measures such as temporary silt rap, stoking of soil away from water course, etc. will be adopted during the construction phase.
▪ noise from construction equipment?	√		Temporary increase in noise level is anticipated during construction phase only. All the construction machineries employed will comply with noise emission standards of Central Pollution Control Board (CPCB). Consultation will be held with local communities for work scheduling at sensitive areas (school, health centers, etc.).
▪ dust?	√		Temporary increase in dust generation is anticipated during construction phase due to movement of vehicles, hauling of materials and earth. Dust suppression measures such as water sprinkling, covering all trucks/ dumpers carrying dispersible, etc. will be employed.

▪ labor-related social problems especially if workers from different areas are hired?		√	No such social conflict is anticipated as maximum number of local labors will be employed during construction phase only. Only few outside skilled labors will be temporarily deployed for specific job.
▪ waterlogging and soil salinization due to inadequate drainage and farm management?		√	The clusters are located on natural slope, no waterlogging is anticipated during farming. Natural drainage pattern will not be altered.
▪ leaching of soil nutrients and changes in soil characteristics due to excessive application of irrigation water?	√		Measures such as training of farmers for rational usage of water resource will be ensured during implementation.
▪ reduction of downstream water supply during peak seasons?		√	CHPMA and WUA members will be trained to maintain downstream flow and sustainably manage available water.
▪ soil pollution, polluted farm runoff and groundwater, and public health risks due to excessive application of fertilizers and pesticides?	√		Contamination to ground water and soil are anticipated due to excessive application of fertilizers and pesticides. Measures for safe handling, storage and usage of fertilizers and pesticides will be followed.
▪ soil erosion (furrow, surface)?		√	Construction work during monsoon shall be carried out with due care so that silt run off due to construction operation is prevented. No construction will be allowed during rains.
▪ scouring of canals?		√	Regular maintenance activities such as removal of sediments and clogging will be involved.
▪ logging of canals by sediments?		√	Construction work during monsoon shall be carried out with due care so that silt run off due to construction operation is prevented. No construction will be allowed during rains.
▪ clogging of canals by weeds?		√	Regular cleaning activities will be involved.
▪ seawater intrusion into downstream freshwater systems?		√	Not Applicable
▪ introduction of increase in incidence of waterborne or water related diseases?		√	No such probable incidence is anticipated.
▪ dangers to a safe and healthy working environment due to physical, chemical and biological hazards during project construction and operation?		√	Occupational health and safety issues will not be significant. These will be managed through EMPs per subproject and environmental clauses in the construction contract.
▪ social conflicts if workers from other regions or countries are hired?		√	Not anticipated.
▪ large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		√	Local labor is to be recruited as much as possible.
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?		√	The proposed project is unlikely to result in significant risks. Specific provision in the contracts together with monitoring of EMP implementation will ensure minimizing such risks.
▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project (e.g., irrigation dams) are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		√	The proposed project is unlikely to result in significant risks. Specific provision in the contracts together with monitoring of EMP implementation will ensure minimizing such risks.

Water Shortage Calculation

Block Name	Irrigation Scheme	Cluster Name	Proposed Irrigation Area (ha)	Minimum Excess / Maximum Shortage Vol (mm ³)	Month of Occurrence
Bamsan	LIS Sachuhi	Sachuin	8.68		
	LIS Dera Parol	Parol	17.51	-0.0108	Dec
Bhoranj	LIS Balor Nallah	Balor-Sangrawar	33.45	-0.0207	Oct
	LIS Jol Nallah	Jol	19.72	-0.0122	Dec
	LIS Lagmanwin Nallah	Lagmanwin	6.90	-0.0041	Dec
	LIS JICA dam, Plassi Nallah	Lambagram/Palasi	18.17	-0.0104	Nov
	LIS Balor Nallah	Mundkhar tushi	27.99	-0.0171	Oct
	LIS Samlog Nallah	Samlog	22.69	-0.0135	Oct
Bijhar	Existing LIS Bhalat Nallah	Bhalat	11.52	-0.0040	Dec
	LIS over New Source	Lafran	13.96	-0.0059	Apr
	Existing LIS Ghangot Nallah	Ghangot	8.42	-0.0046	Dec
	LIS Kalwal	Kalwal	15.75	-0.0086	Dec
	LIS Bhakreri	Seri-Bhakredi	14.88	-0.0089	Dec

For Package # 04 – Hamirpur District - PACKAGE-04 (CWJ/IRG/HMR-02) of HAMIRPUR DISTRICT

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Crop	Water Demand (cu. m. per day)
Hamirpur	Branda	7.90	LIS Nalti Branda	Kunah Khad	Citrus	158.00
	Bakarti-I	29.97	LIS Bakarti	Kunah Khad	Citrus	599.40
	Jangal Ropa	22.20	LIS Jangal Ropa	Kunah Khad	Citrus	444.00
	Haar	14.90	LIS Jangal Ropa Haar	Kunah Khad	Citrus	298.00
	Neri	7.44	LIS Neri	Kunah Khad	Citrus	148.80
Nadaun	Sadhwan	8.80	MIP Nadaun	MIP Nadaun	Citrus	176.00
	Rail-I	6.20	MIP Nadaun	MIP Nadaun	Citrus	124.00
	Baag Bharmoti	6.10	MIP Nadaun	MIP Nadaun	Citrus	122.00
	Kushiar-I	15.80	LIS Khushiya Galol	Maan Khadd	Citrus	316.00
	Bhabran 1	11.22	LIS Bhabran	LIS Bhabran	Citrus	224.40
	Bhabran 2	13.90	LIS Bhabran	LIS Bhabran	Citrus	278.00
	Kaloor	9.74	LIS Kola	Maan Khadd	Citrus	194.80
	Kashmir	6.70	LIS Kashmir	LIS Kashmir	Citrus	134.00
	Phal Palsi	28.20	LIS Palsi	LIS Palsi	Citrus	564.00
	Choru (Bhoo-I)	6.20	LIS Bhoo	LIS Bhoo	Citrus	124.00
	Manjot	7.90	LIS Salasi Nallah	Salasi Nallah	Citrus	158.00
	Manjot 2	1.50	LIS Salasi Nallah	Salasi Nallah	Citrus	30.00
	Tung (Baloh)	14.10	LIS Maan Khadd	Maan Khadd	Citrus	282.00
	Loharda	5.00	MIP Nadaun Right Bank	MIP Nadaun	Citrus	100.00
	Sai Lower	19.00	MIP Nadaun Left Bank	MIP Nadaun	Citrus	380.00
	Pansai 1	32.20	LIS Pansai	LIS Pansai	Citrus	644.00
	Pansai 2	24.20	LIS Pansai	LIS Pansai	Citrus	484.00
Sujanpur	Kheri	12.80	LIS Kheri	LIS Kheri	Pomegranate	256.00
	Beri-1	9.30	LIS Kudana Beri	LIS Kudana Beri	Pomegranate	186.00
	Beri-2	12.40	LIS Kudana Beri	LIS Kudana Beri	Pomegranate	248.00
	Bhahru (Pour)	7.10	LIS Bhahru Jatour	LIS Bhahru Jatour	Pomegranate	142.00
	Bir Baghera	7.00	LIS Pour	LIS Pour	Pomegranate	140.00
	Kudana	7.90	LIS Bhahru Jatour	LIS Bhahru Jatour	Citrus	158.00
	Bhalana Rei	18.21	LIS Pung Khad	LIS Pung Khad	Guava	364.20

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Siting			The proposed sub-project sites/ clusters are located under Hamirpur, Nadaun, and Sujanpur blocks in Hamirpur district in Himachal Pradesh. There are no Wildlife Sanctuaries or National Parks located in Hamirpur district. Hence, the Project sites are not adjacent to or within any environmentally sensitive area.
Is the Project area adjacent to or within any of the following environmentally sensitive areas?			
▪ Protected Area		√	
▪ Wetland		√	
▪ Mangrove		√	
▪ Estuarine		√	

▪ Buffer zone of protected area		√	
▪ Special area for protecting biodiversity		√	
B. Potential Environmental Impacts			
Will the Project cause...			
▪ loss of precious ecological values (e.g., result of encroachment into forests/swamplands or historical/cultural buildings/areas, disruption of hydrology of natural waterways, regional flooding, and drainage hazards)?		√	Under this package, there are 12 non-functional (defunct) and 18 new irrigation schemes that will be developed. There are a total of 5 clusters in Hamirpur block that are covered under Non-Functional Schemes. The sources of 4 clusters are based on ground water, i.e., percolation wells already constructed by JSV. However, one cluster named Branda have their source based on surface water of Kunah khad. It is proposed that subsurface dyke cum check dam of optimum height be constructed on each source of LIS Nalti Branda, Jangal Ropa and Neri across the Kunah khad. This can cause disruption of the hydrology of natural waterways and disruption to the bed of the stream at the project site. Of the clusters in Nadaun block, the sources based on surface water of river Beas are assessed feasible, since river Beas is perennial in nature and has sufficient discharge. For the remaining clusters with sources based on Maan khad, Salasi nallah and Dugh nallah, it is proposed to construct subsurface dyke cum check dam of optimum height across the khad/nallah, which can cause disruption of the hydrology of natural waterways and disruption to the bed of the stream at the project site. For the clusters in Sujampur block, the clusters covered under Non-functional Schemes have their sources as percolation wells, which have been constructed by JSV on the left side of Beas river. These percolation wells have been assessed hydrologically feasible for ground water development.
▪ conflicts in water supply rights and related social conflicts?		√	Estimation of annual yield from surface water of khads / nallahs as the source has been carried out for 13 khads / nallahs using available rainfall data of 12 years. Except for Manjot / Manjot 2 cluster that has excess storage, sources of all other khads indicate shortages in supplying water to the irrigated area in November and October months. Maximum shortage of 0.0163 mm³ is noticed for Jangal Ropa cluster, while minimum shortage of 0.0026 mm³ is noticed for Bakarti cluster. Storage structures with capacity ranging from 0.0040 mm³ to 0.0455 mm³ are proposed to make these clusters workable with water available in proposed source. Thus, it is expected that there will be no conflict in water supply rights and related social conflicts due to project activities. Additionally, the CHPMA and WUA members will be adequately trained to be able to manage water in a sustainable manner.
▪ impediments to movements of people and animals?	√		Temporary disruption of the movement of people and animals is anticipated during the construction phase only. Appropriate work scheduling and temporary access arrangements will be discussed and agreed upon with local communities during the construction phase.
▪ potential ecological problems due to increased soil erosion and siltation, leading to decreased stream capacity?		√	Not anticipated
▪ Insufficient drainage leading to salinity intrusion?		√	Not anticipated.

Over-pumping of groundwater, leading to salinization and ground subsidence?		√	In Hamirpur block, the cluster Branda has its source on the surface of Kunah khad. During peak summer, the Kunah khad has intermittent or negligible flow at some places of upper reaches. A number of percolation wells have been constructed by the Jal Shakti Vibhag, Hamirpur on this khad. Therefore, for future development of the resource of Kunah khad, comprehensive hydrological study of the khad is utmost important and opinion of Hydrologist is mandatory. In Nadaun block, the source of 3 clusters is based on surface water of Mann khad as well as ground water. During peak summer, the Maan khad has intermittent or negligible flow at some places. Therefore, for future development of the resource of Maan khad, comprehensive hydrological study of the khad is utmost important and opinion of Hydrologist is mandatory. For the new clusters, hydrological study of Salasi and Dugh nallahs is obligatory because both have inadequate catchment area and recommendations of Hydrologist is mandatory. In Sujanpur block, the source for the new cluster Bhalana Rei is Hard nallah. The Hard nallah is not have adequate catchment area. Therefore, hydrological study of Hard nallah is obligatory and recommendations of Hydrologist is mandatory.
Impairment of downstream water quality and therefore, impairment of downstream beneficial uses of water?		√	The net yield has been estimated after deducting upstream and downstream demands from monthly yield values. Additionally, CHPMA and WUA members will be trained to maintain downstream flow and sustainably manage available water.
Dislocation or involuntary resettlement of people?		√	The project will not cause any displacement of people.
potential social conflicts arising from land tenure and land use issues?		√	No private land will be involved for the project purpose.
soil erosion before compaction and lining of canals?	√		Protection of embankment will be included in the design option to avoid soil erosion. Measures such as temporary silt rap, stoking of soil away from water course, etc. will be adopted during the construction phase.
noise from construction equipment?	√		Temporary increase in noise level is anticipated during construction phase only. All the construction machineries employed will comply with noise emission standards of Central Pollution Control Board (CPCB). Consultation will be held with local communities for work scheduling at sensitive areas (school, health centers, etc.).
dust?	√		Temporary increase in dust generation is anticipated during construction phase due to movement of vehicles, hauling of materials and earth. Dust suppression measures such as water sprinkling, covering all trucks/ dumpers carrying dispersible, etc. will be employed.
labor-related social problems especially if workers from different areas are hired?		√	No such social conflict is anticipated as maximum number of local labors will be employed during construction phase only. Only few outside skilled labors will be temporarily deployed for specific job.
waterlogging and soil salinization due to inadequate drainage and farm management?		√	The clusters are located on natural slope, no waterlogging is anticipated during farming. Natural drainage pattern will not be altered.
leaching of soil nutrients and changes in soil characteristics due to excessive application of irrigation water?	√		Measures such as training of farmers for rational usage of water resource will be ensured during implementation.

▪ reduction of downstream water supply during peak seasons?		√	A detailed hydrological study has been carried out considering the catchment area, historical rainfall data, population growth and water demand in the area and discharge data. Downstream demands have been accounted for while calculating the net yield. It is concluded that during the peak demand period, most of the sites are likely to face shortages. Thus, CHPMA and WUA members will be trained to maintain downstream flow and sustainably manage available water.
▪ soil pollution, polluted farm runoff and groundwater, and public health risks due to excessive application of fertilizers and pesticides?	√		Contamination to ground water and soil are anticipated due to excessive application of fertilizers and pesticides. Measures for safe handling, storage and usage of fertilizers and pesticides will be followed.
▪ soil erosion (furrow, surface)?		√	Construction work during monsoon shall be carried out with due care so that silt run off due to construction operation is prevented. No construction will be allowed during rains.
▪ scouring of canals?		√	Regular maintenance activities such as removal of sediments and clogging will be involved.
▪ logging of canals by sediments?		√	Construction work during monsoon shall be carried out with due care so that silt run off due to construction operation is prevented. No construction will be allowed during rains.
▪ clogging of canals by weeds?		√	Regular cleaning activities will be involved.
▪ seawater intrusion into downstream freshwater systems?		√	Not Applicable
▪ introduction of increase in incidence of waterborne or water related diseases?		√	No such probable incidence is anticipated.
▪ dangers to a safe and healthy working environment due to physical, chemical and biological hazards during project construction and operation?		√	Occupational health and safety issues will not be significant. These will be managed through EMPs per subproject and environmental clauses in the construction contract.
▪ social conflicts if workers from other regions or countries are hired?		√	Not anticipated.
▪ large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		√	Local labor is to be recruited as much as possible.
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?		√	The proposed project is unlikely to result in significant risks. Specific provision in the contracts together with monitoring of EMP implementation will ensure minimizing such risks.
▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project (e.g., irrigation dams) are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		√	The proposed project is unlikely to result in significant risks. Specific provision in the contracts together with monitoring of EMP implementation will ensure minimizing such risks.

Water Shortage Calculation

Block Name	Irrigation Scheme	Cluster Name	Catchment Area (km ²)	Proposed Irrigation Area (ha)	Minimum Excess / Maximum Shortage Vol (mm ³)	Month of Occurrence
Hamirpur	LIS Nalti Branda	Branda	200.93	7.90	-0.0114	Nov
	LIS Bakarti	Bakarti-I	148.90	29.97	-0.0026	Oct
	LIS Jangal Ropa	Jangal Ropa	182.94	22.20	-0.0163	Oct
	LIS Jangal Ropa Haar	Haar	185.04	14.90	-0.0255	Oct
	LIS Neri	Neri	227.69	7.44	-0.0158	Nov
Nadaun	MIP Nadaun	Sadhwan		8.80		
	MIP Nadaun	Rail-I		6.20		
	MIP Nadaun	Baag Bharmoti		6.10		
	LIS Khusiyar Galol	Kushiar-I	115.18	15.80	-0.0138	Nov
	LIS Bhabran	Bhabran 1		11.22		
	LIS Bhabran	Bhabran 2		13.90		
	LIS Kola	Kaloor	2.70	9.74	-0.0051	Nov
	LIS Kashmir	Kashmir	14.65	6.70	-0.0026	Nov
	LIS Palsi	Phal Palsi	75.15	28.20	-0.0207	Nov
	LIS Bhoo	Choru (Bhoo-I)		6.20		
	LIS Salasi Nallah	Manjot	39.08	7.90	0.0103	Nov

	LIS Salasi Nallah	Manjot 2		1.50		
	LIS Maan Khadd	Tung (Baloh)	148.74	14.10	-0.0138	Nov
	MIP Nadaun Right Bank	Loharda		5.00		
	MIP Nadaun Left Bank	Sai Lower		19.00		
	LIS Pansai	Pansai 1	11.20	32.20	-0.0308	Nov
	LIS Pansai	Pansai 2		24.20		
Sujanpur	LIS Kheri	Kheri		12.80		
	LIS Kudana Beri	Beri-1		9.30		
	LIS Kudana Beri	Beri-2		12.40		
	LIS Bhahru Jatour	Bhahru (Pour)		7.10		
	LIS Pour	Bir Baghera		7.00		
	LIS Bhahru Jatour	Kudana		7.90		
	LIS Pung Khad	Bhalana Rei	3.15	18.21	-0.0103	Oct

For Package # 05 – Bilaspur District - PACKAGE-05 (CWJ/IRG/BLS-01) of BILASPUR DISTRICT

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Crop	Water Demand (cu. m. per day)
Ghumarwin	Dehra	17.90	IPH Scheme	Seer Khad	Citrus	358.00
	Kathalag droun	20.57	IPH Scheme	Seer Khad	Guava	411.40
	Lower Lanjhta	11.61	IPH Scheme – Seer Khad	Seer Khad	Litchi	232.20
	Thandora	7.41	IPH Scheme – Seer Khad	Seer Khad	Litchi	148.20
	Upper Talwara	9.35	LIS Talwara	Khad	Citrus	187.00
	Talwara Lower	1.91	LIS Talwara	Khad	Citrus	38.20
	Talwara Phase-2	6.91	LIS Talwara	Khad	Citrus	138.20
	Kasol	20.53	LIS Kasohal	Seer Khad	Citrus	410.60
	Kasol Balh	8.84	LIS Kasohal	Seer Khad	Citrus	176.80
	Kasol Kanjeen	6.20	LIS Kasohal	Seer Khad	Citrus	124.00
	Mehri Kathla	14.46	LIS Mehri Kathla	Bajrauli Khad	Citrus	289.20
	Nalti Parnal	8.77	LIS Parnal	Seer Khad	Citrus	175.40
	Gwal Muthani (Nanawan)	3.75	LIS Nanawan	Madhi Khad	Guava	75.00
	Chharal Daloli	19.29	New Check Dam	Over LIS Talwara	Citrus	385.80
	Feori (Kothi)	8.67	New Scheme Borewell proposed	Borewell	Citrus	173.40
	Sandhiar (Chhat)	18.97	New Scheme Check Dam proposed	Existing DAM – Nearby Nallah - Sandhiar	Guava	379.40
	Bhadrog (Seu)	8.88	New Scheme IPH Scheme	Seer Khad	Citrus	177.60
	Bhapral	7.11	New LIS	Seer Khad	Guava	142.20
	Samsai	5.34	New scheme Check Dam / Bore	Borewell	Guava	106.80
	Massour / Maloh	6.57	New Check Dam	Seer Khad	Citrus	131.40
	Chhiber	16.99	New Scheme Check Dam existing and proposed	Nearby Nallah	Citrus	339.80
Sadar - Bilaspur	Kotlu	14.23	New scheme to be developed	Ali Khad	Guava	284.60
	Dugga Har (Manjher)	11.43	Kuhl	Kuhl	Citrus	228.60
	Loharda	23.02	Kuhl	Ali Khad	Citrus	460.40
	Kainthal	6.38	Kuhl	Ali Khad	Citrus	127.60
	Khod ka kyar	21.49	IPH Kuhl	Ali Khad	Citrus	429.80
	Karot	21.92	Existing Kuhl	Ali Khad	Citrus	438.40
	Salnu	27.79	New Scheme	Sutlej River	Citrus	555.80

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Siting			The proposed sub-project sites/ clusters are located under Ghumarwin and Sadar-Bilaspur blocks in Bilaspur district in Himachal Pradesh. The Naina Devi and Gobind Sagar Wildlife Sanctuaries are located in the Swarghat tehsil of Bilaspur District. Both the sanctuaries are at a location of more than 50 km from the Project sites in the above blocks. Hence, the Project sites are not adjacent to or within any environmentally sensitive area.
Is the Project area adjacent to or within any of the following environmentally sensitive areas?			
▪ Protected Area		√	
▪ Wetland		√	
▪ Mangrove		√	

▪ Estuarine		√	
▪ Buffer zone of protected area		√	
▪ Special area for protecting biodiversity		√	
B. Potential Environmental Impacts Will the Project cause...			
▪ loss of precious ecological values (e.g., result of encroachment into forests/swamplands or historical/cultural buildings/areas, disruption of hydrology of natural waterways, regional flooding, and drainage hazards)?		√	Under this package, there are 8 functional (existing), 7 non-functional (defunct) and 13 new irrigation schemes that will be developed. The functional schemes in Ghumarwin block have the components in good working condition and can be operated with minor modifications. LIS Kotlu in Sadar Bilaspur block has been listed under Functional scheme, but as per site data, the existing borewell is on a private land and thus, a new scheme needs to be developed. A percolation well with RCC dyke structure has been proposed. For LIS Kasol, a new pump house is proposed since the existing pump house was affected due to floods. For LIS Chhiber, LIS Massour/Malloh, LIS Sandhihar, LIS Meri Kathla (Ghumarwin block) and LIS Karot (Sadar Bilaspur block), a check dam is proposed to be constructed, which can cause disruption of the hydrology of natural waterways and disruption to the bed of the stream at the project site.
▪ conflicts in water supply rights and related social conflicts?		√	Estimation of annual yield from surface water of khads / nallahs as the source has been carried out for 15 khads / nallahs using available rainfall data of 12 years. Except for Kothlu and Karot clusters with source on Ali Khad, sources of all other khads indicate shortages in supplying water to the irrigated area in November and December months. Storage structures with capacity ranging from 0.0050 mm³ at Talwara cluster to 0.0750 mm³ at Kasol and Bhadrog clusters are proposed to make these clusters workable with water available in proposed source. Thus, it is expected that there will be no conflict in water supply rights and related social conflicts due to project activities. Additionally, the CHPMA and WUA members will be adequately trained to be able to manage water in a sustainable manner.
▪ impediments to movements of people and animals?	√		Temporary disruption of the movement of people and animals is anticipated during the construction phase only. Appropriate work scheduling and temporary access arrangements will be discussed and agreed upon with local communities during the construction phase.
▪ potential ecological problems due to increased soil erosion and siltation, leading to decreased stream capacity?		√	Not anticipated
▪ Insufficient drainage leading to salinity intrusion?		√	Not anticipated.
▪ Over-pumping of groundwater, leading to salinization and ground subsidence?		√	In Ghumarwin block, 2 clusters, i.e., Samsai and Feori (Kothi) have their source based on ground water. JSV has proposed borewell near each cluster. Since hydrogeological conditions in the area are not conducive for large drawl ground water development, it has been recommended to investigate an alternate suitable source. Similarly, in Sadar Bilaspur block, the source of clusters Kotlu, Dugga Har, Loharda/Deoth, Kanithal (Manjher) and

			Khod ka kyar is borewell. Since the sites are not conducive for construction of borewell, the source should be reviewed and rainwater harvesting structure or any suitable structure near the cluster area be identified.
▪ Impairment of downstream water quality and therefore, impairment of downstream beneficial uses of water?		√	The net yield has been estimated after deducting upstream and downstream demands from monthly yield values. Additionally, CHPMA and WUA members will be trained to maintain downstream flow and sustainably manage available water.
▪ Dislocation or involuntary resettlement of people?		√	The project will not cause any displacement of people.
▪ potential social conflicts arising from land tenure and land use issues?		√	No private land will be involved for the project purpose.
▪ soil erosion before compaction and lining of canals?	√		Protection of embankment will be included in the design option to avoid soil erosion. Measures such as temporary silt rap, stoking of soil away from water course, etc. will be adopted during the construction phase.
▪ noise from construction equipment?	√		Temporary increase in noise level is anticipated during construction phase only. All the construction machineries employed will comply with noise emission standards of Central Pollution Control Board (CPCB). Consultation will be held with local communities for work scheduling at sensitive areas (school, health centers, etc.).
▪ dust?	√		Temporary increase in dust generation is anticipated during construction phase due to movement of vehicles, hauling of materials and earth. Dust suppression measures such as water sprinkling, covering all trucks/ dumpers carrying dispersible, etc. will be employed.
▪ labor-related social problems especially if workers from different areas are hired?		√	No such social conflict is anticipated as maximum number of local labors will be employed during construction phase only. Only few outside skilled labors will be temporarily deployed for specific job.
▪ waterlogging and soil salinization due to inadequate drainage and farm management?		√	The clusters are located on natural slope, no waterlogging is anticipated during farming. Natural drainage pattern will not be altered.
▪ leaching of soil nutrients and changes in soil characteristics due to excessive application of irrigation water?	√		Measures such as training of farmers for rational usage of water resource will be ensured during implementation.
▪ reduction of downstream water supply during peak seasons?		√	A detailed hydrological study has been carried out considering the catchment area, historical rainfall data, population growth and water demand in the area and discharge data. Downstream demands have been accounted for while calculating the net yield. It is concluded that during the peak demand period, most of the sites are likely to face shortages. Thus, CHPMA and WUA members will be trained to maintain downstream flow and sustainably manage available water.
▪ soil pollution, polluted farm runoff and groundwater, and public health risks due to excessive application of fertilizers and pesticides?	√		Contamination to ground water and soil are anticipated due to excessive application of fertilizers and pesticides. Measures for safe handling, storage and usage of fertilizers and pesticides will be followed.
▪ soil erosion (furrow, surface)?		√	Construction work during monsoon shall be carried out with due care so that silt run off due to construction operation is prevented. No construction will be allowed during rains.
▪ scouring of canals?		√	Regular maintenance activities such as removal of sediments and clogging will be involved.
▪ logging of canals by sediments?		√	Construction work during monsoon shall be carried out with due care so that silt run off due to construction operation is prevented. No construction will be allowed during rains.
▪ clogging of canals by weeds?		√	Regular cleaning activities will be involved.

▪ seawater intrusion into downstream freshwater systems?	√	Not Applicable
▪ introduction of increase in incidence of waterborne or water related diseases?	√	No such probable incidence is anticipated.
▪ dangers to a safe and healthy working environment due to physical, chemical and biological hazards during project construction and operation?	√	Occupational health and safety issues will not be significant. These will be managed through EMPs per subproject and environmental clauses in the construction contract.
▪ social conflicts if workers from other regions or countries are hired?	√	Not anticipated.
▪ large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?	√	Local labor is to be recruited as much as possible.
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?	√	The proposed project is unlikely to result in significant risks. Specific provision in the contracts together with monitoring of EMP implementation will ensure minimizing such risks.
▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project (e.g., irrigation dams) are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?	√	The proposed project is unlikely to result in significant risks. Specific provision in the contracts together with monitoring of EMP implementation will ensure minimizing such risks.

Water Shortage Calculation

Sr. No.	Cluster Name	Source of Water	Catchment Area (km ²)	Proposed Irrigation Area (ha)	Minimum Excess / Maximum Shortage Vol (mm ³)	Month of Occurrence
1	Chhiber	Chhiber Nallah	4.62	16.99	-0.0102	Dec
2	Dehra	Seer Khad	208.71	38.47	-0.0236	Oct
3	Nalti Parnal		226.94	8.77	-0.0053	Nov
4	Talwara		307.70	18.17	-0.0034	Nov
5	Chharal		311.00	19.29	-0.0132	Nov
6	Bhapral		315.37	7.11	-0.0169	Nov
7	Lajanta		316.68	19.02	-0.0292	Nov
8	Kasol		331.76	35.56	-0.0468	Nov
9	Bhadrog		381.30	8.88	-0.0490	Dec
10	Massour / Maloh	Massour Nallah	1.57	6.57	-0.0040	Dec
11	Sandhihar	Soyed Nallah	8.67	18.97	-0.0115	Dec
12	Mehri Kathla	Bakrauli Khad	23.66	14.46	-0.0083	Dec
13	LIS Percolation Well – Jarad Khad	Percolation well on Jarad Khad	12.00	62.32	-0.0365	Dec
14	Kothlu	Ali Khad	144.65	14.23	0.0255	Dec
15	Karot		159.44	21.90	0.0111	Dec

For Package # 06 – Bilaspur District - PACKAGE-06 (CWJ/IRG/BLS-02) of BILASPUR DISTRICT

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Crop	Water Demand (cu. m. per day)
Jhandutta	Balh Sinha	32.14	LIS from JICA check dam	JICA dam	Litchi	642.80
	Kosarian-I	30.03	New scheme Perennial Nala	Kosari Nall	Citrus	600.60
	Lehar	24.51	New scheme Perennial Nala	Neri Dam	Guava	490.20
	Tikari Kotlu	22.94	New scheme Perennial Nala	Seer khad	Guava	458.80
	Fagog	22.28	LIS Seerkhad	JICA dam	Citrus	445.60
	Fagog Banjholi	11.77	Sukar Khad	JICA dam	Citrus	235.40
	Jhandu	15.35	Defunct Scheme of MHWDP Perennial Nala	JICA dam	Guava	307.00
	Tihri	29.15	LIS Tihri	LIS Tihri	Pomegranate	583.00
Swarghat	Bassi	12.44	LIS Changer	BBMB Canal	Citrus	248.80
	Dulhet 3	29.62	LIS Changer	BBMB Canal	Citrus	592.40
	Ghattewal	28.26	LIS Changer	BBMB Canal	Citrus	565.20

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Siting			The proposed project sites/clusters are located under Swarghat and Jhandutta blocks in Bilaspur district in Himachal Pradesh. The Naina Devi Wildlife Sanctuaries is located in the Swarghat tehsil of Bilaspur District. It extends over 17.1sq. km, in two Parts I, II, as it is at the valley side of Naina Devi Mountain range. The project villages in the Swarghat Block are in the buffer zone of the conservation reserve and are excluded from the conservation area. (refer - https://hpforest.nic.in/files/SriNainaDeviConservationReserve_A1b_1.pdf) The conservation reserve is covered by northern dry mixed deciduous forest. The commonly found animals in the sanctuary include langur, leopard, jungle cat, Bengal fox, Indian hare, yellow-throated marten, cobra and common giant flying squirrel.
Is the Project area adjacent to or within any of the following environmentally sensitive areas?			
▪ Protected Area	√		
▪ Wetland		√	
▪ Mangrove		√	
▪ Estuarine		√	
▪ Buffer zone of protected area	√		
▪ Special area for protecting biodiversity		√	
B. Potential Environmental Impacts			
Will the Project cause...			
▪ loss of precious ecological values (e.g. result of encroachment into forests/swamplands or historical/cultural buildings/areas, disruption of hydrology of natural waterways, regional flooding, and drainage hazards)?		√	There are 3 functional (existing), 4 non-functional (defunct) and 4 new irrigation schemes that will be developed. There are few existing irrigation schemes such as LIS Changer in the Swarghat block (water extracted from Anand Sahib Hydrel channel), LIS Tihri and JICA Dam. The rest of the new schemes are planned from other few local Nallah or Khud. The construction of a small-scale LIS scheme will not cause any disruption of hydrology/ local flooding/ drainage hazards. While the three clusters namely, Ghattewal, Bassi, and Dulhet (Dhalet) are located at the periphery of the Naina Devi Conservation Reserve, no major construction activities will be carried out in these clusters as LIS Changer is an existing scheme. Only Separate gravity main is being proposed from the existing Zone 1B and Zone 2B tanks to connect the proposed cluster tanks of Ghattewal, Bassi and Dulhet 3. Since the intake well is on the other side of the valley of the conservation reserve, the ecology of the reserve will not get disturbed.

▪ conflicts in water supply rights and related social conflicts?		√	The proposed project will not create any water rights related social conflict. Farmers and water users will be organized and trained.
▪ impediments to movements of people and animals?	√		Temporary disruption of the movement of people and animals is anticipated during the construction phase only. Appropriate work scheduling and temporary access arrangements will be discussed and agreed upon with local communities during the construction phase.
▪ potential ecological problems due to increased soil erosion and siltation, leading to decreased stream capacity?		√	The intake is on the man-made channel and is dredged periodically.
▪ Insufficient drainage leading to salinity intrusion?		√	Not anticipated.
▪ Over-pumping of groundwater, leading to salinization and ground subsidence?		√	No groundwater abstraction.
▪ Impairment of downstream water quality and therefore, impairment of downstream beneficial uses of water?		√	Consultation has been conducted with downstream water users. No such potential impact is anticipated.
▪ Dislocation or involuntary resettlement of people?		√	The project will not cause any displacement of people.
▪ Disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		√	Not anticipated.
▪ potential social conflicts arising from land tenure and land use issues?		√	No private land will be involved for the project purpose.
▪ soil erosion before compaction and lining of canals?	√		Protection of embankment will be included in the design option to avoid soil erosion. Measures such as temporary silt trap, stoking of soil away from water course etc will be adopted during the construction phase.
▪ noise from construction equipment?	√		Temporary increase in noise level is anticipated during construction phase only. All the construction machineries employed will comply with noise emission standards of Central Pollution Control Board (CPCB). Consultation will be held with local communities for work scheduling at sensitive areas (school, health centers etc).
▪ dust during construction?	√		Temporary increase in dust generation is anticipated during construction phase due to movement of vehicles, hauling of materials and earth. Dust suppression measures such as water sprinkling, covering all trucks/ dumpers carrying dispersible etc. will be employed.
▪ labor-related social problems especially if workers from different areas are hired?		√	No such social conflict is anticipated as maximum number of local labors will be employed during construction phase only. Only few outside skilled labors will be temporarily deployed for specific job.
▪ waterlogging and soil salinization due to inadequate drainage and farm management?		√	The clusters are located on natural slope, no waterlogging is anticipated during farming. Natural drainage pattern will not be altered.
▪ leaching of soil nutrients and changes in soil characteristics due to excessive application of irrigation water?	√		Measures such as training of farmers for rational usage of water resource will be ensure during implementation.
▪ reduction of downstream water supply during peak seasons?		√	The source of water are perennial, having much higher water flow throughout the year. Therefore, reduction of downstream water supply is not anticipated during peak summer season.
▪ soil pollution, polluted farm runoff and groundwater, and public health risks due to excessive application of fertilizers and pesticides?	√		Contamination to ground water and soil are anticipated due to excessive application of fertilizers and pesticides. Measures for safe handling, storage and usage of fertilizers and pesticides will be followed.

▪ soil erosion (furrow, surface)?		√	Construction work during monsoon shall be carried out with due care so that silt run off due to construction operation is prevented. No construction will be allowed during rains.
▪ scouring of canals?		√	Regular maintenance activities such as removal of sediments and clogging will be involved.
▪ logging of canals by sediments?		√	Construction work during monsoon shall be carried out with due care so that silt run off due to construction operation is prevented. No construction will be allowed during rains.
▪ clogging of canals by weeds?		√	Regular cleaning activities will be involved.
▪ seawater intrusion into downstream freshwater systems?		√	Not Applicable
▪ introduction of increase in incidence of waterborne or water related diseases?		√	No such probable incidence is anticipated.
▪ dangers to a safe and healthy working environment due to physical, chemical and biological hazards during project construction and operation?	√		Occupational health and safety issues will not be significant. These will be managed through EMPs per subproject and environmental clauses in the construction contract.
▪ social conflicts if workers from other regions or countries are hired?		√	Not anticipated.
▪ large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		√	Local labor is to be recruited as much as possible.
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?	√		The proposed project is unlikely to result in significant risks. Specific provision in the contracts together with monitoring of EMP implementation will ensure minimizing such risks.
▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project (e.g., irrigation dams) are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		√	The proposed project is unlikely to result in significant risks. Specific provision in the contracts together with monitoring of EMP implementation will ensure minimizing such risks.

For Package # 07 – Mandi District - PACKAGE-07 (CWJ/IRG/MANDI-01) of MANDI DISTRICT

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Crop	Water Demand (cu. m. per day)
Chauntara	Golwan	17.19	LIS Golwan	Ropdi Khad	Guava	343.80
	Kothi – I (Balh)	9.3	LIS from TW 1	Tubewell	Guava	186.00
	Kothi - II	8.3	LIS from TW 2	Tubewell	Citrus	166.00
	Dhelu (Dhog)	9.97	LIS Dhelu	Tubewell	Guava	199.40
	Dol	33.29	LIS from TW 3	Tubewell	Litchi	665.80
	Khadiyal	23.24	LIS from TW 4	Tubewell	Litchi	464.80
Gopalpur	Sulpur	7.5	LIS Sulpur Bahi	Percolation well, Seer Khad	Pomegranate	150.00
	Dhar	10.16	LIS Basantpur	Beas River	Guava	203.20
	Barchwar	10.82		River Beas	Guava	216.40
	Ghadhyani	7.24		River Beas	Guava	144.80
	Kharoh (Kalerka)	17.11		Beas River	Guava	342.20
	Bhadarwar Khobla	9.02	LIS Bhadharwaar, Bhudroli Khad	Rissa Khad	Guava	180.40
	Bahi	8.71	LIS Percolation-Seer Khad	Percolation well, Seer Khad	Guava	174.20
	Bhambhla-I	14.15	LIS from Seer Khad	Seer Khad	Citrus	283.00
	Thouna/Dhalait	8.18	FIS Thouna Kuhal	Local Nallah	Guava	163.60
	Rasher	10.95	LIS Son Khadd	Son Khad	Citrus	219.00
	Batail 2	9.13	LIS from TW 5	Tubewell	Citrus	182.60
	Batal 1	19.7			Plum	394.00
	Bag-chuhku	12.86	LIS from TW 6	Tubewell	Citrus	257.20
	Mataur Tanda	13.05	LIS Infiltration-Seer Khad	Seer Khad	Pomegranate	261.00
Dharampur	Richhli	12.81	LIS Bari Marhi Dhwali	Beas River	Citrus	256.20
	Mannu Dhar (Joh)	13.68			Citrus	273.60
	Haryanal	12.55			Guava	251.00
	Satrehar	12.52			Citrus	250.40
	Ghanswai	8.3			Guava	166.00
	Aarli Paryal	9.87			Citrus	197.40
	Richhali / Dhwali	5.75			Guava	115.00
	Tarohla	8			Guava	160.00
	Taroon	9.26			Citrus	185.20
	Chhapanu	8.38			Citrus	167.60
	Banwaar Kalaan	13.16			Citrus	263.20
	Dhardi-1	2.67			Citrus	53.40
	Baratpur	7.49			Citrus	149.80
	Balhara 1	1.46			Citrus	29.20
	Balhara 2	2.45			Citrus	49.00
	Dhardi 2	3.55			Citrus	71.00
	Lalana	4.27			Citrus	85.40
	Parli Paryal	1.7			Citrus	34.00
	Sakran Dhar	5.36			Citrus	107.20
	Sherpur	1.24			Guava	24.80
	Chakyana	3.72			Citrus	74.40
	Chunighat	14.14			Citrus	282.80
	Gorat	12.25			Citrus	245.00
	Pakhdol	4.39			Citrus	87.80
	Tourjajar	9.74	LIS Baroti-Mandap-Joddan	Beas River	Citrus	194.80
	Galoo (Chanouta)	6.19			Citrus	123.80
	Siram(Sarskan)	7.05			Citrus	141.00
	Trembala	6.06			Citrus	121.20

	Hiun	3.96			Citrus	79.20
	Kumarhda 2	10.22			Plum	204.40
	Didnu	5.2			Citrus	104.00
	Banerti-2	10.44			Plum	208.80
	Pehad-2	10.04			Plum	200.80
	Chhater	10.86			Guava	217.20
	Drumman	30.76			Citrus	615.20
	Kumahrda	13.84			Plum	276.80
	Giun	27.8			Citrus	556.00
	Cheh	8.67			Guava	173.40
	Bahn	5.63			Citrus	112.60
	Chatroun (Lower)	11.26	LIS Kothua Dhallara	Beas River	Guava	225.20
	Dhalara 1	9.35			Citrus	187.00
	Dhalara 2	8.7			Citrus	174.00
	Lower Balh	6.24			Citrus	124.80
	Single Kuhat	3.7			Citrus	74.00
	Kanohi	1.32	LIS Sandhole	Beas River	Guava	26.40
	Lahsani	1.35			Guava	27.00
	Churu ra Balh	20.88	LIS Churu Balh	Nald Khad	Citrus	417.60
	Seoh II	27.49		Beas River	Citrus	549.80
	Seoh (Balh) Nichla Ropa	18.74	LIS Seoh	Beas River	Citrus	374.80
	Lower (Nichali) Bairi	9.13	LIS Bairi	Beas River	Citrus	182.60
	Upper Bairi	23.98			Citrus	479.60
	Barota	4.37	LIS Brang	Soan Khad	Guava	87.40
	Manyoh- Lambri	20.14			Guava	402.80
	Thanna (Ropari)	8.18			Citrus	163.60
	Patti (Kot)	6.9			Guava	138.00
	Darwaar	9.27			Guava	185.40
	Digho-Baglana (Karyal)	7.28	LIS Tihra	Beas River	Guava	145.60
	Skohta	1.82			Citrus	36.40
	Khajurti	5.76			Guava	115.20
	Bandal	10.71			Guava	214.20
	Chandpur	11.98			Citrus	239.60
	Tikri	14.51			Plum	290.20
	Dyol	5.59			Litchi	111.80

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Siting			The proposed sub-project sites/ clusters are located under Chauntara, Gopalpur and Dharampur blocks in Mandi district in Himachal Pradesh.
Is the Project area adjacent to or within any of the following environmentally sensitive areas?			
▪ Protected Area		√	Bandli wildlife sanctuary is located in the Sundernagar block in Mandi district. Nargu wildlife sanctuary lies on the east side of the Uhl River in Mandi district and lies majorly in the Kullu district. Shikari Devi wildlife sanctuary is located near the Karsog valley in Mandi district.
▪ Wetland		√	
▪ Mangrove		√	
▪ Estuarine		√	All the sanctuaries are at a location of more than 30 km from the Project sites in the above blocks. Hence, the Project sites are not adjacent to or within any environmentally sensitive area.
▪ Buffer zone of protected area		√	
▪ Special area for protecting biodiversity		√	
B. Potential Environmental Impacts			
Will the Project cause...			
▪ loss of precious ecological values (e.g., result of encroachment into forests/swamplands or		√	Under this package, there are 56 functional (existing), 3 non-functional (defunct) and 24 new irrigation schemes

historical/cultural buildings/areas, disruption of hydrology of natural waterways, regional flooding, and drainage hazards)?			that will be developed. For the clusters in Chauntara block, no major civil work is proposed as the sources of majority of the clusters are existing borewells. For the clusters in Gopalpur block, a check dam of height 3 m is proposed across Rissa khad for the clusters Bhadarwar Khobla (functional) and Rasher (new). Also, for the clusters Bhamla-1, Batail 2, Bag-Chuhku, Matour Tanda and Sulpur, 4 Infiltration Galleries are recommended across Seer Khad. For cluster Bahi, a subsurface dyke cum check dam of height 1 to 2 m is recommended. The proposed construction can cause disruption of the hydrology of natural waterways and disruption to the bed of the stream at the project site. For the clusters in Dharampur block, majority of them have their source from river Beas. The river Beas is perennial and presently has sufficient discharge.
conflicts in water supply rights and related social conflicts?		√	The adequacy of water source has been tested for two types of proposed sources, viz. water supplied from Khads and water supplied from river Beas. The estimation of adequacy of yield from Khads has been done for 10 clusters and maximum shortage has been observed in October for Golwan, Bahi and Bhamla I clusters. The maximum shortage of 0.0080 Mm³ is noticed for Bhamla I cluster, while minimum shortage of 0.0028 Mm³ is noticed for Bahi cluster. It is expected that there will be no conflict in water supply rights and related social conflicts due to project activities. Additionally, the CHPMA and WUA members will be adequately trained to be able to manage water in a sustainable manner.
impediments to movements of people and animals?	√		Temporary disruption of the movement of people and animals is anticipated during the construction phase only. Appropriate work scheduling and temporary access arrangements will be discussed and agreed upon with local communities during the construction phase.
potential ecological problems due to increased soil erosion and siltation, leading to decreased stream capacity?		√	Not anticipated
Insufficient drainage leading to salinity intrusion?		√	Not anticipated.
Over-pumping of groundwater, leading to salinization and ground subsidence?		√	In Chauntara block, 5 clusters have their source based on groundwater (borewells). The hydrogeological survey for these borewells has been conducted by JSV. Since the CCA area of the clusters is minimal, there will not be over-pumping of groundwater. In Gopalpur block, the source of 5 clusters is Seer khad, of which Sulpur cluster has its source from a functional scheme. For the other 4 clusters, Infiltration Galleries are proposed across the Seer khad since the hydrogeological setup is not conducive for construction of tubewells. No tubewells are proposed for Dharampur block.
Impairment of downstream water quality and therefore, impairment of downstream beneficial uses of water?		√	The net yield has been estimated after deducting upstream and downstream demands from monthly yield values. Additionally, CHPMA and WUA members will be trained to maintain downstream flow and sustainably manage available water.
Dislocation or involuntary resettlement of people?		√	The project will not cause any displacement of people.
potential social conflicts arising from land tenure and land use issues?		√	No private land will be involved for the project purpose.

▪ soil erosion before compaction and lining of canals?	√		Protection of embankment will be included in the design option to avoid soil erosion. Measures such as temporary silt rap, stoking of soil away from water course, etc. will be adopted during the construction phase.
▪ noise from construction equipment?	√		Temporary increase in noise level is anticipated during construction phase only. All the construction machineries employed will comply with noise emission standards of Central Pollution Control Board (CPCB). Consultation will be held with local communities for work scheduling at sensitive areas (school, health centers, etc.).
▪ dust?	√		Temporary increase in dust generation is anticipated during construction phase due to movement of vehicles, hauling of materials and earth. Dust suppression measures such as water sprinkling, covering all trucks/ dumpers carrying dispersible, etc. will be employed.
▪ labor-related social problems especially if workers from different areas are hired?		√	No such social conflict is anticipated as maximum number of local labors will be employed during construction phase only. Only few outside skilled labors will be temporarily deployed for specific job.
▪ waterlogging and soil salinization due to inadequate drainage and farm management?		√	The clusters are located on natural slope, no waterlogging is anticipated during farming. Natural drainage pattern will not be altered.
▪ leaching of soil nutrients and changes in soil characteristics due to excessive application of irrigation water?	√		Measures such as training of farmers for rational usage of water resource will be ensured during implementation.
▪ reduction of downstream water supply during peak seasons?		√	A detailed hydrological study has been carried out considering the catchment area, historical rainfall data, population growth and water demand in the area and discharge data. Downstream demands have been accounted for while calculating the net yield. It is concluded that during the peak demand period, most of the sites are likely to face shortages. Thus, CHPMA and WUA members will be trained to maintain downstream flow and sustainably manage available water.
▪ soil pollution, polluted farm runoff and groundwater, and public health risks due to excessive application of fertilizers and pesticides?	√		Contamination to ground water and soil are anticipated due to excessive application of fertilizers and pesticides. Measures for safe handling, storage and usage of fertilizers and pesticides will be followed.
▪ soil erosion (furrow, surface)?		√	Construction work during monsoon shall be carried out with due care so that silt run off due to construction operation is prevented. No construction will be allowed during rains.
▪ scouring of canals?		√	Regular maintenance activities such as removal of sediments and clogging will be involved.
▪ logging of canals by sediments?		√	Construction work during monsoon shall be carried out with due care so that silt run off due to construction operation is prevented. No construction will be allowed during rains.
▪ clogging of canals by weeds?		√	Regular cleaning activities will be involved.
▪ seawater intrusion into downstream freshwater systems?		√	Not Applicable
▪ introduction of increase in incidence of waterborne or water related diseases?		√	No such probable incidence is anticipated.
▪ dangers to a safe and healthy working environment due to physical, chemical and biological hazards during project construction and operation?		√	Occupational health and safety issues will not be significant. These will be managed through EMPs per subproject and environmental clauses in the construction contract.
▪ social conflicts if workers from other regions or countries are hired?		√	Not anticipated.

▪ large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		√	Local labor is to be recruited as much as possible.
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?		√	The proposed project is unlikely to result in significant risks. Specific provision in the contracts together with monitoring of EMP implementation will ensure minimizing such risks.
▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project (e.g., irrigation dams) are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		√	The proposed project is unlikely to result in significant risks. Specific provision in the contracts together with monitoring of EMP implementation will ensure minimizing such risks.

Water Shortage Calculation

Sr. No.	Cluster Name	Source Name	Catchment Area (km ²)	Proposed Irrigation Area (ha)	Minimum Excess / Maximum Shortage Vol (Mm ³)	Month of Occurrence
1	Golwan	Ropdi Khad	3.08	17.19	-0.0038	Oct
2	Sulpur	Percolation well, Seer Khad	93.91	7.50	0.0055	Oct
3	Bhadarwar Khobla	Rissa Khad	30.74	12.92	0.0075	Oct
4	Bahi	Percolation well, Seer Khad	24.60	8.71	-0.0028	Oct
5	Bhambhla - I	Seer Khad	3.08	14.15	-0.0080	Jan
6	Thouna / Dhalait	Local Nallah	22.90	8.18	0.0058	Nov
7	Rasher	Son Khad	28.74	10.95	0.0077	Oct
8	Mataur Tanda	Seer Khad	200.87	13.05	0.0171	Oct
9	Barota	Son Khad	135.84	4.37	0.0046	Oct
10	Churu ka Balh	Nald Khad		20.88		

For Package # 08 – Mandi District - PACKAGE-08 (CWJ/IRG/MANDI-02) of MANDI DISTRICT

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Crop	Water Demand (cu. m. per day)
Drang	Baragaon – I & II	14.32	LIS Baragaon	Baragaon nalla	Guava	286.40
Gohar/Balh	Dharwahan-II (Sehal)	17.39	New LIS 10 Behl-Ksarla	BSL Canal	Guava	347.80
	Sawla	17.46	IPH Chamber	IPH Chamber	Persimmon	349.20
	Bagga Chalog	8.63	New LIS – Bagga Chalog	Jiuni Khad	Plum	172.60
	Latogali I	26.97	New LIS – Kuklah to Latogali	Bakhli Khad	Persimmon	539.40
	Brikhmani	16.76	FIS Anu Darbehead	Brikhmani Nalla	Plum	335.20
	Darvehad	12.33	LIS Zone no. 5 Balbehli	BSL Canal	Plum	246.60
	Manjhog Dhaniut	9.66	FIS Majhog Dhanyot	Dhaniut nalla	Plum	193.20
	Manjhagan Chudara	28.56	LIS – Manjhagan Chudara	Jiuni Khad	Plum	571.20
Sadar	Dhaniyara	17.85	LIS Dhanyara	Arnodi Khad	Litchi	357.00
	Binol	7.21	LIS Binol Neeyul	Beas River	Citrus	144.20
Sundernagar	Palhota	17.11	Functional Lift Irrigation Scheme, Nehra, Palhota (Kansa Khad)	Kansa Khad	Citrus	342.20
	Kuthain	15.45	Piped Irrigation Scheme Chirdi Boudhal Dhar	Kansa Khad	Citrus	309.00
	Bhantraed	11.85	Functional Lift Irrigation Scheme, Bhantraed (Bhantraed Khad)	Bhantraed Khad	Citrus	237.00
	Khagron	10.15	New LIS from Kiyargi Nallah	Kiyargi Nalla source	Plum	203.00

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Siting			The proposed sub-project sites/ clusters are located under Drang, Gohar/Balh, Sadar, and Sundernagar blocks in Mandi district in Himachal Pradesh. Bandli wildlife sanctuary is located in the Sundernagar block in Mandi district. Nargu wildlife sanctuary lies on the east side of the Uhl River in Mandi district and lies majorly in the Kullu district. Shikari Devi wildlife sanctuary is located near the Karsog valley in Mandi district. The clusters in Sundernagar block are located at a distance of about 15 km from Bandli wildlife sanctuary, while those in Sadar block are located at a distance of about 30 km from the sanctuary. Thus, these Project sites lie in the buffer zone of the protected area. All other Project sites are not adjacent to or within any environmentally sensitive area.
Is the Project area adjacent to or within any of the following environmentally sensitive areas?			
▪ Protected Area		√	
▪ Wetland		√	
▪ Mangrove		√	
▪ Estuarine		√	
▪ Buffer zone of protected area	√		
▪ Special area for protecting biodiversity		√	
B. Potential Environmental Impacts			
Will the Project cause...			

loss of precious ecological values (e.g., result of encroachment into forests/swamplands or historical/cultural buildings/areas, disruption of hydrology of natural waterways, regional flooding, and drainage hazards)?		√	Under this package, there are 13 functional (existing) and 2 new irrigation schemes that will be developed. For the functional irrigation schemes, no major civil work is proposed. For the new schemes, the proposed construction can cause disruption of the hydrology of natural waterways and disruption to the bed of the stream at the project site.
conflicts in water supply rights and related social conflicts?		√	The adequacy of water source has been tested for two types of proposed sources, viz. water supplied from Khads and water supplied from river Beas. Maximum shortage/excess is noticed majorly in the months of October to December, followed by February. Except for Baragaon, Latogali and Khargaon clusters, the rest have shortages. The maximum shortage of 0.0119 mm³ is noticed for Palhota cluster, while minimum shortage of 0.0008 mm³ is noticed for Manjhagan Chudara cluster. Storage structures with capacity ranging from 0.0180 to 0.0012 mm³ are proposed to make these clusters workable with water available in proposed source. It is expected that there will be no conflict in water supply rights and related social conflicts due to project activities. Additionally, the CHPMA and WUA members will be adequately trained to be able to manage water in a sustainable manner.
impediments to movements of people and animals?	√		Temporary disruption of the movement of people and animals is anticipated during the construction phase only. Appropriate work scheduling and temporary access arrangements will be discussed and agreed upon with local communities during the construction phase.
potential ecological problems due to increased soil erosion and siltation, leading to decreased stream capacity?		√	Not anticipated
Insufficient drainage leading to salinity intrusion?		√	Not anticipated.
Over-pumping of groundwater, leading to salinization and ground subsidence?		√	Since all the clusters in the 4 blocks of Mandi district use surface water from khad / nallah / river / canal, no over-pumping of groundwater is anticipated.
Impairment of downstream water quality and therefore, impairment of downstream beneficial uses of water?		√	The net yield has been estimated after deducting upstream and downstream demands from monthly yield values. Additionally, CHPMA and WUA members will be trained to maintain downstream flow and sustainably manage available water.
Dislocation or involuntary resettlement of people?		√	The project will not cause any displacement of people.
potential social conflicts arising from land tenure and land use issues?		√	No private land will be involved for the project purpose.
soil erosion before compaction and lining of canals?	√		Protection of embankment will be included in the design option to avoid soil erosion. Measures such as temporary silt rap, stoking of soil away from water course, etc. will be adopted during the construction phase.
noise from construction equipment?	√		Temporary increase in noise level is anticipated during construction phase only. All the construction machineries employed will comply with noise emission standards of Central Pollution Control Board (CPCB). Consultation will be held with local communities for work scheduling at sensitive areas (school, health centers, etc.).

▪ dust?	√		Temporary increase in dust generation is anticipated during construction phase due to movement of vehicles, hauling of materials and earth. Dust suppression measures such as water sprinkling, covering all trucks/ dumpers carrying dispersible, etc. will be employed.
▪ labor-related social problems especially if workers from different areas are hired?		√	No such social conflict is anticipated as maximum number of local labors will be employed during construction phase only. Only few outside skilled labors will be temporarily deployed for specific job.
▪ waterlogging and soil salinization due to inadequate drainage and farm management?		√	The clusters are located on natural slope, no waterlogging is anticipated during farming. Natural drainage pattern will not be altered.
▪ leaching of soil nutrients and changes in soil characteristics due to excessive application of irrigation water?	√		Measures such as training of farmers for rational usage of water resource will be ensured during implementation.
▪ reduction of downstream water supply during peak seasons?		√	A detailed hydrological study has been carried out considering the catchment area, historical rainfall data, population growth and water demand in the area and discharge data. Downstream demands have been accounted for while calculating the net yield. It is concluded that during the peak demand period, most of the sites are likely to face shortages. Thus, CHPMA and WUA members will be trained to maintain downstream flow and sustainably manage available water.
▪ soil pollution, polluted farm runoff and groundwater, and public health risks due to excessive application of fertilizers and pesticides?	√		Contamination to ground water and soil are anticipated due to excessive application of fertilizers and pesticides. Measures for safe handling, storage and usage of fertilizers and pesticides will be followed.
▪ soil erosion (furrow, surface)?		√	Construction work during monsoon shall be carried out with due care so that silt run off due to construction operation is prevented. No construction will be allowed during rains.
▪ scouring of canals?		√	Regular maintenance activities such as removal of sediments and clogging will be involved.
▪ logging of canals by sediments?		√	Construction work during monsoon shall be carried out with due care so that silt run off due to construction operation is prevented. No construction will be allowed during rains.
▪ clogging of canals by weeds?		√	Regular cleaning activities will be involved.
▪ seawater intrusion into downstream freshwater systems?		√	Not Applicable
▪ introduction of increase in incidence of waterborne or water related diseases?		√	No such probable incidence is anticipated.
▪ dangers to a safe and healthy working environment due to physical, chemical and biological hazards during project construction and operation?		√	Occupational health and safety issues will not be significant. These will be managed through EMPs per subproject and environmental clauses in the construction contract.
▪ social conflicts if workers from other regions or countries are hired?		√	Not anticipated.
▪ large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		√	Local labor is to be recruited as much as possible.
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?		√	The proposed project is unlikely to result in significant risks. Specific provision in the contracts together with monitoring of EMP implementation will ensure minimizing such risks.

community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project (e.g., irrigation dams) are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		√	The proposed project is unlikely to result in significant risks. Specific provision in the contracts together with monitoring of EMP implementation will ensure minimizing such risks.

Water Shortage Calculation

Sr. No.	Cluster Name	Source Name	Catchment Area (km ²)	Proposed Irrigation Area (ha)	Minimum Excess / Maximum Shortage Vol (Mm ³)	Month of Occurrence
1	Baragaon – I & II	Baragaon nalla	28.128	14.32	0.00254	
2	Dharwahan-II (Sehal)	BSL Canal		17.39	NA	NA
3	Sawla	IPH Chamber	190.466	17.46	-0.0106	October
4	Bagga Chalog	Jiuni Khad	13.329	8.63	-0.0038	December
5	Latogali I	Bakhli Khad	266.201	26.97	0.0060	
6	Brikhmani	Brikhmani Nalla	4.080	16.76	-0.0098	December
7	Darvehad	BSL Canal		12.33	NA	NA
8	Manjhog Dhaniut	Dhaniut nalla	8.522	9.66	-0.0032	February
9	Manjhagan Chudara	Jiuni Khad	178.180	28.56	-0.0008	December
10	Dhaniyara	Arnodi Khad	14.697	17.85	-0.0105	October
11	Binol	Beas River		7.21	NA	NA
12	Palhota	Kansa Khad	42.073	17.11	-0.0119	February
13	Kuthain	Kansa Khad	35.085	15.45	-0.0025	February
14	Bhantraed	Bhantred Khad	36.308	11.85	-0.0030	October
15	Khagron	Kiyargi Nalla source	14.517	10.15	0.0077	

For Package # 09 – Kangra District - PACKAGE-09 (CWJ/IRG/KNG-01) of KANGRA DISTRICT

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Crop	Water Demand (cu. m. per day)
Bajjnath	Langhu – 1	6.20	LIS on Binwa Khad	Binwa Khad	Guava	124.00
	Langhu – 2	7.25			Guava	145.00
	Upper Bhet	8.42			Guava	168.40
	Manghota	6.00	LIS Manghota Cluster	Binwa Khad	Guava	120.00
	Kudail	16.61	LIS Kudail Cluster	Dea Nallah	Guava	332.20
	Utrala	4.85	Binwa River / Tundal Kholi Nala	Binwa River / Tundal Kholi Nala	Pecan nut	97.00
Bhawarna	Thandol – 1	16.95	LIS Thandol Cluster	Mol Khad	Guava	339.00
	Ghar	8.21	LIS Ghar Cluster	Mand Khad	Citrus	164.20
	Malahu II	8.46	LIS on Mol Khad	Mol Khad	Litchi	169.20
	Malahu I	5.29			Citrus	105.80
	Sidhpur	30.09	LIS Sidhpur Cluster	Nugal Khad	Citrus	601.80
	Chartkhola	18.67	LIS on Tahl Khad	Tahl Khad	Citrus	373.40
	Ludhran 1 & 2	15.09	LIS on Tahl Khad	Tahl Khad	Litchi	301.80
Lambagaon	Maldoan	10.59	Existing Functional LIS Alampur Extension	Nugal Khad	Citrus	211.80
	Jangal	9.15	LIS Alampur Extension	Nugal Khad	Citrus	183.00
	Odri	8.76	LIS Bandhui Extension	Mol Khad	Citrus	175.20
	Kotlu	4.52	LIS Bandhui Extension	Mol Khad	Citrus	90.40
	Kathla	7.59	LIS Kathla Cluster	Beas River	Citrus	151.80
	Thanpal / Chambi	8.34	LIS Thanpal / Chambi Cluster	Beas River	Citrus	166.80
Panchrukhi	Trehal	8.22	LIS Trehal Cluster	Tubewell	Guava	164.40
	Agozar	7.03	LIS Agozar Cluster	Tubewell	Citrus	140.60
	Rajhot 1	17.27	LIS Rajhot – 1 & 2 Cluster	Awah Khad	Citrus	345.40
	Ladoh 1	17.21	LIS Ladoh-1 Cluster	Tubewell	Litchi	344.20
	Ladoh 2	5.53	LIS Ladoh-2 Cluster	Alang Nallah	Litchi	110.60
	Banuri	7.73	LIS Banuri Cluster	Gharuhal Khul	Citrus	154.60
	Tatehal	3.44	LIS Tatehal Cluster	Tubewell	Citrus	68.80
	Saliana	7.33	LIS Saliana Cluster	Nai Khul	Citrus	146.60
	Molichak	6.15	LIS Molichak Cluster	Tubewell	Citrus	123.00
	Jandpur	8.54	LIS Jandpur Cluster	Tubewell	Citrus	170.80
Sullah	Dheera 1 & 2	23.47	LIS Dheera – 1 & 2 Cluster	Nugal Khad	Citrus	469.40
	Dheera 3	10.81	LIS Dheera – 3 Cluster	Nugal Khad	Citrus	216.20
	Chainchadi – Kuthera	10.19	LIS Chainchadi – Kuthera Cluster	Mand Khad	Citrus	203.80

	Purba	15.36	LIS Purba Cluster	Nugal Khad	Citrus	307.20
	Chandar	36.60	LIS Chandar Cluster	Mol Khad	Litchi	732.00
	Gagal Khas	23.47	LIS Gagal Khas Cluster	Tal Khad	Litchi	469.40

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Siting Is the Project area adjacent to or within any of the following environmentally sensitive areas?			The proposed sub-project sites/ clusters are located under Baijnath, Bhawarna, Lambagaon, Panchrukhi, and Sullah blocks in Kangra district in Himachal Pradesh.
▪ Protected Area		√	Dhauladhar wildlife sanctuary is located in the Gopalpur block in Kangra district. Pong Dam Lake wildlife sanctuary is located across Beas river, in the wetland of Shivalik hills of Kangra district.
▪ Wetland		√	
▪ Mangrove		√	The clusters covered in this package are located at a distance of more than 30 km from Dhauladhar wildlife sanctuary and more than 100 km from Pong Dam Lake wildlife sanctuary.
▪ Estuarine		√	
▪ Buffer zone of protected area		√	Thus, the Project sites are not adjacent to or within any environmentally sensitive area.
▪ Special area for protecting biodiversity		√	
B. Potential Environmental Impacts Will the Project cause...			
▪ loss of precious ecological values (e.g., result of encroachment into forests/swamplands or historical/cultural buildings/areas, disruption of hydrology of natural waterways, regional flooding, and drainage hazards)?		√	Under this package, there are 9 functional (existing) and 23 new irrigation schemes that will be developed. For the functional irrigation schemes, no major civil work is proposed. For the new schemes, the proposed construction can cause disruption of the hydrology of natural waterways and disruption to the bed of the stream at the project site.
▪ conflicts in water supply rights and related social conflicts?		√	The adequacy of water source has been tested for two types of proposed sources, viz. water supplied from Khads and water supplied from river Beas. Maximum shortage is noticed majority of times in November followed by October. Except for Manghota cluster, rest of the clusters, who have their source based on a khad, have shortage. The maximum shortage of 0.03022 mm ³ is noticed for Jangal Malodha cluster in Lambagaon block, while minimum shortage of 0.0062 mm ³ is noticed for Malahu 1 & 2 cluster in Bhawarna Block as well as Chainchadi Kuthera cluster in Sullah Block. Storage structures with capacity ranging from 0.0065 to 0.0455 mm ³ are proposed to make these clusters workable with water available in proposed source. It is expected that there will be no conflict in water supply rights and related social conflicts due to project activities. Additionally, the CHPMA and WUA members will be adequately trained to be able to manage water in a sustainable manner.

▪ impediments to movements of people and animals?	√		Temporary disruption of the movement of people and animals is anticipated during the construction phase only. Appropriate work scheduling and temporary access arrangements will be discussed and agreed upon with local communities during the construction phase.
▪ potential ecological problems due to increased soil erosion and siltation, leading to decreased stream capacity?		√	Not anticipated
▪ Insufficient drainage leading to salinity intrusion?		√	Not anticipated.
▪ Over-pumping of groundwater, leading to salinization and ground subsidence?		√	In Baijnath block, of the 6 clusters covered under New Proposed Scheme, the sources of 3 clusters are based on surface water of Binwa Khad, which is perennial in nature and assessed to be hydrologically feasible for providing irrigational schemes. The sources of remaining 3 clusters i.e., Kundail, Utrala, Upper Bhet are based on local nallahs namely Dea, Manai and Punni respectively. Of these, 2 nallahs, i.e., Manai and Punni seem to be perennial in nature as their origin is snow fed. For cluster Kundail, the source is based on Dea nallah which is not perennial in nature. The source is not feasible for providing irrigation scheme to Kundail cluster. The site is also not assessed to be hydrogeologically feasible for ground water development. In Bhawarna block, there are 6 clusters. Out of these, 4 clusters covered under new proposed scheme and 2 clusters taken under functional scheme. Out these 4 clusters (NPS), the source of 3 clusters are tubewells and one cluster named Khara have source - surface water proposed from Khara Nallah. The sources of 6 clusters, i.e., Thandol-I and Malahu I & II, Ghar, Chartkhola and Ludhran 1&2 are based on surface water of various khads namely Mol khad, Mand khad and Tahl khad respectively. Hydrological study of Mol and Mand khad is essential and recommendations of Hydrologist is mandatory. The behavior of Tahl khad near source of cluster Chartkhola and Ludhran 1&2 is ephemeral. The hydrogeological conditions assessed in the cluster area or nearby are not conducive for large scale ground water development. In Lambagaon block, the source of 2 clusters, i.e., Maldoan and Jangal with single location is based on surface water of Neugal khad, which is perennial in nature and have sufficient discharge. The source of clusters Oderi and Kotlu is not perennial near area of the clusters. Therefore, keeping in view, the behavior of Mol khad, which is tributary of Neugal khad, hydrological study of the khad is indispensable and recommendations of Hydrologist are mandatory. In Panchrukhi block, the sources of all 10 clusters are based on ground water as per field survey team. Out of 10 clusters, the sources of 8 clusters including functional scheme as intimated by the field team are assessed hydrogeologically feasible for ground water development. However, the 2 clusters i.e., Agozar and Tatehal have close proximity towards Siwalik rocks. The hydrogeological conditions on both locations are not favorable for large scale ground water development. Hence, both sites are not recommended for construction of tubewells. Therefore, for site Agozar, surface water of the local nallah, which is perennial and flowing adjoining to the proposed location of Agozar tubewell site. However, the tubewell site Tatehal may be shifted to nearby hydrogeologically favourable location. In Sullah block, the sources of 3 clusters, i.e., Dheera

			1&2, Dheer 3 and Purba are based on surface water of Neugal khad, which is perennial in nature. The sources of clusters Chainchandi Kuthera and Chandar are based on Mand khad and Mol khad respectively. Both khads are perennial in nature near the source area. The source of Gagaj Khas is based on surface water of Tal khad, which is not perennial in nature. The hydrological study of Tal khad is essential and recommendations of Hydrologist are mandatory.
▪ Impairment of downstream water quality and therefore, impairment of downstream beneficial uses of water?		√	The net yield has been estimated after deducting upstream and downstream demands from monthly yield values. Additionally, CHPMA and WUA members will be trained to maintain downstream flow and sustainably manage available water.
▪ Dislocation or involuntary resettlement of people?		√	The project will not cause any displacement of people.
▪ potential social conflicts arising from land tenure and land use issues?		√	No private land will be involved for the project purpose.
▪ soil erosion before compaction and lining of canals?	√		Protection of embankment will be included in the design option to avoid soil erosion. Measures such as temporary silt rap, stoking of soil away from water course, etc. will be adopted during the construction phase.
▪ noise from construction equipment?	√		Temporary increase in noise level is anticipated during construction phase only. All the construction machineries employed will comply with noise emission standards of Central Pollution Control Board (CPCB). Consultation will be held with local communities for work scheduling at sensitive areas (school, health centers, etc.).
▪ dust?	√		Temporary increase in dust generation is anticipated during construction phase due to movement of vehicles, hauling of materials and earth. Dust suppression measures such as water sprinkling, covering all trucks/ dumpers carrying dispersible, etc. will be employed.
▪ labor-related social problems especially if workers from different areas are hired?		√	No such social conflict is anticipated as maximum number of local labors will be employed during construction phase only. Only few outside skilled labors will be temporarily deployed for specific job.
▪ waterlogging and soil salinization due to inadequate drainage and farm management?		√	The clusters are located on natural slope, no waterlogging is anticipated during farming. Natural drainage pattern will not be altered.
▪ leaching of soil nutrients and changes in soil characteristics due to excessive application of irrigation water?	√		Measures such as training of farmers for rational usage of water resource will be ensured during implementation.
▪ reduction of downstream water supply during peak seasons?		√	A detailed hydrological study has been carried out considering the catchment area, historical rainfall data, population growth and water demand in the area and discharge data. Downstream demands have been accounted for while calculating the net yield. It is concluded that during the peak demand period, most of the sites are likely to face shortages. Thus, CHPMA and WUA members will be trained to maintain downstream flow and sustainably manage available water.
▪ soil pollution, polluted farm runoff and groundwater, and public health risks due to excessive application of fertilizers and pesticides?	√		Contamination to ground water and soil are anticipated due to excessive application of fertilizers and pesticides. Measures for safe handling, storage and usage of fertilizers and pesticides will be followed.
▪ soil erosion (furrow, surface)?		√	Construction work during monsoon shall be carried out with due care so that silt run off due to construction operation is prevented. No construction will be allowed during rains.
▪ scouring of canals?		√	Regular maintenance activities such as removal of sediments and clogging will be involved.

