KHORLOCHHU HYDRO POWER LIMITED

4x150MW KHORLOCHHU HYDROPOWER PROJECT

TRASHIYANGTSE: BHUTAN

BIDDING DOCUMENT

FOR

CONTRACT PACKAGE: KHM

DESIGN, MANUFACTURING, SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF HYDRO-MECHANICAL WORKS

VOLUME - 1

INSTRUCTIONS TO BIDDERS (ITB)

International Competitive Bidding

These documents are meant for the exclusive purpose of bidding against this NIT and shall not be transferred, reproduced or otherwise used for purposes other than that for which they are specifically issued.

Tender Ref. No. KHPL/C&PD/TENDER:KHM/2025/11534 dt. 07.08.2025

LAYOUT OF BIDDING DOCUMENTS

CONTRACT PACKAGE: KHM

Design, Manufacturing, Supply, Installation, Testing and Commissioning of Hydro-Mechanical Works

Volume - 1: Instructions to Bidders (ITB)

- Section - 1 Abridged Notice Inviting Tender and Notice Inviting Tender (NIT)
- Section - 2 Instructions to Bidders (ITB), Bid Data Sheet, Qualification Forms, Information for Bidders (IFB) and Work Schedule

Volume - 2: General Conditions of Contract (GCC) and Particular Conditions of Contract (PCC)

- Section - 3 General Conditions of Contract (FIDIC) for Plant and Design-Build Contract 2nd Edition (2017 Yellow Book).
- Section - 4 Particular Conditions of Contract
  - Part A: Contract Data
  - Part B: Special Provisions
  - Appendix to Tender
- Section - 5 Forms and Procedures
  - Form-1: Letter of Tender
  - Form-2: Form of Agreement
  - Form-3: Performance Security Form
  - Form-4: Bank Guarantee Form for Advance Payment
  - Form-5: Form of Taking Over Certificate
  - Form-6: Hindrance Register
  - Form-7: Dispute Adjudication Agreement

Volume-3: Price Schedules

Volume-4: Employer's Requirements

- Section - 6 General Technical Specification (GTS)
- Section - 7 Particular Technical Specification (PTS)
- Section - 8 Quality Assurance Plan (QAP)
- Section - 9 Technical Data Sheets

Volume-5: Tender Drawings

Volume-6: Data Sheets



TABLE OF CONTENTS

ABRIDGED NOTICE INVITING TENDER 3
NOTICE INVITING TENDER 4
INSTRUCTIONS TO BIDDERS (ITB) 6
A. General 6
1. Scope of Bid 6
2. Source of Funds 6
3. Eligible Bidders 6
4. Eligible Materials, Plant, Supplies, Equipment and Services 7
5. Qualification of the Bidder 7
6. Nature of Bidders 12
7. Cost of Bidding 13
8. Site Visit 13
B. Bid Documents 14
9. Content of Bid Documents 14
10. Clarification of Bid Documents 15
11. Amendment to Bid Documents 15
C. Preparation of Bids 16
12. Language of Bid 16
13. Documents Comprising the Bid 16
14. Letter of Tender and Price Schedule 17
15. Bid Price 17
16. Currencies of Bid and Payment 17
17. Bid Validity 17
18. Bid Security 18
19. Pre-Bid Meeting 18
20. Format and Signing of Bid 19
D. Submission of Bids 19
21. Preparation and Submission of Bids 19
22. Deadline for Submission of Bids 21
23. Late Bids 21
24. Modification, Substitution and Withdrawal of Bids 21
E.Bid Opening and Evaluation 21
25. Bid Opening 21
26. Process to be Confidential 22
27. Clarification of Bids 22
28. Examination of Bids and Determination of Responsiveness 22
29. Evaluation and Comparison of Bids 23
F. Award of Contract 24
30. Award 24
31. Employer's right to accept any Bid and to reject any or all Bids 24

Khorlochhu Hydro Power Ltd.

32. Notification of Award 24
33. Signing of Agreement 24
34. Performance Security 24
35. Corrupt or Fraudulent Practices 25
ANNEXURE - A 27
Technical Evaluation: 27
BID DATA SHEET 28
QUALIFICATION FORMS 30
APPLICATION FORM – 1 31
General Information 31
APPLICATION FORM – 2 32
Financial Data 32
APPLICATION FORM – 3 33
General Experience 33
APPLICATION FORM - 4 34
Specific Experience 34
SUMMARY OF FULFILMENT OF TECHNICAL CRITERIA 36
APPLICATION FORM - 5 37
Current Contract Commitments/Works in Progress 37
APPLICATION FORM - 6 38
Calculations of Bid Capacity 38
APPLICATION FORM – 7 39
Litigation History 39
INFORMATION FOR BIDDERS (IFB) 40
CONSTRUCTION SCHEDULE 52

ABRIDGED NOTICE INVITING TENDER

Ref. No.: KHPL/C&PD/TENDER:KHM/2025/11534 August 07, 2025

Khorlochhu Hydro Power Limited (KHPL) invites sealed bids through International Competitive Bidding Process from an experienced, reputed, competent and financially sound Bhutanese/Indian Bidders registered in Bhutan/India and meeting the minimum qualification criteria for the works as mentioned below for **4x150MW Khorlochhu Hydropower Project** located under Trashiyangtse Dzongkhag, Bhutan, as follows:

Contract Package No.	Description of Work	Bid Security Amount (BTN/INR)	Time for Completion (in Months)
KEM-1	Design, Manufacturing, Supply, Installation, Testing and Commissioning of **Electro-Mechanical Works** of 4x150MW Khorlochhu Hydropower Project.	180.00 million	**42 Months**
KHM	Design, Manufacturing, Supply, Installation, Testing and Commissioning of **Hydro-Mechanical Works** of 4x150MW Khorlochhu Hydropower Project.	90.00 million	**42 Months**

The complete set of Bidding Document can be downloaded from following websites www.khpl.bt and www.drukgreen.bt. Amendment(s), if any, shall be issued by KHPL in the above websites only.

The Bidding Documents shall be made available from **August 08, 2025, till October 17, 2025**, and it can be downloaded from the above websites (free of cost) during the period. However, the Bidders should register with KHPL before the deadline for submission of Bids.

KHPL reserves the right to cancel or annul the whole bidding process without assigning any reasons thereof. For further queries, kindly contact KHPL at Mobile No. 17289767/17625818, during office hours only.

General Manager,
Contracts & Procurement Division,
Khorlochhu Hydro Power Limited,
Post Box No. 46002
Doksum New Township, Trashiyangtse, Bhutan
Email: gm.cnp@khpl.bt



NOTICE INVITING TENDER

Ref No.: KHPL/C&PD/TENDER:KHM/2025/11534 Dated: August 07, 2025

1. Khorlochhu Hydro Power Project (KHPL) invites sealed Bids from eligible Bidders through Single-Stage Process Two Envelope Method meeting the qualification requirements for procurement of "Contract Package KHM: Design, Manufacturing, Supply, Installation, Testing and Commissioning of Hydro-Mechanical Works" as per the scope of works mentioned hereinafter.

2. The scope of work comprises the design, manufacturing, supply, installation, testing and commissioning of Hydro-Mechanical Works including steel liners of 4 x 150MW Khorlochhu Hydropower Project.

3. Detailed specifications, scope of works and terms & conditions are provided in the Bidding Documents, which are available as per the following schedule:

NIT No.	:	KHPL/C&PD/TENDER:KHM/2025/11534 dated 07.08.2025
Bidding Document availability date	:	From August 08, 2025 to October 17, 2025
Bid Receipt date and time Place	: :	Up to October 17, 2025 by 10:30 AM (BST) Corporate Office, KHPL, Doksum New Township, Trashiyangtse
Pre-Bid Meeting, Date and Time Place	: :	From September 09 - 11, 2025. Corporate Office, KHPL, Doksum New Township, Trashiyangtse
Bid Opening Date and Time Place	: :	October 17, 2025 at 11:30 AM (BST) Corporate Office, KHPL, Doksum New Township, Trashiyangtse

4. Bidding Documents shall be downloaded from the websites www.khpl.bt or www.drukgreen.bt (free of cost). Bidders downloading the documents from the website should register themselves by informing the nodal officer of KHPL immediately after the documents are downloaded, or before the deadline for submission of Bid and their intention to submit the Bid.

5. Downloading of Bidding Documents shall not automatically construe that the Bidder fulfils the Qualifying Requirements which shall be determined during Bid evaluation based on data/documents submitted by the Bidder. Bids shall be submitted at the address given below and shall be opened in the presence of Bidder's representatives who choose to attend.

6. All Bids must be accompanied by Bid Security for an amount of **BTN/INR 90.00 million (Bhutanese Ngultrum/India Rupees Ninety Million)** only, in the form of Demand Draft /Cash Warrant/Bank Guarantee, issued by any Financial Institutions of Bhutan or any foreign bank acceptable and enforceable by any financial institution of Bhutan and shall remain valid till May 15, 2026. Bids not accompanied with an acceptable Bid Security as specified in the Bidding Documents or Bids accompanied with Bid Security of inadequate value and validity shall be rejected by KHPL and in such cases Bids shall be returned to the Bidders.

7. Qualification Requirement for Bidders shall be as specified in the BDS.

8. The Bidder shall be a single entity for participation in the tendering for this Project. Detail of the nature of Bidder are specified in the Bidding Documents. The Bidders not having requisite specific experience can associate Sub-contractor(s) for specified activities in which he does not have relevant experience. The proposed Sub-Contractor(s) shall individually meet at least one or more of the Specific Experience.

9. Bidders must submit the copies of

(i) latest Tax Clearance Certificate & Trade License & CDB Registration Certificate (for Bhutanese Bidders);

(ii) Certificate of Incorporation in case of companies or any other certificate as an evidence of being a legal entity (for International Bidders) and

(iii) Signed Integrity Pact statement as per the format provided in the Bidding Documents along with their Bid.

10. The Bidders shall be required to attain the Completion of Works within the time for completion as specified in the SCC.

11. The Employer reserves the right to accept or reject any or all Bids without assigning any reasons thereof and in such case no Bidder shall have any claim arising out of such action of the Employer.

12. The address for communication is:

General Manager,
Contracts & Procurement Division,
Khorlochhu Hydro Power Limited
Postal Code No. 46002,
Doksum New Township, Trashiyangtse, Bhutan
Email: gm.cnp@khpl.bt Website: www.khpl.bt

INSTRUCTIONS TO BIDDERS (ITB)

A. General

1. Scope of Bid

1.1 The Khorlochhu Hydro Power Limited (KHPL), having its registered office at Trashiyangtse, Bhutan, hereinafter referred to as "the Employer", invites bids for the Hydro-Mechanical Works Contract Package KHM, as described in this Bidding Documents and summarized in the Bid Data, hereinafter referred to as "the Works"

1.2 The successful bidder will be required to complete the 'Works' within the period stated in the 'Bid Data' and 'Particular Conditions of Contract' effective from the Commencement Date.

1.3 Throughout these Bidding Documents, the terms bid and tender and their derivatives (bidder/tenderer, bid/tender, bidding/tendering etc.) are synonymous; day means calendar day; singular also means plural, unless these are repugnant to the context.

2. Source of Funds

2.1 The Project financing will be done through 30% equity contribution by Shareholders through a strategic partnership between Druk Green Power Corporation (DGPC), Bhutan and The Tata Power Company Limited (TPC), India in the ratio of 60:40. The 70% debt portion will be raised through a debt financing from Power Finance Corporation Limited (PFC), India.

3. Eligible Bidders

3.1 This invitation to bid is open to all experienced, reputed, competent and financially sound Indian and Bhutanese Contractors who meet the Qualification Criteria as per ITB Clause-5 [Qualification of the Bidder] hereunder.

3.2 Bidders should not have been under the status of banned/ de-listed/ blacklisted/ debarred from business by the Employer or any Government institution or public sector enterprise or any Government, as on the time of bid submission deadline. A declaration to this effect shall be submitted under **Attachment-3 of Form-1: Letter of Tender appended under Section-5 of Volume 2**.

3.3 The Integrity Pact, signed by all the prospective Bidders and the Employer, shall commit the persons/officials of both the parties, not to exercise any corrupt/ fraudulent/ collusive/ coercive practices in the tendering process and also during implementation of the Contract. Only those bidders who have entered into Integrity Pact with the Employer shall be eligible to participate in the bidding process. Entering into Integrity Pact, as per **Attachment-5 under Section- 5: Forms and Procedures, Volume 2** of Bidding Documents is a basic qualifying requirement.

The form of Integrity Pact included in the Bidding Documents, duly signed by authority by authorized representative of Employer at the time of issue of Bidding Documents, shall be signed by the Bidder while submitting the bid. Signing authorities will be the representative of Bidder authorized to sign the bid and the authorized representative of the Employer.

The successful Bidder shall submit duly executed Integrity Pact on Legal stamp of the Royal Government of Bhutan (RGoB) of appropriate value prior to signing of Contract Agreement.

3.4 Bidders do not and will not appoint Local agents in Bhutan. A declaration to this effect shall be submitted under **Attachment-3 of Form-1, Letter of Tender appended under Section-5 of Volume 2**.

4. Eligible Materials, Plant, Supplies, Equipment and Services

4.1 The materials, Plant or Contractor's Equipment, other supplies, and services to be provided under the contract, shall have their origin in eligible source countries, defined under the Bidding Document and all expenditures made under the contract will be limited to such materials, Plant or Contractor's Equipment, other supplies, and services.

4.2 For purposes of Sub-Clause 4.1 above, origin means the place where the materials, plant, equipment, and other supplies are mined, grown, produced, or manufactured, and from which the services are supplied.

5. Qualification of the Bidder

5.1 Bidders shall, as part of their bid:

a) Submit a written Power of Attorney (PoA) authorizing the signatory of the bid to commit the bidder;

i) In case of a General Power of Attorney, a true copy of the POA shall be duly notarized by Notary Public along with a declaration from the Company Secretary/Corporate Secretary endorsing the validity of the Power of Attorney.

ii) In case of a specific Power of Attorney (as per format included in forms & procedures), the original POA along with a copy of the resolution of Board of Directors for the specific appointment. In case of delegation by a General POA holder, the documents as sought under i) above shall be submitted along with the original specific POA.

b) Submit/include in their bids the following information/documents:

i) work commitments;

ii) availability of key personnel; and

iii) availability of major Contractor's Equipment

c) Each Bidder shall duly fill in the prescribed Data Sheets/ qualification particulars along with relevant experience certificates, Annual Reports and other information evidencing proof of their meeting the qualification criteria stipulated herein.

d) Submit an offer which is clear, comprehensive, unambiguous and complete in all respects including all necessary technical, contractual and commercial information.

e) Submit a Declaration, as per Proforma given in **Attachment-3, of Form-1; Letter of Tender appended under Section-5 of Volume 2** confirming that the bid submitted by the bidder is strictly in conformity with the documents issued by the Employer.

f) The payments against the Contract shall be made through Escrow account only.

5.2 Bids by Merged/Acquired/Subsidiary Company shall comply with the following minimum requirements:

i) Commitment by the parent/holding company to sign a separate agreement with Employer (as per format contained in **Attachment-6 of Form-1, Letter of Tender appended under Section-5 of Volume 2** confirming full support for the technical and financial requirements of the subsidiary company and commit to take up the work itself in case of non-performance by the subsidiary company in the event of award of the work to the subsidiary company.

ii) Parent/holding company shall submit an undertaking along with the bid as per format contained in **Attachment-5 of Form-1, Letter of Tender appended under Section-6 of Volume 2** that in case Bidding Company(Subsidiary Company)gets qualified and awarded the work package on the strength of Parent/holding Company, Parent/holding company shall furnish an additional performance bank guarantee of value equivalent to (5%) five percent of the Accepted Contract Amount or the portion of work (where the

Khorlochhu Hydro Power Ltd.

subsidiary company is Joint Venture Partner) as the case may be, in addition to normal Performance Bank Guarantee to be submitted by the Bidder to the Employer besides entering into a separate Agreement (**as per Form-9 or Form-10 appended under Section-5 of Volume 2)**, as applicable.

5.3 Bids submitted by a Bidder with Sub-contractor(s), shall comply with the following minimum requirements:

i) The Bidder and Sub-contractor(s) should submit separate undertakings (as per Form-10 appended under Section-5 of Volume 2) that the Bidder and Sub-contractor(s) shall be responsible for execution of that items of the work for which they claim to have specific experience.

ii) In order to ensure serious participation of the Sub-contractor(s) for work proposed to be executed by the Sub-contractor(s), a Joint Deed of Undertaking (as per Form-10 appended under Section-5 of Volume 2) shall be required to be submitted by the Bidder and Sub-contractor(s). Besides this, Sub-contractor(s)/Manufacturer(s) shall submit an additional Performance Bank Guarantee equivalent to 5% (five percent) of corresponding value of work sublet in addition to Performance Bank Guarantee for whole Contract submitted by the bidder on award of work.

5.4 The minimum qualifying requirement for the eligible bidders is as under:

a. Technical Criteria

i) General Experience

Experience as a prime Contractor having successfully completed at least one Hydro-Mechanical work in a hydropower project on EPC/turnkey basis of Contract Value not less than **BTN/INR 3,000.00 million** (Ngultrum/Rupees Three Thousand Million only), with minimum installed capacity of 400 MW in preceding twenty (20) years (start to finish) reckoned up to 28 days prior to bid submission deadline and which are in successful operation for at least two (2) years without any major operational issues reckoned from the taking over of the works.

To determine the value of work done by the Contractor during the last 20 years it shall be escalated at the rate of 5%, compounded annually.

ii) Specific Experience

Must have successfully carried out design, manufacturing, supply, erection and commissioning of the following Hydro-Mechanical works in hydropower projects in preceding twenty (20) years (start to finish) reckoned up to 28 days prior to bid submission deadline and which are in successful operation for at least two (2) years reckoned from the taking over of the works.

a) Radial Gates (Submerged/Crest) operated by Hydraulic Hoist

Successful experience, either by bidder itself or an unconditional undertaking from the proposed Sub-Contractor(s) authorizing the bidder to use their work completion certificate(s) of:

- Design, manufacturing, installation, testing & commissioning of Submerged/ Crest type Radial Gates (having breast wall at top of gate) operated by Hydraulic Hoists having A x H $\geq$ 3030.00 m^2 x m, and H $\geq$ 35.00 m in last 20 years (from start to finish).

The above experience can be from different projects.

b) Vertical Lift Gates (Fixed Wheel/Slide type)

Successful experience, either by the bidder itself or an unconditional undertaking from the proposed Sub-Contractor(s) authorizing the bidder to use their work completion certificate(s) of:

- Design, manufacturing, installation, testing & commissioning of Vertical Lift Gates having A x H ≥ 1330 m^2 x m and H ≥ 100 m operated by Hydraulic Hoists or Rope Drum Hoist or Gantry Crane in last 20 years (from start to finish)

The above experience can be from different projects.

c) Steel Liner for Pressure Shaft/Penstock

Successful experience, either by the bidder itself or an unconditional undertaking from the proposed Sub-Contractor(s) authorizing the bidder to use their work completion certificate(s) of:

- Fabrication, erection, testing & commissioning of Steel liner for Pressure Shaft Liner having a value of D x H ≥ 1520 m x m, D ≥ 3.3m
- Thickness of pressure shaft liner up to 40 mm thickness

The above experience can be from different projects.

Where;

"A" denotes an area (clear width by clear height) of one gate in m^2;

"Clear Width" denotes the distance between inner faces of two opposite sides.

"Clear Height" denotes the vertical height between the sill to center line of top seal.

"H" (for gates) denotes the normal design head at the bottom of the gate in meter;

"D" denotes the maximum inside diameter in meter of the steel liner;

"H" (for steel liner) denotes the maximum design head in meter.

The bidder shall provide a notarized copy of the Completion Certificate indicating successful completion of the scope of works. In addition, corresponding to the Work Completion Certificate of at least one EM Works in Hydropower Projects under the General Experience, the bidder should also submit Performance Certificate issued by the Employer/Client that the EM components has been in successful operation without any major operational issues for last two years reckoned from the taking over of the Works.

b. Financial Experience

i) **Net-worth** of the Bidder for Financial Year immediately preceding the date of bid opening shall be equal to or more than **BTN/INR 1,100.00 million**.

Net worth for this purpose shall be defined as:

= Paid up share capital
Add: Reserves net of losses
Subtract: Revaluation reserves
Subtract: Intangible Assets
Subtract: Miscellaneous expenditures to the extent not written off]

Net-worth of the Bidder shall be based on the audited accounts.

ii) **Average Annual Turnover** for the last 5 (Five) Financial Years immediately preceding the last date of Bid submission shall be equal to **BTN/INR 5,500.00 million** only.

iii) The Bidder must have a minimum credit facility of **BTN/INR 1,800.00 million**, in any one of the following:

- BG Limits
- LC Limits
- Overdraft/Cash Credit Limits

c. Bid Capacity

The available bid capacity of the bidder as of 28 days prior to deadline for bid submission date, calculated as under, should not be less than the estimated cost of the contract package.

Available Bid Capacity = 2.0 x A x N – B, where:

A = Maximum value of works executed in any one year during last five years (updated to the current price level i.e. 28 days prior to deadline for bid submission date by adding 5% per year, compounded annually) for construction works completed/under execution.

N = number of years prescribed for completion of the contract package under consideration/bidding.

B = value at current price level of existing commitments and ongoing works to be completed in the next 'N' year

Bidders to furnish details for ascertaining Bid Capacity under **APPLICATION FORM-5 under Section 2 of Volume 1** of Bidding Document.

Notes for Technical Criteria:

1. *For both General Experience and Specific Work Experience requirements, during the past 20 years shall mean start to finish of the work in the preceding 20 years. The beginning and end date shall fall within the preceding 20 years reckoned 28 days prior to bid submission deadline.*
2. *For evaluation of specific experience of Bidder, following criteria shall be considered:*

   i) The evaluation of Bidder's specific experience for a work executed on JV basis shall be based on his role and scope of work in such joint ventures. To establish his role and scope of work in such joint venture contracts, the Bidder shall adduce documentary evidence to the extent of his claimed experience. In case the quantum of work as per experience certificate does not match with the scope of work as defined in the JV Agreement, the experience credentials shall be considered as per the experience certificate issued by the Employer/Client.

   ii) In case the specific work experience certificate has been issued in the individual name of the JV partner, the work executed by the Bidder shall be considered.

   iii) In case scope of work of individual partners is not clearly defined in the JV agreement, then credentials of Bidders being partner in a JV shall be decided in the following manner:

      a) Where specific experience certificate in respect of individual JV partner is available, the same shall be considered to the extent of work executed by such JV partner.

      b) Where specific experience certificate is not available, or experience certificate is issued in the name of JV, the evaluation shall be done in the following manner:

i. *In case the participation/profit sharing percentage of Bidders as per JV agreement is at least 35%, full credit of the work executed by the JV shall be given to such Bidders.*

ii. *In case the participation/profit sharing percentage of Bidders in JV agreement is less than 35%, no credit of work executed under JV shall be given to such Bidders.*

iii. *Notwithstanding i) and ii) above, in case of availability of specific experience certificate, a) above shall apply.*

iv) *In case both participations share and profit-sharing ratio are available in the JV Agreement, participation share shall prevail.*

3. *The word **"successfully executed/completed/carried out"** means the bidder should have completed the specified parameter mentioned above even if the entire work of the contract is not completed .*

4. *The word **"major operational issues"** shall mean failure of the Generating Unit arising from defects in design and/or workmanship, which resulted in the Unit being in a continuous breakdown condition for a period of thirty (30) consecutive calendar days or more.*

5. *All qualifying works can be from the same project or different projects.*

Notes for financial criteria:

1. *The Net-worth shall be calculated based on subscribed and paid-up Share Capital plus Share Premium plus Free Reserve plus Unallocated balance/surplus amount of Profit & Loss Accounts less (a) Expenses not written off and (b) Accumulated Loss in Profit & Loss Accounts if not reduced from Reserve & Surplus. The revaluation reserves, capital reserves and amount of intangible assets like goodwill etc. will not be taken into account while calculating Net Worth.*
2. *Income other than related business shall not be considered for arriving at the Average Annual Turnover.*
3. *The Bidder's financial evaluation vis a vis the requirement as stipulated above shall be done on the basis of duly Audited Annual Report for the immediately preceding 5 (five) years submitted by the Bidder along with the Bid. Further, standalone audited Annual Financial Statement of the Bidder shall be forming part of the Annual Report.*
4. *In case where Audited financial results for the immediately preceding year are not available, then a statement of account as on the closing date of the immediately preceding financial year depicting the Turnover, working capital and Net Worth (calculated as per laid down criteria) duly certified by their Statutory Auditor/ Certified Public Accountant carrying out the statutory audit shall be enclosed with the Bid along with copy of appointment letter of the Statutory Auditor.*
5. *Wherever, the Annual Report duly notarized copies of Audited Annual Financial Statement are in language other than English, then copy duly translated in English language and certified by approved/ recognized English translator shall be submitted with the Bid.*
6. *In addition to above wherever audited Annual Financial Statement contain turnover pertaining to other activities besides related business turnover of Bidder and breakup of related business turnover is not directly available from such financial statements, then statement of account depicting the related business turnover for that year duly certified by their Statutory Auditor shall also be enclosed with the Bid.*

Khorlochhu Hydro Power Ltd.

7. *For the purpose of compliance to the stipulated turnover criteria given at Financial Criteria, the turnover from Joint Ventures(s) as declared in the Joint Venture Agreement shall also be considered.*
8. *The proportionate JV Turnover shall be certified by their statutory Auditor in the absence of the same not appearing separately/distinguished item in Audited Financial Statement.*
9. *The aggregate of cash flow as depicted from audited balance sheet shall be considered for the purpose of calculating Cash flow. Current assets and current liabilities will be considered as classified in the audited balance sheet for the year immediately preceding the date of opening of Bids. In case current assets and/or current liabilities are not classified separately in audited Balance Sheet, a certificate from Statutory Auditor/CPA carrying out the Statutory Audit, for current assets and/or current liabilities, as the case may be, clearly defining the items considered for the same, should be enclosed. However, trade payables shall be a part of current liabilities. The statement displaying Cash Credit limits shall not be more than three months old as on the last date for submission of Bids.*
10. *The banking reference/letter of comfort issued to the bidder by the bank for providing working capital shall not be accepted and considered.*
11. *Sub-contractor(s)/Manufacturer(s) turnover shall not be considered.*

5.5 The Bidder shall also submit detailed proposals outlining bidders proposed methodology of manufacturing and erection backed with their Equipment planning and deployment, duly supported with broad calculations and quality control procedures proposed to be adopted, demonstrating their capability of achieving the completion of Works as per specified Interim Contract Milestones within the stipulated Time for Completion referred to in Appendix to Tender.

5.6 Litigation History

The bidder shall furnish disclosure in respect of past history of litigation for a period of 5 years. The litigation history shall comprise the contracts which are completed and also under execution at present.

6. Nature of Bidders

6.1 The Bidder should be a single entity for participating in the tendering for this Project or with Sub-contractor. Bids from subsidiary Company shall also be considered.

Attachment-7 of Form-1, Letter of Tender appended under Volume 2.

6.2 Bids by Merged/ Acquired/ Subsidiary Companies

In case of a Bidder's company formed after merger and/ or acquisition of other companies, past experience and other antecedents of the merged/ acquired companies will be considered for qualification of such Bidders Company provided such Bidders Company continues to own the requisite assets and resources of the merged/acquired companies needed for execution and successful implementation of the work packages put to tender.

Similarly, if the Bidder's Company is a subsidiary company and applies for qualification on the unconditional technical and financial strength of the Parent/ holding company, the same shall be considered provided the Parent/Holding company commits to sign a separate agreement with the Employer evincing full support for the technical and financial requirements of the subsidiary company and commits to take up the work itself in case of non-performance by the subsidiary company in the event of award of the work to subsidiary company. An undertaking by the Parent/Holding Company to this effect shall be accompanied by Board resolution passed to this effect & submitted along with the bid (in the format provided in the Bid Document).

In case Bidding Company (subsidiary company) gets qualified and awarded the work package, the Parent company/holding Company will be required to furnish an additional performance bank guarantee of value equivalent to (5%) five percent of the Accepted Contract Amount or portion of work (where subsidiary Company is Joint Venture partner) as the case may be, in addition to normal Performance Bank Guarantee to be submitted by the Bidder to the Employer besides entering into a separate Agreement in the requisite Format provided in the Bid Document. However, for fulfillment of financial criteria, financial evaluation vis-à-vis the requirement as stated above shall be done on the basis of consolidated printed annual report for the immediately preceding 5 (five) years of the Parent/Apex Parent company submitted by the bidder along with the bid.

6.3 Bids with Sub-Contractor(s)

In case the Bidder does not have all requisite specific experience, he can associate Sub-contractor(s) for specified activities which he does not have the relevant experience.

The criteria to be met by such Bidders shall be as follows:

(i) The bidder himself to fully meet the following:
- General experience criteria specified in para 5.4, a, i);
- Specific experience criteria specified in para 5.4, a, ii);
- All criteria mentioned under Financial Experience in para 5.4, b.; and
- Bid Capacity as mentioned in para 5.4, c.

(ii) The Bidders and his Sub-contractor(s)/manufacturer(s) should submit separate undertakings that the Applicant/Sub-contractor(s)/manufacturer(s) shall be responsible for execution of that item of work for which they claim to have specific experience.

(iii) Sub-contractor other than Design Consultant shall submit Performance Bank Guarantee equivalent to 5% of value of Work sublet in addition to the Performance Bank Guarantee for whole contract submitted by the Bidders on award of Work.

7. Cost of Bidding

7.1 The bidder shall bear all costs associated with the preparation and submission of its bid, and the Employer will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

8. Site Visit

8.1 The bidders in their own interest, should inspect and examine the site and its surroundings and satisfy themselves, before submitting their bid, in respect of the site conditions including but not restricted to the following which may influence or affect the Works or cost thereof under the Contract:

a. Site conditions including access to the Site, existing and required roads and other means of transport/ communication for use by them in connection with the Works;

b. Requirement and availability of land and other facilities, for their enabling works, colonies, stores and workshops, etc.;

c. Ground conditions including those bearing upon transportation, handling and storage of materials required for the work or obtained there from;

d. Source and extent of availability of suitable materials including water, etc. and labour (skilled and un-skilled), required for Works and laws and regulations governing their use and employment;

e. Geological, meteorological, topographical and other general features of the site and its surroundings as are pertaining to and needed for the performance of the Works;

Khorlochhu Hydro Power Ltd.

f. The type of Contractor's Equipment and facilities needed, preliminary to, for and in the performance of the Works; and

g. All other information pertaining to and needed for the Works including information as to the risks, contingencies and other circumstances which may influence or affect the work or the cost thereof under this Contract.

h. Environmental & social aspects.

i. All applicable taxes, duties, royalty, cess, octroi etc.

8.2 The bidders should note that information, if any, in regard to the site and local conditions, in these Bid Documents is indicative only and has been given merely to assist the bidders and is not exhaustive.

8.3 The bidders should note and keep in mind that the Employer shall bear no responsibility for former's lack of acquaintance of the Site and other conditions or any information relating thereto. The consequences of the lack of any knowledge, as aforesaid, on the part of the bidders shall be at their risk and cost and no charges or claims whatsoever consequent upon the lack of any information, knowledge or understanding shall be entertained or payable by the Employer.

8.4 The bidder and any of its personnel will be granted permission by the Employer to enter upon its premises and lands for the purpose of such visit, but only upon the express condition that the bidder, its personnel will release and indemnify the Employer and its personnel 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.

8.5 The bidders should note and bear in mind that the costs of visiting the Site shall be at the bidder's own expenses.

8.6 The site visit report shall form part of Attachment - 4, "Bidder's Appreciation of the Project" as per requirement of Sub-clause 13.2 of ITB.

B. Bid Documents

9. Content of Bid Documents

9.1 The Bid Documents are those stated below, and should be read in conjunction with any Addenda issued in accordance with Clause 11:

Volume – 1	Section – 1	Abridged Notice Inviting Tender and Notice Inviting Tender (NIT).
	Section – 2	Instructions to Bidders (ITB), Bid Data, Qualification Forms, Information for Bidders (IFB) and Construction Schedule.
Volume – 2	Section – 3	General Conditions of Contract (FIDIC) for Plant and Design-Build Contract for Electrical & Mechanical Plant and for Building & Engineering Works Designed by the Contractor **(FIDIC Yellow Book, 1st Edition 1999)**.
	Section - 4	Particular Conditions of Contract and Appendix to Tender

Khorlochhu Hydro Power Ltd.

	Section - 5	Forms & Procedure - Form-1: Letter of Tender - Form-2: Form of Contract Agreement - Form-3: Bank Guarantee Form for Performance Security - Form-4: Bank Guarantee Form for Advance Payment - Form-5: Form of Taking Over Certificate - Form-6: Bank Guarantee Form for Release of Retention Money - Form-7: Hindrance Register - Form-8: Dispute Adjudication Agreement - Form-9: Parent/Holding Company Agreement Form-10: Proforma for Joint Deed of Undertaking
Volume - 3		Price Schedules
Volume – 4	Section – 6 Section – 7 Section – 8	General Technical Specification (GTS) Particular Technical Specification (PTS) Model Quality Assurance Plan (QAP)
Volume - 5		Tender Drawings
Volume - 6		Technical Data Sheets

10. Clarification of Bid Documents

10.1 A prospective Bidder requiring any clarification on the Bid Documents may notify the Employer in writing at the address indicated in the Bid Data Sheet under clause 21.8(a). The Employer will respond to such requests by clarifying the same in the pre-bid meeting, which are received 7 days prior to pre-bid meeting. Any clarification requiring an amendment to the Bid Documents shall be issued as Addenda as per the Clause 11 [Amendment to Bid Documents]. The Employer shall not be obliged to respond to any request for clarification received later than the above period. Further, mere request for clarification from the Bidders shall not be a ground for seeking extension in the deadline for submission of bids. Employer's response (including an explanation of the query but not identification of its source) will be communicated in writing/e-mail to all the purchasers of Bid Document. The prospective bidders shall promptly acknowledge receipt thereof in writing.

11. Amendment to Bid Documents

11.1 At any time prior to the deadline for submission of Bids, the Employer may, for any reason, whether at its own initiative, or in response to a clarification requested by a prospective Bidder, amend the Bid Documents by issuing Addenda.

11.2 Any Addendum thus issued shall be part of the Bid Documents pursuant to Sub-Clause 9.1 and shall be communicated in writing/e-mail to all the purchasers of bid document. The prospective bidders shall promptly acknowledge receipt thereof in writing. The amendments to the Bid Documents will be binding on the bidders and it shall be construed that such amendment(s) to the Bid Documents have been taken into account by the Bidder in its bid.

11.3 To give prospective Bidders reasonable time in which to take an Addendum into account in preparing their Bids, the Employer shall extend as necessary the deadline for submission of Bids, in accordance with Clause 22 [Deadline for Submission of Bids].

C. Preparation of Bids

12. Language of Bid

12.1 The Bid, and all correspondence and documents related to the Bid exchanged by the bidder and the Employer shall be written in English. Supporting documents and printed literature furnished by the Bidder may be in another language provided they are accompanied with a certificate of the authorized translator certifying therein an accurate translation of the relevant passages in the above stated language, in which case, for the purposes of interpretation of the Bid, the translation shall prevail.

13. Documents Comprising the Bid

13.1 The Bid submitted by the Bidder shall comprise the following documents:

a. Letter of Tender duly completed and signed by the Bidder, together with all Attachments identified in Sub-Clause 13.2 below.
b. Data related to Qualifying requirements (including Qualification Forms and Data Sheets).
c. Price schedule duly completed by the Bidder.

13.2 Each Bidder shall submit with Letter of Tender, the following attachments:

a. Attachment - 1: Bid Security

A bid security furnished in accordance with Clause 18.

b. Attachment - 2: Power of Attorney

A Power of Attorney, as per Sub-Clause 5.1 (a), indicating that the person(s) signing the Bid has the authority to sign the Bid and that the Bid is binding upon the Bidder during the full period of its validity in accordance with Clause 17.

c. Attachment - 3: Bidder's Eligibility and Qualifications

A declaration in respect of the submitted bid conforming to the requirement of Sub-Clause 5.1 (e).

d. Attachment - 4: Bidder's Appreciation of the Project

It should include a report on the site inspection, awareness and understanding of all the principal technical and logistic problems related to transportation and erection of the Contractor's Equipment and construction of Works. The site visit report shall form part of this Attachment.

e. Attachment - 5: Integrity Pact.

Integrity Pact Duly signed between Employer and the Bidder in accordance with Sub-Clause 3.3.

f. Attachment – 6: Undertaking by the Parent/ Holding company

The commitment by the Parent / Holding Company to sign a separate agreement with Employer for bids submitted by merged / acquired / subsidiary company and confirming full support for the technical and financial requirements of the subsidiary company (if applicable)

g. Attachment – 7: Undertaking by the Sub-contractor(s)

The commitment by the Sub-contractor to submit the Joint Deed of Undertaking in compliance to ITB Clause 5.4(ii) (if awarded the work).

h. Attachment-8: List of approved Sub-contractors/vendors and name of Sub-contractors/vendors proposed by the Bidder (if applicable).

i. All other bidding documents issued by KHPL except Price Schedule not covered above shall be duly stamped and signed on each page by the authorized signatory(ies) to the bid.

 # (Any other Attachment, if required, shall be attached with letter of Tender)

14. Letter of Tender and Price Schedule

14.1 The Bidders shall complete the Letter of Tender and the appropriate Price Schedule furnished in the Bid Documents as indicated therein and in the Sub-section "Letter of Tender" and Price Schedules" of the Bid Documents, following the requirements of Clauses 15 [Bid Price] and 16 [Currencies of Bid and Payment].

15. Bid Price

15.1 Unless stated otherwise in the Bid Documents, the Contract shall be for the whole Works as described in Sub-Clause 1.1, based on unit rates and prices quoted in the Price Schedules submitted by the bidders.

15.2 Bidders shall also include in their prices, cost of construction of infrastructural facilities not included in the Permanent Works and all temporary works as costs of performance and discharge of all obligations of the Bidders for the construction, execution and delivery of the works comprising the work packages.

15.3 The bidder shall fill in rates and prices for all items of the Works described in the Price Schedules. 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 Price Schedules. However, in case of major items not being quoted for, such bids shall be considered non-responsive and shall be liable for rejection, in which case the decision of Employer shall be final and binding.

15.4 All duties, taxes, royalty charges, outgoings and other levies applicable as on 28 days prior to bid due date shall be as described in clauses 7.8 & 14.1 of the PCC and all such costs related to taxes, duties, royalty charges and outgoings etc. shall be deemed to be the responsibility of the selected bidder and shall not be paid for by the Employer.

15.5 Unless otherwise provided in the Bid Data and Particular Conditions, the rates and prices are subject to adjustment during the performance of the contract in accordance with the relevant provisions of contract.

15.6 The Bidders may offer discount/rebate on percentage basis in "Letter of Tender" which shall be applied uniformly to all unit rates and lump sum amount of the Price Schedules. Any discount/rebate not offered in the form and manner prescribed here-in-above shall not be considered by the Employer for the purpose of evaluation.

15.7 The trade terms used in the Bidding Documents shall be governed by the rules prescribed in the current edition of incoterms, published by the International Chamber of Commerce.

16. Currencies of Bid and Payment

The currency(ies) of the bid shall be, as specified in the BDS. The unit rate and the price of each item given in the Price Schedules shall be quoted by Bidder, as stated in the Bid Data Sheet. The payment shall be made by the Employer in Bhutanese Ngultrum/Indian Rupee or Euro, as per Price Schedule.

17. Bid Validity

17.1 Bids shall remain valid for the period stipulated in the Bid Data from the Bid submission deadline.



17.2 In exceptional circumstances, prior to expiry of the original bid validity period, the Employer may request the bidders to extend the period of bid validity for a specified additional period. The request and the responses thereto shall be made in writing or by e-mail. A bidder may refuse the request without forfeiting its bid security. A bidder agreeing to the request will not be permitted to modify its bid, but will be required to extend the validity of its bid security for the period of the extension, and in compliance with Clause 18 [Bid Security] in all respects.

18. Bid Security

18.1 The bidder shall furnish, as part of its bid, a bid security for the amount and currency stipulated in the Bid Data.

18.2 The bid security shall be in the following manner:

a. An irrevocable unconditional bank guarantee issued by a bank/financial institution in Bhutan or any nationalized/scheduled bank in India with endorsement/counter guarantee by a bank/financial institution in Bhutan.

b. Bank Guarantees for the Bid Security shall be valid for a period of not less than 210 (two hundred and ten days from the Bid Submission deadline specified in Clause 25 [Bid Opening]. The Bid Security shall be made payable without any condition/demur 'on demand' to the Employer.

c. The format of the bank guarantee shall be in accordance with the form of bid security included in Attachment -1, Volume -2, Section - 5.

18.3 Any Bid not accompanied by an acceptable Bid Security and Letter of Tender together with its attachments shall be rejected by the Employer as non-responsive.

18.4 Save as provided in Clause below, the Bid Security of the unsuccessful Bidders will be discharged / returned as promptly as possible, but not later than 90 (ninety) days after the expiration of the Bid Validity Period or award of the Works whichever is earlier. No interest shall be payable on the amount of security.

18.5 The Bid Security of the successful Bidder will be returned when the Bidder has signed the Agreement and furnished the required performance security.

18.6 The Bid Security shall be forfeited if:

a. the Bidder withdraws its Bid or varies any terms & conditions in regard thereto during period of bid validity or;

b. in the case of a successful Bidder, if he fails within the specified time limit to;

i. sign the Agreement, or

ii. furnish the required performance security.

c. the Bidder adopts corrupt or collusive or coercive or fraudulent practices covered under ITB Clause-35 [Corrupt or Fraudulent Practices] or defaults committed under Integrity pact.

d. the Bidder does not accept the corrections of errors.

19. Pre-Bid Meeting

19.1 The Bidder is invited to attend a Pre-Bid meeting, which will take place at the venue and time stipulated in the Bid Data. Non-attendance at the pre-bid meeting will not be a cause for the disqualification of a bidder.

19.2 The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.



19.3 The Bidder is requested to submit any questions in writing/e-mail not later than 7 days before the pre-bid meeting which will be responded to and clarified in the Pre-Bid meeting.

19.4 Any modifications of the Bid Documents listed in Sub-Clause 9.1 which 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 Clause 11[Amendment to Bid Documents].

20. Format and Signing of Bid

20.1 The Bidder shall prepare the documents comprising the Bid as described in Clause 13[Documents Comprising the Bid] of these Instructions to Bidders.

20.2 The Bid shall be signed by a person duly authorized to sign on behalf of the Bidder, pursuant to Sub-Clause 5.1(a) or 5.2(b), as the case may be.

20.3 The Bid shall contain no overwriting, alterations, omissions, or additions, unless such corrections are initialed by the person or persons signing the Bid. Corrections if any shall only be made by scoring out the cancelled portion, writing the correction, initialing and dating it by the person or persons signing the Bid.

20.4 The Bids shall be signed as under:

a. If the Bid is submitted by an individual, it shall be signed by the proprietor above his full name and name of the firm with its current business address.

b. If the Bid is submitted by a proprietary firm, it shall be signed by the proprietor.

c. If the Bid is submitted by a firm in partnership, it shall be signed by a partner holding the power of attorney. A certified copy of the partnership deed duly registered and current business address of all the partners of the firm shall also accompany the Bid.

d. If the Bid is submitted by a limited company, it shall be signed by a duly authorized person holding the power of attorney together with a Board resolution in this regard for signing the Bid, in which case a certified copy of the power of attorney supported with resolution of Board of Directors shall accompany the Bid. Such limited company may be required to furnish satisfactory evidence of its existence before the contract is awarded.

e. All witnesses and sureties shall be persons of status and their full names, occupations and addresses shall be stated below their signatures.

D. Submission of Bids

21. Preparation and Submission of Bids

21.1 Bids shall be submitted in single stage with contents indicated in paragraphs 21.2 and 21.3 below. The Bids shall be submitted in one original and two copies marked as ‘Original’, ‘Copy 1’ and ‘Copy 2’, as per the submission schedule laid by the Employer. The Bid shall be submitted in separately sealed envelopes duly marked Envelope I and Envelope II and each envelope shall contain documents as stated below.

The bid should be serially numbered and properly indexed mentioning all constituents of bid including any enclosures/attachments etc. and their location page numbers in the bid. Failure to submit the bid in systematic manner as above may result oversight of any important information provided by the bidder for which Employer shall not be responsible.

The Techno-commercial bid of only those bidders who meet the qualifying criteria shall be evaluated. After Techno-commercial evaluation, the Price Schedules of Bidders whose Techno-commercial proposals are found responsive shall be opened.



21.2 Bidders shall submit the following documents in separate sealed envelopes by the due date and time of receipt of bid as mentioned in Bid Data. The envelope received late or after the prescribed due date and time will not be entertained. Employer will not be responsible for any postal delay.

Envelope-I: Technical Bid (Qualification Particulars and Techno-commercial Unpriced Bid) shall contain the following:

i. The Letter of Tender (including all attachments) duly filled in and signed without indicating the prices.
ii. Data related to Qualifying requirements (including Qualification Forms and Data Sheets).
iii. All information and other data required to be submitted by Bidders in accordance with the Instructions to Bidders and the Addenda, including all supporting documentation, which the Bidder wishes to submit as part of his Techno-commercial Bid.

All bidding forms and data sheets relating to prices or having other financial implications shall be left blank, which must also contain no other information, data and details relating to prices. The above documents shall be duly signed by the Bidder.

The documents specified under ITB Clause 9.1, which are not submitted with the bid, will be deemed to be part of the bid and the bidder by submitting its bid shall be deemed to have accepted them unconditionally. The bidder shall treat the bidding documents and contents thereof as confidential.

21.3 **Envelope-II: Financial Bid** (Price Bid) shall contain the following:

a. The Letter of Tender, complete in all respects and duly signed.
b. The Price Schedules duly filled in conformity with the tender specifications.
c. All other material required as per the Instructions to Bidders or Addenda to be included in the Price Bid.

No material relating to any technical matters shall be included in the Price Bid.

21.4 All instructions in this respect contained in Section-2 (Instructions to Bidders) and Addenda, if any, shall be followed.

21.5 **Marking of Submission:** Envelope I shall be super scribed on top as “TECHNCIAL BID KHM” and Envelope II shall be super scribed on top as “FINANCIAL BID – KHM”.

21.6 The Bidder has the option of sending the Bid by registered post/courier or by submitting the Bid in person, so as to reach by the date and time indicated in the Bid Data under clause 22 [Deadline for Submission of Bids]. Bids submitted electronically shall not be accepted. The Bidder shall be responsible for timely delivery of Bids and Bids received after the stipulated date and time shall not be accepted.

21.7 No price sensitive information is to be submitted in Envelope-I.

21.8 The inner and outer envelopes shall;

a. be address to the Employer at the address provided in the Bid Data;
b. bear the name and identification number of the contract as defined in the Bid Data; and
c. provide a warning not to open before the time and date for bid opening, as specified in the Bid Data.

21.9 In addition to the identification required in sub-clause 21.7, the envelope shall indicate the name and address of the Bidder to enable the bid to be returned unopened in case it is declared “late” pursuant to Clause 22 [Deadline for Submission of Bids] and to identify pursuant to Clause 24 [Modification, Substitution and Withdrawal of Bids].

Khorlochhu Hydro Power Ltd.

21.10 If the envelopes are not sealed and marked as above, the Employer will assume no responsibility for the misplacement

22. Deadline for Submission of Bids

22.1 Complete Bids must be received by the Employer at the address as specified in Sub-Clause 21.8 not later than the time and date stipulated in the Bid Data. In the event of the specified date for the submission of bids being declared a holiday for the Employer, the bids will be received up to the specified time on the next working day.

22.2 The Employer may, in exceptional circumstances and at its discretion, extend the deadline for submission of bids by issuing an Addendum in accordance with Clause 11[Amendment to Bid Documents], in which case all rights and obligations of the Employer and the bidders previously subject to the original deadline will thereafter be subject to the deadline as extended.

23. Late Bids

23.1 Bids, if received by the Employer after the deadline for submission of Bids prescribed in Bid Data, will be considered as "Late Bid" and shall be returned unopened.

24. Modification, Substitution and Withdrawal of Bids

24.1 The Bidders may modify, substitute, or withdraw his bid after its submission but in any case, before the official deadline for submission mentioned in Bid Data under clause 22 [Deadline for Submission of Bids] by giving modification or substitution or withdrawal notice in writing to the Employer. The Bidder's modification or substitution or withdrawal notice shall be prepared, sealed and clearly marked as "MODIFICATION" or "SUBSTITUTION" or "WITHDRAWAL" as appropriate and delivered prior to the Bid Due Date and Time.

24.2 Any alteration/ Modification in the Bid or additional information supplied subsequently to the Bid Due date and Time, shall be disregarded.

24.3 Withdrawal of a Price Bid during the interval between the deadline for submission of Bids and expiration of the period of Bid validity specified in Clause 17 [Bid Validity] shall result in the forfeiture of the Bid Security pursuant to Sub-Clause 18.6 hereby.

E. Bid Opening and Evaluation

25. Bid Opening

25.1 The Employer will open the Bids in the presence of Bidders' designated representatives (authorization letter to be submitted) who choose to attend, at the time, date, and location stipulated in the Bid Data.

The Bidders' representatives who are present shall sign a register evidencing their attendance. No Bid shall be rejected at the Bid opening except for the conditions stipulated under Clause 23 [LATE BIDS] and Sub-Clause 5.2.d. hereof.

Envelopes marked "WITHDRAWAL" and/or "MODIFICATION" and/or "SUBSTITUTION" shall be opened and read out first. Bids for which an acceptable notice of withdrawal has been submitted pursuant to Clause 24 of the ITB shall not be opened. Unopened bids shall immediately be returned to the respective Bidder.

The date of opening of Price Bids shall be intimated separately to all the Bidders meeting the specified qualifying criteria and also whose techno-commercial bids are found responsive. Price Bids shall be opened on due time, date and place as specified in invitation letter by the Employer. Price Bids of the Bidders not meeting specified qualifying criteria

Khorlochhu Hydro Power Ltd.

and/or whose techno-commercial bids are not found responsive shall not be considered for opening and shall be returned unopened to the bidder.

25.2 At the time of opening, all important information and any such other details as the Employer may consider appropriate, will be announced by the Employer. This shall include but may not be limited to the Bidders' names, the Bid Prices including deviation, any discounts and the presence (or absence) of bids security.

25.3 The Employer will open the Bids in the presence of Bidders' designated representatives (authorization letter to be submitted) who choose to attend, at the time, date, and location stipulated in the Bid.

26. Process to be Confidential

26.1 Information relating to the examination, clarification, evaluation and comparison of bids, and recommendations for the award of a contract shall not be disclosed to bidders or any other persons not officially concerned with such process until the award to the successful bidder has been announced. Any effort by a bidder to influence the Employer's processing of Bids or award decisions may result in the rejection of the bidder's bid.

27. Clarification of Bids

27.1 To assist in the examination, evaluation, and comparison of bids, the Employer may, at its discretion, ask any bidder for clarification of its Bid, including breakdown of unit rates as per the format given in Data Sheet – 10, Volume - 6, Section 9. The request for clarification and the response shall be in writing but no change in the price or substance of the bid shall be sought, offered, or permitted except as required to confirm the correction of arithmetical errors discovered by the Employer in the evaluation of the Bids in accordance with Clause 28 [Examination of Bids and Determination of Responsiveness] hereof.

28. Examination of Bids and Determination of Responsiveness

28.1 The basis and methodology for evaluation of the Qualification Particulars and techno-commercial bids shall generally be as described in the supplement to Instructions to Bidders attached as ANNEXURE - A to this ITB. The Employer will examine the bids to determine whether they are complete, whether any computational errors have been made, whether required securities and cost of Bid Document have been furnished, whether the documents have been properly signed, whether all the requisite declaration, undertakings have been furnished and whether the bids are generally in order

28.2 Arithmetical errors will be corrected at the time of evaluation of Price Bid and the corrected figure will be considered for the purpose of evaluating Bid price. The corrections in the Bid price shall be done as per the provisions of this clause and shall be binding on the Bidder. If the Bidder does not accept the correction of errors as per the provisions of this clause, the Bid will be rejected and the Bid security will be forfeited.

i. If there is a discrepancy between the product of unit price & quantity for any item and the total price for such item, the product of unit price and quantity, will prevail and the total price shall be corrected.

ii. If there is discrepancy between summation of subtotals and total price, the summation of subtotal price shall prevail, and the total price shall be corrected.

iii. If there is a discrepancy between words and figure, wherever the Bid document requires the figures to be written in both words and figures, the amount in word will prevail unless the amount expressed in figures has an arithmetic error.

iv. In case the Bidder has not filled up unit price as well as amount against any item, Employer shall treat the price of unfilled items as zero for the purpose of evaluation & comparison and award, with the assumption that the cost have been absorbed

Khorlochhu Hydro Power Ltd.

elsewhere in the Price Bid unless the item, in view of Employer, is declared as major item pursuant to Sub-Clause 15.3.

v. In case prices for some items are given by a Bidder as lump sum where unit rates are required, Employer reserves the right to arrive at unit rate on the basis of dividing the entered lump sum amount by the specified quantity.

28.3 The Employer may waive any minor informality, non-conformity or irregularity in a bid that does not constitute a material deviation and that does not prejudice or affect the relative ranking of any Bidder as a result of the evaluation of Bids, pursuant to these Clauses. In case a Bidder chooses to offer a discount/rebate, then he may do so by offering it on a percentage basis in 'Letter of Tender' which shall be applied uniformly to all the unit rates and lump sum amount of the Price Schedules. Any discount/rebate not offered in the form and manner prescribed here-in-above shall not be considered by the Employer for the purpose of evaluation.

28.4 Prior to the detailed evaluation, the Employer will determine whether each Bid is of acceptable quality, is complete and is substantially responsive to the Bid documents. For purposes of this determination, a substantially responsive Bid is one that conforms to all the terms, conditions and specifications of the Bid documents without material deviations, objections, conditionality or reservations. A material deviation, objection, conditionality or reservation is one (i) that affects in any substantial way the scope, quality or performance of the Contract; (ii) that limits in any substantial way, inconsistent with the Bid documents, the Employer's rights or the successful Bidder's obligations under the Contract; or (iii) whose rectification would unfairly affect the competitive position of other Bidders who are presenting substantially responsive bids.

The Employer's determination of a Bid's responsiveness is to be based on the content of the Bid itself without recourse to extrinsic evidence.

28.5 If a Bid is not substantially responsive, it will be rejected by the Employer, and shall not subsequently be made responsive by correction or withdrawal of the nonconforming deviation or reservation.

28.6 All the bidders shall be informed, about their status of qualification/disqualification/techno-commercial responsiveness, in a single letter.

29. Evaluation and Comparison of Bids

29.1 In evaluating the Price Bids, the Employer will determine for each Bid the Evaluated Bid Price by adjusting the Bid Price as follows:

a) making any correction for errors pursuant to Sub-Clause 28.2;

b) taking into account discount offered (if any) pursuant to Sub-Clause 28.3.