▪ logging of canals by sediments?		√	Construction work during monsoon shall be carried out with due care so that silt run off due to construction operation is prevented. No construction will be allowed during rains.
▪ clogging of canals by weeds?		√	Regular cleaning activities will be involved.
▪ seawater intrusion into downstream freshwater systems?		√	Not Applicable
▪ introduction of increase in incidence of waterborne or water related diseases?		√	No such probable incidence is anticipated.
▪ dangers to a safe and healthy working environment due to physical, chemical and biological hazards during project construction and operation?		√	Occupational health and safety issues will not be significant. These will be managed through EMPs per subproject and environmental clauses in the construction contract.
▪ social conflicts if workers from other regions or countries are hired?		√	Not anticipated.
▪ large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		√	Local labor is to be recruited as much as possible.
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?		√	The proposed project is unlikely to result in significant risks. Specific provision in the contracts together with monitoring of EMP implementation will ensure minimizing such risks.
▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project (e.g., irrigation dams) are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		√	The proposed project is unlikely to result in significant risks. Specific provision in the contracts together with monitoring of EMP implementation will ensure minimizing such risks.

Water Shortage Calculation

Sr. No.	Cluster Name	Source Name	Catchment Area (km ²)	Proposed Irrigation Area (ha)	Minimum Excess / Maximum Shortage Vol (Mm ³)	Month of Occurrence
1	Langhu – 1	Binwa Khad	226.957	6.20	-0.0103	Oct
2	Langhu – 2			7.25		
3	Upper Bhet			8.42		
4	Manghota	Binwa Khad	124.920	6.00	0.0264	Jun
5	Kudail	Dea Nallah	1.092	16.61	-0.0097	Oct
6	Utrala	Binwa River / Tundal Kholi Nala		4.85		
7	Thandol – 1	Mol Khad	0.096	16.95		
8	Ghar	Mand Khad	7.973	8.21	-0.0042	Nov

9	Malahu II	Mol Khad	20.947	8.46	-0.0062	Nov
10	Malahu I			5.29		
11	Sidhpur	Nugal Khad	0.362	30.09	-0.01854	Oct
12	Chartkhola	Tahl Khad	2.676	18.67	-0.0201	Oct
13	Ludhran 1 & 2	Tahl Khad		15.09		
14	Maldoan	Nugal Khad	379.541	10.59	-0.03022	Nov
15	Jangal	Nugal Khad		9.15		
16	Odri	Mol Khad	64.527	8.76	-0.0250	Nov
17	Kotlu	Mol Khad		4.52		
18	Kathla	Beas River		7.59		
19	Thanpal / Chambi	Beas River		8.34		
20	Trehal	Tubewell		8.22		
21	Agozar	Tubewell		7.03		
22	Rajhot 1	Awah Khad	45.431	17.27	-0.0128	Oct
23	Ladoh 1	Tubewell		17.21		
24	Ladoh 2	Alang Nallah	1.591	5.53	-0.0032	Nov
25	Banuri	Gharuhal Khul	0.452	7.73	-0.00468	Oct
26	Tatehal	Tubewell		3.44		
27	Saliana	Nai Khul	0.642	7.33	-0.004335	Oct
28	Molichak	Tubewell		6.15		
29	Jandpur	Tubewell		8.54		
30	Dheera 1 & 2	Nugal Khad	158.480	23.47	-0.0182	Nov
31	Dheera 3	Nugal Khad		10.81		
32	Chainchadi – Kuthera	Mand Khad	50.125	10.19	-0.0062	Nov
33	Purba	Nugal Khad	50.103	15.36	-0.0243	Nov
34	Chandar	Mol Khad	47.157	36.60	-0.0257	Nov
35	Gagal Khas	Tal Khad		23.47		

For Package # 10 – Kangra District - PACKAGE-10 (CWJ/IRG/KNG-02) of KANGRA DISTRICT

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Crop	Water Demand (cu. m. per day)
Dehra	Jakhota	226.98	New Proposed	Beas River	Citrus	4539.60
	Dhanot	205.66	New Proposed	Beas River	Citrus	4113.20
	Bhatoli Phakasian	10.88	LIS Dibber Rour (F)	Banner Khad (rivulet)	Citrus	217.60
	Bhatera Bassa	13.90	LIS Bhatera Bassa (F)	Banner Khad (rivulet)	Citrus	278.00
	Lalwada	29.85	New Proposed	Beas River	Citrus	597.00
	Chamba Khas	11.07	LIS Chamba Khas (N/F)	Beas River	Citrus	221.40
	Kuhna	11.31	New Proposed	Beas River	Citrus	226.20

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Siting Is the Project area adjacent to or within any of the following environmentally sensitive areas?			
• Protected Area		▪	25.32 km from Dhauladhar Reserve Forest
• Mangrove		▪	NA
• Estuarine		▪	NA
• Buffer zone of protected area		▪	NA
• Special area for protecting biodiversity		▪	There are only two wild-life sanctuaries in Kangra – Dhauladhar and Pong-dam Lake, and the project sites are far away from these.
B. Potential Environmental Impacts Will the Project cause...			
loss of precious ecological values (e.g., result from encroachment into forests/swamplands or historical/cultural buildings/areas, disruption of the hydrology of natural waterways, regional flooding, and drainage hazards)?	▪		About 4 new sites will be developed under this package. Thus, there is likely to be some disruption of the hydrology of natural waterways during the construction period. However, since all of them will be developed on Beas River, which is a glacial-fed perennial river, and 90% & 75% dependable flow at lean period suggest surplus availability.
conflicts in water supply rights and related social conflicts?		▪	Farmers water user communities will be organized and trained.
impediments to movements of people and animals?	▪		Some disruption of movement of people and animals is expected during construction phase. Appropriate works scheduling and temporary access arrangements will be discussed and agreed with the communities during construction phase.
potential ecological problems due to increased soil erosion and siltation, leading to decreased stream capacity?		▪	Not anticipated

Insufficient drainage leading to salinity intrusion?		▪	Not anticipated
over pumping of groundwater, leading to salinization and ground subsidence?		▪	No groundwater pumping, it's a surface irrigation project
impairment of downstream water quality and therefore, impairment of downstream beneficial uses of water?	▪		The construction work will be carried out at the bank of the river. Construction measures will be applied to avoid significant pollution of river water. Some additional turbidity may be rendered to river water. No Hazardous Waste will be used in construction. Pre-fabricated structures will be installed.
dislocation or involuntary resettlement of people?		▪	No IR is triggered in this project
disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		▪	No IP is triggered in this project
potential social conflicts arising from land tenure and land use issues?		▪	No project is beneficial to the local farmers
soil erosion before compaction and lining of canals?	▪		Soil erosion may happen during the installation of Raising Main GI pipes. No major impact is expected. Mitigation measures include: (i) diversion drains and bunds, and temporary silt traps/ponds; and (ii) stockpiling of soil in flat areas and far from drainage routes; (iii) followed by soil compaction
noise from construction equipment?	▪		No major impact is expected as there is no sensitive receptor at the construction sites Mitigation Decibel limits to be followed to the extent possible. Discussions will be held with communities to agree on schedules and duration of noisy construction activities. All construction vehicles and equipment must be well maintained. Contractors must be licensed to carry out their work.
Dust during construction?	▪		Dust pollution likely to happen during field preparation. Mitigation Adequate water sprinkling will be carried out during field preparation
labour-related social problems especially if workers from different areas are hired?	▪		Migrated labours maybe used during construction period. However, these workers commonly migrate to the State for civil and other works. Thus, project will not induce any additional migration. Mitigation EPC Contractor shall provision necessary work and stay support to such workers and engage with them to avoid any social conflicts.
waterlogging and soil salinization due to inadequate drainage and farm management?		▪	Fields will be supplied with drip irrigation facilities thus no water logging situation will arise.

leaching of soil nutrients and changes in soil characteristics due to excessive application of irrigation water?		▪	Fields will be supplied with drip irrigation facilities thus there will be no excessive application of irrigation water which may lead to leaching of soil nutrients and changes in soil characteristics
reduction of downstream water supply during peak seasons?		▪	Water demand and water budgeting has been appropriately carried out during the design of the subprojects.
soil pollution, polluted farm runoff and groundwater, and public health risks due to excessive application of fertilizers and pesticides?	▪		Fertigation will be carried out through drip irrigation system, thus there will be control over amount of fertilizer being used. Only prescribed level as per SOPs will be applied by the farmers. Further, farmers will be trained on application of organic farming and development of such value chain.
soil erosion (furrow, surface)?	▪		Adequate terracing and bed compaction will be carried out during field preparation. Additionally, intercropping will also help in avoiding soil erosion from the furrows.
scouring of canals?		▪	Not Applicable
logging of canals by sediments?		▪	Not Applicable
clogging of canals by weeds?		▪	Not Applicable
seawater intrusion into downstream freshwater systems?		▪	Not Applicable
introduction of increase in incidence of waterborne or water related diseases?		▪	
dangers to a safe and healthy working environment due to physical, chemical and biological hazards during project construction and operation?			
social conflicts if workers from other regions or countries are hired?			
large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?			
risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?			
community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project (e.g., irrigation dams) are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?			

Climate Change and Disaster Risk Questions	Yes	No	Remarks
The following questions are not for environmental categorization. They are included in this checklist to help identify potential climate and disaster risks.			
Is the Project area subject to hazards such as earthquakes, floods, landslides, tropical cyclone winds, storm surges, tsunami or volcanic eruptions and climate changes?	Yes		Irrigation facilities are subjected to flood and landslides and Horticulture fields are subjected to heavy rain and hailstorm
Could changes in temperature, precipitation, or extreme storm surges over the Project lifespan affect technical or financial sustainability (e.g., changes in rainfall patterns disrupt reliability of water supply; sea level rise creates salinity intrusion into proposed water supply source)?	Yes		Water availability in Baner Khad is likely to reduce during lean periods (month of May, Oct – Jan) – go below 75% dependable flow.
Are there any demographic or socio- economic aspects of the Project area that are already vulnerable (e.g., high incidence of marginalized populations, rural-urban migrants, illegal settlements, ethnic minorities, women or children)?		No	Project-based Poverty, Social and Gender assessment does not suggest any significant adverse impact on such a population.
Could the Project potentially increase the climate or disaster vulnerability of the surrounding area (e.g., by using water from a vulnerable source that is relied upon by many user groups, or encouraging settlement in earthquake zones)?		No	Following data components have been used for estimation of sustainable or 75% dependable yield of the source: - Hydro-meteorological data extending to recent 30 years • Observed rainfall stations near and within the cluster area • Observed discharges at the gauging stations on different khads - Evaporation data that is representative of the cluster area - Existing and future water demand along with the proposed cropping pattern to be grown in each cluster - Map showing catchment area of the khad in case water is being drawn from surface water in the respective khad. - Results of pumping test carried out to determine the yield from open well or bore well or tube well Thus, all adequate measures have been taken to ensure source sustainability.

For Package # 11 – Una District - PACKAGE-11 (CWJ/IRG/UNA-02) of UNA DISTRICT

Block Name	Cluster Name	Cluster Area (ha)	Irrigation Scheme	Source of Water	Crop	Water Demand (cu. m. per day)
Bangana	Boul – 1	19.32	LIS from RWHS Samoor	RWH	Guava	386.40
	Boul – 2	24.55	LIS from RWHS Samoor	RWH	Guava	491.00
	Dulehri Rajputa	9.11	Dulheri Rajputa and Thana Khurd	Nallah	Pomegranate	182.20
	Sanhal	13.58	LIS from RWHS Samoor	RWH	Guava	271.60
	Thana Khurd	22.24	Dulheri Rajputa and Thana Khurd	Nallah	Pomegranate	444.80
	Balh	14.02	LIS over Check dam	Check Dam	Pomegranate	280.40
	Chadoli	26.75	LIS over RWH-1	RWH	Guava	535.00
	Dumkhar	10.75	RWHS upstream of Khad	RWH	Pomegranate	215.00
	Hatli	6.38	LIS over RWH-2	RWH	Guava	127.60
	Kathoh	11.90	LIS over RWH-3	RWH	Guava	238.00
	Muchali 1 & 2	21.26	LIS over RWH	RWH	Guava	425.20
	Nalwari	36.52	RWHS upstream of Khad	RWH	Pomegranate	730.40
	Tureta	13.46	LIS over Nallah-1	Nallah	Guava	269.20
	Baral	36.26	LIS over Nallah-2	Nallah / Check dam	Guava	725.20
	Handola	11.84	LIS Handola	River Satluj	Guava	236.80
	Dobad	8.70	LIS over RWH	Check dam	Pomegranate	174.00

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Siting Is the Project area adjacent to or within any of the following environmentally sensitive areas?			The proposed sub-project sites/ clusters are located under Bangana block in the Una district in Himachal Pradesh. There are no environmentally sensitive areas nearby to project sites.
▪ Protected Area		√	
▪ Wetland		√	
▪ Mangrove		√	
▪ Estuarine		√	
▪ Buffer zone of protected area		√	
▪ Special area for protecting biodiversity		√	
B. Potential Environmental Impacts Will the Project cause...			
▪ loss of precious ecological values (e.g., the result of encroachment into forests/swamplands or historical/cultural buildings/areas, disruption of the hydrology of natural waterways, regional flooding, and drainage hazards)?		√	Under this package, there are 4 functional (existing) schemes out of which 1 is non-functional (defunct) and 10 new irrigation schemes are proposed. The existing and in working conditions are being well operated and do not require any civil work; The LIS Handola is proposed for rehabilitation as it has lived its design life of 20 years. This is over River Satluj is one of the main perennial rivers of the state and therefore no disruption of the hydrology of the natural waterway is expected. However, there could be flood hazards. Scheme over Chaplah Khad – there is an existing check dam based on which the scheme will be developed. Thus, this is not going to cause, disruption

			of the hydrology of natural waterways. For other new schemes, check dams are proposed this is likely to cause disruption of the hydrology of natural waterways and disruption to the bed of the stream at the project site. There are no ecologically sensitive features nearby.
conflicts in water supply rights and related social conflicts?	√		As per the hydrological assessment of the sources, the project sites are expected to experience water shortages during the winter months (Oct to Feb) due to a lack of rainfall during the period. The shortages have been estimated on the net availability after deducting the following environmental flows (E-flow) – - existing and future water demand on upstream and downstream riparian rights – in absence of actual data considered 80% of the flow; - water requirement for all clusters is taken as 20 m³/day/ha; - E-flow and future demand at each source were taken as 15% and 20% yield respectively of net available; There is likely to be shortage of water at all source locations in the winter months due to no rain (detail is given at the end of the assessment). However, since the calculation has considered E-flows and Future consumption as well as 80% for upstream and downstream consumption, it is expected that there will be no conflict in water supply rights and related social conflicts due to project activities. Additionally, the CHPMA and WUA members will be adequately trained to be able to manage water in a sustainable manner.
impediments to movements of people and animals?	√		Temporary disruption of the movement of people and animals is anticipated during the construction phase only. Appropriate work scheduling and temporary access arrangements will be discussed and agreed upon with local communities during the construction phase.
potential ecological problems due to increased soil erosion and siltation, leading to decreased stream capacity?		√	Not anticipated.
Insufficient drainage leading to salinity intrusion?		√	Not anticipated.
Over-pumping of groundwater, leading to salinization and ground subsidence?		√	No groundwater abstraction is proposed in this package.
impairment of downstream water quality and therefore, impairment of downstream beneficial uses of water?	√		15% of the required environmental flow will be maintained. However, during lean water flow, and to avoid such impact CHPMA and WUA members will be adequately trained to be able to manage water in a sustainable manner.
dislocation or involuntary resettlement of people?		√	The project will not cause any displacement of people.
Disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		√	Not anticipated.
potential social conflicts arising from land tenure and land use issues?		√	No private land will be involved for the project purpose.
soil erosion before compaction and lining of canals?	√		Protection of embankment has been included in the design option to avoid soil erosion. Measures such as temporary silt rap, stoking of soil away from watercourse etc. will be adopted during the construction phase.

▪ noise from construction equipment?	√		A temporary increase in noise level is anticipated during the construction phase only. All the construction machinery employed will comply with the noise standards of the Central Pollution Control Board (CPCB). Consultation will be held with local communities for work scheduling at sensitive areas (school, health centers etc).
▪ dust during construction?	√		Temporary increase in dust generation is anticipated during the construction phase due to the movement of vehicles, hauling of materials and earth. Dust suppression measures such as water sprinkling, covering all trucks/ dumpers carrying dispersible etc. will be employed.
▪ labor-related social problems especially if workers from different areas are hired?		√	No such social conflict is anticipated as maximum number of local labors will be employed during construction phase only. Only few outside skilled labors will be temporarily deployed for specific job.
▪ waterlogging and soil salinization due to inadequate drainage and farm management?		√	The clusters are located on a natural slope, no waterlogging is anticipated during farming. Natural drainage patterns will not be altered.
▪ leaching of soil nutrients and changes in soil characteristics due to excessive application of irrigation water?	√		Measures such as training farmers for rational usage of water resources will be ensured during implementation.
▪ reduction of downstream water supply during peak seasons?	√		A detailed hydrological study has been carried out considering the catchment area, historical rainfall data, population growth and water demand in the area and discharge data. A 15% environmental flow has also been considered to maintain the downstream water supply. It is concluded that during the peak demand period, most of the sites are likely to face shortages. Thus, CHPMA and WUA members will be trained to maintain downstream flow and sustainably manage available water.
▪ soil pollution, polluted farm runoff and groundwater, and public health risks due to excessive application of fertilizers and pesticides?	√		Contamination to groundwater and soil are anticipated due to excessive application of fertilizers and pesticides. Measures for safe handling, storage and usage of fertilizers and pesticides will be followed.
▪ soil erosion (furrow, surface)?		√	Construction work during monsoon shall be carried out with due care so that silt run off due to construction operation is prevented. No construction will be allowed during rains.
▪ scouring of canals?		√	Regular maintenance activities such as removal of sediments and clogging will be involved.
▪ logging of canals by sediments?		√	Construction work during monsoon shall be carried out with due care so that silt run off due to construction operation is prevented. No construction will be allowed during rains.
▪ clogging of canals by weeds?		√	Regular cleaning activities will be involved.
▪ seawater intrusion into downstream freshwater systems?		√	Not Applicable
▪ introduction of an increase in the incidence of waterborne or water-related diseases?		√	No such probable incidence is anticipated.
▪ dangers to a safe and healthy working environment due to physical, chemical and biological hazards during project construction and operation?	√		Occupational health and safety issues will not be significant. These will be managed through EMPs per subproject and environmental clauses in the construction contract.
▪ social conflicts if workers from other regions or countries are hired?	√		Migrant laborer for construction work is common in the state. The project may hire them. The contractor will be guided by the best labour laws to ensure no social conflict arises. The social specialist in the PMU and PISC team will monitor and report in this issue.

▪ large population influx during project construction and operation that causes an increased burden on social infrastructure and services (such as water supply and sanitation systems)?		√	Local labour is to be recruited as much as possible. Labour flux due to the project is not expected.
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?		√	The proposed project is unlikely to result in significant risks. The specific provision in the contracts together with monitoring of EMP implementation will ensure minimizing such risks.
▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project (e.g., irrigation dams) are accessible to members of the affected community or where their failure could result in injury to the community throughout the project construction, operation and decommissioning?		√	The irrigation schemes are far away from local settlements. The proposed project is unlikely to result in significant risks. The specific provision in the contracts together with monitoring of EMP implementation will ensure minimizing such risks.

Water Shortage Calculation

#	Cluster Name	Source	Catchment Area (km ²)	Irrigation Area (ha)	Month	Shortage Volume million m ³ (million lit)
1	Sanhal	Samoor Khad	13.00	57.45	Nov	-0.0312, (31.2)
2	Boul1					
3	Boul 2					
4	Dulheri Rajput	Dulheri Nallah	00.29	31.35	Jan	-0.0193 (19.3)
5	Thana Khurd					
6	Handola	Handola (River Satluj)	Perennial source	11.84		No shortage
7	Nalwari	Chapla Khad	1.00	74.03	Jan	-0.0453 (45.3)
8	Dumkhar					
9	Chadoli					
10	Muchali 1&2	Muchali Nallah	5.83	21.25	Nov	-0.0113 (11.3)
11	Hatli	Rit Sthrukha Khad	0.35	6.39	Nov	-0.0024 (2.4)
12	Kathoh	Kathoh Khad	8.00	11.90	Nov	-0.0051 (5.1)
13	Tureta	Kolhri Tureta Nallah-1	0.59	13.46	Jan	-0.0080 (8)
14	Balh	Balh Khad	6.19	14.03	Nov	-0.0067 (6.7)
15	Baral	Baral Nallah-2	0.92	36.27	Jan	-0.0219 (21.9)

Source: DETAILED PROJECT REPORT ON IRRIGATION SYSTEM DESIGN FOR PACKAGE-11 (CWJ/IRG/UNA-02) of UNA DISTRICT, June 2022

Annexure 2: LOCATION DETAILS

Table 18: Cluster wise location details

#	District	Block Name	Cluster Name	Area (Ha)	Latitude (°N)	Longitude (°E)	Irrigation Source	Latitude (°N)	Longitude (°E)
1	Solan	Kunihar	Sai	6.74	31.14898333	76.87228222	Natural Spring	31.159220	76.872062
2	Solan	Kunihar	Ser-Delag	21.56	31.15610694	76.93369417	Spring	31.164402	76.933752
3	Solan	Kunihar	Chunad	15.64	31.12043639	76.92716389	Ghumber Khad	31.097813	76.915729
4	Solan	Kunihar	Daseran	32.90	31.25030361	76.89639556	Ali Khad	31.345290	76.751710
5	Solan	Kunihar	Datti	13.75	31.21343139	76.94200389	Natural Spring	31.2134	76.9455
6	Solan	Kunihar	Giana	6.69	31.24251417	76.97371000	Jadol Nallah	31.244797	76.971309
7	Solan	Kunihar	Jailang	9.65	31.09635806	76.91457500	Need to propose parallel scheme – Ghumber Khad	31.097813	76.915729
8	Solan	Kunihar	Pajeena	13.70	31.27216667	76.98509361	Pajeena Nallah	30.904486	77.096733
9	Solan	Nalagarh	Badhal	6.42	31.09822444	76.76164583	Perennial Nallah	31.0191	76.9101
10	Solan	Nalagarh	Baduan Bharmana	17.35	31.04498472	76.77025778	Halyara Khad / Nallah	31.0191	76.9101
11	Solan	Nalagarh	Batiakh	14.42	31.16189528	76.79551417	Ghumber Khad	31.244797	76.971309
12	Solan	Nalagarh	Beli khol 1	10.17	30.98765028	76.72758639	Tubewell	30.9739	76.7443
13	Solan	Nalagarh	Beli khol 2	1.44	31.14599222	76.70339500	Tubewell	30.9739	76.7443
14	Solan	Nalagarh	Doli	16.20	31.16989861	76.78858083	Ghumber Khad	31.244797	76.971309
15	Solan	Nalagarh	Kohla	6.26	31.23740056	76.72957750	Swarghat Nallah	31.230126	76.717771
16	Solan	Nalagarh	Kosri	21.38	31.01012000	76.84256667	Kosri Nallah	31.8996485	76.597939
17	Solan	Nalagarh	Palli	10.02	31.14597194	76.70606222	Tubewell	31.1301	76.7074
18	Solan	Nalagarh	Sour	36.41	31.17750417	76.79675861	Ghumber Khad	31.179203	76.789843
19	Sirmaur	Nahan	Bajari	13.99	30.5937217	77.1922458	Ruhn Khadd	30.597300	77.191200
20	Sirmaur	Nahan	Bhogpur	8.49	30.5728959	77.1906703	Ruhn Khadd	30.588700	77.195300
21	Sirmaur	Nahan	Budriyon	16.10	30.5378067	77.1979494	Tubewell 2	30.520805	77.186520
22	Sirmaur	Nahan	Dungi Sher	9.68	30.6331221	77.3480014	Jalal Khadd	30.654500	77.287000
23	Sirmaur	Nahan	Goant	8.00	30.6558489	77.2859328	Existing DAM Goant	30.654500	77.287000
24	Sirmaur	Nahan	Judag	12.61	30.5991439	77.769969	Judag Nallah	30.597400	77.771700
25	Sirmaur	Nahan	Kherichandan 2	13.81	30.6174203	77.3715114	Jalal Khadd	30.625800	77.353400
26	Sirmaur	Nahan	Kherichandan 1	14.41	30.6259144	77.3581800	Jalal Khadd	30.625800	77.353400

#	District	Block Name	Cluster Name	Area (Ha)	Latitude (°N)	Longitude (°E)	Irrigation Source	Latitude (°N)	Longitude (°E)
27	Sirmaur	Nahan	Rama	6.88	30.5508192	77.3764264	Doghat Khadd	30.557017	77.369019
28	Sirmaur	Nahan	Simbalwala	9.99	30.5863383	77.1845022	Ruhn Khadd	30.588700	77.195300
29	Sirmaur	Paonta Sahib	Fatehpur	6.61	30.4935720	77.5572816	Percolation well, Edge of Bata river	30.495545	77.550381
30	Sirmaur	Paonta Sahib	Killour	21.88	30.5347548	77.8167833	Tons River	30.537333	77.428417
31	Sirmaur	Paonta Sahib	Gyayaniwala	10.87	30.5033232	77.7392196	Tubewell 5	30.502320	77.738100
32	Sirmaur	Paonta Sahib	Khara	8.95	30.5059437	77.6101061	Khara Nallah	30.504800	77.611900
33	Sirmaur	Paonta Sahib	Puruwala	13.93	30.4649906	77.5766029	Tubewell 4	30.458442	77.571293
34	Sirmaur	Paonta Sahib	Upper Bhuddi	21.72	30.5044263	77.7456593	Tubewell 3	30.504220	77.745728
35	Hamirpur	Bamsan	Sachuin	8.68	31.8712939	76.6313013	Beas River	31.873213	76.632321
36	Hamirpur	Bamsan	Parol	17.51	31.6476103	76.6179330	Kunah Khadd	31.652820	76.618459
37	Hamirpur	Bhoranj	Balor-Sangrawar	33.45	31.6267243	76.6469965	Balor Nallah	31.625640	76.642828
38	Hamirpur	Bhoranj	Jol	19.72	31.6345183	76.7070369	Jol Nallah	31.632600	76.707228
39	Hamirpur	Bhoranj	Lagmanwin	6.90	31.6237738	76.6737667	Lagmanwin Nallah	31.626210	76.668000
40	Hamirpur	Bhoranj	Lambagram/Palasi	18.17	31.587551	76.6020842	JICA dam, Plassi Nallah	31.581110	76.605492
41	Hamirpur	Bhoranj	Mundkhar tulsai	27.99	31.5936208	76.6912686	Balor Nallah	31.594219	76.693075
42	Hamirpur	Bhoranj	Samlog	22.69	31.6244720	76.6478241	Samlog Nallah	31.622565	76.644925
43	Hamirpur	Bijhar	Bhalat	11.52	31.4915462	76.4880500	Bhalat Nallah	31.487184	76.478259
44	Hamirpur	Bijhar	Lafran	13.96	31.4693719	76.6068068	New Proposed	31.471386	76.591224
45	Hamirpur	Bijhar	Ghangot	8.42	31.4951547	76.5240244	Ghangot Nallah	31.500923	76.521466
46	Hamirpur	Bijhar	Kalwal	15.75	31.4599250	76.5701686	Rihal Nallah	31.466106	76.569910
47	Hamirpur	Bijhar	Seri-Bhakredi	14.88	31.5366703	76.4712635	Existing check dam on Nallah	31.540604	76.462309
48	Hamirpur	Hamirpur	Branda	7.90	31.6731201	76.4576319	Kunah Khad	31.669773	76.458561
49	Hamirpur	Hamirpur	Bakarti-I	29.97	31.6612258	76.4883073	Kunah Khad	31.656500	76.489167
50	Hamirpur	Hamirpur	Jangal Ropa	22.20	31.5095344	76.4892714	Kunah Khad	31.656634	76.480294
51	Hamirpur	Hamirpur	Haar	14.90	31.6588406	76.4705583	Kunah Khad	31.657474	76.470988
52	Hamirpur	Hamirpur	Neri	7.44	31.6925099	76.4653874	Kunah Khad	31.692480	76.463274
53	Hamirpur	Nadaun	Sadhwan	8.80	31.7361754	76.4061855	MIP Nadaun	31.772473	76.371551
54	Hamirpur	Nadaun	Rail-I	6.20	31.7465415	76.4239991	MIP Nadaun	31.783160	76.4139923
55	Hamirpur	Nadaun	Baag Bharmoti	6.10	31.7628663	76.5112561	MIP Nadaun	31.772473	76.371551
56	Hamirpur	Nadaun	Kushiar-I	15.80	31.6584886	76.3774049	Maan Khadd	31.663182	76.379099

#	District	Block Name	Cluster Name	Area (Ha)	Latitude (°N)	Longitude (°E)	Irrigation Source	Latitude (°N)	Longitude (°E)
57	Hamirpur	Nadaun	Bhabran 1	11.22	31.7347585	76.3203030	LIS Bhabran	31.774385	76.322273
58	Hamirpur	Nadaun	Bhabran 2	13.90	31.7415313	76.3310206	LIS Bhabran	31.774385	76.322273
59	Hamirpur	Nadaun	Kaloor	9.74	31.7707178	76.3145780	Maan Khadd	31.771716	76.313962
60	Hamirpur	Nadaun	Kashmir	6.70	31.6287562	76.4006653	LIS Kashmir	31.626333	76.403328
61	Hamirpur	Nadaun	Phal Palsi	28.20	31.6230277	76.4102881	LIS Palsi	31.617213	76.411050
62	Hamirpur	Nadaun	Choru (Bhoo-I)	6.20	31.7921165	76.4282142	LIS Bhoo	31.794568	76.417278
63	Hamirpur	Nadaun	Manjot	7.90	31.7670861	76.4471159	Salasi Nallah	31.765812	76.448997
64	Hamirpur	Nadaun	Manjot 2	1.50	31.7670861	76.4471159	Salasi Nallah	31.765812	76.448997
65	Hamirpur	Nadaun	Tung (Baloh)	14.10	31.6987400	76.3589300	Maan Khadd	31.698665	76.359087
66	Hamirpur	Nadaun	Loharda	5.00	31.7675205	76.4243682	MIP Nadaun	31.783160	76.4139923
67	Hamirpur	Nadaun	Sai Lower	19.00	31.7243331	76.3875920	MIP Nadaun	31.772473	76.371551
68	Hamirpur	Nadaun	Pansai 1	32.20	31.6809831	76.4003736	LIS Pansai	31.676901	76.397406
69	Hamirpur	Nadaun	Pansai 2	24.20	31.6809831	76.4003736	LIS Pansai	31.676901	76.397406
70	Hamirpur	Sujanpur	Kheri	12.80	31.8866228	76.5938123	LIS Kheri	31.883472	76.592959
71	Hamirpur	Sujanpur	Beri-1	9.30	31.8796727	76.5592765	LIS Kudana Beri	31.875614	76.556180
72	Hamirpur	Sujanpur	Beri-2	12.40	31.8761100	76.5554519	LIS Kudana Beri	31.875614	76.556180
73	Hamirpur	Sujanpur	Bhahru (Pour)	7.10	31.8734661	76.5513655	LIS Bhahru Jatour	31.874561	76.552682
74	Hamirpur	Sujanpur	Bir Baghera	7.00	31.8618202	76.5310328	LIS Pour	31.873138	76.545810
75	Hamirpur	Sujanpur	Kudana	7.90	31.8721611	76.5618942	LIS Bhahru Jatour	31.874561	76.552682
76	Hamirpur	Sujanpur	Bhalana Rei	18.21	31.7599613	76.5073172	LIS Pung Khad	31.760586	76.510104
77	Bilaspur	Ghumarwin	Dehra	17.90	31.5797081	76.7145722	Seer Khad	31.563439	76.724167
78	Bilaspur	Ghumarwin	Kathalag droun	20.57	31.5752181	76.7159644	Seer Khad	31.563439	76.724167
79	Bilaspur	Ghumarwin	Lower Lanjhta	11.61	31.5068239	76.6851564	Seer Khad	31.512679	76.690000
80	Bilaspur	Ghumarwin	Thandora	7.41	31.5153603	76.6745814	Seer Khad	31.512679	76.690000
81	Bilaspur	Ghumarwin	Upper Talwara	9.35	31.5302792	76.7054515	Khad	31.536281	76.699059
82	Bilaspur	Ghumarwin	Talwara Lower	1.91	31.5324636	76.7028193	Khad	31.536281	76.699059
83	Bilaspur	Ghumarwin	Talwara Phase-2	6.91	31.5324636	76.7028193	Khad	31.536281	76.699059
84	Bilaspur	Ghumarwin	Kasol	20.53	31.4849383	76.6987277	Seer Khad	31.488194	76.692361
85	Bilaspur	Ghumarwin	Kasol Balh	8.84	31.4864853	76.6916486	Seer Khad	31.488194	76.692361
86	Bilaspur	Ghumarwin	Kasol Kanjeen	6.20	31.4849332	76.6914975	Seer Khad	31.488194	76.692361

#	District	Block Name	Cluster Name	Area (Ha)	Latitude (°N)	Longitude (°E)	Irrigation Source	Latitude (°N)	Longitude (°E)
87	Bilaspur	Ghumarwin	Mehri Kathla	14.46	31.5458322	76.7192386	Bajrauli Khad	31.542958	76.714021
88	Bilaspur	Ghumarwin	Nalti Parnal	8.77	31.5473236	76.7080033	Seer Khad	31.542958	76.714021
89	Bilaspur	Ghumarwin	Gwal Muthani (Nanawan)	3.75	31.4418170	76.7991770	Madhi Khad	31.441854	78.799186
90	Bilaspur	Ghumarwin	Chharal Daloli	19.29	31.5233955	76.7025217	Over LIS Talwara	31.529381	76.696333
91	Bilaspur	Ghumarwin	Feori (Kothi)	8.67	31.2489801	76.8172279	Borewell	31.499348	76.757196
92	Bilaspur	Ghumarwin	Sandhiar (Chhat)	18.97	31.4316867	76.6285428	Existing DAM – Nearby Nallah - Sandhiar	31.427904	76.625242
93	Bilaspur	Ghumarwin	Bhadrog (Seu)	8.88	31.4667108	76.6947181	Seer Khad	31.469722	76.701667
94	Bilaspur	Ghumarwin	Bhapral	7.11	31.5228953	76.6912169	Seer Khad	31.521026	76.692330
95	Bilaspur	Ghumarwin	Samsai	5.34	31.5308969	76.6460608	Borewell	31.530131	76.642988
96	Bilaspur	Ghumarwin	Massour / Maloh	6.57	31.5142537	76.7282825	Seer Khad	31.513147	76.715551
97	Bilaspur	Ghumarwin	Chhiber	16.99	31.2765847	76.9633500	Nearby Nallah	31.415177	76.728692
98	Bilaspur	Sadar-Bilaspur	Kotlu	14.23	31.3224814	76.8192886	Ali Khad	31.318971	76.819722
99	Bilaspur	Sadar-Bilaspur	Dugga Har (Manjher)	11.43	31.2492828	76.8258989	Kuhl	31.248326	76.821016
100	Bilaspur	Sadar-Bilaspur	Loharda	23.02	31.2480992	76.8351036	Ali Khad	31.248326	76.821016
101	Bilaspur	Sadar-Bilaspur	Kainthal	6.38	31.2481381	76.8276553	Ali Khad	31.248326	76.821016
102	Bilaspur	Sadar-Bilaspur	Khod ka kyar	21.49	31.4135231	76.8234664	Ali Khad	31.248326	76.821016
103	Bilaspur	Sadar-Bilaspur	Karot	21.92	31.3358917	76.8212728	Ali Khad	31.330205	76.819376
104	Bilaspur	Sadar-Bilaspur	Salnu	27.79	31.4140614	76.8007331	Sutlej River	31.418299	76.800314
105	Bilaspur	Jhandutta	Balh Sinha	32.14	31.41790942	76.59028479	JICA Dam	31.421006	76.586704
106	Bilaspur	Jhandutta	Kosarian-I	30.03	31.43209728	76.50926669	Kosari Nalla	31.435352	76.510241
107	Bilaspur	Jhandutta	Lehar	24.51	31.33832364	76.64886813	Neri Dam	31.339178	76.652056
108	Bilaspur	Jhandutta	Tikkari Kotlu	22.94	31.37288592	76.64987101	Seer Khad	31.395545	76.626585
109	Bilaspur	Jhandutta	Fagog	22.28	31.401528191	76.62442038	JICA Dam	31.394951	76.626561
110	Bilaspur	Jhandutta	Fagog Banjholi	11.17	31.401953390	76.61774010	JICA Dam	31.394951	76.626561
111	Bilaspur	Jhandutta	Jhandu	15.35	31.365346250	76.64471864	JICA Dam	31.365975	76.643564
112	Bilaspur	Jhandutta	Tihri	29.15	31.428668750	76.64133546	LIS Tihri	31.430524	76.638139
113	Bilaspur	Swarghat	Bassi	12.44	31.311250280	76.51066361	BBMB Canal	31.410830	76.433330
114	Bilaspur	Swarghat	Dulhet 3	29.62	31.363684000	76.47051000	BBMB Canal	31.410830	76.433330
115	Bilaspur	Swarghat	Ghattewal	28.26	31.333254720	76.48952139	BBMB Canal	31.410830	76.433330

#	District	Block Name	Cluster Name	Area (Ha)	Latitude (°N)	Longitude (°E)	Irrigation Source	Latitude (°N)	Longitude (°E)
116	Mandi	Chauntara	Golwan	17.19	31.9830937	76.6983887	Ropdi Khad	31.609210	76.738469
117	Mandi	Chauntara	Kothi – I (Balh)	9.3	31.8594537	76.7446334	Tubewell	31.865520	76.744170
118	Mandi	Chauntara	Kothi - II	8.3	31.8633729	76.7419522	Tubewell	31.865520	76.744170
119	Mandi	Chauntara	Dhelu (Dhog)	9.97	32.0067600	76.7700830	Tubewell	31.897369	76.765790
120	Mandi	Chauntara	Dol	33.29	31.8476768	76.7641587	Tubewell	31.897369	76.765790
121	Mandi	Chauntara	Khadiyal	23.24	31.8648875	76.7563886	Tubewell	31.897369	76.765790
122	Mandi	Gopalpur	Sulpur	7.5	31.5946180	76.7273648	Percollation well, Seer Khad	31.596290	76.727312
123	Mandi	Gopalpur	Dhar	10.16	31.6714219	76.7133737	Beas River	31.490055	76.462896
124	Mandi	Gopalpur	Barchwar	10.82	31.6771775	76.7281829	River Beas	31.490055	76.462896
125	Mandi	Gopalpur	Ghadhyani	7.24	31.6775041	76.7215515	River Beas	31.490055	76.462896
126	Mandi	Gopalpur	Kharoh (Kalerka)	17.11	31.6822917	76.7249867	Beas River	31.490055	76.462896
127	Mandi	Gopalpur	Bhadarwar Khobla	9.02	31.6966322	76.7840976	Rissa Khad	31.688938	76.785604
128	Mandi	Gopalpur	Bahi	8.71	31.6052590	76.7392989	Percollation well, Seer Khad	31.609210	76.738469
129	Mandi	Gopalpur	Bhambhala-I	14.15	31.5900390	76.7360520	Seer Khad	31.583410	76.729555
130	Mandi	Gopalpur	Thouna/Dhalait	8.18	31.7158760	76.8165771	Local Nallah	31.722365	76.816548
131	Mandi	Gopalpur	Rasher	10.95	31.6801242	76.7848271	Son Khad	31.679490	76.784995
132	Mandi	Gopalpur	Batail 2	9.13	31.5759188	76.7321673	Tubewell	31.581675	76.732964
133	Mandi	Gopalpur	Batal 1	19.7	31.5809700	76.7334120	Tubewell	31.581675	76.732964
134	Mandi	Gopalpur	Bag-chuhku	12.86	31.6194678	76.7194994	Tubewell	31.581675	76.732964
135	Mandi	Gopalpur	Mataur Tanda	13.05	31.5662513	76.7298865	Seer Khad	31.568450	76.727623
136	Mandi	Dharampur	Richhli	12.81	31.8016374	76.7259886	Beas River	31.828721	76.763119
137	Mandi	Dharampur	Mannu Dhar (Joh)	13.68	31.8050280	76.7171720	Beas River	31.828721	76.763119
138	Mandi	Dharampur	Haryanal	12.55	31.8094694	76.7266067	Beas River	31.828721	76.763119
139	Mandi	Dharampur	Satrehar	12.52	31.8164980	76.7516000	Beas River	31.828721	76.763119
140	Mandi	Dharampur	Ghanswari	8.3	31.8148300	76.7124217	Beas River	31.828721	76.763119
141	Mandi	Dharampur	Aarli Paryal	9.87	31.8237646	76.7096901	Beas River	31.828721	76.763119
142	Mandi	Dharampur	Richhali / Dhwali	5.75	31.8085777	76.7252515	Beas River	31.828721	76.763119
143	Mandi	Dharampur	Tarohla	8	31.8055123	76.7339227	Beas River	31.828721	76.763119
144	Mandi	Dharampur	Taroon	9.26	31.8371523	76.7173412	Beas River	31.828721	76.763119
145	Mandi	Dharampur	Chhapanu	8.38	31.8133850	76.7624460	Beas River	31.828721	76.763119
146	Mandi	Dharampur	Banwaar Kalaan	13.16	31.8060280	76.7458640	Beas River	31.828721	76.763119

#	District	Block Name	Cluster Name	Area (Ha)	Latitude (°N)	Longitude (°E)	Irrigation Source	Latitude (°N)	Longitude (°E)
147	Mandi	Dharampur	Dhardi-1	2.67	31.8185658	76.7193243	Beas River	31.828721	76.763119
148	Mandi	Dharampur	Baratpur	7.49	31.7631150	76.7648390	Beas River	31.828721	76.763119
149	Mandi	Dharampur	Balhara 1	1.46	31.8186283	76.7459246	Beas River	31.828721	76.763119
150	Mandi	Dharampur	Balhara 2	2.45	31.8186283	76.7459246	Beas River	31.828721	76.763119
151	Mandi	Dharampur	Dhardi 2	3.55	31.8185650	76.7193220	Beas River	31.828721	76.763119
152	Mandi	Dharampur	Lalana	4.27	31.8099510	76.7003630	Beas River	31.828721	76.763119
153	Mandi	Dharampur	Parli Paryal	1.7	31.8306630	76.7125230	Beas River	31.828721	76.763119
154	Mandi	Dharampur	Sakran Dhar	5.36	31.8125823	76.7203980	Beas River	31.828721	76.763119
155	Mandi	Dharampur	Sherpur	1.24	31.8030010	76.6917340	Beas River	31.828721	76.763119
156	Mandi	Dharampur	Chakyan a	3.72	31.8224115	76.7655930	Beas River	31.828721	76.763119
157	Mandi	Dharampur	Chunighat	14.14	31.8017370	76.7044530	Beas River	31.828721	76.763119
158	Mandi	Dharampur	Gorat	12.25	31.8545549	76.7050816	Beas River	31.828721	76.763119
159	Mandi	Dharampur	Pakhdol	4.39	31.8657849	76.6986251	Beas River	31.828721	76.763119
160	Mandi	Dharampur	Tourjajar	9.74	31.7659198	76.7968914	Beas River	31.817593	76.777859
161	Mandi	Dharampur	Galloo (Chanouta)	6.19	31.7624375	76.7726141	Beas River	31.817593	76.777859
162	Mandi	Dharampur	Siram(Sarskan)	7.05	31.7929750	76.7764500	Beas River	31.817593	76.777859
163	Mandi	Dharampur	Trembala	6.06	31.6802985	76.7848850	Beas River	31.817593	76.777859
164	Mandi	Dharampur	Hiun	3.96	31.7659198	76.7968914	Beas River	31.817593	76.777859
165	Mandi	Dharampur	Kumarhda 2	10.22	31.7939110	76.8111070	Beas River	31.817593	76.777859
166	Mandi	Dharampur	Didnu	5.2	31.7830993	76.7606468	Beas River	31.817593	76.777859
167	Mandi	Dharampur	Banerti-2	10.44	31.8099205	76.7900955	Beas River	31.817593	76.777859
168	Mandi	Dharampur	Pehad-2	10.04	31.8083512	76.8076911	Beas River	31.817593	76.777859
169	Mandi	Dharampur	Chhater	10.86	31.7438326	76.7847476	Beas River	31.817593	76.777859
170	Mandi	Dharampur	Drumman	30.76	31.7686593	76.8110470	Beas River	31.817593	76.777859
171	Mandi	Dharampur	Kumahra	13.84	31.7828430	76.8105300	Beas River	31.817593	76.777859
172	Mandi	Dharampur	Giun	27.8	31.7765780	76.8074337	Beas River	31.817593	76.777859
173	Mandi	Dharampur	Cheh	8.67	31.7681666	76.7836031	Beas River	31.817593	76.777859
174	Mandi	Dharampur	Bahn	5.63	31.8574380	76.6735770	Beas River	31.871832	76.672854
175	Mandi	Dharampur	Chatroun (Lower)	11.26	31.8554744	76.6715649	Beas River	31.871832	76.672854
176	Mandi	Dharampur	Dhalara 1	9.35	31.8481990	76.6828370	Beas River	31.871832	76.672854
177	Mandi	Dharampur	Dhalara 2	8.7	31.8424829	76.6811115	Beas River	31.871832	76.672854
178	Mandi	Dharampur	Lower Balh	6.24	31.8598720	76.6888403	Beas River	31.871832	76.672854

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179	Mandi	Dharampur	Single Kuhat	3.7	31.8490200	76.6539130	Beas River	31.871832	76.672854
180	Mandi	Dharampur	Kanohi	1.32	31.8345995	76.6465384	Beas River	31.871832	76.672854
181	Mandi	Dharampur	Lahsani	1.35	31.8327101	76.6711235	Beas River	31.871832	76.672854
182	Mandi	Dharampur	Churu ra Balh	20.88	31.7856097	76.7331716	Nald Khad	31.785623	76.733106
183	Mandi	Dharampur	Seoh II	27.49	31.8696840	76.7153400	Beas River	31.875368	76.710540
184	Mandi	Dharampur	Seoh (Balh) Nichla Ropa	18.74	31.8776340	76.7145740	Beas River	31.875368	76.710540
185	Mandi	Dharampur	Lower (Nichali) Bairi	9.13	31.8186283	76.7459246	Beas River	31.871832	76.672854
186	Mandi	Dharampur	Upper Bairi	23.98	31.8768570	76.6851710	Beas River	31.871832	76.672854
187	Mandi	Dharampur	Barota	4.37	31.7631150	76.7648390	Soan Khad	31.4535	76.4508
188	Mandi	Dharampur	Manyoh-Lambri	20.14	31.7608300	76.6391320	Beas River	31.870957	76.648691
189	Mandi	Dharampur	Thanna (Ropari)	8.18	31.7251319	76.6960048	Beas River	31.870957	76.648691
190	Mandi	Dharampur	Patti (Kot)	6.9	31.7428867	76.6610650	Beas River	31.870957	76.648691
191	Mandi	Dharampur	Darwaar	9.27	31.7554972	76.6918485	Beas River	31.870957	76.648691
192	Mandi	Dharampur	Digho-Baglana (Karyal)	7.28	31.7162952	76.6908846	Beas River	31.870957	76.648691
193	Mandi	Dharampur	Skohta	1.82	31.7489201	76.6415149	Beas River	31.870957	76.648691
194	Mandi	Dharampur	Khajurti	5.76	31.8188871	76.6378875	Beas River	31.870957	76.648691
195	Mandi	Dharampur	Bandal	10.71	31.7420410	76.6786810	Beas River	31.870957	76.648691
196	Mandi	Dharampur	Chandpur	11.98	31.7427630	76.6846590	Beas River	31.870957	76.648691
197	Mandi	Dharampur	Tikri	14.51	31.7659920	76.6690850	Beas River	31.870957	76.648691
198	Mandi	Dharampur	Dyol	5.59	31.8657849	76.6986251	Beas River	31.870957	76.648691
199	Mandi	Drang	Baragaon – I & II	14.32	31.7915433	76.9146556	Baragaon nalla	31.791041	76.918390
200	Mandi	Gohar/Balhalh	Dharwah an-II (Sehal)	17.39	31.6309600	76.8984490	BSL Canal	31.539108	76.891403
201	Mandi	Gohar/Balhalh	Sawla	17.46	31.6639201	77.0534616	IPH Chamber	31.654467	77.050035
202	Mandi	Gohar/Balhalh	Bagga Chalog	8.63	31.6049749	77.0641159	Jiuni Khad	31.604170	77.064440
203	Mandi	Gohar/Balhalh	Latogali I	26.97	31.6529281	77.0910827	Bakhli Khad	31.651607	77.090040
204	Mandi	Gohar/Balhalh	Brikhmani	16.76	31.5489911	76.9665451	Brikhmani Nalla	31.543316	76.972369
205	Mandi	Gohar/Balhalh	Darvehad	12.33	31.5477490	76.9552920	BSL Canal	31.539108	76.891403
206	Mandi	Gohar/Balhalh	Manjhog Dhaniut	9.66	31.5059961	76.9788832	Dhaniut nalla	31.503610	76.992780
207	Mandi	Gohar/Balhalh	Manjhogan Chudara	28.56	31.6407385	77.0687996	Jiuni Khad	31.635346	77.067108

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208	Mandi	Sadar	Dhaniyara	17.85	31.7552707	76.8660706	Arnodi Khad	31.753450	76.864714
209	Mandi	Sadar	Binol	7.21	31.7035696	77.0414134	Beas River	31.691158	77.038793
210	Mandi	Sundernagar	Palhota	17.11	31.5245214	76.9313617	Kansa Khad	31.522679	76.938181
211	Mandi	Sundernagar	Kuthain	15.45	31.5210536	76.9336357	Kansa Khad	31.505457	76.961034
212	Mandi	Sundernagar	Bhantraed	11.85	31.4318637	76.8056505	Bhantred Khad	31.429721	76.802746
213	Mandi	Sundernagar	Khagron	10.15	31.4914587	76.9592190	Kiyargi Nalla source	31.491524	76.957698
214	Kangra	Baijnath	Langhu – 1	6.20	32.0050052	76.6226181	Binwa Khad	32.014526	76.556383
215	Kangra	Baijnath	Langhu – 2	7.25	32.0096201	76.6183845		32.014526	76.556383
216	Kangra	Baijnath	Upper Bhet	8.42	32.0109667	76.6183845		32.014526	76.556383
217	Kangra	Baijnath	Manghotra	6.00	32.0584983	76.6516371	Binwa Khad	32.066442	76.653601
218	Kangra	Baijnath	Kudail	16.61	31.9841382	76.6773283	Dea Nallah	31.987437	76.678660
219	Kangra	Baijnath	Utrala	4.85	32.1116769	76.6626785	Binwa River / Tundal Kholi Nala	32.111734	76.710976
220	Kangra	Bhawarna	Thandol – 1	16.95	32.0101534	76.5278518	Mol Khad	32.011838	76.505194
221	Kangra	Bhawarna	Ghar	8.21	32.0433008	76.5438725	Mand Khad	32.041854	76.535867
222	Kangra	Bhawarna	Malahu II	8.46	32.0061150	76.5177770	Mol Khad	32.011838	76.505194
223	Kangra	Bhawarna	Malahu I	5.29	32.0115298	76.5088622		32.011838	76.505194
224	Kangra	Bhawarna	Sidhpur	30.09	32.0984580	76.4650962	Nugal Khad	32.116166	76.514466
225	Kangra	Bhawarna	Chartkhola	18.67	32.1017123	76.4317642	Tahl Khad	32.095246	76.436456
226	Kangra	Bhawarna	Ludhran 1 & 2	15.09	32.0909335	76.4312896	Tahl Khad	32.095246	76.436456
227	Kangra	Lambagaon	Maldoan	10.59	31.8700740	76.4899877	Nugal Khad	31.858220	76.492220
228	Kangra	Lambagaon	Jangal	9.15	31.8583494	76.4950284	Nugal Khad	31.858220	76.492220
229	Kangra	Lambagaon	Odri	8.76	31.9026321	76.5009377	Mol Khad	31.908113	76.490632
230	Kangra	Lambagaon	Kotlu	4.52	31.9184718	76.4976195	Mol Khad	31.908113	76.490632
231	Kangra	Lambagaon	Kathla	7.59	31.8792136	76.6326662	Beas River	31.883276	76.633760
232	Kangra	Lambagaon	Thanpal / Chambi	8.34	31.8950035	76.6238812	Beas River	31.883276	76.633760
233	Kangra	Panchru khi	Trehal	8.22	32.0479542	76.6045931	Tubewell	32.046542	76.612365
234	Kangra	Panchru khi	Agozar	7.03	32.0348853	76.5808869	Tubewell	32.037890	76.603328
235	Kangra	Panchru khi	Rajhot 1	17.27	32.0273912	76.5912430	Awah Khad	32.032411	76.585905
236	Kangra	Panchru khi	Ladoh 1	17.21	32.0483302	76.5631179	Tubewell	32.047299	76.548987
237	Kangra	Panchru khi	Ladoh 2	5.53	32.0503098	76.5585241	Alang Nallah	32.050930	76.556383
238	Kangra	Panchru khi	Banuri	7.73	32.0879769	76.5715521	Gharuhal Khul	32.090133	76.571402

#	District	Block Name	Cluster Name	Area (Ha)	Latitude (°N)	Longitude (°E)	Irrigation Source	Latitude (°N)	Longitude (°E)
239	Kangra	Panchru khi	Tatehal	3.44	32.0359752	76.5566549	Tubewell	32.036320	76.582391
240	Kangra	Panchru khi	Saliana	7.33	32.0715315	76.5652309	Nai Khul	32.072317	76.565244
241	Kangra	Panchru khi	Molichak	6.15	32.0806183	76.5620395	Tubewell	32.091321	76.552391
242	Kangra	Panchru khi	Jandpur	8.54	32.0600477	76.6002992	Tubewell	32.071342	76.574321
243	Kangra	Sullah	Dheera 1 & 2	23.47	32.0163427	76.4532748	Nugal Khad	32.009706	76.455714
244	Kangra	Sullah	Dheera 3	10.81	32.0163427	76.4532748	Nugal Khad	32.009706	76.455714
245	Kangra	Sullah	Chainchadi – Kuthera	10.19	31.9716811	76.5307206	Mand Khad	31.972991	76.529502
246	Kangra	Sullah	Purba	15.36	31.9576174	76.4513130	Nugal Khad	31.954891	76.448075
247	Kangra	Sullah	Chandar	36.60	31.9700109	76.4959473	Mol Khad	31.972840	76.497745
248	Kangra	Sullah	Gagal Khas	23.47	32.0353877	76.4487074	Tal Khad	32.056311	76.427621
249	Kangra	Dehra	Bhatera Bassa	13.90	32.0138911	76.17543044	Baner Khad	32.016758	76.180749
250	Kangra	Dehra	Bhatoli Phakasia n	11.44	31.97886204	76.13474061	Baner Khad	32.016758	76.180749
251	Kangra	Dehra	Dhanot-1	206.22	31.81110434	76.31440190	River Beas	31.809105	76.285860
252	Kangra	Dehra	Jakhota	227.54	31.79071685	76.32153773	River Beas	31.809105	76.285860
253	Kangra	Dehra	Chamba Khas	11.62	31.8197400	76.2569800	River Beas	31.809105	76.285860
254	Kangra	Dehra	Kuhna	11.86	31.8094100	76.2850100	River Beas	31.809105	76.285860
255	Kangra	Dehra	Lalwada	30.41	31.8243680	76.3179600	River Beas	31.809105	76.285860
256	Una	Bangan a	Boul-1	19.32	31.5550988	76.2997035	Samoor Khad	31.531456	76.307145
257	Una	Bangan a	Boul-2	24.55	31.4641060	76.4165480	Samoor Khad	31.531456	76.307145
258	Una	Bangan a	Dulehri Rajputa	9.11	31.52801468	76.36090279	Dulheri Nallah	31.524390	76.353672
259	Una	Bangan a	Sanhal	13.58	31.54250961	76.33819189	Samoor Khad	31.531456	76.307145
260	Una	Bangan a	Thana Khurd	22.24	31.52461287	76.35735983	Dulheri Nallah	31.524390	76.353672
261	Una	Bangan a	Balh	14.02	31.54990226	76.35127819	Balh Khad	31.5504	76.3513
262	Una	Bangan a	Chadoli	26.75	31.63384094	76.29607939	Chplah Khad	31.6349	76.3048
263	Una	Bangan a	Dumkhar	10.75	31.61201092	76.34466224	Chplah Khad	31.6349	76.3048
264	Una	Bangan a	Hatli	6.38	31.63928174	76.34096037	Rit Sthrukha Khad	31.6395	76.3403
265	Una	Bangan a	Kathoh	11.90	31.58783849	76.28505197	Kathoh Khad	31.5854	76.2840
266	Una	Bangan a	Muchali 1 & 2	21.26	31.61899450	76.34832520	Muchali Nallah	31.6154	76.3505
267	Una	Bangan a	Nalwari	36.52	31.60697863	76.34802809	Chplah Khad	31.6349	76.3048
268	Una	Bangan a	Tureta	13.46	31.57533119	76.40221155	Kolhri Tureta Nallah	31.5782	76.4033

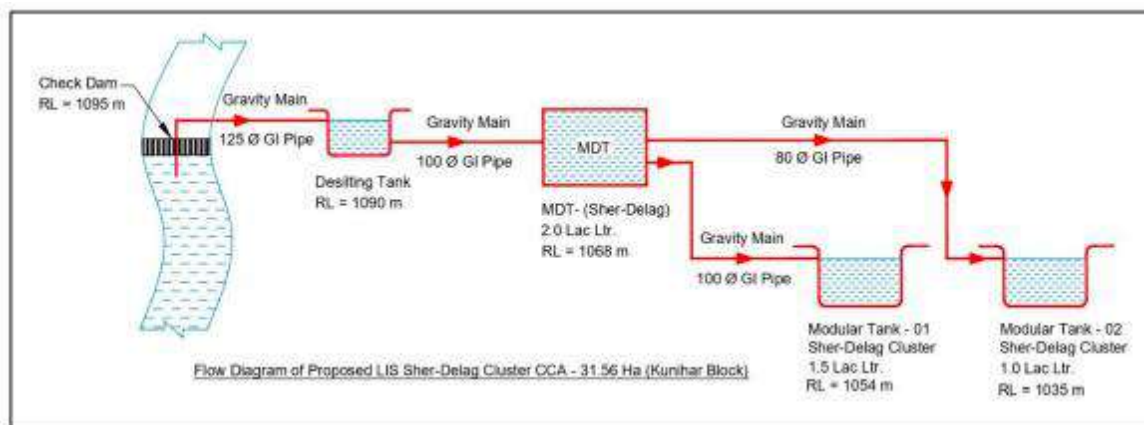
#	Distric t	Block Name	Cluster Name	Area (Ha)	Latitude (°N)	Longitud e (°E)	Irrigation Source	Latitud e (°N)	Longitud e (°E)
269	Una	Bangan a	Baral	36.26	31.552528 00	76.37782 700	Baral Nallah	31.5517	76.3775
270	Una	Bangan a	Handola	11.84	31.424963 22	76.38866 420	River Satluj	31.4263 71	76.393711
271	Una	Bangan a	Dobad	8.75	31.460114 68	76.41874 421			

Annexure 3: IRRIGATION DESIGN DETAIL – PACKAGE-WISE

Irrigation Scheme flow-diagram of Package – 01 (Solan District):