29.2 The 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.

29.3 Any adjustments in price that result from the above procedures shall be carried out, for purposes of comparative evaluation, to arrive at an "Evaluated Bid Price."

29.4 If the Bid, which results in the lowest Evaluated Bid Price, is front loaded in relation to the Employer's estimate of the items of work to be performed at early stage under the Contract, the Bidder may require to furnish additional performance security as determined by the Employer, to cover front loading and valid up to 90 days beyond defects liability period, set forth in Clause 34 [Performance Security] hereof at the expense of the bidder to protect the Employer against financial loss in the event of default of the successful Bidder under the Contract.

Khorlochhu Hydro Power Ltd.

F. Award of Contract

30. Award

30.1 Subject to Clause 32 [Notification of Award] hereunder, the Employer will award the contract to the Bidder, meeting the specified qualifying requirement and also whose Bid has been determined to be substantially responsive to the Bid Documents and who has offered the lowest Evaluated Bid Price pursuant to Clause 29, provided that such Bidder has been determined to be eligible in accordance with the provisions of Clause 3 [Eligible Bidders] and 5 [Qualification of the Bidder] of ITB hereof.

31. Employer's right to accept any Bid and to reject any or all Bids

31.1 The Employer reserves the right to accept or reject any Bid, or cancel/ withdraw invitation to Bid for any reason including national defense and security considerations, and annul the bidding process and reject all Bids at any time prior to award of contract, without thereby incurring any liability to the affected Bidder(s).

32. Notification of Award

32.1 Prior to expiration of the period of Bid validity prescribed by the Employer, the Employer will notify the successful Bidder by electronically and confirmed by registered letter or courier that its Bid has been accepted. This letter (hereinafter and in the Conditions of the Contract) shall be called the "Letter of Acceptance" as prescribed in the Bid document.

32.2 The notification of award (letter of Acceptance) will constitute the formation of the contract until the contract has been effected pursuant to clause 33 [Signing of Agreement] hereunder.

32.3 The unsuccessful bidders shall be informed simultaneously about status of their Bids,

33. Signing of Agreement

33.1 After notifying the successful Bidder that its Bid has been accepted, the Employer will prepare the Agreement in the form provided in the Bid Documents, incorporating all agreements between the parties. The contract shall be signed in three originals (two for Employer and one for Contractor). The Contractor shall provide to the Employer 25 sets of the Contract for its execution, free of charges.

33.2 After issue of Letter of Acceptance, the Employer shall notify the contractor about the readiness of the Agreement. The Employer and the successful Bidder shall sign the Agreement within 28 days from the date of issue of Letter of Acceptance to the Contractor.

33.3 Upon issue of Letter of Acceptance as per Clause 32 [Notification of Award] hereof, the Employer will notify the other Bidders that their Bids have been unsuccessful and their Bid Security will be returned.

34. Performance Security

34.1 Within 28 days from the date of issue of Letter of Acceptance, the successful bidder shall furnish to the Employer a Performance Bank Guarantee in the form stipulated in the Conditions of Contract and additional Performance Security (if required by the Employer) as per Clause ITB 29.4 above.

34.2 In case Bidding Company (Subsidiary Company) gets qualified and awarded the work package, the Parent company/Holding company, within 28 days from the date of issue of Letter of Acceptance, will be required to furnish an additional performance bank guarantee, as per Clause 4.2 of Particular Conditions of Contract, of value equivalent to five percent (5%) of the Accepted Contract Amount or portion of work (where subsidiary Company is Partner) as the case may be, in addition to normal Performance Bank Guarantee to be submitted by the Bidder to the Employer besides entering into a separate agreement in the requisite Format provided in the Bid Document.

34.3 The bidders who are qualified on the strength of their Sub-contractor shall be required to furnish an additional Performance Bank Guarantee from their Sub-contractor as per Clause 4.2 of Particular Conditions of Contract.

34.4 The form of Performance Bank Guarantee provided in Volume - 2, Section 5, of the Bid Documents may be used.

34.5 Failure of the successful bidder to comply with the requirements of Clause 33 [Signing of Agreement] or Clause 34 hereof shall constitute a breach of contract, cause for annulment of the award, forfeiture of the Bid Security, and any such other remedy the Employer may take under the provisions of the Contract .

35. Corrupt or Fraudulent Practices

35.1 It is expected from the Bidders that they will observe the highest standard of ethics during the bidding process and execution of such Contracts in pursuance of this policy:

a. For the purpose of this provision, the terms set-forth below shall mean as under:

(i) "corrupt practice" means the offering, giving, receiving or soliciting of anything of value to influence the action of a public official in the procurement process or in Contract execution.

(ii) "fraudulent practice" means a misrepresentation or omission of facts in order to influence a procurement process or the execution of a Contract.

(iii) "collusive practice" means a scheme or arrangement between two or more bidders, with or without the knowledge of Client, designed to establish bid prices at artificial, non-competitive levels.

(iv) "coercive practice" means harming or threatening to harm, directly or indirectly, person or their property to influence or affect the execution of Contract.

(v) "Integrity Pact" means an agreement signed between the Contractor and the Employer committing the persons/officials of both the parties, not to exercise any corrupt influence on any aspect of the Tender/Contract.

b. An agreement called Integrity Pact between the prospective Bidders and the Employer shall be signed committing the persons/officials of both the parties, not to exercise any corrupt influence on any aspect of the Tender/Contract.

c. A Bid shall be rejected by the Employer if it is determined at any stage that respective Bidder has engaged in corrupt or fraudulent or collusive or coercive practices or defaulted commitments under Integrity Pact in competing for or in executing the Contract in question and his Bid Security shall be forfeited. The Contractor shall not be entitled for any compensation whatsoever under this clause.

d. The Employer may declare a bidder ineligible, either indefinitely or for a stated period of time, to be awarded a Contract if it at any time determines that the bidder has engaged in corrupt or fraudulent or collusive or coercive practices in competing for, or in executing a Contract.

e. The documents/information submitted by Contractor may be verified by the officials of the Employer for its authenticity at any time and the Contractor shall provide all

facilities/co-operation in this regard. If it is found that any of the documents/ information submitted by the Contractor is not genuine, the Employer shall have full rights to cancel his Bid, forfeit the bid security and terminate the Contract, if awarded.

ANNEXURE - A

(ITB Clause 28.1)

Technical Evaluation:

1. Technical Evaluation shall be carried out on the basis of the technical submission by the Bidder, which will include the information and data provided by Bidders as specified in the Bid/Technical Data Sheets:
   - Work Commitment (Data Sheet 1)
   - Personnel Capabilities; Personnel Candidate data (Data Sheet 2 and 2A).
   - Contractor's Equipment Data (Data Sheet 3, 3A, 3B & 3C).
   - Quality Control Procedures (Data Sheet 4)
   - Proposed Site Organization, (Data Sheet 5).
   - Construction Programme (Data Sheet 6)
   - Construction Methodology (Data Sheet 7)
   - Bidder's Appreciation of the Project (Attachment 5 to Letter of Tender).

   The Bidders appreciation of the project should include a report on the site inspection carried out prior to submission of bid and must demonstrate full awareness and understanding of all the principal technical and logistic problems related to transportation and erection of the Contractor's Equipment, Materials, availability of Land and Infrastructures, Local Taxes/ duties/ royalties/levies/cess & applicable Laws for supply/erection works and other services.

2. To facilitate completion of the technical evaluation in the limited time available, Bidders are advised.
   a. To submit their technical documentation and all other data in the form and order indicated in the data sheets and/or as instructed above, and to ensure that all specific points on which information has to be submitted, as detailed in the Instructions to Bidders and any addenda thereto, are fully covered.
   b. To ensure that the documentation submitted is complete in all respects but also concise.

   As the Programme for Bid evaluation is short, the Employer cannot accept any obligation to request clarifications or substantiating information after bids have been submitted.
3. Even though the bidders meet the qualifying criteria as per clause No. 5 (ITB), they are subject to be disqualified if they have:
   a. made misleading or false representations in the forms, statements, declarations and attachments submitted in proof of the qualification requirements; and/or
   b. record of poor performance such as abandoning the works, not properly completing the contract, inordinate delays in completion, or financial failures etc.
   c. participated in the previous bidding for the same work and had quoted abnormally high or low bid prices and could not furnish rational justification for it to the Employer.



BID DATA SHEET

The following specific data for the Works to be procured shall complement, amend, or supplement the provisions in the Instructions to Bidders (ITB). Whenever there is a conflict, the provisions herein shall prevail over those in Instructions to Bidders.

Instructions to Bidders (ITB) Clause Reference	
1.1	**Summary of Works:** Design, manufacturing, supply, installation, testing and commissioning of Hydro-Mechanical Works of (4 x 150MW) Khorlochhu Hydropower Project located in Trashiyangtse District, Bhutan.
1.1	**Name and Address of the Employer:** Khorlochhu Hydro Power Limited, Corporate Office, Post Box No. 46002, Doksum New Township, Trashiyangtse, Bhutan. Website: www.khpl.bt
1.2	**Period of Completion:** 42 Months
16.	The currencies of the Bid shall be combination of Bhutanese Ngultrum (BTN) or Indian Rupees (INR) and Euro (EUR) as detailed below: a) Bidders will quote in BTN/INR for components supplied from India or Bhutan. b) Bidders will quote in foreign currency EUR for components supplied from countries other than India or Bhutan. c) Bidders will quote in BTN/INR for services. Payment shall be made in the currencies as quoted in the Price Schedule.
17.1	**Period of Bid Validity**: 180 days
18.1	**Amount of Bid Security**: BTN/INR 90.00 Million
19.1	**Venue, Date and Time of Pre-Bid Meeting:** **Venue**: Corporate Office, Khorlochhu Hydro Power Limited, Doksum New Township, Trashiyangtse, Bhutan. **Date and Time**: September 09 - 11, 2025 at 10.00 AM (BST).
21.8 (a)	**Employer's Address for the purpose of Bid Submission**: General Manager, Contracts & Procurement Division, Khorlochhu Hydro Power Limited, Corporate Office, Postal Box No. 46002, Doksum New Township, Trashiyangtse, Bhutan Email: gm.cnp@khpl.bt
21.8 (b)	**Contract Reference No.**: KHPL/C&PD/TENDER:KHM/2025/11534 dated 07.08.2025
22.1	**Deadline for Submission of Bids:** **Time and Date**: October 17, 2025 up to 10.30 AM (BST).

25.1	**Venue, Date and Time of Bid Opening:** **Venue:** Corporate Office, KHPL, Doksum New Township, Trashiyangtse, Bhutan. **Date and Time:** Envelope - I: October 17, 2025 at 11.00 AM (BST). Envelope - II: to be intimated later on to the bidders meeting the specified qualifying criteria and also whose Technical Bids are determined/found responsive.

QUALIFICATION FORMS

(Refer ITB Sub-Clause 13.1 b)



APPLICATION FORM – 1

General Information

1.	**Name of firm**	In case of Consortium/Sub-contractor ( ) Lead Partner ( ) Partner ( )Sub-contractor			
2.	**Head office address**				
		Country:			
3.	**Telephone** **Fax** **Email**	**Contact Person(s)** **Name** **Title/Position**			
4.	**Place of incorporation / registration Date**				
5.	**Legal status of firm**	**Field of specialty in business**			
6.	**Nationality of majority of owners or share-holders**	**Number of management executives** **Persons**			
7.	**Number of present permanent employee:**				**(unit: persons)**
		Name of Country	**Electrial Engineers**	**Other Engineer**	**Non-Engineering**
	Name of Country				
	Overseas branch 1				
	Overseas branch 2				
	All other branches				
8.	**Quality assurance system in head office**	**Certified by:**			

Date: _____ **Signature:** _____

APPLICATION FORM – 2

Financial Data

Name of the Company:*(Sole Bidder Consortium and/or Sub-contractor(s))*

Each Bidder or Partner must fill this form.

Description	FY 1	FY 2	FY 3	FY 4	FY 5
Turnover from EM Works (in BTN/INR)					
Total Assets (TA)					
Total Liabilities (TL)					
Net Worth (NW):					
a. Subscribed and Paid-up share Capital					
b. Share Premium					
c. Free Reserves					
d. Unallocated balance/surplus amount of profit and loss accounts					
e. Expenses not written off					
f. Accumulated loss in profit and loss accounts if not reduced from reserves and surplus					
Total Net worth (a+b+c+d-e-f)					
Current Assets – Current Liabilities					

Fiscal Year (FY) begins from -------- in each calendar year.

Date _____ **Signature** _____

NB: *The Bidder's shall submit Audited Annual Report for the immediately preceding 5 (five) years in support of aforesaid financial details.*



APPLICATION FORM – 3

General Experience

Name of the Company: *(Sole Bidder or Partner and/or Sub-contractor(s)*

Experience as a prime Contractor having successfully completed at least one Hydro-Mechanical work in a hydropower project on EPC/turnkey basis of Contract Value not less than **BTN/INR 3,000.00 million** only, with a minimum installed capacity of 400 MW in preceding twenty (20) years (start to finish) reckoned up to 28 days prior to bid submission deadline, and in successful operation for at least two (2) years without any major operational issues reckoned from taking over of the works.

To determine the value of work done by the Contractor during the last 20 years it shall be escalated at the rate of 5%, compounded annually.

Sr. No.	Name of Project	Country	Applicant's own works done	Role of the Applicant (Prime contractor, or partner in JV)	Contract period m/yr to m/yr	Bidder's Contract Price(Rs.)
1						
2						
3						
4						
5						

Date _____ **Signature** _____

NB:

i) To please attach detailed data sheet wherever possible.

ii) Bidder to attach certificates in support of declarations made here-in-above.

APPLICATION FORM - 4

Specific Experience

Name of the Company: *(Sole Bidder or Partner and/or Sub-Contractor(s))*

Bidder is required to list contracts which have been successfully executed/completed/carried out up to the specified parameter mentioned here-in-below:

Name of Project	Country of Execution	Name of Contract	Contractor's Role& Share *(Sole/Partner or Sub-Contractor)*	Schedule Completion/ actual Completion (month/year)	Details of Works executed w.r.t. Qualifying criteria
1. Experience of completing either as a bidder itself or an unconditional undertaking from the proposed Sub-Contractors authorizing the bidder to use their work completion Certificate(s) of Design, Manufacturing, Installation, Testing & Commissioning of Submerged/Crest type Radial Gates (having breast wall at top of gate) operated by Hydraulic Hoist with A x H ≥ 3030 m^2 x m, and H ≥ 35 m in last 20 years (from start to finish)					
2. Experience of completing either as a bidder itself or an unconditional undertaking from the proposed Sub-Contractors authorizing the bidder to use their work completion Certificate(s) of Design, Manufacturing, Installation, Testing & Commissioning of Vertical Gates (Fixed Wheel/Slide type) operated by Hydraulic Hoist or Rope Drum Hoist or Gantry Crane having, A x H ≥ 1330 m^2 x m, H ≥ 100 m in last 20 years (from start to finish).					
3. Experience of completing either as a bidder itself or an unconditional undertaking from the proposed Sub-Contractors authorizing the bidder to use their work completion Certificate(s) of Design, Fabrication, Erection, Testing & Commissioning of Steel liner for Pressure Shaft having a value of D × H ≥ 1520 m x m, D ≥ 3.3 m, and thickness of pressure shaft liner up to 40 mm in last 20 years (from start to finish).					
To define similarity, the following data may also be furnished for each project: ○ *Gate: Indicate type of gates, clear span, clear height, design head, type of hoist.* ○ *Pressure Shaft Liner: Indicate inside diameter, design head, type of steel.*					

Date_____ **Signature**_____

NB: *To please attach detailed data sheet wherever possible.*

Note:

i. *Bidder to attach certificates in support of declarations made here-in-above.*
ii. *Bidder may furnish additional information with regard to above Qualification Requirement by attaching separate sheets duly filled in the above format for such additional claimed works.*



SUMMARY OF FULFILMENT OF TECHNICAL CRITERIA

(To be submitted by the Bidder)

Qualifying Criteria	Reference (Page No.)
A. General Experience	
1. Experience as a prime contractor or as a lead partner in a JV or Sub-contractor of the main contractor approved by the Employer of executing at least one large Hydro-Mechanical works in a Hydropower project having minimum capacity of 400MW of Contract Value not less than BTN/INR 3,000.00 million only, in preceding twenty (20) years (start to finish) and which are in successful operation.	
B. Specific Experience	
1. Successful experience, either by bidder itself or an unconditional undertaking from the proposed Sub-Contractor(s) authorizing the bidder to use their work completion certificate(s) of design, manufacturing, installation, testing & commissioning of Submerged/ Crest type Radial Gates (having breast wall at top of gate) operated by Hydraulic Hoists having A x H $\geq$ 3030.00 m^2 x m, and H $\geq$ 35.00 m in last 20 years (from start to finish) and which are in successful operation for at least two (2) years reckoned from the taking over of the works.	
2. Successful experience, either by the bidder itself or an unconditional undertaking from the proposed Sub-Contractor(s) authorizing the bidder to use their work completion certificate(s) of design, manufacturing, installation, testing & commissioning of Vertical Lift Gates having A x H $\geq$ 1330 m^2 x m, and H $\geq$ 100 m operated by Hydraulic Hoists or Rope Drum Hoist or Gantry Crane in last 20 years (from start to finish) and which are in successful operation for at least two (2) years reckoned from the taking over of the works.	
3. Successful experience, either by the bidder itself or an unconditional undertaking from the proposed Sub-Contractor(s) authorizing the bidder to use their work completion certificate(s) of Design, fabrication, erection, testing & commissioning of Steel liner for Pressure Shaft having D x H $\geq$ 1520 m x m, D $\geq$ 3.3 m and thickness of pressure shaft liner up to 40 mm (start to finish) and which are in successful operation for at least two (2) years reckoned from the taking over of the works.	
To define similarity, the following data may also be furnished for each project: ○ *Gate: Indicate type of gates, clear span, clear height, design head, type of hoist.* ○ *Pressure Shaft Liner: Indicate inside diameter, design head, type of steel.*	

Date_____ **Signature**_____

APPLICATION FORM - 5

Current Contract Commitments/Works in Progress

Name of the Company: *(Sole Bidder or Partner of a joint venture/consortium and/or Sub-contractor(s))*

Maximum value of Hydro-Mechanical works executed in any one year during last five years (at current price level) for projects completed/under execution: .....

Bidder should provide information about maximum value of works executed in any one year during last five years and their current commitments on all HM contracts that have been awarded, or for which a letter of intent or acceptance has been received, or for contracts approaching completion.

Name of Contract	Description of works	Stipulated date of completion	Contract Value (equivalent BTN/INR)*	Value of outstanding work (BTN/INR equivalent)*	Estimated completion date
1.					
2.					
3.					
4					
5					
6.					
7.					
8.					
9.					
10.					

i) Exchange rate as on date of award of Contract.
ii) Mention exchange rate adopted.
iii) Bidder to attach certificates in support of declarations made here-in-above..

Date _____ **Signature** _____

APPLICATION FORM - 6

Calculations of Bid Capacity

Name of Company: *(Sole Bidder or Partner of a Joint Venture/Consortium and/or Sub-contractor(s))*

Bidder should provide following information and calculation of bid capacity based on information so submitted.

A = Maximum value of works executed in any one year during last five years (at current price level) for construction works completed/under execution *(Bidders to attach certificates in support of declaration made herein above)*		BTN/INR_____
N = Number of years prescribed for completion of the contract package under consideration/bidding	=	Nos.
B =. Value at current price level of existing commitments and ongoing works to be completed in the next 'N' year	=	BTN/INR_____
Available Bid Capacity	=	BTN/INR_____

Date_____ **Signature**_____

APPLICATION FORM – 7

Litigation History

Name of the Company: *(Sole Bidder or Partner of a joint venture/consortium and/or Sub-contractor(s))*

Each Bidder or partner of a JV must fill in this form

Year	Matter in Dispute	Value of Pending Claims in BTN/INR Equivalent	Value of Pending Claims as a percentage of Net Worth

Date _____ **Signature** _____



INFORMATION FOR BIDDERS (IFB)

1. Project Profile and Scope of Work

1.1. Background

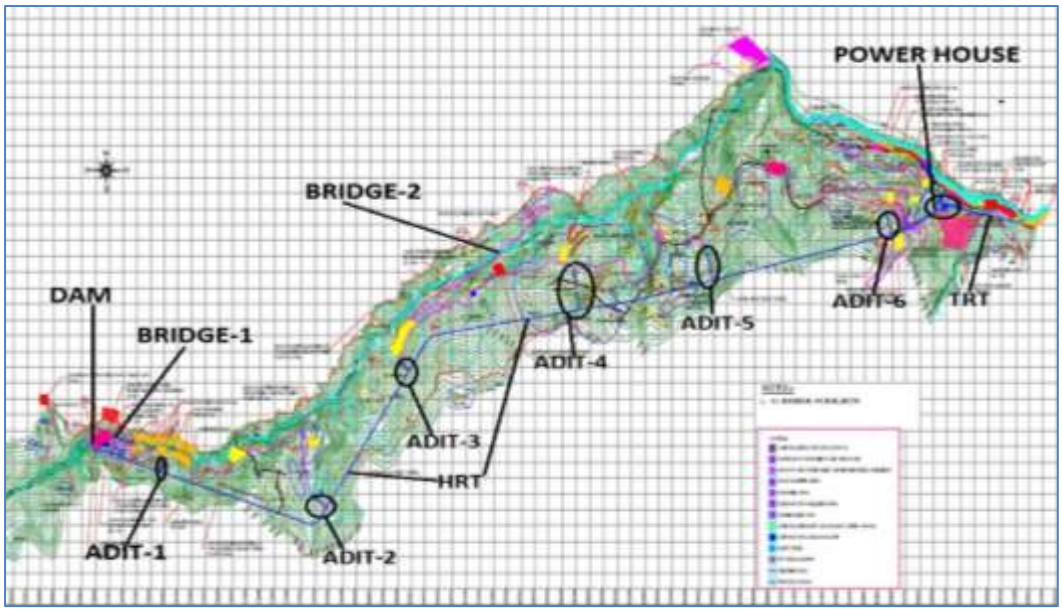
Detailed Project Report (DPR) for Khorlochhu Hydropower Project (KHPP) was prepared and completed on June 2011. The Final DPR was approved by CEA, GOI on November 5, 2012, and subsequently by the then Department of Hydropower & Power Systems (DHPS), RGoB on May 23, 2013.

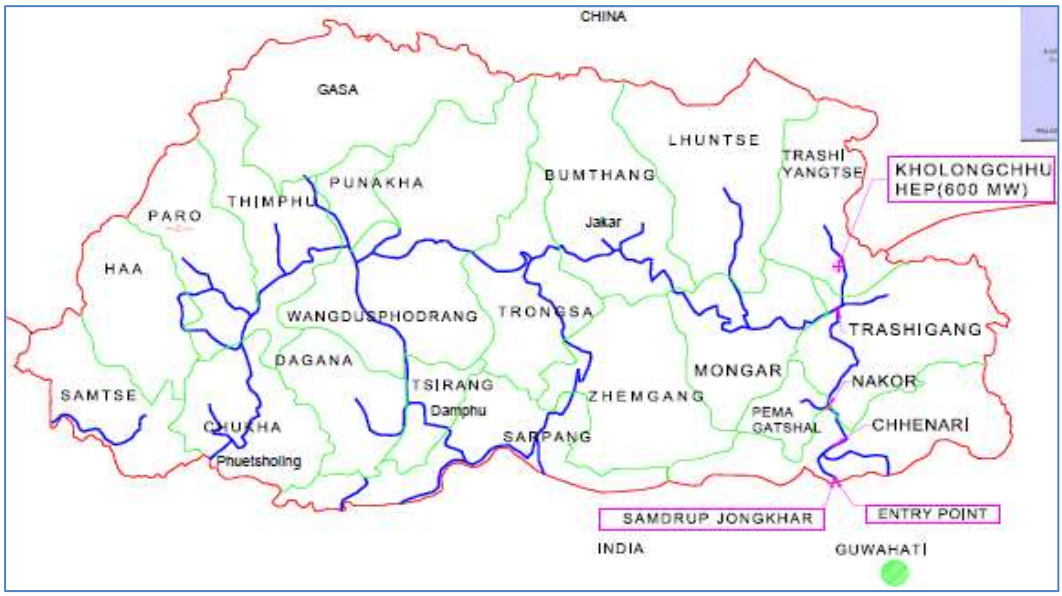
Khorlochhu Hydropower Project (KHPP) is implemented through a strategic partnership between Druk Green Power Corporation (DGPC), Bhutan and Tata Power Company Limited (TPCL), India and is registered as "Khorlochhu Hydro Power Limited" under the Companies Act of Kingdom of Bhutan 2000, for execution of 4x150 MW KHPP.

1.2. Description of Khorlochhu HPP

KHPP is a run-of-the-river scheme hydropower project. It envisages construction of 95 m high concrete gravity Dam above deepest foundation level for diverting the Khorlochhu into the water conductor system. Two D-shaped underground Desilting Chambers of 300 m length and 13 m width each are located on the right bank of the river. This underground Desilting Chambers will be designed to remove the silt particles of size 0.2 mm and above. From the underground Desilting Chambers, 15.77 km long, 5.7 m diameter horse-shoe shape Head Race Tunnel (HRT) shall convey the design discharge of 89 cumecs water into the 2 Nos., 1.2 km long each circular Pressure Shaft with a diameter of 3.3 m and then into an underground Power House with four generating units of 150 MW each Pelton Turbines. A 1.522 km long, 6m diameter, D- shaped Tail Race Tunnel shall convey the turbine discharge back to Drangmechhu (Gongrichhu) river. The annual design energy generation at 90% dependable year with 95% plant availability is estimated at 2524.88 MU. The project is scheduled to be completed in 54 months after the award of main civil works.

1.3. Project Location and Layout





The project area is partly located at the lower course of Khorlochhu River just before its confluence with Drangmechhu (Gongrichu) in Trashiyangtse Dzongkhag (District) of Bhutan touching upon the gewogs (blocks) of Yangtse, Tongzhang and Jamkhar. The water conductor system and all the project components are located along the right bank of Khorlochhu. The underground Power House is located on the right bank of Drangmechhu (Gongrichu), 5 kms downstream of Doksum town. The locations of the main project components are shown below.

1.4. Access to Project Sites

The Dam site is located near Buyang, 13 km downstream of Chorten Kora, Trashiyangtse Dzongkhag and the Power House is located on the right bank of Dramengchu (Gongrichu) at a place called Tshergom.

The nearest broad gauge railway station is Rangia (Assam), India about 270 km from Power House site. The nearest airport is at Guwahati (India) about 320 km. The Paro International airport in Bhutan is located at a road distance of 598 km from Power House site. From Rangia / Guwahati, the project is approachable by road via. Samdrup Jongkhar (Border town of India/Bhutan), Trashigang (Distt.

Khorlochhu Hydro Power Ltd.

Headquarter) and Chazam Bridge (junction of Trashigang - Thimphu road). The approximate distance of different locations from Guwahati is as under:

Guwahati to Samdrup Jongkhar/Daranga	= 110 Km
Samdrup Jongkhar to Trashigang	= 180 Km
Trashigang to Chazam	= 14 Km
Chazam to Power House Location	= 10 Km
Chazam to Doksum	= 15 Km
Doksum to Dam Site Location	= 17 Km
Doksum to Trashiyangtse	= 30 Km

1.5. Implementation of the Project and Contract Package

Khorlochhu Hydropower Project is being executed by Khorlochhu Hydro Power Limited (KHPL) through a strategic partnership between Druk Green Power Corporation (DGPC), Bhutan and Tata Power Company Limited (TPC), India, registered in Bhutan under Companies Act of Kingdom of Bhutan, 2000.