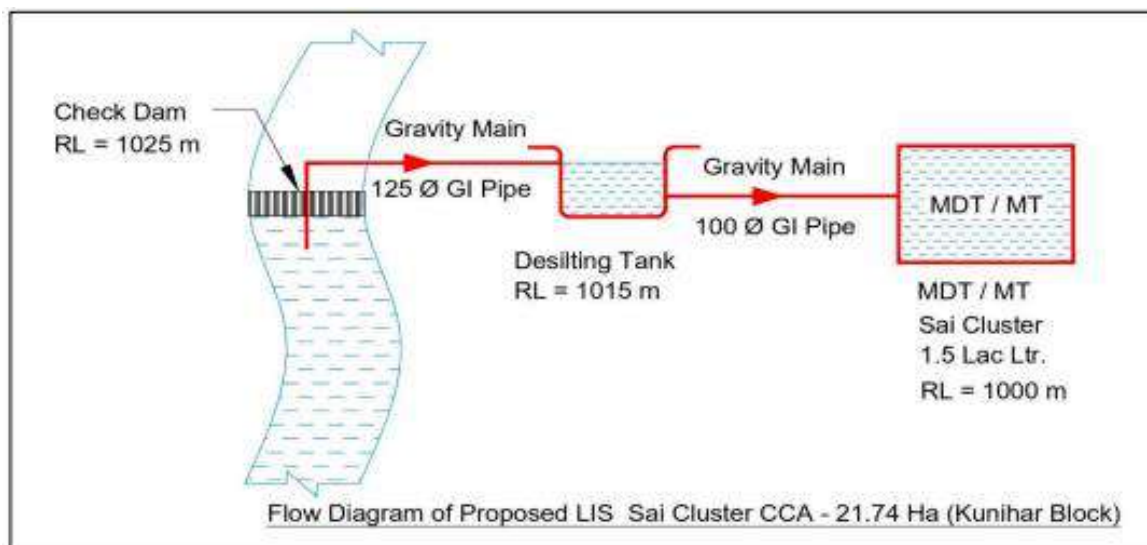
1. Proposed LIS – Ser Delag

Figure 12: Flow Diagram of Proposed LIS Ser Delag



2. Proposed LIS – Sai

Figure 13: Flow Diagram of Proposed LIS Sai



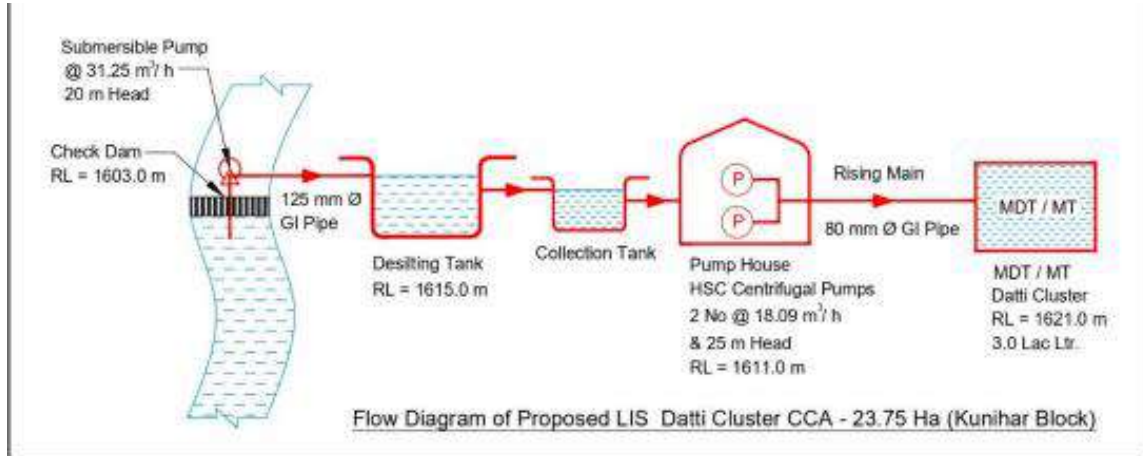
3. Proposed LIS – Jailang

Figure 14: Flow Diagram of Proposed LIS Jailang



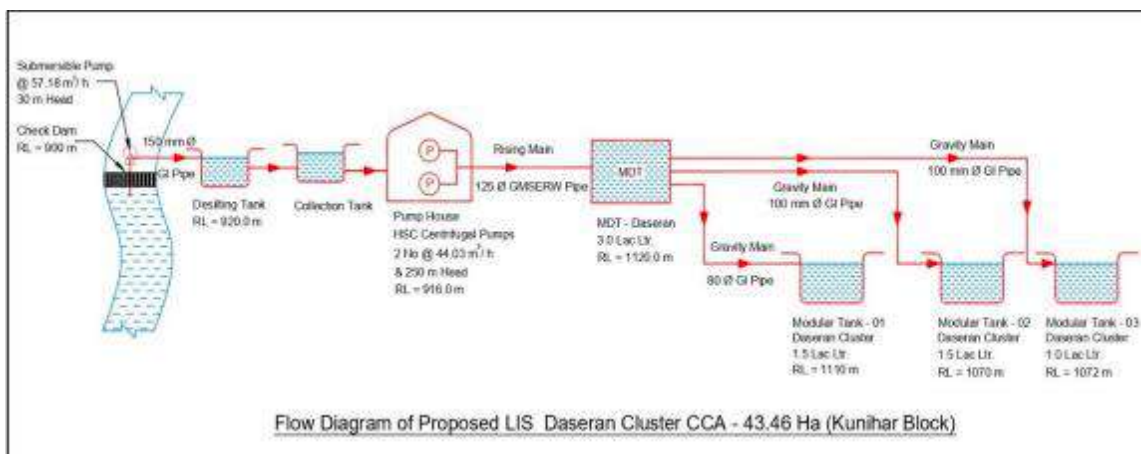
4. Proposed LIS – Datti

Figure 15: Flow Diagram of Proposed LIS Datti



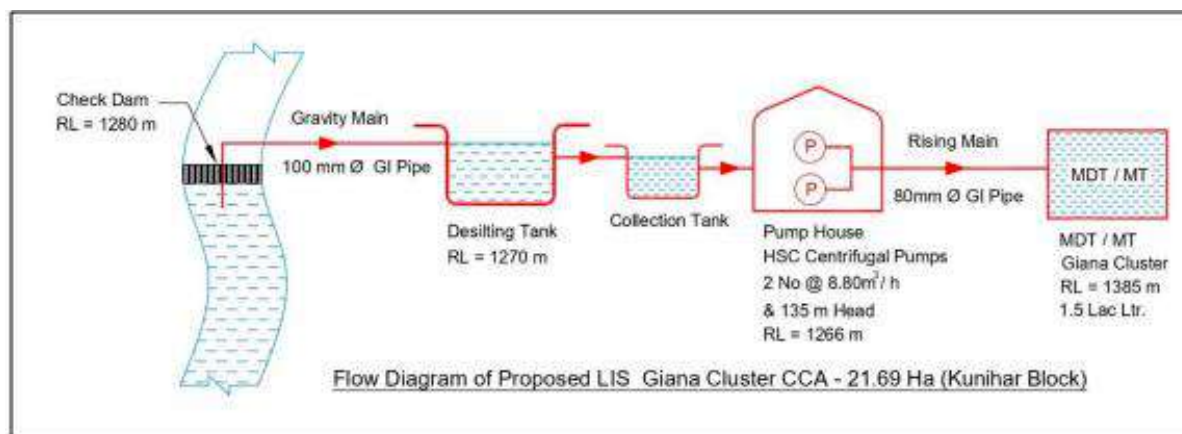
5. Proposed LIS – Daseran

Figure 16: Flow Diagram of Proposed LIS Daseran



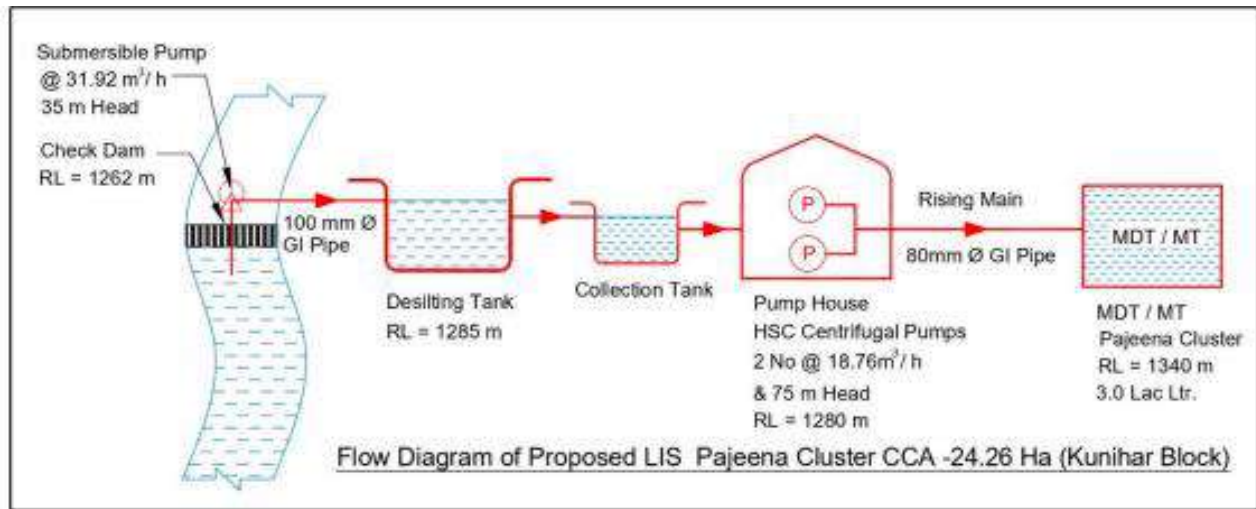
6. Proposed LIS – Giana

Figure 17: Flow Diagram of Proposed LIS Giana



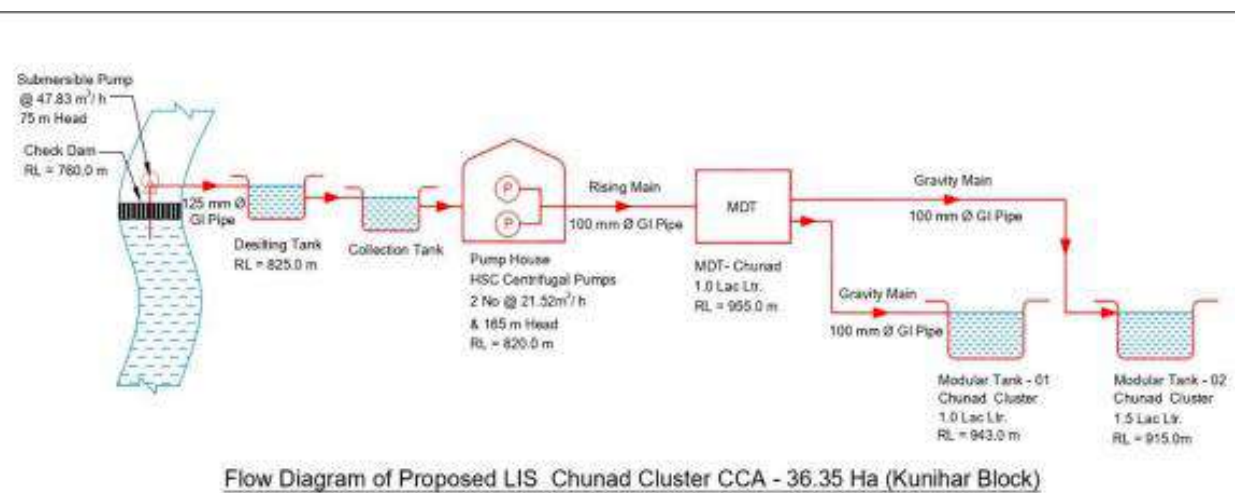
7. Proposed LIS – Pajeena

Figure 18: Flow Diagram of Proposed LIS Pajeena



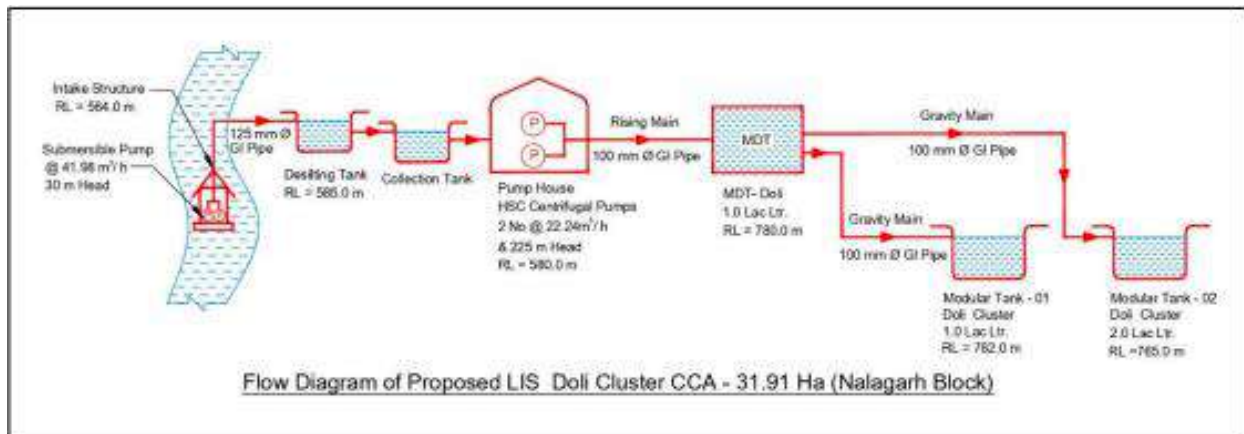
8. Proposed LIS – Chunarad

Figure 19: Flow Diagram of Proposed LIS Chunarad



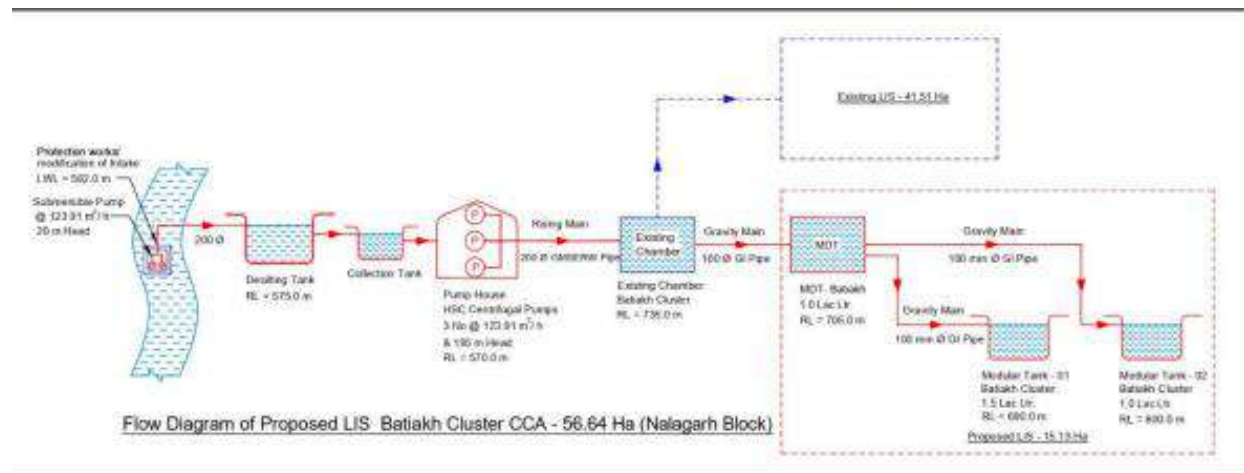
9. Proposed LIS – Doli

Figure 20: Flow Diagram of Proposed LIS Doli



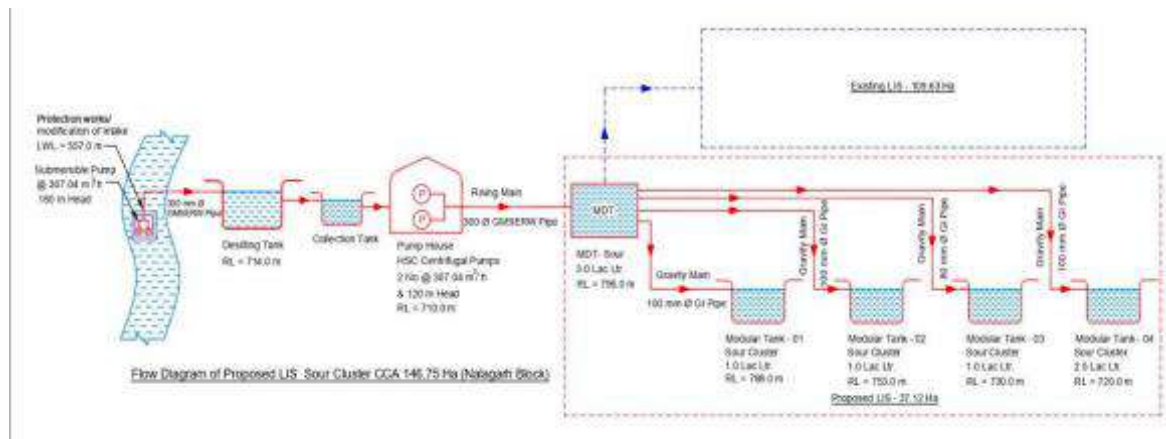
10. Proposed LIS – Batiakh

Figure 21: Flow Diagram of Proposed LIS Batiakh



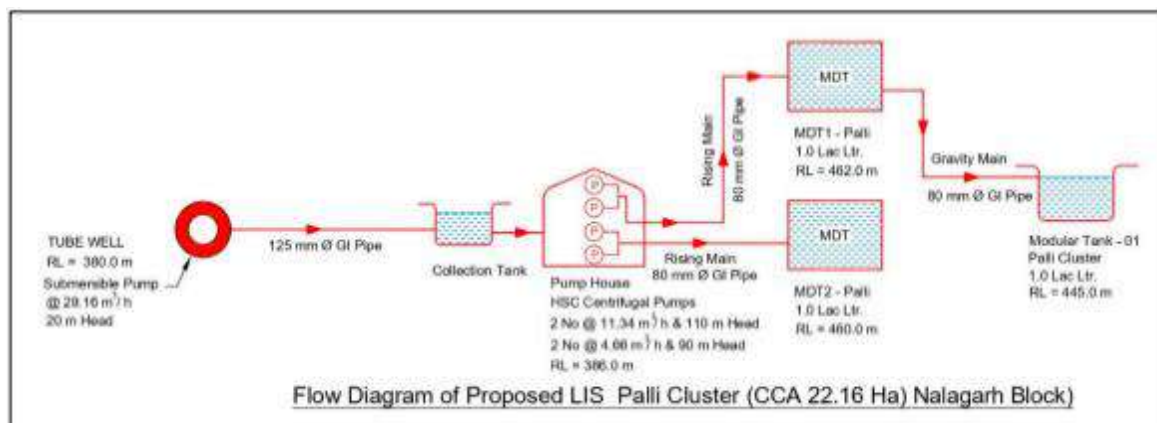
11. Proposed LIS – Sour

Figure 22: Flow Diagram of Proposed LIS Sour



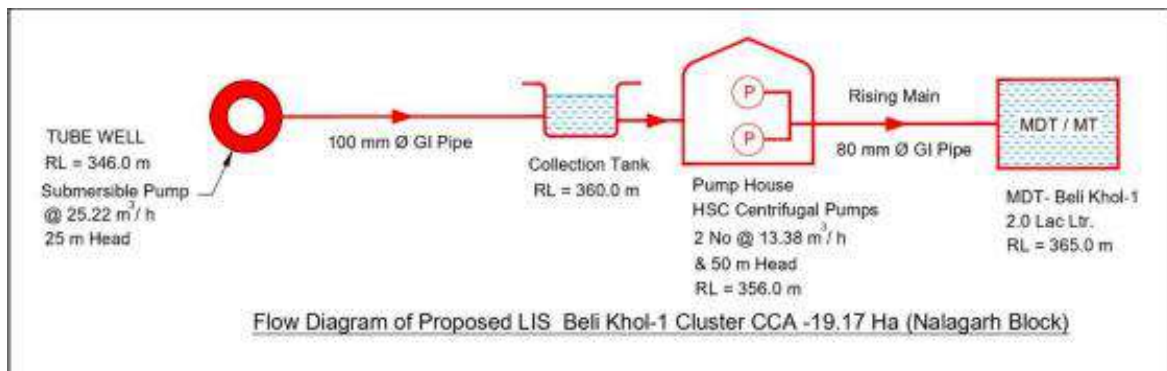
12. Proposed LIS – Palli

Figure 23: Flow Diagram of Proposed LIS Palli



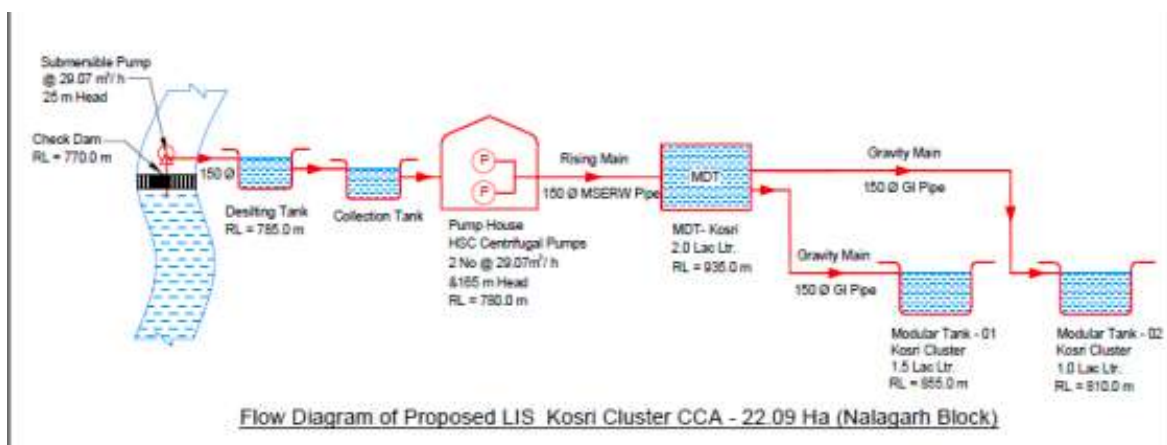
13. Proposed LIS – Beli Khol 1

Figure 24: Flow Diagram of Proposed LIS Beli Khol 1



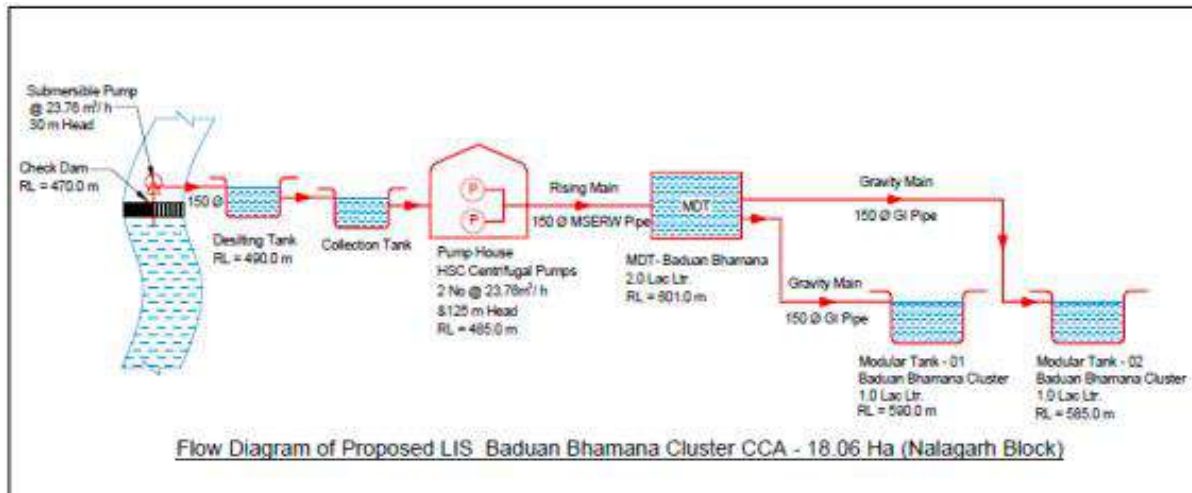
14. Proposed LIS – Kosri

Figure 25: Flow Diagram of Proposed LIS Kosri



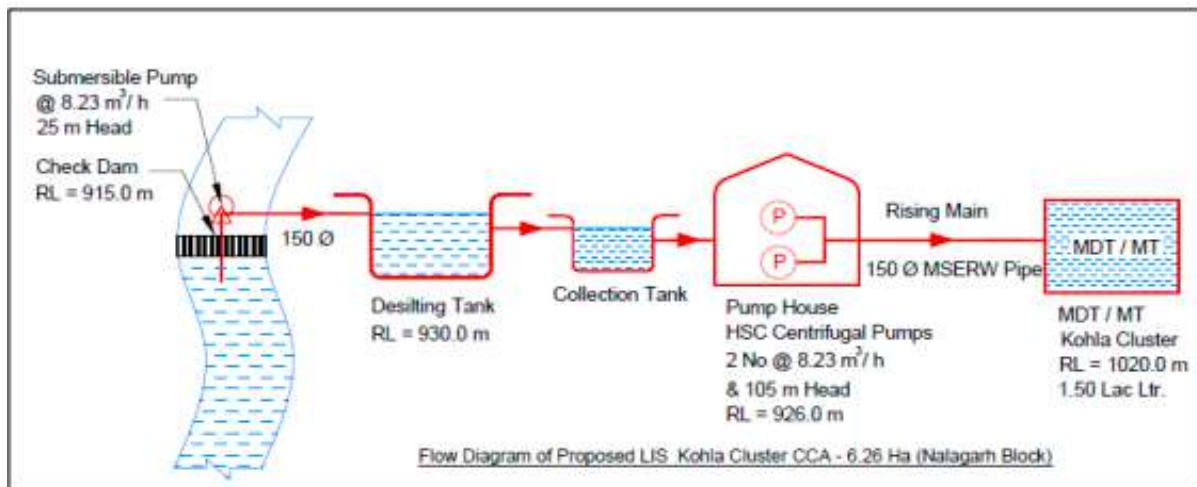
15. Proposed LIS – Baduan Bharmana

Figure 26: Flow Diagram of Proposed LIS Baduan Bharmana



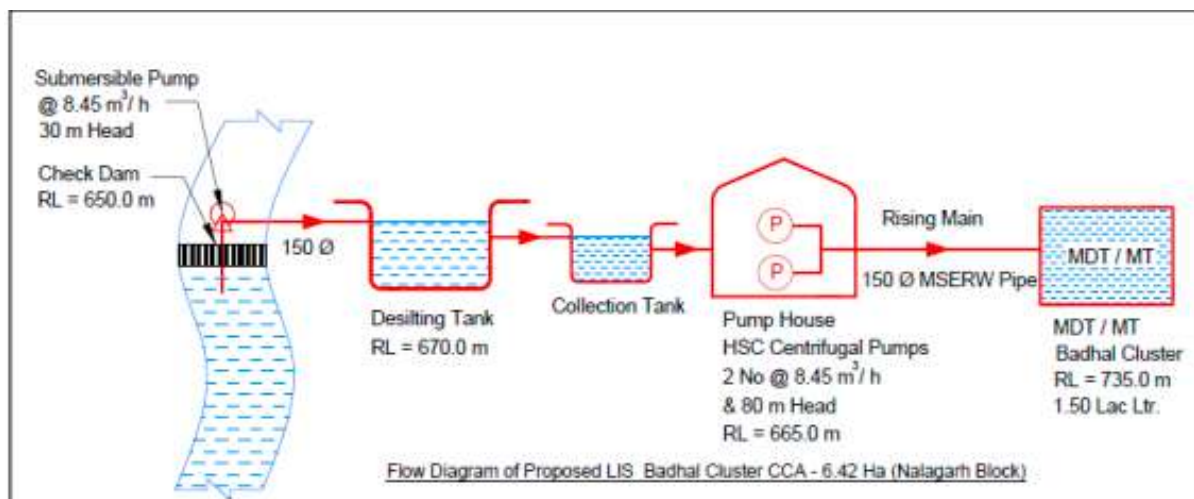
16. Proposed LIS – Kohla

Figure 27: Flow Diagram of Proposed LIS Kohla



17. Proposed LIS – Badhal

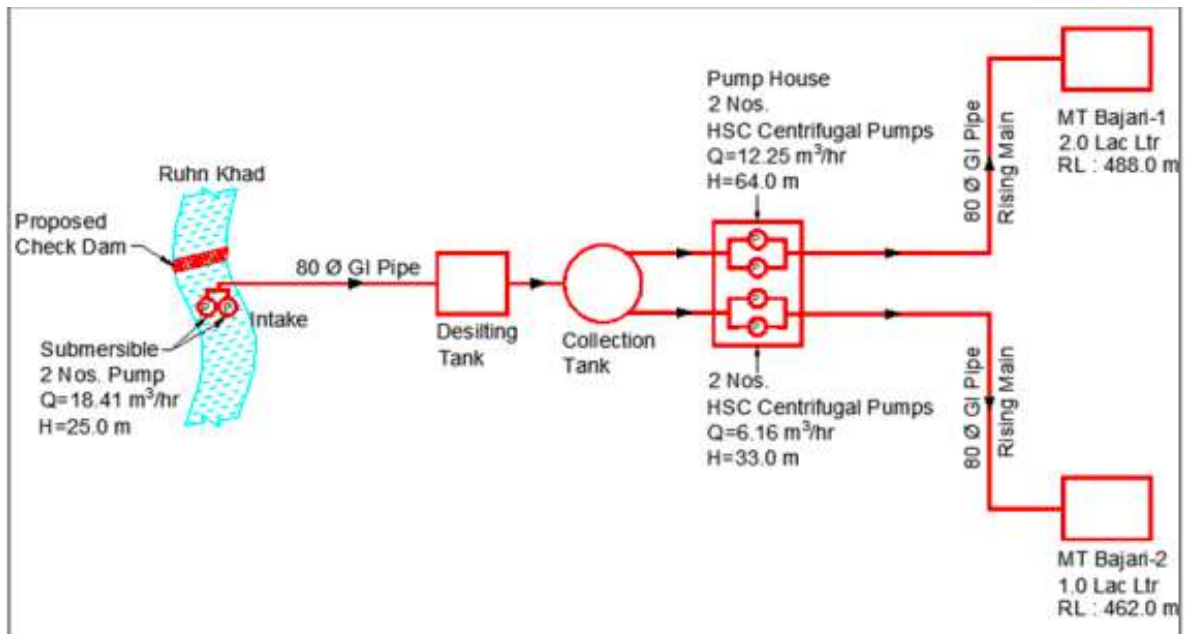
Figure 28: Flow Diagram of Proposed LIS Badhal



Irrigation Scheme flow-diagram of Package – 02 (Sirmaur District):

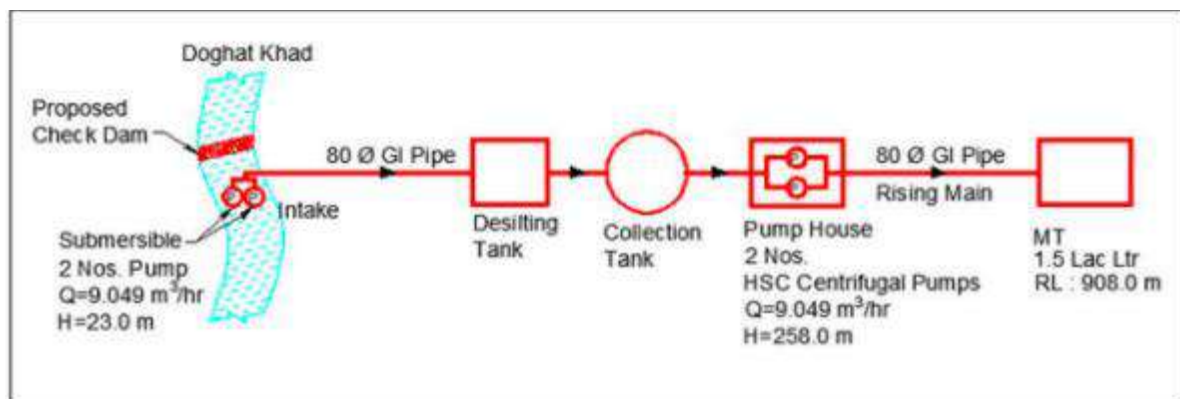
1. Proposed LIS – Bajari 1 & 2

Figure 29: Flow Diagram of Proposed LIS Bajari 1 & 2



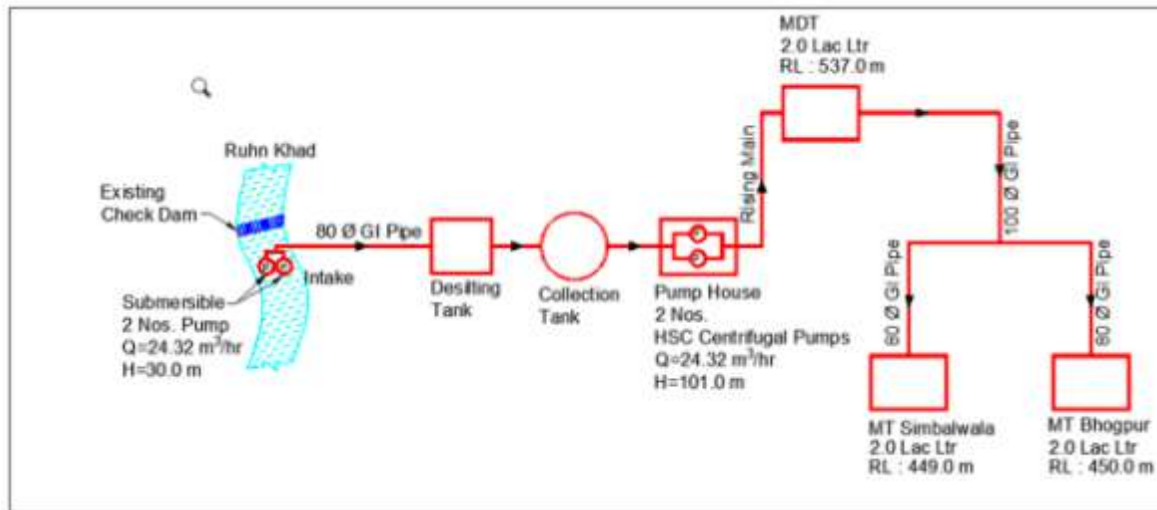
2. Proposed LIS – Rama

Figure 30: Flow Diagram of Proposed LIS Rama



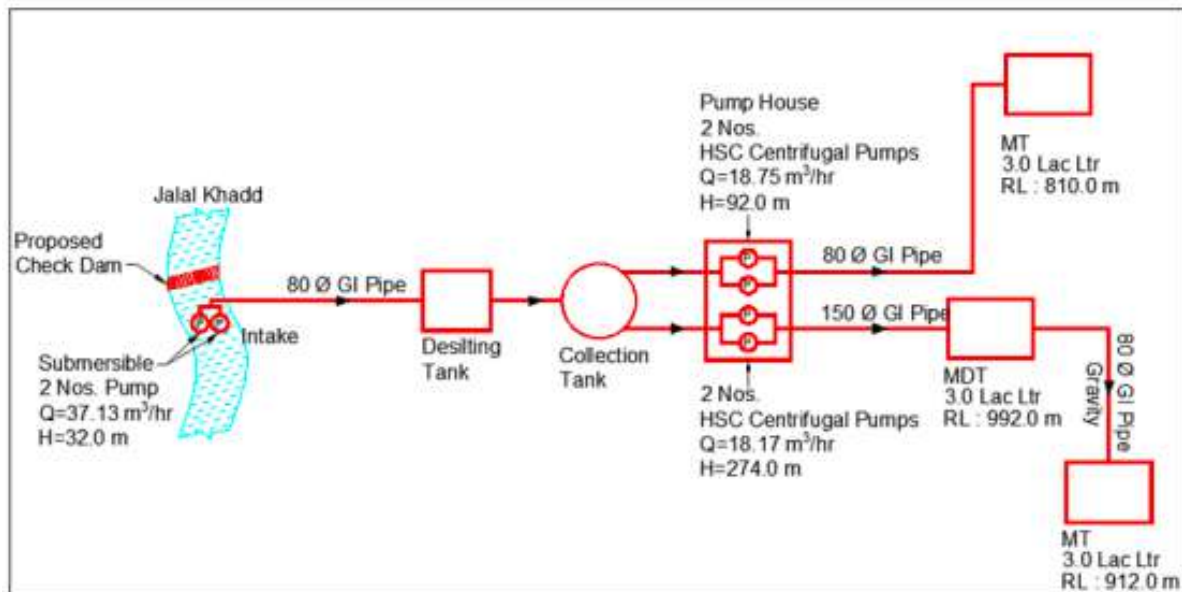
3. Proposed LIS Jungle Bhood – Simbhalwala & Bhogpur

Figure 31: Flow Diagram of Proposed LIS Jungle Bhood - Simbhalwala & Bhogpur



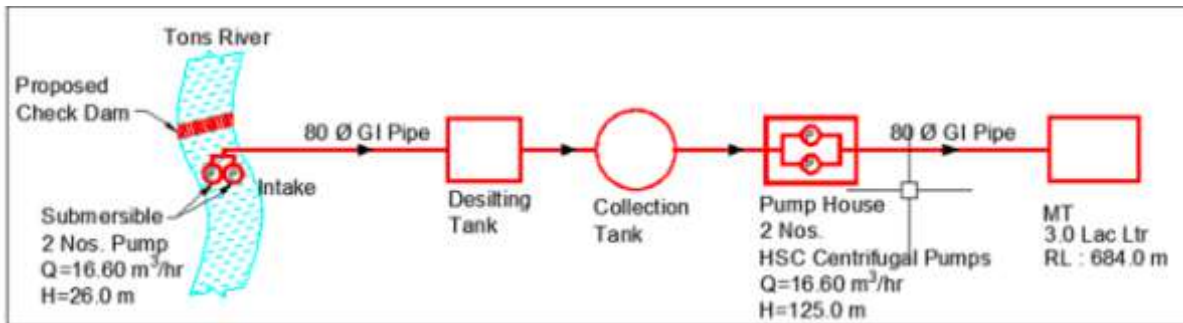
4. Proposed LIS – Khairi Chandan 1 & 2

Figure 32: Flow Diagram of Proposed LIS Khairi Chandan 1 & 2



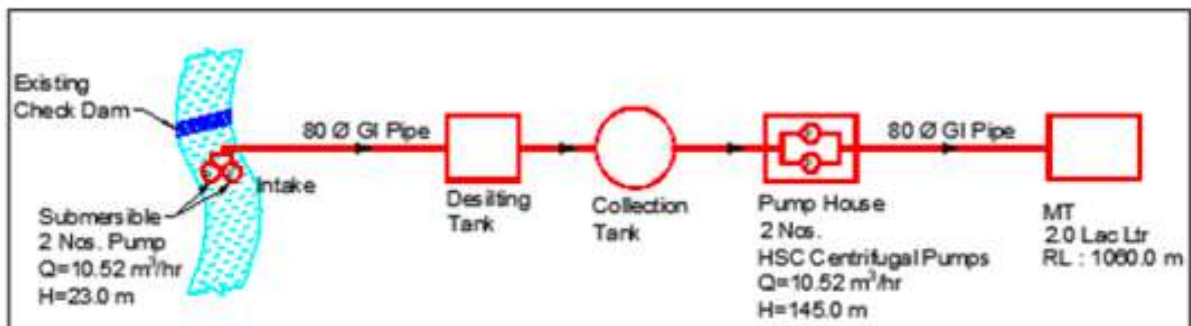
5. Proposed LIS – Judag

Figure 33: Flow Diagram of Proposed LIS Judag



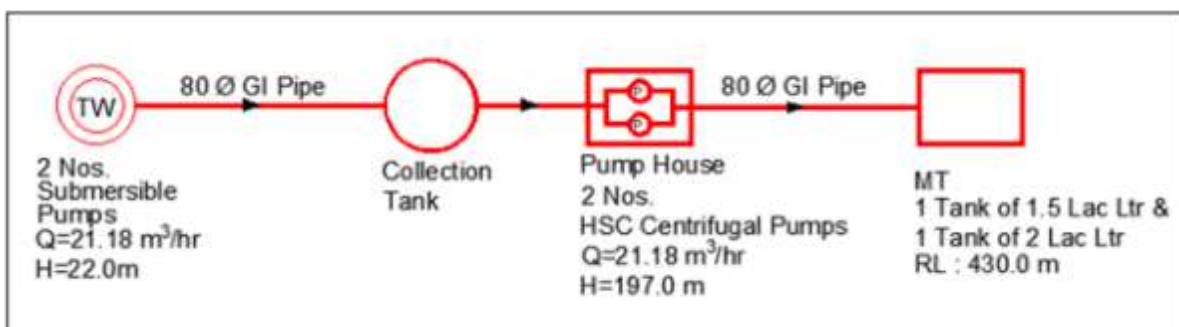
6. Proposed LIS – Goant

Figure 34: Flow Diagram of Proposed LIS Goant



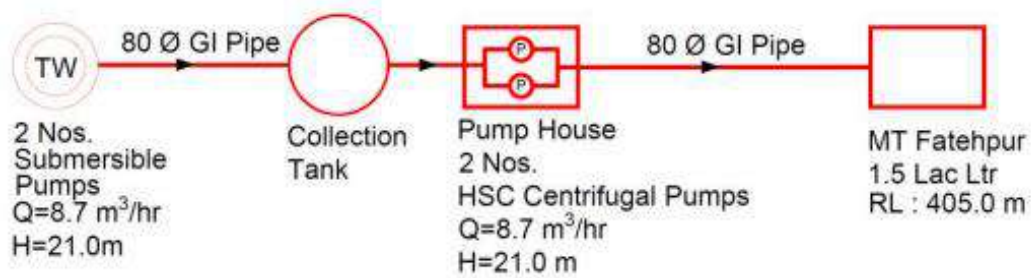
7. Proposed LIS – Budriyon

Figure 35: Flow Diagram of Proposed LIS Budriyon



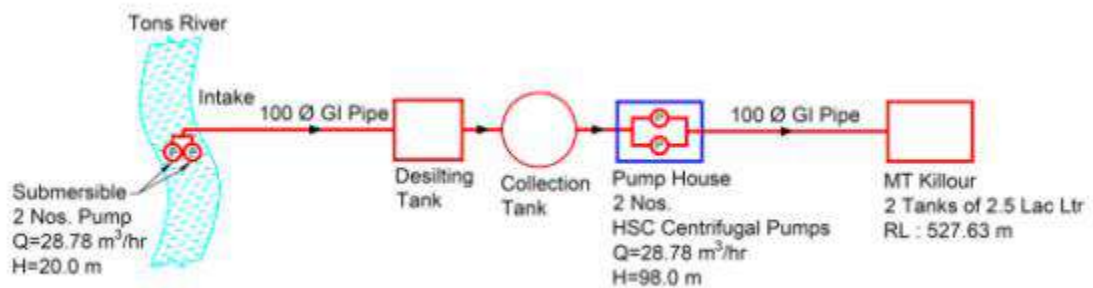
8. Proposed LIS – Fatehpur

Figure 36: Flow Diagram of Proposed LIS Fatehpur



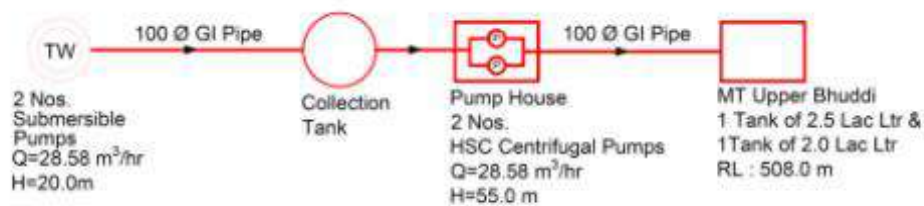
9. Proposed LIS – Killour

Figure 37: Flow Diagram of Proposed LIS Killour



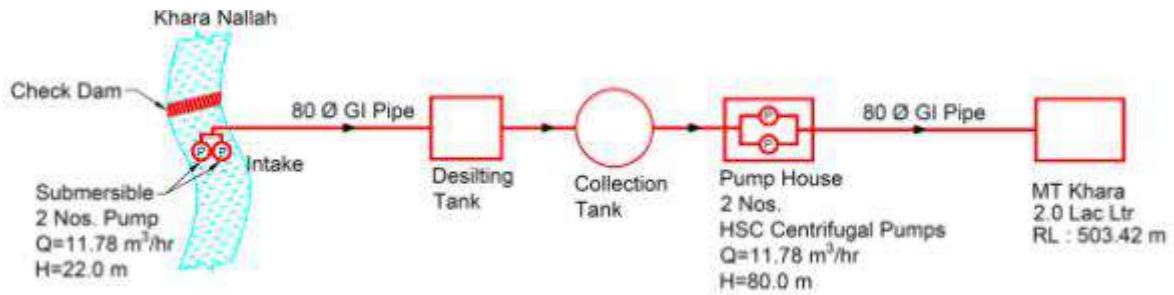
10. Proposed LIS – Upper Bhuddi

Figure 38: Flow Diagram of Proposed LIS Upper Bhuddi



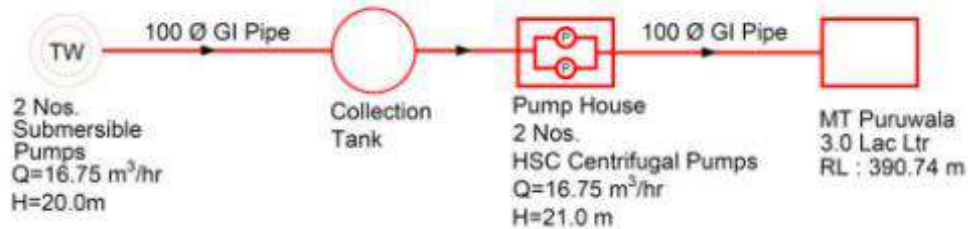
11. Proposed LIS – Khara

Figure 39: Flow Diagram of Proposed LIS Khara



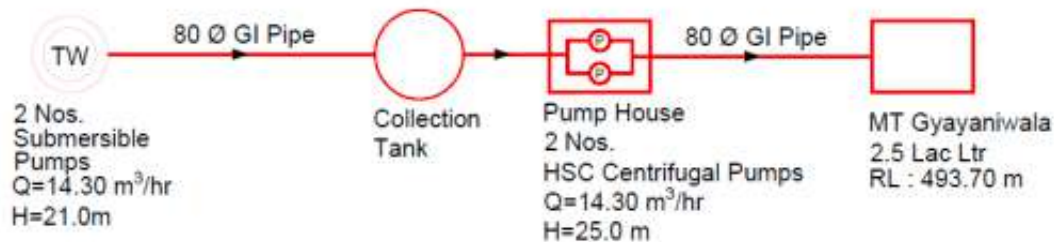
12. Proposed LIS – Puruwala

Figure 40: Flow Diagram of Proposed LIS Puruwala



13. Proposed LIS – Gyayaniwala

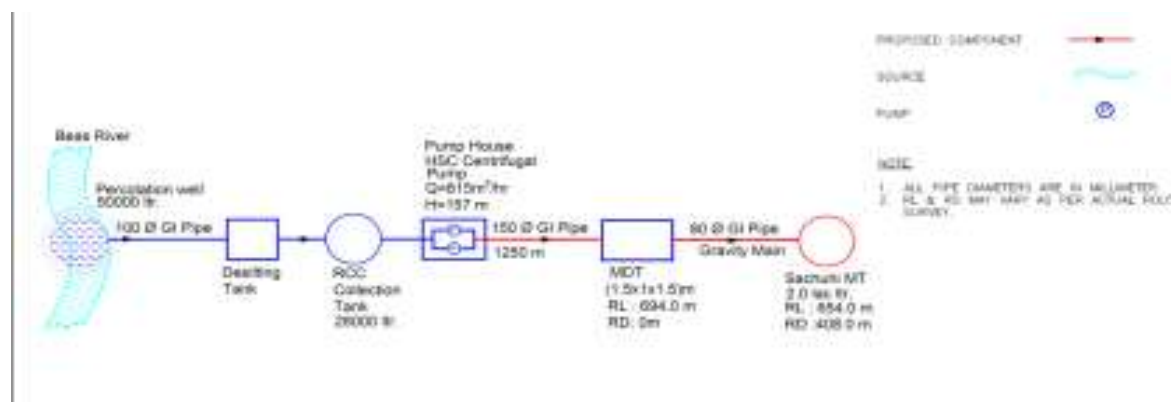
Figure 41: Flow Diagram of Proposed LIS Gyayaniwala



Irrigation Scheme flow-diagram of Package – 03 (Hamirpur District):

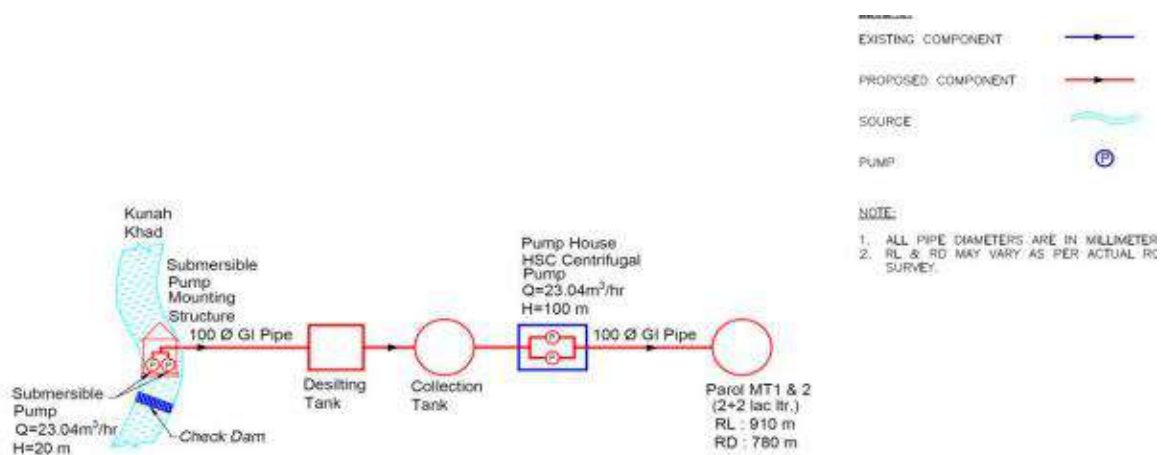
1. Proposed LIS – Sachuin

Figure 42: Flow Diagram of Proposed LIS Sachuin



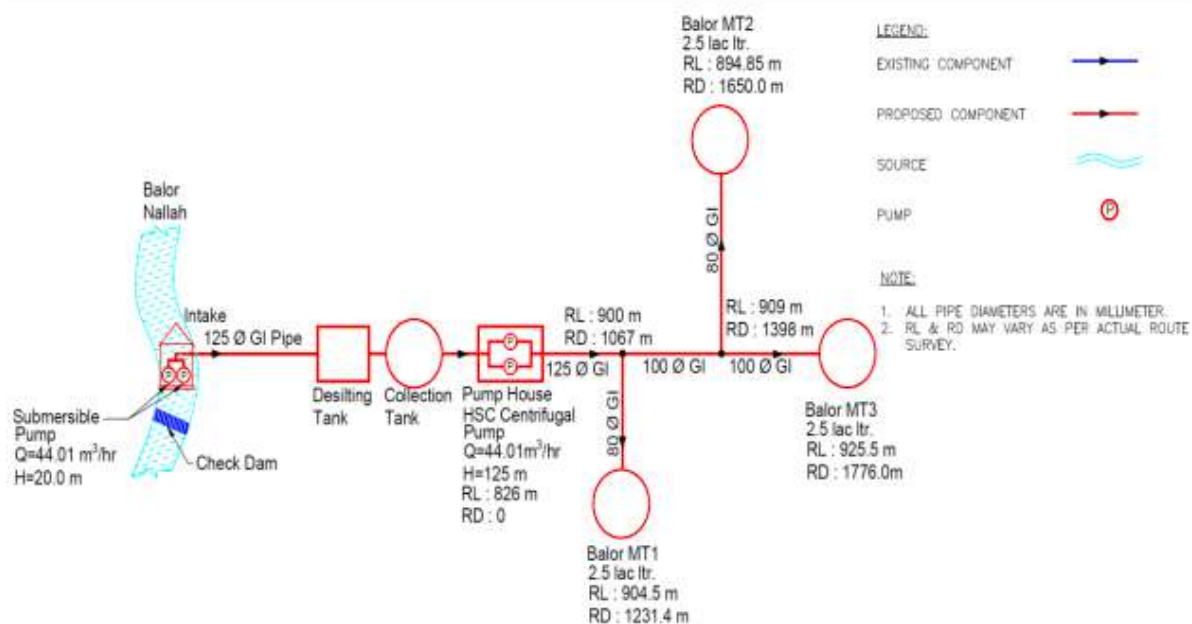
2. Proposed LIS – Dera Parol

Figure 43: Flow Diagram of Proposed LIS Dera Parol



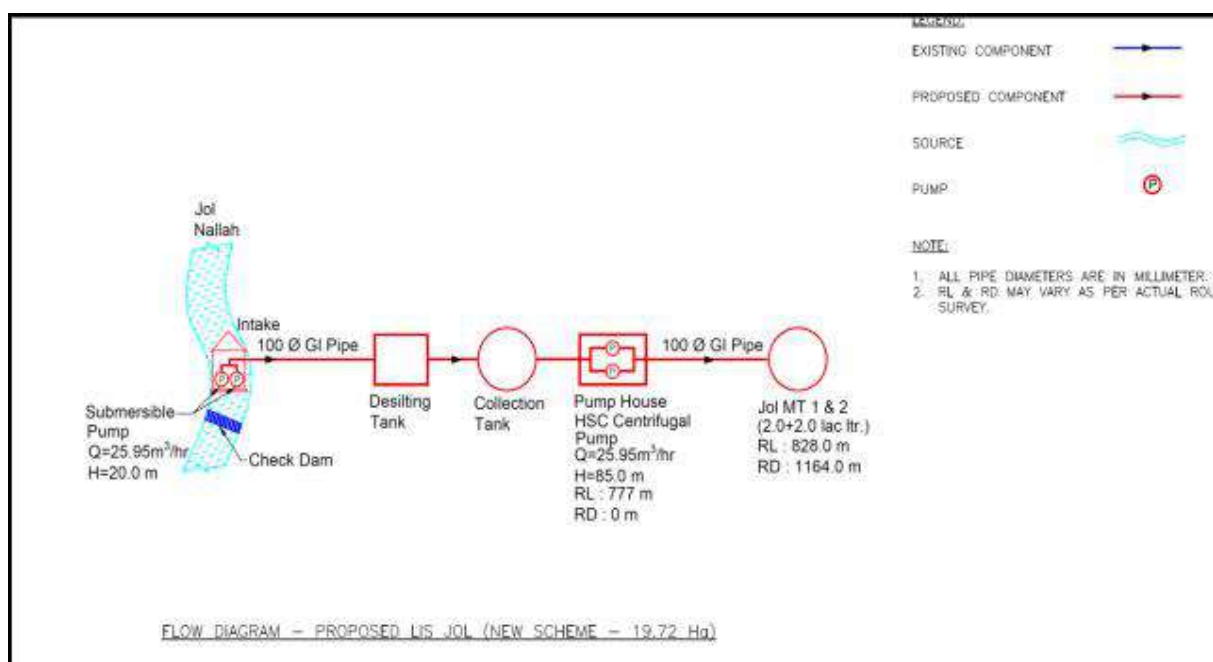
3. Proposed LIS – Balor-Sangrawar

Figure 44: Flow Diagram of Proposed LIS Balor-Sangrawar



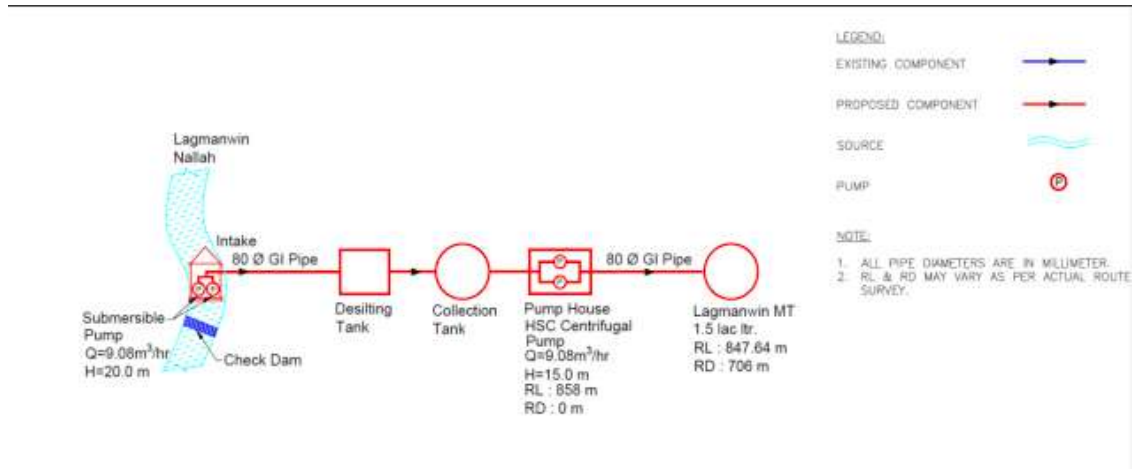
4. Proposed LIS – Jol

Figure 45: Flow Diagram of Proposed LIS Jol



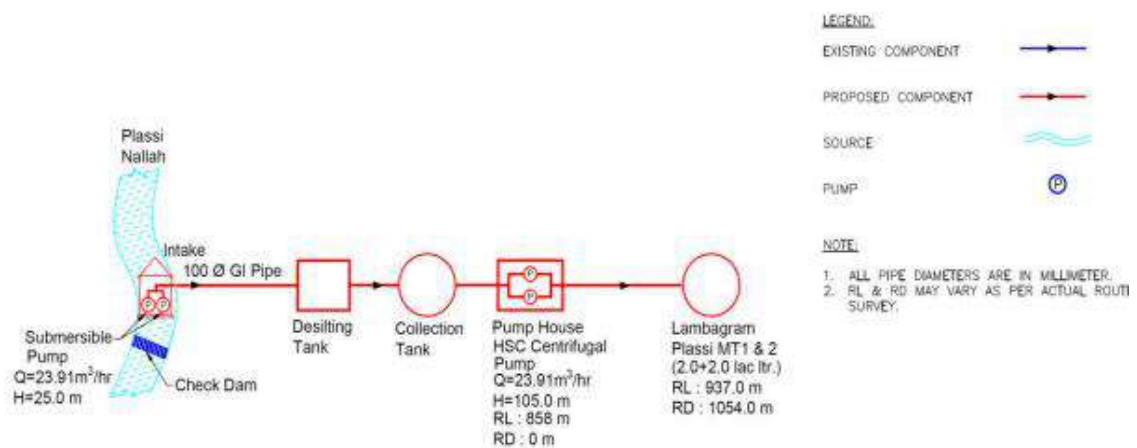
5. Proposed LIS – Lagmanwin

Figure 46: Flow Diagram of Proposed LIS Lagmanwin



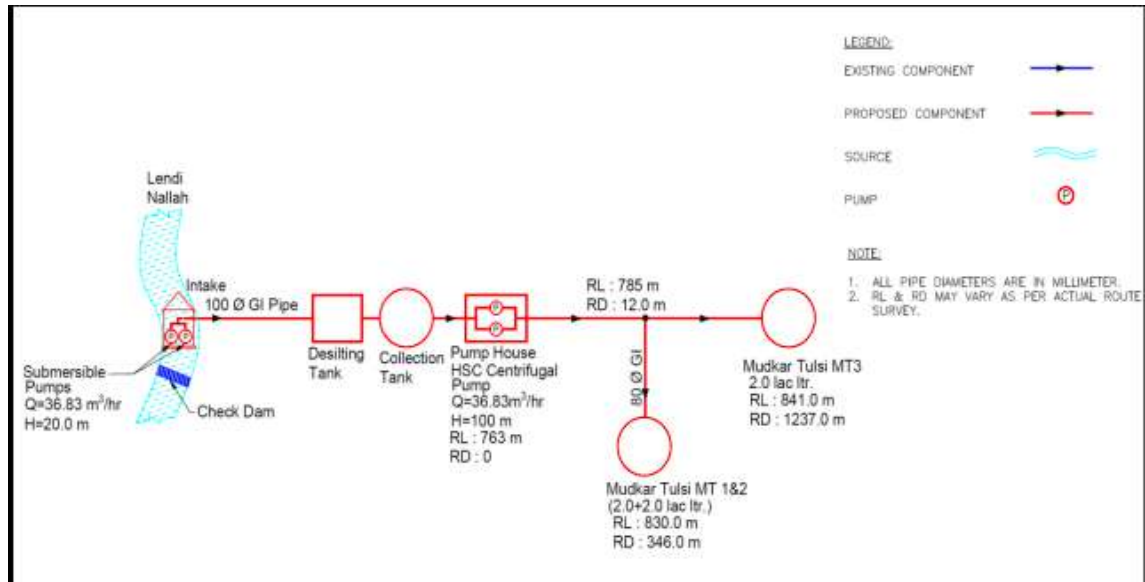
6. Proposed LIS – Lambagram/Palasi

Figure 47: Flow Diagram of Proposed LIS Lambagram/Palasi



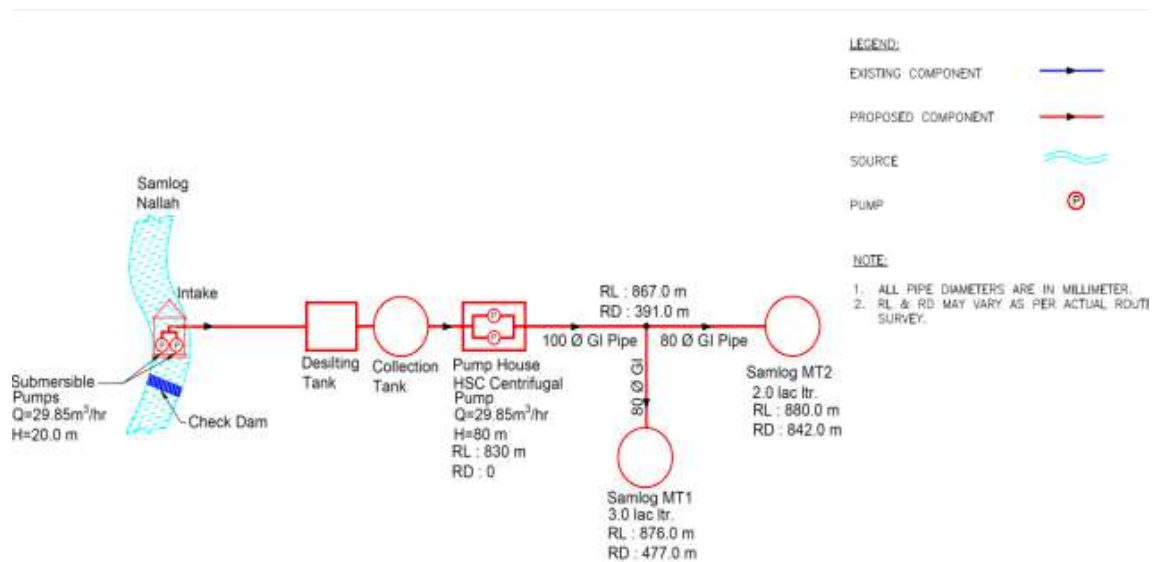
7. Proposed LIS – Mundkhar Tulsi

Figure 48: Flow Diagram of Proposed LIS Mundkhar Tulsi



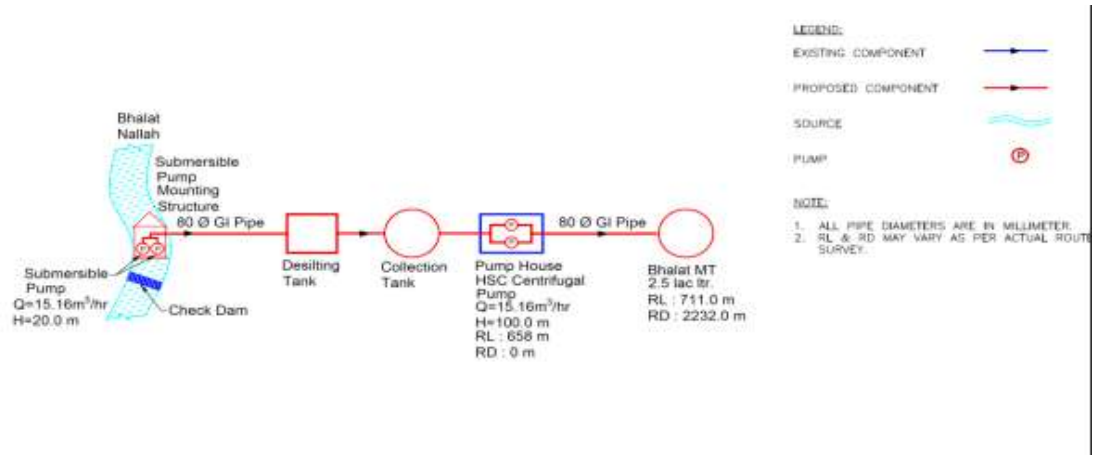
8. Proposed LIS – Samlog

Figure 49: Flow Diagram of Proposed LIS Samlog



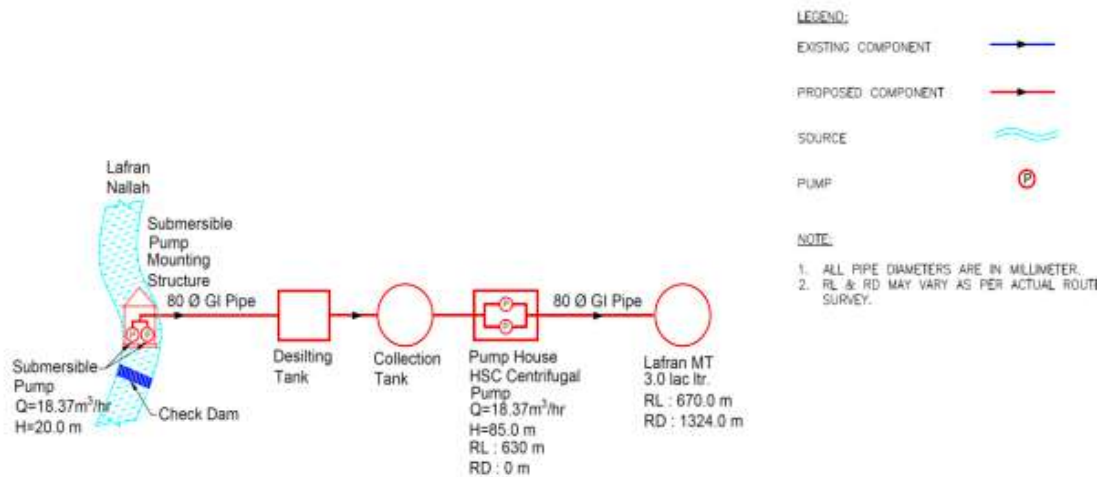
9. Proposed LIS – Bhalat

Figure 50: Flow Diagram of Proposed LIS Bhalat



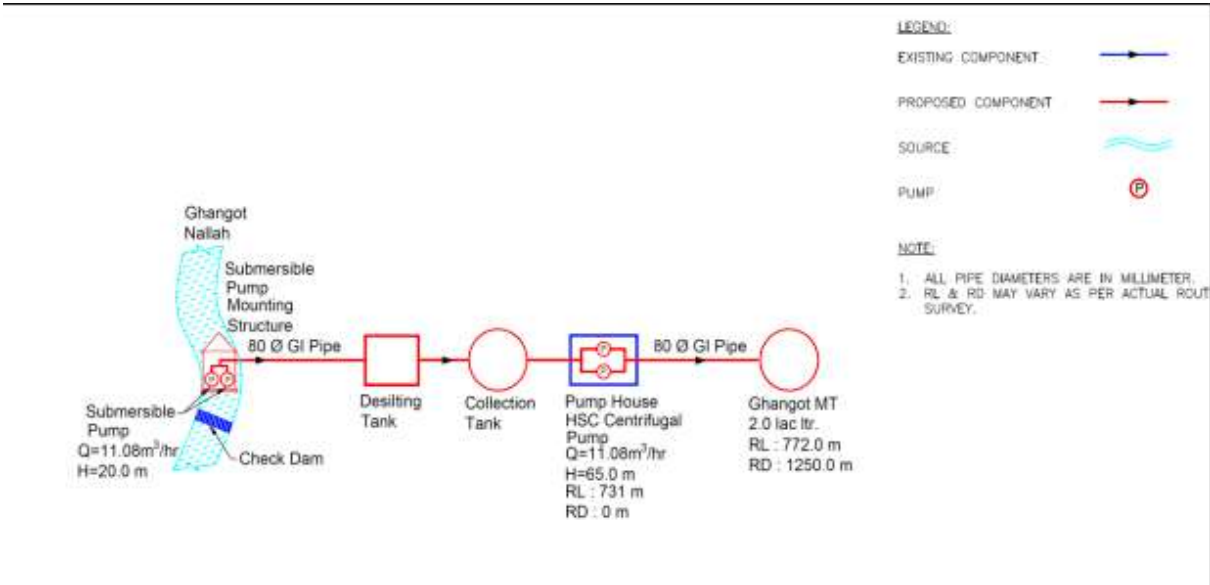
10. Proposed LIS – Lafran

Figure 51: Flow Diagram of Proposed LIS Lafran



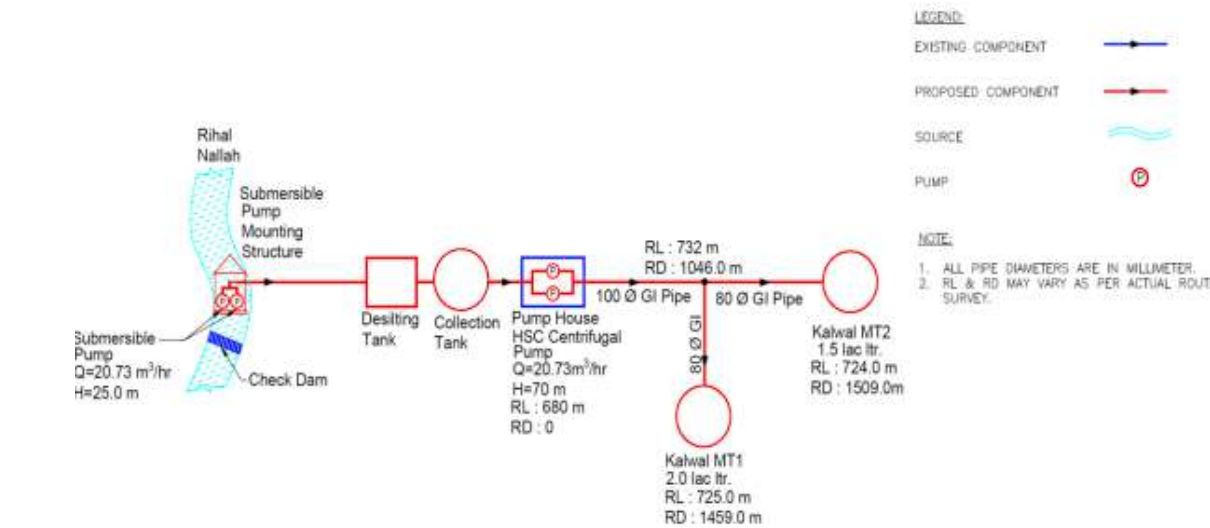
11. Proposed LIS – Ghangot

Figure 52: Flow Diagram of Proposed LIS Ghangot



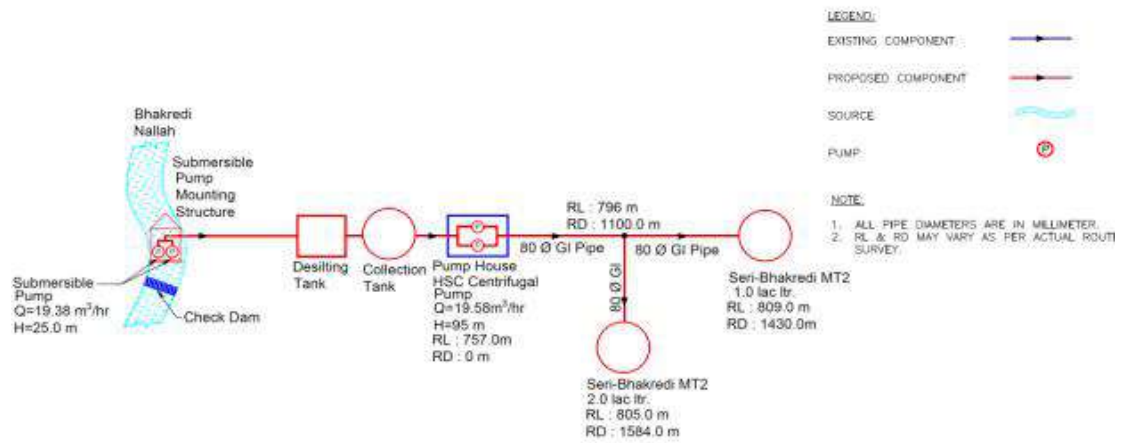
12. Proposed LIS – Kalwal

Figure 53: Flow Diagram of Proposed LIS Kalwal



13. Proposed LIS – Seri-Bhakredi

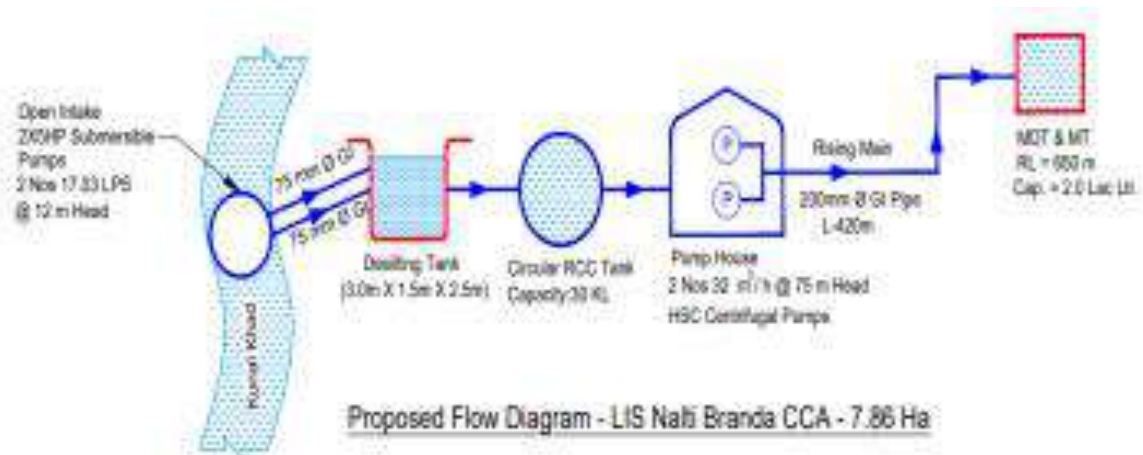
Figure 54: Flow Diagram of Proposed LIS Seri-Bhakredi



Irrigation Scheme flow-diagram of Package – 04 (Hamirpur District):