1.6. Scope of Works

The total works of project will be executed under International Competitive Bidding by splitting the project works into suitable Contract Packages e.g. Civil Works, Hydro-mechanical Works, Electro-mechanical Works (Package KEM-1 and KEM-2) etc.

The scope of works for KHM are as defined below:

i) **PART A:** Design, Manufacture, Supply, Fabrication, Erection, Testing and Commissioning of Hydro Mechanical Items including bought out items inclusive of packing, forwarding and handling charges

Sl. No.	Description
1	Spillway Radial Gates with Hydraulic Hoist
2	Spillway Stop logs & Gantry Crane, Mandatory Spare Parts
3	Overflow Spillway Service Gates and Motorized Screw hoist
4	HRT Intake Trash Rack
5	Trash Rack Cleaning Machine and Disposal Vehicle Tripper
6	HRT Intake Gate and Rope Drum Hoist
7	Intake Bulkhead Gate and Gantry Crane
8	Downstream Desilting Chamber Gate and Rope Drum Hoists
9	Silt Flushing Service Gates with Hydraulic Hoists
10	Silt Flushing Emergency Gates & Hydraulic Hoists
11	Surge Shaft Gate & Rope Drum Hoists
12	Tailrace Gates (2 Nos.) & Gantry Crane (1 No.)
13	TRT Outfall Gate & Rope Drum Hoists
14	Adit Gates for HRT Adit No-2 & Adit No-5
15	Chaplangchhu Trash Screen
16	Chaplangchhu Intake Gate and Motorized Screw Hoist
17	Chaplangchhu Desilting Chamber Outlet Gate and Hoist
18	Chaplangchhu Silt Flushing Tunnel (SFT) Gate and Hydraulic Hoist
19	Chaplangchhu De-gravelling Gate and Hoist
20	Aquatic Life Discharge Piping with Valves
21	Instrumentation
22	Pressure Shaft Inspection Trolley
23	Mandatory Tool & Tackles

Khorlochhu Hydro Power Ltd.

ii) **Part B:** Manufacture, Supply, Fabrication, Erection, Testing and Commissioning of Pressure Shaft Liners including bought out items inclusive of packing, forwarding and handling charges

Sl. No.	Description
1	Providing, fabricating, erecting and fixing in position Stainless Steel (ASTM A 537 Cl.2) for Penstock, Pressure Shaft and Pressure Tunnel.
2	Providing, fabricating, erecting and fixing in position Structural Steel (ASTM A 517 Gr F) for Penstock, Pressure Shaft and Pressure Tunnel
3	Providing, fabricating, erecting and fixing in position stainless steel (ASTM A 537 Cl.2) for HRT Liner
4	Mandatory Tool & Tackles
5	Any other items/systems not mentioned above but required for completeness of the scope of entire work and satisfactory performance /operation of the project.

1.7. Salient Features

Installed Capacity	600 MW (4X150 MW)
Location	
Country	Bhutan
District	Trashiyangtse
River	Khorlochhu
Nearest Village (Dam Site)	Buyang
Nearest Village (Power House Site)	Doksum
Access	
Airport	Paro (Bhutan)
	Guwahati (Assam, India) 320km
Rail Head	Rangia (Assam, India) 270km
Geographical Co-ordinate	
Dam Site	
Latitude (N)	27° 32' 50"
Longitude (E)	91° 30' 49"
Power House	
Latitude (N)	27° 24' 23"
Longitude (E)	91° 32' 57"
Hydrology	
Catchment Area at Diversion Site	1044 Sq.km
Snow Catchment (out of Total)	15 Sq.km
Maximum Observed Discharge at Dam site	929 cumecs
Minimum Observed Discharge at Dam site	10.3 cumecs
Probable Maximum Flood (PMF)	8750 cumecs
Average Annual Yield	1621 MCM
Reservoir	
Full Reservoir Level (FRL)	EL 1572.00 m
Minimum Draw Down Level (MDDL)	EL 1558.00 m
Water Spread at FRL	12.68 Ha
Gross Storage at FRL	2.90 MCM
Dead Storage at FRL	1.52 MCM
Live Storage	1.38 MCM
Length of Reservoir	1.40 km

Khorlochhu Hydro Power Ltd.

Dam	
Type of Dam	Concrete Gravity Dam
Top Elevation of Dam	El. 1574.00 m
River bed level at Dam Site	El. 1512.00 m
Dam Height above River bed	62 m
Deepest Foundation Level	El. 1479.65 m
Maximum Height above Foundation Level	95 m
Length of Dam at Top	167 m
Top Width of Dam	9.5 m
Spillway	
Design Flood	8750 cumecs (PMF)
Energy Dissipation System	Trajectory Bucket with naturally formed Plunge Pool
Lower Tier	
Type	Ogee with Sluice type
No. of Bays	5 Bays
Size of Gate	6.8 m (W) X 12.9 m (H)
Crest Level	EL. 1515.00 m
Upper Tier	
Type	Ogee with Open Crest
No. of Bays	1 Bay
Size of Gate	4.0 m (W) X 5.00 m (H)
Crest Level	EL. 1567.00 m
Diversion Tunnel	
Location of Diversion Tunnel	Left Bank
No. of Tunnel/s	1 No.
Size, Shape & Length of Tunnel	10.0 m Dia/Horse Shoe Shape/692.75 m
Diversion Discharge (25 years)	1112 cumecs
Inlet Invert Level	EL. 1518.00 m
Outlet Invert Level	EL. 1497.00 m
Diversion Tunnel Gate	4.5 m (W) X 10.0 m (H)
Power Intake	
Type	Straight Type with Incline Trash Rack
Number/s	2 Nos.
Design Discharge (All units running at full load including 20% of Flushing Discharge)	56.4 cumecs each
Invert Level	EL. 1546.65 m
Level at Centre of Tunnel	EL. 1549.00 m
Top Level	EL. 1574.00 m
Intake Feeder Tunnel	
No. of Tunnel/s	2 Nos.
Size of Tunnel	4.7 m Diameter
Shape of Tunnel	Horse Shoe Shape
Length	248 m & 283 m
Desilting Chamber	
Number/s	2 Nos.
Size	300 (L) x 13 (W) X 17.5 (H)
Average Design Discharge (with 10% Overload)	53.85 cumecs each
Maximum Particle Size to be Removed	0.2 mm and above
Silt Flushing Tunnel	
Main Tunnel	

Size of Tunnel	2.5 (W) X 3.5 (H)
Shape of Tunnel	D Shape
Length of Tunnel	97 m
Branch Tunnel	
Size of Tunnel	2.5 (W) X 2.2 (H)
Shape of Tunnel	D Shape
Length of Tunnel	125, 200 m
Head Race Tunnel	
Design Discharge	89.0 cumecs
Size of Tunnel	5.7 Diameter
Shape of Tunnel	Horse Shoe Shape
Length of Tunnel	16.23 km
Adits	6 Nos. 6.8 Diameter, D Shape
Chaplangchu Diversion	
FSL	EL. 1576.00 m
Design Discharge	5 cumecs
Trench Weir	24.0 m (L) X 3.0m (W) X 3.0 m (H)
Intake Invert Level	EL. 1574.30 m
Feeder Tunnel	2 (W) X 2.5 (H), 110 m Long
Desilting Chamber	6.0 m (W) X 6.5 m (H), 55.00 m Long
Inlet Tunnel to Drop Shaft	1.8 m (W) X 2.1 m (H), 194 m Long
Drop Shaft	2.5 Diameter, 104.0 m deep, Open to Sky
Connecting Tunnel - Drop Shaft to HRT	1.8(W) X 2.1(H), 485m Long
Surge Shaft	
Number/s	1 No.
Type	Restricted Orifice Type
Size & shape	9.5 m Diameter, circular
Height	162.8 m
Top Level	EL. 1650.00 m
Gates	2.75 (W) X 5.22 (H), 2 Nos.
Valve House	
Number/s	2 Nos.
Type	Butterfly Valve
Size of valve	3.3 m Diameter
Pressure Shaft	
Main Pressure Shaft	
Number/s	2 Nos.
Type	Circular
Size	3.3 m Diameter
Length	1,565.00 m (approx..) each
Branch Pressure Shaft	
Number/s	4 Nos.
Type	Circular
Size	2.35 m Diameter
Length	187 m Long
Power House Complex	
Type	Underground Power House
Location	Right Bank of Dramengchu (Gongrichu)
No. of Cavern/s	2 Nos.
Power House - Machine Hall	
Size	140.5 m (L) X 21.0 m (W) X 44.5 m (H)
Type of Turbine	Pelton Wheel

Khorlochhu Hydro Power Ltd.

Number/s	4 Nos.
Capacity	150 MW each
Distributor Centre line Level	EL. 772.50 m
Turbine Floor Level	EL. 775.00 m
Generator Floor Level	EL. 779.50 m
Service Bay Floor Level	EL. 784.00 m
Maximum Tail Water Level	EL. 768.00 m
Design Head	761.53 m (net)
Transformer Hall, GIS cum TRT Gate Operation Cavern	
Facilities	Transformer Hall, GIS, TRT Gate Operation
Size	124.5 m (L) X 16.0 m (W) X 26.5 m (H)
Transformer Hall Floor Level	EL. 784.00 m
Access Tunnels (PH Complex)	
Main Access Tunnel (MAT)	
Size, Shape & Length	8 m Diameter, D Shape, 257.00 m long
Cable Access Tunnel (CAT)	
Size, Shape & Length	6.5 m Diameter, D Shape, 205.00 m long
Ventilation Tunnel	
Size, Shape & Length	6.5 m Diameter, D Shape, 102.96 m long
Drainage Gallery	
Size, Shape & Length	2.5 x 4.0 m, D Shape, 457.15 m long
Access Tunnel	
Size, Shape & Length	7 m Diameter, D Shape, 50 m long
Escape Tunnel	
Size, Shape & Length	3 m Diameter, D Shape, 50 m long
Tail Race Tunnel	
Unit TRT	
Number/s	4 Nos.
Type	D Shape
Size	4.00 m (W) X 4.50 m (H)
Length	605.19 m Long
Main TRT	
Number/s	1 Nos.
Type	D Shape
Size	6 (W) X 6 (H) m
Length	1798.41 m Long
Power Generation	
Design Energy in 90% Dependable year with 95% Plant availability	2524.00 MU
Annual Load Factor	48.02%
Construction Period	54 months

2. Transportation and Communication Facilities

The following information and data is provided by the Employer in good faith. Applicant should check for themselves during preparatory site visit as to correctness of information

2.1. Transportation

2.1.1. Rail Head

The nearest broad gauge rail Head is at Rangia (Assam), India which is about 270 km from Power House site.

2.1.2. Access to the Project and Road within Project Area

The project is approachable by road from Rangia/Guwahati via Samdrup Jongkhar (border town of India/Bhutan), Trashigang (district headquarter) and Chazam Bridge (junction of Trashigang - Thimphu road).

The different components of Project are accessible by various Project Access Roads, which shall be maintained by Contractors of Civil Works Packages. The Contractor of Hydro Mechanical Packages shall coordinate with Contractors of Civil Works Packages for use of Project Access Roads.

2.1.3. Specifications of Access Road

The term 'Project Road', 'approach road' and 'access road' referred to in this document are synonymous and shall mean 'Access Road'.

Sl. No	Specification	Details
a	Formation Width	5.4 m except road to dam site which is 7.5 m.
b	Carriage way Width	4.0 m. for all roads except road to Dam site which is 6.0 m.
c	Shoulder Width on one side	0.5m
d	Drains	Lined V-shaped drain (600x300)mm
e	Load Classifications IRC class	40 R (wheeled / Tracked)
f	Pavement	WBM

2.1.4. Bridges (Project Area)

Sl. No	Location	Bridge Type	Span (m)	Carriage way width (m)
a	Khorlo Zam (Bridge at Dam Site)	Bailey Bridge	42	4.25
b	Shali – Tongzhang Zam (Bridge near Shali)	Bailey Bridge	42	4.25

2.2. Communication

Mobile phone facility is available in and around Trashiyangtse Dzongkhag (District). The contractor will install communication system on his own for reliable communication and shall be responsible for all issues related to frequency, license and mandatory compliances.

3. Hydrology

3.1. Basin Characteristics

Khorlochhu is a tributary of Drangmechhu (Gongrichu), which in turn is a tributary of river Manas. It originates from the snowy range along the northern Bhutan frontier. It generally flows in the southern direction up to the diversion site. The elevation at diversion site is EL 1512 m. The catchment falls between latitude 27^0 27' 00'' N to 27^0 57' 56'' N and Latitude 91^0 18' 36'' E to 91^0 39' 36'' E. The catchment area up to Diversion site is 1044 sq.km including snow fed catchment of 15 sq. Km (approximately). The catchment area of Chaplangchhu at diversion site is 40 sq.km.

3.2. Precipitation Characteristics

In the monsoon months this region receives major precipitation in the form of rainfall from June to October. During the winter season, the higher region of Himalayas receives precipitation in the form of snow while moderate rainfall occurs in the foothills and adjoining plains.

Average Ten daily discharge series for Khorlochhu Hydropower Project have been considered on the basis of ten daily discharge data of river Khorlochhu at Trashiyangtse and Muktirap located slightly

Khorlochhu Hydro Power Ltd.

upstream of the diversion site for period 1987 – 1998 and 2001 – 2010 respectively. The water availability at diversion site has been derived from the above data on the basis of catchment area proportion.

3.3. Design Flood

The floods in the river Khorlochhu are generally due to monsoon rains and melting of snow during summer months. Estimation of design flood has been done by several combinations of metrological and hydrological factors that are applicable in the region. The design flood is determined by Clarks approach, Dimensionless UG and frequency analysis. The design flood has been estimated as 8750 cumec at diversion site.

3.4. Sediment

Himalayan rivers are well known to bring lot of sediments during floods. Sediment observations have been made for Khorlochhu River since 2010.

4. Seismicity

The project area falls in Zone-V of Seismic Zone Map of India.

5. Power Potential Studies

As per CERC guidelines the 50% and 90% dependable years are determined by arranging unrestricted annual energy in descending order. Installation of 600MW capacity comprising 04 units of 150 MW each Pelton wheel turbine is proposed.

6. Power Plant

Khorlochhu Hydropower Project envisages installation of four units, each of 150 MW in underground Powerhouse. Main equipment comprises of 4 nos. of Pelton wheel turbines & main inlet valve of butterfly type complete with unit auxiliaries, 13 nos. single phase transformer. Design discharge and net head are 89 cumec and 761.53 m respectively.

7. Power Evacuation Aspects

The power evacuation system has been planned as per NTGMP by the Central Electricity Authority (CEA) and RGoB as a part of Integrated Power Evacuation Plan for all the power plants being set up in Bhutan in near future. As per this plan, two single circuit 400kV transmission lines on two double circuit towers will take off from Pothead yard of Khorlochhu HP Project and terminate at Yangbari Substation about 70 km from the Project.

8. Environment Aspects

There is negligibly small displacement of population from the project site. The project has been approved by the National Environment Commission (NEC), Royal Govt. of Bhutan for environment clearance.

9. Main Civil Works

a) **KC-1:** Construction of concrete gravity Dam, diversion tunnel, inlet & outlet portals, gate & plug, Spillway & Cofferdams, Intake Structure, Intake Tunnels, Branch HRT, Silt Flushing Tunnel (SFT), Branch SFT, Adit to Desilting Chambers (DC), Adit to Gate Operating Chambers (GOC) of DC, Gate operating Chambers of Desilting Chambers, Adit to GOC of SFT, GOC of SFT, Gate Shaft and 2 nos. Desilting Chambers, Adit-I and HRT (RD 0 to RD 2303 m).

b) **KC-2A:** Construction of Head Race Tunnel (HRT) from RD 3,941.34 m (18.85 m downstream of Adit II) to 14,091.07 m including Construction Adits III, IV and V.

c) **KC-2B**: Construction of Head Race Tunnel (HRT) from RD 2,303.00 m to 3,941.34 m (up to 18.85 m downstream of Adit II), Adit II to HRT and Chaplangchhu Diversion Works.

d) **KC-3A:** Construction of Pressure Shafts, Powerhouse Complex and Tailrace Tunnel.

e) **KC-3B:** Construction of Head Race Tunnel from RD 14,091.07m to RD 15,762.80m including Construction Adit-VI, Surge Shaft and Butterfly Valve Chamber.

10. Hydro Mechanical Works

The hydro mechanical equipment comprising gates, hoist, stop logs, cranes, valves, pressure shaft liners etc. are provided on the Dam, intake and other structures for storage, controlled, discharge, generation of power etc.

11. Construction Power

The power at 33kV shall be provided near all Adit Portals of HRT and Pressure Shafts, Dam site, Surge Shaft and Powerhouse site each at a single point. The Contractor shall bear all the charges for internal arrangement and consumption of grid power which shall be taken at 33kV bus. The contractor shall also make necessary arrangements for standby power. The domestic electricity tariff rate and miscellaneous charges are available on the website https://www.bpc.bt/electricity-tariff/

12. Other/Miscellaneous

i) General Climatic Conditions in the Project Area

Bhutan's climate is influenced mainly by the monsoon wind, which blows from the Bay of Bengal. Local topography and the variations in elevations affect the climate as one moves from south to the north. In general, the climate is characterized by dry winter and wet summer monsoon and the temporal variations in climate are correspondingly extreme. The climate in Trashiyangtse (Eastern Bhutan) tends to be semi tropical with very cool winters. The summer monsoon last from June to September with heavy rains & high humidity. The coldest months in the region are December, January and February when the minimum temperature drops below freezing point. The warmest months are those from July to September when the maximum temp varies between 32º C to 35 º C with average being 28 º C.

ii) Port Facilities

For handling of imported machinery, nearest available port is at Kolkata, from where equipment can be transported through broad gauge rail network up to Rangia and from Rangia to project site by road.

iii) Availability of Land to the Contractor

The land will be provided to the Contractor for the construction of the project. Land shall also be made available to the contractor for developing temporary infrastructures, job facilities, power supply, communications etc., free of cost. In case any additional land is required for infrastructure works, the same will be arranged by the contractor at his own cost.

The Contractor has to make his own arrangements to develop infrastructure for their men and material required during construction period. The necessary residential and labour camps including other facilities like water supply, sanitation etc. shall be developed by the contractor at his own cost. All the camps, facility area, main works area etc. shall be fenced and protected by the contractor at his own cost.

To kick start the execution of the work immediately upon award of contract, certain access roads may be provided at no cost to the Contractor on as is where basis.

iv) Drinking Water Arrangement

The requirement of water for drinking and construction purpose will be met from the nearby natural sources/Nalah as per suitability. Main source of water supply is river water. Water for construction and potable water for the township shall have to be arranged by the Contractor at his own cost. Further, charges and clearance/arrangement with stakeholders, if any, leviable for usage of water from any source for construction/drinking purpose by the local authorities including charges for any facility which is required to be created shall be borne by the Contractor.

v) Medical facilities

There is a Dzongkhag (District) level hospital at Trashiyangtse and Primary Health Center at Tshenkharla.

vi) School

Khorlochhu Hydro Power Ltd.

Three Central Schools up to 12th standard are available in and around the Project area. In addition to this, there are also several primary schools available in the project area.

vii) Bank

Branches of Bank of Bhutan are available at Trashiyangtse and Doksum. In addition to this, Bhutan National Bank & Bhutan Development Bank is also functioning at Trashiyangtse.

viii) Insurance

Royal Insurance Corporation of Bhutan (RICB) has its office at Trashiyangtse presently.

ix) Work permit for contractors and his workmen

Work permit is required for foreign nationals to work in Bhutan. Contractor has to arrange work permit for his manpower at his own level. The Employer shall assist contractor in obtaining work permits. The contractor shall diligently comply with rules/regulations of the RGoB authorities.

x) Available of nearest fuel Station.

The nearest fuel station is available in Doksum, Trashiyangtse. In addition to this a fuel station is also available in Trashigang, which is about 60 km from Trashiyangtse, 30 km from Doksum and 25 km from Power House site. ~~Main fuel station is, however, is at Samdrup Jongkhar about 200 km away from Power House site.~~ The contractor shall make arrangement for his own fuel station having sufficient storage capacity for meeting his petrol and HSD requirement, subject to adherence to applicable regulations.

xi) Manpower

The Contractor is encouraged, to the extent possible and reasonable, to employ staff and labour with appropriate qualifications and experience from Bhutan. To the extent possible, the unskilled labour shall, in principle, be recruited from this region.

The Employer may impose certain restrictions on the Contractors to deploy staff and labour as per the Laws of country. The Contractor shall not employ any person who has not completed 18 years of age. The Contractor shall arrange permits for the labour/staff for their entry into Bhutan, at his own cost.

13. Factors Influencing Construction

The constraints, not limited to those listed below, may be faced during the execution of the project for which Employer shall assume no responsibility and Contractor shall take appropriate measures at his own cost for completion of Works within Time for Completion:

a. Remote location of the project involving long road transport.

b. High precipitation in the project region particularly during monsoon season which extends from June to October. The road network and other infrastructure may be affected (due to landslides, flood and breaching of roads) during monsoon season leading to disruption of normal activities.

c. Frequent landslides and blockade of highway and other approach roads including restrictions on the bridges.

d. Power failures, voltage fluctuations and quality of power available.

Besides the above constraints which have been informed to the bidders in good faith, the bidders should ascertain for themselves about the extent of the above constraints and other constraints/obstructions likely to be encountered during execution of works.

14. Construction Period

The construction period of Main Civil and Electro-mechanical Works are scheduled to be completed as under:

Package No.	Description of Work	Completion Period (Months)
KC-1	Construction of river diversion works, Dam, Intake, Desilting arrangement and HRT from RD 0.00 m to RD 2,303.00 m including Construction Adit I	54
KC-2A	Construction of Head Race Tunnel (HRT) from RD 3,941.34 m (18.85 m downstream of Adit II) to 14,091.07 m including Construction Adits III, IV and V.	54
KC-2B	Construction of Head Race Tunnel (HRT) from RD 2,303.00 m to 3,941.34 m (up to 18.85 m downstream of Adit II), Adit II to HRT and Chaplangchhu Diversion Works.	54
KC-3A	Construction of Pressure Shafts, Power House Complex and Tailrace Tunnel.	54
KC-3B	Construction of Head Race Tunnel from RD 14,091.07m to RD 15,762.80m including Construction Adit-VI, Surge Shaft and Butterfly Valve Chamber.	54
KEM-1	Design, Manufacturing, Supply, Installation, Testing and Commissioning of Electro-Mechanical Works of 4x150MW Khorlochhu Hydropower Project.	42
KEM -2	Design, engineering, manufacturing, fabrication, shop assembly, painting, testing at works, transportation, supply, erection, testing and commissioning of control SCADA and protection system.	42

15. Sacred Cultural/Religious Sites

The Contractor shall execute all activities in line with the guidelines of the Department of Culture, RGoB and the Guide and location map of Sacred Cultural/Religious Sites which contain the details of sacred sites/objects/monuments in the project area provided by the employer. The contractor shall take specific measures as may be warranted for physical and spiritual preservation of sacred cultural/religious sites/monuments. Under no circumstances, whatsoever, the contractor shall cause any damages to such sacred cultural/religious sites or monuments in the vicinity of the project by any construction activity particularly blasting. Extraction of construction materials such as boulders and timber from nearby such sacred sites shall not be permitted. Due reverence shall be exhibited by the contractor and its employees towards these sacred monuments and the religious sentiments of the local people shall be respected at all times.

The contractor shall ensure proper sanitation in and around the sacred sites. No wastes of any kind shall be disposed near the sacred sites. It shall be the responsibility of the contractor to make workers aware about the sacred sites. The behavior such as substance abuse, sexual misconducts and other nuisances in the vicinity of sacred sites is prohibited. The contractor shall not bar the public from visit to sacred sites unless written notices are fitted with the approval of the Employer and the contractor shall treat any public visiting the sacred sites with courtesy.

Smoking, drinking, sexual activities, slaughter of animals etc. by the contractor or its staff and its business associates/partners in the vicinity of sacred sites and public places are prohibited.

Khorlochhu Hydro Power Ltd.

CONSTRUCTION SCHEDULE

The Bidder shall be required to submit with its bid a detailed program, normally in the form of a bar chart, showing how and the order in which it intends to perform the Contract and showing the Milestone Dates and major events requiring action or decision by the Employer.

In preparing this Program, the Bidder shall adhere to the Time(s) for Completion given in the Bid Data Sheet or give its reasons for not adhering thereto. The Time Schedule submitted by the selected Bidder and amended as necessary prior to award of Contract shall be included as Appendix to the Contract Agreement before the Contract is signed



KHORLOCHHU HYDRO POWER LIMITED

4x150 MW KHORLOCHHU HYDROPOWER PROJECT

TRASHIYANGTSE; BHUTAN

BIDDING DOCUMENT

FOR

CONTRACT PACKAGE: KHM

DESIGN, MANUFACTURING, SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF HYDRO-MECHANICAL WORKS

VOLUME - 2

GENERAL CONDITIONS OF CONTRACT, PARTCULAR CONDITIONS OF CONTRACT AND APPENDIX TO TENDER

International Competitive Bidding

These documents are meant for the exclusive purpose of bidding against this NIT and shall not be transferred, reproduced or otherwise used for purposes other than that for which they are specifically issued.

LAYOUT OF BIDDING DOCUMENTS

CONTRACT PACKAGE: KHM

Design, Manufacturing, Supply, Installation, Testing and Commissioning of Hydro-Mechanical Works

Volume - 1: Instructions to Bidders (ITB)

- Section - 1 Abridged Notice Inviting Tender and Notice Inviting Tender (NIT)
- Section - 2 Instructions to Bidders (ITB), Bid Data, Qualification Forms, Information for Bidders (IFB) and Work Schedule

Volume - 2: General Conditions of Contract (GCC) and Particular Conditions of Contract (PCC)

- Section - 3 FIDIC General Conditions of Contract (GCC) for Plant and Design-Build Contract (First Edition 1999)
- Section - 4 Particular Conditions of Contract (PCC) and Appendix to Tender
- Section - 5 Forms and Procedures
  - Form-1: Letter of Tender
  - Form-2: Form of Contract Agreement
  - Form-3: Bank Guarantee Form for Performance Security
  - Form-4: Bank Guarantee Form for Advance Payment
  - Form-5: Form of Taking Over Certificate
  - Form-6: Bank Guarantee Form for Release of Retention Money
  - Form-7: Hindrance Register
  - Form-8: Dispute Adjudication Agreement
  - Form-9: Parent/Holding Company Agreement
  - Form-10: Proforma for Joint Deed of Undertaking

Volume-3: Price Schedules

Volume-4: Employer's Requirements

- Section - 6 General Technical Specifications (GTS)
- Section - 7 Particular Technical Specifications (PTS)
- Section - 8 Quality Assurance Plan (QAP)

Volume-5: Tender Drawings

Volume-6: Technical Data Sheets



TABLE OF CONTENTS

SECTION - 3: GENERAL CONDITIONS OF CONTRACT (GCC) 6
SECTION - 4: PARTICULAR CONDITIONS OF CONTRACT (PCC) 8
1. General Provisions 8
1.1 Definitions 8
1.1.1 The Contract 8
1.1.4 Money and Payments 8
1.1.5 Works and Goods 8
1.1.6 Other Definitions 8
1.2 Interpretation 9
1.5 Priority of Documents 9
1.8 Care and Supply of Documents 9
1.15 Severability 10
2. The Employer 10
2.1 Right of Access to the Site 10
3. The Engineer 10
3.1 Engineer's Duties and Authority 10
3.5 Determinations 11
4. The Contractor 11
4.1 Contractor's General Obligations 11
4.2 Performance Security 11
4.3 Contractor's Representative 12
4.4 Subcontractors 12
4.6 Co-operation 13
4.7 Setting Out 14
4.8 Health and Safety Obligations 14
4.10 Site Data 14
4.11 Sufficiency of the Accepted Contract Amount 14
4.16 Transport of Goods 14
4.17 Contractor's Equipment 15
4.18 Protection of the Environment 15
4.19 Electricity, Water and Gas 17
4.21 Progress Reports 18
4.25 Land 19
4.26 Assignment and Novation of Manufacturer's Warranties 20
5.1 General Design Obligations 20
5.4 Technical Standards and Regulations 21
5.5 Trainings 22
5.6 As-Built Documents 22

Khorlochhu Hydro Power Ltd.