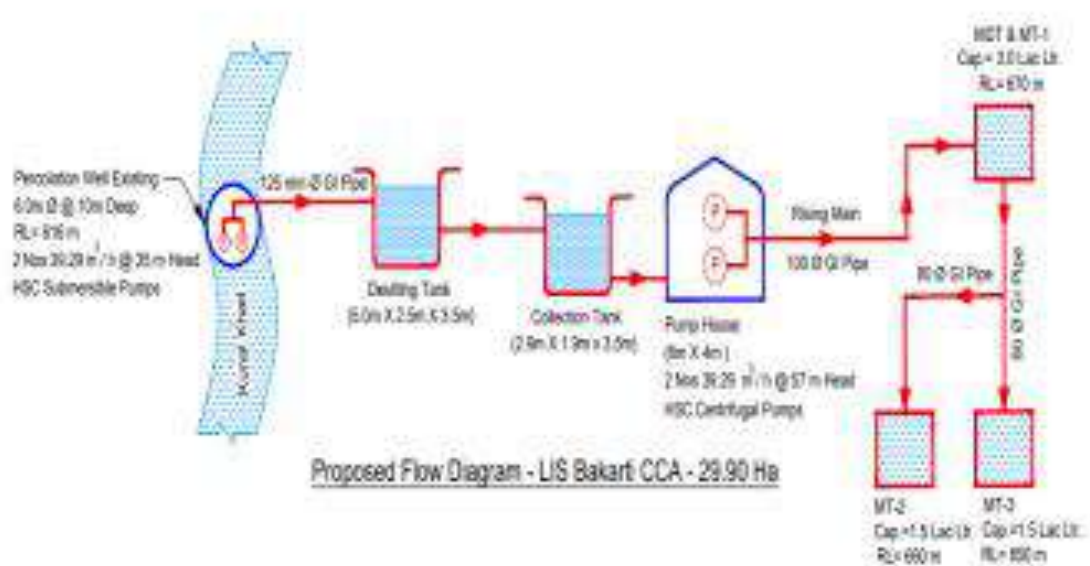
1. Proposed LIS – Nalti Branda

Figure 55: Flow Diagram of Proposed LIS Nalti Branda



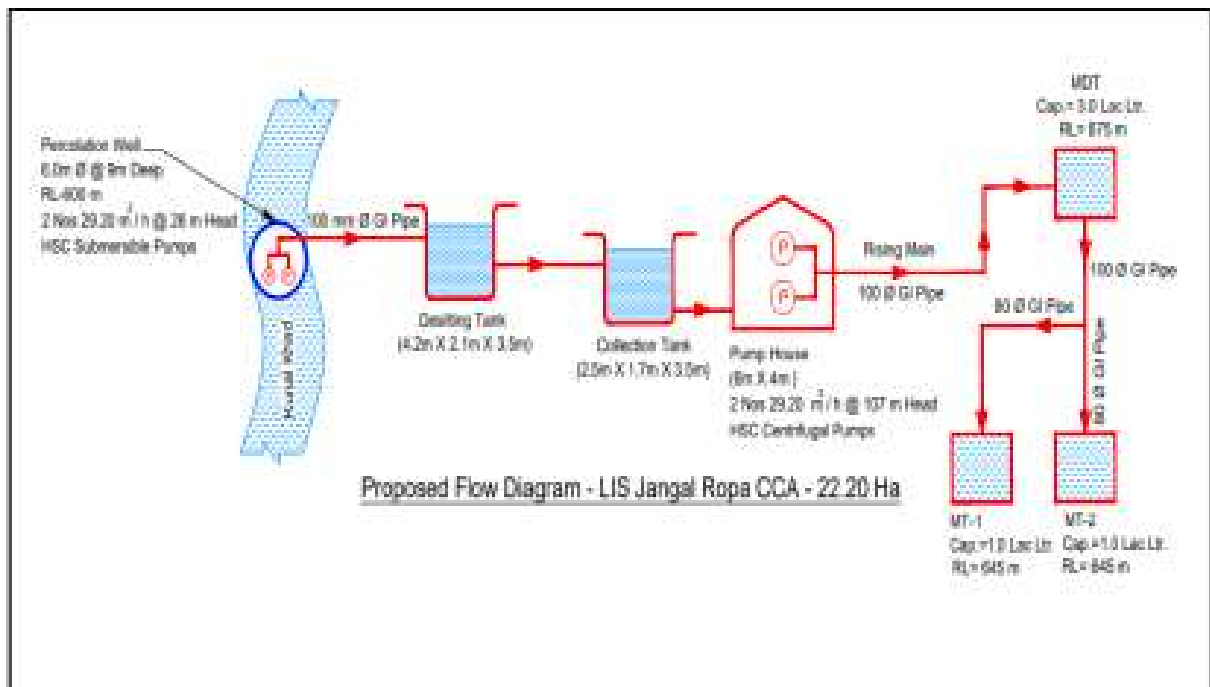
2. Proposed LIS – Bakarti-I

Figure 56: Flow Diagram of Proposed LIS Bakarti-I



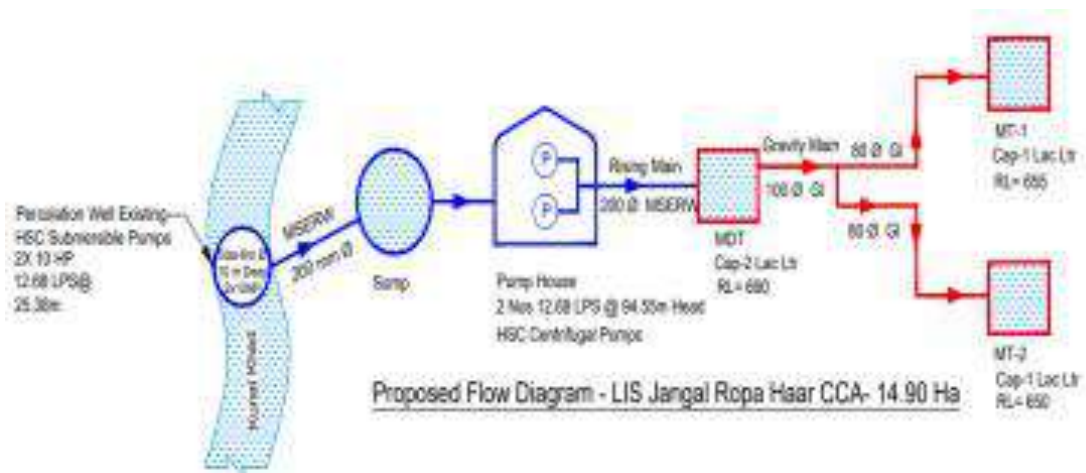
3. Proposed LIS – Jangal Ropa

Figure 57: Flow Diagram of Proposed LIS Jangal Ropa



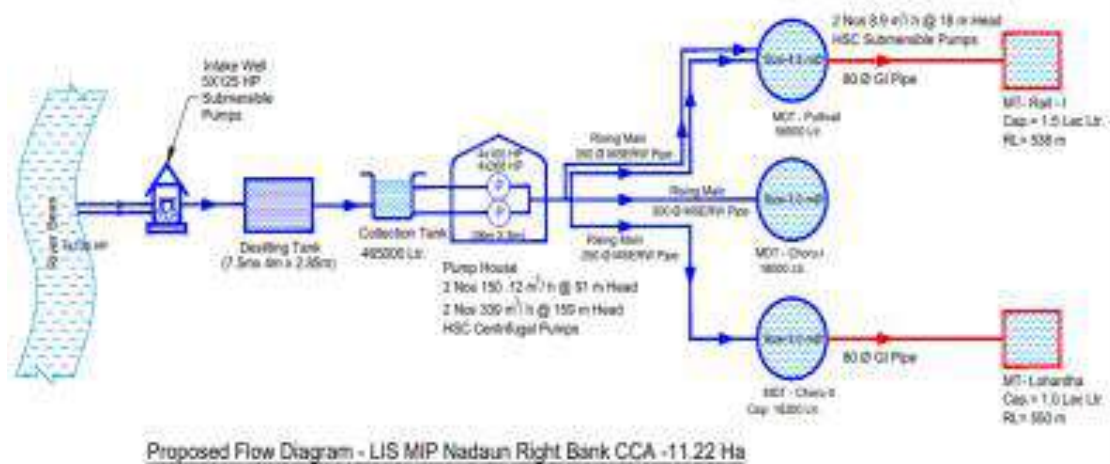
4. Proposed LIS – Jangal Ropa Haar

Figure 58: Flow Diagram of Proposed LIS Jangal Ropa Haar



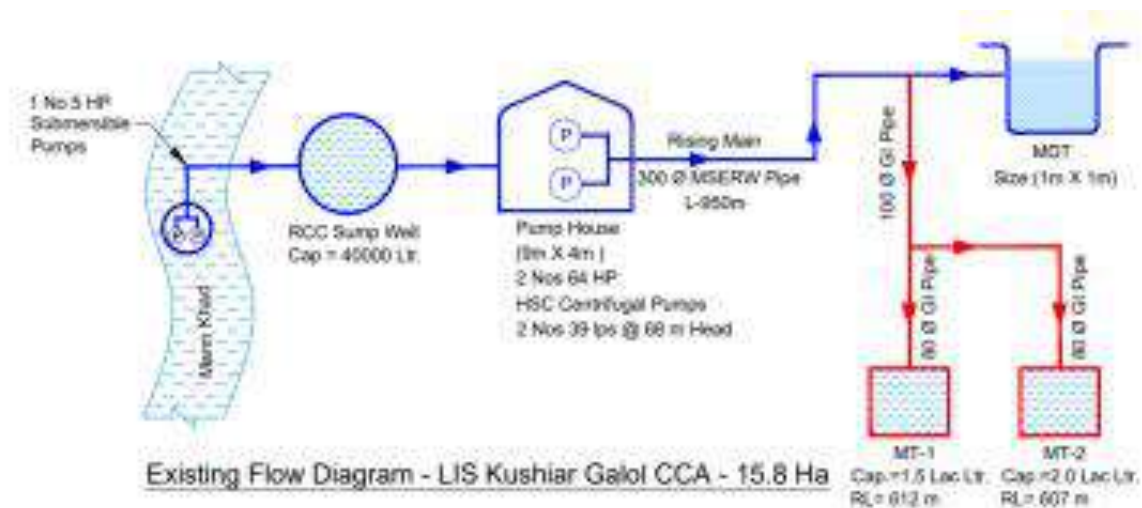
7. Proposed LIS – MIP Nadaun Right Bank

Figure 61: Flow Diagram of Proposed LIS MIP Nadaun Right Bank



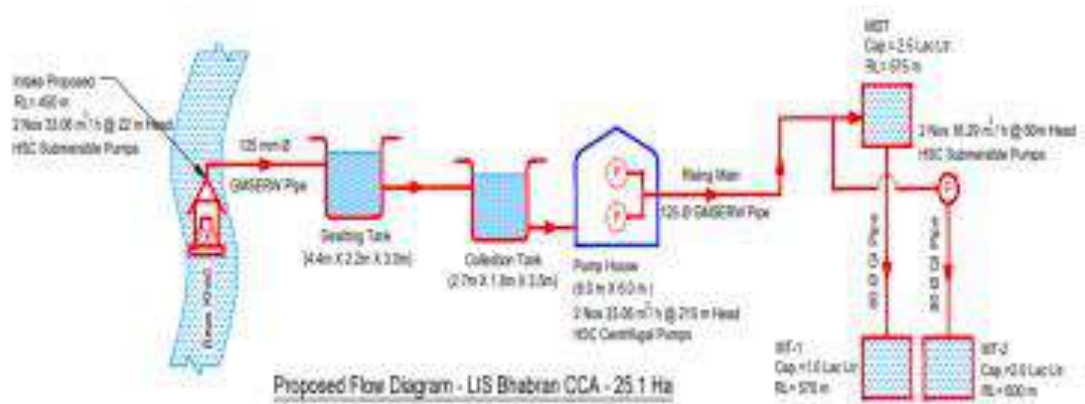
8. Proposed LIS – Kushiar Galol

Figure 62: Flow Diagram of Proposed LIS Kushiar Galol



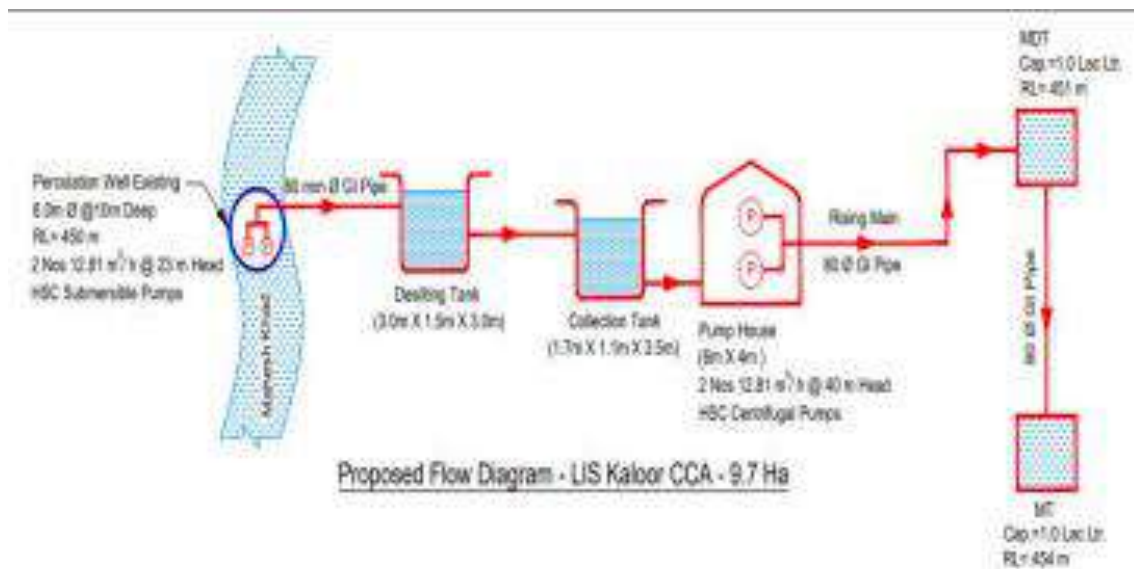
9. Proposed LIS – Bhabran

Figure 63: Flow Diagram of Proposed LIS Bhabran



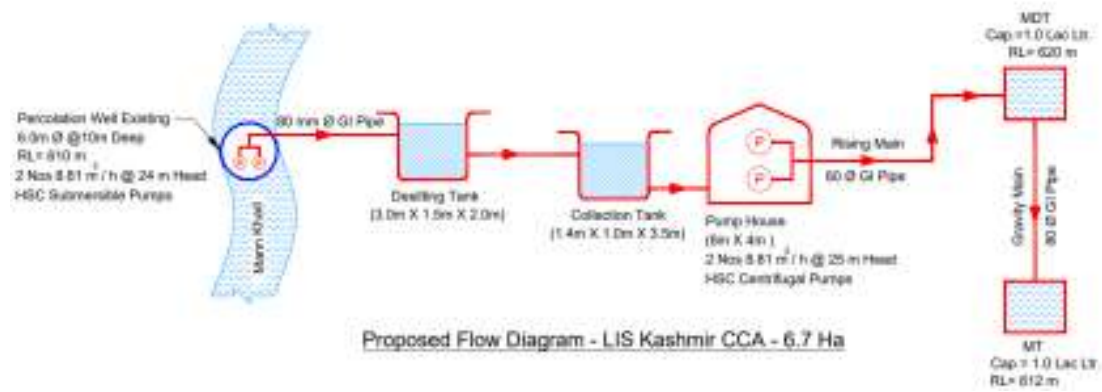
10. Proposed LIS – Kaloor

Figure 64: Flow Diagram of Proposed LIS Kaloor



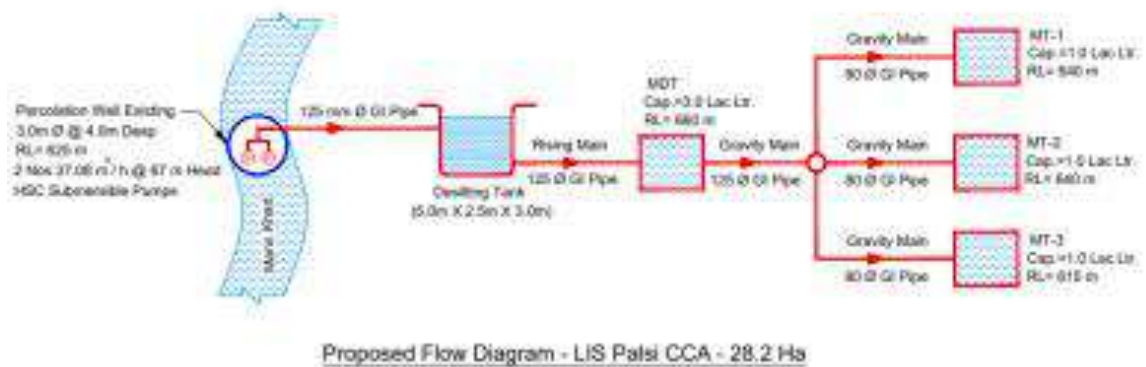
11. Proposed LIS – Kashmir

Figure 65: Flow Diagram of Proposed LIS Kashmir



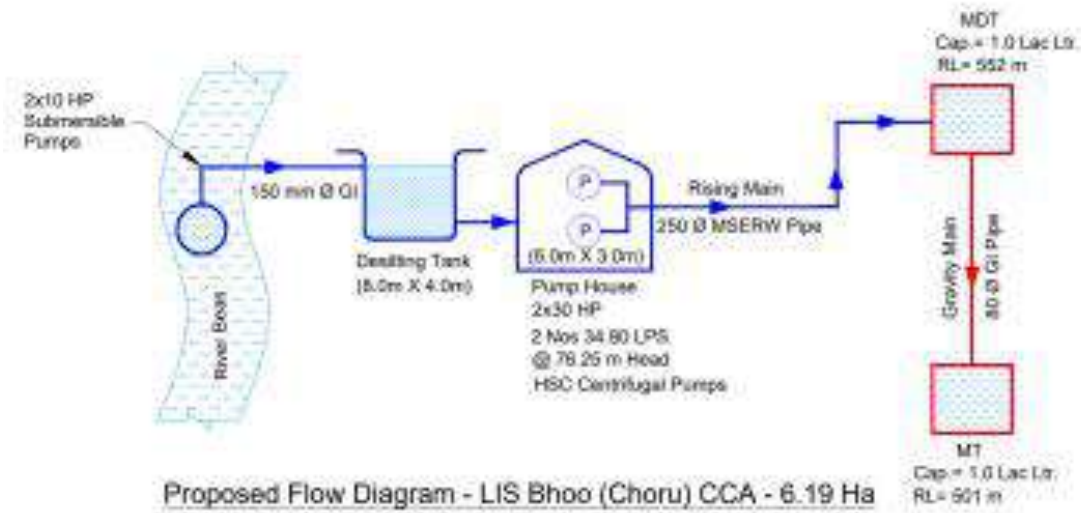
12. Proposed LIS – Palsi

Figure 66: Flow Diagram of Proposed LIS Palsi



13. Proposed LIS – Bhoo

Figure 67: Flow Diagram of Proposed LIS Bhoo



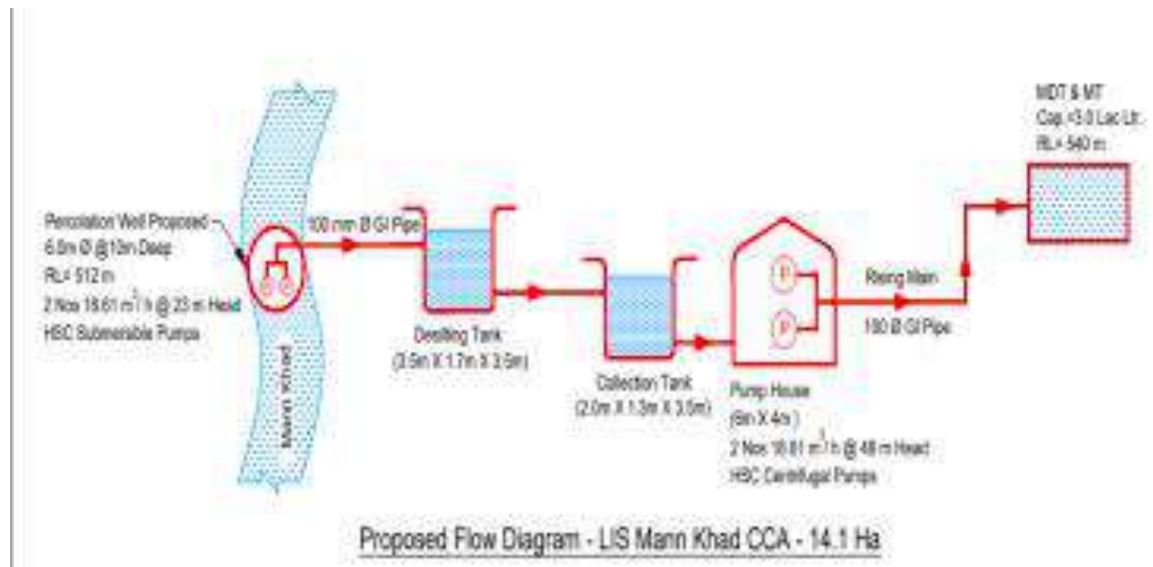
14. Proposed LIS – Salasi Nallah

Figure 68: Flow Diagram of Proposed LIS Salasi Nallah



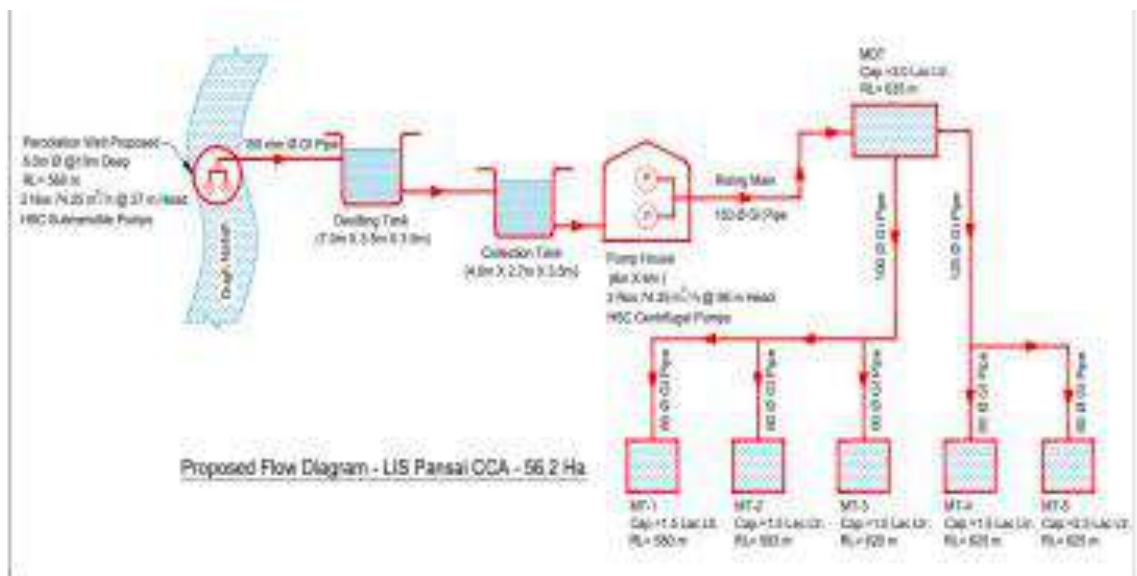
15. Proposed LIS – Mann Khad

Figure 69: Flow Diagram of Proposed LIS Mann Khad



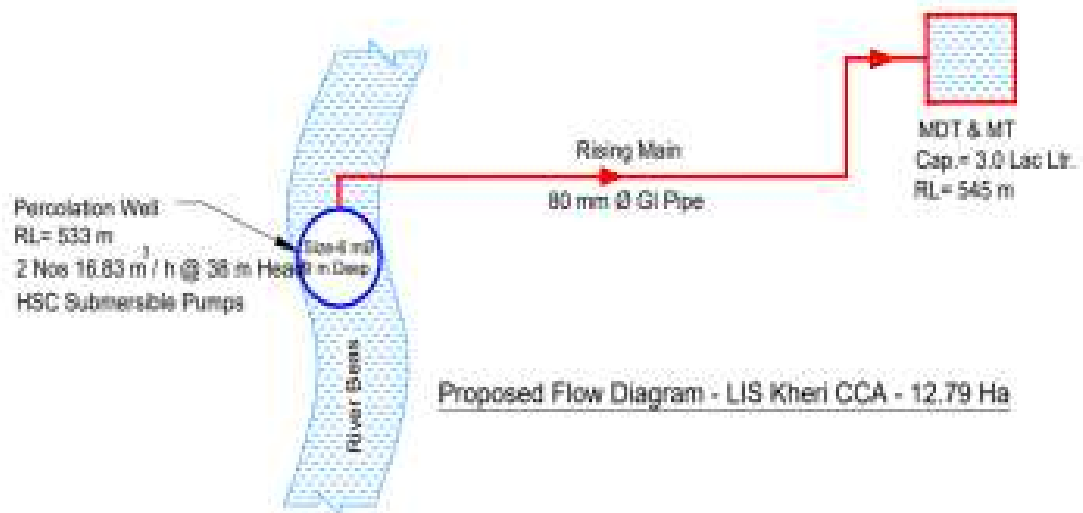
16. Proposed LIS – Pansai

Figure 70: Flow Diagram of Proposed LIS Pansai



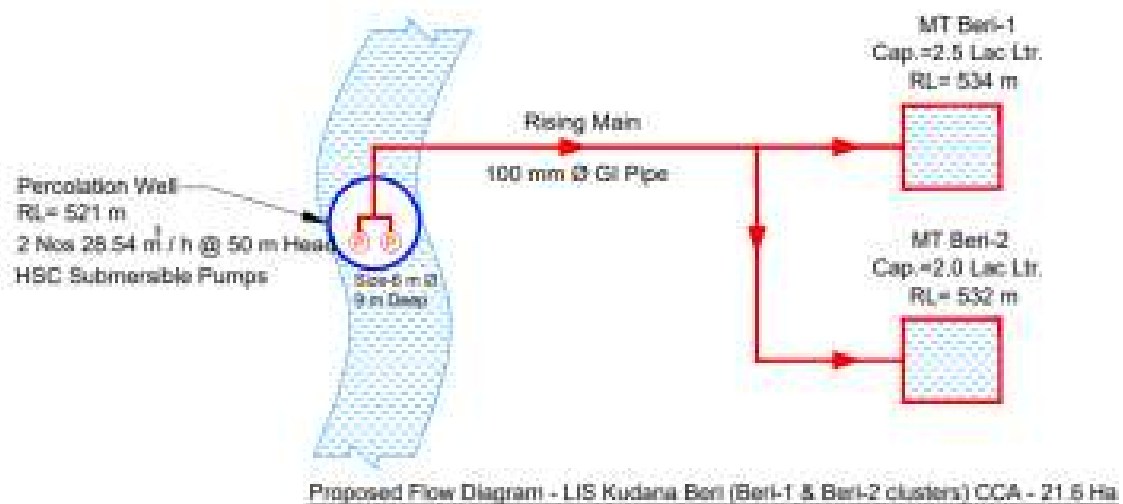
17. Proposed LIS – Kheri

Figure 71: Flow Diagram of Proposed LIS Kheri



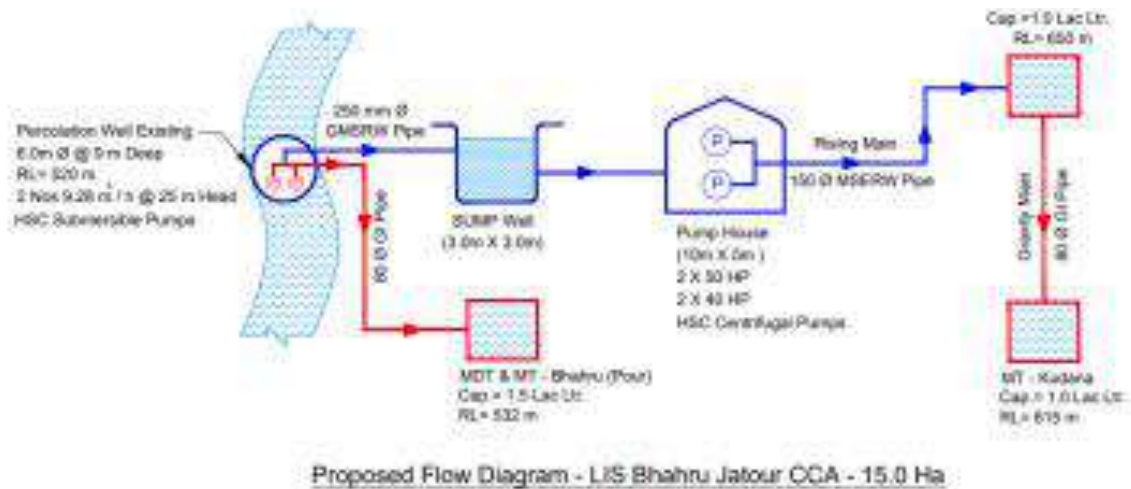
18. Proposed LIS – Kudana Beri

Figure 72: Flow Diagram of Proposed LIS Kudana Beri



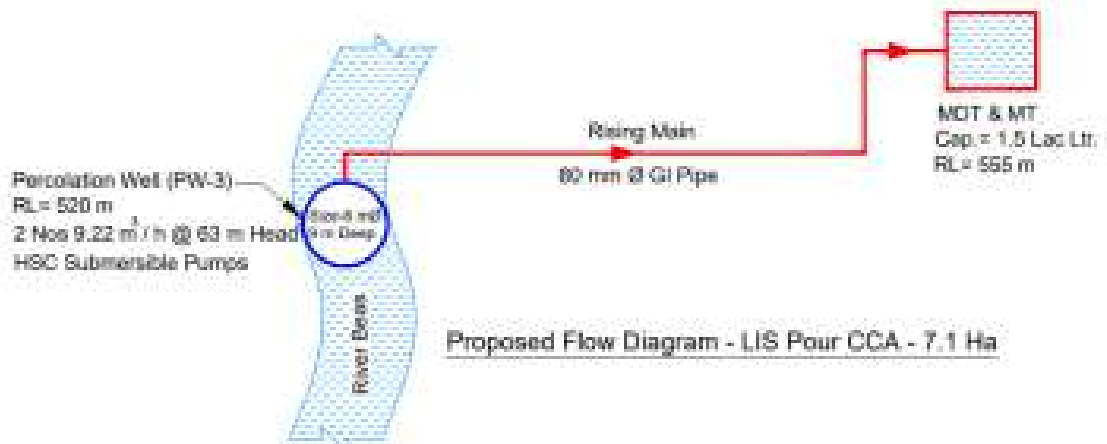
19. Proposed LIS – Bhahru Jatour

Figure 73: Flow Diagram of Proposed LIS Bhahru Jatour



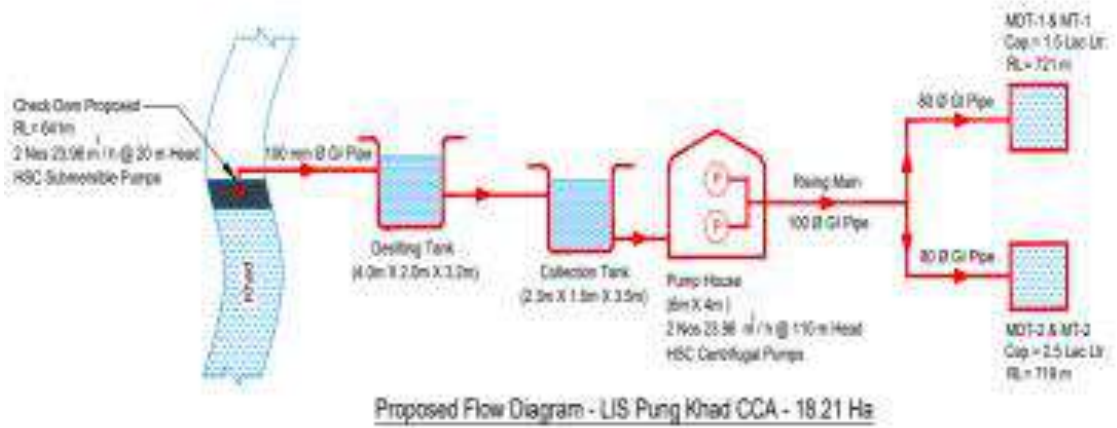
20. Proposed LIS – Pour

Figure 74: Flow Diagram of Proposed LIS Pour



21. Proposed LIS – Pung Khad

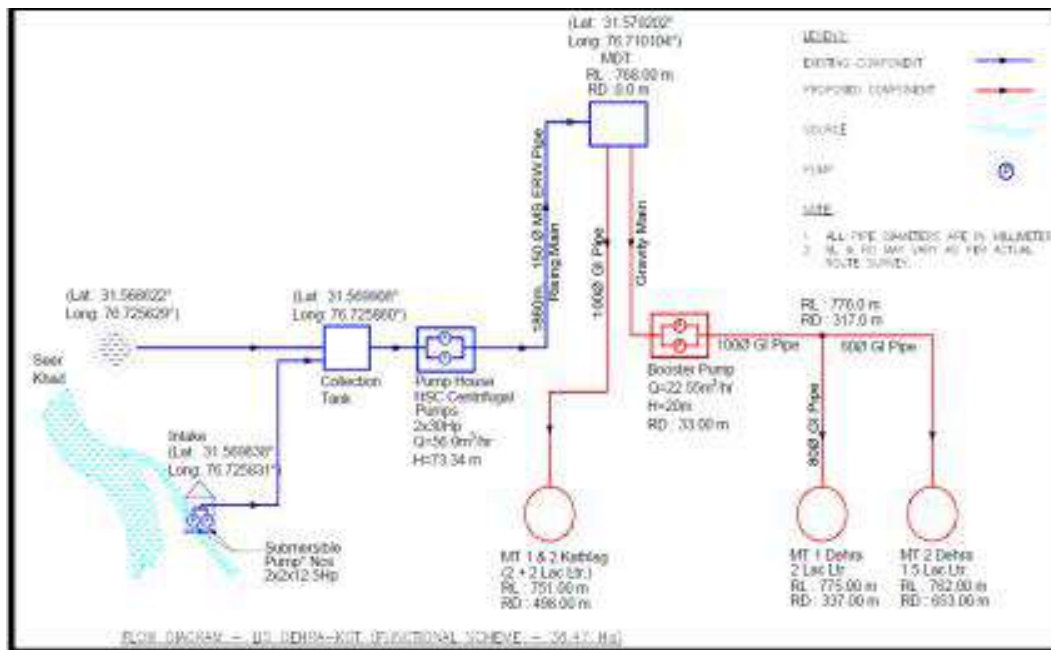
Figure 75: Flow Diagram of Proposed LIS Pung Khad



Irrigation Scheme flow-diagram of Package – 5 (Bilaspur District):

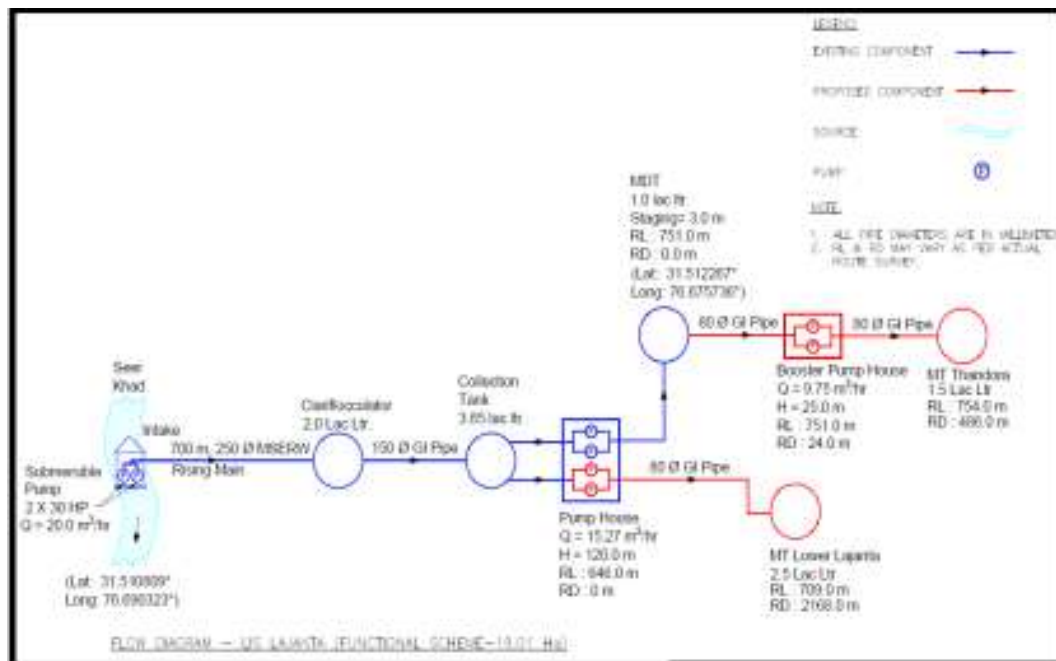
1. Proposed LIS – Dehra Kot

Figure 76: Flow Diagram of Proposed LIS Dehra Kot



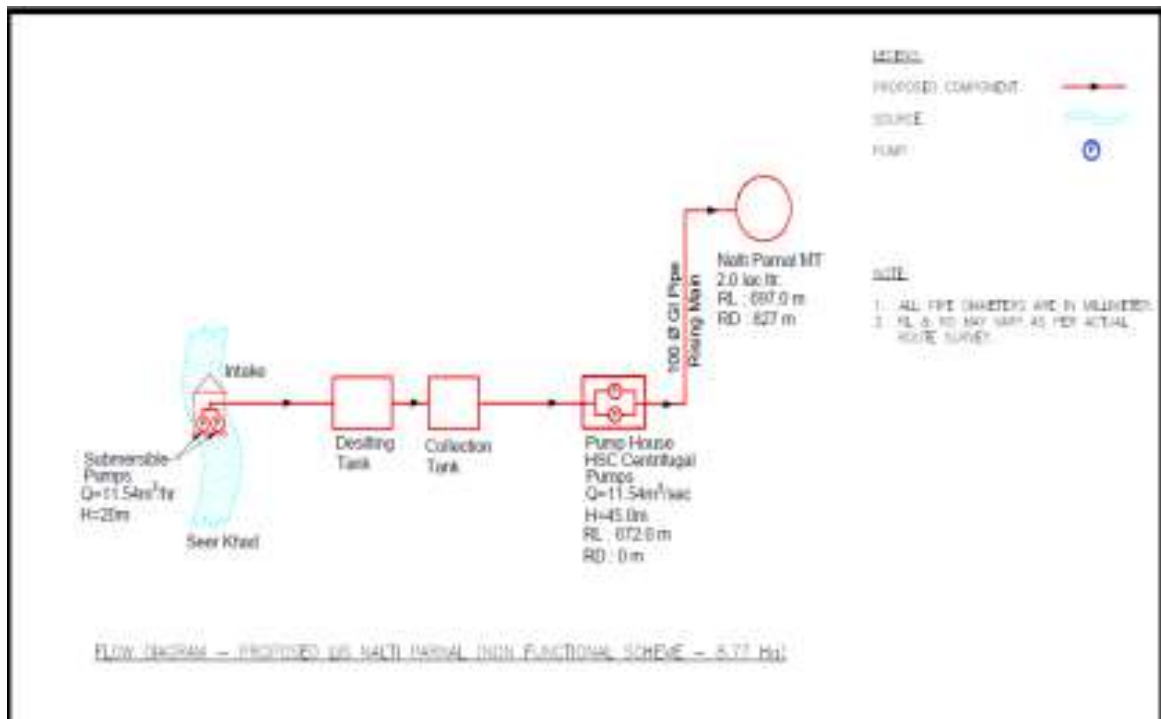
2. Proposed LIS – Lajanthia

Figure 77: Flow Diagram of Proposed LIS Lajanthia



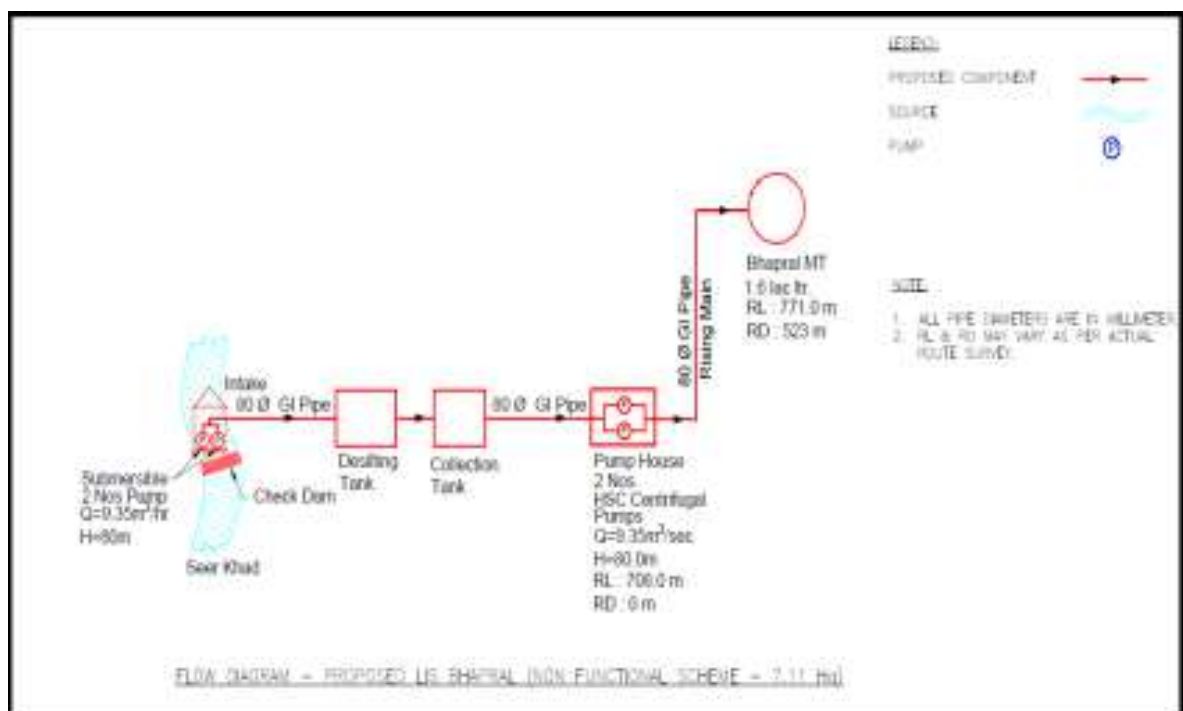
5. Proposed LIS – Nalti Parnal

Figure 80: Flow Diagram of Proposed LIS Nalti Parnal



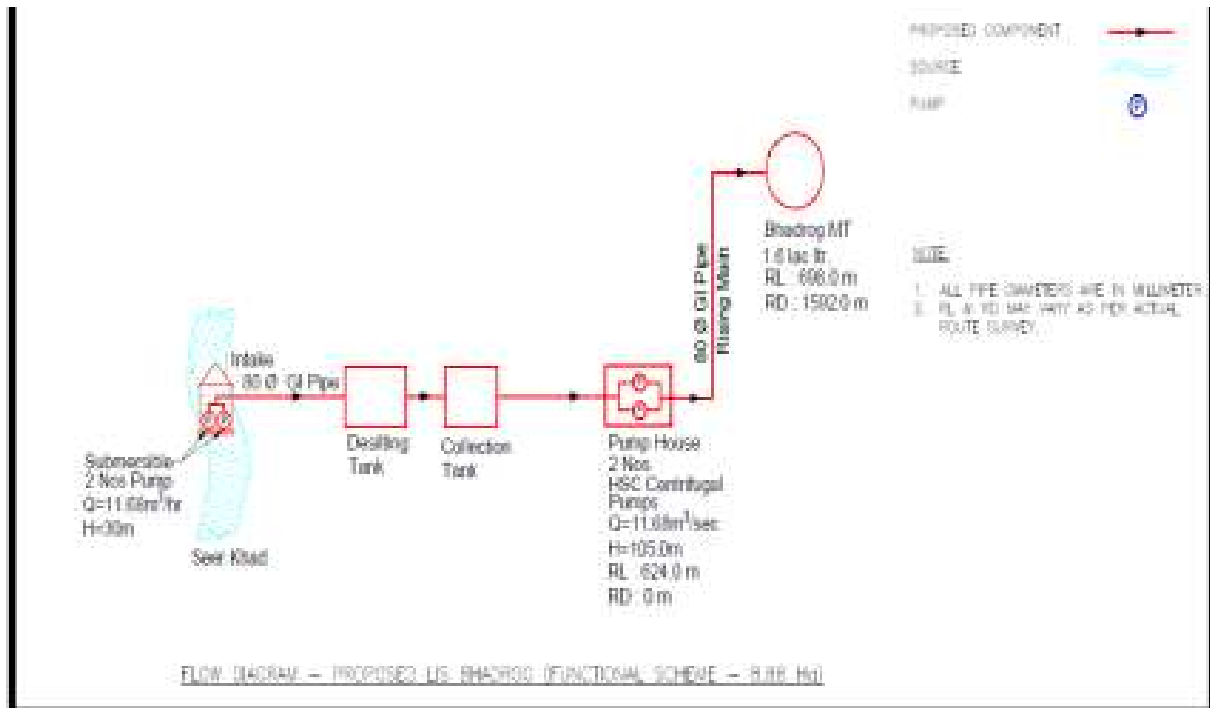
6. Proposed LIS – Bhapral

Figure 81: Flow Diagram of Proposed LIS Bhapral



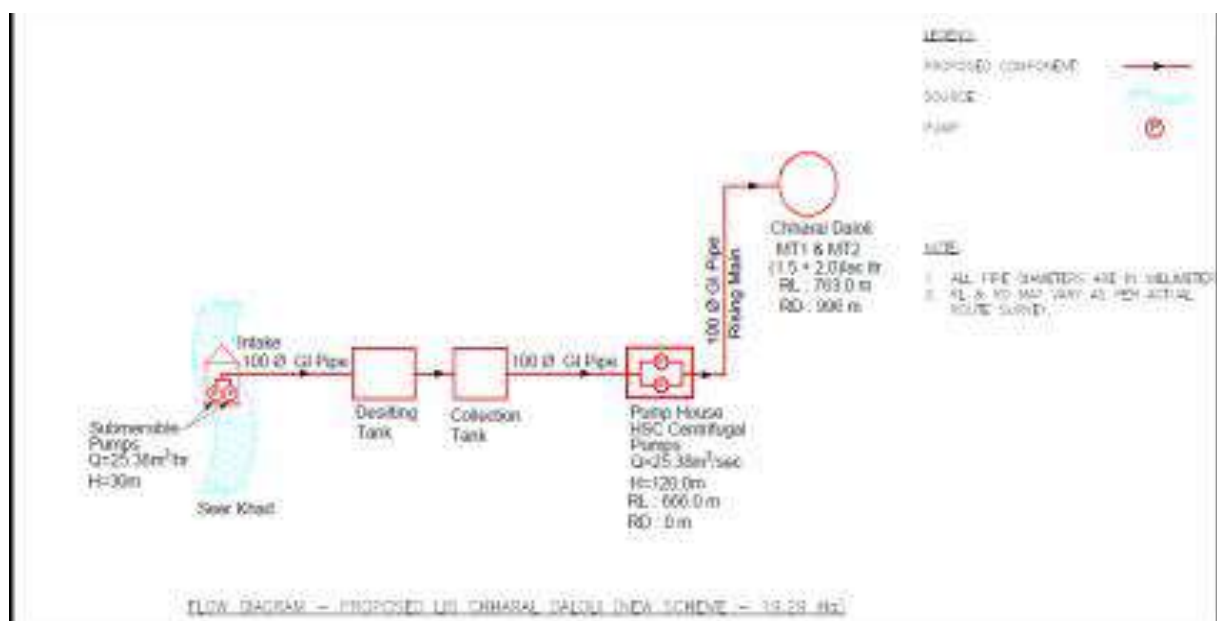
7. Proposed LIS – Bhadrog

Figure 82: Flow Diagram of Proposed LIS Bhadrog



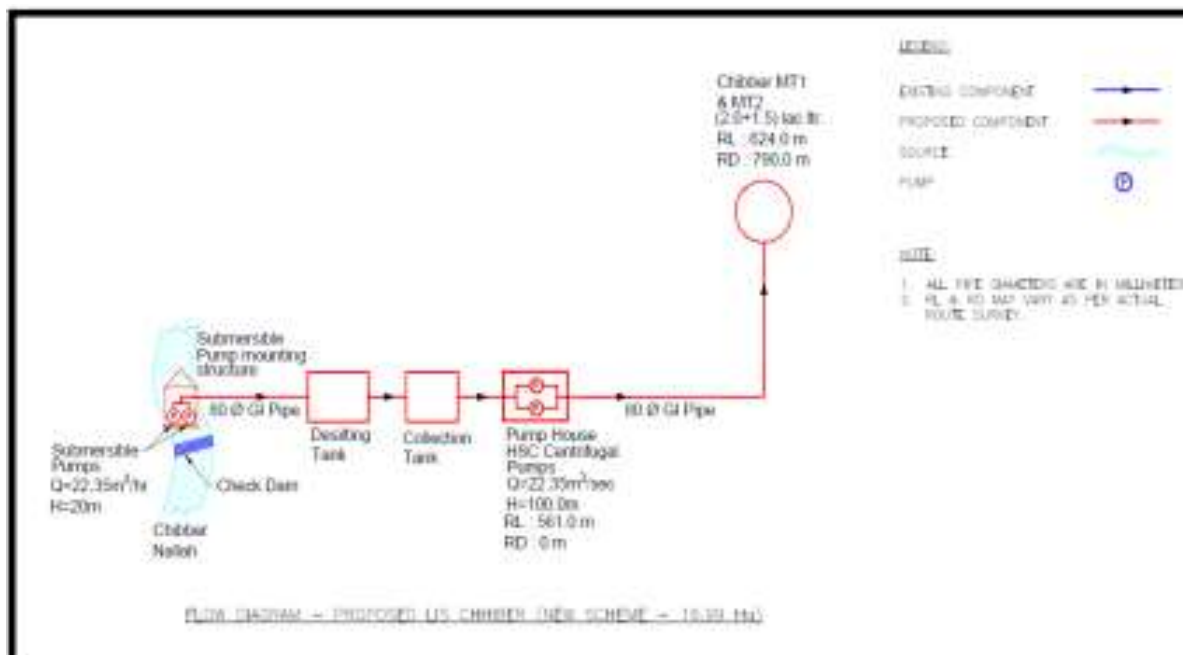
8. Proposed LIS – Chharal

Figure 83: Flow Diagram of Proposed LIS Chharal



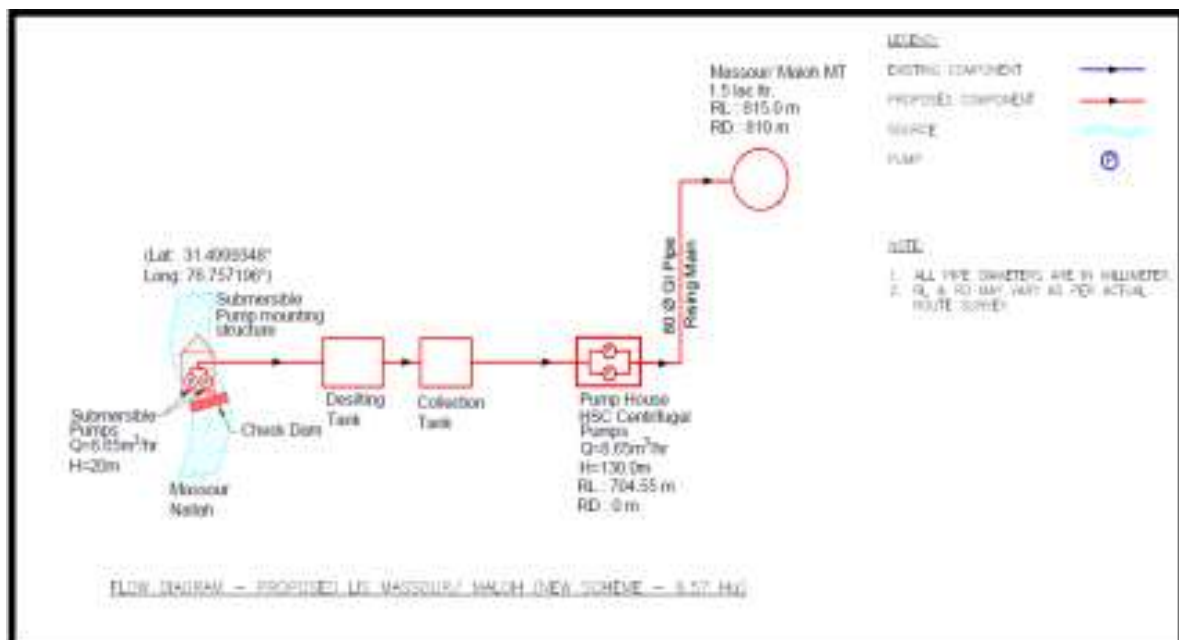
9. Proposed LIS – Chhiber

Figure 84: Flow Diagram of Proposed LIS Chhiber



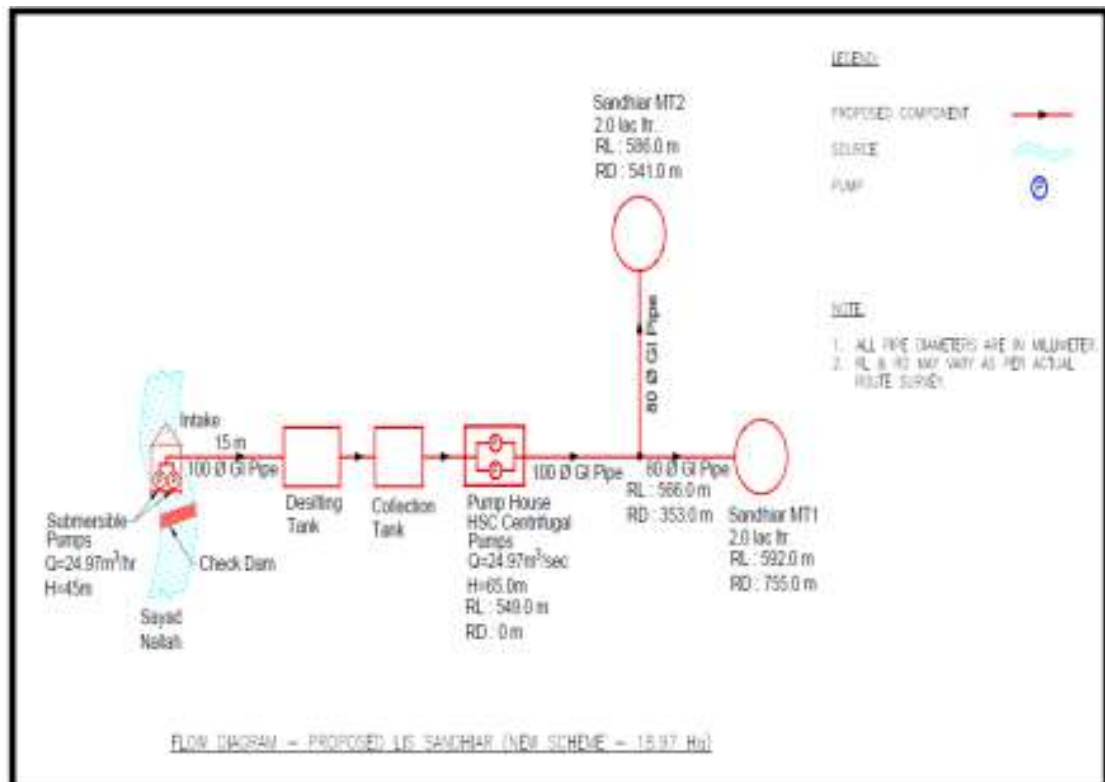
10. Proposed LIS – Massour / Malloh

Figure 85: Flow Diagram of Proposed LIS Massour / Malloh



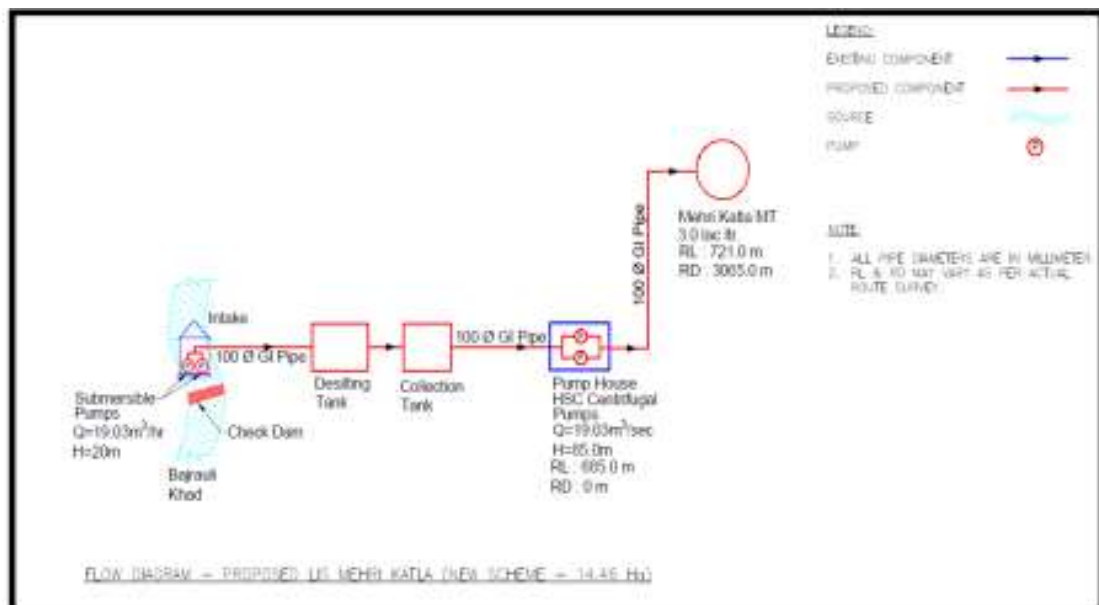
11. Proposed LIS – Sandhihar

Figure 86: Flow Diagram of Proposed LIS Sandhihar



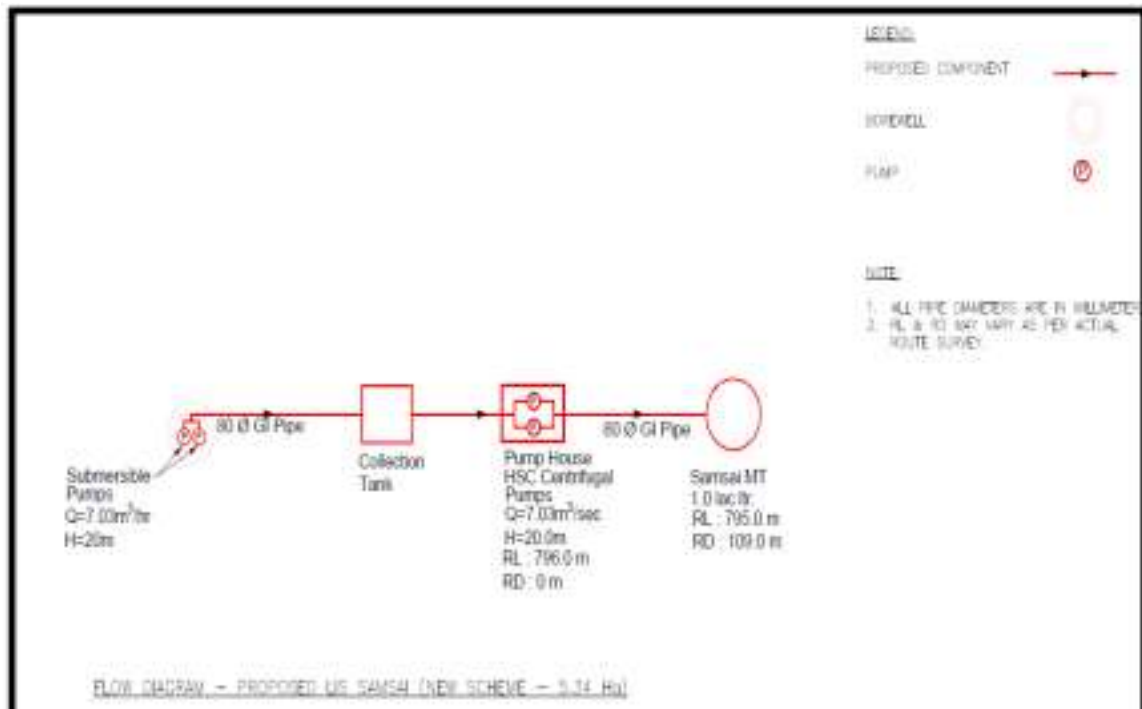
12. Proposed LIS – Meri Kathla

Figure 87: Flow Diagram of LIS Meri Kathla



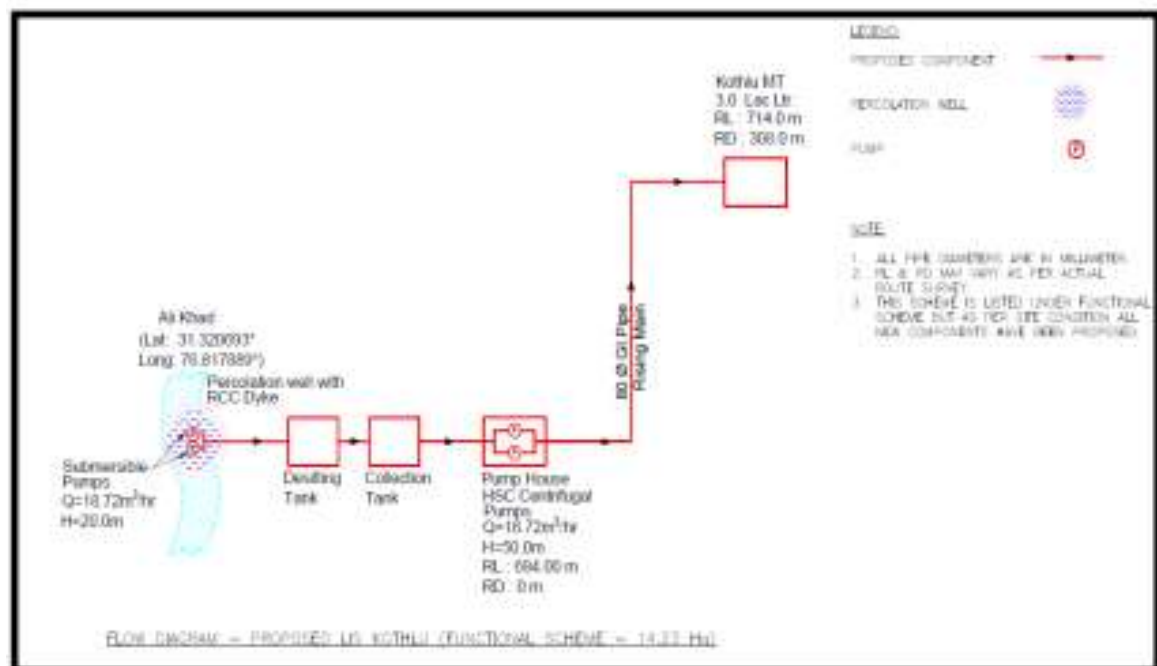
13. Proposed LIS – Samsai

Figure 88: Flow Diagram of Proposed LIS Samsai



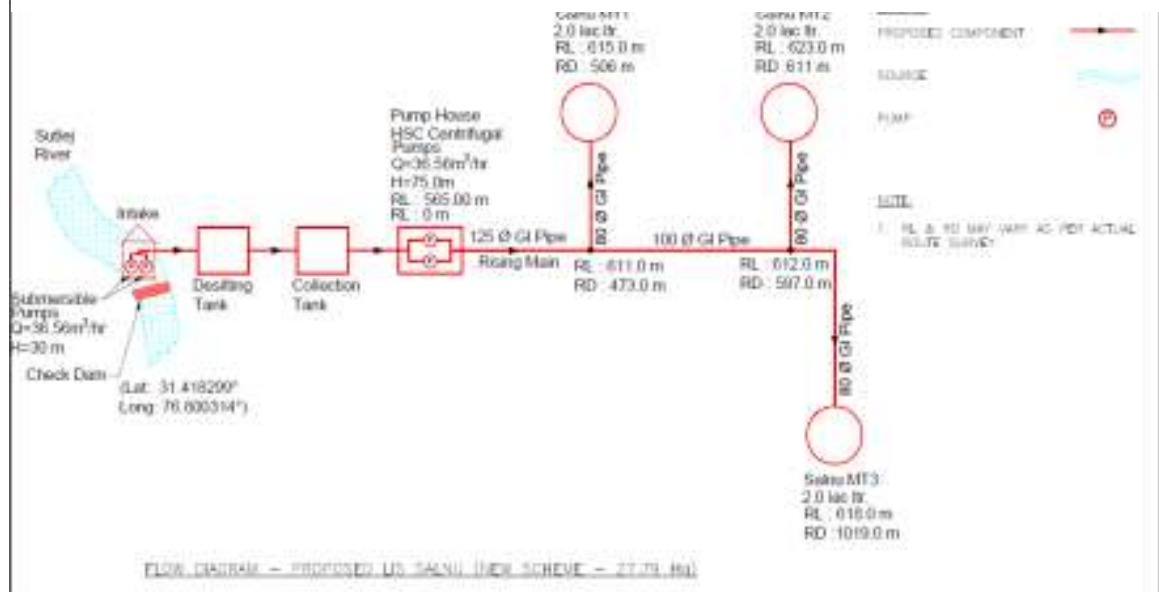
14. Proposed LIS – Kothlu

Figure 89: Flow Diagram of Proposed LIS Kothlu



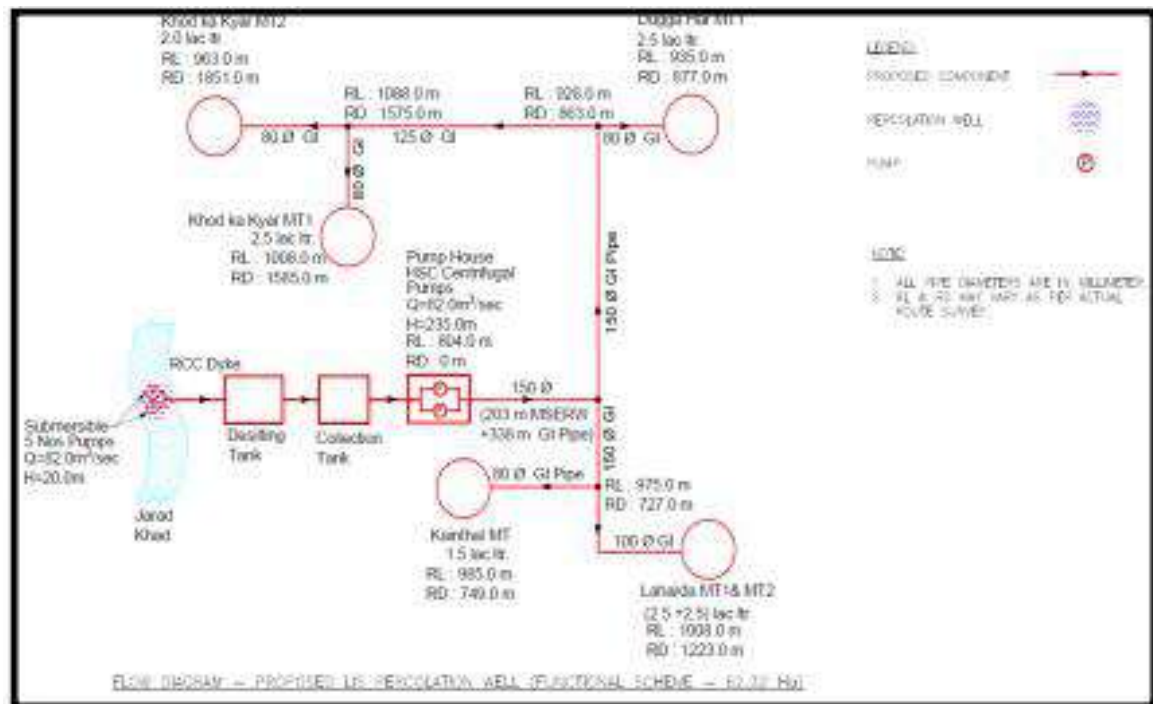
15. Proposed LIS – Salnu

Figure 90: Flow Diagram of Proposed LIS Salnu



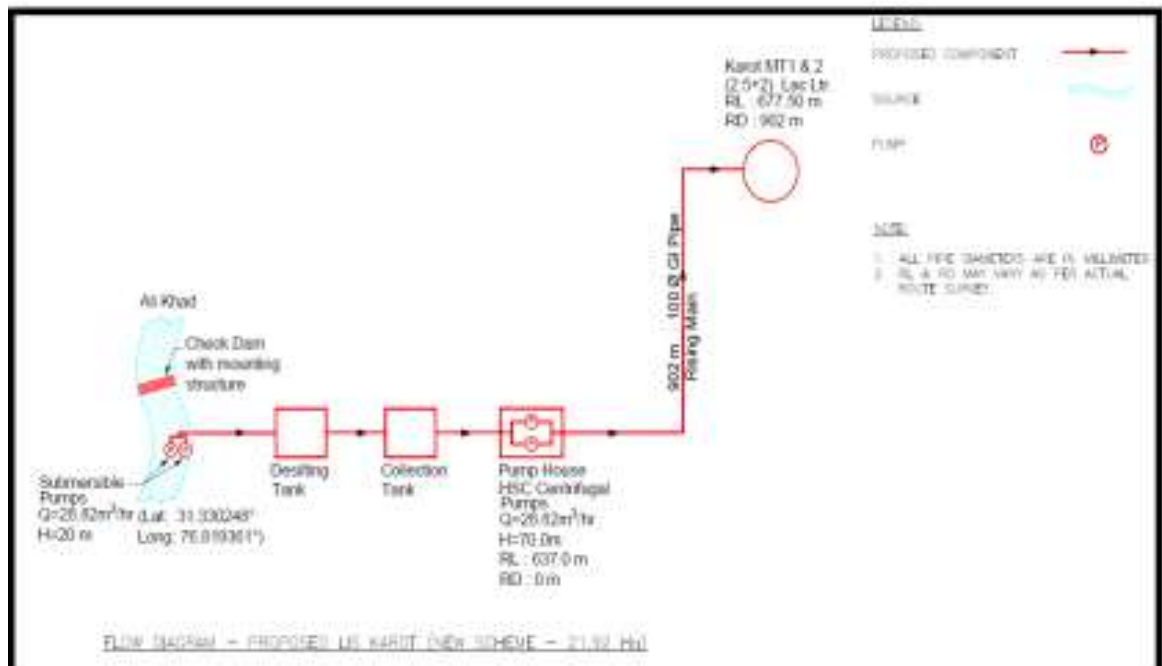
16. Proposed LIS – Percolation Well near Jarad Khad

Figure 91: Flow Diagram of Proposed LIS from Percolation Well near Jarad Khad



17. Proposed LIS – Karot

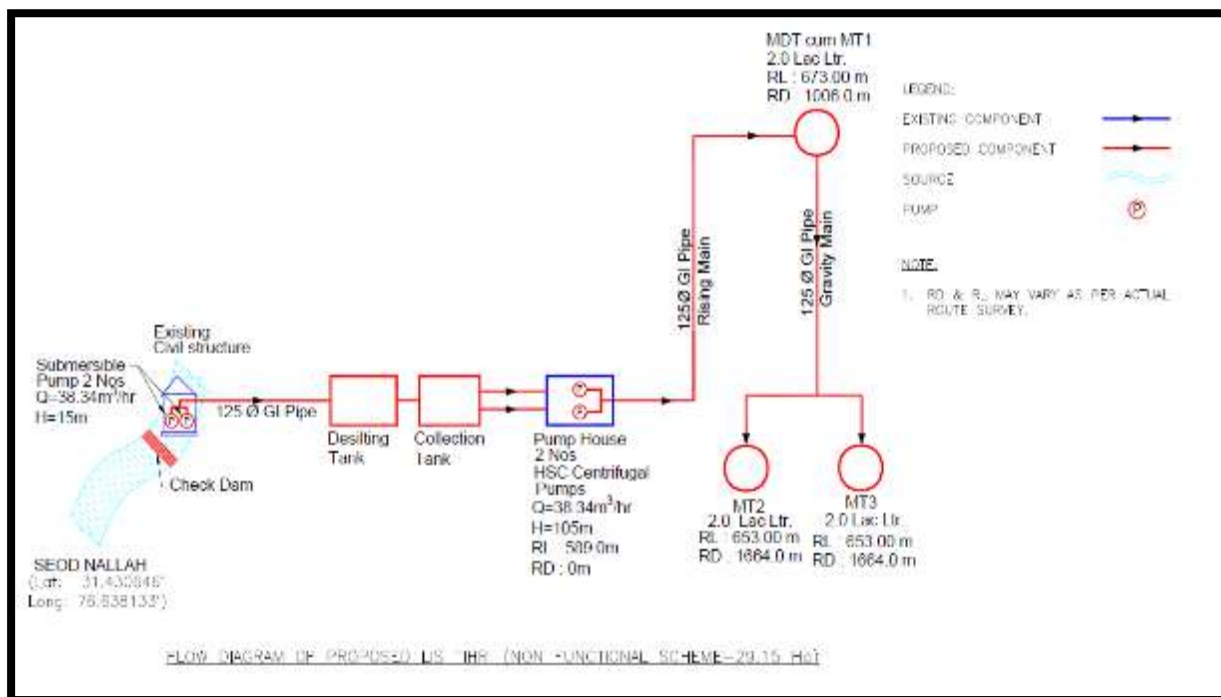
Figure 92: Flow Diagram of Proposed LIS Karot



Irrigation Scheme flow-diagram of Package – 6 (Bilaspur District):

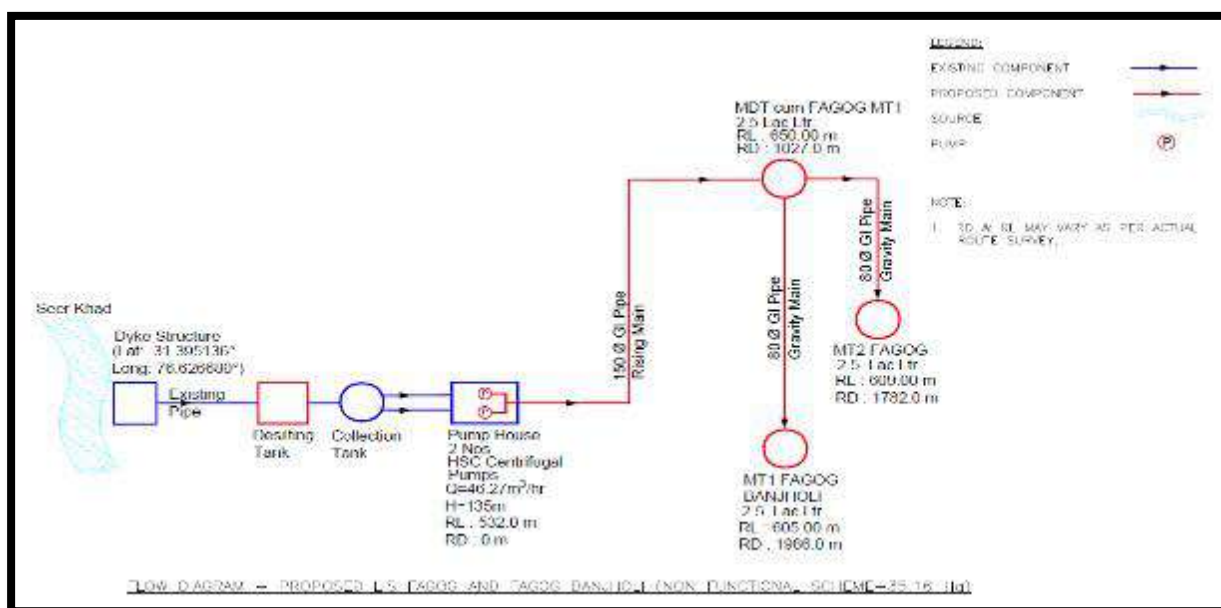
1. Proposed LIS - Tihri

Figure 93: Flow Diagram of Proposed LIS Tihri



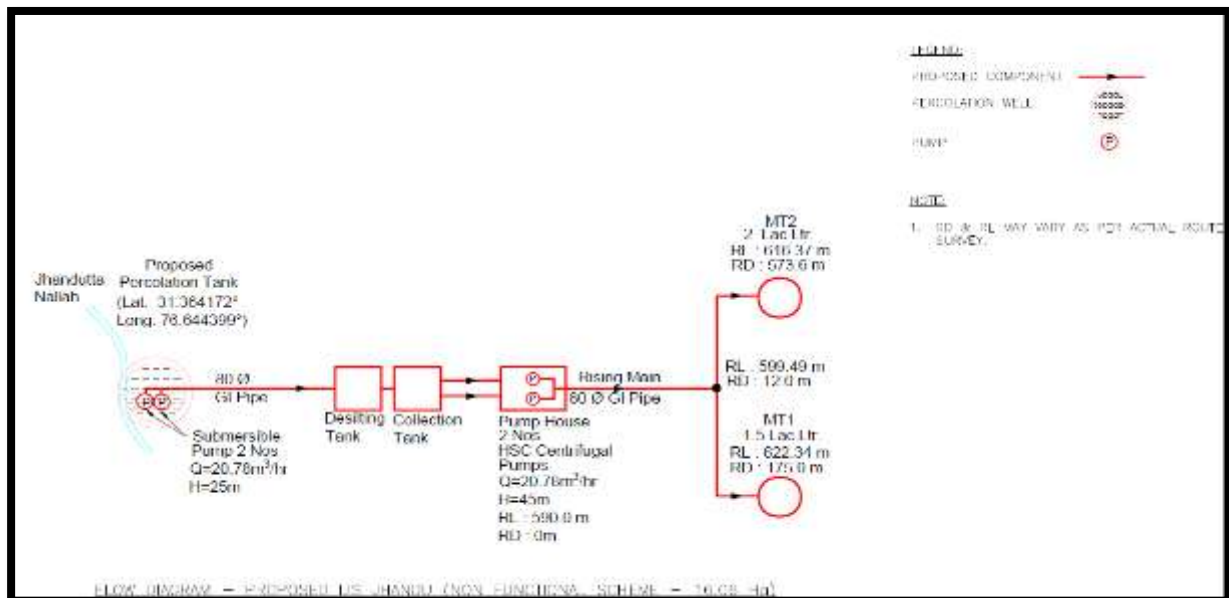
2. Proposed LIS - Fagog Bhanjholi and Fagog

Figure 94: Flow Diagram of Proposed LIS Fagog Bhanjholi and Fagog



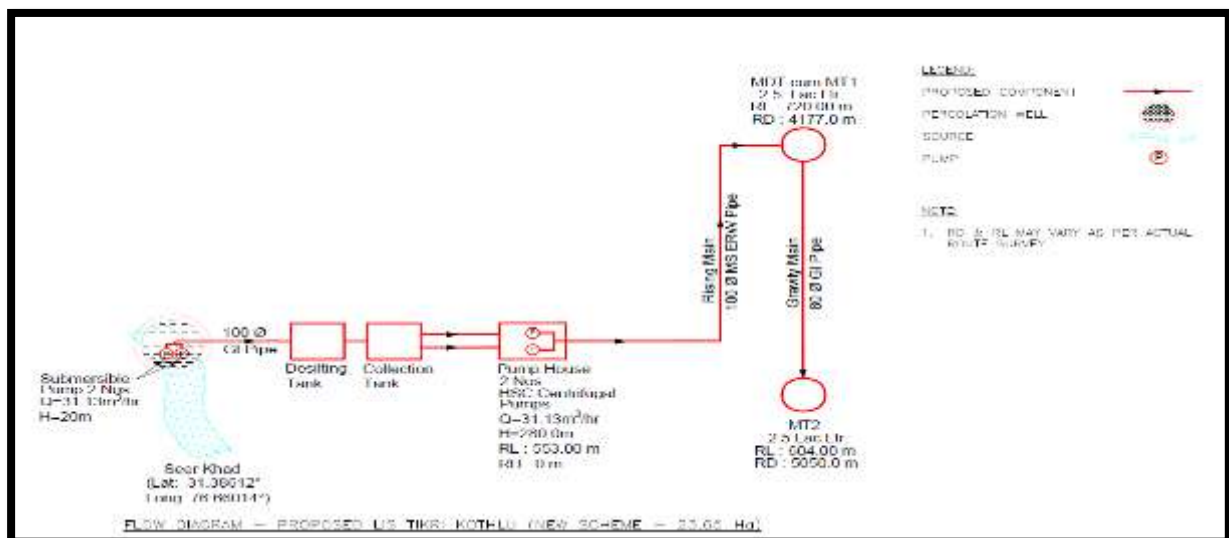
3. Proposed LIS – Jhandu

Figure 95: Flow Diagram of Proposed LIS Jhandu



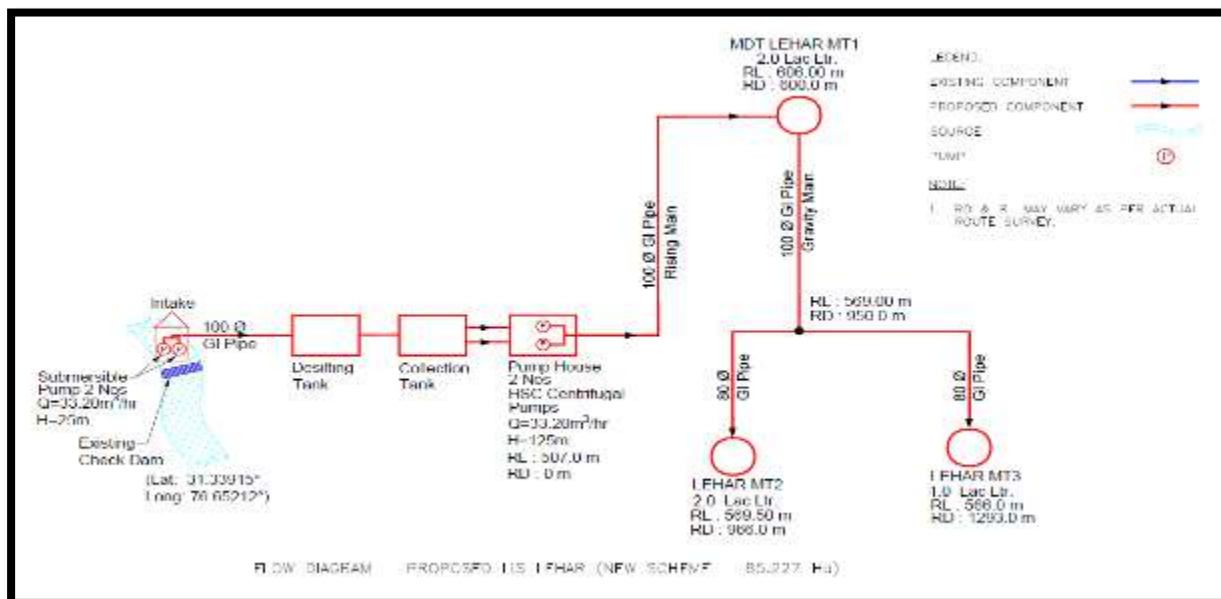
4. Proposed LIS – Tikri Kothlu

Figure 96: Flow Diagram of Proposed LIS Tikri Kothlu



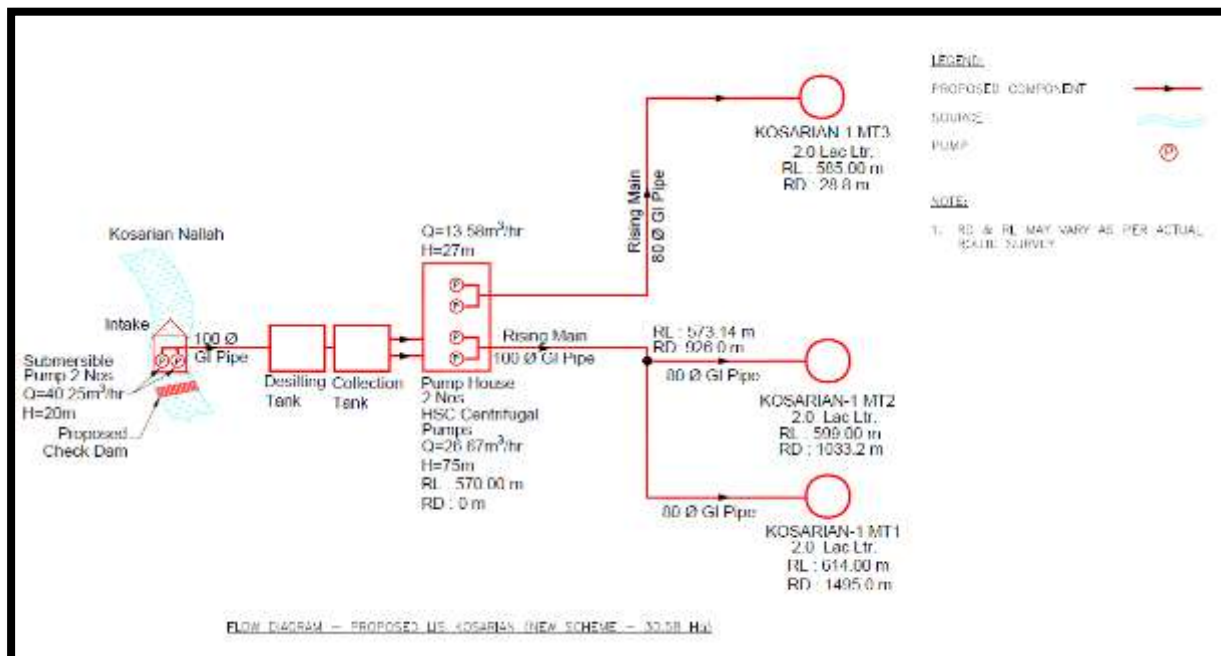
5. Proposed LIS – Lehar

Figure 97: Flow Diagram of Proposed LIS Lehar



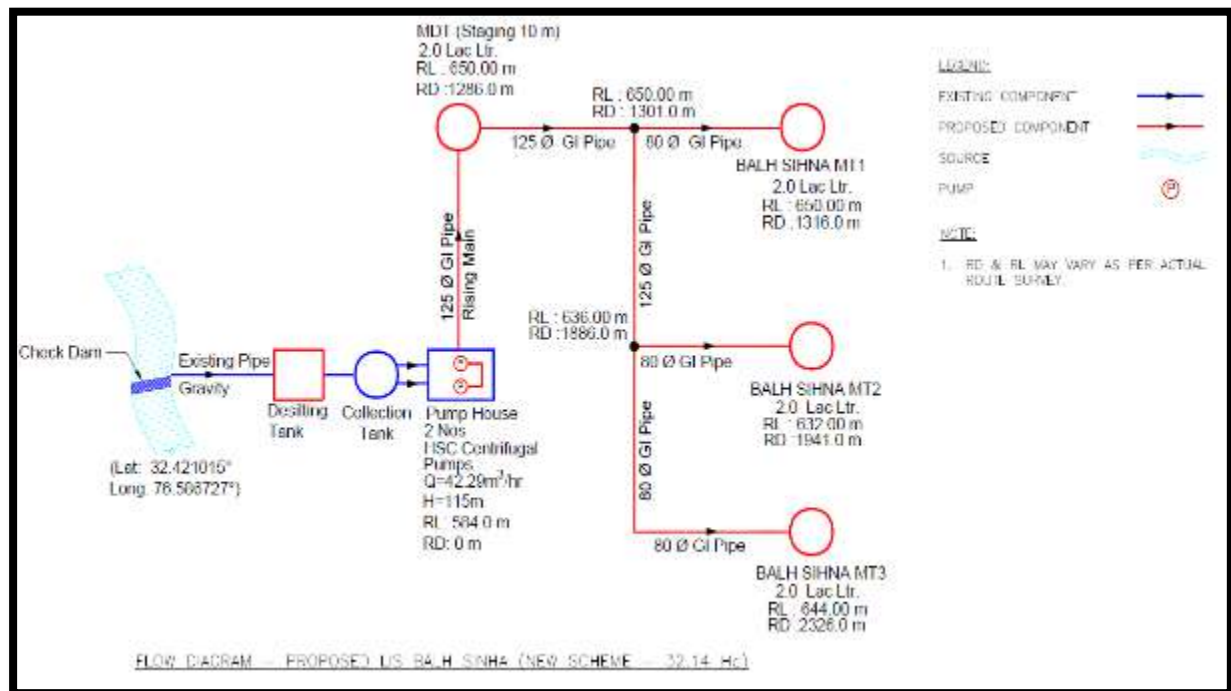
6. Proposed LIS – Kosarian

Figure 98: Flow Diagram of Proposed LIS Kosarian



7. Proposed LIS – Balh Sinha

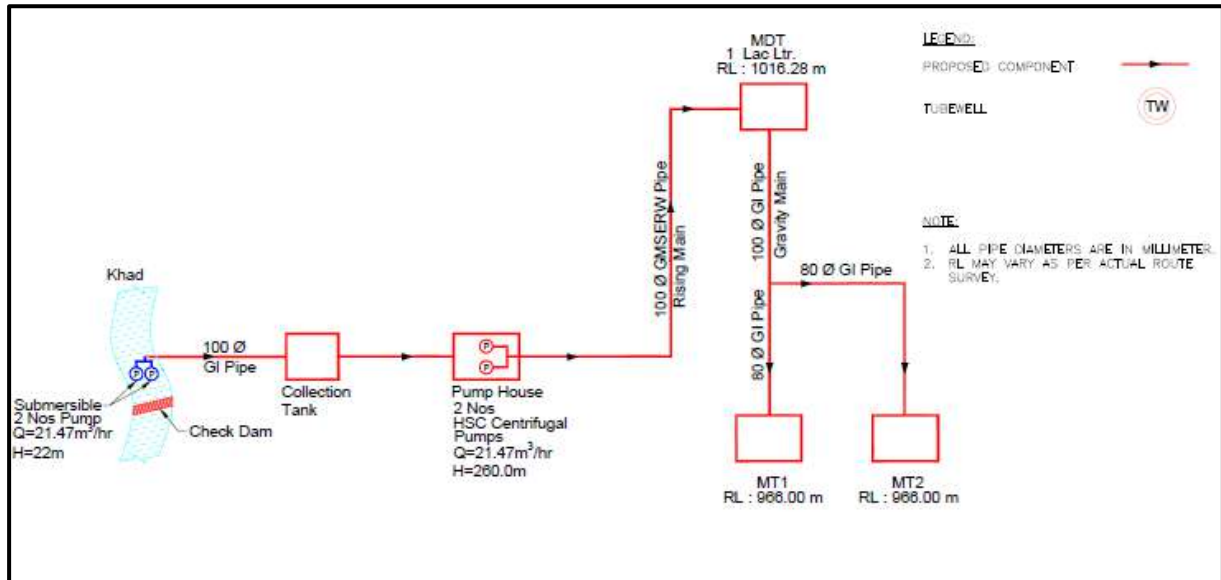
Figure 99: Flow Diagram of Proposed LIS Balh Sinha



Irrigation Scheme flow-diagram of Package – 7 (Mandi District):

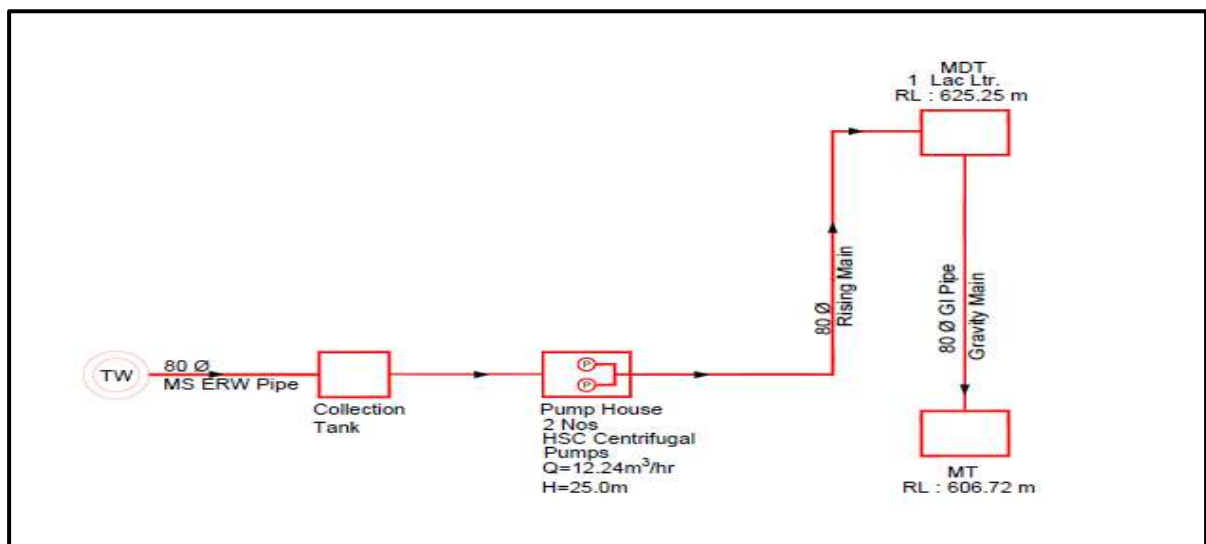
1. Proposed LIS – Golwan

Figure 100: Flow Diagram of Proposed LIS Golwan



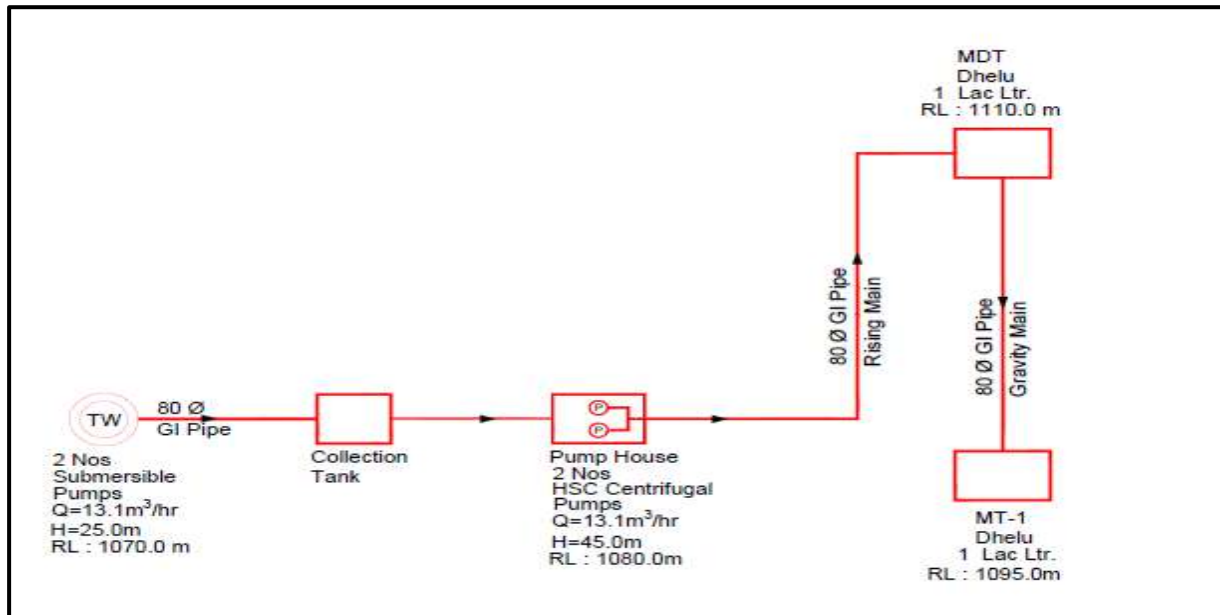
2. Proposed LIS – TW1

Figure 101: Flow Diagram of Proposed LIS TW1



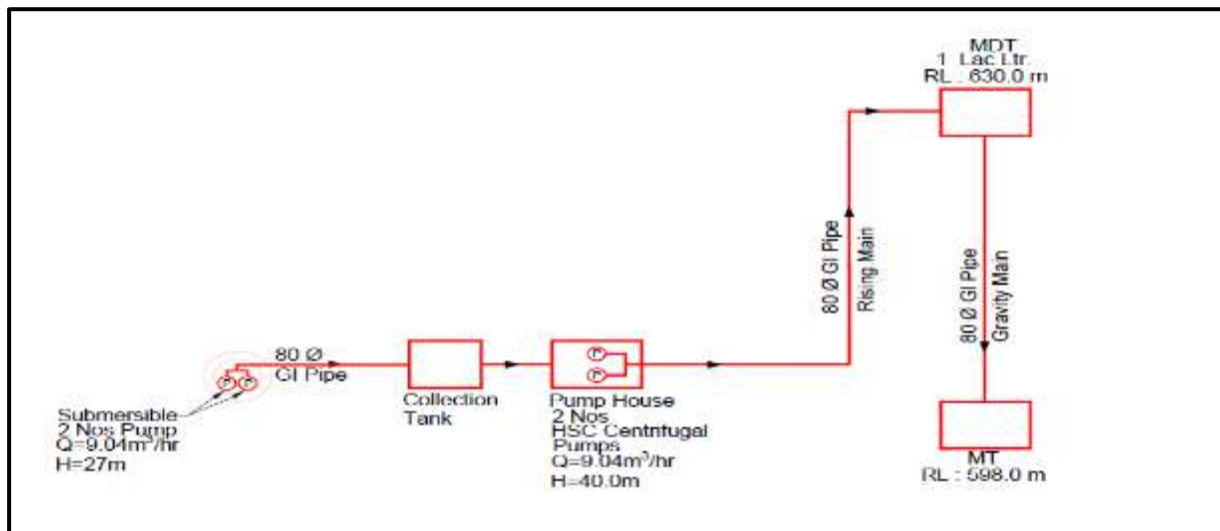
3. Proposed LIS – Dhelu

Figure 102: Flow Diagram of Proposed LIS Dhelu



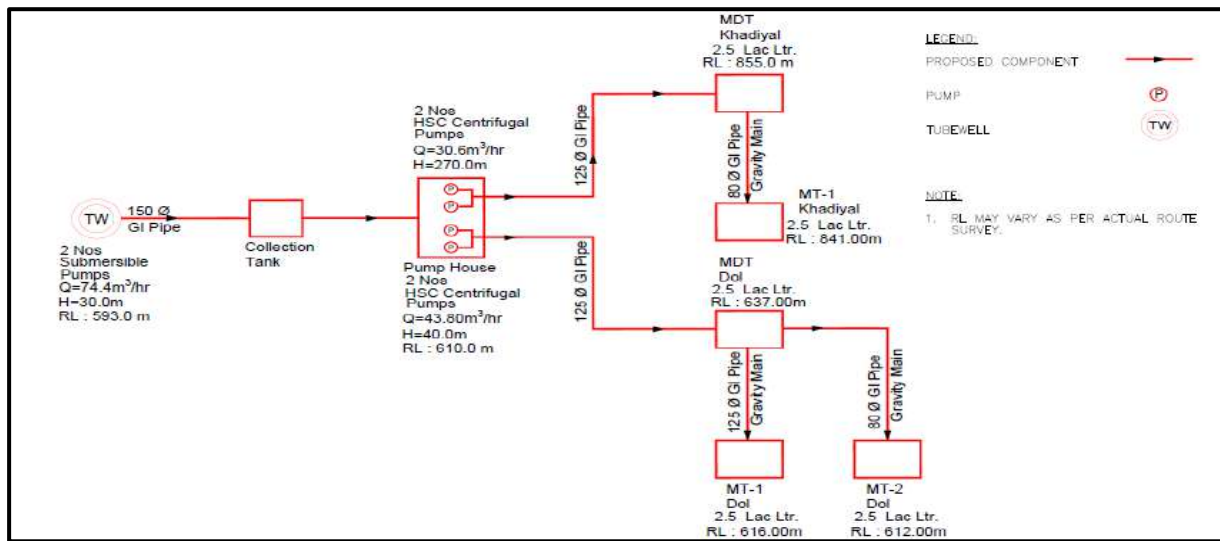
4. Proposed LIS – TW2

Figure 103: Flow Diagram of Proposed LIS TW2



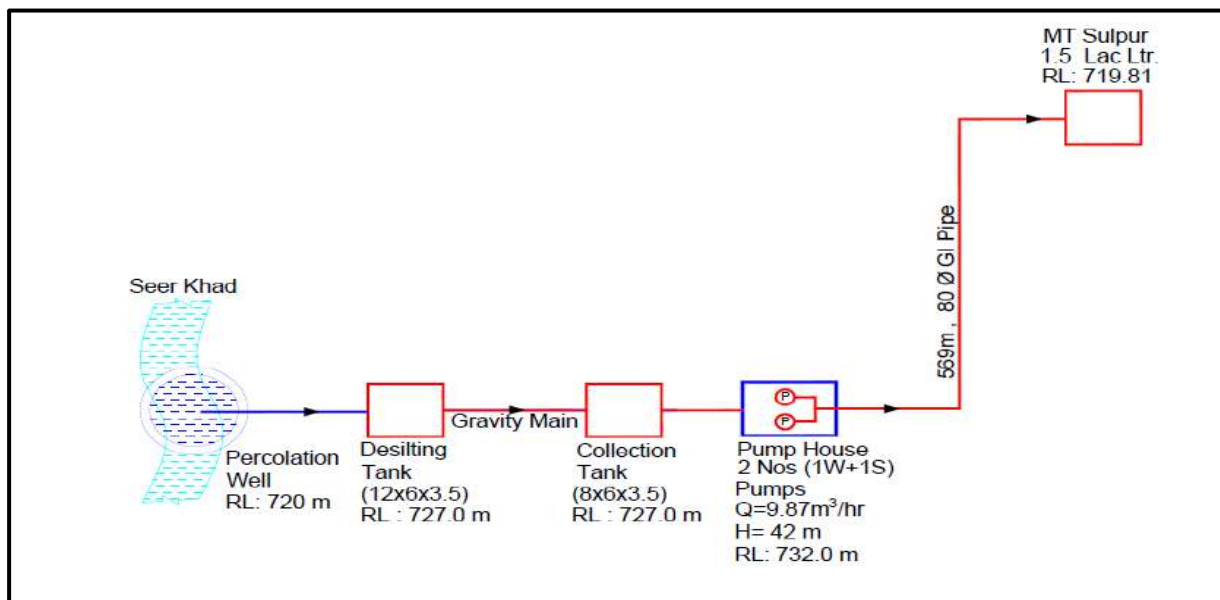
5. Proposed LIS – TW3 & TW4 Khadiyal & DoI

Figure 104: Flow Diagram of Proposed LIS TW3 & TW4 Khadiyal & DoI



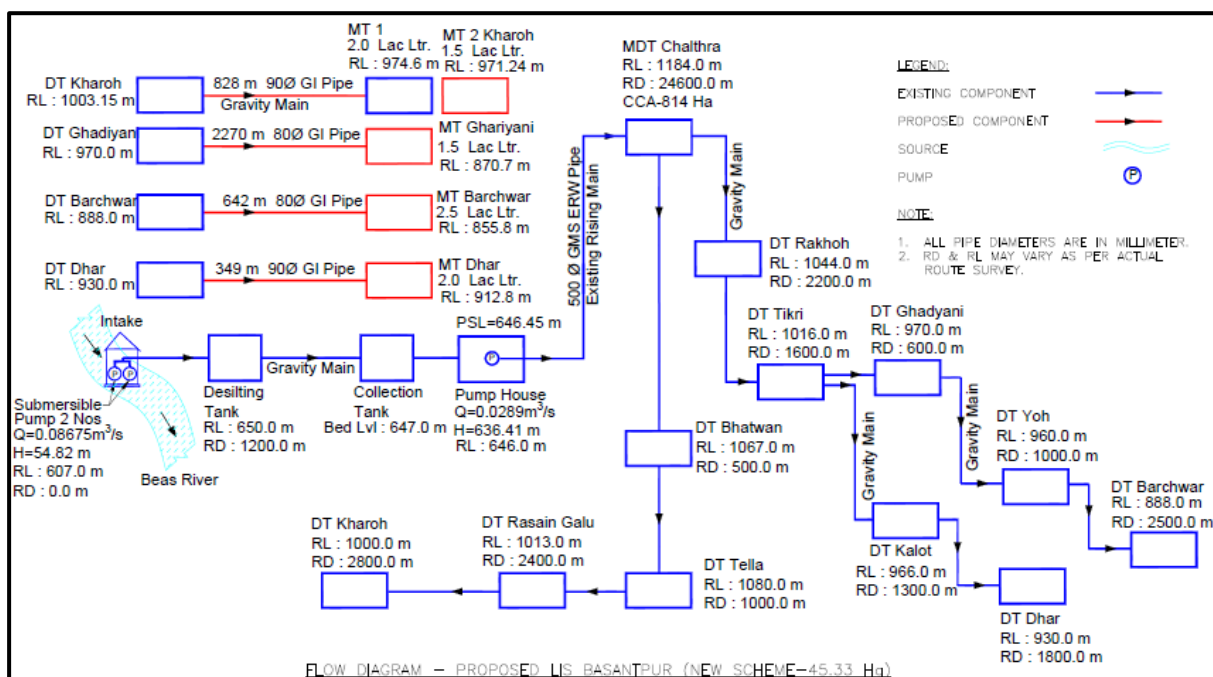
6. Proposed LIS – Sulpur

Figure 105: Flow Diagram of Proposed LIS Sulpur



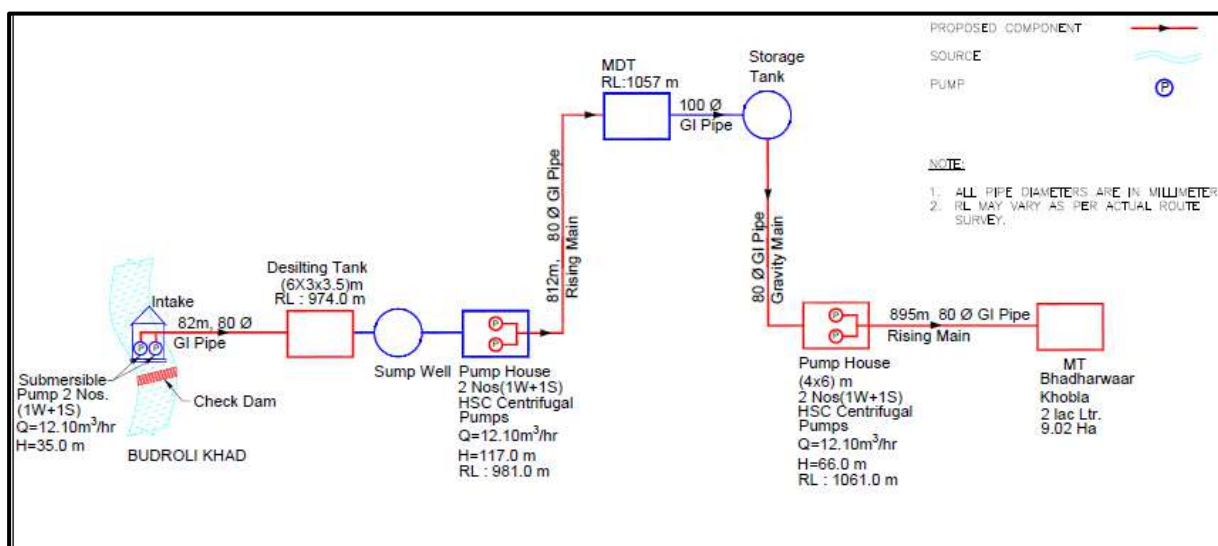
7. Proposed LIS – Basantpur

Figure 106: Flow Diagram of Proposed LIS Basantpur



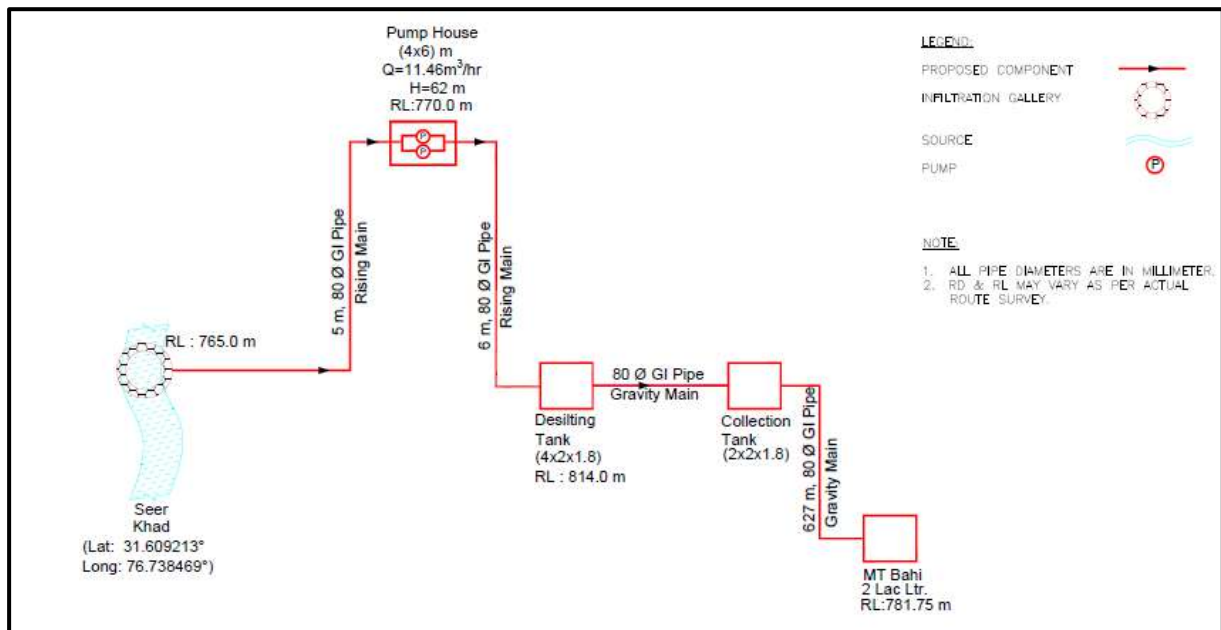
8. Proposed LIS – Bhadarwar

Figure 107: Flow Diagram of Proposed LIS Bhadarwar



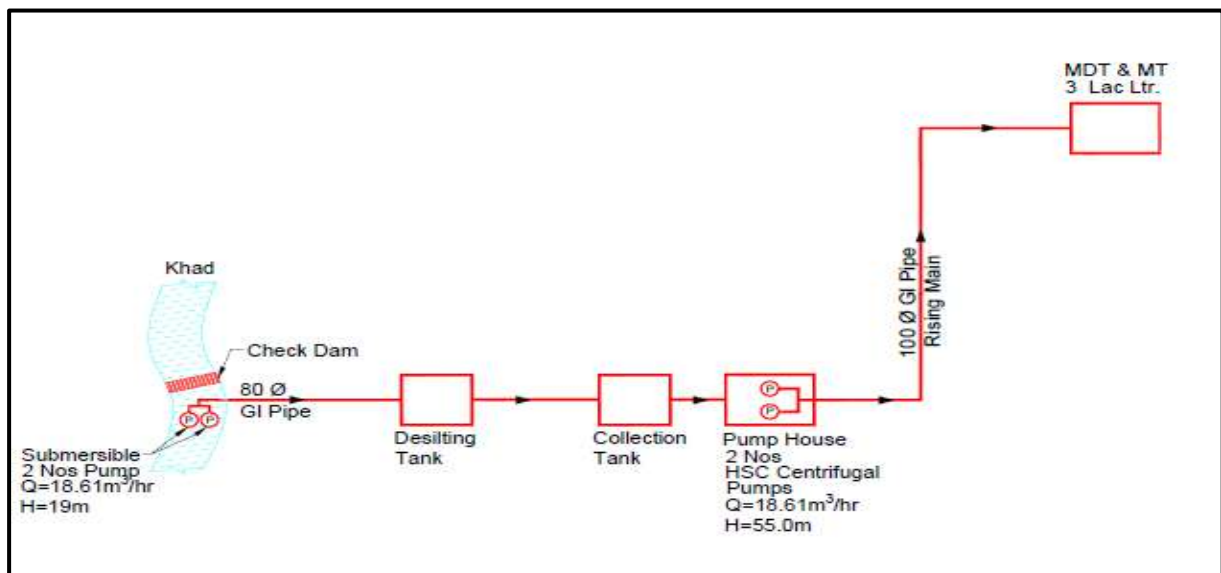
9. Proposed LIS – Percolation Seer Khad

Figure 108: Flow Diagram of Proposed LIS Percolation Seer Khad



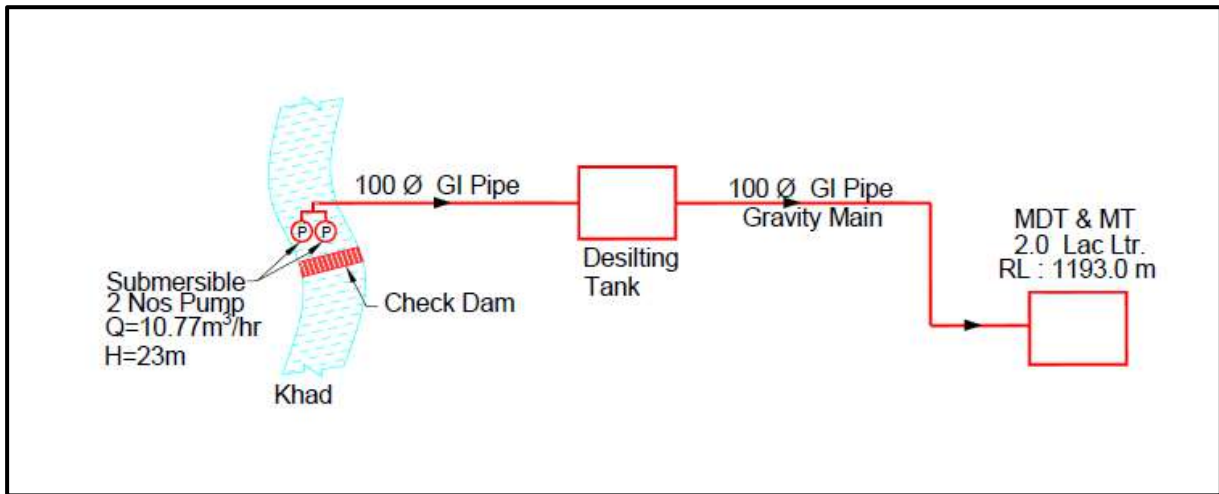
10. Proposed LIS – Seer Khad

Figure 109: Flow Diagram of Proposed LIS Seer Khad



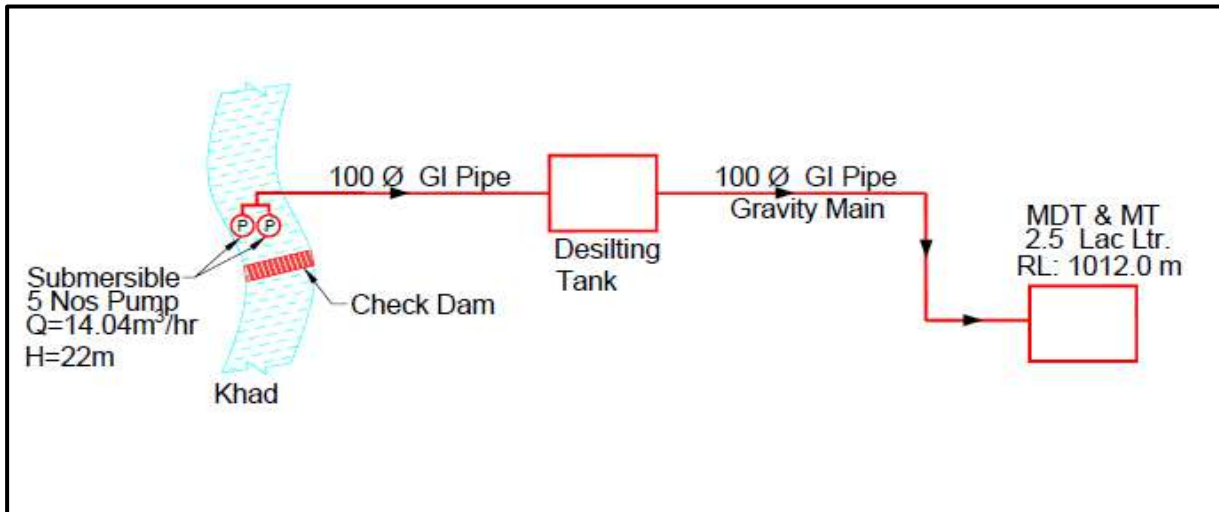
11. Proposed LIS – Thouna Kuhal

Figure 110: Flow Diagram of Proposed LIS Thouna Kuhal



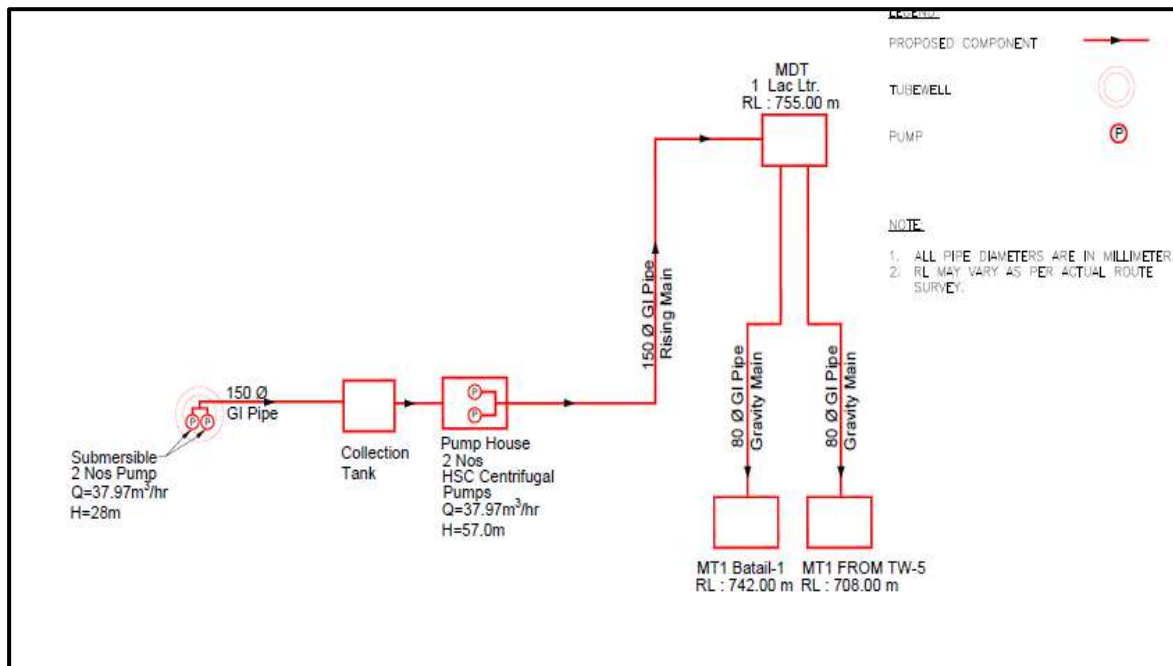
12. Proposed LIS – Son Khad

Figure 111: Flow Diagram of Proposed LIS Son Khad



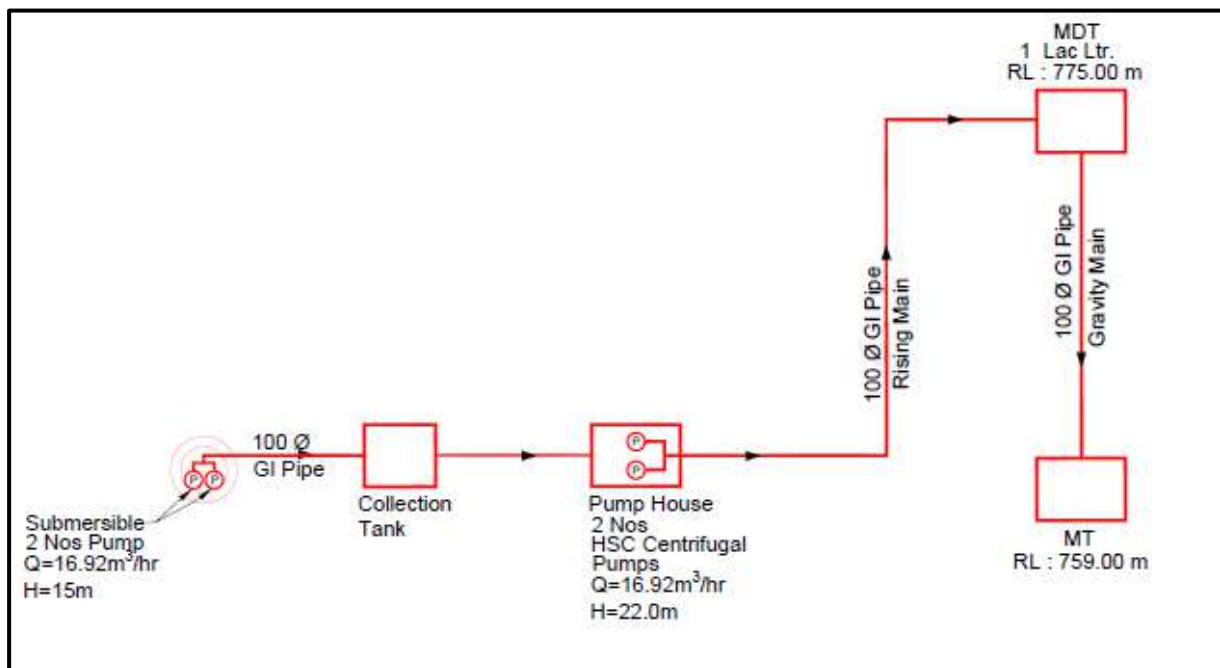
13. Proposed LIS – TW5

Figure 112: Flow Diagram of Proposed LIS TW5



14. Proposed LIS – TW6

Figure 113: Flow Diagram of Proposed LIS TW6



Khad

Check Dam

100 Ø GI Pipe

Submersible
2 Nos Pump
 $Q=17.07\text{m}^3/\text{hr}$
 $H=23\text{m}$

Desilting Tank

Collection Tank

Pump House
2 Nos
HSC Centrifugal
Pumps
 $Q=17.07\text{m}^3/\text{hr}$
 $H=28.0\text{m}$

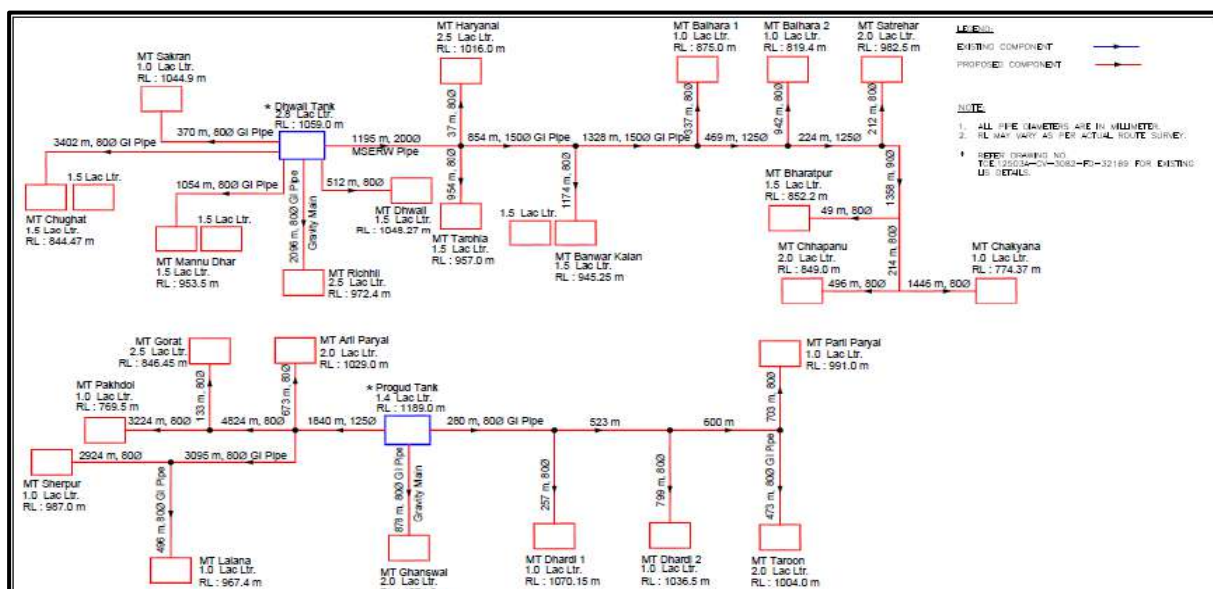
100 Ø GI Pipe
Rising Main

MDT
1 Lac Ltr.
RL : 712.00 m

100 Ø GI Pipe
Gravity Main

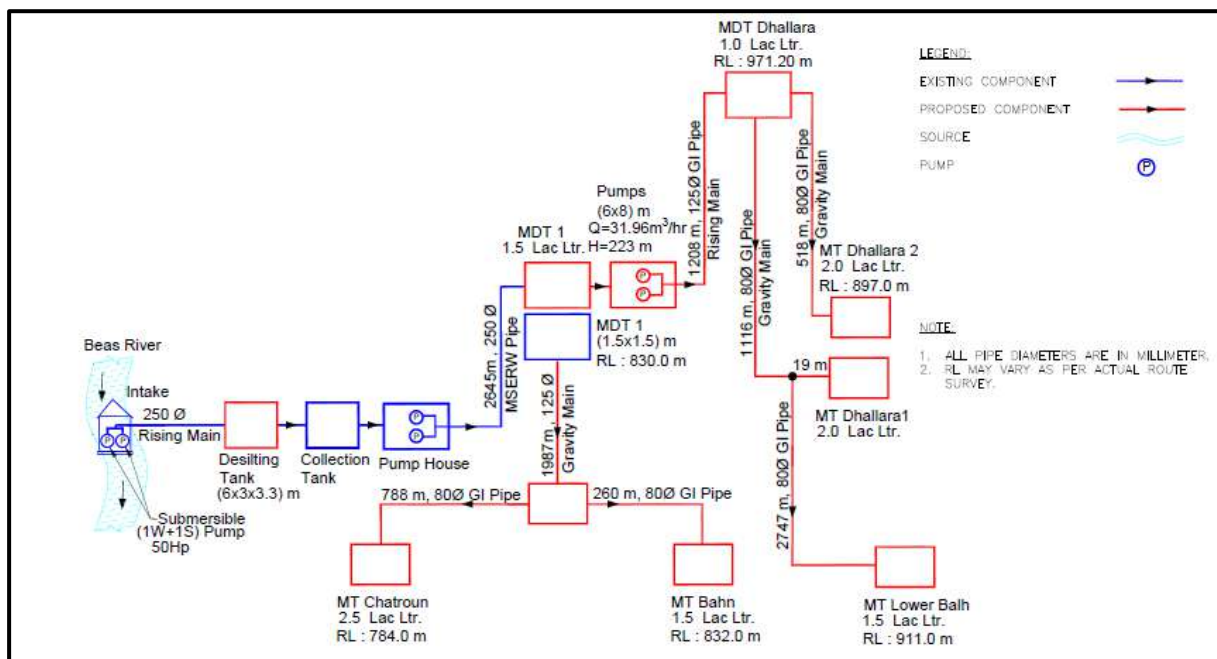
MT
RL : 703.00 m

Figure 115: Flow Diagram of Proposed LIS Barhi Marhi Dhawali



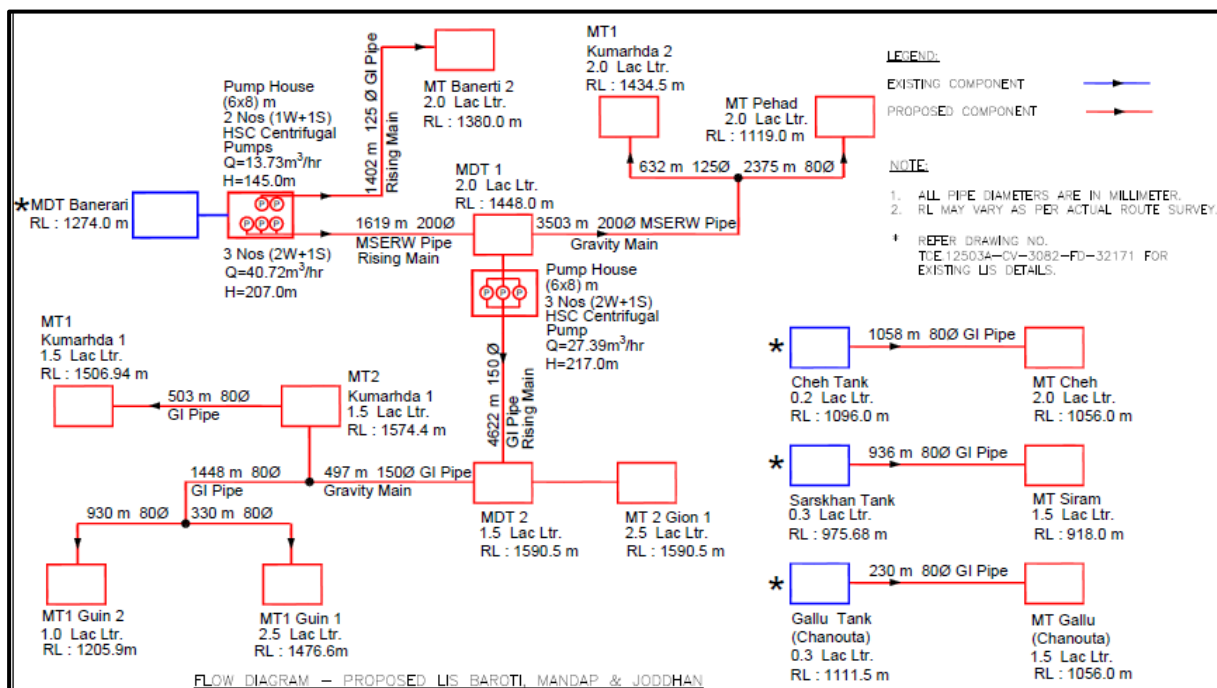
17. Proposed LIS – Kothua Dhallara

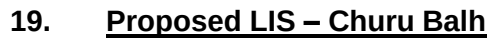
Figure 116: Flow Diagram of Proposed LIS Kothua Dhallara



18. Proposed LIS – Baroti Mandap Jodhan

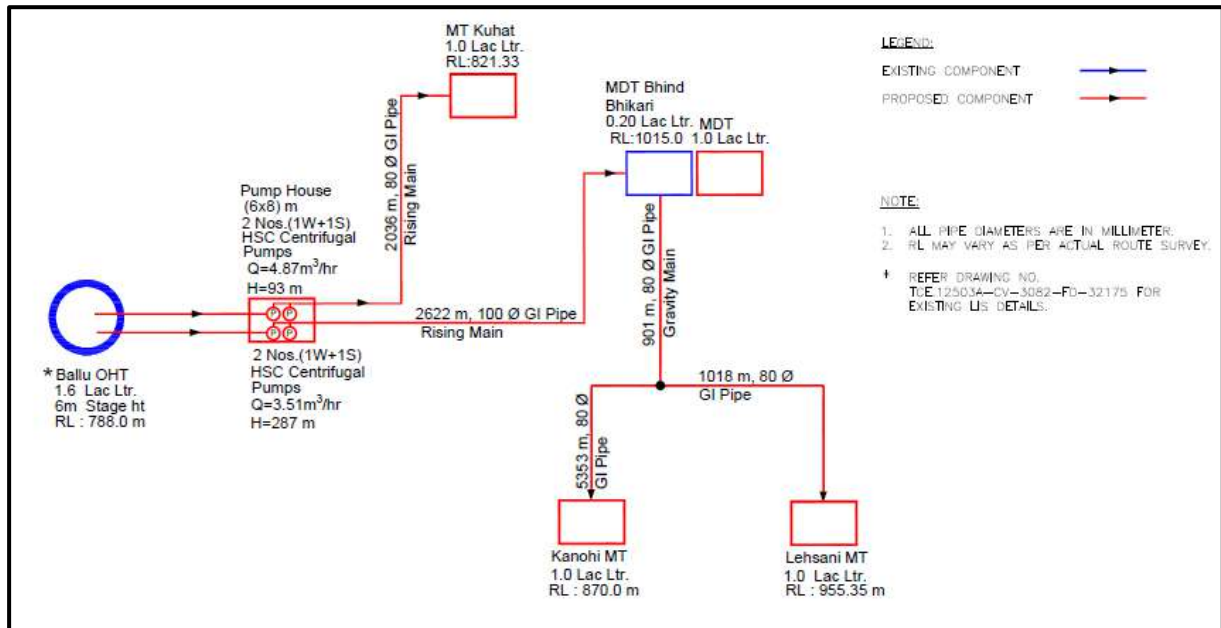
Figure 117: Flow Diagram of Proposed LIS Baroti Mandap Jodhan





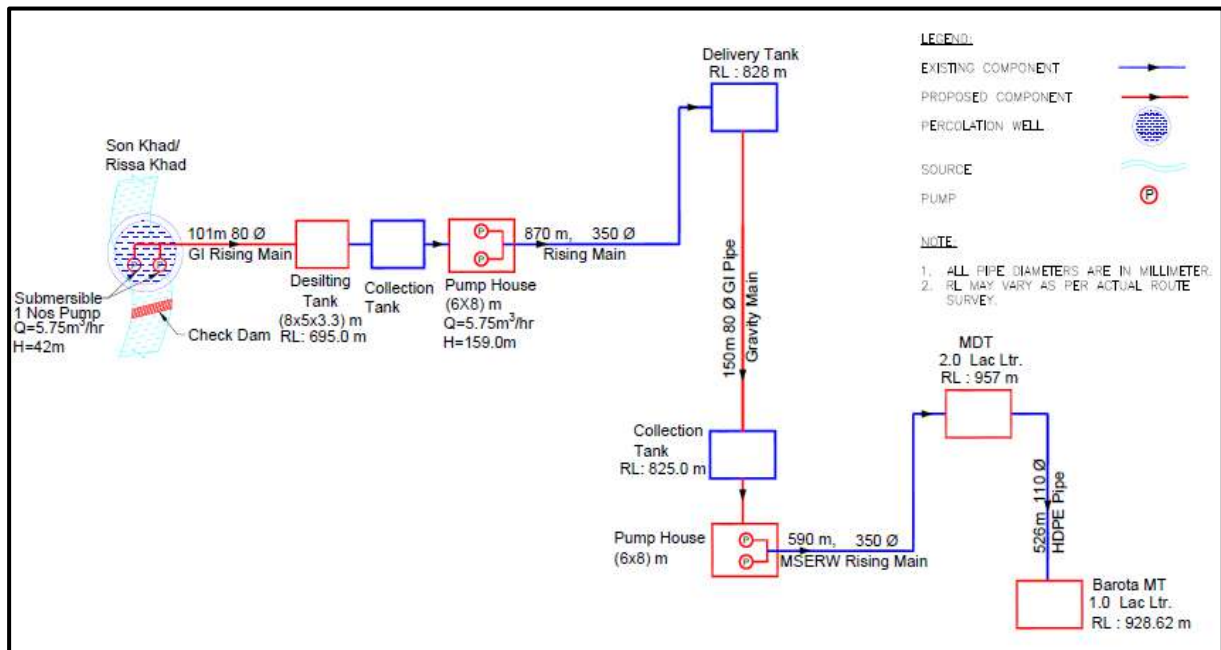
21. Proposed LIS – Sandhole

Figure 120: Flow Diagram of Proposed LIS Sandhole



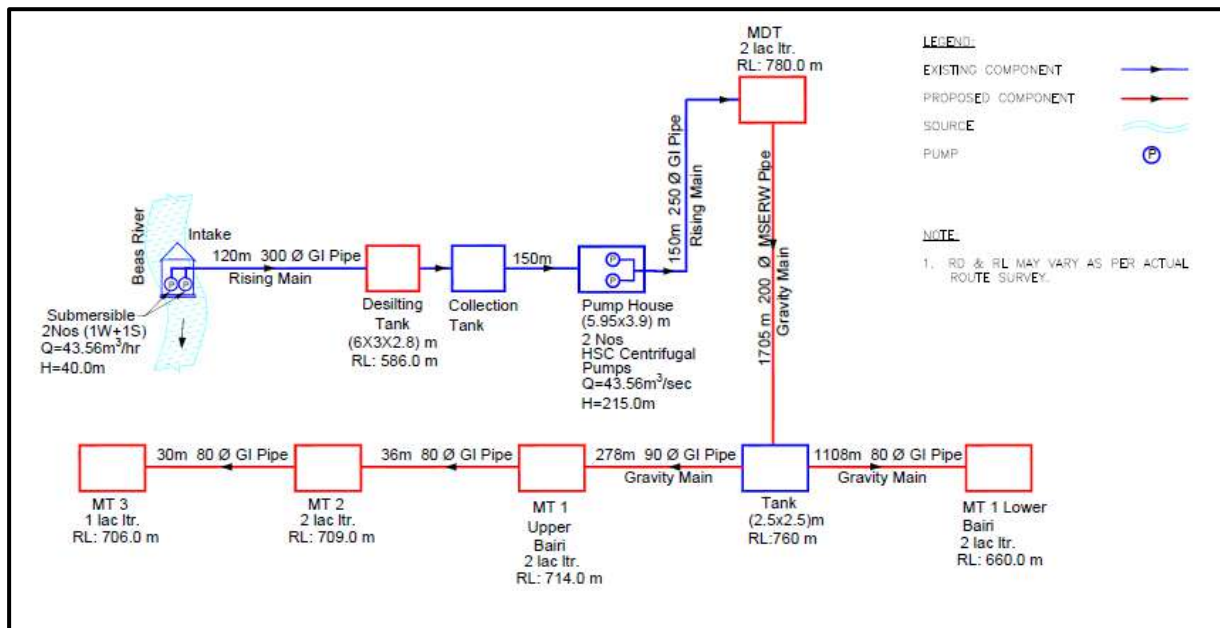
22. Proposed LIS – Brang

Figure 121: Flow Diagram of Proposed LIS Brang



23. Proposed LIS – Bairi

Figure 122: Flow Diagram of Proposed LIS Bairi



24. Proposed LIS – Tihra

Figure 123: Flow Diagram of Proposed LIS Tihra

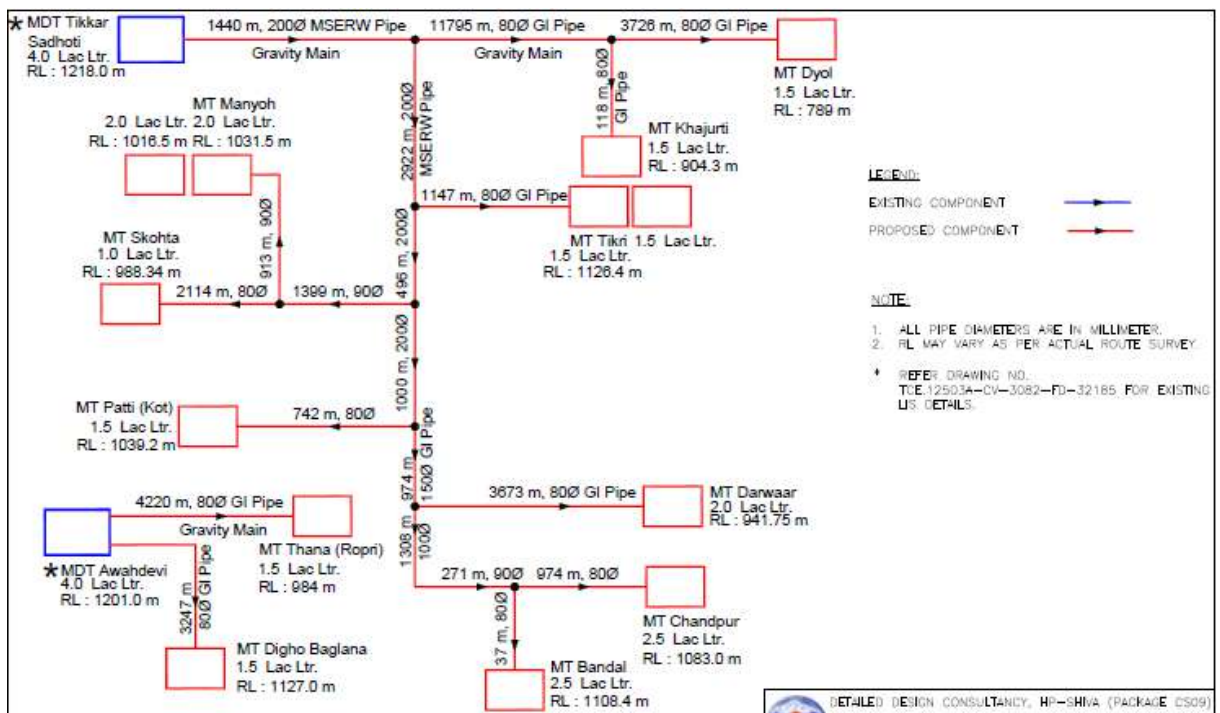


Figure 124: Flow Diagram of Proposed LIS Baragaon I & II

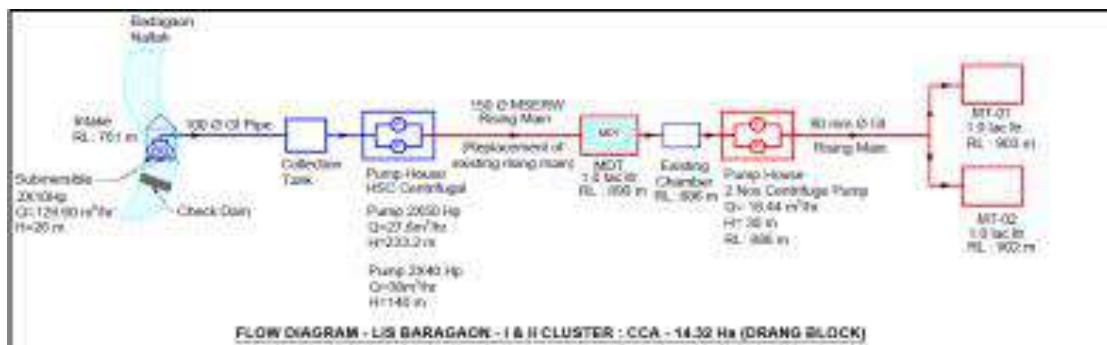
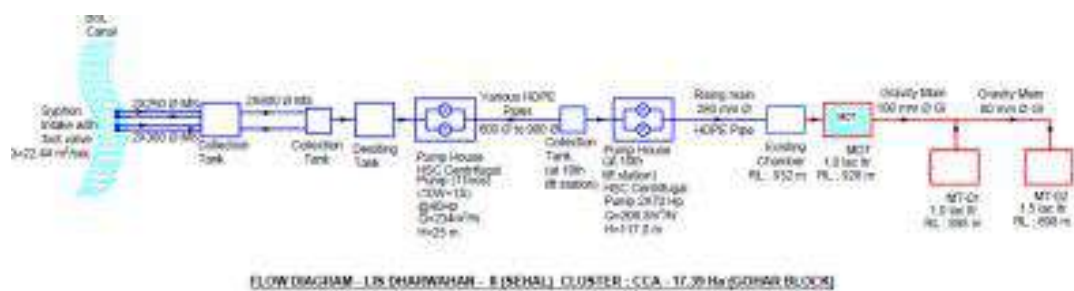
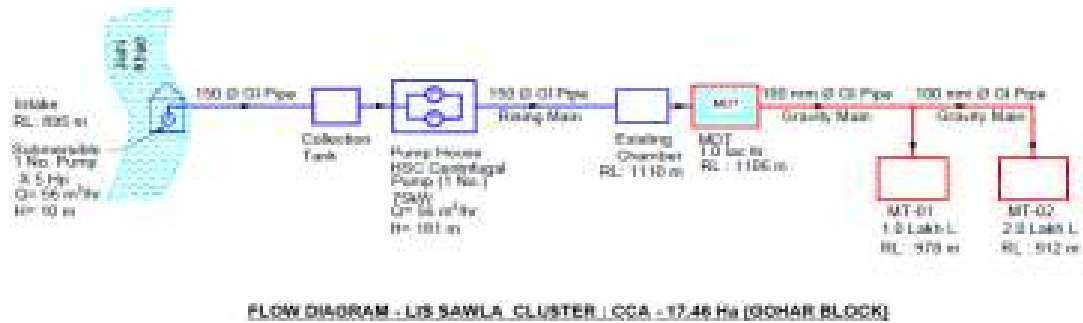


Figure 125: Flow Diagram of Proposed LIS Dharwahan II



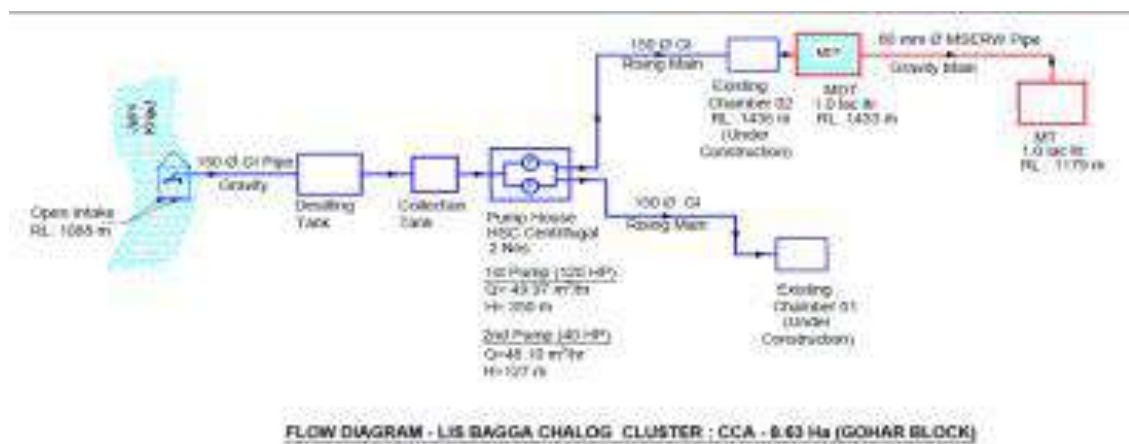
3. Proposed LIS – Sawla

Figure 126: Flow Diagram of Proposed LIS Sawla



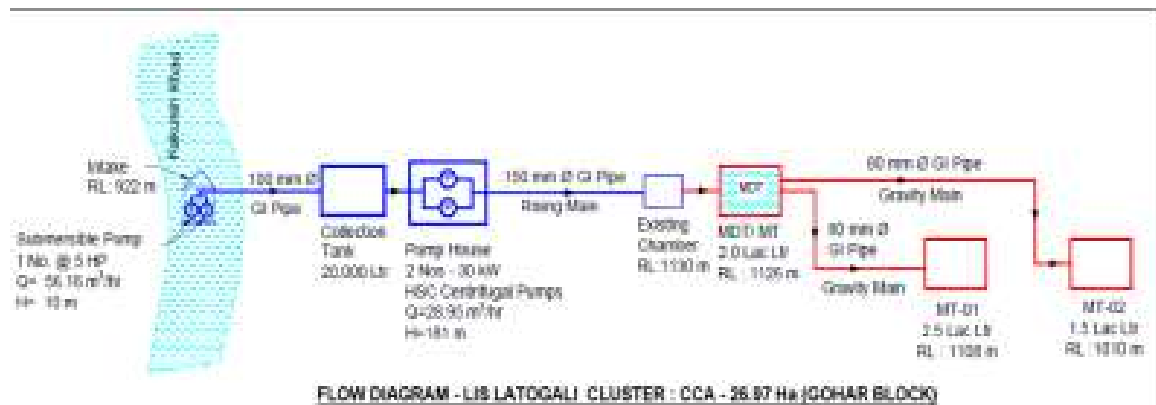
4. Proposed LIS – Bagga Chalog

Figure 127: Flow Diagram of Proposed LIS Bagga Chalog



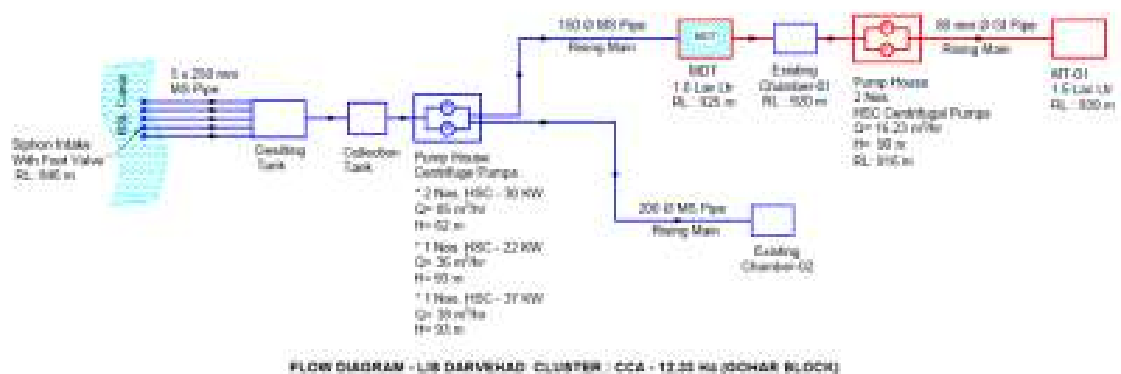
5. Proposed LIS – Latogali I

Figure 128: Flow Diagram of Proposed LIS Latogali I



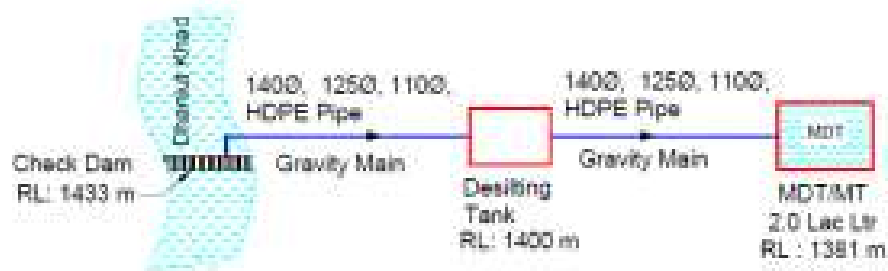
6. Proposed LIS – Darvehad

Figure 129: Flow Diagram of Proposed LIS Darvehad



7. Proposed LIS – Manjhog Dhaniut

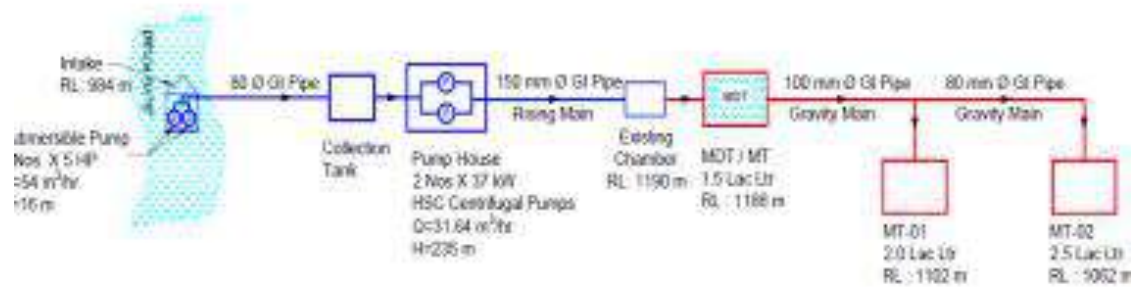
Figure 130: Flow Diagram of Proposed LIS Manjhog Dhaniut



FLOW DIAGRAM - LIS MANJHOG DHANIUT CLUSTER : CCA - 9.66 Ha (GOHAR BLOCK)