5.8 Design Error 22
5.9 Warranty by the Contractor 22
6. Staff and Labour 23
6.1 Engagement of Staff and Labour 23
6.3 Persons in the Service of Employer 23
6.4 Labour Laws 23
6.5 Working Hours 25
6.7 Health and Safety 25
7. Plant, Materials and Workmanship 25
7.1 Manner of Execution 25
7.4 Testing 25
7.6 Remedial Work 25
7.7 Ownership of Plants and Materials 25
8. Commencement, Delays and Suspension 25
8.1 Commencement of Works 25
8.3 Programme 25
8.4 Extension of Time for Completion 26
8.7 Delay Damages 26
9.1 Contractor's Obligations 27
10. Employer's Taking Over 27
10.2 Taking Over of Parts of the Works 27
10.3 Interference with Tests on Completion 27
11. Defects Liability 27
11.8 Contractor to Search 27
11.12 Latent Defects Liability 27
11.13 Defect Liability of Spares 28
11.14 Warranty and Liability of Software 30
12. Tests after Completion 30
12.1 Procedure for Tests after Completion 30
12.2 Delayed Tests 31
12.4 Failure to Pass Tests after Completion 31
13. Variations and Adjustments 31
13.1 Right to Vary 31
13.2 Value Engineering 31
13.3 Variation Procedure 31
13.5 Provisional Sums 32
13.6 Daywork 32
13.7 Adjustments for Changes in Legislations 32
13.8 Adjustments for Changes in Cost 33

Khorlochhu Hydro Power Ltd.

14. Contract Price and Payment 35
14.1 The Contract Price 35
14.2 Advance Payment 36
14.4 Schedules of Payments 37
14.5.1Materials 41
14.6 Issue of Interim Payment Certificates 42
14.7 Payment 42
14.8 Delayed Payment 43
14.9 Release of Retention Money 43
14.10 Statement at Completion 44
14.15 Currencies of Payment 44
15. Termination by Employer 44
15.2 Termination by Employer 44
16. Suspension and Termination by Contractor 44
16.1 Contractor's Entitlement to Suspend Work 44
16.2 Termination by Contractor 44
16.3 Cessation of Work and Removal of Contractor's Equipment 44
18. Insurance 45
18.2 Insurance for Works and Contractor's Equipment 45
18.5 Insurance for Design 45
19. Force Majeure 45
19.4 Consequences of Force Majeure 45
20. Claims, Disputes and Arbitration 45
20.1 Contractor's Claims 45
20.4 Obtaining Dispute Adjudication Board's Decision 46
20.6 Arbitration 46
APPENDIX TO TENDER 47
Annexure - I of Appendix to Tender 50
Annexure - II of Appendix to Tender 52
Annexure - III of Appendix to Tender 61
Form - I: Employment Card Regulation 66
Form - II: Attendance-Cum-Wage Card 67
Form – III: Register of Fines 68
Form – IV: Register of Deductions for Damages or Loss Regulation 68
Annexure - IV to Appendix to Tender 69
Annexure - V of Appendix to Tender 71
Annexure – VI of Appendix to Tender 73
Annexure - VII of Appendix to Tender 74
SECTION-5: Forms & Procedures 84

Khorlochhu Hydro Power Ltd.

Form - 1: Letter of Tender 84
Attachment - 1: 88
Attachment - 2 90
Attachment - 3 92
Attachment - 4 93
Attachment - 5 94
Attachment - 6 97
Attachment - 7 99
Attachment - 8 100
Attachment - 9 104
Attachment - 10 105
Form - 2: Form of Contract Agreement 106
Form - 3: Bank Guarantee for Performance Security 110
Form - 4: Bank Guarantee for Advance Payment 112
Form – 5: Form of Taking-Over Certificate 114
Form – 6: Bank Guarantee Form for Release/Payment of Retention Money 115
Form – 7: Hindrance Register 117
Form – 8: Dispute Adjudication Agreement 118
Form - 9: Parent/Holding Company Agreement 120
Form - 10: Proforma of Joint Deed of Undertaking by Subcontractor and Bidder/Contractor 123

SECTION – 3:

GENERAL CONDITIONS OF CONTRACT (GCC)



SECTION - 3: GENERAL CONDITIONS OF CONTRACT (GCC)

The General Conditions of Contract (GCC) shall be those stipulated in the FIDIC Conditions of Contract for **"Plant and Design-Build Contract (First Edition 1999)"**, for Electrical & Mechanical Plant and for Building & Engineering Works Designed by the Contractor, prepared by the ***Federation Internationale des Ingenieurs - Conseils (FIDIC).***

These Conditions are subject to the variations and additions set out hereof entitled **"Particular Conditions of Contract (PCC)"**.

A copy of the General Conditions of Contract is not included with the Bid Documents for the works and reference should therefore be made to the published FIDIC document.

In accordance with Clause 33.1 of Instructions to Bidders, the Contractor shall provide 15 (fifteen) sets of the original FIDIC Conditions of Contract in the required format as directed by the Employer.

Copies of the FIDIC Conditions of Contract (Yellow Book First Edition 1999) can be obtained from https://fidic.org/books/plant-and-design-build-contract-1st-ed-1999-yellow-book and from:

FIDIC – International Federation of Consulting Engineers
World Trade Center II - Geneva Airport
P. O. Box 311
CH-1215 Geneva 15
Switzerland
Website: www.fidic.org

SECTION - 4

PARTICULAR CONDITIONS OF CONTRACT (PCC)



SECTION - 4: PARTICULAR CONDITIONS OF CONTRACT (PCC)

The following "Particular Conditions of Contract (PCC)", which include amendments and additions to the General Conditions of Contract (GCC) shall supplement the GCC. The General Conditions of Contract (GCC) are linked with the Particular Conditions of Contract (PCC) by the corresponding numbering of the Clauses, so that GCC and PCC together comprise the conditions governing the rights and obligations of the parties. In case of any inconsistency between the conditions contained in GCC and those in PCC, the conditions contained in PCC shall prevail over those of GCC.

1. General Provisions	
1.1 Definitions	
1.1.1 The Contract	
1.1.1.5	*At the end of Sub-Clause 1.1.1.5, insert:* The words "Employer's Requirements" are synonymous with "Technical Specifications", "General Technical Specifications (GTS)", and "Particular Technical Specifications (PTS)"
1.1.1.8	*At the end of Sub-Clause 1.1.1.8, insert:* The word "Tender" is synonymous with "Bid."
1.1.4 Money and Payments	
1.1.4.8	*At the end of Sub-Clause 1.1.4.8 insert:* "BTN" or "Ngultrum" means Bhutanese Ngultrum, legal tender of the Kingdom of Bhutan . "INR" or "Rupees" means Indian Rupees, legal tender of the Republic of India. "EUR" or "Euro" means the legal tender of the EU Member Countries.
1.1.5 Works and Goods	
1.1.5.1	*At the end of Sub-Clause 1.1.15, insert:* The words "Construction Equipment" or "Equipment" are synonymous with "Contractor's Equipment."
1.1.6 Other Definitions	
1.1.6.8	*Delete 1.1.6.8 and substitute by the following:* Unforeseeable means not reasonably foreseeable physical ground conditions by an experienced contractor. This shall not include conditions other than ground conditions.
	At the end of Sub-Clause 1.1.6.9, insert: 1.1.6.9.1 "**Milestone**" means an intermediate event or landmark identified in the Contract, which is critical for Completion of Works within Time for Completion. Milestone shall not be construed to mean Section of Works. 1.1.6.9.2 "**Integrity Pact**" means the Pact signed between the Employer and Contractor committing the persons/officials of both the parties, not to exercise any corrupt influence on any aspect of the Tender/Contract.

	1.1.6.9.3 "**RGoB**" means Royal Government of Bhutan. 1.1.6.9.4 "**Agents / agent**" are / is a person(s) engaged by another person (called the "principal") to do any act on behalf of the principal or to represent the principal in dealings with third parties. It does not include the vendor(s) or any other persons nominated or approved through the Employer.
1.2 Interpretation	*At the end of Sub-Clause 1.2, add:* In these Conditions, provisions relating to the expression "Cost plus reasonable profit" for example in GCC Clause 1.9, 2.1, 4.7, 7.4, 10.2, 10.3, 12.2, 12.4, 16.1, the term "plus reasonable profit" shall be taken as nil and accordingly the words "Cost plus reasonable profit" shall be substituted by the word "Cost."
1.5 Priority of Documents	The documents forming the Contract are to be taken as mutually explanatory of one another. If an ambiguity or discrepancy is found, the priority shall be such as may be accorded by the governing law. The Engineer has authority to issue any instruction which he considers necessary to resolve an ambiguity or discrepancy. *Delete the documents listed from (a) to (h) in Sub-Clause 1.5 and substitute by:* a) the Contract Agreement (if completed), b) the Letter of Acceptance, c) the Letter of Tender, d) Appendix to Tender e) these Particular Conditions f) these General Conditions, g) the Employer's Requirements h) the Tender Drawings, i) the Price Schedules, j) the Data Sheets, k) the Information for Bidders, l) the Contractor's proposal, and m) any other documents forming part of the Contract.
1.8 Care and Supply of Documents	*In the first paragraph, replace 2nd sentence as under:* The Contractor shall supply to the Engineer (5) hard copies-original and two (2) electronic copies (out of which one electronic copy shall be in source format/software in editable format). *At the end of Sub-Clause 1.8, add the following:* In the preparation of the calculations and drawings, the Contractor shall anticipate and be responsible for updating the Contractor's Documents to incorporate: (i) changes to suit modifications arising from the encountered conditions revealed during construction, including instructions issued by the Engineer; (ii) drawing revisions issued by the Engineer; and (iii) drawings issued by other Contractors and arising from the specified liaison with other Contractors.
	After Sub-Clause 1.14, add new Sub-Clause 1.15 as below:

1.15 Severability	If any provision or condition of the Contract is prohibited or rendered invalid or unenforceable by law, such prohibition, invalidity or unenforceability shall not affect the validity or enforceability of any other provisions and conditions of the Contract.
2. The Employer	
2.1 Right of Access to the Site	*Replace the word "Cost plus reasonable profit" appearing at the end of the third paragraph under this clause by the word "Cost" only.*
3. The Engineer	
3.1 Engineer's Duties and Authority	*Add the word "one of its Employee(s) as" after the word "appoint" in the 1st line of 1st para.* *At the end of Sub-Clause 3.1, add the following paragraphs:* Any consultation that the Engineer holds with the Employer in pursuant to the Contract shall be entirely an internal matter between the Engineer and the Employer. The recommendations and determinations by the Engineer are subject to review and finalization by the Employer. The same shall not be subject to matter of reference either by the Contractor or any arbitral Tribunal. The requirement, in the various Sub-Clauses of GCC and these Conditions of Contract, to consult and/ or to notify the Employer of all the instructions, actions and correspondences of the Engineer with the Contractor is dispensed with. The Engineer shall obtain the specific approval of the Employer before taking action under the following Sub-Clauses of GCC and these Conditions: (a) consenting to the subletting of any part of the Works under Clause 4.4; (b) Determining an extension of Time for Completion under Clause 8.4; (c) Sub-Clause 4.12: Agreeing or determining of Delay and/or Cost, (d) Sub-Clause 13.1: Instructing a Variation, except; i) in an emergency situation as determined by the Engineer, or ii) if such a Variation would increase the Accepted Contract Amount by less than the percentage specified in the Contract Data (e) Sub-Clause 13.3: Approving a proposal for Variation submitted by the Contractor in accordance with Sub-Clause 13.1 or 13.2; Notwithstanding the obligation, as set out above, to obtain approval, if, in the opinion of the Engineer, an emergency occurs affecting the safety of life or of the Works or of adjoining property, he may, without relieving the Contractor of any of his duties and responsibilities under the Contract, instruct the Contractor to execute all such work or to do all such things as may, in the opinion of the Engineer, be necessary to abate or reduce the risk. The

Khorlochhu Hydro Power Ltd.

	Contractor shall forthwith comply, despite the absence of approval of the Employer, with any such instruction of the Engineer. The Engineer shall determine an addition to the Contract Price, in respect of such instruction, in accordance with Clause 13 and shall notify the Contractor accordingly."
3.5 Determinations	*At the end of Sub-Clause 3.5, add:* Determination of Cost related to extension of time for completion referred in clause 1.9, 2.1, 4.7, 4.12, 4.24, 7.4, 8.9, 10.3, 11.8, 16.1 & 19.4 for the purpose of determination referred to in GCC or these conditions "reasonable profit" wherever referred to shall be treated as nil and "Cost" shall be determined as per mechanism provided for in **Appendix to Tender (Annexure-I)**. The determinations under this Sub-Clause shall, however, be subject to provisions of Sub-Clause 3.1. The cost claims related to extension of time for completion (if admissible under the contract) shall be limited to the losses suffered/cost incurred during the hindrances of contemporary period. No claim shall be payable related to consequent effects/cost in extended stay period.
4. The Contractor	
4.1 Contractor's General Obligations	Delete the first paragraph and replace with: "The Contractor shall design, execute and complete the Works and shall remedy any defects in the Works in accordance with the Contract, including: (a) Best Industry Practices, (b) all applicable Laws and the terms of any licenses, permits and consents, (c) the Technical Specifications, and (d) the Programmer. The Contractor shall warrant that, when completed, the Works shall be fit for purpose for which the Works are intended as described in the Contract." Between the fourth and fifth paragraph insert: "The Contractor shall conduct his operations in such a manner as to avoid injury or damage to adjacent property or facilities. The Contractor shall note that this responsibility shall apply to the whole of the land or facilities occupied or used by him for the purpose of the Works." *At the end of this Sub-Clause add the following:* The Contractor's obligations shall extend to any interfaces between his works and those of Other Contractors.
4.2 Performance Security	*Delete first paragraph of Sub-Clause 4.2.1 and substitute by the following paragraphs:* The Contractor shall deliver Performance Security to the Employer with a copy to the Engineer within 28 days of issue of Letter of Acceptance. The Performance Security shall be in the form of a

	bank guarantee for the amount stipulated by the Employer as under: In case Bidding Company (subsidiary company) gets qualified and awarded the work package on the strength of Parent/Holding Company, the Parent company / holding Company (registered in India/Bhutan) shall furnish an additional unconditional Performance Bank Guarantee of value equivalent to five (5) percent of the Accepted Contract Amount, in addition to normal Performance Bank Guarantee to be submitted by the Bidder to the Employer besides entering into a separate Agreement in the requisite Format provided in the Bid Document. The Contractor who are qualified on the strength of their Subcontractor shall be required to furnish an additional Performance Bank Guarantee from their Subcontractor within 28 days of issue of Letter of Acceptance, if required, under the Contract. The Performance Security shall be in the form of a bank guarantee, as stipulated by the Employer in **Section-5, Forms and Procedures, Form-3**. The Performance Security shall be denominated in the types and proportions of currencies in which the Accepted Contract Amount is payable. In case of Bidders not having requisite experience of Design, is engaging Design Consultant having prior experience of similar works, such consulting company shall be required to furnish an additional performance bank guarantee to zero-point five percent (0.5%) of the Accepted Contract Amount in addition to normal Performance Bank Guarantee to be submitted by the Bidder to the Employer. The Performance Bank Guarantee provided by the Contractor and/or Parent Company shall be valid up to Ninety (90) days beyond Defect Notification Period. The additional performance bank guarantee provided by Subcontractor shall be valid till completion of part of the Works executed by the Sub-contractor. The performance bank guarantee provided by the Design Consultant (if associated) shall be valid up to Ninety (90) days beyond Defects Notification Period. The Performance Security shall be denominated in the currency of bid. A Bank Guarantee either issued by a bank/financial institution in Bhutan or any nationalized/scheduled bank in India with endorsement/counter guaranteed by a bank/financial institution in Bhutan shall only be acceptable.
4.3 Contractor's Representative	*At the end of second paragraph of Sub-Clause 4.3, add:* "If Contractor's Representative is not, in the opinion of the Engineer, fluent in English, the Contractor shall have available on site at all times a competent interpreter to ensure the proper transmission of instructions and information."
4.4 Subcontractors	*Sub-Clause 4.4 is deleted and substituted by the following:*

	"The Contractor shall not subcontract any portion of the Works without the approval of the Engineer. Appointment of any Subcontractor and any subcontracting shall not relieve in any way or manner whatsoever the Contractor from any of its obligations, liabilities and responsibilities under the Contract. The Contractor shall be responsible for the acts and defaults of any Subcontractor/Manufacturer/Vendor and Employees, as if they were the acts and defaults of the Contractor. Save and except as set forth here-in-under, the Contractor shall give the Engineer not less than 60 (sixty) days' notice of: (a) The intended appointment of the Subcontractor, with detailed particulars which shall include his relevant experience and other details considered necessary by the Employer, (b) The intended commencement of the Subcontractor's work Notwithstanding the provisions contained in above, the consent of the Engineer shall not be required in respect of Sub-Contracting or Sub-letting of the following: (i) Provision of labour/Piece Rate Work (PRW), (ii) For Construction Equipment and Temporary Works, (iii) For clearance and/or transportation, The contractor shall strictly adhere to and select and employ its Subcontractors/Manufacturer/Sub-vendor from the lists specified under **Section-5, Forms and Procedures, Form-1: Letter of Tender [Attachement-8].** Bidders can also suggest alternate names for inclusion into the list fulfilling the specific qualification criteria listed against those items as specified under **Section-5, Forms and Procedures, Form-1: Letter of Tender, [Attachment-9]**. The Contractor may from time to time propose any addition to or deletion from any such list. The Contractor shall submit any such lists or any modification thereto to the Employer for its approval in sufficient time so as not to impede the progress of work on the Facilities. Such approval by the Engineer for any of the Subcontractors/sub-vendors proposed by the Contractor or selection of any Subcontractors/sub-vendors by the Contractor from the list provided in the Bid Document, shall not relieve the Contractor from any of its obligations, duties or responsibilities under the Contract. The contractor shall also submit the list of Subcontractors for erection, testing and commissioning of the Works. The Subcontractors shall fulfill the specific qualification criteria listed under **Section-5, Forms and Procedures, Form-1:Letter of Tender [Attachement-10]**.
4.6 Co-operation	*Add the following new paragraphs at the end of this Sub-Clause:* "The Project involves other Contracts, including in particular the Civil and Hydro-mechanical Works for the execution of the various other Works on the Project which will be performed concurrently with the Works under this Contract. The Contractor

	shall co-ordinate his general day-to-day activities with the Employer's other Contractors to avoid hindrance and obstruction of the Employer's other Contractors as far as is appropriate and reasonable. This will include co-ordination and co-operation with the Employer's other Contractors at any interfaces between the Work of this Contract and the Work of the Employer's other Contractors and for joint use of facilities such as roads, site installation areas and other general site services. Such general co-operation shall be foreseen and provided for in the Contractor's programming and is deemed to be included in the Accepted Contract Amount."
4.7 Setting Out	*Substitute the last word "Cost plus reasonable profit" of Sub-Clause 4.7.3(ii) by the word Cost.*
4.8 Health and Safety Obligations	*After Sub-Clause 4.8, add the following:* f) "The Contractor shall be liable to be levied penalty for non-compliance or repeated failure in implementation of requisite safety measures as described above. The amount of penalty applicable for different types of violations shall be as specified under **Annexure-II of Appendix to Tender.** However, the cumulative limit for the penalty under a contract shall be 1.0 (one) percent of Accepted Contract Amount. This penalty shall be in addition to all other penalties specified elsewhere in the contract. If cumulative limit of penalty is exceeded but the Contractor continues to neglect the requisite safety measures, the same shall be considered as breach of contract. Such sums shall be deducted from any monies payable/due to the Contractor. No claim for levy of such penalty on account of non-observance of safety measures by the Contractor shall be entertained by the Employer. Further, imposition of penalty does not make the contractor eligible to continue the work in unsafe manner."
4.10 Site Data	*At the end of Sub-Clause, add point (f) to (g):* f) "Site conditions including access to the site, existing and required roads and other means of transport/ communication for use by them in connection with the Works; g) Requirement and availability of land and other facilities for their enabling works, colonies, stores and workshops etc. such land shall be arranged by the Contractor at his own cost, if not provided by the Employer."
4.11 Sufficiency of the Accepted Contract Amount	*At the end of Sub-Clause 4.11, add:* "Items of the works described in the Price Schedule for which no rate and price has been entered in the Contract shall be considered (up to the quantities provided in Price Schedule) as included in other rates and prices in the Contract and will not be paid separately by the Employer."
4.16 Transport of Goods	*At the end of Sub-Clause 4.16, add:*

Khorlochhu Hydro Power Ltd.

	"The contractor shall give preference to Bhutanese for transportation of Goods for the project. The contractor shall show proof of adequate efforts made for such recruitment. If it is found necessary for the Contractor to move one or more oversized/overweight loads of Goods over roads, highways, bridges on which such oversized and overweight items are not normally allowed to be moved, the Contractor shall obtain prior permission from the concerned authorities. Project road constructed by employer/ civil contractor shall be used by the contractor on "As is where is Basis" for transport of goods. Project Roads constructed by Employer will be of WBM standard only. However, major parts of the Project Roads may be black topped (tarred) by the Civil Contractor. The contractor shall share with other contractors the use of project access roads"
4.17 Contractor's Equipment	*At the end of the Sub-Clause 4.17, add:* "If in the opinion of Engineer, the Equipment deployed by the Contractor are old/inapt for carrying out the works and the works are likely to be delayed due to deployment of such Equipment, the Engineer can ask the Contractor to replace such Equipment. Also, based on the nature and exigency of work, Engineer may direct the Contractor to deploy such additional Equipment as is deemed necessary for timely completion of Works without any extra payment whatsoever on account of replacement of old Equipment and/or deployment of additional Equipment."
4.18 Protection of the Environment	*At the end of Sub-Clause 4.18, add:* "The Contractor shall be required to ensure that there shall be no felling of trees or unauthorized quarrying by him or his labourers or their family members and he will be solely responsible for their acts in this regard. The Contractor shall maintain ecological balance by preventing deforestation, water pollution and defacing of natural landscape in the vicinity of work areas. The Contractor shall so conduct his construction operations as to prevent any unnecessary destruction of, scarring or defacing the natural surroundings in the vicinity of the work area. In order to maintain the ecological balance, the Contractor shall specifically comply with the following instructions: a) The Contractor shall strictly follow all notifications/guidelines of RGoB related to protection of Environment, conditions stipulated by the National Environment Commission (NEC), RGoB while according the environment clearances to KHPL and conditions stipulated in Technical Specifications. b) Where unnecessary destruction, scarring, damage or defacing may occur as a result of the Contractor's operation, the same shall be repaired, replanted or otherwise corrected at the Contractor's expense. The Contractor will prevent scattering of rocks and other debris outside the work areas. All work areas shall be smoothed and graded in a manner to conform to the natural appearance of the landscape as directed by the Engineer.

	c) All trees and shrubs which are not specifically required to be cleared or removed for construction purposes shall be preserved and protected from any damage that may be caused by the Contractor's construction operation and equipment. The removal of trees or shrubs will be permitted only after prior approval from the relevant authorities. Special care shall be exercised where trees or shrubs are exposed to injuries by Construction Equipment, blasting, excavating, dumping, chemical damage or other operation and the Contractor shall adequately protect such trees by use of protective barriers or other methods approved by the Engineer. Trees shall not be used for anchorage. d) The Contractor's construction activities shall be performed by methods that will prevent entrance or accidental spillage of solid matter contaminants, debris and other objectionable pollutants and wastage into the river. Pollutants and wastes shall be disposed-off in a manner and at sites in conformity with applicable Laws. e) In the conduct of construction activities and operation of Construction Equipment, the Contractor shall utilize such practicable methods and devices as are reasonably available to control, prevent and otherwise minimize air pollution. The Contractor shall fully comply with all applicable Laws in this regard. f) Burning of materials resulting from clearing of tree, bush, combustible construction materials and rubbish may be permitted only when atmospheric conditions for burning are considered favourable. g) Contractor (including its Sub-contractor) shall provide alternative fuel arrangement i.e. cooking gas/ kerosene oil, electricity free of cost to all its canteen /mess, labourers and staff working in the Project during the whole period of construction activity to avoid felling of trees for use as firewood. In case alternative fuels supply i.e. kerosene, gas, electricity is not available in the project area, the Contractor shall approach the Department of Forests and Park Services/Natural Resources Development Corporation Limited to open fuel wood depot in the project area for meeting the demand of fuel wood. h) The Contractor shall be required to prevent flowing of debris and muck into the river. Necessary retaining structures like walls/crates etc. shall be constructed for the purpose. The Contractor shall also stabilize the muck fully i.e. consolidation and compaction of the muck shall be carried out in the muck dump sites before handing it over to the Employer at the end of construction period. i) Medical facilities as well as the recreational facilities shall also be provided to the labourers. j) All labourers to be engaged for the construction work shall be thoroughly examined by health personnel and adequately treated before they are deployed in the work.