8. Proposed LIS – Manjhagan Chudara

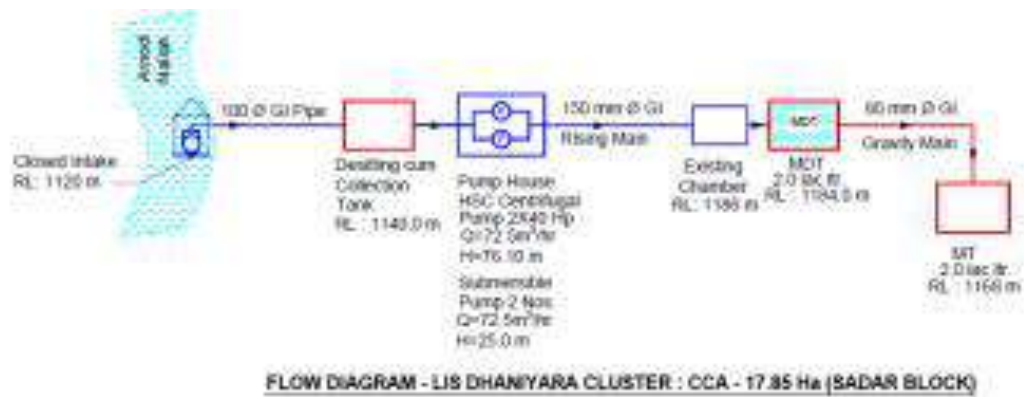
Figure 131: Flow Diagram of Proposed LIS Manjhagan Chudara



FLOW DIAGRAM - LIS MANJHAGAN CHUDARA CLUSTER : CCA - 28.56 Ha (GOHAR BLOCK)

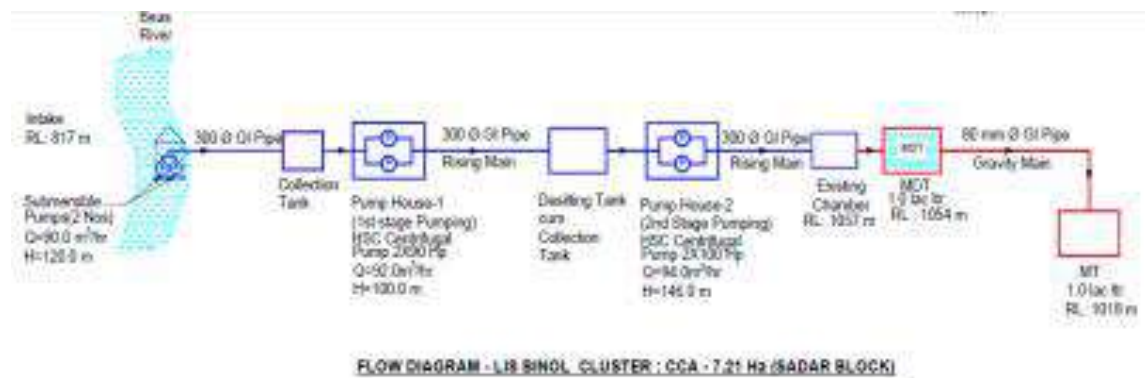
9. Proposed LIS – Dhaniyara

Figure 132: Flow Diagram of Proposed LIS Dhaniyara



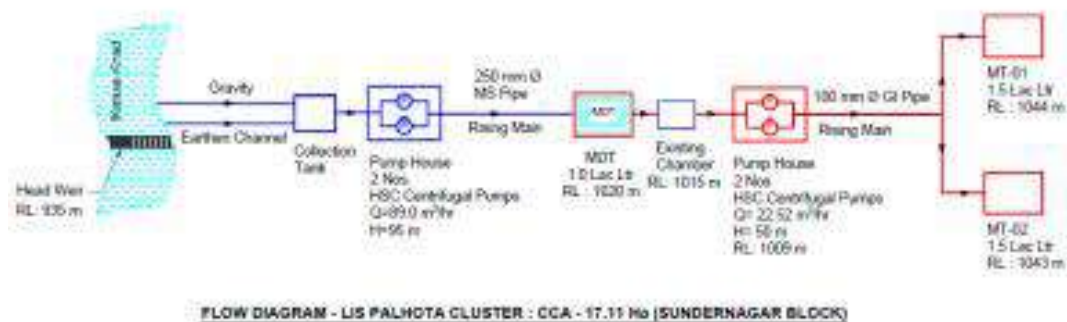
10. Proposed LIS – Binol

Figure 133: Flow Diagram of Proposed LIS Binol



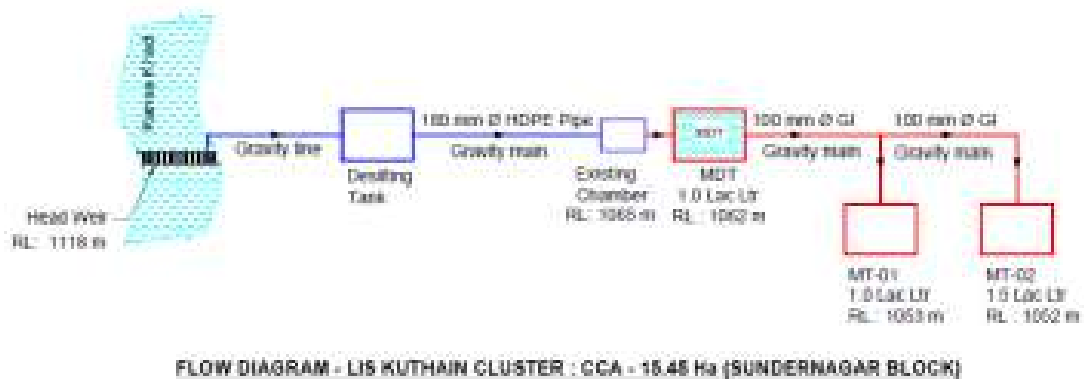
11. Proposed LIS – Palhota

Figure 134: Flow Diagram of Proposed LIS Palhota



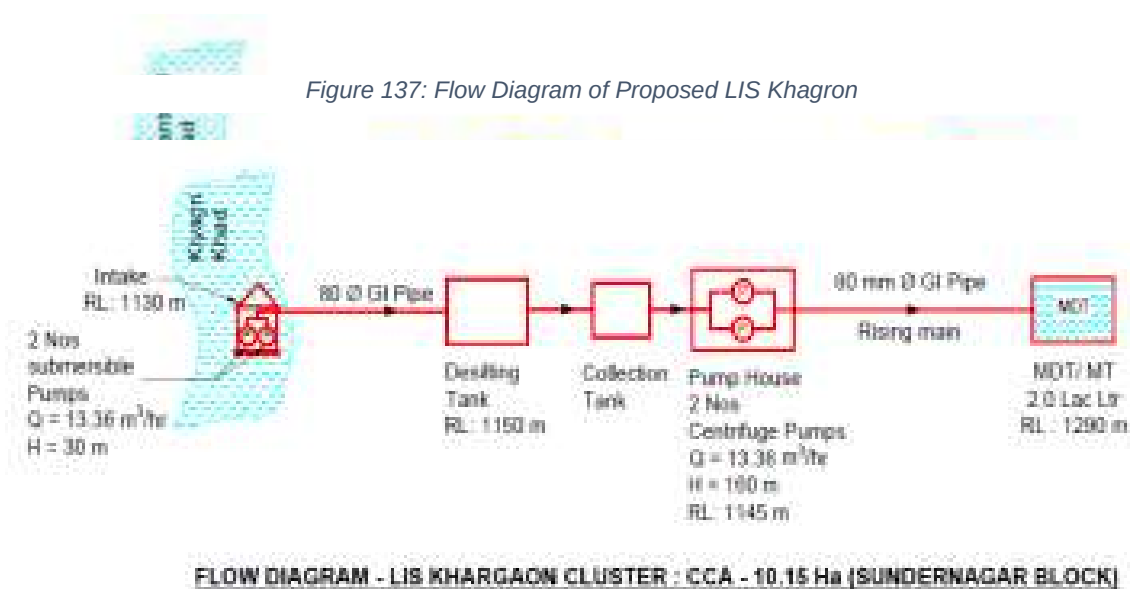
12. Proposed LIS – Kuthain

Figure 135: Flow Diagram of Proposed LIS Kuthain



13. Proposed LIS – Bhantraed

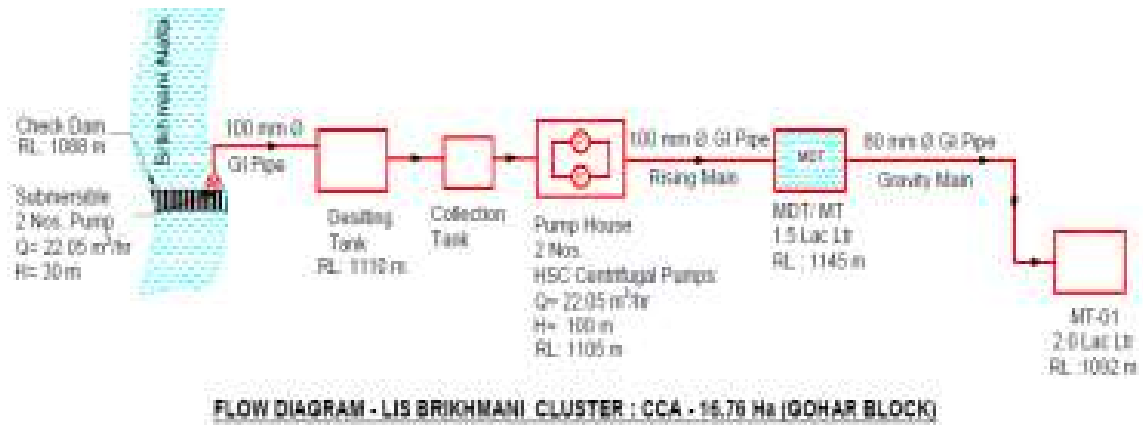
Figure 136: Flow Diagram of Proposed LIS Bhantraed



14. Proposed LIS – Khagron

15. Proposed LIS – Brikhmani

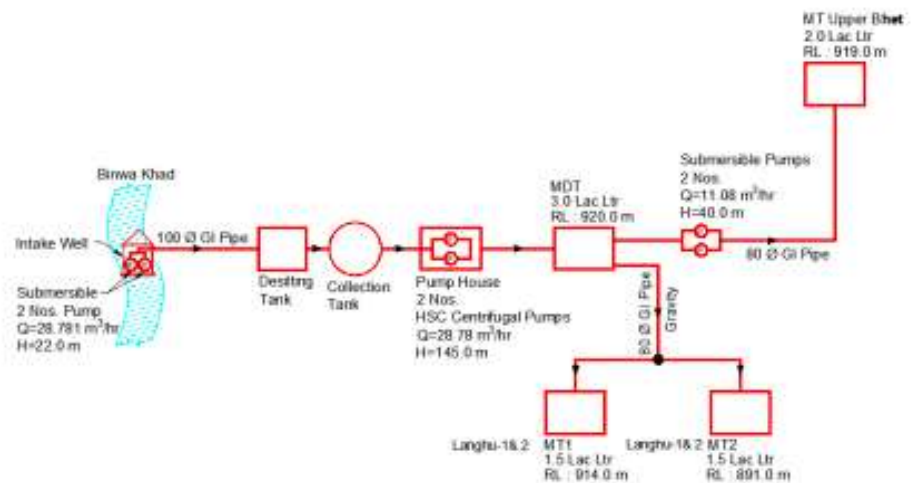
Figure 138: Flow Diagram of Proposed LIS Brikhmani



Irrigation Scheme flow-diagram of Package – 09 (Kangra District):

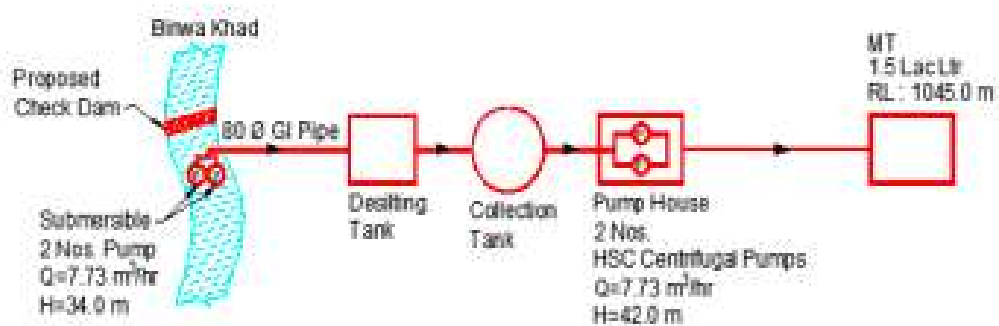
1. Proposed LIS – Binwa Khad

Figure 139: Flow Diagram of Proposed LIS Binwa Khad



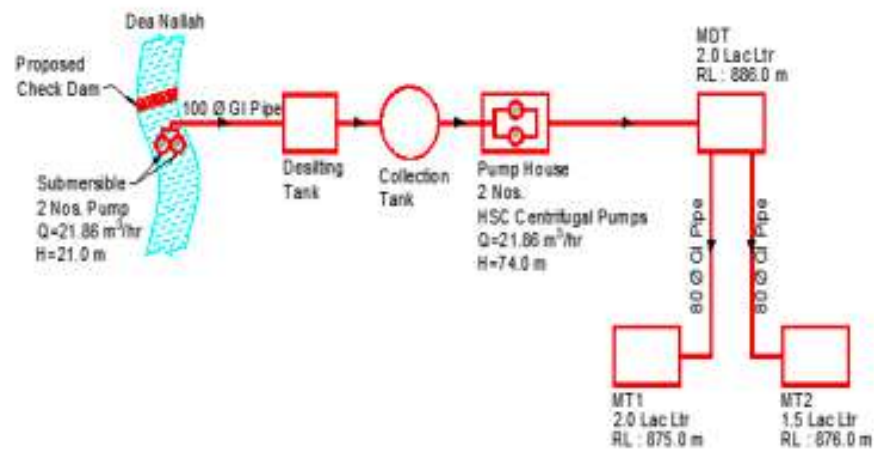
2. Proposed LIS – Manghota

Figure 140: Flow Diagram of Proposed LIS Manghota



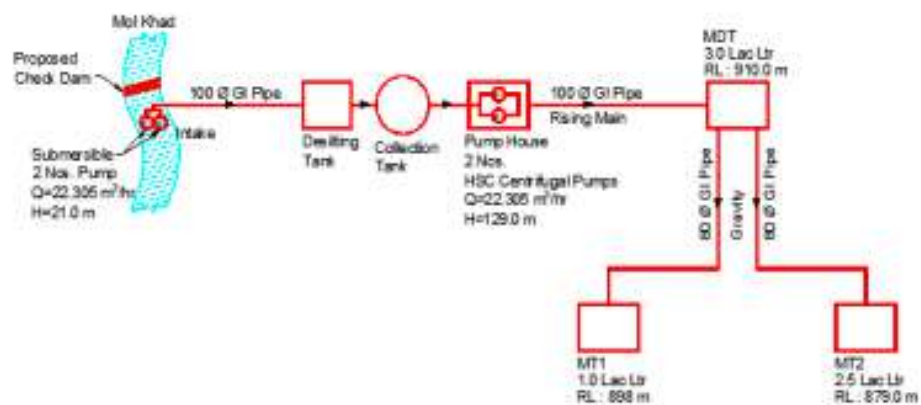
3. Proposed LIS – Kudail

Figure 141: Flow Diagram of Proposed LIS Kudail



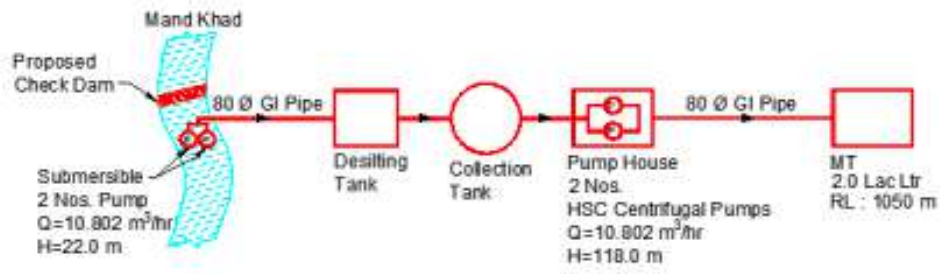
4. Proposed LIS – Thandol

Figure 142: Flow Diagram of Proposed LIS Thandol



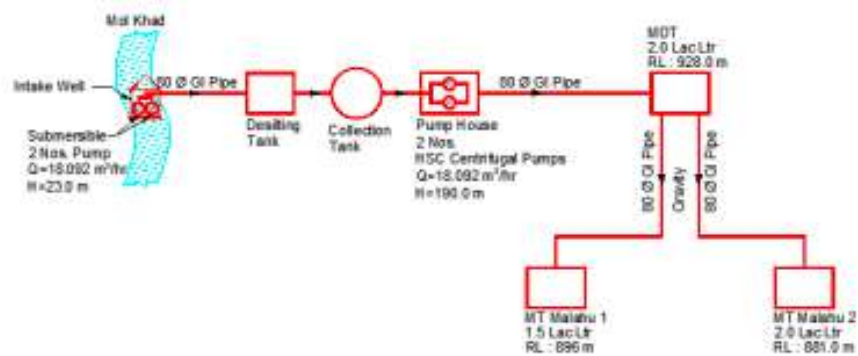
5. Proposed LIS – Ghar

Figure 143: Flow Diagram of Proposed LIS Ghar



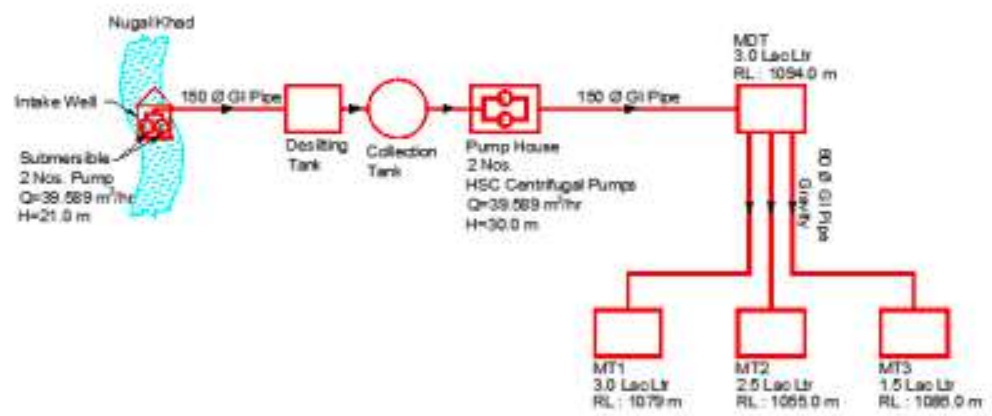
6. Proposed LIS – Malahu

Figure 144: Flow Diagram of Proposed LIS Malahu



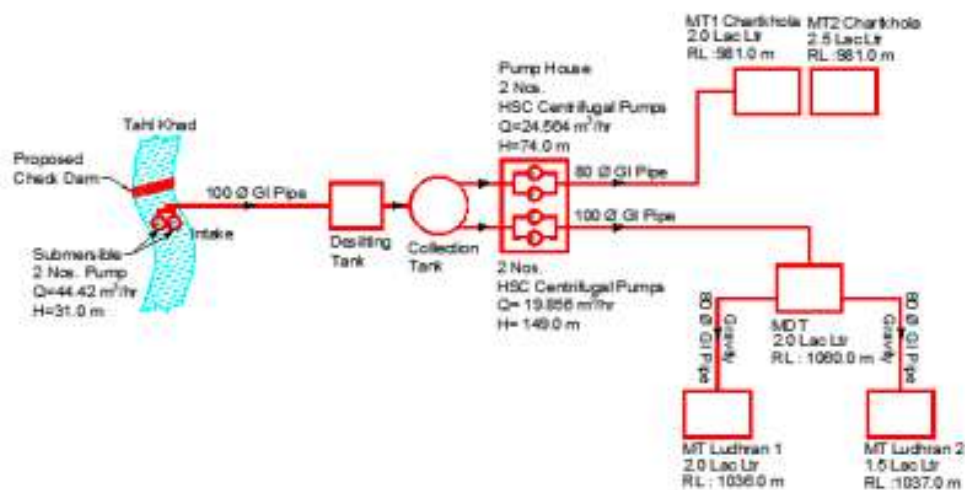
7. Proposed LIS – Sidhpur

Figure 145: Flow Diagram of Proposed LIS Sidhpur



8. Proposed LIS – Tahl Khad

Figure 146: Flow Diagram of Proposed LIS Tahl Khad



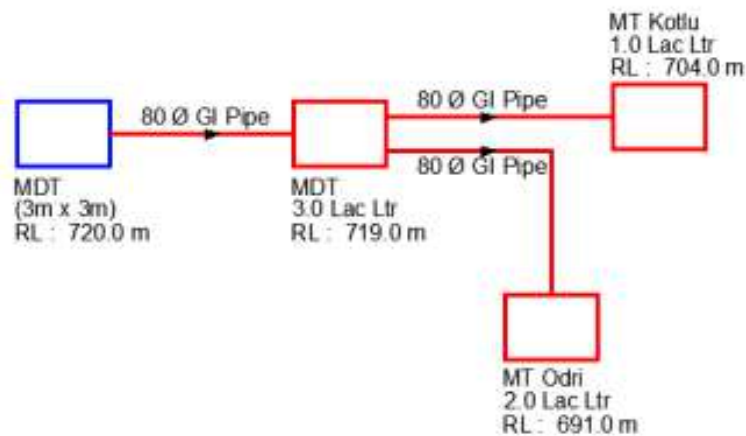
9. Proposed LIS – Alampur

Figure 147: Flow Diagram of Proposed LIS Alampur



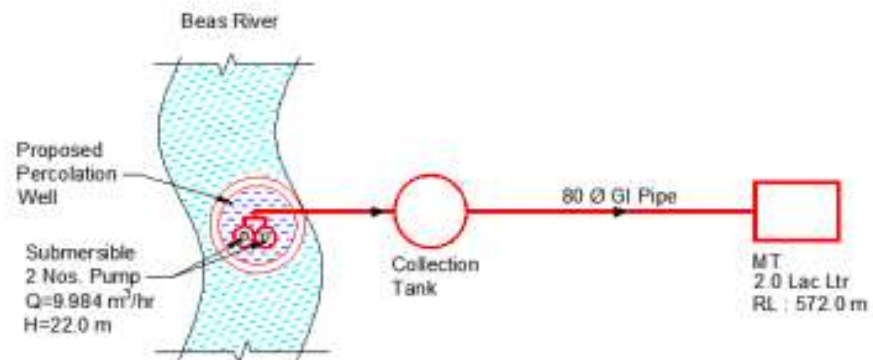
10. Proposed LIS – Bandhui

Figure 148: Flow Diagram of Proposed LIS Bandhui



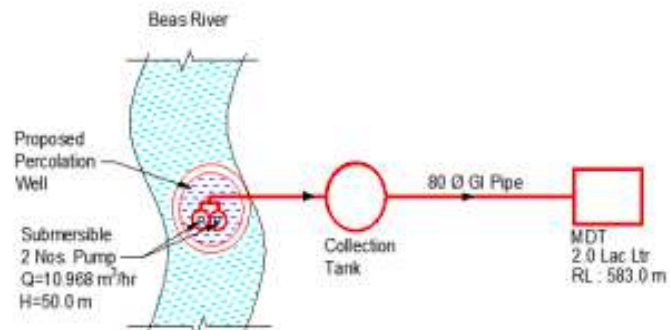
11. Proposed LIS – Kathla

Figure 149: Flow Diagram of Proposed LIS Kathla



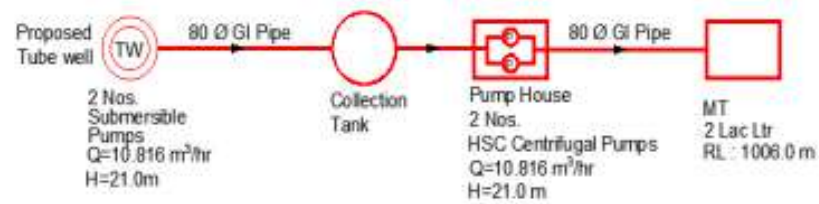
12. Proposed LIS – Thanpal/Chambi

Figure 150: Flow Diagram of Proposed LIS Thanpal/Chambi



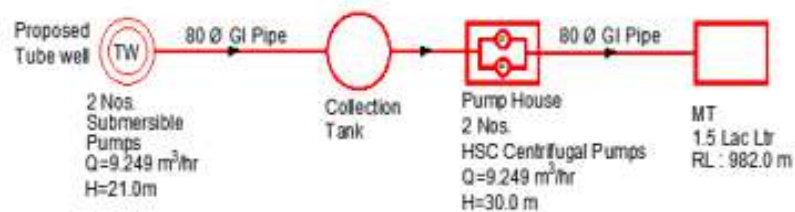
13. Proposed LIS – Trehal

Figure 151: Flow Diagram of Proposed LIS Trehal



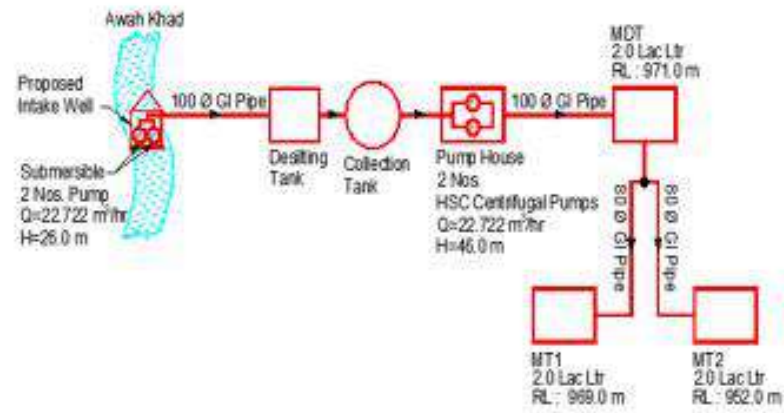
14. Proposed LIS – Agozar

Figure 152: Flow Diagram of Proposed LIS Agozar



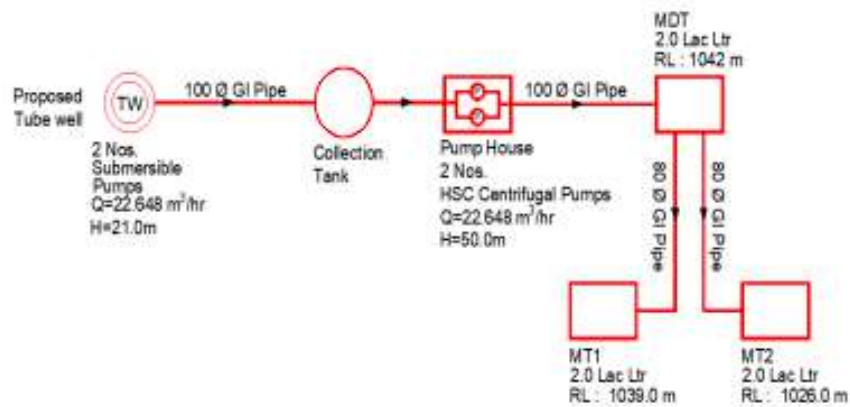
15. Proposed LIS – Rajhot-1 & 2

Figure 153: Flow Diagram of Proposed LIS Rajhot-1 & 2



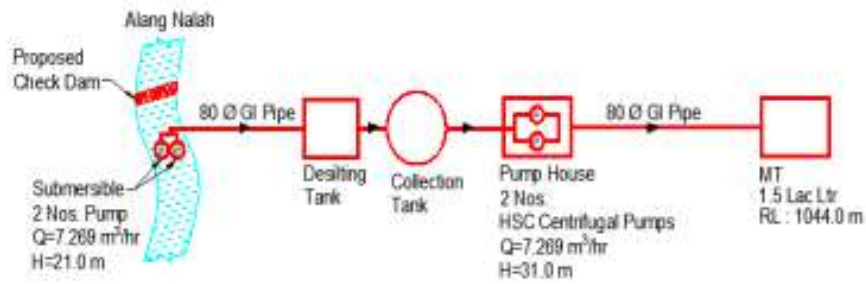
16. Proposed LIS – Ladoh-1

Figure 154: Flow Diagram of Proposed LIS Ladoh-1



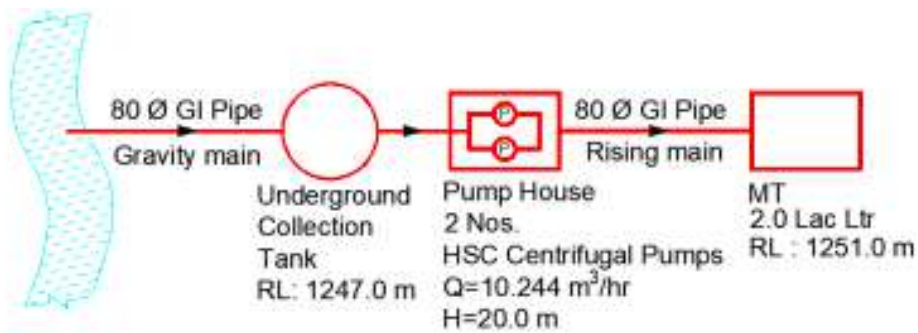
17. Proposed LIS – Ladoh-2

Figure 155: Flow Diagram of Proposed LIS Ladoh-2



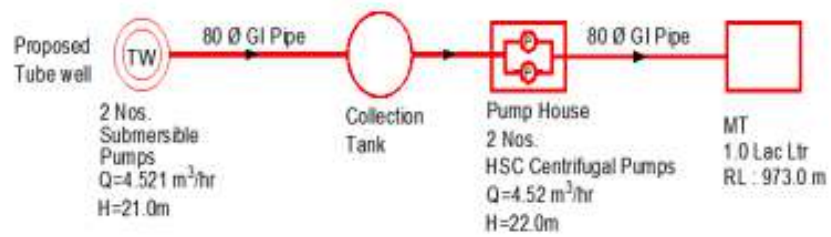
18. Proposed LIS – Banuri

Figure 156: Flow Diagram of Proposed LIS Banuri



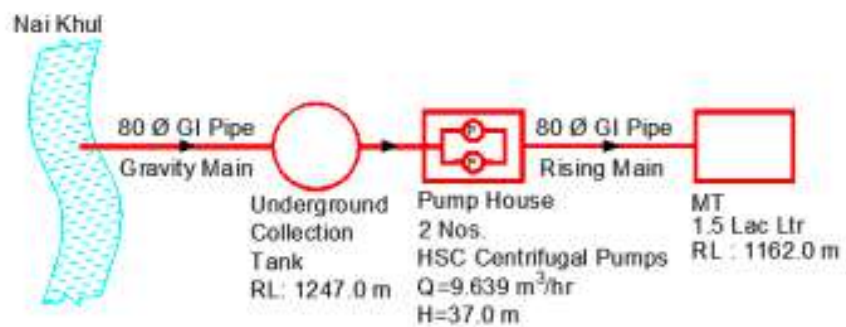
19. Proposed LIS – Tatehal

Figure 157: Flow Diagram of Proposed LIS Tatehal



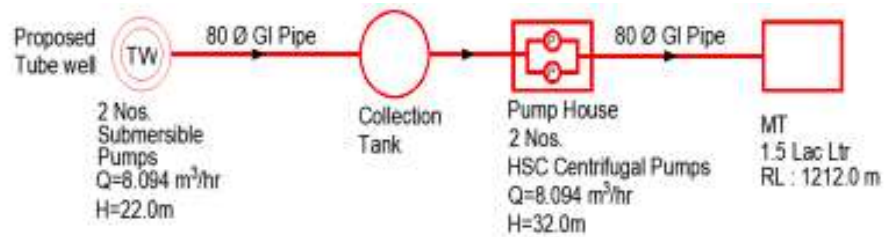
20. Proposed LIS – Saliana

Figure 158: Flow Diagram of Proposed LIS Saliana



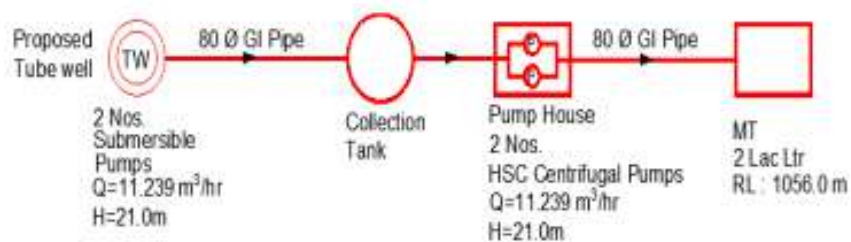
21. Proposed LIS – Molichak

Figure 159: Flow Diagram of Proposed LIS Molichak



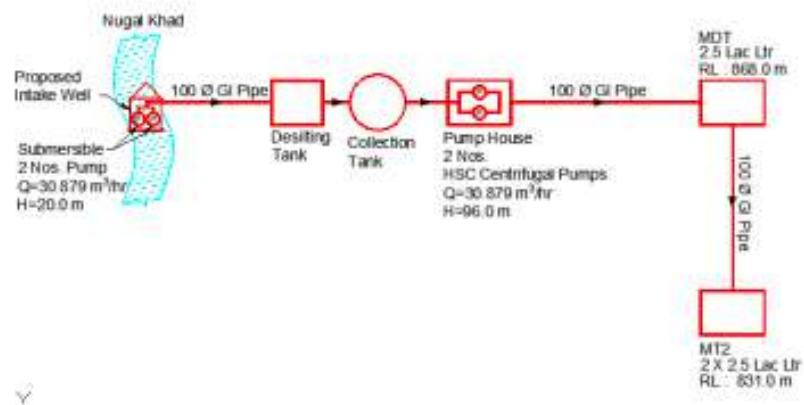
22. Proposed LIS – Jandpur

Figure 160: Flow Diagram of Proposed LIS Jandpur



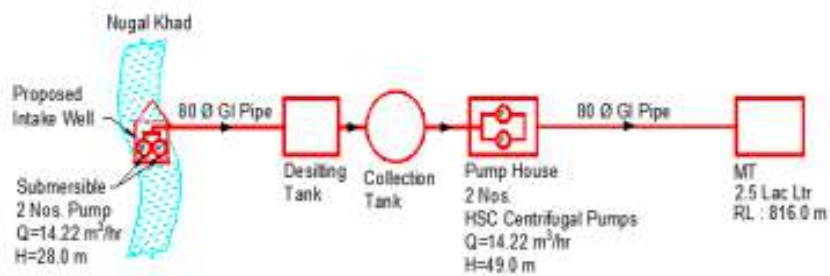
23. Proposed LIS – Dheera 1 & 2

Figure 161: Flow Diagram of Proposed LIS Dheera 1 & 2



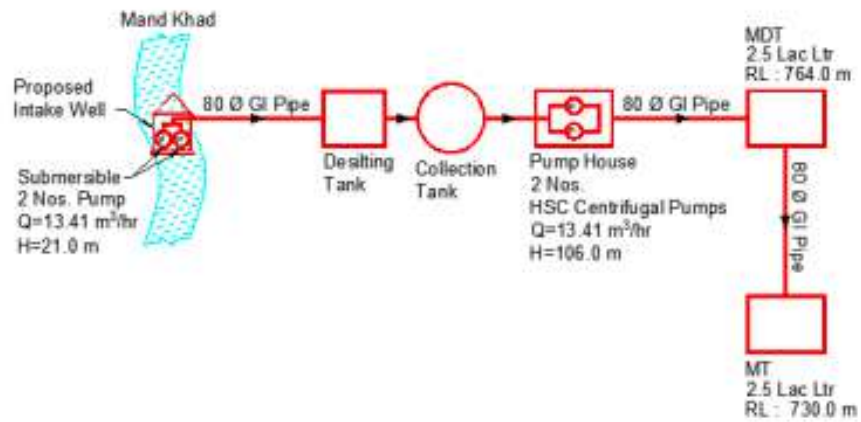
24. Proposed LIS – Dheera 3

Figure 162: Flow Diagram of Proposed LIS Dheera 3



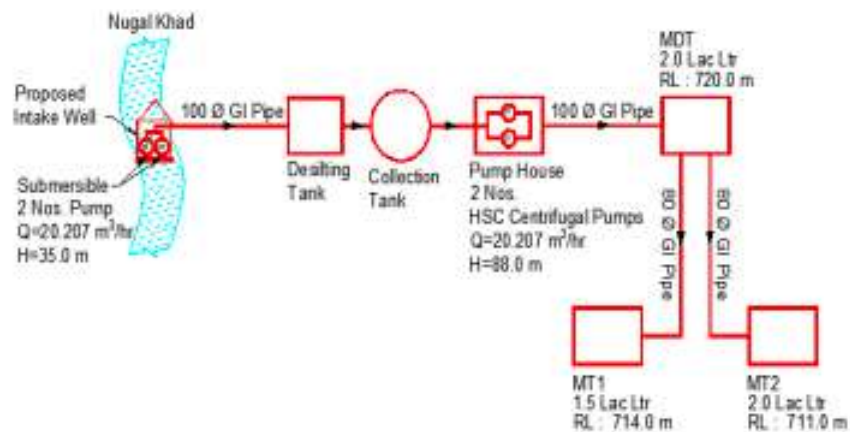
25. Proposed LIS – Chainchadi-Kuthera

Figure 163: Flow Diagram of Proposed LIS Chainchadi-Kuthera



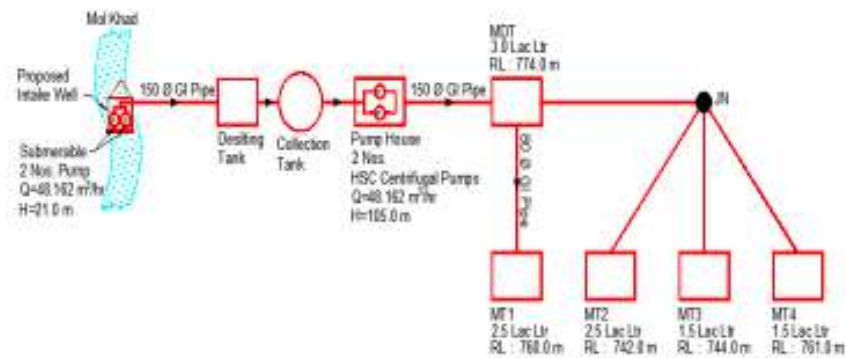
26. Proposed LIS – Purba

Figure 164: Flow Diagram of Proposed LIS Purba



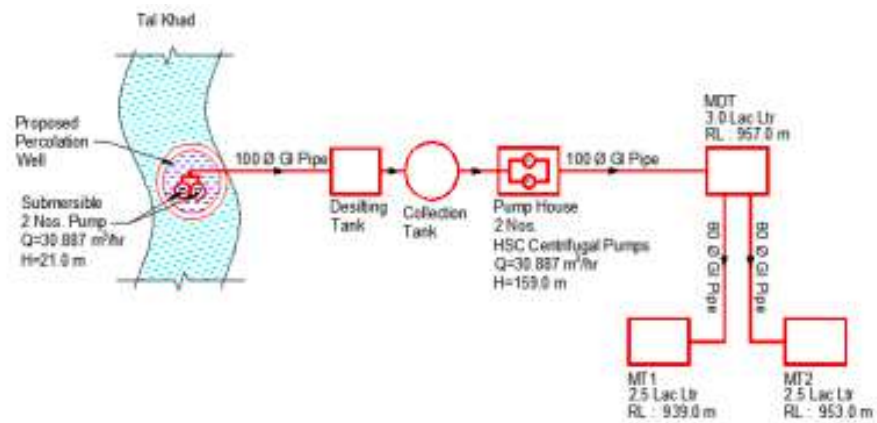
27. Proposed LIS – Chandar

Figure 165: Flow Diagram of Proposed LIS Chandar



28. Proposed LIS – Gagaj Khas

Figure 166: Flow Diagram of Proposed LIS Gagaj Khas

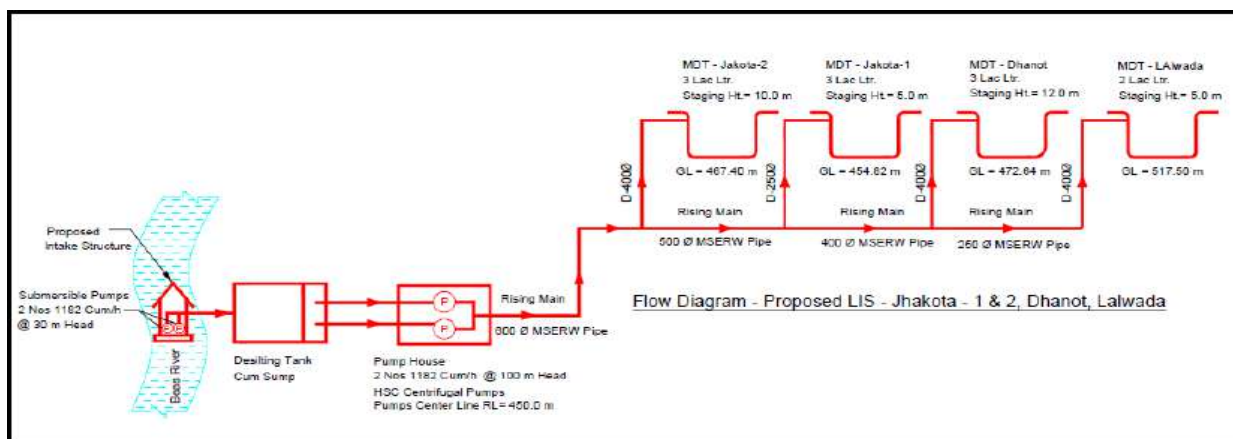


Irrigation Scheme flow-diagram of Package – 10 (Kangra District):

1. Lalwada, Jhakota, Dhanot LIS New Schemes

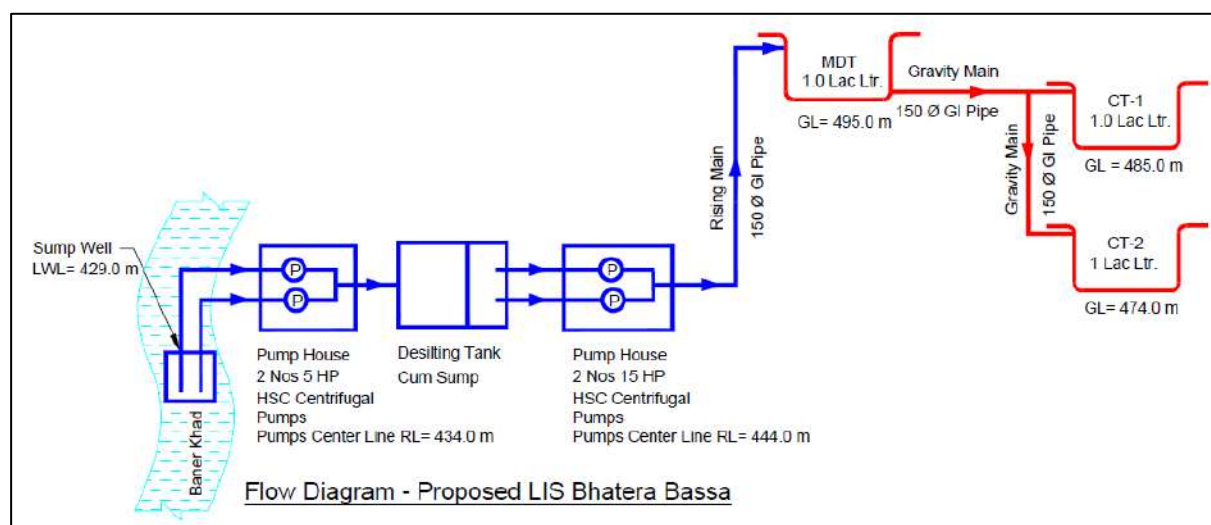
Flow diagram of proposed Lift irrigation scheme of Jhakota Dhanot Lalwada is as below:

Figure 167: Flow Diagram of New Proposed LIS – Jhakota Dhanot Lalwada



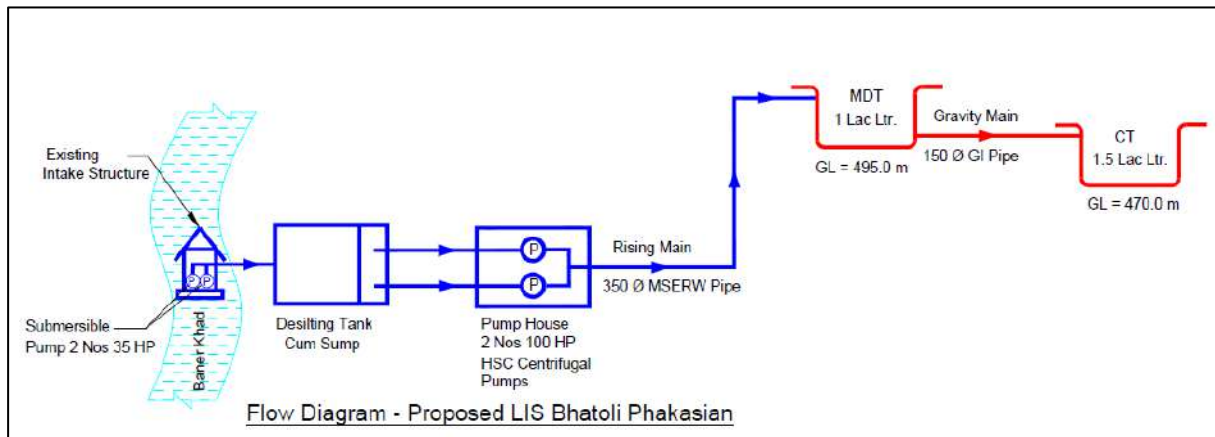
2. LIS Bhatera Bassa

Figure 168: Flow Diagram LIS Bhatera Bassa



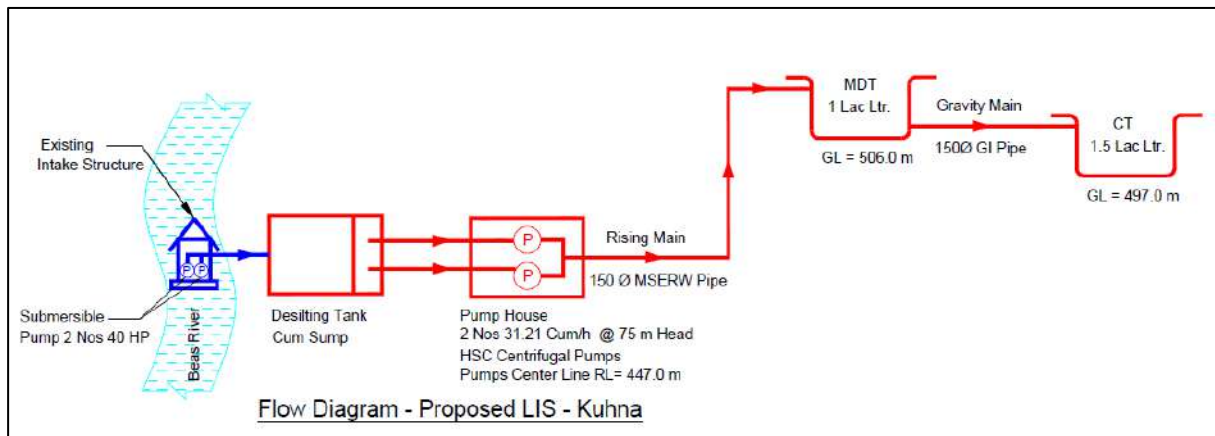
3. LIS Bhatoli Phakasian

Figure 169: Flow Diagram LIS Bhatoli Phakasian



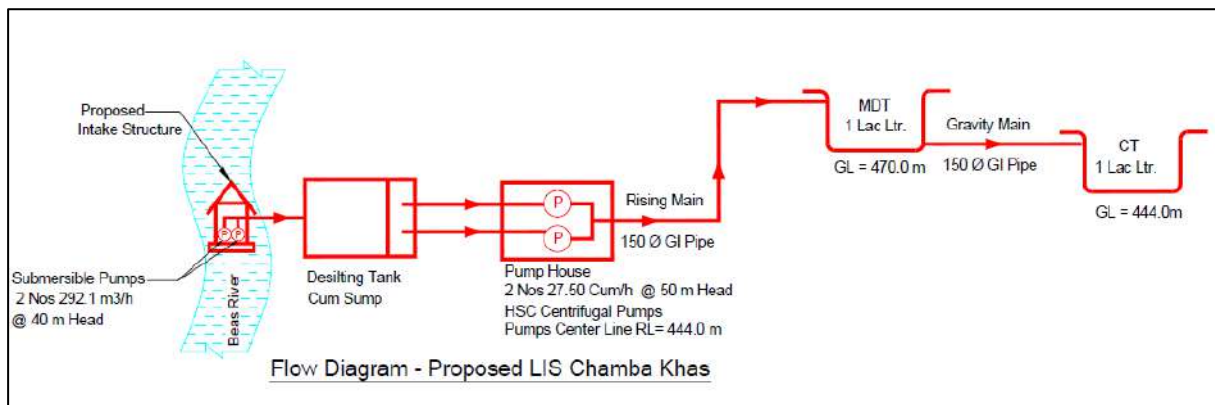
4. LIS Kuhna

Figure 170: Flow Diagram LIS Kuhna



5. LIS Chamba Khas

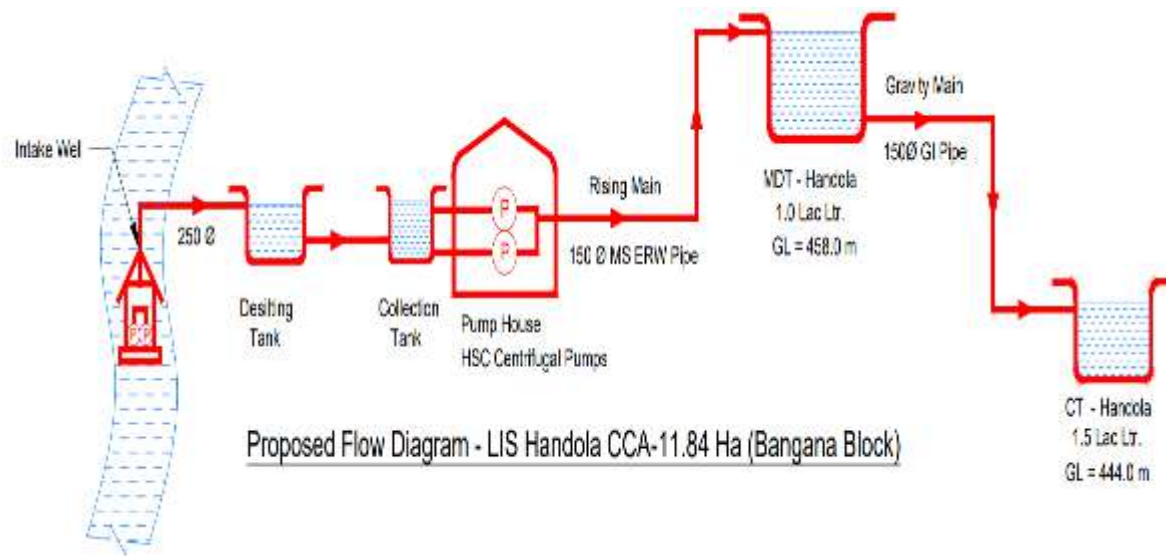
Figure 171: Flow Diagram - LIS Chamba Khas



Irrigation Scheme flow-diagram of Package – 11 (Una District):

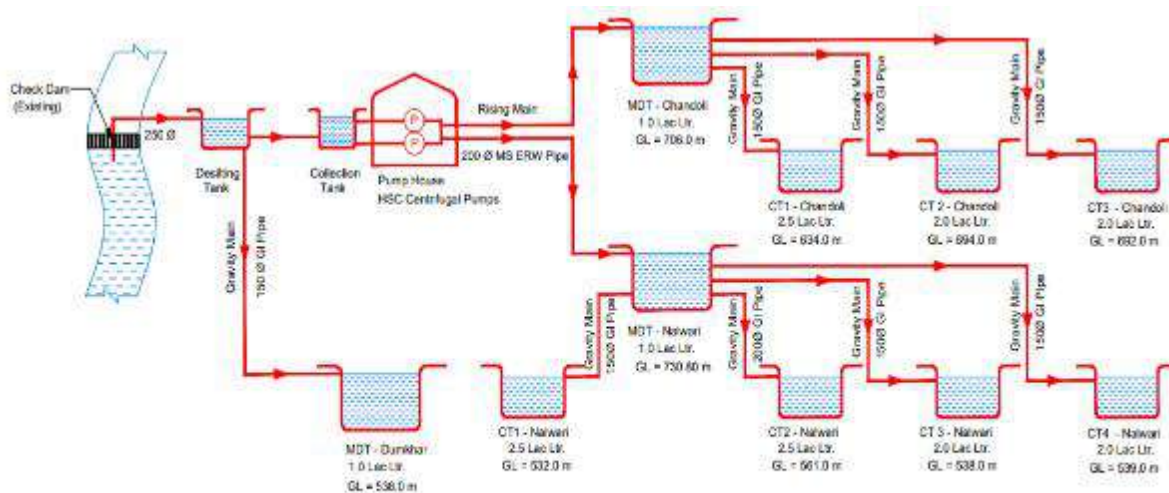
1. LIS Handola

Figure 172: Flow Diagram of Proposed LIS Handola



2. LIS Dulheri Rajputa and Thana Khurd

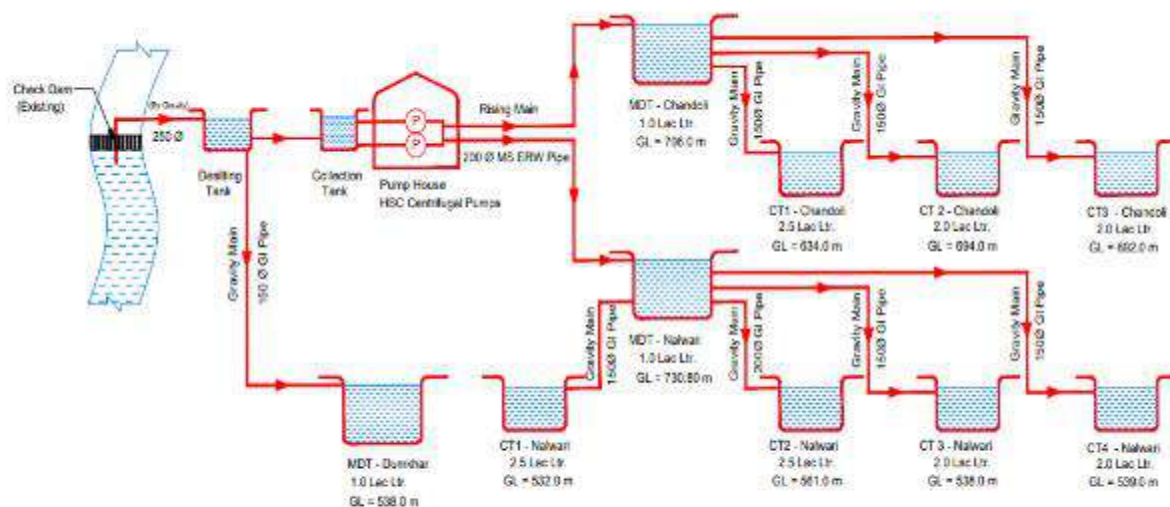
Figure 173: Flow Diagram of Proposed LIS Dulheri Rajputa and Thana Khurd



Proposed Flow Diagram - LIS Chpla Dam, CCA - 74.03 Ha (Bangana Block)

3. LIS over Chapla Dam

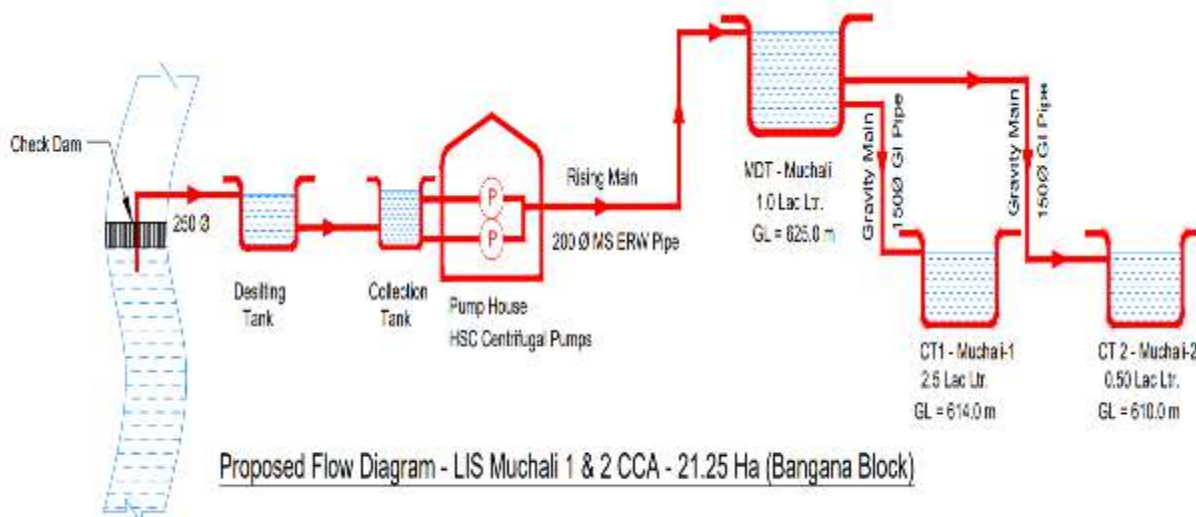
Figure 174: Flow Diagram of Proposed LIS Chapla Dam (Nalwari, Dumkhar and Charoli)



Proposed Flow Diagram - LIS Chpla Dam, CCA - 74.03 Ha (Bangana Block)

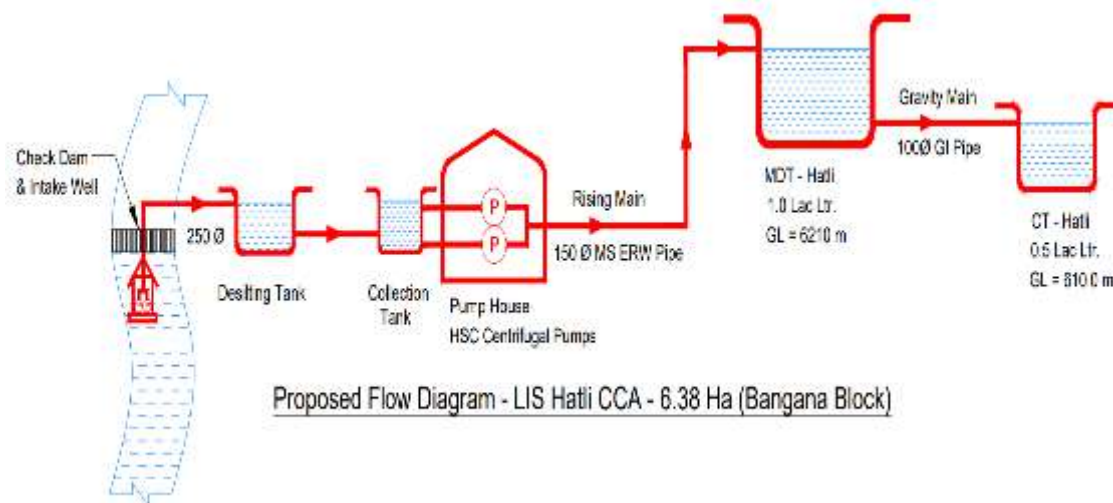
4. LIS over Muchali 1 & 2

Figure 175: Flow Diagram of Proposed LIS - Muchali 1 & 2

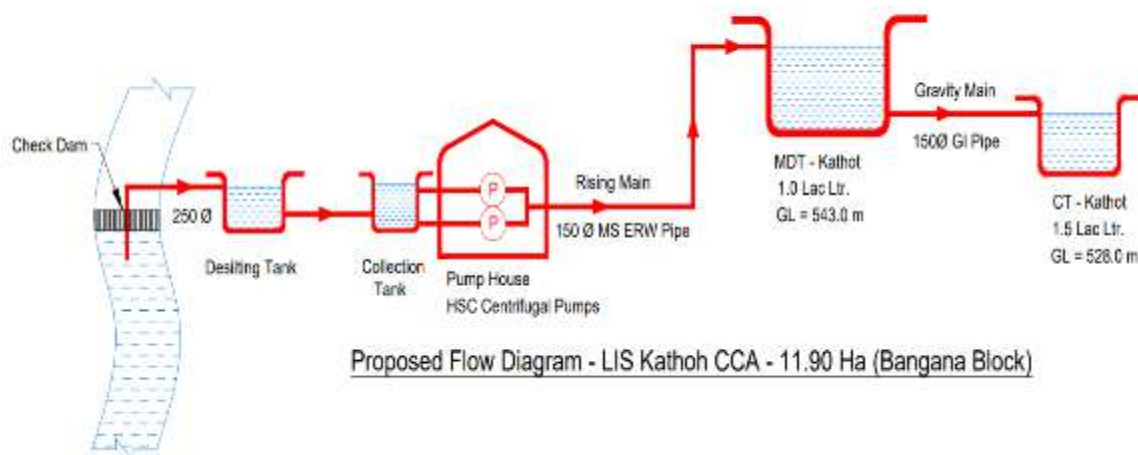


Proposed Flow Diagram - LIS Muchali 1 & 2 CCA - 21.25 Ha (Bangana Block)

5. LIS Haldi

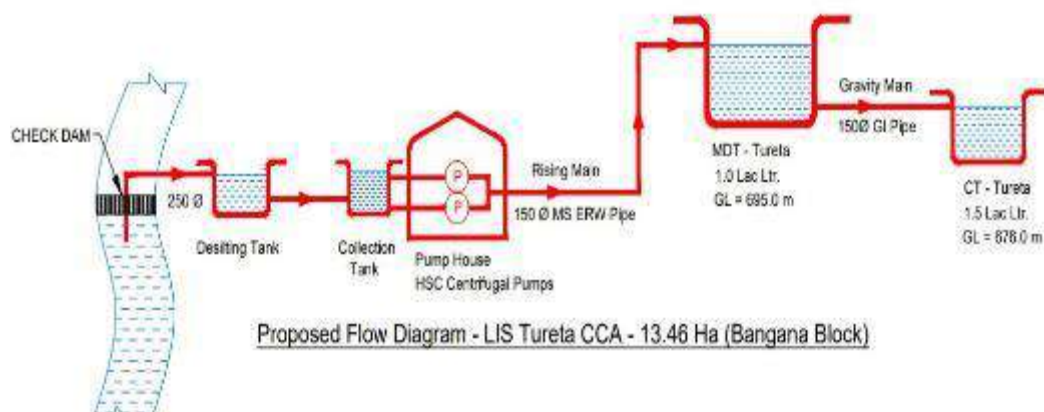


6. LIS Kathoh

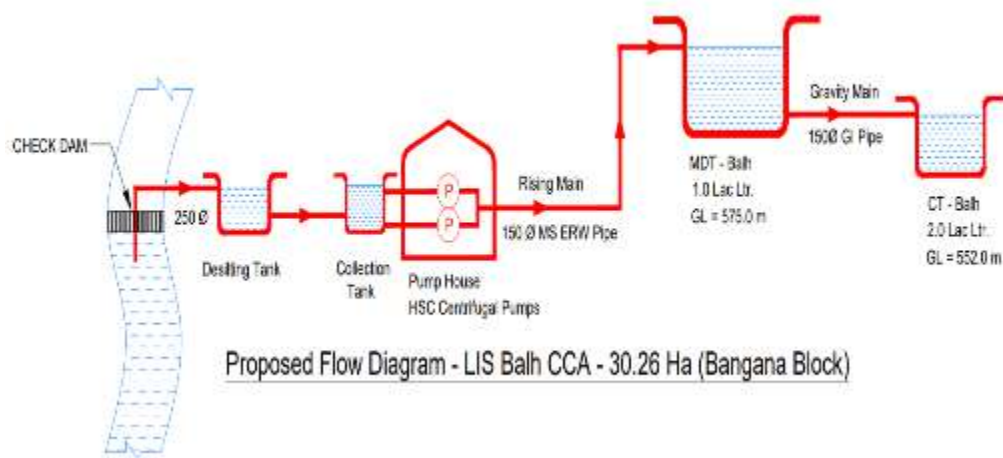


7. LIS Tureta

Figure 178: Flow Diagram of Proposed LIS Tureta

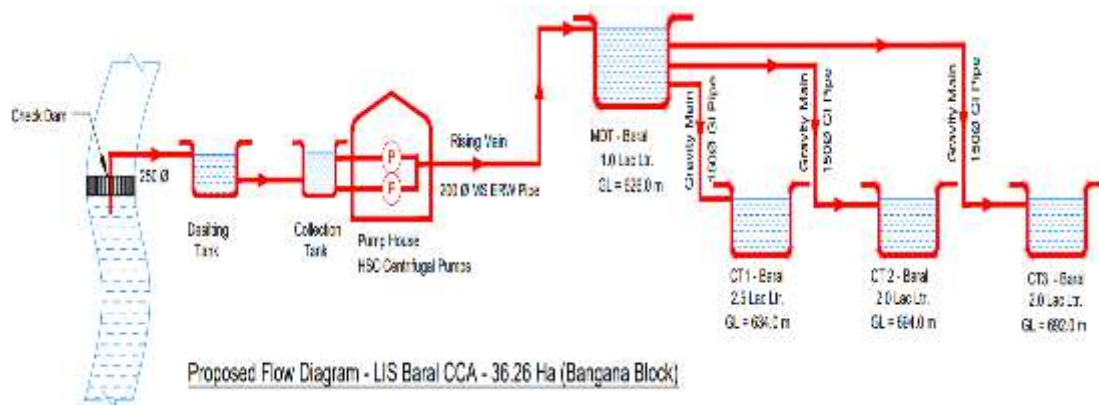


8. LIS Balh



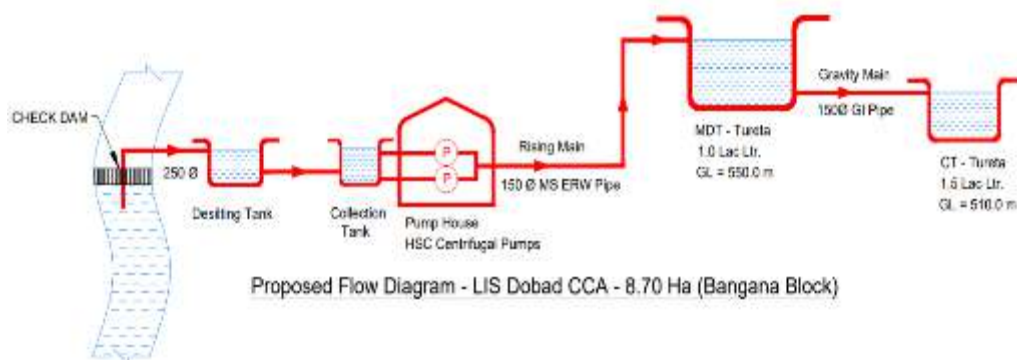
9. LIS Baral

Figure 180: Flow Diagram of Proposed LIS Baral



10. LIS Dobad

Figure 181: Flow Diagram of Proposed LIS Dobad



Annexure 4: LIST OF BANNED PESTICIDES IN INDIA¹⁹

1. Pesticides / Formulations banned in India - Pesticides banned for manufacture, import and use

- Alachlor (Vide S.O. 3951 (E), dated 08.08.2018)
- Aldicarb (vide S.O. 682 (E) dated 17th July 2001)
- Aldrin
- Benzene Hexachloride
- Benomyl (vide S.O 3951(E) dated 8th August 2018)
- Calcium Cyanide
- Carbaryl (vide S.O 3951(E) dated 8th August 2018)
- Chlorbenzilate (vide S.O. 682 (E) dated 17th July 2001)
- Chlordane
- Chlorofenvinphos
- Copper Acetoarsenite
- Diazinon (vide S.O 3951(E) dated 8th August 2018)
- Dibromochloropropane (DBCP) (vide S.O. 569 (E) dated 25th July 1989)
- Dichlorovos (Vide S.O. 3951 (E), dated 08.08.2018)
- Dieldrin (vide S.O. 682 (E) dated 17th July 2001)
- Endosulfon (vide ad-Interim order of the Supreme Court of India in the Writ Petition (Civil) No. 213 of 2011 dated 13th May 2011 and finally disposed of dated 10th January 2017)
- Endrin
- Ethyl Mercury Chloride
- Ethyl Parathion
- Ethylene Dibromide (EDB) (vide S.O. 682 (E) dated 17th July 2001)
- Fenarimol (vide S.O 3951(E) dated 8th August 2018)
- Fenthion (vide S.O 3951(E) dated 8th August 2018)
- Heptachlor
- Lindane (Gamma-HCH)
- Linuron (vide S.O 3951(E) dated 8th August 2018)
- Maleic Hydrazide (vide S.O. 682 (E) dated 17th July 2001)
- Menazon
- Methoxy Ethyl Mercury Chloride (vide S.O 3951(E) dated 8th August 2018)
- Methyl Parathion (vide S.O 3951(E) dated 8th August 2018)
- Metoxuron
- Nitrofen
- Paraquat Dimethyl Sulphate
- Pentachloro Nitrobenzene (PCNB) (vide S.O. 569 (E) dated 25th July 1989)
- Pentachlorophenol
- Phenyl Mercury Acetate
- Phorate (Vide S.O. 3951 (E), dated 08.08.2018)
- Phosphamidon (Vide S.O. 3951 (E), dated 08.08.2018)
- Sodium Cyanide (banned for Insecticidal purpose only vide S.O 3951(E) dated 8th August 2018)
- Sodium Methane Arsonate
- Tetradifon
- Thiometon (vide S.O 3951(E) dated 8th August 2018)
- Toxaphene (Camphechlor) (vide S.O. 569 (E) dated 25th July 1989)
- Triazophos (Vide S.O. 3951 (E), dated 08.08.2018)
- Tridemorph (vide S.O 3951(E) dated 8th August 2018)
- Trichloro Acetic Acid (TCA) (vide S.O. 682 (E) dated 17th July 2001)
- Trichlorfon (Vide S.O. 3951 (E), dated 08.08.2018)

Pesticide formulations banned for import, manufacture, and use

- Carbofuron 50% SP (vide S.O. 678 (E) dated 17th July 2001)
- Methomyl 12.5% L
- Methomyl 24% formulation
- Phosphamidon 85% SL

¹⁹ List of Pesticides which are banned, refused registration and restricted in use (as on 01.04.2022)
http://ppqs.gov.in/sites/default/files/banned_pesticides.pdf

Pesticide / Pesticide formulations banned for use but continued to manufacture for export

- Captafol 80% Powder (vide S.O. 679 (E) dated 17th July 2001)
- Dichlorvos (vide S.O. 1196 (E) dated 20th March 2020)
- Nicotin Sulfate (vide S.O. 325 (E) dated 11th May 1992)
- Phorate (vide S.O. 1196 (E) dated 20th March 2020)
- Triazophos (vide S.O. 1196 (E) dated 20th March 2020)