Khorlochhu Hydro Power Ltd

	k) All the Construction Equipment which are likely to generate high noise levels are to be fully equipped (with noise reduction measures) to meet the ambient noise control standards. l) The Employer shall facilitate/assist Contractors in obtaining necessary permits from concerned authorities/agencies of RGoB. The Contractor shall not allow any of its employee/labourers employed by it to settle in forest area even temporarily. If any provision(s) is not complied with within a reasonable time even after issue of a notice in this respect, the necessary operations would be carried out by the Engineer/concerned authorities of RGoB at the cost of the Contractor plus administrative charges of Employer. The Contractor shall indemnify and hold the Employer harmless against and from all claims, damages, losses and expenses (including legal fees and expenses) resulting from the consequences of any failure by the Contractor to comply with the provisions of this Sub-Clause. In addition, the contractor shall execute all activities in line with the guidelines of the Department of Culture, RGoB and the Guide and location map of Sacred Cultural/Religious Sites which contain the details of sacred sites/objects/monuments in the project area provided by the employer. The contractor shall take specific measures as may be warranted for physical and spiritual preservation of sacred cultural/religious sites/monuments. Under no circumstances, whatsoever, the contractor shall cause any damages to such sacred cultural/religious sites or monuments in the vicinity of the project by any construction activity particularly blasting. Extraction of construction materials such as boulders and timber from nearby such sacred sites shall not be permitted. Due reverence shall be exhibited by the contractor and its employees towards these sacred monuments and the religious sentiments of the local people shall be respected at all times. The contractor shall ensure proper sanitation in and around the sacred sites. No wastes of any kind shall be disposed near the sacred sites. It shall be the responsibility of the contractor to make workers aware about the sacred sites. The behavior such as substance abuse, sexual misconducts and other nuisances in the vicinity of sacred sites is prohibited. The contractor shall not bar the public from visit to sacred sites unless written notices are fitted with the approval of the Employer and the contractor shall treat any public visiting the sacred sites with courtesy. Smoking, drinking, sexual activities, slaughter of animals etc. by the contractor or its staff and its business associates/partners/ Subcontractors in the vicinity of sacred sites and public places are prohibited.”
4.19 Electricity, Water and Gas	*At the end of Sub-Clause 4.19, add:* “The construction power for the Project shall be arranged and provided to the Contractor by the Employer at 33 kV bus at various

	identified locations/construction sites. Step-down arrangement is to be made by the Contractor at its own cost. Contractor shall, along with its Bid, submit the power requirements in kVA at each working area location. Each supply point shall be treated as separate connection. Arrangements for further distribution of power to the Contractor's Site, fix equipment, workshops, colonies and offices from the point of supply shall be made by the Contractor at his own cost. The electrical installation plan shall be submitted for approval of the Engineer. Before the release of grid connection, the Contractor shall make all applicable advances/ fees/deposits at prevalent rates as per rules of RGoB to the Employer/ Bhutan Power Corporation (BPC), as the case may be. The domestic electricity tariff rate and miscellaneous charges are available on the website https://www.bpc.bt/electricity-tariff/ Contractor shall also make necessary back-up arrangements of construction power by installing sufficient number of diesel generating (DG) sets & lines and operate these sets for his requirements of power at no cost to the Employer. Permission for installation of DG sets shall be taken by the Contractor at his own cost as per applicable rules from concerned authorities in Bhutan. The Contractor shall comply with all the conditions of power supply rules and regulations prevalent in Bhutan. The Contractor shall pay the applicable energy charges to the concerned agencies from time to time. Any variation in power tariff as may be applicable during execution of Works, shall be borne by the Contractor and shall not be paid by the Employer separately under clause 13.7 of GCC (Adjustment for Changes in Legislation). No claims shall be entertained by the Employer on account of non-availability or inadequate quality of construction power. The Contractor shall ensure effective enforcement of the provisions under the Water Act of Bhutan 2011 and its Regulation 2014."
4.21 Progress Reports	*At the end of Sub-Clause 4.21, insert the following paragraph:* (i) List of all insurance claims lodged with the insurance companies showing details viz. nature and amount of claim lodged, status of settlement, reasons for delay in settlement of claim(s) (if any), amount settled and paid by insurance company, amount of settled claim paid or to be paid to the Employer (where Employer has interest in the claim) etc. (j) The Contractor/Engineer is required to maintain Hindrance Register(s) as per **(Section-5, Forms and Procedures-Form-7)** for reporting hindrances if any, while executing the work in respect of design, engineering, procurement, supply and site work related issues. The Contractor/Engineer shall record hindrances in the Hindrance Register(s) and Contractor shall bring each hindrance to the notice of Engineer not later than 7 days of the happening of the

	hindrance failing which the same shall not be considered or taken into account for any purpose whatsoever. The Contractor shall submit in the monthly progress report up to date hindrance record in the format as mentioned in the hindrance register with reference number and date of intimation of occurrence of each hindrance(s). (k) In case of any hindrance, if the Contractor's resources are idle, the Contractor shall get the same verified from the Engineer on a regular basis. Up to date duly verified idling of manpower and Equipment shall be submitted by the Contractor in the format given in **Volume-6, Technical Data Sheets** and other supplementary formats as approved by the Engineer. The Contractor shall submit the above details along with reasons for such idling. (l) List of all the claims submitted by the Contractor. (m) List of the Construction Equipment brought at Site during the period with purchase invoices. Further, the Contractor shall submit annual report regarding the status of works undertaken in pursuance to the contract. In addition to other annual reports namely gist of progress during the year; photograph showing status of works at the end of the accounting year; details of the Contractor's personnel and equipment; details of claims preferred; safety statistics including hazardous accidents; main environment aspects; the Contractor shall also submit report on annual accounts of the works undertaken by the Contractor under the Contract as a separate accounting unit. The annual accounts shall be compiled in accordance with applicable accounting standards, audited by their statutory auditors/independent Chartered Accountant. The Contractor shall submit the audited annual accounts within 60 days from the end of accounting year.
	After 4.24, add new Sub-Clauses 4.25 and 4.26 as below:
4.25 Land	The Employer shall make available land as indicated in the tender drawings, free of cost, for construction of Contractor's construction facilities like temporary houses for staff and labour, field offices, workshop, stores, fabrication shops, etc. required for execution of the Contract. Levelling and dressing of the land for contractor's construction facilities as per plan approved by the engineer shall be done by the contractor at his own cost. Additional land, if required by the Contractor for construction facilities shall be arranged by him at his own cost. The Contractor shall obtain the environment clearances from concerned authorities as per provisions of the Environment Assessment Act, 2000 and its Regulations 2002 for setting up his construction facilities at his own cost. The Employer shall extend all necessary assistance to the Contractor to obtain required environment clearances. Levelling and dressing of the site and construction of temporary roads, houses, offices, workshops, etc. as per the plan approved by the Engineer shall be done by the contractor at its own cost. The Final payment Certificate shall not be issued, until and unless the Contractor has handed over the possession of land allotted to

	him in good condition after obtaining clearances from the relevant agencies of RGoB and free from all encumbrances. The use or occupation of the land by the Contractor shall not confer on him any right of tenancy or possession thereof. The Contractor shall vacate immediately land upon one month notice of the Engineer.
4.26 Assignment and Novation of Manufacturer's Warranties	The Contractor shall procure that any warranty, express or implied, with respect to any Plant or Materials used in the construction of the Works made or given by the manufacturer, any Subcontractor, any supplier, or any other seller thereof, will be made in favour of the Employer, or will be assigned or otherwise made available to the Employer or such entity that the Employer nominates. The Contractor must ensure that all warranties given by the manufacturer, Subcontractor or supplier, or any other seller thereof, will be capable of novation from the Employer to any entity to be nominated by the Employer. To the extent that the warranties cannot be made in favour of the Employer, assigned or otherwise made available to the Employer, the Contractor agrees (at its cost) to use its best endeavours to enforce such rights as the Contractor may have, for the benefit of the Employer. The Works shall not be considered to be completed for the purposes of being Taken Over under Sub-Clause 10.1 [*Taking Over the Works and Sections*] until the Employer has received such warranties and confirmation that the warranties are capable of novation from the Employer to any entity to be nominated by the Employer.
5. Design	
5.1 General Design Obligations	*Delete Sub-Clause 5.1 and substitute by the following paragraphs:* "The Contractor shall carry out, and be responsible for, the design of the Works consistent with Best Industry Practices. Design shall be prepared by qualified, experienced and competent designers who are engineers or other professionals who comply with the criteria (if any) stated in the Technical Specifications. Unless otherwise stated in the Contract, the Contractor shall submit to the Engineer for consent the name and particulars of each proposed designer and design sub-contractor. The Contractor shall at his own expense carry out all investigations, model studies, design and preparation of specifications, construction, working, shop drawings and all other things as necessary for the performance of the Works. The design and drawings shall be accompanied by detailed calculations, including design philosophy, references (if any) and standards, and shall be submitted to the Engineer, in accordance with Sub-Clause 5.2 [*Contractor's Documents*] and the Technical Specifications, for approval, before commencement of the Works. However, the scope of design of steel liner works shall be carried out by the Design & Engineering Consultant of KHPL and approved by the Employer. The Contractor shall comply with the final approved design of steel liners and shall be fully responsible

Khorlochhu Hydro Power Ltd.

	for the supply, fabrication and erection works in complete as per the Employer's Requirements. The Contractor shall be responsible for coordinating his detailed design with the Civil Contractor & Electro-mechanical Contractor, failure to do so shall not entitle the Contractor to any extension of Time for Completion or any additional costs or other compensation. The Contractor shall warrant that he, his designers and design Subcontractors have the experience, capability and competence necessary for the design. The Contractor shall undertake that the designers shall be available to attend discussions with the Engineer at all reasonable times (on or off the Site), until the issue of the Performance Certificate. Upon receiving notice under Sub-Clause 8.1 [*Commencement of Works*], the Contractor shall scrutinise the Employer's Requirements (including design criteria and calculations, (if any) and the items of reference mentioned in Sub-Clause 4.7 [*Setting Out*]. Within the period stated in the Appendix to Tender, calculated from the Commencement Date, the Contractor shall give notice to the Engineer of any error, fault or other defect found in the Employer's Requirements or these items of reference. After receiving this notice, the Engineer shall determine whether Clause 13 [*Variations and Adjustments*] shall be applied and shall give notice to the Contractor accordingly. If and to the extent that (taking account of cost and time) an experienced contractor exercising due care would have discovered the error, fault or other defect when examining the Site and the Technical Specifications before submitting the Tender, the Time for Completion shall not be extended, and the Contract Price shall not be adjusted."
5.4 Technical Standards and Regulations	*In the first paragraph delete "*the Country's technical standards" *and replace with:* "those technical standards referred to in the Employer's Requirements or where no technical standards are referred to in the Employer's Requirements with accepted International Standards approved by the Employer/the Engineer," *Insert the following at the end of the first paragraph:* "The work shall comply with the latest issue of internationally acceptable standards. The Contractor shall identify the standards he intends to use and shall submit copies of latest editions of relevant standards to the Employer. By definition, such international acceptable standards comprise organizations such as the BIS (Bureau of Indian Standards), ASTM (American Society for Testing and Materials), ISO (International Organization for Standardization), DIN (German Code), BS (British Standards), SS (Swedish Standards), and EN (European Standards). Should the Contractor request alternative to the above standards, other relevant standards may not be used without the Employer's approval. Difference between the standards specified and the proposed alternative standards must be fully described in writing

Khorlochhu Hydro Power Ltd.

	by the Contractor and submitted to the Employer for review and approval. The latest edition of the standards and codes, including amendments thereof, shall be used by the Contractor."
5.5 Trainings	*At the end of Sub-clause 5.5, add:* The contractor and its subcontractor shall mandatorily and practically engage the operation and maintenance staff deployed by Employer consisting of personnel at officers and technicians level for erection, testing and commissioning of all the Hydro-Mechanical Equipment. The Employer's personnel shall act only and in compliance with the instructions and orders given by the Contractor or its Subcontractors. The contractor shall not be liable for any loss and damage resulting from any non-compliance with the Contractors or its Subcontractors instructions and orders or any actions not covered by such instructions. The Contractor shall provide 3 man-months of training as specified under **Volume-4 [Employer's Requirements]**, with no additional cost to the Employer.
5.6 As-Built Documents	*Insert the following at the end of this Sub-Clause 5.6:* "The Contractor shall supply the Employer with five (5) hard copies and two (2) electronic copies (out of which one electronic copy shall be in source format/software in editable form) of each As-Built Records"
5.8 Design Error	*Delete Sub-Clause 5.8 in its entirety and replace with:* "The Contractor shall be responsible for any errors, omissions, ambiguities, inconsistencies or other defects in the Contractor's Documents or Drawings, and the approval by the Employer or the Engineer of these documents shall not relieve the Contractor in any way from this responsibility. With respect to designs prepared by the Contractor on the basis of Drawings, documents or other information which he receives from the Employer or the Engineer, the responsibilities of the Contractor with respect to the correctness of such Drawings, documents or other information and for notifying the Engineer of any errors, omissions, ambiguities, inconsistencies or other defects therein shall be in accordance with Sub-Clause 1.9 [Errors in the Employer's Requirements]."
Insert new Sub-Clause 5.9 as follows;	
5.9 Warranty by the Contractor	Except as otherwise provided in the Contract, the Contractor: (a) warrants that he did not in any way rely upon: (i) any information, data, representation, statement or document made, or provided to the Contractor, by the Employer, or anyone on behalf of the Employer or any other information, data, representation, statement or document for which the Employer is responsible or

Khorlochhu Hydro Power Ltd.

	may be responsible whether or not obtained from the Employer or anyone on behalf of the Employer; or (ii) the accuracy, adequacy, suitability or completeness of such information, data, representation, statement or document, for the purposes of entering into the Contract; (b) warrants that he enters into the Contract based on his own investigations, interpretations, deductions, information and determinations; and (c) acknowledges that he is aware that the Employer has entered into this Contract relying upon the warranties, acknowledgements and agreements in this Sub-Clause.
6. Staff and Labour	
6.1 Engagement of Staff and Labour	*At the end of Sub-Clause 6.1, add:* "The Contractor is encouraged to the extent possible and reasonable, to employ staff and labour with appropriate qualifications and experience from Bhutan. To the extent possible, the unskilled labour, shall be recruited from Bhutan. The Employer may impose certain restrictions on the Contractors to deploy staff and labour as per the Laws of the Country. The Contractor shall not employ any person who has not completed 18 years of age. The Contractor shall arrange permits for the labour/staff for their entry into Bhutan, at his own cost."
6.3 Persons in the Service of Employer	*At the end of Sub-clause 6.3, add:* *"*Neither the Employer nor the Engineer shall recruit, or attempt to recruit, staff and labour from the amongst the Contractor's personnel working at the Project*"*
6.4 Labour Laws	*Delete Sub-Clause 6.4 and substitute:* "During the subsistence of the Contract, the Contractor and its Subcontractors shall observe, comply and abide at all times with all applicable Laws as applicable to the Contractor's Personnel including all Laws relating to their employment, health, safety, welfare, insurance, gratuity, provident fund, pension, child labour, industrial disputes, contract labour, employment of women etc. The Contractor shall be solely responsible for and shall require and ensure that all the Contractor's Personnel and its Subcontractors and their employees comply with all applicable Laws including labour laws and those concerning safety at Works. The Contractor shall not permit any of the Contractor's Personnel to maintain any temporary or permanent living quarters within the structures forming part of the Permanent Works. The Contractor shall send to the Employer and other authorities as applicable, details of any accident as soon as practicable after its occurrence. The Contractor shall maintain records and make reports concerning health, safety and welfare of persons, and damage to person or property, as the Employer may reasonably require. The Contractor shall keep the Employer, Employer's Personnel and their respective agents, directors, servants and workman

	indemnified and saved harmless at all times notwithstanding termination of the Contract against and from all demands, actions, claims, proceedings, losses, damages, costs and expenses (including legal fees and expenses) by any Government Instrumentality including any account or in respect of any contravention or failure to observe or comply with any Laws including labour laws. If the Employer or any of the Employer's Personnel are required to pay or reimburse any amount on account of any of the aforesaid or any recovery is made on account thereof by any person, court or Government Instrumentality, the Employer shall have the right to recover the same by deduction from any money due or payable to Contractor including from the Security Deposit. The Employer shall also have right to recover from the Contractor any sum required or estimated to be required for making good any loss or damage suffered or incurred by the Employer. The employees of the Contractor and the Subcontractors shall in no event be treated as the employees of the Employer at any point of time. The Contractor shall get all its employees (including employees of Subcontractors) insured with Insurance Companies of Bhutan and comply with Labour and Employment Act of Bhutan 2007 (https://nab.gov.bt/page/acts) from start of work till completion of Works. The Contractor shall have no right to demand payments/claims whatsoever on account of his compliance with its obligations under this Clause including compliance with Laws save and except those specifically mentioned in the Sub-Clause 13.8 of the GCC to the extent as mentioned therein pertaining to Price Adjustment. Without prejudice to the foregoing, the Contractor shall indemnify and keep indemnified and saved harmless the Employer, the Employer's Personnel, and their respective agents, directors, servants and workmen against and from all claims, damage, losses and expenses (including legal fees and expenses) in respect of: *(a) bodily injury, sickness, disease or death, of any person whatsoever including Contractor's Personnel arising out of or in the course of or by reason of the design (where Contractor is responsible), execution and completion of the Works and the remedying of any Defects,* *(b) damage to or loss of any property, real or personal (other than the Works), to the extent that such damage or loss arises out of or in the course of or by reason of the design (where Contractor is responsible), execution and completion of the Works and the remedying of any Defects.* The Contractor shall abide at all times by the Contractor's Labour regulations appended under **Annexure-III of Appendix to Tender**.

6.5 Working Hours	*Delete Sub-Clause 6.5 and substitute:* "Subject to any provision contained in the Contract, the Contractor shall have the option to work continuously by day and by night and on locally recognized holidays or days of rest, without any additional cost to the Employer."
6.7 Health and Safety	*At the end of Sub-Clause 6.7, add:* "The Contractor shall provide and maintain upon the works sufficient, proper and efficient life-saving appliances and first-aid equipment to the approval of the Engineer. The appliances and equipment shall be available for use at all times. The model rules for Health & Sanitary arrangements for Contractor's workmen shall be as specified under **Annexure - IV** of **Appendix to Tender** respectively."
7. Plant, Materials and Workmanship	
7.1 Manner of Execution	*Insert the following paragraphs at the end of this Sub-Clause:* "All Materials and Plant that are intended to be or will be incorporated in the Permanent Works shall be new, unless specified otherwise, and shall conform to the Technical Specifications. Such Materials and Plant shall not have been used in Temporary Works or for any other prior purpose whatsoever. Contractor shall warrant that all Materials used by them in carrying out the Works shall be free from defects, of the best quality available and fit for their intended purpose, taking into account local climatic conditions at the Site."
7.4 Testing	*At the end of fifth paragraph, under (b) substitute the words:* "Cost plus reasonable profit" by Cost, which shall be included in the Contract Price."
7.6 Remedial Work	*Under the third paragraph sub clause 7.6 (i), substitute the words:* "Cost plus reasonable profit" by Cost, which shall be included in the Contract Price."
7.7 Ownership of Plants and Materials	*Delete sub para (a) of Sub-Clause 7.7 and substitute by the following:* (a) when it is incorporated in Works.
8. Commencement, Delays and Suspension	
8.1 Commencement of Works	*Delete first sentence of the first paragraph of Sub-Clause 8.1 and substitute:* The Commencement Date shall be reckoned from the date of Signing of Contract Agreement.
8.3 Programme	*Replace 1st line of Sub-Clause 8.3 with the following:* "The Contractor shall submit a detailed work programme to the Engineer within 28 days from the Commencement made in the form of critical path method (CPM), the Program Evaluation and Review Technique (PERT) network, using a latest project management software Primavera Professional 6 or Microsoft Project, and showing the sequence in which, it proposes to design, manufacture, transport, assemble, install and pre-commission the

Khorlochhu Hydro Power Ltd.

	facilities. The schedule shall identify the critical path activities and shall have capabilities of predicting completion date of the Works with periodic progress updates during the execution of contract."
8.4 Extension of Time for Completion	*Under Sub-clause 8.4(c), "exceptionally adverse climatic conditions" shall not include rainfall and snowfall.* *Add the following at the end of the Sub-clause 8.4:* "Contractor shall submit application for extension of time with supporting documents within 28 days at the end of each quarter failing which it would be construed that there was no hindrance (even though the hindrance has been brought to the notice of Engineer as per Clause 4.20) during the quarter requiring extension of Time for Completion and Contractor shall forfeit his claim for extension of Time for Completion. In case, hindrances resulting from interface activities with other agencies working at the project are brought to the notice of Engineer, the Employer shall determine the duration of such interface activities as per the schedule of interface activities formulated jointly by Contractors and Employer during the course of execution."
8.7 Delay Damages	*At the end of first paragraph of Sub-Clause 8.8, add:* "The Contractor guarantees that it shall attain Completion of the Facilities (or a part for which a separate time for completion is specified in the Contract) within the Time for Completion specified in the Contract pursuant to Sub-Clause 8.2 [*Time for Completion*], or within such extended time to which the Contractor shall be entitled under Sub-Clause 8.5 [*Extension of Time for Completion*] hereof. Delay damages shall be recoverable for delay in completion of interdependent contract milestones and completion of KHM Work milestones as stated in **Annexure-V** to **Appendix to Tender**. Further, the delay damages levied on account of delay in the completion of some Milestones and if, the Contractor achieves the subsequent milestone within specified time, the delay damages already levied forth at item of work shall be refunded. The aggregate amount of such delayed damages shall in no event exceed the ten percent (10%) of the Accepted Contract Amount. Once the "Maximum" is reached, the Employer may consider termination of the Contract, pursuant to Sub-Clause 15.2 [*Termination for Contractor's Default*]. However, the payment of delay damages shall not in any way relieve the Contractor from any of its obligations to complete the Facilities or from any other obligations and liabilities of the Contractor under the Contract. No bonus will be given for earlier Completion of the Facilities or part thereof."
9. Tests on Completion	

9.1 Contractor's Obligations	*Delete first paragraph of Sub-Clause 9.1 and replace with:* "The Contractor shall carry out the Tests on Completion in accordance with this Clause, Sub-Clause 4.9 [*Quality Assurance*] and Sub-Clause 7.4 [*Testing*], after providing the required documents in accordance with the Employer's Requirements, including those referred to in Sub-Clause 5.6 [*As-Built Documents*] and Sub-Clause 5.7 [*Operation and Maintenance Manuals*]." *At the beginning of the third paragraph delete* "Unless otherwise stated in the Particular Conditions" *and replace with:* "The Tests on Completion shall be carried out in the sequence and in accordance with the requirements set out in the Employer's Requirements. Where no sequence is set out in the Employer's Requirements, the Test on Completion shall be carried out in the following sequence": *Insert the following additional Sub-Clause*s after 9.1. (c) (d) if required by the Engineer, shall be carried out in the presence of any other person nominated by the Engineer; and (e) shall be coordinated with, or carried out in conjunction with the Contractor(s) of other packages. *Insert the following paragraph between fifth and sixth paragraph*: The Employer will issue the Operational Acceptance Certificate upon completion of the required tests as per Employer's Requirements. However, the issuance of Operational Acceptance Certificate shall not constitute the taking-over under Clause 10 *[Employer's Taking Over]*.
	Insert new Sub-clause 9.5 as follows:
10. Employer's Taking Over	
10.2 Taking Over of Parts of the Works	*The phrase "Cost plus reasonable profit" under Sub-Clause 10.2 is substituted by "Cost".*
10.3 Interference with Tests on Completion	*The phrase "Cost plus reasonable profit" under Sub-Clause 10.3 is substituted by "Cost".*
11. Defects Liability	
11.8 Contractor to Search	*The phrase "Cost of the search plus reasonable profit" under Sub-Clause 11.8 is substituted by "Cost of the search".*
Insert new Sub-Clauses 11.12, 11.13 and 11.14 as follows;	
11.12 Latent Defects Liability	At the end of the Defect Notification Period, the Contractor's Liability shall cease except for latent defects and defect liability of spares as specified in Sub-Clause 11.13 [*Defect Liability of Spares*]. The Contractor's liability for latent defects warranty shall be limited to a period of **five (5) years from the end of Defect Notification Period**.

	For the purpose of this clause, the latent defects shall be the defects inherently lying within the material or arising out of design deficiency, which do not manifest themselves during the Defect Notification Period, but at a later point of time.
11.13 Defect Liability of Spares	All spares shall be supplied new and defect liability shall be in accordance with the Contract Documents and shall be free from defects in design, engineering, material and workmanship and shall further guarantee as under: a) For five (5) years operational spares (both mandatory and recommended spares): (i) For any item of spares ordered or to be ordered by the Employer for five (5) years operational requirement of the Plant and Equipment which are manufactured as a continuous operation together with the corresponding main equipment/ component, the defects liability period will be 1095 days from the scheduled date of commercial operation of main equipment/plant under the Contract. 'Commercial Operation' shall mean the conditions of operation in which the complete equipment covered under the Contract is officially declared by the Employer to be available for continuous operation at different loads up to and including rated capacity. Such declaration by the Employer, however, shall not relieve or prejudice the Contractor of any of his obligations under the Contract. In case of any failure in the original component/equipment due to faulty designs, materials and workmanship, the corresponding spare parts, if any, supplied will be replaced without any extra cost to the Employer unless a joint examination and analysis by the Employer and the Contractor of such spare parts prove that the defect found in the original part that failed, can safely be assumed not to be present in spare parts. Such replaced spare parts will have the same defect liability as applicable to the replacement made for the defective original part/component provided that such replacement for the original equipment and the spare replaced are again manufactured together. This discarded spare parts will become the property of the Contractor as soon as they have been replaced by the Contractor. (ii) For the item of spares ordered or to be ordered by the Employer for five (5) years operational requirement of the Plant and Equipment, which with the written approval of the Employer, are not manufactured as a continuous operation together with the manufacture of the corresponding main equipment/component, will be warranted for trouble free operation if used within a period of 1095 days (reckoned from the date of delivery at Site). However, if such spare parts are put to use after 1095 days of the delivery at Site then the guarantee of such spares will stand valid till the expiry of 730 days from the date of issue of Test on Completion Certificate of equipment/plant for trouble free operation after such spares are put in service. (iii) For long term requirement of spares that may be ordered by the Employer to cover requirements beyond five (5) years

Khorlochhu Hydro Power Ltd.

	of initial operation of plants, the warranty period will be 730 days from the date they are put into trouble free operation if used within a period of 730 days from the delivery at Site. b) The defect liability of spares that are not used within 24 months from the respective dates of the delivery at Site covered in para (ii) and (iii) above, will however be subject to condition that all such spares being stored/maintained/preserved in accordance with Contractor's standard recommended practice, if any, and the same has been furnished to the Employer. c) To enable the Employer to finalize the requirement of recommended spare which are to be ordered subsequent to placement of order for main Plant and Equipment, in addition to necessary technical details, catalogue and such other information brought-out herein above, the Contractor will also provide a justification in support of reasonableness of the quoted prices of spares which will, inter-alia, include documentary evidence that the prices quoted by the Contractor to the Employer are not higher than those charged by him from other customers in the same period. d) In addition to the spares recommended by the Contractor, if the Employer further identifies certain particular items of spares, the Contractor will submit the competitive prices and delivery quotation for such spares within 30 days of receipt of such request with a validity period of 6 months for consideration by the Employer and placement of order for additional spares if the Employer so desires. e) The Contractor shall guarantee the long-term availability of spares to the Employer for the full life of the equipment covered under the Contract. The Contractor shall guarantee that before going out of production of spare parts of the equipment covered under the Contract, he shall give the Employer at least 2 years advance notice so that the latter may order his bulk requirement of spares if it so desires. The same provision will also be applicable to Subcontractors. Further, in case of discontinuance of manufacture of any spares by the Contractor and/or his Subcontractors, the Contractor will provide the Employer, 6 months in advance, with full non-proprietary manufacturing drawings, material specifications and technical information including information on alternative equipment makes required by the Employer for propose of manufacture/procurement of such items. f) The price of all future requirements of items of spares beyond 3 years operational requirement will be derived from the corresponding ex-works price at which the order for such spares have been placed by Employer as a part of mandatory spare parts or recommended spares. Ex-works order price of future spares shall be computed in accordance with the price adjustment provisions covered under the main Contract with the base indices mentioned therein and there will be no ceiling on the amount of variation in the prices. The above option for procuring future recommended spares by the Employer shall remain valid for the period of 5 (five) years from the date of issue of Test on Completion Certificate of the equipment.