Annexure 5: NATIONAL PARKS AND WILDLIFE SANCTUARIES IN HIMACHAL PRADESH

Table 19: List of National Parks & Wildlife Sanctuaries of the state

Sr No.	National Park	Area (Sq. KM)	District	Flora	Fauna
1	Simbalbara National Park	27.88	Sirmaur	Sal trees (Shorea Robusta) and grassy glades	Goral (Naemorhedus), Sambar (Rusa unicolor), Spotted Deer or Chital (Axis axis), Himalayan black bear (Ursus thibetanus laniger), Hanuman langurs (Semnopithecus), Indian muntjacs (Muntiacus muntjak)
Sr No.	Wildlife Sanctuary	Area (Sq. KM)	District	Flora	Fauna
2	Bandli	41.32	Mandi	Northern Dry Mixed Deciduous (Isoetes bilaspurensis), Himalayan Subtropical Chir Pine (Pinus roxburghii), Ban Oak (Quercus leucotrichophora)	Snow leopard (Panthera uncia), Cheer pheasant (Catreus wallichii), Himalayan Black Bear (Ursus thibetanus laniger), common Palm Civet (Paradoxurus hermaphroditus), Barking Deer (Muntiacus), Goral (Naemorhedus), Indian hare (Lepus nigricollis), Rhesus Macaque (Macaca mulatta)
3	Chail	110.00	Solan	Dense cover of Oak (Quercus), Pine (Pinus) and grassland.	Sambar deer (Rusa unicolor), Goral (Naemorhedus), Cheer pheasant (Catreus wallichii), Rhesus macaque (Macaca mulatta), Leopard (Panthera pardus), Indian muntjac (Muntiacus muntjak), Porcupine (Hystrix indica), Wild boar (Sus scrofa), Langur (Semnopithecus) and Himalayan black bear (Ursus thibetanus laniger).
4	Churdhar	56.16	Sirmaur	Coniferous forest (Pinophyta), Alpine meadows (Eucalyptus delegatensis), Deodar (Cedrus deodara), Oak (Quercus)	Common langur (Semnopithecus), Rhesus macaque (Macaca mulatta), Leopard (Panthera pardus), Himalayan black bear (Ursus thibetanus laniger), Wild boar (Sus scrofa), Barking deer (Muntiacus), Musk deer (Moschus), Goral (Naemorhedus), Royle's pika (Ochotona roylei), Indian porcupine (Hystrix indica)
5	Dhauladhar	982.86	Kangra	Western mixed coniferous forest (Pinophyta) with Deodar (Cedrus deodara), Fir (Abies), White Pine (Pinus wallichiana), Oaks (Quercus), Alpine Pastures (Eucalyptus delegatensis)	Musk deer (Moschus), Himalayan black bear (Ursus thibetanus laniger), Serow (Capricornis), Himalayan Weasel (Mustela sibirica), Himalayan palm civet (Paguma larvata), Cheer Peasant (Catreus wallichii), Western Tragopan

					(Tragopan melanocephalus)
6	Majathal	39.40	Solan	Pine (Pinus), Oak (Quercus)	Cheer Peasant (Catreus wallichii), Goral (Naemorhedus), Himalayan Black Bear (Ursus thibetanus laniger), Leopard (Panthera pardus), Rhesus Macaque (Macaca mulatta), Jungle Cat (Felis chaus), Himalayan Palm civet (Paguma larvata), Barking Deer (Muntiacus), Sambar (Rusa unicolor)
7	Nargu	132.37	Mandi	Moru Oak (Quercus floribunda), Ban Oak (Quercus leucotricophora), Kharsu Oak (Quercus semecarpifolia), Moist Deodar (Cedrus deodara), Moist temperate Deciduous, western mixed Coniferous (Pinophyta)	Monal (Lophophorus), Himalayan black bear (Ursus thibetanus laniger), Musk deer (Moschus), Serow (Capricornis), Barking deer (Muntiacus), Black bear (Ursus thibetanus laniger), Goral (Naemorhedus)
8	Pong Dam Lake	207.59	Kangra	Eucalyptus (Eucalyptus globulus Labill), Acacia, Jamun (Syzygium cumini), Shisham (Dalbergia sissoo), Mango (Mangifera), Mulberry (Morus alba), Ficus, Kachnar (Bauhinia variegata), Amla (Phyllanthus emblica), Plum (Prunus)	Barking deer (Muntiacus), Sambar (Rusa unicolor), Wild Boars (Sus scrofa), Nilgai (Boselaphus tragocamelus), Leopard (Panthera pardus), Oriental small-clawed Otters (Aonyx cinereus)
9	Renuka	4.03	Sirmaur	Dry mixed Deciduous (Isoetes bilaspurensis), Dry Sal (Shorea Robusta), Khair (Senegalia catechu), Shisham (Dalbergia sissoo), Carrie (Mangifera indica), Cordia	Leopard (Panthera pardus), Sambar (Rusa unicolor), Spotted Deer (Axis axis), Barking deer (Muntiacus), Jackal (Canis aureus), Jungle Cat (Felis chaus), Palm civet (Paguma larvata), Black Partridge (Melanoperdix niger)
10	Shikari Devi	29.94	Mandi	Ban Oak (Quercus leucotricophora), Western Mixed Coniferous (Pinophyta), Kharsu Oak (Quercus semecarpifolia), West Himalayan Upper Oak, Moist Temperate Deciduous	Goral (Naemorhedus), Monal (Lophophorus), Black Bear (Ursus thibetanus laniger), Barking Deer (Muntiacus), Musk Deer (Moschus), Cat Leopard (Prionailurus bengalensis), Himalayan Black Bear (Ursus thibetanus laniger)
11	Gobind Sagar Wildlife Sanctuary	167.40	Bilaspur	Deciduous, Khair (Senegalia catechu), Sisso	Sambar (Rusa unicolor), Wild boar (Sus scrofa), Barking deer (Muntiacus), Red junglefowl (Gallus gallus)
12	Naina Devi Wildlife Sanctuary	123.00	Bilaspur	Deciduous, Sisso, Bamboo (Bambusoideae), Scrub (Quercus berberidifolia), Pine	Jackal (Canis aureus), Leopard (Prionailurus bengalensis), Rhesus (Macaca mulatta), Himalayan yellow throated

				(Pinus)	Marten (Martes flavigula), Serow (Capricornis), Porcupine (Hystrix indica), Sambar (Rusa unicolor)
13	Shilli Wildlife Sanctuary	2.14	Solan	Deodar (Cedrus deodara), Fir (Abies), Ban Oak trees (Quercus leucotrichophora) and numerous medicinal plants	Mammals - Black Bear (Ursus thibetanus laniger), Brown Bear (Ursus arctos), Leopard (Prionailurus bengalensis), Jackal (Canis aureus), Hyena (Hyaenidae), Musk Deer (Moschus), Barking Deer (Muntiacus), Bear (Ursidae). Birds – Woodpecker (Picidae), Peacock (Pavo cristatus), Duck (Anatidae), Parrot (Psittaciformes), Myna (Acridotheres tristis), Pheasant (Phasianus colchicus), and Hornbill (Bucerotidae) Reptiles - Monitor Lizard (Varanus), Indian Cobra (Naja naja), Python (Pythonidae), Indian Krait (Bungarus caeruleus), Flying Squirrel (Pteromyini)

Table 20: Flora species in Himachal Pradesh

Sr No.	Scientific Name	Common Name	IUCN Conservation Status
1	Abies	Fir	LC
2	Acacia	Acacia	LC
3	Bambusoideae	Bamboo	LC
4	Bauhinia variegata	Kachnar	LC
5	Cedrus deodara	Deodar	LC
6	Dalbergia sissoo	Shisham	LC
7	Eucalyptus delegatensis	Alpine Meadows	LC
8	Eucalyptus globulus Labill	Eucalyptus	LC
9	Isoetes bilaspurensis	Dry Mixed Deciduous	LC
10	Mangifera indica	Common Indian Mango	DD
11	Morus alba	Mulberry	LC
12	Phyllanthus emblica	Amla	LC
13	Pinus roxburghii	Himalayan Subtropical Chir Pine	LC
14	Pinus wallichiana	White Pine	LC
15	Prunus	Plum	LC
16	Quercus berberidifolia	Scrub	LC
17	Quercus floribunda	Moru Oak	LC
18	Quercus leucotrichophora	Ban Oak	LC
19	Quercus semecarpifolia	Kharsu Oak	LC
20	Senegalia catechu	Khair	LC
21	Shorea Robusta	Sal	LC
22	Syzygium cumini	Jamun	LC

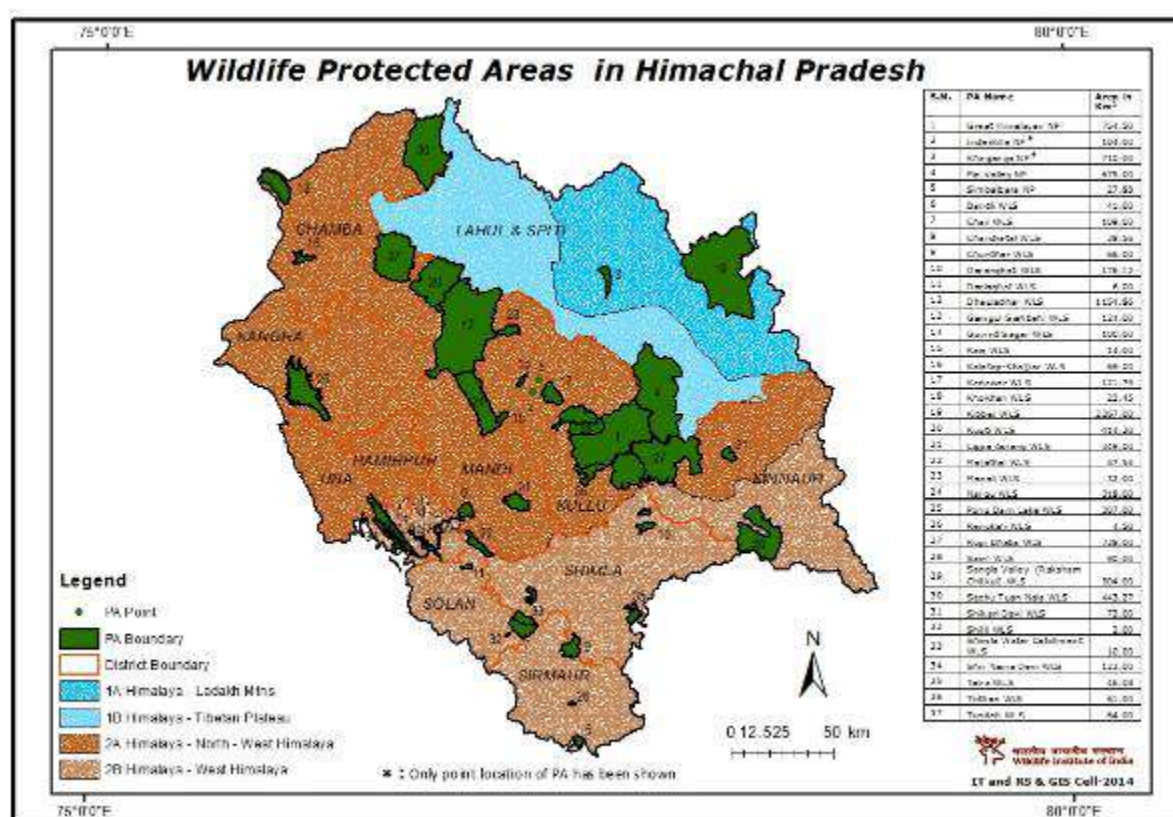
DD: Data Deficient; LC: Least Concerned

Table 21: Fauna Species in Himachal Pradesh

Sr No.	Scientific Name	Common Name	IUCN Conservation Status
1	Acridotheres tristis	Myna	LC
2	Aonyx cinereus	Oriental small-clawed Otter	VU
3	Axis axis	Chital	LC
4	Bungarus caeruleus	Indian Krait	LC
5	Canis aureus	Jackal	LC
6	Capricornis	Serow	LC
7	Catreus wallichii	Cheer Pheasant	VU
8	Felis chaus	Jungle Cat	LC
9	Gallus gallus	Red Junglefowl	LC
10	Hystrix indica	Indian Porcupine	LC
11	Lepus nigricollis	Indian Hare	LC
12	Lophophorus	Monal	LC
13	Macaca mulatta	Rhesus Macaque	LC
14	Martes flavigula	Himalayan Yellow-throated Marten	LC
15	Melanoperdix niger	Black Partridge	VU
16	Moschus	Musk Deer	EN
17	Muntiacus muntjac	Indian Muntjacs	LC
18	Mustela sibirica	Himalayan Weasel	LC
19	Naemorhedus	Goral	NT
20	Naja naja	Indian Cobra	LC
21	Ochotona roylei	Royle's Pika	LC
22	Paguma larvata	Himalayan Palm civet	LC
23	Panthera uncia	Snow Leopard	VU
24	Panthera pardus	Leopard	VU
25	Paradoxurus hermaphroditus	Common Palm Civet	LC
26	Pavo cristatus	Peacock	LC
27	Phasianus colchicus	Pheasant	LC
28	Prionailurus bengalensis	Cat Leopard	LC
29	Pythonidae	Python	LC
30	Rusa unicolor	Sambar	VU
31	Semnopithecus	Hanuman Langur	LC
32	Sus scrofa	Wild Boar	LC
33	Tragopan melanocephalus	Western Tragopan	VU
34	Ursus thibetanus laniger	Himalayan Black Bear	VU
35	Ursus arctos	Brown Bear	LC

EN: Endangered; LC: Least Concern; NT: Near Threatened; VU: Vulnerable

Figure 182: Wildlife Protected Areas in Himachal Pradesh



Annexure 6: STANDARD CONSTRUCTION CONTRACT ENVIRONMENTAL AND SOCIAL SAFEGUARD CLAUSES

Environmental clauses to be included in the bid document are delineated in the subsequent subsections.

- Contractor shall be responsible for implementation of Environmental Management Plan (EMP) in addition to adhering to relevant statutory environmental requirements to all engineering works as a part of good engineering practices.
- All works undertaken towards protection of environmental resources as part of the EMP and as part of good engineering practices while adhering to relevant specifications will be deemed to be incidental to works being carried out and no separate payment will be made unless otherwise specified explicitly. The cost towards environmental management as per EMP unless otherwise provided as a separate head, will be deemed to be part of Bill of Quantity of the project. The Scope of Work (SoW) of the Contractor towards implementation of environmental provision shall be as follows:
- Abide by all existing environmental regulation and requirements of the Government of India and State Government of Maharashtra during proposed construction and implementation.
- Comply with all mitigation measure and monitoring requirements set out in the EMP.
- Submission of methodology stating how EMP will be complied including method and schedule of monitoring.
- Monitoring of project environmental performance and periodic submission of monitoring report.
- Compliance with all measures required for construction activities in sensitive areas (if any), in line with the regulatory requirements adopted by MoEF & CC, GoI.
- Compliance of all safety rules at work, and provision of adequate health and safety measures such as water, food, sanitation, personal protective equipment, workers insurance, and medical facilities and rest shelters.
- The Contractor should procure construction materials from the licensed/ authorized agents/ dealers. Procurement of materials from the unauthorized sources shall be considered as illegal and appropriate measures shall be taken.
- Construction and Demolition waste shall be handled as per the provisions laid down in the C&D Waste Management Rules 2016.
- The Contractor shall ensure that construction activities do not cause contamination of water and dispose off solid wastes, resulting from construction related activities, anywhere on the premises but dispose of as per the C&D Waste Management Rules 2016.

Annexure 7: SCEP FRAMEWORK

Table 22: Process and Mechanism for Information Sharing

Process	Mechanism
Correspondences (Phone, Emails)	• Distribute Project brief/information to Government officials, NGOs, Local Government, and organizations/agencies • Invite stakeholders to meetings and follow-up
One-on-one meetings	• Seeking views and opinions • Enable stakeholders to speak freely about sensitive issues • Build personal relationships • Record meetings
Formal meetings	• Present the Project information to a group of stakeholders • Allow the group to comment – opinions and views • Build impersonal relations with high-level stakeholders • Disseminate technical information (as required) • Record discussions
Public meetings	• Present Project information to a large group of stakeholders, especially communities • Allow the group to provide their views and opinions • Build a relationship with the communities, especially those impacted • Distribute non-technical information (as required) • Facilitate meetings with presentations, PowerPoint, posters, etc. • Record discussions, comments, and questions.
Focus group meetings	• Present Project information to a group of stakeholders • Allow stakeholders to provide their views on targeted baseline information • Build relationships with communities • Record responses
Project website and disclosure	• Present project information and progress updates • Disclose ESMP, RAP, SCEP, Contract Progress, RAP Implementation progress, Grievances and redresses of Grievances, and other relevant project documentation.
Direct communication with people	• Share information on the timing of commencement of civil works • Agree to options for removing crops and relocating fences/structures, e.g., sheds, if applicable.
Road signs	• Share information on project activities • Reminders of potential impacts (e.g., for possible landslides, road clearance activities)
Project leaflet	• Brief project information to provide regular update • Site-specific project information. • Information on disruption of water supply etc.

Table 23: Stakeholder Communication Strategy

Stakeholder Group	Objective	Function/Interest in Project	Message	Means of Communication	Timelines	Responsibility	Resources
Beneficiary communities include small and marginal farmer production groups, women and men farmers, WUAs, CHPMA members, the private sector, and local microcredit/microfinance institutions.	Ensure a good two-way flow of information, and promote ownership over subproject activities and climate-resilient horticulture value chains sector development	Direct project beneficiaries; local authorities participating in the implementation and follow-up of subprojects; beneficiaries of identified clusters; participants in horticulture enterprise development; participants in technical and climate-resilient and drip irrigation training, workshops, and exposure visits, etc.	Local collaboration and support are fundamental to project effectiveness; information must be shared openly and transparently; inputs into design and recommendations for improvements are welcome. Clear information on implementation arrangements and schedule of project interventions, including construction and civil works. <i>This will also contain details on OHS, community safety, and the role of contractors and labors.</i> Update on subproject progress and roles for any operation and maintenance after completion. Measures will be taken to	Information: Community meetings to disseminate information on project scope, design elements, and participation mechanisms. Consultation: Regular village meetings and discussions (both mixed gender and women's meetings) to monitor progress and discuss measures to enhance project benefits and mitigate risks. Decisions: Community members contribute with suggestions for effective participation and guidelines for capacity building needs with support from village leaders to ensure they are inclusive, with equal representatives of women. Details of how and where to register feedback and complaints (e.g., with CHPMA staff) are to be provided.	During the detailed design of subprojects, including civil works, and throughout the implementation of the project.	EA (DoH); IAs (DoH and JSV); IEC Specialist, PMU; Social Development and Gender Specialist, PMU	Budget for consultations, feedback, production of all communication materials, and recruiting local communication consultant to design materials, where necessary.

Stakeholder Group	Objective	Function/Interest in Project	Message	Means of Communication	Timelines	Responsibility	Resources
			manage and mitigate noise, air, or traffic impacts. The impact on community land/CPR will be minimal, and no private property will be acquired. Details on water resources & ensuing source sustainability, crop identification, waste management of horticulture/ agriculture, handling and storage of pesticides and other chemicals, improving soil fertility, etc.				
Ensure an adequate two-way flow of project information to women beneficiaries and ethnic minority beneficiaries	Women, poor and vulnerable households, IPs/ minority groups (where applicable)	As above	As above plus disseminate the contents of GESI/GAP Due diligence to ensure IPs are not adversely affected by project (where applicable) Opportunities to participate in training in income generating	As mentioned above plus disseminate the contents of GESI/GAP Due diligence to ensure IPs are not adversely affected by the project (where applicable) Opportunities to participate in income-generating activities Separate meetings with women organized; (i) WUA, (ii)	During the detailed design of subprojects and preparation activities – regular follow-up throughout the project lifecycle.	EA (DoH); Social Development-Specialist, PMU; Social Focal Person, PIU	Capacity building budget Budget for community engagement and mobilization efforts Budget for information development and dissemination.

Stakeholder Group	Objective	Function/Interest in Project	Message	Means of Communication	Timelines	Responsibility	Resources
			activities	CHPMA, and (iii) IP groups in the local language, where applicable. Printed information about the project posted in local and accessible language (or visual depictions) posted in accessible public areas. Training on WUAs and CHPMA manuals – ensuring effective management and functioning Media outreach: local radio (including local language), television, print, social media			
Beneficiary communities.	Raise visibility and awareness of the benefits of horticulture development for inclusive growth and for building ownership over ongoing infrastructure development (e.g., fruits, biofertilizer plant) and farmer production groups and horticulture cooperative development.	Direct and indirect beneficiaries of the project.	Project investments and horticulture promotion are beneficial to the local economy, culture, and gender equity.	Media press releases and coverage about the project by local media – print, radio, and TV features (if possible). Signboards promoting the visibility of DoH, ADB, and line department's collaboration for climate-resilient horticulture/ agriculture and value chain development and improvements. Inaugurations of completed construction and civil works with promotional events at subproject sites.	At project launch and midway through as tangible results are realized. Signboards at appropriate locations at the start of construction and through project implementation.	EA (DoH), Social Development and Gender Specialist, PMU and local authorities	Capacity Enhancement; Equity
Project affected persons	Ensure meaningful consultation for complete understanding and acceptance of the project and	Direct and indirect beneficiaries of project; partners in development	Project plans (IEE/EMP, RP/RF), land acquisition impacts, entitlement	Project plans (IEE/EMP, RP/RF), land acquisition impacts, entitlements, compensation rates, GRM, and	During the detailed design of subprojects and preparation	EA (DoH); Social Safeguards Specialist, PMU; Social	Human resources (PMU and PIU). Capacity building and technical

Stakeholder Group	Objective	Function/Interest in Project	Message	Means of Communication	Timelines	Responsibility	Resources
	related environmental and social/resettlement impacts, entitlements, and GRM channels.	activities.	s, compensation rates, and GRM, as well as resettlement and income restoration strategies. Project description, environmental impacts and mitigation, EMP, and GRM. Activities during project preparation and implementation.	resettlement and income restoration strategies. Project description, environmental impacts and mitigation, EMP, and GRM. Activities during project preparation and implementation. Meeting with project-affected persons. Distribution of material/documents on entitlements in local language Project PID, i.e., posters, public notices. Executive Summary of the IEE (translated to the local language) posted in local government offices (village, district, etc.) GRM channels and contact persons Sustained and regular engagement with communities	activities – regular follow-up throughout the project lifecycle.	Focal Person, PIU; ADB	support in communications and community engagement Budget for IEC, PID, translation, and public posting of the IEE's executive summary and regular meetings. Budget for technical support and capacity building.
Private sector, enterprises and cooperatives	Private sector participation and partnership for effective agribusiness/horticulture development.	Direct and indirect beneficiaries of project; partners in development activities.	Promote participation in agribusiness/horticulture initiatives, which will increase the available supply of good quality products such as fresh fruits, employment	Partnership in workshops/meetings/surveys on horticulture development and marketing/promotion programs. A local Communications consultant will develop a unique dissemination/engagement plan as part of his/her core activities, including the design and production of a full suite of marketing	Ongoing during implementation of project activities	EA (DoH) / Social Development-Gender Specialist/ Project implementation consultants	Capacity development

Stakeholder Group	Objective	Function/Interest in Project	Message	Means of Communication	Timelines	Responsibility	Resources
			nt creation, and endeavors to promote climate-friendly agribusiness value chain development	materials.			
DoH / PMU	Setting policy and guidelines, coordination meetings, and approvals Ensure a good two-way flow of project information and promote women's ownership over subproject activities and horticulture development Ensure understanding of project impacts, outcomes, and outputs, and the importance of the theme of inclusive growth	Promote women's ownership over subproject activities and horticulture development Plays a role in overseeing gender inclusiveness in horticulture development in Project clusters Responsible for project implementation and O&M of constructed infrastructure subprojects and civil works	Key benefits and gender equity of subproject activities and climate-resilient horticulture and value chain development Disseminate information on progress on gender equity Main project impacts (positive and negative); implementation arrangements and schedule of construction and civil works Community collaboration and an inclusive approach are essential to effective project delivery	Policy Guidance and Approvals: Semiannual meetings of the project (executing) committee to provide direction on project implementation matters. Reviews of periodic progress reports and any special reports. Regular coordination meeting for detail design of construction and civil works, and implementation of project activities. Regular flow and sharing of documentation. Formats and simple chart (s) showing responsibilities for project implementation, flow of funds, flow of activities, monitoring and follow-up. Project website	From the outset of the project and regularly throughout the project lifetime.	EA (DoH)	Inputs of the ADB

Annexure 8: STAKEHOLDER CONSULTATIONS

Table 24: Field visits by Safeguards experts

Date	Stakeholders	Participants	Key observation and Findings
02 December 2021	Farmer's consultation in PRF cluster at Kalohad, Sundarnagar, Mandi	Farmers from PRF clusters, CHPMA members, Govt. officials (from IPHE), Consultant team from GT	Farmers are motivated and convinced to cultivate horticulture crops; they expect it will change their economic condition; by inclusion of their land within the cluster they are able to keep the stray animal away by implementing solar fencing; existing lift irrigation scheme is in use; issues like resource sharing will be more carefully considered during the planning for new clusters
02 December 2021	Farmer's consultation in FLD clusters at Kuthain and Palhota, Sundarnagar, Mandi	Farmers from FLD clusters, CHPMA members, Govt. officials (from IPHE), Consultant team from GT	Existing farming practice; motivation and willingness for participation in horticulture cultivation; there is existing functional irrigation scheme in Kuthain; development of irrigation scheme will ensure availability of water in the clusters; participation of women in farming; intrusion of monkey, wild boar and peacock are reported from the clusters; few trees felling required for site preparation.
03 December 2021	Stakeholder consultation with Departmental staff in FLD cluster at Rihan, Sadar, Bilaspur	Departmental staff from IPHE, Consultant team from GT	The FLD clusters are proposed in flood plain of the river; the structures constructed by the department has washed of few years back due to flush flood; the approach towards the proposed intake point is through the forest land; the issues such as climate change impact on the proposed clusters, viability of structures, interference through forest land etc will be considered during project preparation.
04 December 2021	Stakeholder consultation with Dept. of Horticulture		Expert team has shared their experience about the field visit; also expressed their views and suggestions regarding environmental, social, climate change and gender aspects of the project; discussed data sharing and finalization of survey format.
06 December 2021	Farmer's consultation in FLD clusters at Ser Delag, Datti and Chunar cluster at Kuniyar, Solan	Farmers from FLD clusters, CHPMA members, Govt. officials (from IPHE), Consultant team from GT	The increase of hailstorm and frost in the region has resulted in high crop loss. The water source for irrigation is river. There are past instances of rivulet drying or river changing its course.
07 December 2021	Stakeholder consultation with Dept of Irrigation		Explanation about functional/ non-functional/ new irrigation scheme proposed for the project; discussion source of water (ground water for Una); hydrological and catchment area study requirement; resource partitioning; land holding type for different project activities; contamination and pollution issues during construction and operation phase; probable categorization of the project.
07 December 2021	Stakeholder consultation with CHPMA in-charge		Explain about CHPMA role and importance with respect to the project; approach for resolving different issues; institutional arrangement; gender

			equality; post harvesting facility; crop insurance etc.
08 February 2022	Farmer's consultation in PRF cluster Mataur Tanda, Mandi	Farmers from PRF cluster, CHPMA members, Consultant team from GT	Farmers are managing farming on their land individually, and not collectively. Some farmers have taken up intercropping for additional income during the initial period.
09 February 2022	Farmer's consultation in FLD cluster Upper Beri, Dharampur, Mandi	Farmers from FLD cluster, CHPMA members, Consultant team from GT	The irrigation source is Beas river as well as JSV Irrigation scheme. The cultivated crop is Sweet Orange. There is a good amount of women participation in the farm activities. A portion of the solar fencing was observed to be damaged, due to which there were instances of entry of wild animals.

Table 25: Summary of stakeholders and issues discussed

Stakeholders	Main topics discussed
Jal Shakti Vibhag (formerly known as DIPH), Department of Forest, Public Works Department	- Goals/objectives DOH wants to achieve with the project - Tentative design of the project components to meet the expectations of the HPSHIVA Project - Strategies to achieve the goals - Monitoring mechanism for the project - Implementation arrangement for the project - Project preparation timeline and the documentation required, such as the environmental and social management plan, the stakeholder communication and engagement plan and the compliance with gender requirements of the Asian Development Bank - Feedback mechanism and grievance redressal.
NABARD and FIS	- Consultations on potential synergies and cross-sectoral collaboration on the overlapping issues and the potential inclusion in the project design. - Area of synergy for improved finance to farmers and entrepreneurs / priority sector lending - Extension supports to farmers in accessing finance/credit
Cluster farmers (Male and Female farmers for agriculture, horticulture)	- Project details and possible interventions to improve agriculture/horticulture production, including crops selection - Key impediments to agriculture/horticulture production - Existing markets; price and quality of agriculture inputs and requirements - Input requirements – technical and financial support, access to credit/finance, infrastructure (storage and transport) - Grievance redress mechanism - Stakeholders' opinion about the project
Private Sector	- Inputs to the beneficiaries for horticulture value chain development - Ways to improve product quality and shelf life - Infrastructure requirements – sorting/grading facilities, cold chain

Photos of consultations and site visits



Attendance Sheet of Consultation

Himachal Pradesh Subtropical Horticulture, Irrigation & Value assets Addition Project (HPSHIVA)
 Department of Horticulture - Government of Himachal Pradesh
 Preparation of Social Safeguard Documents
 Stakeholder Consultation

Attendance Register

Stakeholder Group: FarmersName of the cluster/Location: GanttiDate: 06/12/2021

Sl No	Name of the participant	Sex	Mobile Number	Signature
1	शशि अता	Male	9817808959	शशि
2	Narayan Dutt	"	9418044834	Narayan Dutt
3	Mast Ram	"	9816895079	Mast Ram
4	Beli Ram	"	9805323263	Beli Ram
5	Ramesh	"	9816190606	Ramesh
6	Desh Raj	"	9816377101	Desh Raj
7	Margat	"	9415925260	Margat
8	hokh Raj	"	9816676811	hokh Raj
9	Vinla	Female	8894177404	Vinla
10	Veena	"	8219353043	Veena
11	Nita	"	8894718588	Nita
12	Meera	"	9816089572	Meera
13	Lata	"	8091077112	Lata
14	Kumta	"	9816695145	Kumta
15	Laxya	"	9805319874	Laxya
16	Lata	"	9805725315	Lata

Himachal Pradesh Subtropical Horticulture, Irrigation & Value assets Addition Project (HPSHIVA)
 Department of Horticulture - Government of Himachal Pradesh
 Preparation of Social Safeguard Documents
 Stakeholder Consultation

Attendance Register

Stakeholder Group: Farmers

Name of the cluster/Location: Ghatt?

Date: 06/12/2021

Sl No	Name of the participant	Sex	Mobile Number	Signature
17	Minaxi	Female	9816133645	
18	Heera Devi	"	9805225785	
19	Ramanand	Male	7876346752	
20	Sant Ram	"	9459794195	
21	Narresh	"	9918210485	
22	Prem Lal	"	9805197006	
23	Deo Prakash	"	9816018736	
24	Virender	"	98160-02264	
25	Chet Ram	"	39881-62715	
26	Jagdish.		701842597	
27	Mansa Ram		8894987925	
28	Lekh Raj		8219133567	
29	Hem Raj		9816479076	
30	Indra wati	Female	9816054498	
31	Nand Lal.			
32	Madan Lal	Male	9816281500	

Handwritten signature/initials

Himachal Pradesh Subtropical Horticulture, Irrigation & Value assets Addition Project (HPSHIVA)
Department of Horticulture -Government of Himachal Pradesh
Preparation of Social Safeguard Documents
Stakeholder Consultation

Attendance Register

Stakeholder Group: *Formerly*

Name of the cluster/Location: Gyathi

Date: 06/12/2021

[illegible]

Baseline Survey

To ensure a complete geographic coverage, all 28 blocks in the 7 project districts were covered for the baseline survey. A sample of 10 – 15 potential participants per cluster, covering a minimum of 2 clusters in each block whose locations would be provided by the client, were selected at random. A total of 1016 potential participants within the 28 blocks (82 clusters) were surveyed for the baseline study.

Table 26: District-wise breakup of households covered in Baseline survey

Sr. No.	District	# Blocks	# Clusters	# Households
1	Bilaspur	4	12	145
2	Hamirpur	6	15	221
3	Kangra	7	20	234
4	Mandi	6	20	236
5	Sirmaur	2	6	69
6	Solan	2	6	71
7	Una	1	3	40
TOTAL		28	82	1016

Baseline Survey Form

**Himachal Pradesh Subtropical Horticulture, Irrigation & Value assets Addition Project
(HPSHIVA)**
Department of Horticulture - Himachal Pradesh
Preparation of Baseline & Social Safeguard Documents
(To be provided by individual farmers)

Cluster Details

S. No.	Details	Response
1.	Name of the District	
2.	Name of the Tehsil / Block	
3.	Name of the Panchayat	
4.	Name of Cluster	

S. No.	Details	Response				
Individual Farmer's Details						
1.	Name of the landowner					
2.	Age of the landowner					
3.	Educational qualification of landowner	Up to 10 th 12 th Diploma Graduate Post Grad				
4.	Address of the landowner					
5.	Contact no. of the landowner					
6.	Category	General ST SC OBC				
7.	Primary occupation of Landowner	Agriculture Other (specify)				
Family Details						
1.	Working / Salaried / Pensioner (above 18 years)	Male Female				
2.	Non-working (above 18 years)	Male Female				
3.	Children (below 18 years)	Male Female				
Land Details (Conversion ratio – 1 Ha = 12.5 Bigha)						
1.	Total Land Holding (Ha)					
2.	Land to be included in HPSHIVA (in Ha)					

Irrigation Details			
3.	Irrigation Practice	Yes ☐	No ☐
4.	If yes, what type of practice	Open / Flood ☐	Drip / Sprinkler ☐
5.	If No, Irrigation practice	Rainfall ☐	Tubewell ☐ River ☐
Present Cultivation in the land to be given in the cluster Area			
1.	Type of crop in the land selected for the cluster formation	1) Wheat 2) Gram 3) Mustard 4) Paddy 5) Maize 6) Barren Land 7) Any other please specify (including trees)	
2.	Manuring Practice	Natural Manure ☐	Fertilizers ☐
3.	Pesticides Used	Yes ☐	No ☐
4.	Agri Equipment's used	Yes ☐	No ☐
	(if yes please mention name of equipment's)		
5.	Any major pest infestation observation	Yes ☐	No ☐
	(if yes please mention pest name)		
6.	Any wildlife disturbances	Yes ☐	No ☐
	(if yes, please specify the species name)		
General cultivation practices for the land contributed to the cluster by farmer			
1.	Land to be included in HPSHIVA (in Ha)		
2.	A.	Crop-wise cultivated area – Kharif (in Ha)	
		1) Paddy 2) Maize 3) Any other please specify	
	B.	Crop-wise cultivated area – Rabi (in Ha)	
		1) Wheat 2) Gram 3) Mustard 4) Any other please specify	
	C.	Crop production (in quintals)	1) Wheat 2) Paddy 3) Maize 4) Gram 5) Mustard 6) Any Other

	D.	Crop-wise Input cost (in Rs/Ha)	Wheat	Paddy	Maize	Other 1	Other 2
		Seed					
		Fertilizers					
		Manure					
		Plant Protection					
		Equipment (Tractors/others)					
		Hired Labour					
		Self Labour					
		Any other, please specify					
	E.	Consumption of produce (in quintals)	Self	Animals	Market Surplus		
		1) Wheat					
		2) Paddy					
		3) Maize					
		4) Other 1					
		5) Other 2					
	F.	Yearly cost saving (2021) due to above consumption					
		1) Self (Qty X Wholesale Rate)					
		2) Animals (Qty X Wholesale Rate)					
		3) Sale of cultivated crop in market					
	H.	Name of any other cultivation / by produce (Fodder, Tree, Vegetable, Fruit, etc.)					
		Yearly cost saving (2021) due to consumption of other agri produce					
	I.	Yearly Family Income from other sources of livelihood (in Rs / year)					
		1) Service					
		1) Trading / Business					
		2) Labour (Casual, MNREGA, etc.)					
3) Pension							
4) Income from other agricultural land							
	5) Others						

Date:

Signature

Name of farmer

Contact Details

Name of Surveyor:

Sample filled form

Himachal Pradesh Subtropical Horticulture, Irrigation & Value assets Addition Project
(HPSHIVA)
Department of Horticulture - Himachal Pradesh
Preparation of Baseline & Social Safeguard Documents
(To be provided by individual farmers)

Cluster Details

S. No.	Details	Response
1.	Name of the District	UNA
2.	Name of the Tehsil / Block	BANARNA
3.	Name of the Panchayat	MUCHALI
4.	Name of Cluster	MUCHALI

Individual Farmer's Details

S. No.	Details	Response
1.	Name of the landowner	SHAKTI CHAND
2.	Age of the landowner	72 years
3.	Educational qualification of landowner	☒ Up to 10 th ☐ 12 th ☐ Diploma ☐ Graduate ☐ Post Grad
4.	Address of the landowner	Shakti Chand Go Lala Ram vill Muchali P.O Banarna
5.	Contact no. of the landowner	755971001 9816442522
6.	Category	☒ General ☐ ST ☐ SC ☐ OBC
7.	Primary occupation of Landowner	☒ Agriculture ☐ Other (specify) Pensioner

Family Details

S. No.	Details	Male	Female
1.	Working / Salaried / Pensioner (above 18 years)	2	—
2.	Non-working (above 18 years)	—	3
3.	Children (below 18 years)	4	—

Land Details (Conversion ratio – 1 Ha = 12.5 Bigha)

S. No.	Details	Response
1.	Total Land Holding (Ha)	5 Agha
2.	Land to be included in HPSHIVA (in Ha)	5 Agha

Page 1 of 2

Irrigation Details			
3.	Irrigation Practice	Yes ☐	No ☒
4.	If yes, what type of practice	Open / Flood ☐	Drip / Sprinkler ☐
5.	If No, irrigation practice	Rainfall ☒	Tubewell ☐ River ☐
Present Cultivation in the land to be given in the cluster Area			
1.	Type of crop in the land selected for the cluster formation	☒ 1) Wheat ☐ 2) Gram ☐ 3) Mustard ☐ 4) Paddy ☒ 5) Maize ☐ 6) Barren Land ☐ 7) Any other please specify (including trees)	
2.	Manuring Practice	Natural Manure ☒	Fertilizers ☐
3.	Pesticides Used	Yes ☒	No ☐
4.	Agri Equipment's used (if yes please mention name of equipment's)	Yes ☐	No ☒
5.	Any major pest infestation observation (if yes please mention pest name)	Yes ☒	No ☐
6.	Any wildlife disturbances (if yes, please specify the species name)	Yes ☒	No ☐
General cultivation practices for the land contributed to the cluster by farmer			
1.	Land to be included in HPSHVA (in Ha)	5 Bigha	
2.	A. Crop-wise cultivated area - Kharif (in Ha) 1) Paddy ☒ 2) Maize 3) Any other please specify	5 Bigha	
	B. Crop-wise cultivated area - Rabi (in Ha) ☒ 1) Wheat ☐ 2) Gram ☐ 3) Mustard ☐ 4) Any other please specify	5 Bigha	
	C. Crop production (in quintals)	☒ 1) Wheat 2000 P ☐ 2) Paddy ☒ 3) Maize 3000 P ☐ 4) Gram ☐ 5) Mustard ☐ 6) Any Other	

D.	Crop-wise input cost (in Rs/Ha)	Wheat	Paddy	Maize	Other 1	Other 2
	Seed	1000		1000		
	Fertilizers	1000		1000		
	Manure	2000		2000		
	Plant Protection	500		1000		
	Equipment (Tractors/others)	1500		2000		
	Hired Labour	—		—		
	Self Labour	1000		1000		
	Any other, please specify <i>Shankar/shalka</i>	1000		1000		
E.	Consumption of produce (in quintals)	Self	Animals	Market Surplus		
	1) Wheat	2970				
	2) Paddy					
	3) Maize	1970		3970		
	4) Other 1					
	5) Other 2					
F.	Yearly cost saving (2021) due to above consumption	Rs 4000 wheat				
	1) Self (Qty X Wholesale Rate)	Rs 1800 maize				
	2) Animals (Qty X Wholesale Rate)	—				
	3) Sale of cultivated crop in market	Rs 3500				
H.	Name of any other cultivation / by produce (Fodder, Tree, Vegetable, Fruit, etc.)					
	Yearly cost saving (2021) due to consumption of other agri produce					
I.	Yearly Family Income from other sources of livelihood (in Rs / year)					
	1) Service	20000/-				
	1) Trading / Business					
	2) Labour (Casual, MNREGA, etc.)					
	3) Pension	15000/-				
	4) Income from other agricultural land					
	5) Others	2000/-				

Date:

Signature

Name of farmer

Contact Details

9/7/2022
 21/11/2022
 Prakash Choudhary
 98164-48922

Name of Surveyor:

Cluster in charge – Consultation Form

**Himachal Pradesh Subtropical Horticulture, Irrigation & Value assets Addition Project
(HPSHIVA)
Department of Horticulture - Himachal Pradesh
Preparation of Baseline & Social Safeguard Documents**

(To be provided by Cluster In-charge)

Cluster Details

S. No.	Details	Response
1.	Name of Cluster	
2.	Name of the District	
3.	Name of the Block	
4.	Name of the Panchayat	
5.	Coordinates of cluster location	Latitude Longitude

S. No.	Details	Response		
1.	Population Detail of the Cluster			
	Total Beneficiaries of the Cluster		Male	Female
	Total Area of the cluster (in Hectare)			
2.	Cluster Accessibility			
	A What is the current mode of accessibility to the cluster? (Kacha Road, Puckka Road, by Walk or any other)			
	If the existing accessibility is only via walking. Is any plan to improve the existing accessibility proposed.	Yes ☐	No ☐	
	B Any common infrastructure within the cluster (Public road, Panchayat Ghar, Dispensary, School etc.)			
	Distance of the nearest common property ¹ from the cluster area. Also specify the type of property (Panchayat Ghar, Dispensary, School etc.)			

¹ (Common property includes School, Gram Panchayat, Community Centre etc.)

3.	Labour Details					
	Are migrant labour employed for horticulture	Yes ☐			No ☐	
	If Yes, provide approximate number (Man Days/year)	Total		Male		Female
	Will the migrant labour be required to stay in the project area?	Yes ☐			No ☐	
	For local labour, what is the number (Man Days/year)	Male		Female		
	What is the number of self labour involved within the cluster? (Man Days/year)	Male		Female		

Date:

Signature

Name

Designation

Contact Details

Name of Surveyor:

Annexure 9: GUIDANCE ON PREPARATION OF MUCK/ DEBRIS DISPOSAL PLAN

A large quantity of muck is expected to be generated as a result of construction civil work. Muck generated from excavation of any project component is required to be disposed in a planned manner so that it takes a least possible space and is not hazardous to the environment. The disposal of muck has to be scientifically planned by keeping in view no or low interface with any surface water body and or groundwater, and less travel of dumpers to the disposal site. The muck management and disposal plan can be prepared keeping in view the following guiding points:

- First quantify the muck expected to be generated during construction based final designs;
- Then calculate the amount of muck that can be utilized in project construction work, such as use of stone chips/ rocks for compaction of earth;
- The balance to be disposed of away from the site and clear the site for construction;
- Till the muck is not transferred to the disposal site, the muck shall be properly compacted (i.e. with the use of a roller), and stored in form of small hills covered with tarpaulin to avoid fugitive dust emissions;
- Thereafter, the muck should be either disposed of to the site designated by the local authority and or identify a low-lying area and dispersions and ensure to have taken appropriate permission depending on the owner of the land;
- Muck generally lacks nutrients and therefore, are difficult to re-vegetate. Thus, a layer of top-soil can be laid and plant trees of suitable species and soil binding grass and shrubs.
- Costing of disposal and plantation should be part of contractor's work schedule and payment.

Annexure 10: FORMAT FOR QUARTERLY REPORT ON TRACKING OF GRIEVANCES REDRESSAL

Cumulative Number of grievances received till date	Number of grievances received during the quarter	Nature of grievances	Status of action taken	No. of grievances resolved during the quarter	No. of grievances resolved till date	Cumulative progress

Annexure 11: LIST OF THREATENED PLANT AND ANIMAL SPECIES IN HP

As per Himachal Pradesh State Biodiversity Board.

THE GAZETTE OF INDIA : EXTRAORDINARY		[PART II—SEC. 3(ii)]	
2		(1)	(2)
2	संबंधित राज्य जैवविविधता बोर्ड निम्नलिखित अधवा कार्यवाई करेंगे :—	11.	<i>Capra falconeri</i> (Wagner)
	(i) समग्र जानकारी के लिए, अधिसूचित प्रजातियों के सभी पहलुओं का अध्ययन करना।	12.	<i>Moschus chrysogaster</i> (Hodgson, 1839)
	(ii) स्वस्थाने और स्थान बाह्य संरक्षण और पुनःस्थापन के प्रयोजनार्थ, अधिसूचित प्रजातियों का प्रचार; और	13.	<i>Gyps bengalensis</i> (Gmelin, 1788)
	(iii) जागरूकता कार्यक्रम चलाना और वन विभाग के कार्मिकों, जैवविविधता प्रबंधन समितियों, पारिपर्यटन कार्यक्रमों और वनवासियों तथा जनजातियों को अधिसूचित प्रजातियों के संबंध में शैक्षिक सामग्री उपलब्ध कराना।	14.	<i>Gyps tenuirostris</i> Gray, 1844
		15.	<i>Sarcogyps calvus</i> (Scopoli, 1786)
		16.	<i>Vanellus gregarious</i> (Pallas, 1771)
		17.	<i>Cervus elaphus hanguli</i>
		18.	<i>Capricornis sumatraensis</i>
		ANNEXURE	
		Condition No.	Conditions
	[फा. सं. 28-12/2008-सी एस-III]	1.	No plant or animal species as notified above shall be collected in live or dead condition by any except, for purposes mentioned below, with the approval of the concerned State Biodiversity Board; and also in accordance with the provisions of the Indian Forest Act, 1927 (16 of 1927) and the Wild Life (Protection) Act, 1972 (53 of 1972) of the relevant State Forest and Wild Life Legislations, namely :—
	ए. के. गोयल, संयुक्त सचिव	(a)	Scientific research;
	MINISTRY OF ENVIRONMENT AND FORESTS	(b)	Herbarium and museum of scientific and academic institutions;
	NOTIFICATION	(c)	Propagation; and
	New Delhi, the 17th March, 2009	(d)	Any other scientific investigation.
	S.O. 783(E).—In exercise of powers conferred by Section 38 of the Biological Diversity Act, 2002 (18 of 2003), the Central Government in consultation with the Government of Himachal Pradesh, hereby notifies the species of plants and animals which are on the verge of extinction, as listed in column (2) of the Table given below, and prohibit or regulate the collection thereof subject to the conditions specified in the Annexure to this notification, for the State of Himachal Pradesh, namely :—	2.	The concerned State Biodiversity Board shall initiate or conduct :—
Sl. No.	Name of the species	(i)	studies on all aspects of the notified species for holistic understanding;
(1)	(2)	(ii)	propagation of the notified species for the purpose of <i>in situ</i> and <i>ex situ</i> conservation and rehabilitation; and
	Plants	(iii)	awareness programmes and provide educational materials on notified species for forest department personnel, Biodiversity Management Committees, ecotourism programmes, and forest dwellers and tribals.
1.	<i>Aconitum deinorrhizum</i> Stapf		
2.	<i>Aconitum heterophyllum</i> Wall. ex Royle		
3.	<i>Aconitum violaceum</i> Jacq. Ex Stapf		
4.	<i>Eremostachys superba</i> Royle ex Benth		
5.	<i>Jasminum parkeri</i> Dunn		
6.	<i>Nardostachys grandiflora</i> DC.		
7.	<i>Dactylorrhiza hetegiera</i>		
8.	<i>Taxus wallichiana</i>		
	Animals		
9.	<i>Murina grisea</i> Peters, 1872		
10.	<i>Cervus duvaucelii</i> (Cuvier, 1823)		

[F.No. 28-12/2008-CS-III]

A. K. GOYAL, Jt. Secy.

Annexure 12: SAMPLE WATER TEST RESULT

WATER TESTING LABORATORY

IPH SUB-DIVISION : NALAGARH

DISTRICT : SOLAN

Based Upon BIS : 10500-2012

Lab Ref. No.

Name and Address of Sender-AE IPH SUB DIVISION,

Date: 07/07/2022

Name of District: Solan Block: Nalagarh Sub Division: Ramshehar

Gram Panchayat: Delli Village: Habitation:

Name of Scheme & Source: Gamber Khad

Date & Time of Collection: 02/07/2022; 8:00 am

Date & Time of Receipt at Laboratory: 02/07/2022; 11:30 am

Date & Time of Commencing:

Type of Sample :- 1. Raw Water 2. Filtered Water 3. Chlorinated 4. Distributed system (Pvt. tap, Public stand post) 5. Hand pump

A	PHYSICAL TEST	1	2	3
Sr. No.	TESTS	Desirable Limit	Permissible Limit	Actual Result
1.	Temperature			°C
2.	Colour	5	15	15
3.	Odour	Agreeable	Agreeable	Agreeable
4.	Taste	Agreeable	Agreeable	Agreeable
5.	Turbidity	1 NTU	5 NTU	30 NTU
6.	TDS/Conductivity	500mg/l	2000mg/l	1535 mg/l
B	CHEMICAL TESTS :-			
7.	pH	6.5	8.5	7.26
8.	Total Alkalinity	200mg/l	600mg/l	248 mg/l
9.	Chlorides	250mg/l	1000mg/l	180 mg/l
10.	Fluoride	1.0mg/l	1.5mg/l	1.0 mg/l
11.	Nitrate	45mg/l	45mg/l	31 mg/l
12.	Sulphate	200mg/l	400mg/l	226 mg/l
13.	Total Hardness	200mg/l	600mg/l	241 mg/l
14.	Iron	0.1mg/l	0.3mg/l	0.1 mg/l
15.	Manganese	0.1mg/l	0.3mg/l	0.1 mg/l
16.	Total Arsenic	0.01mg/l	0.01mg/l	0.01 mg/l
17.	Residual Chlorine	0.2mg/l	1mg/l	0.2 mg/l
C	BACTERIOLOGICAL TEST :-			
18.	Total Coli form	0 MPN	0 MPN	NCL MPN
19.	E.Coli/Thermo-tolerant Coli form	0 MPN	0 MPN	MPN

Remarks :

Observations are within given limits

Assistant Chemist
Water Testing Lab NalagarhJunior Engineer
Jal Shakti Section NalagarhAssistant Engineer
Jal Shakti Sub Division
Nalagarh

WATER TESTING LABORATORY

IPH SUB-DIVISION : NALAGARH

DISTRICT : SOLAN

Based Upon BIS : 10500-2012

Date : 05/07/2022

Lab Ref. No.

Name and Address of Sender-AE IPH SUB DIVISION,

Name of District : Solan Block : Dharampur Sub Division :

Gram Panchayat : Sai Village : Kosai Habitation :

Name of Scheme & Source : Shiva Project

Date & Time of Collection : 01/07/22 : 9:15 am

Date & Time of Receipt at Laboratory : 01/07/22 : 9:50 am

Date & Time of Commencing :

Type of Sample :- 1. Raw Water 2. Filtered Water 3. Chlorinated 4. Distributed system (Pvt. tap, Public stand post) 5. Hand pump

A	PHYSICAL TEST	1	2	3
Sr. No.	TESTS	Desirable Limit	Permissible Limit	Actual Result
1.	Temperature			°C
2.	Colour	5	15	5
3.	Odour	Agreeable	Agreeable	Agreeable
4.	Taste	Agreeable	Agreeable	Agreeable
5.	Turbidity	1 NTU	5 NTU	2 NTU
6.	TDS/Conductivity	500mg/l	2000mg/l	538 mg/l
B	CHEMICAL TESTS :-			
7.	pH	6.5	8.5	7.24
8.	Total Alkalinity	200mg/l	600mg/l	248 mg/l
9.	Chlorides	250mg/l	1000mg/l	260 mg/l
10.	Fluoride	1.0mg/l	1.5mg/l	1.0 mg/l
11.	Nitrate	45mg/l	45mg/l	36 mg/l
12.	Sulphate	200mg/l	400mg/l	224 mg/l
13.	Total Hardness	200mg/l	600mg/l	233 mg/l
14.	Iron	0.1mg/l	0.3mg/l	0.1 mg/l
15.	Manganese	0.1mg/l	0.3mg/l	0.1 mg/l
16.	Total Arsenic	0.01mg/l	0.01mg/l	0.01 mg/l
17.	Residual Chlorine	0.2mg/l	1mg/l	0.2 mg/l
C	BACTERIOLOGICAL TEST :-			
18.	Total Coli form	0 MPN	0 MPN	NIL MPN
19.	E.Coil/Thermo-tolerant Coli form	0 MPN	0 MPN	MPN

Remarks : Observations are within given limit

Assistant Chemist
Water Testing Lab NalagarhJunior Engineer
IPH Section Nalagarh
JSVAssistant Engineer
Jal Shakti Sub Division
IPH Sub Division Nalagarh
Nalagarh



HIMACHAL PRADESH
WATER TESTING LABORATORY
JALSHAKTI VIBHAG, NAHAN

TEST REPORT

Sample No.: 1214

Date: 13/7/22

Test Report No.: DWTL-NAHAN-2021-1214

Name & Address of Customer: sub divi dadahu

Sampling Method: N/A

Sample Description: Water

Sample Quantity: 1 liter

Collected on: 11/7/22

Test Start Date: 11/7/22

Test End Date: 13/7/22

Condition of Sample When received: OK

Name of Source/Scheme: Jaland River sample for Shiva Project

Name of Panchayat: Dadahu

Name of Village: Dadahu

Name of Habitation: dadahu / khori chengan

Type of Source: Jaland River

Sr. No.	Test	Test Method	Result	Requirement As per IS 10500:2012	
				Acceptable Limit	Permissible limit in the absence of alternate source
Physical Parameters					
1	Turbidity, NTU, Max	IS 3025 (Part 10) : 1984	4.6 NTU	1 NTU	5 NTU
2	Colour, Hazen units, Max	APHA 23 rd Edition 2017, 2120-Method B (Visual Comparison Method)	BDL (DL-5)	5	15
3	Odour	IS 3025 (Part 5) : 2018	Agreeable	Agreeable	Agreeable
4	Taste	IS 3025 (Part 7 & 8) : 2017	Agreeable	Agreeable	Agreeable
5	pH value	APHA 23 rd Edition 2017, 4500-H ⁺ Method B (Electrometric Method)	7.5	6.5-8.5	No relaxation
6	Total Dissolved Solids mg/l, Max	APHA 23 rd Edition 2017, 2540-C (Total Dissolved Solids Dried at 180° C)	271 mg/l	500 mg/l	2000 mg/l
Chemical Parameters					
7	Total Alkalinity (as CaCO ₃), mg/l, Max	IS 3025 (Part 23) : 1986	152 mg/l	200 mg/l	600 mg/l
8	Chloride (as Cl ⁻), mg/l, Max	IS 3025 (Part 32) : 1988 (Argenometric Method)	25.5 mg/l	250 mg/l	1000 mg/l
9	Total Hardness (as CaCO ₃), mg/l, Max	IS 3025 (Part 21) : 2009	256 mg/l	200 mg/l	600 mg/l
10	Calcium (as Ca), mg/l, Max	APHA 23 rd Edition 2017, 3500- Ca Method B (EDTA Titrimetric Method)	59.3 mg/l	75 mg/l	200 mg/l
11	Magnesium (as Mg), mg/l, Max	APHA 23 rd Edition 2017, 3500-Mg-B (Calculation Method)	26.2 mg/l	30 mg/l	100 mg/l

Remarks (if any): BDL: Below Detection Limit; DL = Detection Limit

Note :

- This report should not be produced partly or full without approval of signatory authority for legal purpose.
- The results refer only to tested samples and parameters tested.
- Samples will be stored for a period of 7 days from the date of issue of report.

Tested By
Water Testing Laboratory, Nahan

Authorized Signatory
SUMIT GOYAL
Water Testing Laboratory, Nahan

Section 7: General Conditions of Contract

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A. General

1. Definitions

1.1 Boldface type is used to identify defined terms.

- (a) The **Accepted Contract Amount** means the amount accepted in the Letter of Acceptance for the execution and completion of the Works and the remedying of any defects.
- (b) The **Activity Schedule** is a schedule of the activities comprising the construction, installation, testing, and commissioning of the Works in a lump sum contract. It includes a lump sum price for each activity, which is used for valuations and for assessing the effects of Variations and Compensation Events.
- (c) The **Adjudicator** is the person appointed jointly by the Employer and the Contractor to resolve disputes in the first instance, as provided for in GCC 29.1 [Appointment of Adjudicator] hereunder.
- (d) **Bank** means the financing institutions named in the **Particular Conditions of Contract (PCC)**.
- (e) **Bill of Quantities** means the priced and completed Bill of Quantities forming part of the Bid.
- (f) **Compensation Events** are those defined in GCC 51.1 [Compensation Events] hereunder.
- (g) The **Completion Date** is the date of completion of the Works as certified by the Project Manager, in accordance with GCC 69.1 [Completion].
- (h) The **Contract** is the Contract between the Employer and the Contractor to execute, complete, and maintain the Works. It consists of the documents listed in GCC 2.3 below.
- (i) The **Contractor** is the party whose Bid to carry out the Works has been accepted by the Employer.
- (j) The **Contractor's Bid** is the completed bidding document submitted by the Contractor to the Employer.
- (k) The **Contract Price** is the Accepted Contract Amount stated in the Letter of Acceptance and thereafter as adjusted in accordance with the Contract.
- (l) **Days** are calendar days; months are calendar months.
- (m) **Dayworks** are varied work inputs subject to payment on a time basis for the Contractor's employees and Equipment, in addition to payments for associated Materials and Plant.
- (n) A **Defect** is any part of the Works not completed in accordance with the Contract.
- (o) The **Defects Liability Certificate** is the certificate issued by the Project Manager upon correction of defects by the Contractor.
- (p) The **Defects Liability Period** is the period calculated from the Completion Date where the Contractor remains responsible for

remedying defects.

- (q) **Drawings** include calculations and other information provided or approved by the Project Manager for the execution of the Contract.
- (r) The **Employer** is the party who employs the Contractor to carry out the Works, as specified in the **PCC**.
- (s) **Equipment** is the Contractor's machinery and vehicles brought temporarily to the Site to construct the Works.
- (t) **Force Majeure** means an exceptional event or circumstance: which is beyond a Party's control; which such Party could not reasonably have provided against before entering into the Contract; which, having arisen, such Party could not reasonably have avoided or overcome; and, which is not substantially attributable to the other Party.
- (u) **In writing** or **written** means hand-written, type-written, printed, or electronically made, and resulting in a permanent record.
- (v) The **Initial Contract Price** is the Contract Price listed in the Employer's Letter of Acceptance.
- (w) The **Intended Completion Date** is the date on which it is intended that the Contractor shall complete the Works. The Intended Completion Date is specified in the **PCC**. The Intended Completion Date may be revised only by the Project Manager by issuing an extension of time or an acceleration order.
- (x) **Letter of Acceptance** means the formal acceptance by the Employer of the Bid and denotes the formation of the Contract at the date of acceptance.
- (y) **Materials** are all supplies, including consumables, used by the Contractor for incorporation in the Works.
- (z) **Party** means the Employer or the Contractor, as the context requires.
- (aa) **PCC** means Particular Conditions of Contract.
- (bb) **Plant** is any integral part of the Works that shall have a mechanical, electrical, chemical, or biological function.
- (cc) The **Project Manager** is the person named in the **PCC** (or any other competent person appointed by the Employer and notified to the Contractor, to act in replacement of the Project Manager) who is responsible for supervising the execution of the Works and administering the Contract.
- (dd) **Retention Money** means the aggregate of all monies retained by the Employer pursuant to GCC 55.1 [Retention].
- (ee) **Schedules** means the document(s) entitled schedules, completed by the Contractor and submitted with the Letter of Bid, as included in the Contract. Such document may include the Bill of Quantities, data, lists, and schedules of rates and/or prices.
- (ff) The **Site** is the area defined as such in the **PCC**.

- (gg) **Site Investigation Reports** are those that were included in the bidding documents and are factual and interpretative reports about the surface and subsurface conditions at the Site.
- (hh) **Specification** means the Specification of the Works included in the Contract and any modification or addition made or approved by the Project Manager.
- (ii) The **Start Date** is given in the **PCC**. It is the latest date when the Contractor shall commence execution of the Works. It does not necessarily coincide with any of the Site Possession Dates.
- (jj) A **Subcontractor** is a person or corporate body who has a Contract with the Contractor to carry out a part of the work in the Contract, which includes work on the Site.
- (kk) **Temporary Works** are works designed, constructed, installed, and removed by the Contractor that are needed for construction or installation of the Works.
- (ll) A **Variation** is an instruction given by the Project Manager which varies the Works.
- (mm) The **Works** are what the Contract requires the Contractor to construct, install, and turn over to the Employer, as defined in the **PCC**.

2. Interpretation

- 2.1 In interpreting these GCC, singular also means plural, male also means female or neuter, and the other way around. Headings have no significance. Words have their normal meaning under the language of the Contract unless specifically defined. The Project Manager shall provide instructions clarifying queries about these GCC.
- 2.2 If sectional completion is specified in the **PCC**, references in the GCC to the Works, the Completion Date, and the Intended Completion Date apply to any Section of the Works (other than references to the Completion Date and Intended Completion Date for the whole of the Works).
- 2.3 The documents forming the Contract shall be interpreted in the following order of priority:
 - (a) Contract Agreement,
 - (b) Letter of Acceptance,
 - (c) Letter of Bid,
 - (d) Particular Conditions of Contract,
 - (e) the List of Eligible Countries that was specified in Section 5 of the bidding document,
 - (f) General Conditions of Contract,
 - (g) Specifications,
 - (h) Drawings,
 - (i) Completed Activity Schedules or Bill of Quantities, and
 - (j) any other document listed in the **PCC** as forming part of the Contract.

- 3. Language and Law**
- 3.1 The language of the Contract and the law governing the Contract are stated in the **PCC**.
- 3.2 Throughout the execution of the Contract, the Contractor shall comply with the import of goods and services prohibitions in the Employer's country when
- (a) by an act of compliance with a decision of the United Nations Security Council taken under Chapter VII of the Charter of the United Nations, the Borrower's Country prohibits any import of goods from, or any payments to, a particular country, person, or entity. Where the Borrower's country prohibits payments to a particular firm or for particular goods by such an act of compliance, that firm may be excluded.
- 4. Contract Agreement**
- 4.1 The Parties shall enter into a Contract Agreement within 28 days after the Contractor receives the Letter of Acceptance, unless the Particular Conditions establish otherwise. The Contract Agreement shall be based upon the attached Contract forms in Section 8. The costs of stamp duties and similar charges (if any) imposed by law in connection with entry into the Contract Agreement shall be borne by the Employer.
- 5. Assignment**
- 5.1 Neither Party shall assign the whole or any part of the Contract or any benefit or interest in or under the Contract. However, either Party
- (a) may assign the whole or any part with the prior agreement of the other Party, at the sole discretion of such other Party; and
- (b) may, as security in favor of a bank or financial institution, assign its right to any moneys due, or to become due, under the Contract.
- 6. Care and Supply of Documents**
- 6.1 The Specification and Drawings shall be in the custody and care of the Employer. Unless otherwise stated in the Contract, two copies of the Contract and of each subsequent Drawing shall be supplied to the Contractor, who may make or request further copies at the cost of the Contractor.
- 6.2 Each of the Contractor's Documents shall be in the custody and care of the Contractor, unless and until taken over by the Employer. Unless otherwise stated in the Contract, the Contractor shall supply to the Engineer six copies of each of the Contractor's Documents.
- 6.3 The Contractor shall keep, on the Site, a copy of the Contract, publications named in the Specification, the Contractor's Documents (if any), the Drawings and Variations and other communications given under the Contract. The Employer's Personnel shall have the right of access to all these documents at all reasonable times.
- 6.4 If a Party becomes aware of an error or defect in a document which was prepared for use in executing the Works, the Party shall promptly give notice to the other Party of such error or defect.
- 7. Confidential Details**
- 7.1 The Contractor's and the Employer's Personnel shall disclose all such confidential and other information as may be reasonably required in order to verify the Contractor's compliance with the Contract and allow its proper implementation.

- 7.2 Each of them shall treat the details of the Contract as private and confidential, except to the extent necessary to carry out their respective obligations under the Contract or to comply with applicable Laws. Each of them shall not publish or disclose any particulars of the Works prepared by the other Party without the previous agreement of the other Party. However, the Contractor shall be permitted to disclose any publicly available information, or information otherwise required to establish his qualifications to compete for other projects.
- 7.3 Notwithstanding the above, the Contractor may furnish to its Subcontractor(s) such documents, data and other information it receives from the Employer to the extent required for the Subcontractor(s) to perform its work under the Contract, in which event the Contractor shall obtain from such Subcontractor(s) an undertaking of confidentiality similar to that imposed on the Contractor under this Clause.

8. Compliance with Laws

- 8.1 The Contractor shall, in performing the Contract, comply with applicable Laws.
- 8.2 Unless otherwise stated in the Particular Conditions,
- (a) the Employer shall acquire and pay for all permits, approvals, and/or licenses from all local, state, or national government authorities or public service undertakings in the [Employer's Country or country where the Site is located] which (i) such authorities or undertakings require the Employer to obtain in the Employer's name, and (ii) are necessary for the execution of the Contract, including those required for the performance by both the Contractor and the Employer of their respective obligations under the Contract;
 - (b) the Contractor shall acquire and pay for all permits, approvals, and/or licenses from all local, state, or national government authorities or public service undertakings in the [Employer's Country or country where the Site is located] which such authorities or undertakings require the Contractor to obtain in its name and which are necessary for the performance of the Contract, including, without limitation, visas for the Contractor's and Subcontractor's personnel and entry permits for all imported Contractor's Equipment. The Contractor shall acquire all other permits, approvals, and/or licenses that are not the responsibility of the Employer under Subclause 8.2(a) hereof and that are necessary for the performance of the Contract. The Contractor shall indemnify and hold harmless the Employer from and against any and all liabilities, damages, claims, fines, penalties, and expenses of whatever nature arising or resulting from the violation of such laws by the Contractor or its personnel, including the Subcontractors and their personnel, but without prejudice to Subclause 8.1 hereof.

9. Joint and Several Liability

- 9.1 If the Contractor is a Joint Venture of two or more persons, all such persons shall be jointly and severally liable to the Employer for the fulfillment of the provisions of the Contract, and shall designate one of such persons to act as a leader with authority to bind the Joint Venture. The composition or the constitution of the Joint Venture shall not be

altered without the prior consent of the Employer.

10. Project Manager's Decisions	10.1 Except where otherwise specifically stated, the Project Manager shall decide contractual matters between the Employer and the Contractor in the role representing the Employer.
11. Delegation	11.1 The Project Manager may delegate any of his duties and responsibilities to other people, except to the Adjudicator, after notifying the Contractor, and may cancel any delegation after notifying the Contractor.
12. Communications	12.1 Communications between parties that are referred to in the Conditions shall be effective only when in writing. A notice shall be effective only when it is delivered.
13. Subcontracting	13.1 The Contractor may subcontract with the approval of the Project Manager, but may not assign the Contract without the approval of the Employer in writing. Subcontracting shall not alter the Contractor's obligations.
14. Other Contractors	14.1 The Contractor shall cooperate and share the Site with other contractors, public authorities, utilities, and the Employer between the dates given in the Schedule of Other Contractors, as referred to in the PCC . The Contractor shall also provide facilities and services for them as described in the Schedule. The Employer may modify the Schedule of Other Contractors, and shall notify the Contractor of any such modification.
15. Personnel and Equipment	15.1 The Contractor shall employ the key personnel and use the equipment identified in its Bid to carry out the functions stated in the Schedule or other personnel and equipment approved by the Project Manager. The Project Manager shall approve any proposed replacement of key personnel and equipment only if their relevant qualifications or characteristics are substantially equal to or better than those proposed in the Bid. 15.2 If the Project Manager asks the Contractor to remove a person who is a member of the Contractor's staff or work force, stating the reasons, the Contractor shall ensure that the person leaves the Site within 7 days and has no further connection with the work in the Contract. 15.3 Should any employee of the Contractor be determined, based on reasonable evidence, to have engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices or other integrity violations during the execution of the Works, then that employee shall be removed in accordance with Clause 15.2 above.
16. Employer's and Contractor's Risks	16.1 The Employer carries the risks which this Contract states are Employer's risks, and the Contractor carries the risks which this Contract states are Contractor's risks.
17. Employer's Risks	17.1 From the Start Date until the Defects Liability Certificate has been issued, the following are Employer's risks: (a) The risk of personal injury, death, or loss of or damage to property (excluding the Works, Plant, Materials, and Equipment), which are due to (i) use or occupation of the Site by the Works or for the

purpose of the Works, which is the unavoidable result of the Works, or

- (ii) negligence, breach of statutory duty, or interference with any legal right by the Employer or by any person employed by or contracted to him except the Contractor.

- (b) The risk of damage to the Works, Plant, Materials, and Equipment to the extent that it is due to a fault of the Employer or in the Employer's design, or due to war or radioactive contamination directly affecting the country where the Works are to be executed.

17.2 From the Completion Date until the Defects Liability Certificate has been issued, the risk of loss of or damage to the Works, Plant, and Materials is an Employer's risk except loss or damage due to

- (a) a Defect which existed on the Completion Date,
- (b) an event occurring before the Completion Date, which was not itself an Employer's risk, or
- (c) the activities of the Contractor on the Site after the Completion Date.

18. Contractor's Risks

18.1 From the Starting Date until the Defects Liability Certificate has been issued, the risks of personal injury, death, and loss of or damage to property (including, without limitation, the Works, Plant, Materials, and Equipment) which are not Employer's risks, are Contractor's risks.

19. Insurance

19.1 The Contractor shall provide, in the joint names of the Employer and the Contractor, insurance cover from the Start Date to the end of the Defects Liability Period, in the amounts and deductibles stated in the **PCC** for the following events, which are due to the Contractor's risks:

- (a) loss of or damage to the Works, Plant, and Materials;
- (b) loss of or damage to Equipment;
- (c) loss of or damage to property (except the Works, Plant, Materials, and Equipment) in connection with the Contract; and
- (d) personal injury or death.

19.2 Policies and certificates for insurance shall be delivered by the Contractor to the Project Manager for the Project Manager's approval before the Start Date. All such insurance shall provide for compensation to be payable in the types and proportions of currencies required to rectify the loss or damage incurred.

19.3 If the Contractor does not provide any of the policies and certificates required, the Employer may effect the insurance, which the Contractor should have provided and recover the premiums the Employer has paid from payments otherwise due to the Contractor or, if no payment is due, the payment of the premiums shall be a debt due.

19.4 Alterations to the terms of an insurance shall not be made without the approval of the Project Manager.

- 19.5 Both parties shall comply with any conditions of the insurance policies.
- 20. Site Investigation Reports** 20.1 The Contractor, in preparing the Bid, shall rely on any Site Investigation Reports referred to in the **PCC**, supplemented by any information available to the Contractor.
- 21. Contractor to Construct the Works** 21.1 The Contractor shall construct and install the Works in accordance with the Specifications and Drawings.
- 22. The Works to Be Completed by the Intended Completion Date** 22.1 The Contractor may commence execution of the Works on the Start Date and shall carry out the Works in accordance with the Program submitted by the Contractor, as updated with the approval of the Project Manager, and complete them by the Intended Completion Date.
- 23. Designs by Contractor and Approval by the Project Manager** 23.1 The Contractor shall carry out design to the extent specified in the **PCC**. The Contractor shall promptly submit to the Employer all designs prepared by him. Within 14 days of receipt, the Employer shall notify any comments. The Contractor shall not construct any element of the permanent work designed by him within 14 days after the design has been submitted to the Employer or where the design for that element has been rejected. Design that has been rejected shall be promptly amended and resubmitted. The Contractor shall resubmit all designs commented on, taking these comments into account as necessary.
- 23.2 The Contractor shall submit Specifications and Drawings showing the proposed Temporary Works to the Project Manager, who is to approve them if they comply with the Specifications and Drawings..
- 23.3 The Contractor shall be responsible for design of Temporary Works.
- 23.4 The Project Manager's approval shall not alter the Contractor's responsibility for design of the Temporary Works.
- 23.5 The Contractor shall obtain approval of third parties to the design of the Temporary Works, where required.
- 23.6 All Drawings prepared by the Contractor for the execution of the temporary or permanent Works, are subject to prior approval by the Project Manager before this use.
- 24. Safety** 24.1 The Contractor shall be responsible for the safety of all activities on the Site.
- 25. Discoveries** 25.1 Anything of historical or other interest or of significant value unexpectedly discovered on the Site shall be the property of the Employer. The Contractor shall notify the Project Manager of such discoveries and carry out the Project Manager's instructions for dealing with them.
- 26. Possession of the Site** 26.1 The Employer shall give possession of all parts of the Site to the Contractor. If possession of a part is not given by the date stated in the **PCC**, the Employer shall be deemed to have delayed the start of the relevant activities, and this shall be a Compensation Event.