Khorlochhu Hydro Power Ltd.

	g) The Contractor will indicate in advance the delivery period of the items of spares, which the Employer may procure in accordance with above Sub-clause. In case of emergency requirements of spares, the Contractor would make every effort to expedite the manufacture and delivery of such spares on the basis of mutually agreed time schedule. h) In case the Contractor fails to supply the mandatory spare parts, recommended or long-term spares in the terms stipulated above, for reasons attributable to the Contractor, the Employer shall be entitled to purchase the same from the alternate sources at the risk and the cost of the Contractor and recover from the Contractor, the excess amount paid by the Employer over the rates worked on the above basis. In the event of such risk purchase by the Employer, the purchase will be as per the Works and Procurement Policy of the Employer prevalent at the time of such purchases and the Employer at his option may include a representative from the Contractor in finalizing the purchases. i) It is expressly understood that the final settlement between the Parties in terms of relevant clauses of the Contract shall not relieve the Contractor of any of his obligations under the provision of long-term availability of spares and such provisions shall continue to be enforced till the expiry of 5 years period reckoned from the date of issue of Test on Completion Certificate of the Plant/Equipment unless otherwise discharged expressly in writing by the Employer. Further, the provisions pertaining to long-term availability of spares shall be extended beyond 5 years applicability period mentioned herein above if so desired by the Employer up to 15 years and at the mutually acceptable escalation formula.
11.14 Warranty and Liability of Software	Subject to the defect notification period, the Contractor's warranty and liability for its own software included in the Facilities shall be limited solely to the elimination of reproducible errors and malfunction thereof, provided the software is installed on hardware supplied or authorized by the contractor. The contractor shall be granted sufficient access by the employer with all documentation and information to trace the error. Instead of eliminating errors in the supplied version of software, the contractor shall have the right to establish an error free later version and supply the same at no additional cost to the Employer. The newer version so implemented shall be compatible with the existing hardware supplied or authorized by the Contractor. With respect to standard software (e.g. UNIX, DOS, Words, Excel etc.,) licensed from others, the Contractor's warranty and liability shall be limited solely to the warranties and liabilities by the licenses of such software.
12. Tests after Completion	
12.1 Procedure for Tests after Completion	*Delete sub-paragraph (a) and replace with:* "(a) The Contractor shall be responsible for the provision of all electricity, fuel and materials for the tests, at his own cost." *Delete Sub-clause (b) and replace with:*

	"(b) The Contractor shall provide adequately qualified personnel, sufficient supply of all raw materials, utilities, lubricants, chemicals, catalysts and other materials as required, together with all necessary plant and equipment; and shall perform all the works and services of whatsoever nature required to properly carry out the Tests and Commissioning."
12.2 Delayed Tests	*The phrase "Cost plus reasonable profit" at the end of 1st para of this Sub-Clause 12.2 be substituted by "Cost".*
12.4 Failure to Pass Tests after Completion	*The phrase "Cost plus reasonable profit" at the end of this Sub-Clause is substituted by "Cost".*
13. Variations and Adjustments	
13.1 Right to Vary	*Replace second sentence of this sub clause as under:* "Other than as stated under Sub-clause 11.4 [*Failure to Remedy Defects*] and in the event of a variation omitting part of the Works, the Contractor shall have no claim against the Employer (including claim for profit) except in relation to those Costs already incurred by the Contractor in anticipation of carrying out that part of the Works" *Insert the following paragraph at the end of this Sub-clause* "However, any works identified by the Employer as being necessary to amend the Contractor's Design to make the Works fit for the purposes intended, as described in the Employer's Requirements, shall not be considered a Variation."
13.2 Value Engineering	*Add the following after Sub-Clause 13.2* "Similarly, Employer may, at any time, ask the Contractor to study and evaluate a proposal suggested by the Employer, which (in the Employer's opinion) will, if adopted, (i) accelerate completion, (ii) reduce the cost to the Employer for executing, maintaining or operating the Works, (iii) improve the efficiency or value to the Employer of the completed Works, or (iv) otherwise be of benefit to the Employer without resulting in reductions in quality, anticipated life or operational efficiencies. The contractor shall study and evaluate at its own cost and respond to the proposal from Employer in writing within 28 (Twenty-Eight) days regarding the suitability of the proposal. If such a proposal as suggested by the Employer and is agreed by the Contractor, the proposal shall be prepared at the cost of the Contractor and shall include the items listed in Sub-Clause 13.3 [*Variation Procedure*]." Both parties (Employer and Contractor) shall also agree for adjustment in the Contract Price, if any, resulting from the change. The overall responsibilities, safety and suitability of the Works shall be of the contractor, if such proposal as requested by the Employer is agreed by the Contractor."
13.3 Variation Procedure	*Insert the following paragraph at the end of this Sub-clause*

	"Where the Employer has instructed a Variation, if the Employer and Contractor are unable to agree upon the valuation of the work which is the subject of the Variation, the Engineer shall determine the valuation of the Variation in accordance with Sub-Clause 3.5 [*Determinations*] and as follows: (i) if the Pricing Schedule prescribes specific rates or prices to be applied in determining the valuation, the rates or prices will be used; (ii) if Sub-Clause 13.3(i) does not apply, the rates or prices set out in the Pricing Schedule will be applied to the extent that the Engineer determines it is reasonable to apply them; (iii) to the extent that neither Sub-Clause 13.3 (i) or (ii) apply, a reasonable amount determined by the Engineer; having regard to the cost of material, actual wages of labour, and ownership and operation cost of construction equipment required as per standard norms or if standard norms are not specified/ available then on the basis of labour/ material/ construction equipment actually engaged for particular work. Over and above the cost of labour, material arranged by contractor ownership and operation cost of construction equipment and other direct related cost, an element of 10% shall be allowed to cover the contractor's supervision charges. (iv) in determining the deduction to be made for scope which is taken out of the Contract, or for a Variation which results in a saving to Contractor, the deduction will include an amount for overhead and profit; and (v) the Employer's valuation of the Variation under Sub-Clause 13.3(iii) and (iv) shall include an amount equal to five percent (5%) for overheads and five percent (5%) for profit. At the Employer's request, the Contractor shall provide priced copies of vendor and/or subcontractor quotations, in relation to the costs of any Plant, Materials, labour, equipment not previously set out in or covered by the rates and prices in the Pricing Schedule and which form the basis of the Contractor's proposal for adjustment to the Contract Price in accordance with Sub-Clause 13.3(iii)."
13.5 Provisional Sums	*Sub-Clause 13.5 is not applicable*
13.6 Daywork	*Sub-Clause 13.6 is not applicable*
13.7 Adjustments for Changes in Legislations	*At the end of Sub-Clause 13.7, add:* "Notwithstanding the foregoing, such additional or reduced cost shall not be separately paid or credited if the same shall already have taken into account in the indexing or any inputs to the Price Adjustment Formulae in accordance with the provisions of Sub-Clause 13.8. Provided always that any variations resulting from the changes in legislation, in respect of wages of the labour and staff of the

Khorlochhu Hydro Power Ltd.

	Contractor, shall be deemed to be included in the Adjustment for Changes in Cost (price adjustment formula) included in Sub-Clause 13.8 hereof and shall not be paid separately by the Employer under this Sub-Clause 13.7. Any variation in power tariff as may be applicable during execution of works shall be borne by the Contractor and shall not be paid by the Employer separately under this Sub-Clause 13.7."
13.8 Adjustments for Changes in Cost	*Delete Sub-Clause 13.7 and substitute:* "The amounts payable to the Contractor shall be adjusted for rise or fall in the cost of labour, goods and other inputs to the Works, by the addition or deduction of the amounts determined by the formulae prescribed in this Sub-Clause. To the extent that full compensation for any rise or fall in Costs is not covered by the provisions of this or other Clauses, the Accepted Contract Amount shall be deemed to have included amounts to cover the contingency of other rises and falls in costs. Subject to the conditions laid down hereunder, Contract Price is subject to price adjustment in accordance with the Price Adjustment formulae incorporated in this clause. However, if the Contractor fails to complete whole of the Works within the Time for Completion prescribed under Clause 8.2, adjustment of prices thereafter until the date of completion of the Works shall be made using either: (i) the indices or prices applicable on the date 49 days prior to the expiry of the Time for Completion, or (ii) the current indices or prices; whichever is more favourable to the Employer. No price variation shall be admissible for: a) An amount of 15% (Fifteen percent) of the Accepted Contract Amount which shall be fixed element. b) The advance payment up to the point the advance was released under Sub-Clause 14.2. c) Any items valued at current prices. Payment to Contractor for work done shall be adjusted for increase or decrease in the cost of labour and materials according to the procedure mentioned hereafter. The price adjustment provisions under this clause shall be applicable to the price breakup furnished by the Contractor and applicable only for the work that is carried out within the Time for Completion and for authorized extended time. The Price adjustment formula is as given below: **I. Supply of Hydro-Mechanical Equipment** **a) For Supply of Hydro-Mechanical Equipment** $$P_V = P_0 \times \left[0.15 + 0.50 \frac{S_n}{S_0} + 0.35 \frac{L_n}{L_0} \right] - P_0$$ Where,

P_V = Price adjustment amount payable

P_0 = Adjusted value of supply till project site (minus advance payment)

A = 15%, as fixed component, which is not subject to any price adjustment

S_0 = Steel price index 28 days prior to bid submission from the country of origin.

S_n = Monthly average steel price indices from the country of origin one month prior to date of Invoice.

L_O = Labour price index 28 days prior to bid submission from the country of origin.

L_n = Labour Price index from the country of origin one month prior to date of Invoice.

The percentage of components for compensation due to variation in labour and steel are as defined below**:**

Description	**A**	**P_S**	**P_L**
For Hydro-mechanical Equipment	15	50	35

Indices - For Supply from Bhutan and India

L = All India Consumer Price Index for Industrial Workers, Base (2016=100) as published by Labour Bureau, Ministry of Labour & Employment, Government of India.

S = Wholesale Price Index for Manufacture of Basic Metals, Mild Steel - Flat Products, Base (2011-12=100), as issued by Office of Economic Advisor, MoCI, India.

Indices - For Supply from Country other than Bhutan and India

For supply off-shore supply, the indices of the respective country of origin shall be applicable. The Bidder should submit the indices to the Employer.

II. Erection, Testing and Commissioning

The adjustment in respect of changes in cost or services shall be determined from the following formula:

$$P_X = P_0 \times \left[0.15 + 0.60\frac{L_n}{L_0} + 0.15\frac{F_n}{F_0} + 0.10\frac{E_n}{E_0} \right] - P_0$$

Where,

P_v = Price adjustment amount payable

P_0 = Cost of Complete Erection, Testing, Commissioning and other Services.

A = 15%, as fixed component, not subject to any price adjustment

L = All India Consumer Price Index for Industrial Workers, Base (2016=100) as published by Labour Bureau,

	Ministry of Labour & Employment, Government of India. F = Retail Price of HSD at Doksum outlet which is inclusive of taxes and duties per litre of HSD. E = Wholesale Price Index of Manufacture of Metal-forming Machinery and Machine Tools Base (2011-2012 = 100) as issued by Office of Economic Advisor, MoCI, Government of India. The weightings shall be those listed in the **Annexure-VI of Appendix to Tender**. **Base, Current and Provisional Indices** The base date shall be twenty-eight (28) days prior to the date of submission of bids. The current indices or prices shall be those prevailing one month prior to the last day of the period to which a particular Interim Payment Certificate is related. If at any time the current indices are not available, provisional indices as determined by the Engineer will be used, subject to subsequent correction of the amounts paid to the Contractor when the current indices become available. In case Government of India, stops publishing any of the price indices at any time and announces a new series with a linking factor for conversion of index of new series to the old series, regulation of price variation will be done using the indices of new series along with linking factor from the period the indices of old series become unavailable. However, if the new series released by the relevant source does not have the linking factor the new series shall be used without use of Linking Factor and current as well as base indices of new series shall be used from the date, indices of old series becomes unavailable. Items of works for which rates have been derived from Price Schedules and analogous items in the Price Schedules shall be eligible for Price Adjustment as per the Price Adjustment formula with base date as per the contract. The maximum amount of price adjustment payable shall be up to twenty percent (20%) of the Accepted Contract Amount. **Other Changes in Cost** To the extent that full compensation for any rise or fall in costs to the Contractor is not covered by the provisions of this or other Articles in the Contract, the unit rates and prices included in the Contract shall be deemed to include such difference.
14. Contract Price and Payment	
14.1 The Contract Price	*After subparagraph (d) in Sub-Clause 14.1, add the following:* All Goods imported by the Contractor into the Country for direct use for the Works of Project shall be exempted from customs & other import duties and taxes, with Employer's prior written approval obtained for import. The Employer shall endorse the necessary exemption documents prepared by the Contractor for presentation in order to clear the Goods through customs.

	Similarly, all Goods and materials procured within the Country for direct use for the Works of the Project shall be exempted from taxes imposed within the country. If exemption is not granted, the customs duties and Bhutan Sales Tax payable and paid by the Contractor in the Country shall be reimbursed by the Employer. All Contractors' equipment shall be re-exported on completion of the Contract. If not re-exported, the Goods will be assessed for duties applicable to the Goods involved in accordance with the Laws of the Country. However, exemption may not be available for i) Goods which are similar to those locally produced, unless they are not available in sufficient quantities or are of a different standard to that which is necessary for the works; ii) Goods which are of personnel use for the Contractor's staff and labourers; and iii) any element of duty or tax inherent in the price of goods or services procured in the country, which shall be deemed to be included in the Contract Price. The Bid Price shall include all Custom and other duties, levies, taxes, etc. outside the Employer's Country. The Contractor's staff and personnel will be liable to pay personal income tax in the Country in respect of such of their salaries and wages as are chargeable under the laws and regulations in force in the Country, and the Contractor shall perform such duties in regard to such deductions thereof as may be imposed on him by such laws and regulations. However, Tax Guidelines as applicable for the project have been detailed under **Annexure-VII of Appendix to Tender**. The Royal Government of Bhutan shall receive from the Contractor royalty for timber, boulders, and aggregate and other construction materials required from the Country for the Project. The schedule of royalty for different materials can be obtained from the relevant agencies.
14.2 Advance Payment	*Delete Sub-Clause 14.2 and substitute:* Advance for mobilization and design shall be interest free. The Advance shall be made against Bank Guarantee in the form and manner prescribed by the Employer. The Employer shall pay, if opted for by the Contractor, advance exclusively for the costs of mobilization and design in an amount equal to the advance payment as stated in the Contract Data. The Engineer shall issue an Interim Payment Certificate for the advance payment after receiving a Statement (under Sub-Clause 14.3 [*Application for Interim Payment Certificates*] and after the Employer receives: (i) Performance Security in accordance with the Sub-Clause 4.2 [*Performance Security*]; and (ii) a bank guarantee in the amounts and currencies equal to the advance payment.

	Recovery of advance for mobilization and design shall commence in the next Interim Payment Certificate following that in which the total of all gross value of Interim Payment Certificates has reached 10% of the Accepted Contract Amount and the recovery of the total amount of such advance shall be done on pro-rata basis and shall be completed by the time the gross value of Interim Payment Certificates has reached 80% of the Accepted Contract Amount. The Contractor shall always have the option to have the recoveries commenced and/or completed earlier, and/or to have recoveries effected in installments of higher amounts and also to repay part or whole of the advance by direct payment rather than through running payment. The advances specified here-in-above may be released at any time during pendency of Contract subject to fulfillment of the above stipulated conditions and further provided that the Engineer is fully satisfied that the advance payments so released shall be completely recovered prior to the time when 80 percent of the Accepted Contract Amount has been certified.
14.4 Schedules of Payments	*Delete last paragraph of Sub-Clause and add the following:* The Employer shall pay the Contractor in the following manner and time, on the basis of the Price Breakdown given in section of Price Schedules. Payment will be made in the currencies quoted by the bidder unless otherwise agreed between the parties. Applications for payment in respect of part deliveries may be made on pro-rata basis as work proceeds in accordance with the Terms and Procedures as defined herein. **A. Terms of Payment and Procedure** **i) Plant and Equipment Supplied from Country other than Bhutan and India** In respect of plant and equipment supplied from abroad, the following payments shall be made: ▪ **Ten percent (10%)** of the total CIF/CIP amount as an advance payment against receipt of invoice and an irrevocable advance payment security for the equivalent amount made out in favor of the Employer. The advance payment security may be reduced in proportion to the value of the plant and equipment shipped FOB or delivered to the site, as evidenced by shipping and delivery documents. ▪ **Forty percent (40%)** of the total or pro rata CIF/ CIP amount upon Incoterm "FOB" or "FCA," within 45 days after receipt of invoice and shipping documents duly endorsed by the Employer. ▪ **Forty percent (40%)** of the total or pro rata CIF/ CIP amount upon Incoterm "CIP" till Project Site, within 45 days after receipt of invoice supported with Goods Receipt Note (GRN) duly signed by Project Manager/ Engineer-in-Charge.

Khorlochhu Hydro Power Ltd.

	▪ **Five percent (5%)** of the total or pro rata (generating unit wise) CIF/CIP amount upon issue of the Operational Acceptance Certificate, within 45 days after receipt of invoice. ▪ **Five percent (5%)** of the total or pro rata (generating unit wise) CIF/CIP amount upon issue of the, Taking over Certificate within 45 days after receipt of invoice. **ii) Plant and Equipment Supplied from Bhutan and India** In respect of plant and equipment supplied from Bhutan and India, the following payments shall be made: ▪ **Ten percent (10%)** of the total CIP amount as an advance payment against receipt of invoice, and an irrevocable advance payment security for the equivalent amount made out in favor of the Employer. The advance payment security may be reduced in proportion to the value of the plant and equipment delivered to the site, as evidenced by shipping and delivery documents. ▪ **Forty percent (40%)** of the total or pro rata CIP amount upon Incoterm "Ex-Works," upon delivery to the site within 45 days after receipt of invoice. ▪ **Forty percent (40%)** of the total or pro rata CIP amount upon Incoterm "CIP" till Project Site, within 45 days after receipt of invoice supported with Goods Receipt Note (GRN) duly signed/ endorsed by Project Manager/ Engineer-in-Charge. ▪ **Five percent (5%)** of the total or pro rata CIP amount upon issue of the Operational Acceptance Certificate, within 45 days after receipt of invoice. ▪ **Five percent (5%)** of the total or pro rata CIP amount upon issue of the, Taking over Certificate within 45 days after receipt of invoice. **iii) Installation and other Services** In respect of installation services for both the foreign and local currency portions, the following payments shall be made: ▪ **Ten percent (10%)** of the total installation and other services amount as an advance payment against receipt of invoice and an irrevocable advance payment security for the equivalent amount made out in favor of the Employer. The advance payment security may be reduced in proportion to the value of work performed by the Contractor as evidenced by the invoices for installation services. ▪ **Eighty percent (80%)** of the measured value of work performed by the Contractor, as identified in the said Work Program, during the preceding month, as evidenced by the Employer's authorization of the Contractor's application, will be made monthly within 45 days after receipt of invoice. ▪ **Five percent (5%)** of the total or pro rata value of installation services performed by the Contractor as evidenced by the Employer's authorization of the Contractor's monthly

Khorlochhu Hydro Power Ltd.

applications, upon issue of the Operational Acceptance Certificate, within 45 days after receipt of invoice.

- **Five percent (5%)** of the total or pro rata value of installation services performed by the Contractor as evidenced by the Employer's authorization of the Contractor's monthly applications, upon issue of the, Taking over Certificate within 45 days after receipt of invoice.

iv) Payment Schedule for Steel Liners Works

The payment of Steel liners works under **Price Schedule-2** payable as a unit rate per MT shall be made as follows:

- **Supply of Steel Plates: Seventy percent (70%)** of the amount of quantity of steel plates supplied and delivered at site, upon verification by the Employer.
- **Fabrication: Fifteen percent (15%)** of the amount of quantity of steel plates fabricated at site including successful completion of all necessary test for fabrication complete, as certified by the Employer.
- **Erection: Ten percent (10%)** of the amount of quantity of steel liner works erected at site including successful completion of all necessary tests for erection works in complete, as certified by the Employer.
- **Testing & Commissioning: Five percent (5%)** of the amount of steel liner works after successful completion of the final testing and commissioning of steel liner works and upon issuance of taking over certificate by the Employer.

  However, the total amount payable for steel liner works shall be limited to the final executed quantities, as certified by the Employer and the unit rate payable.

B. Payment Procedure

The procedures to be followed in applying for certification and making payments shall be as follows:

In accordance with the provisions of GCC Clause 14 *[Contract Price and Payment]*, the Employer shall pay the Contractor in the following manner and at the following times, on the basis of the Price Break down given in the section on Price Schedules. Payments will be made in the currencies quoted by the Bidder unless otherwise agreed between the parties. Application for payment in respect of part deliveries made by the Contractor shall be made on pro-rata basis as work proceeds in accordance with the Terms and Procedures as defined herein in this Appendix.

Note

i) All the Payments shall be made by the Employer through Telegraphic Transfer or DD or cheque in favor of Contractor (defined in the Contract Agreement) as per mutually agreed terms between the Parties to the comfort level of Employer. Also, where are to be effected through Letter of Credit (LC) the same shall be subject to the latest Uniform Customs and Practice

for Documentary Credit, of the International Chamber of Commerce. The LC charges shall be borne by the Contractor.

ii) The LC will be irrevocable and will be confirmed at Contractor(s) cost if requested specifically by the Contractor.

iii) If LC is required to be extended/ reinstated for reasons not attributable to the Employer, the charges there off shall be to the Contractor's account.

i) Goods Supplied from country other than Bhutan and India

The following documents shall be furnished for goods supplied from country other than India and Bhutan.

a) Within 24 hours of shipment, the Contractor shall notify the Employer, and the insurance company by cable or telex or fax the full details of the shipment including contract number description of goods, quantity, the vessel, the bill of lading number and date, port of loading, date of shipment, port of discharge etc. The Contractor shall mail the following documents to the Employer, with a copy to the insurance company.

b) 4 copies of Contractor's invoice showing goods description, quantity, unit price, total amount.

c) Original and 4 copies of the negotiable, clean, on-board bill of lading marked freight prepaid and 4 copies of nonnegotiable bill of lading.

d) 4 copies of packing list identifying contents of each package.

e) Insurance certificate.

f) Contractor's guarantee certificate.

g) Inspection certificate, issued by the nominated inspection agency/ Employer and the Contractor's factory inspection report.

h) Certificate of approval of Test report issued by the Employer and Dispatch clearance issued by the Employer.

i) Certificate of confirmation of makes of equipment as agreed between Employer and the Contractor, and

j) 4 copies of Certificate of origin.

The above documents shall be received by the purchaser at least one week before arrival of goods at the port or place of arrival and if not received, the Contractor will be responsible for any consequent expenses.

ii) Goods supplied from Bhutan and India

The following documents shall be furnished for goods supplied from Bhutan and India:

a) Within 24 hours upon delivery of goods to the transporter, the Contractor's shall notify the purchaser and their representative at site, and insurance company by cable/ telex/ fax the full details of the dispatch including contract number, description of the goods, quantity, wagon number,

	railway receipt number and date and name of the consignee etc. The Contractor shall mail the following documents to the Employer with a copy to the insurance company. b) 4 (four) copies of the Contractor's invoice showing goods description, quantity and price, total amount. c) Lorry Receipt (consignment note)/ railway receipt/ acknowledgment of receipt of goods from the Contractor. d) Contractor's guarantee certificate. e) Insurance certificate. f) 4 (four) copies of packing list identifying contents of each package. g) Inspection certificate issued by the nominated inspection agency and the supplier's factory inspection report. h) Certificate of approval of Test Reports issued by the Employer and Dispatch Clearance issued by the Employer. i) Certificate of confirmation of makes of equipment as agreed between employer and the Contractor and, j) 4 (four) copies of certificate of origin. k) Any other certificates as mutually agreed between Employer and the Contractor. The above documents shall be received by the Employer and their representative at site before arrival of the goods (except where the goods have been delivered directly to the consignee with all documents) and if, not received the Contractor will be responsible for any consequent expenses.
	Add New Sub-Clause 14.5.1
14.5.1Materials	"The Contractor shall at his own expense provide/arrange all Materials required for the bonafide use in the Works under the Contract. The Engineer or his representative shall be entitled at any time to inspect and examine any materials intended to be used in the Works, either on the Site or at factory or workshop or other place(s) where such materials are assembled, fabricated, manufactured, or at any place where these are placed or from where these are being obtained. For this purpose, the Contractor shall afford such facilities as may be required for such inspection. (A) The Engineer shall during the progress of the Works have power to order in writing from time to time in respect of following: (i) removal from the Site, within such time or times as may be specified in the order, of any materials which in the opinion of the Engineer, are not in accordance with the Contract; (ii) substitution of proper and suitable materials; and (iii) removal and proper re-execution, notwithstanding any previous test thereof or interim payment therefore, of any work which in respect of materials or workmanship is

	not, in the opinion of the Engineer, in accordance with the Contract. (B) In case of default on the part of the Contractor in carrying out such order, the Employer shall be entitled to employ and pay other persons to carry out the same and all expenses consequent thereon or incidental thereto shall be recoverable from the Contractor by the Employer, or may be deducted by the Employer from any monies due or which may become due to the Contractor or from the bank guarantee provided by the Contractor under this Contract, or otherwise. The Engineer shall have full powers for removal of any or all materials brought to Site by the Contractor, which are not in accordance with the Contract specifications or samples, approved by him. Should the Contractor fail to remove the rejected materials, the Engineer shall be at liberty to have them removed by other means at the Contractor's cost. The Employer shall have full power to procure other proper materials to be substituted at Contractor's costs."
14.6 Issue of Interim Payment Certificates	*At the end of first sentence of Sub-Clause 14.6, add:* "and the Contractor has submitted the proof of payment of insurance premium as per the requirement of the Contract and has submitted detailed programme in accordance with Sub-Clause 8.3 *[Programme]* of the Contract."
14.7 Payment	*Delete sub paragraph (b) of Sub-Clause 14.7 and substitute:* "(b) Application for Interim Payment Certificate submitted by the Contractor shall be paid within 28 days of the submission as verified by the Engineer. If there is delay in release of undisputed payment beyond 56 days, then interest at rate specified in the Appendix to Tender shall be calculated on the payable amount after due recoveries from the 57th day onward till the date of actual payment." *In sub paragraph (c) of Sub-Clause 14.7: delete "56'' and substitute with "112".* *At the end of the Sub-Clause, insert the following paragraph:* The Employer intends that funds released for the project as advance or against the work done is utilized for the project itself and Contractor does not divert project funds for other businesses. The Contractor shall provide a detailed month-wise cash flow estimate at the beginning of each financial year duly revised at quarterly intervals, if required so by the Employer. The submission to and consent by the Employer of such programmes or the provision of such general descriptions or cash flow estimates shall not relieve the Contractor of any of his duties or responsibilities under the Contract. All payments to be made by the Employer to the Contractor (advance, Interim Certificate Payments and Final Bill) shall be released and credited into a designated Escrow Account with the following conditions:

Khorlochhu Hydro Power Ltd.

	The designated Escrow Account shall be opened by the Contractor after Notification of Award with Nationalized/Scheduled Commercial Bank in Bhutan. Particulars of the Escrow Account shall be submitted by the Contractor with the Employer before submitting request for mobilization advance. The Employer will release payments in the Escrow Accounts only. During the currency of the contract, Contractor may become subject to any scheme of Corporate Debt Restructuring or any other scheme of debt restructuring (DR Scheme). Since the Escrow Account involves an independent tripartite agreement between the Bank, Employer and the Contractor, the Escrow Account/Agreement shall have an overriding effect over the terms and conditions of the DR Scheme. The Escrow Account/Agreement shall not be affected by the terms and conditions of DR Scheme and the Contractor shall be required to disclose this condition to the DR Authority while submitting the case under DR Scheme. In case of financial crunch or other exigency, the Employer may make direct payment to the vendor in the interest of the project with the consent of the Contractor.
14.8 Delayed Payment	*Sub-Clause 14.8 is replaced with the following:* "Omissions on the part of the Engineer to pay the amount due upon measurement or otherwise shall neither vitiate nor make the contract void. Further, no claim for interest or damages will be entertained or payable by the Employer upon i) any Bank Guarantee or ii) payments in arrears or iii) any balance which may become due on final settlement / re-conciliation of the account or iv) payments withheld by the Employer owing to any dispute or difference between the parties. Save as above, interest on delayed payments shall be regulated as per Sub-Clause 14.7 [*Payment*]."
14.9 Release of Retention Money	*At the beginning of Sub-Clause 14.9, insert:* "The Contractor may substitute the Retention Money with a bank guarantee in the form, and from a source, acceptable to the Employer valid till 90 days beyond Defects Notification Period. However, the amount of substitution of retention money with a Bank Guarantee shall not be less than Nu. 50.0 million. A Bank Guarantee either issued by a bank/financial institution in Bhutan or any nationalized/scheduled bank in India with endorsement/ counter guarantee by a bank/financial institution in Bhutan shall only be acceptable. The Employer shall return the Retention Money/ Bank Guarantee (which had replaced the Retention Money) to the Contractor within 28 days after issue of Taking Over Certificate in terms of GCC 10.1 [*Taking over of the Works and Sections*]

Khorlochhu Hydro Power Ltd.