- 27. Access to the Site**
- 27.1 The Contractor shall allow the Project Manager and any person authorized by the Project Manager access to the Site and to any place where work in connection with the Contract is being carried out or is intended to be carried out.
- 28. Instructions, Inspections, and Audits**
- 28.1 The Contractor shall carry out all instructions of the Project Manager, which comply with the applicable laws where the Site is located.
- 28.2 The Contractor shall keep, and shall make all reasonable efforts to cause its Subcontractors and subconsultants to keep accurate and systematic accounts and records in respect of the Works in such form and details as will clearly identify relevant time changes and costs.
- 28.3 The Contractor shall permit ADB or its representative to inspect the Contractor's site, assets, accounts, records, and other documents relating to the submission of bids and contract performance and to have them audited by auditors appointed by ADB. The Contractor shall maintain all documents and records related to the bid submission and execution of the Contract for at least 5 years after completing the works contemplated in the relevant contracts or the period prescribed in applicable law, whichever is longer. The Contractor shall provide any documents necessary for the investigation of allegations of corrupt, fraudulent, collusive, coercive, or obstructive practices or other integrity violations and require its employees or agents with knowledge of the Contract to respond to questions from ADB.
- 28.4 ADB's right to inspect the Site and/or the Contractor's accounts and records relating to the performance of the Contract stated in Sub-Clause 28.3 and 74.2 (e) shall survive termination and/ or expiration of this Contract.
- 29. Appointment of the Adjudicator**
- 29.1 The Adjudicator shall be appointed jointly by the Employer and the Contractor, at the time of the Employer's issuance of the Letter of Acceptance. If, in the Letter of Acceptance, the Employer does not agree on the appointment of the Adjudicator, the Employer will request the Appointing Authority designated in the **PCC**, to appoint the Adjudicator within 14 days of receipt of such request.
- 29.2 Should the Adjudicator resign or die, or should the Employer and the Contractor agree that the Adjudicator is not functioning in accordance with the provisions of the Contract, a new Adjudicator shall be jointly appointed by the Employer and the Contractor. In case of disagreement between the Employer and the Contractor, within 30 days, the Adjudicator shall be designated by the Appointing Authority at the request of either party, within 14 days of receipt of such request.
- 30. Procedure for Disputes**
- 30.1 If the Contractor believes that a decision taken by the Project Manager was either outside the authority given to the Project Manager by the Contract or that the decision was wrongly taken, the decision shall be referred to the Adjudicator within 14 days of the notification of the Project Manager's decision.
- 30.2 The Adjudicator shall give a decision in writing within 28 days of receipt of a notification of a dispute.
- 30.3 The Adjudicator shall be paid by the hour at the rate specified in the

PCC, together with reimbursable expenses of the types specified in the **PCC**, and the cost shall be divided equally between the Employer and the Contractor, whatever decision is reached by the Adjudicator. Either party may refer a decision of the Adjudicator to an Arbitrator within 28 days of the Adjudicator's written decision. If neither party refers the dispute to arbitration within the above 28 days, the Adjudicator's decision shall be final and binding.

- 30.4 The arbitration shall be conducted in accordance with the arbitration procedures published by the institution named and in the place specified in the **PCC**.

B. Staff and Labor

31. Forced Labor	31.1 The Contractor shall not employ forced labor, which consists of any work or service, not voluntarily performed, that is exacted from an individual under threat of force or penalty. This covers any kind of involuntary or compulsory labor, such as indentured labor, bonded labor, or similar labor–contracting arrangements.
32. Child Labor	32.1 The Contractor shall not employ children in a manner that is economically exploitative, or is likely to be hazardous, or to interfere with, the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development. Where national laws have provisions for employment of minors, the Contractor shall follow those laws applicable to the Contractor. Children below the age of 18 years shall not be employed in dangerous work.
33. Workers' Organizations	33.1 In countries where national law recognizes workers' rights to form and to join workers' organizations of their choosing without interference and to bargain collectively, the Contractor shall comply with national law. Where national law substantially restricts workers' organizations, the Contractor shall enable alternative means for the Contractor's Personnel to express their grievances and protect their rights regarding working conditions and terms of employment. In either case described above, and where national law is silent, the Contractor shall not discourage the Contractor's Personnel from forming or joining workers' organizations of their choosing or from bargaining collectively, and shall not discriminate or retaliate against the Contractor's Personnel who participate, or seek to participate, in such organizations and bargain collectively. The Contractor shall engage with such workers representatives. Worker organizations are expected to fairly represent the workers in the workforce.
34. Nondiscrimination and Equal Opportunity	34.1 The Contractor shall not make employment decisions on the basis of personal characteristics unrelated to inherent job requirements. The Contractor shall base the employment relationship on the principle of equal opportunity and fair treatment, and shall not discriminate with respect to aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, promotion, termination of employment or retirement, and discipline. In countries where national law provides for non-discrimination in employment, the Contractor shall comply with national law. When national laws are silent on nondiscrimination in employment, the Contractor shall meet this Subclause's requirements. Special measures of protection or assistance to remedy past discrimination or

selection for a particular job based on the inherent requirements of the job shall not be deemed discrimination.

C. Time Control

35. Program

- 35.1 Within the time stated in the **PCC**, after the date of the Letter of Acceptance, the Contractor shall submit to the Project Manager for approval a Program showing the general methods, arrangements, order, and timing for all the activities in the Works. In the case of a lump sum contract, the activities in the Program shall be consistent with those in the Activity Schedule.
- 35.2 An update of the Program shall be a program showing the actual progress achieved on each activity and the effect of the progress achieved on the timing of the remaining work, including any changes to the sequence of the activities.
- 35.3 The Contractor shall submit to the Project Manager for approval an updated Program at intervals no longer than the period stated in the **PCC**. If the Contractor does not submit an updated Program within this period, the Project Manager may withhold the amount stated in the **PCC** from the next payment certificate and continue to withhold this amount until the next payment after the date on which the overdue Program has been submitted. In the case of a lump sum contract, the Contractor shall provide an updated Activity Schedule within 14 days of being instructed to by the Project Manager.
- 35.4 The Project Manager's approval of the Program shall not alter the Contractor's obligations. The Contractor may revise the Program and submit it to the Project Manager again at any time. A revised Program shall show the effect of Variations and Compensation Events.

36. Extension of the Intended Completion Date

- 36.1 The Project Manager shall extend the Intended Completion Date if a Compensation Event occurs or a Variation is issued which makes it impossible for Completion to be achieved by the Intended Completion Date without the Contractor taking steps to accelerate the remaining work, which would cause the Contractor to incur additional cost.
- 36.2 The Project Manager shall decide whether and by how much to extend the Intended Completion Date within 21 days of the Contractor asking the Project Manager for a decision upon the effect of a Compensation Event or Variation and submitting full supporting information. If the Contractor has failed to give early warning of a delay or has failed to cooperate in dealing with a delay, the delay by this failure shall not be considered in assessing the new Intended Completion Date.

37. Acceleration

- 37.1 When the Employer wants the Contractor to finish before the Intended Completion Date, the Project Manager shall obtain priced proposals for achieving the necessary acceleration from the Contractor. If the Employer accepts these proposals, the Intended Completion Date shall be adjusted accordingly and confirmed by both the Employer and the Contractor.
- 37.2 If the Contractor's priced proposals for an acceleration are accepted by the Employer, they are incorporated in the Contract Price and treated

as a Variation.

38. Delays Ordered by the Project Manager	38.1 The Project Manager may instruct the Contractor to delay the start or progress of any activity within the Works.
39. Management Meetings	39.1 Either the Project Manager or the Contractor may require the other to attend a management meeting. The business of a management meeting shall be to review the plans for remaining work and to deal with matters raised in accordance with the early warning procedure. 39.2 The Project Manager shall record the business of management meetings and provide copies of the record to those attending the meeting and to the Employer. The responsibility of the parties for actions to be taken shall be decided by the Project Manager either at the management meeting or after the management meeting and stated in writing to all who attended the meeting.
40. Early Warning	40.1 The Contractor shall warn the Project Manager at the earliest opportunity of specific likely future events or circumstances that may adversely affect the quality of the work, increase the Contract Price, or delay the execution of the Works. The Project Manager may require the Contractor to provide an estimate of the expected effect of the future event or circumstance on the Contract Price and Completion Date. The estimate shall be provided by the Contractor as soon as reasonably possible. 40.2 The Contractor shall cooperate with the Project Manager in making and considering proposals for how the effect of such an event or circumstance can be avoided or reduced by anyone involved in the work and in carrying out any resulting instruction of the Project Manager.

D. Quality Control

41. Identifying Defects	41.1 The Project Manager shall check the Contractor's work and notify the Contractor of any Defects that are found. Such checking shall not affect the Contractor's responsibilities. The Project Manager may instruct the Contractor to search for a Defect and to uncover and test any work that the Project Manager considers may have a Defect.
42. Tests	42.1 If the Project Manager instructs the Contractor to carry out a test not specified in the Specification to check whether any work has a Defect and the test shows that it does, the Contractor shall pay for the test and any samples. If there is no Defect, the test shall be a Compensation Event.
43. Correction of Defects	43.1 The Project Manager shall give notice to the Contractor of any Defects before the end of the Defects Liability Period, which begins at Completion, and is defined in the PCC. The Defects Liability Period shall be extended for as long as Defects remain to be corrected. 43.2 Every time notice of a Defect is given, the Contractor shall correct the notified Defect within the length of time specified by the Project Manager's notice.

44. Uncorrected Defects

- 44.1 If the Contractor has not corrected a Defect within the time specified in the Project Manager's notice, the Project Manager shall assess the cost of having the Defect corrected, and the Contractor shall pay this amount.

E. Cost Control**45. Contract Price**

- 45.1 In the case of an admeasurement contract, the Bill of Quantities shall contain priced items for the Works to be performed by the Contractor. The Bill of Quantities is used to calculate the Contract Price. The Contractor will be paid for the quantity of the work accomplished at the rate in the Bill of Quantities for each item.
- 45.2 In the case of a lump sum contract, the Activity Schedule shall contain the priced activities for the Works to be performed by the Contractor. The Activity Schedule is used to monitor and control the performance of activities on which basis the Contractor will be paid. If payment for Materials on Site shall be made separately, the Contractor shall show delivery of Materials to the Site separately on the Activity Schedule.

46. Changes in the Contract Price

- 46.1 In the case of an admeasurement contract:
- (a) If the final quantity of the work done differs from the quantity in the Bill of Quantities for the particular item by more than 25%, provided the change exceeds 1% of the Initial Contract Price, the Project Manager shall adjust the rate to allow for the change.
 - (b) The Project Manager shall not adjust rates from changes in quantities if thereby the Initial Contract Price is exceeded by more than 15%, except with the prior approval of the Employer.
 - (c) If requested by the Project Manager, the Contractor shall provide the Project Manager with a detailed cost breakdown of any rate in the Bill of Quantities.
- 46.2 In the case of a lump sum contract, the Activity Schedule shall be amended by the Contractor to accommodate changes of Program or method of working made at the Contractor's own discretion. Prices in the Activity Schedule shall not be altered when the Contractor makes such changes to the Activity Schedule.

47. Variations

- 47.1 All Variations shall be included in updated Programs, and, in the case of a lump sum contract, also in the Activity Schedule, produced by the Contractor.
- 47.2 The Contractor shall provide the Project Manager with a quotation for carrying out the Variation when requested to do so by the Project Manager. The Project Manager shall assess the quotation, which shall be given within seven (7) days of the request or within any longer period stated by the Project Manager and before the Variation is ordered.
- 47.3 If the Contractor's quotation is unreasonable, the Project Manager may order the Variation and make a change to the Contract Price, which shall be based on the Project Manager's own forecast of the effects of

the Variation on the Contractor's costs.

- 47.4 If the Project Manager decides that the urgency of varying the work would prevent a quotation being given and considered without delaying the work, no quotation shall be given and the Variation shall be treated as a Compensation Event.
- 47.5 The Contractor shall not be entitled to additional payment for costs that could have been avoided by giving early warning.
- 47.6 In the case of an admeasurement contract, if the work in the Variation corresponds to an item description in the Bill of Quantities and if, in the opinion of the Project Manager, the quantity of work above the limit stated in GCC 46.1 [Changes in the Contract Price] or the timing of its execution do not cause the cost per unit of quantity to change, the rate in the Bill of Quantities shall be used to calculate the value of the Variation. If the cost per unit of quantity changes, or if the nature or timing of the work in the Variation does not correspond with items in the Bill of Quantities, the quotation by the Contractor shall be in the form of new rates for the relevant items of work.

**48. Cash Flow
Forecasts**

- 48.1 When the Program, or, in the case of a lump sum contract, the Activity Schedule, is updated, the Contractor shall provide the Project Manager with an updated cash flow forecast. The cash flow forecast shall include different currencies, as defined in the Contract, converted as necessary using the Contract exchange rates.

**49. Payment
Certificates**

- 49.1 The Contractor shall submit to the Project Manager monthly statements of the estimated value of the work executed less the cumulative amount certified previously.
- 49.2 The Project Manager shall check the Contractor's monthly statement and certify the amount to be paid to the Contractor.
- 49.3 The value of work executed shall be determined by the Project Manager.
- 49.4 The value of work executed shall comprise,
- (a) in the case of an admeasurement contract, the value of the quantities of work in the Bill of Quantities that have been completed; or
 - (b) in the case of a lump sum contract, the value of work executed shall comprise the value of completed activities in the Activity Schedule.
- 49.5 The value of work executed shall include the valuation of Variations and Compensation Events.
- 49.6 The Project Manager may exclude any item certified in a previous certificate or reduce the proportion of any item previously certified in any certificate in the light of later information.

50. Payments

- 50.1 Payments shall be adjusted for deductions for advance payments and retention. The Employer shall pay the Contractor the amounts certified by the Project Manager within 28 days of the date of each certificate. If the Employer makes a late payment, the Contractor shall be paid interest on the late payment in the next payment. Interest shall be calculated from the date by which the payment should have been made up to the date when the late payment is made at the prevailing rate of interest for commercial borrowing for each of the currencies in which payments are made.
- 50.2 If an amount certified is increased in a later certificate or as a result of an award by the Adjudicator or an Arbitrator, the Contractor shall be paid interest upon the delayed payment as set out in this clause. Interest shall be calculated from the date upon which the increased amount would have been certified in the absence of dispute.
- 50.3 Unless otherwise stated, all payments and deductions shall be paid or charged in the proportions of currencies comprising the Contract Price.
- 50.4 Items of the Works for which no rate or price has been entered in shall not be paid for by the Employer and shall be deemed covered by other rates and prices in the Contract.

51. Compensation Events

- 51.1 The following shall be Compensation Events:
- (a) The Employer does not give access to a part of the Site by the Site Possession Date pursuant to GCC 26.1 [Possession of the Site].
 - (b) The Employer modifies the Schedule of Other Contractors in a way that affects the work of the Contractor under the Contract.
 - (c) The Project Manager orders a delay or does not issue Drawings, Specifications, or instructions required for execution of the Works on time.
 - (d) The Project Manager instructs the Contractor to uncover or to carry out additional tests upon work, which is then found to have no Defects.
 - (e) The Project Manager unreasonably does not approve a subcontract to be let.
 - (f) Ground conditions are substantially more adverse than could reasonably have been assumed before issuance of the Letter of Acceptance from the information issued to Bidders (including the Site Investigation Reports), from information available publicly and from a visual inspection of the Site.
 - (g) The Project Manager gives an instruction for dealing with an unforeseen condition, caused by the Employer, or additional work required for safety or other reasons.
 - (h) Other contractors, public authorities, utilities, or the Employer does not work within the dates and other constraints stated in the Contract, and they cause delay or extra cost to the Contractor.

- (i) The advance payment is delayed.
- (j) The effects on the Contractor of any of the Employer's Risks.
- (k) The Project Manager unreasonably delays issuing a Certificate of Completion.

51.2 If a Compensation Event would cause additional cost or would prevent the work being completed before the Intended Completion Date, the Contract Price shall be increased and/or the Intended Completion Date shall be extended. The Project Manager shall decide whether and by how much the Contract Price shall be increased and whether and by how much the Intended Completion Date shall be extended.

51.3 As soon as information demonstrating the effect of each Compensation Event upon the Contractor's forecast cost has been provided by the Contractor, it shall be assessed by the Project Manager, and the Contract Price shall be adjusted accordingly. If the Contractor's forecast is deemed unreasonable, the Project Manager shall adjust the Contract Price based on the Project Manager's own forecast. The Project Manager shall assume that the Contractor shall react competently and promptly to the event.

51.4 The Contractor shall not be entitled to compensation to the extent that the Employer's interests are adversely affected by the Contractor's not having given early warning or not having cooperated with the Project Manager.

52. Tax

52.1 The Project Manager shall adjust the Contract Price if taxes, duties, and other levies are changed between the date 28 days before the submission of bids for the Contract and the date of the last Completion certificate. The adjustment shall be the change in the amount of tax payable by the Contractor, provided such changes are not already reflected in the Contract Price or are a result of GCC 54.1 [Price Adjustment].

53. Currencies

53.1 Where payments are made in currencies other than the currency of the Employer's country specified in the **PCC**, the exchange rates used for calculating the amounts to be paid shall be the exchange rates stated in the Contractor's Bid.

54. Price Adjustment

54.1 Prices shall be adjusted for fluctuations in the cost of inputs only if provided for in the **PCC**. If so provided, the amounts certified in each payment certificate, before deducting for Advance Payment, shall be adjusted by applying the respective price adjustment factor to the payment amounts due in each currency. A separate formula of the type indicated below applies to each Contract currency:

$$P_c = A_c + B_c \text{ Imc/loc}$$

where:

P_c is the adjustment factor for the portion of the Contract Price payable in a specific currency "c."

A_c and B_c are coefficients¹ specified in the **PCC**, representing the nonadjustable and adjustable portions, respectively, of the Contract Price payable in that specific currency “c;” and

I_{mc} is a consolidated index prevailing at the end of the month being invoiced and I_{oc} is the same consolidated index prevailing 28 days before Bid opening for inputs payable; both in the specific currency “c.”

54.2 If the value of the index is changed after it has been used in a calculation, the calculation shall be corrected and an adjustment made in the next payment certificate. The index value shall be deemed to take account of all changes in cost due to fluctuations in costs.

55. Retention

55.1 The Employer shall retain from each payment due to the Contractor the proportion stated in the **PCC** until Completion of the whole of the Works.

55.2 Upon the issue of a Certificate of Completion of the Works by the Project Manager, in accordance with GCC 69.1 [Completion], half the total amount retained shall be repaid to the Contractor and half when the Defects Liability Period has passed and the Project Manager has certified that all Defects notified by the Project Manager to the Contractor before the end of this period have been corrected. The Contractor may substitute retention money with an “on demand” bank guarantee.

56. Liquidated Damages

56.1 The Contractor shall pay liquidated damages to the Employer at the rate per day stated in the **PCC** for each day that the Completion Date is later than the Intended Completion Date. The total amount of liquidated damages shall not exceed the amount defined in the **PCC**. The Employer may deduct liquidated damages from payments due to the Contractor. Payment of liquidated damages shall not affect the Contractor’s liabilities.

56.2 If the Intended Completion Date is extended after liquidated damages have been paid, the Project Manager shall correct any overpayment of liquidated damages by the Contractor by adjusting the next payment certificate. The Contractor shall be paid interest on the overpayment, calculated from the date of payment to the date of repayment, at the rates specified in GCC 50.1 [Payments].

57. Bonus

57.1 The Contractor shall be paid a Bonus calculated at the rate per calendar day stated in the **PCC** for each day (less any days for which the Contractor is paid for acceleration) that the Completion is earlier than the Intended Completion Date. The Project Manager shall certify that the Works are complete, although they may not be due to be complete.

58. Advance

58.1 The Employer shall make advance payment to the Contractor of the amounts stated in the **PCC** by the date stated in the **PCC**, against

¹ The sum of the two coefficients A_c and B_c should be 1 (one) in the formula for each currency. Normally, both coefficients shall be the same in the formulas for all currencies, since coefficient A_c , for the nonadjustable portion of the payments, is a very approximate figure (usually 0.10 ~ 0.20) to take account of fixed cost elements or other nonadjustable components. The sum of the adjustments for each currency is added to the Contract Price.

Payment

provision by the Contractor of an unconditional bank guarantee in a form and by a bank acceptable to the Employer in amounts and currencies equal to the advance payment. The guarantee shall remain effective until the advance payment has been repaid, but the amount of the guarantee shall be progressively reduced by the amounts repaid by the Contractor. Interest shall not be charged on the advance payment.

58.2 The Contractor is to use the advance payment only to pay for Equipment, Plant, Materials, and mobilization expenses required specifically for execution of the Contract. The Contractor shall demonstrate that advance payment has been used in this way by supplying copies of invoices or other documents to the Project Manager.

58.3 The advance payment shall be repaid by deducting proportionate amounts from payments otherwise due to the Contractor, following the schedule of completed percentages of the Works on a payment basis. No account shall be taken of the advance payment or its repayment in assessing valuations of work done, Variations, price adjustments, Compensation Events, Bonuses, or Liquidated Damages.

59. Securities

59.1 The Performance Security shall be provided to the Employer no later than the date specified in the Letter of Acceptance and shall be issued in an amount specified in the **PCC**, by a bank acceptable to the Employer, and denominated in the types and proportions of the currencies in which the Contract Price is payable. The Performance Security shall be valid until a date 28 days from the date of issue of the Certificate of Completion in the case of a bank guarantee.

60. Dayworks

60.1 If applicable, the Dayworks rates in the Contractor's Bid shall be used for small additional amounts of work only when the Project Manager has given written instructions in advance for additional work to be paid for in that way.

60.2 All work to be paid for as Dayworks shall be recorded by the Contractor on forms approved by the Project Manager. Each completed form shall be verified and signed by the Project Manager within 2 days of the work being done.

60.3 The Contractor shall be paid for Dayworks subject to obtaining signed Dayworks forms.

61. Cost of Repairs

61.1 Loss or damage to the Works or Materials to be incorporated in the Works between the Start Date and the end of the Defects Correction periods shall be remedied by the Contractor at the Contractor's cost if the loss or damage arises from the Contractor's acts or omissions.

F. Force Majeure**62. Definition of Force Majeure**

62.1 In this Clause, "Force Majeure" means an exceptional event or circumstance,

(a) which is beyond a Party's control;

- (b) which such Party could not reasonably have provided against before entering into the Contract;
- (c) which, having arisen, such Party could not reasonably have avoided or overcome; and
- (d) which is not substantially attributable to the other Party.

62.2 Force Majeure may include, but is not limited to, exceptional events or circumstances of the kind listed below, so long as conditions (a) to (d) above are satisfied:

- (a) war, hostilities (whether war be declared or not), invasion, act of foreign enemies;
- (b) rebellion, terrorism, sabotage by persons other than the Contractor's Personnel, revolution, insurrection, military or usurped power, or civil war;
- (c) riot, commotion, disorder, strike or lockout by persons other than the Contractor's Personnel;
- (d) munitions of war, explosive materials, ionizing radiation or contamination by radio-activity, except as may be attributable to the Contractor's use of such munitions, explosives, radiation or radio-activity; and
- (e) natural catastrophes such as earthquake, hurricane, typhoon, or volcanic activity.

63. Notice of Force Majeure

63.1 If a Party is or will be prevented from performing its substantial obligations under the Contract by Force Majeure, then it shall give notice to the other Party of the event or circumstances constituting the Force Majeure and shall specify the obligations, the performance of which is or will be prevented. The notice shall be given within 14 days after the Party became aware, or should have become aware, of the relevant event or circumstance constituting Force Majeure.

63.2 The Party shall, having given notice, be excused from performance of its obligations for so long as such Force Majeure prevents it from performing them.

63.3 Notwithstanding any other provision of this Clause, Force Majeure shall not apply to obligations of either Party to make payments to the other Party under the Contract.

64. Duty to Minimize Delay

64.1 Each Party shall at all times use all reasonable endeavours to minimize any delay in the performance of the Contract as a result of Force Majeure.

64.2 A Party shall give notice to the other Party when it ceases to be affected by the Force Majeure.

65. Consequences of Force Majeure

65.1 If the Contractor is prevented from performing its substantial obligations under the Contract by Force Majeure of which notice has been given under GCC Subclause 63 [Notice of Force Majeure], and suffers delay and/or incurs Cost by reason of such Force Majeure, the Contractor shall be entitled subject to GCC Subclause 30.1 [Procedure for

Disputes] to

- (a) an extension of time for any such delay, if completion is or will be delayed, under GCC Subclause 36 [Extension of the Intended Completion Date]; and
- (b) if the event or circumstance is of the kind described in subparagraphs (a) to (d) of GCC Subclause 62.2 [Definition of Force Majeure] and, in the case of subparagraphs (b) to (d), occurs in the Country, payment of any such Cost, including the costs of rectifying or replacing the Works and/or Goods damaged or destructed by Force Majeure, to the extent they are not indemnified through the insurance policy referred to in GCC Subclause 19 [Insurance].

65.2 After receiving this notice, the Project Manager shall proceed in accordance with GCC Subclause 10 [Project Manager's Decisions] to agree or determine these matters.

**66. Force Majeure
Affecting
Subcontractor**

66.1 If any Subcontractor is entitled under any contract or agreement relating to the Works to relief from force majeure on terms additional to or broader than those specified in this Clause, such additional or broader Force Majeure events or circumstances shall not excuse the Contractor's nonperformance or entitle him to relief under this Clause.

**67. Optional
Termination,
Payment and
Release**

67.1 If the execution of substantially all the Works in progress is prevented for a continuous period of 84 days by reason of Force Majeure of which notice has been given under GCC Subclause 63 [Notice of Force Majeure], or for multiple periods which total more than 140 days due to the same notified Force Majeure, then either Party may give to the other Party a notice of termination of the Contract. In this event, the termination shall take effect 7 days after the notice is given, and the Contractor shall proceed in accordance with GCC Subclause 73.5 [Termination].

67.2 Upon such termination, the Project Manager shall determine the value of the work done and issue a Payment Certificate, which shall include

- (a) the amounts payable for any work carried out for which a price is stated in the Contract;
- (b) the Cost of Plant and Materials ordered for the Works which have been delivered to the Contractor, or of which the Contractor is liable to accept delivery: this Plant and Materials shall become the property of (and be at the risk of) the Employer when paid for by the Employer, and the Contractor shall place the same at the Employer's disposal;
- (c) other Costs or liabilities which in the circumstances were reasonably and necessarily incurred by the Contractor in the expectation of completing the Works;
- (d) the Cost of removal of Temporary Works and Contractor's Equipment from the Site and the return of these items to the Contractor's works in his country (or to any other destination at no greater cost); and
- (e) the Cost of repatriation of the Contractor's staff and labor employed wholly in connection with the Works at the date of

termination.

- 68. Release from Performance**
- 68.1 Notwithstanding any other provision of this Clause, if any event or circumstance outside the control of the Parties (including, but not limited to, Force Majeure) arises, which makes it impossible or unlawful for either or both Parties to fulfill its or their contractual obligations or which, under the law governing the Contract, entitles the Parties to be released from further performance of the Contract, then upon notice by either Party to the other Party of such event or circumstance,
- (a) the Parties shall be discharged from further performance, without prejudice to the rights of either Party in respect of any previous breach of the Contract; and
 - (b) the sum payable by the Employer to the Contractor shall be the same as would have been payable under GCC Subclause 67 [Optional Termination, Payment and Release] if the Contract had been terminated under GCC Subclause 67.

G. Finishing the Contract

- 69. Completion**
- 69.1 The Contractor shall request the Project Manager to issue a certificate of Completion of the Works, and the Project Manager shall do so upon deciding that the work is completed.
- 70. Taking Over**
- 70.1 The Employer shall take over the Site and the Works within 7 days of the Project Manager's issuing a certificate of Completion.
- 71. Final Account**
- 71.1 The Contractor shall supply the Project Manager with a detailed account of the total amount that the Contractor considers payable under the Contract before the end of the Defects Liability Period. The Project Manager shall issue a Defects Liability Certificate and certify any final payment that is due to the Contractor within 56 days of receiving the Contractor's account if it is correct and complete. If it is not, the Project Manager shall issue within 56 days a schedule that states the scope of the corrections or additions that are necessary. If the Final Account is still unsatisfactory after it has been resubmitted, the Project Manager shall decide on the amount payable to the Contractor and issue a payment certificate.
- 72. Operating and Maintenance Manuals**
- 72.1 If "as built" Drawings and/or operating and maintenance manuals are required, the Contractor shall supply them by the dates stated in the **PCC**.
- 72.2 If the Contractor does not supply the Drawings and/or manuals by the dates stated in the **PCC** pursuant to GCC 72.1, or they do not receive the Project Manager's approval, the Project Manager shall withhold the amount stated in the **PCC** from payments due to the Contractor.
- 73. Termination**
- 73.1 The Employer or the Contractor may terminate the Contract if the other party causes a fundamental breach of the Contract.
- 73.2 Fundamental breaches of Contract shall include, but shall not be

limited to, the following:

- (a) the Contractor stops work for 28 days when no stoppage of work is shown on the current Program and the stoppage has not been authorized by the Project Manager;
- (b) the Project Manager instructs the Contractor to delay the progress of the Works, and the instruction is not withdrawn within 28 days;
- (c) the Employer or the Contractor is made bankrupt or goes into liquidation other than for a reconstruction or amalgamation;
- (d) a payment certified by the Project Manager is not paid by the Employer to the Contractor within 84 days of the date of the Project Manager's certificate;
- (e) the Project Manager gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Project Manager;
- (f) the Project Manager gives two consecutive Notices to update the Program and accelerate the works to ensure compliance with GCC Subclause 22.1 [The Works to Be Completed by the Intended Completion Date] and the Contractor fails to update the Program and demonstrate acceleration of the works within a reasonable period of time determined by the Project Manager;
- (g) the Contractor does not maintain a Security, which is required;
- (h) the Contractor has delayed the completion of the Works by the number of days for which the maximum amount of liquidated damages can be paid, as defined in the **PCC**; and
- (i) if the Contractor, in the judgment of the Employer has engaged in integrity violations in competing for or in executing the Contract, pursuant to GCC 74.1 [Fraud and Corruption].

73.3 When either party to the Contract gives notice of a breach of Contract to the Project Manager for a cause other than those listed under GCC 73.2 above, the Project Manager shall decide whether the breach is fundamental or not.

73.4 Notwithstanding the above, the Employer may terminate the Contract for convenience.

73.5 If the Contract is terminated, the Contractor shall stop work immediately, make the Site safe and secure, and leave the Site as soon as reasonably possible.

74. Fraud and Corruption

74.1 If the Employer determines, based on reasonable evidence, that the Contractor has engaged in corrupt, fraudulent, collusive or coercive practices, or other integrity violations, including the failure to disclose any required information which constitutes a fraudulent practice, in competing for or in executing the Contract, then the Employer may, after giving 14 days notice to the Contractor, terminate the Contract and expel him from the Site, and the provisions of Clause 73 [Termination] shall apply as if such termination had been made under

Sub-Clause 73.2 (i).

74.2 ADB requires Borrowers (including beneficiaries of ADB-financed activity) and their personnel, as well as firms and individuals participating in an ADB-financed activity, including but not limited to, Bidders, Suppliers, Contractors, agents, subcontractors, subconsultants, service providers, subsuppliers, manufacturers (including their respective officers, directors, employees and personnel) under ADB-financed contracts to observe the highest standard of ethics during the procurement and execution of such contracts in accordance with ADB's Anticorruption Policy (1998, as amended from time to time). In pursuance of this policy, the ADB

- (a) defines, for the purposes of this provision, the terms set forth below as follows:
 - (i) "corrupt practice" means the offering, giving, receiving, or soliciting, directly or indirectly, anything of value to influence improperly the actions of another party;
 - (ii) "fraudulent practice" means any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation;
 - (iii) "coercive practice" means impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party;
 - (iv) "collusive practice" means an arrangement between two or more parties designed to achieve an improper purpose, including influencing improperly the actions of another party;
 - (v) "abuse" means theft, waste, or improper use of assets related to ADB-related activity, either committed intentionally or through reckless disregard;
 - (vi) "conflict of interest" means any situation in which a party has interests that could improperly influence that party's performance of official duties or responsibilities, contractual obligations, or compliance with applicable laws and regulations; and
 - (vii) "integrity violation" is any act, as defined under ADB's Integrity Principles and Guidelines (2015, as amended from time to time), which violates ADB's Anticorruption Policy, including (i) to (vi) above and the following: obstructive practice, violations of ADB sanctions, retaliation against whistleblowers or witnesses, and other violations of ADB's Anticorruption Policy, including failure to adhere to the highest ethical standard.
- (b) will reject a proposal for award if it determines that the Bidder recommended for award or any of its officers, directors, employees, personnel, subconsultants, subcontractors, service providers, suppliers or manufacturers has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive, or

obstructive practices or other integrity violations in competing for the Contract;

- (c) will cancel the portion of the financing allocated to a contract if it determines at any time that representatives of the Borrower or of a beneficiary of ADB-financing engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices or other integrity violations during the procurement or the execution of that contract, without the Borrower having taken timely and appropriate action satisfactory to ADB to remedy the situation, including by failing to inform ADB in a timely manner at the time they knew of the integrity violations;
 - (d) will impose remedial actions on a firm or an individual, at any time, in accordance with ADB's Anticorruption Policy and Integrity Principles and Guidelines, including declaring ineligible, either indefinitely or for a stated period of time, to participate² in ADB-financed, -administered, or -supported activities or to benefit from an ADB-financed, -administered, or -supported contract, financially or otherwise, if it at any time determines that the firm or individual has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices or other integrity violations; and
 - (e) will have the right to require that a provision be included in bidding documents and in contracts financed, administered, or supported by ADB, requiring Bidders, suppliers and contractors, consultants, manufacturers, service providers and other third parties engaged or involved in ADB-related activities, and their respective officers, directors, employees and personnel, to permit ADB or its representative to inspect the site and their assets, accounts and records and other documents relating to the bid submission and contract performance and to have them audited by auditors appointed by ADB.
- 74.3 All Bidders, consultants, contractors, suppliers, manufacturers, service providers, and other third parties engaged or involved in ADB-related activities and their respective officers, directors, employees and personnel are obliged to cooperate fully in any investigation when requested by ADB to do so. As determined on a case by case basis by ADB, such cooperation includes, but is not limited to, the following:
- (a) being available to be interviewed and replying fully and truthfully to all questions asked;
 - (b) providing ADB with any items requested that are within the party's control including, but not limited to, documents and other physical objects;
 - (c) upon written request by ADB, authorizing other related entities to release directly to ADB such information that is specifically and materially related, directly or indirectly, to the said entities

² Whether as a Contractor, Subcontractor, Consultant, Manufacturer or Supplier, or Service Provider; or in any other capacity (different names are used depending on the particular Bidding Document).

or issues which are the subject of the investigation;

- (d) cooperating with all reasonable requests to search or physically inspect their person and/or work areas, including files, electronic databases, and personal property used on ADB activities, or that utilizes ADB's Information and Communications Technology (ICT) resources or systems (including mobile phones, personal electronic devices, and electronic storage devices such as external disk drives);
- (e) cooperating in any testing requested by ADB, including but not limited to, fingerprint identification, handwriting analysis, and physical examination and analysis; and
- (f) preserving and protecting confidentiality of all information discussed with, and as required by, ADB.

74.4 All Bidders, consultants, contractors and suppliers shall require their officers, directors, employees, personnel, agents to ensure that, in its contracts with its subconsultants, Subcontractors and other third parties engaged or involved in ADB-related activities, such subconsultants, Subcontractors and other third parties similarly are obliged to cooperate fully in any investigation when requested by ADB to do so.

74.5 The Contractor undertakes that no fees, gratuities, rebates, gifts, commissions or other payments, other than those shown in the bid, have been given or received in connection with the procurement process or in the contract execution.³

75. Payment upon Termination

75.1 If the Contract is terminated because of a fundamental breach of Contract by the Contractor, the Project Manager shall issue a certificate for the value of the work done and Materials ordered less advance payments received up to the date of the issue of the certificate and less the percentage to apply to the value of the work not completed, as indicated in the **PCC**. Additional Liquidated Damages shall not apply. If the total amount due to the Employer exceeds any payment due to the Contractor, the difference shall be a debt payable to the Employer.

75.2 If the Contract is terminated for the Employer's convenience or because of a fundamental breach of Contract by the Employer, the Project Manager shall issue a certificate for the value of the work done, Materials ordered, the reasonable cost of removal of Equipment, repatriation of the Contractor's personnel employed solely on the Works, and the Contractor's costs of protecting and securing the Works, and less advance payments received up to the date of the certificate.

76. Property

76.1 All Materials on the Site, Plant, Equipment, Temporary Works, and Works shall be deemed to be the property of the Employer if the Contract is terminated because of the Contractor's default.

³ The undertaking also applies during the period of performance of the contract

- 77. Release from Performance**
- 77.1 If the Contract is frustrated by the outbreak of war or by any other event entirely outside the control of either the Employer or the Contractor, the Project Manager shall certify that the Contract has been frustrated. The Contractor shall make the Site safe and stop work as quickly as possible after receiving this certificate and shall be paid for all work carried out before receiving it and for any work carried out afterward to which a commitment was made.
- 78. Suspension of ADB Loan or Credit**
- 78.1 In the event that ADB suspends the Loan or Credit to the Employer, from which part of the payments to the Contractor are being made,
- (a) the Employer is obligated to notify the Contractor, with copy to the Project Manager, of such suspension within 7 days of having received ADB's suspension notice.
 - (b) if the Contractor has not received sums due it within the 28 days for payment provided for in GCC 50.1 [Payments], the Contractor may immediately issue a 14-day termination notice.
- 79. Eligibility**
- 79.1 The Contractor shall have the nationality of an eligible country as specified in Section 5 (Eligible Countries) of the bidding document. The Contractor shall be deemed to have the nationality of a country if the Contractor is a citizen or is constituted, incorporated, or registered, and operates in conformity with the provisions of the laws of that country. This criterion shall also apply to the determination of the nationality of proposed subcontractors or suppliers for any part of the Contract including related services.
- 79.2 The materials, equipment, and services to be supplied under the Contract shall have their origin in eligible source countries as specified in Section 5 (Eligible Countries) of the bidding document and all expenditures under the Contract will be limited to such materials, equipment, and services. At the Employer's request, the Contractor may be required to provide evidence of the origin of materials, equipment, and services.
- 79.3 For purposes of GCC 79.2, "origin" means the place where the materials and equipment are mined, grown, produced, or manufactured, and from which the services are provided. Materials and equipment are produced when, through manufacturing, processing, or substantial or major assembling of components, a commercially recognized product results that differs substantially in its basic characteristics or in purpose or utility from its components.

Section 8: Particular Conditions of Contract

The following Particular Conditions of Contract shall supplement the GCC. Whenever there is a conflict, the provisions herein shall prevail over those in the GCC.

A. General	
GCC 1.1 (d)	The financing institutions is Asian Development Bank (ADB)
GCC 1.1 (r)	The Employer is Executive Engineer Cum Project Manager, Jal Shakti Vibhag, Division Bangana, Government of Himachal Pradesh
GCC 1.1 (w)	The Intended Completion Date for the whole of the Works shall be 18 (Months) – 548 Days from start Date.
GCC 1.1 (cc)	The Project Manager is Executive Engineer, Jal Shakti Vibhag, Division Nalagarh, Government of Himachal Pradesh ZIP code: 174101 Country: India Tel.: 01795- 223506 Email: enalarh@yahoo.in
GCC 1.1 (ff)	The Site is located in Solan district of Himachal Pradesh, and is defined in BDS of the bid document. There are 2 blocks in this project namely (i) Kunihar and Nalagarh.
GCC 1.1 (ii)	The Start Date shall be 15 (fifteen) days from signing of Contract between Contractor and the Employer.
GCC 1.1 (mm)	The Works consist of – Providing Irrigation Facility under HP SHIVA Project for Kunihar and Nalagarh Blocks, District Solan (Himachal Pradesh) – Package-1
GCC 2.2	Sectional Completions are: Not Applicable
GCC 2.3 (j)	The following documents also form part of the Contract: ▪ Bid submitted by the Contractor ▪ Corrigendum / Addendum / Clarification issued by the employer during the bidding process. ▪ Amendments to this contract; and ▪ Power of Attorney submitted by the Bidder ▪ Joint Venture Agreement, if any ▪ Initial Environmental Examination (IEE) ▪ Environment, Health and Safety Management Plan (EHSMP)
GCC 3.1	The language of the contract is English The law that applies to the Contract is the law of India
GCC 11.1	The Project Manager may delegate any of his duties and responsibilities.

GCC 14.1	Schedule of other contractors: The following Contracts may be awarded and may be subject to mobilization and work during the period of this contract: - Contract for Supply and Installation of Animal Solar Fencing Works - Contract for Field Preparation - Contract for Drip Irrigation Works However, the field activities of these other contractors are unlikely to interfere with the work of this contract.
GCC 19.1	The minimum insurance amounts and deductibles shall be: (a) for loss or damage to the Works, Plant and Materials: Either as fixed by the insurance company or 5% (five percentage) of Contract Price, whichever is higher (b) for loss or damage to Equipment: Either as fixed by the insurance company or 5% (five percentage) of Contract Price, whichever is higher (c) for loss or damage to property (except the Works, Plant, Materials, and Equipment) in connection with Contract: Either as fixed by the insurance company or 5% (five percentage) of Contract Price, whichever is higher (d) for personal injury or death: (i) of the Contractor's employees: Minimum 5% (five percentage) of Contract Price (ii) of other people: Minimum 5% (five percentage) of Contract Price
GCC 20.1	Site Investigation Reports (Topographic survey) are available with the Executive Engineer, Jal Shakti Vibhag, Government of Himachal Pradesh.
GCC 22.1	The Contractor shall adequately record the condition of roads, agricultural land and other infrastructures prior to starting to transport materials and construction.
GCC 23.1	The following shall be designed by the Contractor: The contractor is required to get the detailed design and engineering of OHT vetted by any reputed government technical institutions like IIT Mandi, HP.
GCC 26.1	The Site Possession Date(s) shall be: provided within 14 (fourteen) days of Contract signing.
GCC 29.1	Appointing Authority for the Adjudicator: Chairman, Institute of Engineer, Shimla Chapter
GCC 30.3	The Adjudicator shall be paid by the hour at the rate of: INR 1,000 The reimbursable expenses are: With respect to expenses on site visits, stationeries and computer consumables, not exceeding 0.5% of the Contract Price
GCC 30.4	Institution whose arbitration procedures shall be used: Arbitration shall be conducted in accordance with the laws of the Employer's country.
GCC 34.2	The following sentence shall apply: Respectful Work Environment

	The Contractor shall ensure that its employees and Subcontractors observe the highest ethical standards and refrain from any form of bullying, discrimination, misconduct and harassment, including sexual harassment and shall, at all times, behave in a manner that creates an environment free of unethical behavior, bullying, misconduct and harassment, including sexual harassment. The Contractor shall take appropriate action against any employees or Subcontractors, including suspension or termination of employment or sub-contract, if any form of unethical or inappropriate behavior is identified. The Contractor shall conduct training programs for its employees and sub-contractors to raise awareness on and prevent any form of bullying, discrimination, misconduct and harassment including sexual harassment, and to promote a respectful work environment. The Contractor shall keep an up to date record of its employees and Subcontractors who have attended and completed such training programs and provide such records to the Employer or the Engineer at their first written request.
C. Time Control	
GCC 35.1	The Contractor shall submit for approval a Program for the Works within 7 (seven) days prior to the start date as defined in GCC 1.1 (ii).
GCC 35.3	The period between Program updates is 30 (Thirty) days. The amount to be withheld for late submission of an updated Program is INR 1,00,000/-
D. Quality Control	
GCC 43.1	The Defects Liability Period is: 365 days.
E. Cost Control	
GCC 53.1	The currency of the Employer's country is: Indian Rupees (INR)
GCC 54.1	The Contract is not subject to price adjustment in accordance with GCC Clause 54, and the following information regarding coefficients does not apply.
GCC 55.1	The proportion of payments retained is: 5% (Five Percentage) from each payment
GCC 56.1	The liquidated damages for the whole of the Works are 0.1% per day. The maximum amount of liquidated damages for the whole of the Works is 10% (ten percent) of the final Contract Price.
GCC 57.1	Not Applicable
GCC 58.1	The Advance Payments shall be 10% and shall be paid to the Contractor no later than 30 (thirty) days from signing of the Contract.
GCC 58.3	Repayment of the Advance Payments shall be: Advance payment shall be repaid through 10 interim payment certificate of 1/10th of Advance Payment which shall commence after 3 months of giving advance but in any case all amount to be recovered within 14 months of

	giving advance. Entire amount to be recovered by the time, 80% of work is completed or stipulated period of work whichever is early.
GCC 59.1	The Performance Security amount is 10% (ten percentage) of the Contract Price.
G. Finishing the Contract	
GCC 72.1	The date by which operating and maintenance manuals are required is within 30 (thirty) days from Completion Date. The date by which “as built” drawings are required is within 30 (thirty) days from Completion Date.
GCC 72.2	The amount to be withheld for failing to produce “as built” drawings and/or operating and maintenance manuals by the date required in GCC 72.1 is 2.5% of the Contract Price.
GCC 73.2 (h)	The maximum number of days is: 100 (Hundred) days
GCC 75.1	The percentage to apply to the value of the work not completed, representing the Employer’s additional cost for completing the Works, is 10% (ten percentage).

Schedules to General Conditions of Contract

Schedule 1: SOP for COVID 19, as directed by Ministry of Health Government of India.

Schedule 1: SOP for COVID 19, as directed by Ministry of Health, GoHP

Protect yourself and others from getting sick
Wash your hands

- after coughing or sneezing
- when caring for the sick
- before, during and after you prepare food
- before eating
- after toilet use
- when hands are visibly dirty
- after handling animals or animal waste

World Health Organization

2020

SOP-Health and Safety Plan

STOP the SPREAD of COVID-19

Novel Coronavirus (COVID-19)

Basic Protective Measures For All

Help us to help you

- Wash your hands frequently
- Maintain social distancing
- Avoid touching your eyes, nose and mouth
- Practice respiratory hygiene by covering your mouth and nose with your bent elbow or tissue when you cough or sneeze
- If you have fever, cough and difficulty breathing, seek medical care at the earliest
- Stay informed and follow the advice given by your doctor
- See a doctor if you feel unwell - while visiting a doctor wear a mask/cloth to cover your mouth and nose
- If you have any symptoms, please call State Helpline Number or Health Ministry 24*7 helpline number +91-11-23978046 or email at ncov2019@gmail.com

For further information:
Call at Ministry of Health, Govt. of India's 24*7 control room number
+91-11-2397 8046
Email at ncov2019@gmail.com

6 Feet

Prepared by:
Project Management Unit
Madhya Pradesh Urban Development
Company (MPUDC), Government of
Madhya Pradesh

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Health and Safety Plan (H&SP) — TAKING MAXIMUM PRECAUTION DURING COVID-19

1 INTRODUCTION¹

- This document is intended to supplement formal H&S policies, procedures and plans that the contractor has in place for its employees and staff working on MPL projects and under this contract. Hence, this document is not intended to replace any formalized procedures currently in place for the Contractor. Where this guideline does not meet or exceed the standards put forth by the Contractor, the Contractor shall abide by the most stringent procedure available.
- This approved project specific Health and Safety Plan (H&SP) shall be modified to require that the COVID-19 Officer at the Contractor's worksite (appointed by Contractor and agreed by PIU) submit a written daily report to the Client's Representative (PIU Head). The COVID-19 Officer shall certify that the Contractor and all subcontractors are in full compliance with these guidelines.
- The COVID-19 officer should be present on site at all times.
- Any issue of non-compliance with these guidelines shall be a basis for the suspension of work. The Contractor will be required to submit a corrective action plan (on the next day or immediately as per the nature of issue) detailing each issue of non-conformance and a plan to rectify the issue(s). The Contractor will not be allowed to resume work until the plan is approved by the Client (PIU). Any additional issues of non-conformance may be subject to action against the Contractor's as health & safety/safeguard clauses of the contract.
- Construction sites operating during the Covid-19 pandemic need to ensure they are protecting their WORKFORCE and minimising the risk of spread of infection.
- This guidance is intended to introduce consistent measures on sites of all sizes in line with the Government's recommendations on social distancing.
- These are exceptional circumstances and the industry must remain abreast of and comply with the latest Government advice on COVID-19 at all times.
- The health and safety requirements of any construction activity must also not be compromised at this time. If an activity cannot be undertaken safely due to a lack of suitably qualified personnel being available or social distancing being implemented, it should not take place.
- It is to be noted that emergency services are also under great pressure and may not be in a position to respond as quickly as usual.
- Sites should remind the workforce at every opportunity of the Worksite Procedures which are aimed at protecting them, their colleagues, their families and the Madhya Pradesh population.

If a worksite is not consistently implementing the measures in this document, it may be required to shut down.

2 PRINCIPLES OF WORKER PROTECTION

- Consistently practice social distancing
- Cover coughs and sneezes
- Maintain hand hygiene
- Clean surfaces frequently

3 MAXIMUM PRECAUTION FOR PERSONS/LABOURERS REPORTING TO WORK

- IF SICK, STAY HOME
- IF SICK, GO HOME
- IF SOMEONE SICK, SEND THEM HOME

¹ This document may be made available in the local language, and the salient features would be displayed through signages at the appropriate locations throughout work sites and stretches by the Contractor for wider dissemination and awareness.

² The existing safeguards officer OR health & safety officer OR supervisor of the contractor can be designated as COVID-19 officer by undergoing the training available at

(a) <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/training/online-training>

(b) <https://open.who.org/courses/eprotect-acute-respiratory-infections>

(c) <https://open.who.org/courses/COVID-19-IPC-EN>

Contractor to provide face masks (of the type approved by Government for use to protect persons from COVID-19) to all persons working in or visiting the worksite. This along with procedures set out in this document is for maximum precaution to protect all persons/labourers at all times.

4 COVID-19 TYPICAL SYMPTOMS

- Fever
- Cough
- Shortness of Breath
- Sore Throat

All persons at the worksite should have their temperature screened by COVID-19 officer with Infrared Thermometer (handheld non-contact).

5 SELF ATTESTATION BY PERSONS/ LABOUR PRIOR TO WORK

Prior to starting a work (on daily basis) each labour /worker will self-attest to the supervisor

- no Signs of COVID-19 symptoms within the past 24 hours
- No contact with an individual diagnosed with COVID-19. (contact means living with a positive person, being within 6 ft of positive person OR sharing things of positive person)
- Not undergone quarantine or isolation (in case of any labourer /worker who has been quarantined or isolated previously, the engagement shall be only after obtaining the requisite clearance)

The engagement of workers falling in the high-risk category such as workers over the age of 55 years, with underlying medical conditions or health issues, etc. should be done only after obtaining the requisite clearance from trained and registered medical practitioners.

The self-attestation would be verified in collaboration with trained and registered medical practitioners deployed at site through discussions with labourers /workers and/or preliminary checks such as temperature checks, etc. prior to their engagement at site.

In addition, the Contractor shall mandatorily follow all medical test requirements for the workers prior to their engagement and/or mobilization at site as per the guidelines issued by the Central and State government agencies and WHO from time to time.

Persons/Labourers showing COVID-19 symptoms or not providing self-attestation shall be directed to leave the work site and report to the fever clinic/quarantine centre immediately. Labourers not to return to the work site until cleared by fever clinic/quarantine centre.

6 GENERAL DIRECTION

- No handshake, Only Namaste
- Non-essential physical work that requires close contact between workers should not be carried out
- Work requiring physical contact should not be carried out
- Plan all other work to minimise contact between workers
- Wash hands often (every 1-2 hrs or frequently as possible) with soap for at least 20 seconds
- Use hand sanitizer
- No person should enter the work site other than the authorized persons mentioned by supervisor during start of work
- All must implement social distancing by maintaining a minimum distance of 6-feet from others at all times to eliminate the potential of cross contamination.
- Avoid face to face meetings — critical situations requiring in-person discussion must follow social distancing i.e., 6 ft from others.
- Conduct all meetings via conference calls, if possible. Do not convene meetings of more than 10 people. Recommend use of cell phones, texting, web meeting sites and conference calls for project discussion
- All individual work group meetings/ talks should follow social distancing
- At each job briefing/toolbox talk, employees are asked if they are experiencing any symptoms, and are sent home if they are

- Each worksite should have laminated COVID-19 safety guidelines and hand washing instructions
- All restroom/toilet facilities should be cleaned (min twice a day), and hand washing facility must be provided with soap, hand sanitizer and paper towels
- All surfaces should be regularly cleaned, including mobiles, tabletops /surfaces, door handles, laptops, records, etc.
- All common areas and meeting areas are to be regularly cleaned (min twice a day) and disinfected at least twice a day
- All persons to maintain their own water bottle, and should not be shared.
- To avoid external contamination, it is recommended everyone bring food from home
- Please maintain Social Distancing separation during breaks and lunch.
- Cover coughing or sneezing with a tissue, and then throw the tissue in the trash and wash hands, if no tissue is available then cough /sneeze into your upper sleeves or elbow. Do not cough or sneeze into your hands.
- Clean your hands after coughing or sneezing thoroughly by using soap and water (minimum for 20 seconds). If soap and water are not available, please use a hand sanitizer. The Contractor shall ensure adequate quantities of sanitizer and soap are made available at all locations including site offices, meeting rooms, corridors, washrooms /toilets, etc. as appropriate.
- Avoid touching eyes, nose, and mouth with your hands
- To avoid sharing germs, please clean up after yourself. DO NOT make others responsible for moving, unpacking and packing up your personal belongings
- If you or a family member is feeling ill, stay home!⁴
- Work schedules are adjusted to provide time for proper cleaning and disinfecting as required.

7 WORK-SITE PREVENTION PRACTICES

- At the start of each shift, confirm with all employees that they are healthy and inform all workers of reusable and disposable PPE.
- Outside person(s) should be strictly prohibited at worksite
- All construction workers will be required to wear cut-resistant gloves or the equivalent.
- Use of eye protection (reusable safety goggles/face shields) is recommended. The supply of eye protection equipment to the workers is considered as a standard part of PPE during construction works.
- In work conditions where required social distancing is impossible to achieve, such employees shall be supplied with standard face mask, gloves, and eye protection.
- All employees shall drive to work site in a single occupant vehicle. Staff shall not ride together in the same vehicle
- When entering a machine or vehicle which you are not sure you were the last person to enter, make sure that you wipe down the interior and door handles with disinfectant (with 1% sodium hypochlorite solution daily) prior to entry. Adequate quantity of the disinfectant shall be provided by the Contractor at all such site-specific locations.
- Workers should maintain separation of 6' from each other.
- Multi person activities will be limited where feasible (two persons lifting activities)
- Gathering places on the site such as sheds and/or break areas will be eliminated, and instead small break areas will be used with seating limited to ensure social distancing.
- Contact the cleaning person of the worksite and ensure proper COVID-19 sanitation processes. Increase cleaning/disinfection visits to at least 2 times a day. Cleaning person(s) to be provided with gloves, gown and face mask for each cycle of cleaning. The Contractor shall make available adequate supply of PPE and chemicals while the threat of COVID-19 continues.

³Social distancing may not be practical for undertaking certain specific activities within the workplace. It is therefore important to review the work method statements for these types of activities to assess impact and how to find safe ways of doing in line with best available guidance.

The workers with no sick-leave would be supported with additional leave while affected by COVID-19 by the Contractor. The workers who have to stay home because of COVID19 affected family member(s), the Contractor shall pay for the days for staying away from the work.

- Clean all high contact surfaces a minimum of twice a day in order to minimize the spread of germs in areas that people touch frequently. This includes but is not limited to desks, laptops and vehicles
- All employees to maintaining good health by getting adequate sleep; eating a balanced, healthy diet, avoid alcohol; and consume plenty of fluids.
- Continuation of works in construction project with workers available on site and no workers to be brought in from outside
- The site offices shall have adequate ventilation. The air conditioning or ventilation systems installed at the site offices would have high-efficiency air filters to reduce the risk of infection. The frequency of air changes may be increased for areas where close personal proximity cannot be fully prevented such as control rooms, elevators, waiting rooms, etc.
- The Contractor shall carry out contactless temperature checks for the workers prior to site entrance, during working hours and after site works to identify persons
- showing signs of being unwell with the COVID-19 symptoms

8 WASHING FACILITY

- All worksites should have access to toilet and hand washing facility.
- Providing hand cleaning facilities at entrances and exits. This should be soap and water wherever possible or hand sanitizer if water is not available
- Washing facility with hot water, and soap at fire hydrants or other water sources to be used for frequent hand washing for all onsite employees
- All onsite workers must help to maintain and keep stations clean
- If a worker notices soap or towels are running low or out, immediately notify supervisors. Proactively supervisor should make sure shortage situation never occurs.
- Garbage bins will be placed next to the hand wash facility for discarding of used tissues/towels with regular removal and disposal facility (end of each day)

9 CLEANING PROCEDURES

Increase cleaning/disinfection visits to at least 2 times a day. Cleaning person(s) to be provided with gloves, gown and face mask for each cycle of cleaning

Each worksite should have enhanced cleaning and disinfection procedures that are posted and shared including sheds, gates, equipment, vehicles, etc. and shall be posted at all entry points to the sites, and throughout the project site. These include common areas and high touch points like

- Taps and washing facilities
- Toilet flush and seats
- Door handles and push plates
- Handrails on staircases and corridors
- Lift and hoist controls
- Machinery and equipment controls
- Food preparation and eating surfaces
- Telephone equipment / mobiles
- Keyboards, photocopiers and other office equipment

Re-usable PPE should be thoroughly cleaned after use and not shared between workers

10 LABOUR CAMP

Contractor shall follow a zero-tolerance policy on wearing of masks.

Masks (homemade can be thought of) to be provided to all the persons/labourers for use at the camp site as well as at the worksite. Increase cleaning/disinfection visits to at least 2 times a day. Cleaning person(s) to be provided with disposable gloves, gown and face mask for each cycle of cleaning.

10.1 Toilet Facility

- Restrict the number of people using toilet facility at any one time e.g. appoint one welfare attendant among the labours.
- Wash hands before and after using the facilities

- Enhance the cleaning regimes for toilet facilities particularly door handles, locks and the toilet flush
- Portable toilets should be avoided wherever possible, but where in use these should be cleaned and emptied more frequently
- Provide suitable and sufficient rubbish bins for hand towels with regular removal and disposal.

10.2 Eating/Snacks Arrangements

- With eateries having been closed (restricted) across the country, providing permanent (till society is safe from COVID-19) on-camp/off-camp cook/helpers can be implemented. Make sure that the "Guidelines for food handling, preparation and distribution during COVID-19" and its regular updates are being followed.
- Whilst there is a requirement for construction camps to provide a means of heating food and making hot water, these are exceptional circumstances and where it is not possible to introduce a means of keeping equipment clean between uses, etc. must be removed from use.
- Contractor to arrange all daily need items and grocery at site itself and no worker is allowed to go to shops for daily need items.
- Dedicated eating areas should be identified on camp to reduce food waste and contamination
- Break times should be staggered to reduce congestion and contact at all times
- Hand cleaning facilities or hand sanitizer should be available at the entrance of any room where people eat and should be used by workers when entering and leaving the area
- Workers should sit 2 metres apart from each other whilst eating and avoid all contact
- Where catering is provided on camp, it should provide pre-prepared and wrapped food only
 - Payments should be taken by contactless options wherever possible
 - Crockery, eating utensils, cups etc. should be avoided wherever possible
- Drinking water should be provided with enhanced cleaning measures of the tap mechanism introduced
- Tables should be cleaned between each use
- All rubbish should be put straight in the bin and not left for someone else to clear up; only covered pedal operated bins should be used and the bins should be cleared and cleaned regularly, with strict adherence to safety protocols for disposal and hygiene maintenance (including proper PPE's such as gloves, mask and apron worn by the waste handler/cleaner and disposal at a designated place);
- All areas used for eating must be thoroughly cleaned at the end of each break and shift, including chairs, door handles, etc.

10.3 Changing Facilities, Showers and Drying Areas

- Introduce staggered start and finish times to reduce congestion and contact at all times
- Introduce enhanced cleaning of all facilities throughout the day and at the end of each day
- Consider increasing the number or size of facilities available on camp if possible
- Based on the size of each facility, determine how many people can use it at any one time to maintain distance of two metres
- Provide suitable and sufficient garbage bins in these areas with regular removal and disposal.
- Visitor log should be strictly maintained that the labour camp.

*Advisory on use of Homemade Protective Cover for Face & Mouth by GOI

COVID-19 officer will ensure compliance with prevention issues at the labour camp(s).

11 UPDATES ON COVID-19

The Contractor shall be in touch with the Department of Health & Family Welfare and Labour Department to identify any potential worksite exposures relating to COVID-19, including:

- Strictly follow the guidelines issues by Ministry of health and OSHA
- Other workers, vendors, inspectors, or visitors to the worksite with close contact to the individual
- Labour Camps / Work areas such as designated workstations or rooms/sheds
- Work tools and equipment
- Common areas such as break rooms, tables and sanitary facilities

Also refer the following websites from time to time for regular updates.

<https://www.mohfw.gov.in/>

<http://>

This document can be updated from time to time based on the advisories or directions of the Govt.

12 TRAINING

- RPMU/PIU to ensure all workers get training on above requirements before start of any construction activity
- During construction period frequent visual and verbal reminders to workers can improve compliance with hand hygiene practices and thus reduce rates of infection. Hand washing posters should also be displayed at work site and labour camps

13 EMERGENCY CONTACT

- Provide emergency contact number(s) at work site and labour camp for reporting COVID-19 symptoms

Ensure all staff and personal use the Aarogya Setu app, recommended by GOI for tracking COVID-19 patients.



Section 9: Contract Forms

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Notice of Intention for Award of Contract

[on letterhead paper of the Employer]

[date of notification]

To: [name of the Bidder]
 Attention: [insert name of the Bidder's authorized representative]
 Address: [insert address of the Bidder's authorized representative]
 Telephone/Fax numbers: [insert telephone/fax numbers of the Bidder's authorized representative]
 E-mail Address: [insert e-mail address of the Bidder's authorized representative]

This is to notify you of our intention to award the contract [insert name of the contract and identification number, as given in the Bid Data Sheet]. You have [insert number of days as specified in ITB 41.1 of the BDS] days from the date of this notification to (i) request for a debriefing in relation to the evaluation of your Bid; and/or (ii) submit a bidding-related complaint in relation to the intention for award of contract, in accordance with the procedures specified in ITB 46.1.

The summary of the evaluation are as follows:

1. List of Bidders

Name of Bidder	Bid Price as Read Out at Opening	Evaluated Bid Price

2. Reason/s Why Your Bid Was Unsuccessful

.....

3. The Successful Bidder

Name of Bidder:	
Address:	
Accepted Contract Amount:	
Duration of Contract:	
Scope of the Contract Awarded:	
Amount Performance Security Required:	

Authorized Signature:

Name and Title of Signatory:

Name of Agency:

Letter of Acceptance

[on letterhead paper of the Employer]

[date]

To: *[Name and address of the contractor]*

Subject: Contract No. *[please specify]*

This is to notify you that your Bid dated *[date]* for execution of the *[name of the contract and identification number, as given in the Bid Data Sheet]* for the Accepted Contract Amount of the equivalent of *[amount in words and figures and name of currency]*, as corrected and modified in accordance with the Instructions to Bidders is hereby accepted by our Agency.

You are requested to furnish the Performance Security within 28 days in accordance with the Conditions of Contract and any additional security required as a result of the evaluation of your bid, using for that purpose the Performance Security Form included in Section 9 (Contract Forms) of the Bidding Document.

[Choose one of the following statements:]

We accept that *[insert the name of adjudicator proposed by the Bidder]* be appointed as the Adjudicator.

[or]

We do not accept that *[insert the name of the adjudicator proposed by the Bidder]* be appointed as the Adjudicator, and by sending a copy of this Letter of Acceptance to *[insert name of the appointing authority]*, the Appointing Authority, we are hereby requesting such Authority to appoint the Adjudicator in accordance with GCC 29.1.

Authorized Signature:

Name and Title of Signatory:

Name of Agency:

Attachment: Contract Agreement

Contract Agreement

THIS AGREEMENT made the [date] day of [month], [year], between [name of the Employer] (hereinafter "the Employer"), of the one part, and [name of the contractor] (hereinafter "the Contractor"), of the other part:

WHEREAS the Employer desires that the Works known as [name of the contract] should be executed by the Contractor, and has accepted a Bid by the Contractor for the execution and completion of these Works and the remedying of any defects therein,

The Employer and the Contractor agree as follows:

1. In this Agreement, words and expressions shall have the same meanings as are respectively assigned to them in the Contract documents referred to.
2. The following documents shall be deemed to form and be read and construed as part of this Agreement. This Agreement shall prevail over all other Contract documents.
 - (a) Letter of Acceptance,
 - (b) Letters of Technical Bid and Price Bid,
 - (c) Addenda Nos. [insert addenda number if any]⁴
 - (d) Particular Conditions of Contract,
 - (e) List of Eligible Countries that was specified in Section 5 of the bidding document,
 - (f) General Conditions of Contract,
 - (g) Specifications,
 - (h) Drawings,
 - (i) Completed Activity Schedules or Bill of Quantities, and
 - (j) any other documents shall be added here.⁵
3. In consideration of the payments to be made by the Employer to the Contractor as indicated in this Agreement, the Contractor hereby covenants with the Employer to execute the Works and to remedy defects therein in conformity in all respects with the provisions of the Contract.
4. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

⁴ Information contained in the addenda and or addendum should preferably be included in the contract documents to avoid potential ambiguities during contract implementation. If however, unavoidable priority should be decided depending on the nature of information provided in the addenda/addendum.

⁵ Tables of Adjustment Data may be added if the contract provides for price adjustment (see GCC 54.1).

IN WITNESS whereof the parties hereto have caused this Agreement to be executed in accordance with the laws of [*name of the borrowing country*] on the day, month and year indicated above.

Signed by
for and on behalf of the Employer

Signed by
for and on behalf the Contractor

in the presence of:

in the presence of:

Witness, Name, Signature, Address, Date
Date

Witness, Name, Signature, Address,

Performance Security

[Bank's name, and address of issuing branch or office]

Beneficiary: [Name and address of the Employer]

Date:

Performance Guarantee No.:

We have been informed that [name of the contractor] (hereinafter called "the Contractor") has entered into Contract No. [reference number of the contract] dated [date] with you, for the execution of [name of contract and brief description of works] (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, a performance guarantee is required.

At the request of the Contractor, we [name of the bank] hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of [name of the currency and amount in words]⁶ [amount in figures] such sum being payable in the types and proportions of currencies in which the Contract Price is payable, upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation(s) under the Contract, without your needing to prove or to show grounds for your demand or the sum specified therein.

This guarantee shall expire, no later than the [date] day of [month], [year]⁷, and any demand for payment under it must be received by us at this office on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG) 2010

Revisions, ICC Publication No. 758, except that the supporting statement under Article 15(a) is hereby excluded.⁸

.....
[Signature(s) and seal of bank (where appropriate)]

-- Note to Bidder --

- ⁶ The guarantor shall insert an amount representing the percentage of the contract price specified in the contract and denominated either in the currency(ies) of the contract or in any freely convertible currency acceptable to the Employer. If the bank issuing the performance security is located outside the country of the employer, it shall have a correspondent financial institution located in the country of the Employer.
- ⁷ Insert the date 28 days after the defect liability period. The Employer should note that in the event of an extension of the time for completion of the contract, the employer would need to request an extension of this guarantee from the guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee. In preparing this guarantee, the employer might consider adding the following text to the form, at the end of the penultimate paragraph: "The Guarantor agrees to a one-time extension of this guarantee for a period not to exceed [6 months][1 year], in response to the Employer's written request for such extension, such request to be presented to the Guarantor before the expiry of the guarantee."
- ⁸ Or the employer may use "Uniform Rules for Demand Guarantees (URDG), ICC Publication No. 458, except that subparagraph (ii) of Sub-article 20(a) is hereby excluded" as appropriate.

If the bank issuing performance security is located outside the Employer's country, it shall be counter-guaranteed or encashable by a bank in the Employer's country.

Advance Payment Security

[Bank's name, and address of issuing branch or office]

Beneficiary: [Name and address of the Employer]

Date:

Advance Payment Guarantee No.:

We have been informed that [name of the contractor] (hereinafter called "the Contractor") has entered into Contract No. [reference number of the contract] dated [date] with you, for the execution of [name of contract and brief description of works] (hereinafter called "the Contract").

Furthermore, we understand that, according to the Conditions of the Contract, an advance payment in the sum [name of the currency and amount in words]⁹ [amount in figures] is to be made against an advance payment guarantee.

At the request of the Contractor, we [name of the bank] hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of [name of the currency and amount in words]¹⁰ [amount in figures] upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation under the Contract because the Contractor:

- (a) used the advance payment for purposes other than the costs of mobilization and cash flow support in respect of the Works; or
- (b) has failed to repay the advance payment when it has become due and payable in accordance with the conditions of the Contract, specifying the amount payable by the Contractor.

It is a condition for any claim and payment under this guarantee to be made that the advance payment referred to above must have been received by the Contractor on its account number [contractor's account number] at [name and address of the bank].

The maximum amount of this guarantee shall be progressively reduced by the amount of the advance payment repaid by the Contractor as indicated in copies of interim statements or payment certificates which shall be presented to us. This guarantee shall expire, at the latest, upon our receipt of a copy of the interim payment certificate indicating that eighty percent (80%) of the Contract Price has been certified for payment, or on the [date] day of [month], [year]¹¹, whichever is earlier. Consequently, any demand for payment under this guarantee must be received by us at this office on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG) 2010 Revisions, ICC Publication No. 758, except that the supporting statement under Article 15(a) is hereby excluded.¹²

⁹ The guarantor shall insert an amount representing the amount of the advance payment denominated either in the currency(ies) of the advance payment as specified in the Contract, or in any freely convertible currency acceptable to the Employer.

¹⁰ Footnote 1.

¹¹ Insert the expected expiration date of the time for completion. The Employer should note that in the event of an extension of the time for completion of the contract, the Employer would need to request an extension of this guarantee from the guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee. In preparing this guarantee, the Employer might consider adding the following text to the form, at the end of the penultimate paragraph: "The Guarantor agrees to a one-time extension of this guarantee for a period not to exceed [6 months] [1 year], in response to the Employer's written request for such extension, such request to be presented to the Guarantor before the expiry of the guarantee."

¹² Or the employer may use "Uniform Rules for Demand Guarantees (URDG), ICC Publication No. 458, except that subparagraph (ii) of Sub-article 20(a) is hereby excluded" as appropriate.

.....
[Signature(s) and seal of bank (where appropriate)]

-- Note to Bidder --

If the bank issuing advance payment security is located outside the Employer's country, it shall be counter-guaranteed or encashable by a bank in the Employer's country.