14.10 Statement at Completion	*Delete paragraph (c) of Sub-Clause 14.10*
14.15 Currencies of Payment	*Delete the phrase "Sub-Clause 13.5[Provisional Sums] and "under Sub-Clause 14.15(a)(ii).*
15. Termination by Employer	
15.2 Termination by Employer	*At the end of Sub-Clause 15.2 add the following clause:* "The Employer shall terminate any defaulting Subcontractors and forfeit 5% additional performance security furnish by them. In case of such termination, the main contractor subject to approval of the Employer shall field/appoint new Subcontractor for the execution and successful completion of the specified work packages. Such new Subcontractor shall also furnish 5% additional performance security applicable for both supply and service components valid till the Defect Notification Period".
16. Suspension and Termination by Contractor	
16.1 Contractor's Entitlement to Suspend Work	*"21 days" appearing in 1st paragraph of Sub-Clause 16.1 be replaced by "56 days"* *The phrase "Cost plus reasonable profit" under Sub-clause 16.1* is deleted and substituted by *"Cost,* which shall be included in the Contract Price".
16.2 Termination by Contractor	*Delete subparagraph 16.2.1(a) of Sub-Clause 16.2.1* *"14 days" time period appearing under Sub-Clause 16.2 be replaced by "42 days".*
16.3 Cessation of Work and Removal of Contractor's Equipment	*In sub-para (b) between "received" and "payment" insert:* *"or is entitled to receive"* *At the end of sub-paragraph (b) delete* "and" *and at the end of sub-paragraph (c) delete the full stop and replace with comma.* *Insert the following sub-paragraphs (d) and (e) as follows:* (d) to the extend legally possible, procure the assignment or novation or otherwise to the Employer or an entity nominated by the Employer, all rights, title and benefit of the Contractor to the Works and in the Plant, Materials and other work as at the date of termination; and (e) remove from the Site any wreckage, rubbish and debris of any kind and leave the whole of the Site in a clean and safe condition.

18. Insurance	
18.2 Insurance for Works and Contractor's Equipment	*Delete first sentence of Sub-Clause 18.2 and substitute:* The insuring Party shall insure the Works (EAR), Plants, Materials and Contractor's Documents and other policies as may be required) for not less than 125% of Accepted Contract Amount in the joint name with Employer as principal insured. The policies are to be reviewed periodically to maintain them at not less than full replacement cost. In addition to above, policy(ies) shall cover cost of demolition, removal of debris, professional fees, and escalation. Insurance policy shall have an express provision to the effect that the insurer shall necessarily obtain prior 'no objection' certificate from the Engineer before payment of insurance claim under the insurance policy. *Delete last paragraph of Sub-Clause 18.2* *At the end of Sub-Clause 18.2,add:* If the Contractor receives instructions from the Employer to insure against any risk listed in sub para (a) to (h) listed in Sub-Clause 17.3 *[Employer's Risks]*, such insurance if available shall be affected, at the cost of the Employer, with an Insurance Company acceptable to the Employer and shall be in the joint names of the Contractor and the Employer. The insurance policies required under the Contract shall be availed by the Contractor from the insurance companies registered under laws of Bhutan.
Insert new Sub-Clause 18.5 as follows	
18.5 Insurance for Design	The Contractor shall effect the professional indemnity insurance, which shall cover the risk of professional negligence in the design of the Works. This insurance shall be for a limit of not less than 125% of the Accepted Contract Amount. The Contractor shall use his best endeavours to maintain the professional indemnity insurance in full force and effect until the issue of Performance Certificate by the Employer under GCC Sub-Clause 11.9 *[Performance Certificate]*.
19. Force Majeure	
19.4 Consequences of Force Majeure	*Under sub-para (b) of Sub-Clause 19.4, delete "payment of any such Cost" and substitute with "payment of 75% of such Cost".*
20. Claims, Disputes and Arbitration	
20.1 Contractor's Claims	*Under 6th para of Sub-Clause 20.1, delete "42 days" and substitute with "90 days".* *At the end of Sub-Clause 20.1, add the following:* "Further, the resources (Equipment/ Manpower) shown in the Data Sheet are solely the Contractor's estimate and the Contractor has committed to deploy the resources indicated to complete the Works within the Time for Completion. No claims will be entertained on the grounds that there has been less progress than anticipated using these resources. The causes or hindrances would have to be established by the Contractor independently. By making these Data Sheets a part of the Contract does not absolve the

	Contractor from the responsibility of deploying additional resources to complete the Works within Time for Completion. No payments would be made towards the expenses incurred on deploying the additional resources as such unless expressly agreed by the Employer in writing."
21. Disputes and Arbitration	
20.4 Obtaining Dispute Adjudication Board's Decision	*At the end of Sub-Clause 20.4, add:* "The decision of DAB shall be final and binding on the parties for all the cost claims up to and inclusive of Nu. 50.00 Million and such decision of DAB shall not be subject to Arbitration."
20.6 Arbitration	*The Sub-Clause 20.6 is replaced with the following:* "Subject to Sub-Clause 20.4 & 20.5 of these Conditions, unless settled amicably, any dispute in respect of which the DAB's decision (if any) has not become final and binding shall be finally settled by Arbitration. Unless otherwise agreed by both Parties: (a) Any dispute or difference whatsoever arising between the parties and of or relating to the construction, interpretation, application, meaning, scope, operation or effect of this contract or the validity or the breach thereof, shall be settled by arbitration in accordance with Alternative Dispute Resolution Act of Bhutan 2013 and its Rules and Regulations 2019 and amendment thereof, (b) The number of arbitrators shall be three, and (c) the place of Arbitration shall be Bhutan. The cost and expenses of Arbitration proceedings will be borne by each party, as stipulated in the relevant Act. However, the expenses incurred by each party in connection with the preparation, presentation etc. of its proceedings shall be borne by each party itself, Provided always that no reference for arbitration shall be maintainable unless the Contractor deposits to the Employer a sum equal to 1.0% (one percent) of the amount under dispute and the sum so deposited shall, on the termination of the arbitration proceedings be adjusted against the cost, if any, awarded by the arbitral tribunal against the Contractor and the balance remaining after such adjustment or in the absence of any such cost being awarded, the whole of the sum will be refunded to him within one month from the date of the arbitral award. No interest shall be paid by the Employer on the amount deposited by the Contractor for referring the claim to arbitration. Performance under the Contract shall continue during the arbitration proceedings and payments due to the Contractor by the owners shall not be withheld, unless they are the subject matter of the arbitration proceedings. The Arbitral Tribunal shall give a written reasoned Award and the final award by a majority of Arbitrators rendered in writing shall be binding upon the parties."

Khorlochhu Hydro Power Ltd.

APPENDIX TO TENDER

Sl. No.	Sub-Clause	Data to be given	Data
1	1.1.2.2 & 1.3	Employer's name and address:	Khorlochhu Hydro Power Limited (KHPL), Post Box No. 46002, Doksum New Township, Trashiyangtse, Bhutan
2	1.1.2.3 & 1.3	Contractor's name and address:	To be provided by the Contractor
3	1.1.2.4 & 1.3	Engineer's name and address:	Will be nominated and intimated by the Employer.
4	1.1.3.3	Time for Completion of the Works:	42 months from the Date of Commencement
5	1.1.3.7	Defect Notification Period:	24 Months
6	1.2	Where Contract allows for Cost plus reasonable Profit, the percentage profit to be added is:	5% (five percent)
7	1.3	Electronic transmission systems:	Duly scanned copy of signed notices/communications by authorized representatives by electronic address (e-mail)
8	1.3(d)	Address of the Employer for communications:	General Manager, Contracts & Procurement Division, Khorlochhu Hydro Power Limited (KHPL), Post Box No. 46002, Doksum New Township, Trashiyangtse, Bhutan.
9	1.3(d)	Address of Engineer for communications:	Will be provided later
10	1.3(d)	Address of Contractor for communications:	Tenderer to complete _____ _____ _____ _____
11	1.4	Governing Law:	Law of the Kingdom of Bhutan
12	1.4	Jurisdiction:	Courts of Bhutan
13	1.4	Ruling language:	English
14	1.4	Language for communication:	English
15	2.1	Time for access to the Site:	Within 15 days from the Commencement Date
16	3.5	Idle Time Cost Claims:	Refer Annexure-I of Appendix to Tender

Sl. No.	Sub-Clause	Data to be given	Data
17	4.2	Amount of the Performance Security:	10% of the Accepted Contract Amount and as per the currency of the Bid. Additional Performance Securities as per Section-4, Particular Conditions of Contract under Sub Clauses 4.2.
18	4.8	Safety Procedures:	Refer Annexure-II of Appendix to Tender
19	5.1	Period for notifying any errors, faults and defects in the Employer's Requirements:	42 days calculated from the Commencement Date.
20	6.4	Contractor's Labour Regulations:	Refer Annexure-III of Appendix to Tender
21	6.7	Health and Safety:	Refer Annexure-IV of Appendix to Tender
22	8.7	Delay Damages for Interdependent Milestones	Refer Annexure-V of Appendix to Tender
23	8.7	Maximum Amount of Delay Damages on account of Works	10% of the Accepted Contract Amount
24	14.2	Total Advance Payment:	10% of the Accepted Contract Amount
25	14.2	Number and timing of instalments:	1 (one) only.
26	14.2	Currency or currencies and proportions	As per the currency and proportions of the Bid
27	14.6	Minimum amount of Interim Payment Certificates:	1% of the Accepted Contract Amount
~~28~~	14.8	Financing Charges for delayed payment:	6% p.a. (simple interest).
29	14.15	Currency/Currencies of payment:	As per currency of the Bid
30	18.1	General requirements:	
		(i) Insuring Party	(i) Is the Contractor
		(ii) Evidence of insurance	(ii) 60 days from Commencement Date
		(iii) Relevant policies	(iii) 120 days from Commencement date
		(iv) Interest on payment made by Employer against Insurance Premium on behalf of Contractor	(iv) Base rate of RMA plus 2%
31	18.2	Amount of insurance required for Works (EAR Policy):	125 % of Accepted Contract Amount,
32	18.2	Amount of insurance required for Contractor's Equipment (CPM):	Full replacement value including delivery to site

Sl. No.	Sub-Clause	Data to be given	Data
33	18.2	Amount of insurance required for Goods:	125 % of Accepted Contract Price
34	18.2 (d)	Maximum amount of deductibles for insurance of the Employer's risks as well as other risks Amount of insurance required CPM	5 % of each loss subject to maximum of BTN/INR 5.0 million.
35	18.3	Minimum amount of Third Party Insurance:	Minimum amount of third-party insurance is BTN/INR 100.00 million per occurrence and on reinstatement basis
36	20.2	The DAB shall comprise of:	3 (three) members
37	20.3	Appointment (if not agreed) to be made by:	Director General/ Director, Department of Energy, Ministry of Economic Affairs, RGoB or such other officer as may be duly authorized by the RGoB from time to time for such an action.

Annexure - I of Appendix to Tender

(Refer GCC/PCC Sub-Clause – 3.5)

PROCEDURE FOR IDLING TIME COST CLAIMS

The valuation of idling time cost claims of the Contractor's shall cover compensation for idling time related cost as given below:

(a) Cost of owned Equipment

Cost of owned Equipment will comprise of the following elements:

i) Depreciation Cost

Annual Depreciation (Based on life in years)	= 0.90 × Book Value/Life in years
Depreciation Cost payable for idling	= [(Idle Period in days/365) × 0.67 × Annual Depreciation]

However, if the equipment has completed its scheduled life in years, in that case the depreciation shall be considered as zero.

ii) Interest on Capital Investment: (Rate of Interest* /100) × Average Annual Cost

The average annual cost is determined as follows:

Average Annual Cost	= Book value of Equipment × (n+1)/2n
Interest on Capital Investment payable for Idling Period	= [(Idle Period in days/365) x (Rate of interest*/100) × Average Annual Cost]

Where:

- "n" refers for number in years of life of equipment.
- Book Value = purchase price plus freight, insurance, all taxes and duties, port clearance charges, erection and commissioning charges and other incidental charges.
- * the interest rate shall be @ 12% p.a. (simple rate of interest).

iii) Insurance Charges

Insurance charges payable during idling period in respect of Contractor's Plant & Machinery (CPM) policy shall be considered as per actual.

(b) Cost of leased/hired Equipment

In case of leased/hired equipment, the hire charges shall be admissible for the idle period. The value of the claim amount shall be assessed by the Owner/Employer keeping in view documentary evidence provided by the Contractor, prevailing market rate and reasonableness of the claim.

NOTE: Cost of equipment either at (a) or (b) above shall be applicable for the specific equipment i.e. owned or hired or leased as the case may be.

(c) Cost of Labour

The labour directly engaged for the works at Site by the Contractor or through Sub-Contractor, as verified by the Engineer, will be reimbursed for idle period in case Contractor produces proof that idle labour has been paid wages during the period of idling.

Cost of equipment related labour, as verified by Engineer, will be worked out as per CWC norms limited to actual whichever is lower.

The above cost will be considered for payment based on the supporting details such as attendance sheet, receipt of deposit of provident fund duly certified by the Contractor.

Khorlochhu Hydro Power Ltd.

In addition to actual cost of labour, indirect charges shall be considered. The indirect charges (other than salary) shall be 80% and 55% for skilled and unskilled labour respectively. Indirect charges shall be applicable on the basic wages. Basic wages mean component of wages on which statutory deductions like Provident Fund is deposited to the statutory authority.

(d) Cost of Site staff

The Cost of site executives/supervisory staff shall be considered for payment as per actual. The site staff implies all the staff posted at the site excluding staff posted at the Head office. Cost of site staff shall be supported by relevant documents. The cost shall be considered for payment based on the supporting details in form of pay ledger, bank details, detailed pay slips, certificate of income tax deducted at source issued by the Contractor as well as Sub-Contractor's and receipt of deposit of Provident Fund duly certified by the Contractor. In this head, staff physically deployed at site shall only be considered.

(e) Overheads

Overhead costs include but not limited to Office and share of head office expenses, Legal charges, General establishment, Watch and Ward, Local conveyance, Travelling expenses, Social welfare, salaries of Managerial and clerical staff etc. and Publicity etc.

$$\text{Overhead Charges} = \frac{\text{5\% of Accepted Contract Amount} \times \text{Authorized Time Extension (in days) for Compensation Events}}{\text{Construction Period (in days) as per Letter of Acceptance}}$$

The lump-sum component of overhead as 5% shall cover all other charges not included expressly in any of the items of claim at Sl. (a) to (d) as above.

(f) Bank Guarantees and Insurance charges

These charges are to be considered towards cost compensation for the idle period based upon documentary evidence of payment of premium/additional charges by the Contractor towards Insurance/Performance Bank Guarantee and Retention Money Bank Guarantee.

(g) The taxes applicable on cost claims

The applicable taxes on the above elements of cost claim shall be reimbursed to the Contractor as per actual based on the documentary evidence.

Khorlochhu Hydro Power Ltd.

Annexure - II of Appendix to Tender

(Refer GCC/PCC Sub-Clause 4.8)

SAFETY PRECAUTIONS

1. Safety Precautions

1.1 Suitable scaffolds shall be provided for workmen for all works that cannot safely be done from the ground, or from solid construction except such short period work as can be done safely from ladders. When a ladder is used, an extra workman shall be engaged for holding the ladder. If the ladder is used for carrying materials as well, suitable footholds and handholds shall be provided on the ladder and the ladder shall be given an inclination not steeper than 0.25 to 1 (0.25 horizontal and 1 vertical).

1.2 Scaffolding or staging more than 3.6 m above the ground or erected floor, swung or suspended from an overhead support or erected with stationary support shall have a guard rail properly attached, bolted, braced and otherwise secured at least 0.9 m high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such opening as may be necessary for the delivery of the materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the structure.

1.3 Working platform, gangways and stairways shall be so constructed that they do not sag unduly or unequally, and if the height of the platform or the gangway or the stairway is more than 3.6 m above ground level or floor level, they shall be closely boarded, and shall have adequate width and shall be suitably fastened as described in para 7.1 above.

1.4 Every opening in the floor of a structure or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 0.9 m. Employees working on steep slopes or otherwise subject to possible falls from levels not protected by guardrails or safety nets, shall be secured by safety belts and lifelines.

1.5 Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9.0m in length while the width between side rails in hung ladder shall, in no case, be less than 28 cm. for ladder up to and including 3.0 m in length.

For longer ladders, this width shall be increased at least by 6mm for each additional 30 cm of length. Uniform step spacing shall not exceed 30 cm. Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the Sites of Work shall be so stacked or placed as to cause danger or inconvenience to any person or the public.

1.6 All trenches, 1.2 m or more in depth, shall, at all times, be supplied with at least one ladder for each 30 metres length of fraction thereof. Ladder shall be extended from bottom of the trench to at least 0.9 m above the surface of the ground. The side of the trenches which are 1.5 m or more in depth shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger of sides to collapse. The excavated materials shall not be placed within 1.5 m of the edges of the trench or half of the depth by the trench whichever is more. Cutting shall be done from top to bottom. Under no circumstances undermining or undercutting shall be done.

1.7 Before any demolition work is commenced and also during the process of the Work:

i) All roads and open areas adjacent to the Site shall either be closed or suitably protected.

ii) No electric cable or apparatus which is liable to be a source of danger over a cable or apparatus used by the operator shall remain electrically charged.

iii) All practical steps shall be taken to prevent danger to persons employed from risk of fire or explosion or flooding. No floor, roof or other part of the structure shall be overloaded with debris or materials as to render it unsafe.

1.8 All necessary personal safety equipment as considered adequate by the Engineer shall be kept available for the use of the persons employed on the Site and maintained in conditions suitable for immediate use, and the Contractor shall take adequate steps to ensure proper use of equipment by those concerned.

i) Workers employed on mixing asphaltic materials, cement mortar and cement concrete shall be provided with protective footwear and protective goggles.

ii) Those engaged in mixing or stacking of cement bags or any materials which is injurious to eyes shall be provided with protective goggles.

iii) Those engaged in welding works shall be provided with welder's protective eye shields.

iv) Stone breakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.

v) The Contractor shall not employ any person below the age of 18 years. Whenever a person above the age of 18 years is employed on the work of lead painting, the following precautions shall be taken:

a) No paint containing lead, sulphate of lead or products containing heir pigments shall be used except in the form of paste or readymade paint.

b) Suitable face masks shall be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.

c) Overalls shall be supplied by the Contractor to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of Work.

d) Measures shall be taken, whenever required, in order to prevent danger arising from the application of a paint in the form of spray.

e) Measures shall be taken, whenever practicable, to prevent danger arising out of dust caused by dry rubbing down and scrapping.

f) Suitable arrangements shall be made to prevent clothing put off during working hours, being spoiled by painting materials.

g) Cases of lead poisoning and suspected lead poisoning shall be notified and shall be subsequently verified by a medical officer appointed by the competent authority of the Employer.

h) The Employer, when necessary, shall arrange for medical examination of workers.

i) Instructions with regard to special hygienic precautions to be taken in the painting trade shall be distributed to working painters.

j) The Contractor shall observe all safety precautions to control the noise on all Sites and also provide all workmen deployed in the affected areas with the necessary equipment for safety against noise.

1.9 When the Work is done near any place where there is risk of drowning, all necessary equipment shall be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision shall be made for prompt first aid treatment of all injuries likely to be sustained during the course of the Work.

1.10 Use of hoisting machines and shackle including their attachments, anchorage and supports shall conform to the following standards or conditions:

Khorlochhu Hydro Power Ltd.

i) These shall be of good mechanical construction, sound materials and adequate strength and free from patent defect and shall be kept in good working order.

ii) Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength and free from patent defects.

iii) Every crane driver or hoisting appliance operator shall be properly qualified for his job.

iv) In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or a means of suspension, the safe working load shall be ascertained by adequate means. Every hosing machine and all gears referred to above shall be plainly marked with the safe working load.

In case of hoisting machine having a variable safe working load, each safe working load and the conditions under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing. The capacity of the hoisting machines shall be periodically checked.

v) The Contractor shall notify the safe working load of the machines to the Engineer whenever he brings any machinery to Site of work and get it verified by the Engineer or his representative.

1.11 Motors, gearing, transmission, electric wiring and other wiring and other dangerous parts of hoisting appliances shall be provided with efficient safeguards. Hoisting appliances shall be provided with such means as shall reduce to the minimum, the risk of any part of a suspended load becoming accidentally displaced. When workmen are employed on or near electrical installations which are already energized, insulating mats, wearing apparel, such as gloves, sleeves and boot, as may be necessary, shall be provided. The workers shall not wear any rings, watches and carry keys or other materials which are good conductors of electricity.

1.12 All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in safe conditions and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities shall be provided at or near place of work.

1.13 These safety provisions shall be brought to the notice of all concerned by display on a notice board at a prominent place on the Site. The person responsible for compliance of the safety code shall be named therein by the Contractor.

1.14 To ensure effective enforcement of the rules and regulations relating to safety precautions, the arrangements made by the Contractor shall be open to inspection by the Labour Officer or the Engineer.

1.15 In addition to above, the Contractor shall take the following specific precautions for the underground works:

i) All precautions regarding safety of personnel working in tunnels / caverns / shafts, in connection with the handling of electric installations, loading, blasting and seepage water etc. as specified in the relevant stipulations of IS codes shall be taken by the Contractor in order to ensure safe underground working. He shall also provide adequate medical, drinking water, sanitation, lighting and ventilation facilities.

ii) Emergency material shall be provided at each underground excavation heading. This equipment shall include, but not be limited to the following:

- 3 stretchers
- 3 woolen blankets
- 2 appliances for artificial breathing

Khorlochhu Hydro Power Ltd.

- 1 oxygen flask
- 3 explosion – proof lamps
- Wound dressing and disinfection material
- Anti pain injections
- Gas masks

iii) At least two members of the Rescue Team as described hereinafter, properly instructed and trained in the rescue procedures, shall be in each crew working ground.

iv) Prior to the commencement of construction, the Contractor shall organize and train a Rescue Team composed of his employees. This Rescue Team shall be capable of rendering help after accidents caused by fire, gas explosion and avalanche etc.

v) The Rescue Team shall be organized in such a way that sufficient number of members are ready for action at any time until the Completion of works.

vi) The Rescue Team shall be instructed and trained for their task by a qualified and experienced person. If required, the Contractor shall hire an outside specialist to impart such training. A refresher training for all members of the Rescue Team shall be conducted at least every six months.

vii) Each Rescue Team member shall be skilled in giving the first aid, dealing with the appliances for artificial respiration and firefighting equipment and shall possess a good local knowledge. Adequate equipment for reaching even the remotest working area shall be at their disposal.

viii) The Contractor shall submit the details of the proposed Rescue Team organization to the Engineer for approval.

1.16 The Contractor shall at all times exercise reasonable and proper precautions for the safety of the people engaged in the construction of the Works and shall comply with the provisions of current safety laws and building and construction codes as may be applicable. All machinery and equipment and other sources of physical hazards shall be properly guarded.

The Contractor shall have a full-time staff exclusively in-charge of securing the safety of the Works ensuring that all safety regulations are followed and in – charge of indoctrination and teaching courses on safety to the work force.

1.17 The Contractor shall provide all necessary fencing and lights to protect the public from accidents and shall be bound to bear all the expenses of defense of every suit, action and other proceedings at Law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and costs which may be awarded in any such suit, action and proceedings to any such persons or which may, with the consent of the Contractor, be paid to compromise any claim by any person.

1.18 About his employees, the Contractor shall ensure as follows:

i. Each employee shall be provided initial indoctrination regarding safety by the Contractor so as to enable him to conduct his work in a safe manner.

ii. No employee shall be given a new assignment of work unfamiliar to him without proper introduction as to the hazardous incident thereto, both to himself and his fellow employees.

iii. Under no circumstances shall an employee hurry or take unnecessary chances when working under hazardous conditions.

iv. Employees shall not leave naked fire unattended. Adequate firefighting equipment shall be provided at crucial locations.

Khorlochhu Hydro Power Ltd.

v. Employees under the influence of any intoxicating beverage, even to the slightest degree, shall not be permitted to remain on work.

vi. There shall be a suitable arrangement on every site for rendering prompt and sufficient first aid to the injured under the guidance of the Medical Officer.

vii. The staircase and passage ways shall be adequately lighted.

viii. The employees, when working around moving machinery, shall not be permitted to wear loose garments. Safety shoes are recommended when working in shops or places where materials or tools are likely to fall. Only experienced workers shall be permitted to go behind guard rails or to clean around energized or moving equipment.

ix. The employees shall use the standard protection equipment intended before and after it is used.

1.19 The following precautions shall be taken for fire prevention:

i. All construction areas and storage yards shall be kept clean and well arranged.

ii. A clear space of 15 meters around the outer boundary of saw mill and lumber storage area may be provided. All lumber shall be stored in section with fire breaks with a distance of 15 meter between consecutive sections.

iii. All combustible waste material, wood scaling and soiled rag etc. shall be removed daily and burnt in suitable burning areas. The saw mill and lumber yard shall be kept free from accumulation of combustible debris.

iv. Fire, welding, flame cutting shall in general not permitted in combustible areas. Fires and open flame devices shall not be left unattended.

v. Smoking shall be prohibited in all fire prone areas, flammable material storages viz. carpentry, paint shops, garages, service stations etc. “No Smoking” signs shall be pasted on all such areas.

vi. Accumulations of flammable liquids on floors, walkways, etc. should be prohibited. All spills of flammable liquids shall be cleaned up immediately.

vii. Smoke pipes from Diesel Engines passing through roof of combustible material e.g. in compressor stations on various sites shall be insulated by asbestos. All joints of smoke pipe shall be riveted, welded or otherwise securely fastened together and supported to prevent accidental displacement or separation. The joints shall not be leaky.

viii. Flammable liquids, lubricants etc. shall be handled and transported in safety containers and drums which can be kept tightly capped.

ix. Storage of fuels and other flammable materials and liquids shall be set not less than 100 m away from the Works and permanent installations. All storage installations and tanks conform to the regulations set out in relevant Indian Standards.

x. Petrol or other flammable liquids with a flash point below 100 degrees Centigrade shall not be used for cleaning purpose.

xi. Oxygen cylinders shall not be stored with combustible materials.

xii. All electric installations shall be properly earthed. Repair shall not be made on electrical circuits until the circuit has been de-energized.

1.20 The following firefighting arrangements shall be made by the Contractor.

i. Fire extinguishers and fire buckets, painted red, shall be provided at all fire hazardous locations viz. Batching and Mixing Plants, Winch houses, Workshops, Store yards, saw-mill, switch gear room, compressor stations, officer establishments etc. The extinguishers shall be inspected, serviced and maintained in accordance with

Khorlochhu Hydro Power Ltd.

manufacturer's instructions. The inspection shall be evidenced by notations on tag attached to the extinguisher.

ii. Full reliance shall be placed on portable hand extinguishers as all of these have a very limited capacity. Water, in ample quantity and under adequate pressure, shall always be available for firefighting.

iii. Where a group of work points water supply, the installation of a water system for private fire protection shall be warranted.

iv. Evacuation facilities and fire exit shall be provided at all locations featuring fire hazards.

v. Siren or other suitable fire alarm arrangement shall be made on all Sites. Warning signs shall be pasted at all locations having fire hazards.

vi. All staff shall be conversant with the use of all types of fire extinguishing apparatus.

vii. Demonstrations and training in firefighting shall be conducted at sufficient intervals to ensure that sufficient personnel are familiar with and are capable of operating firefighting equipment.

1.21 When any work is carried on, which is likely to affect the security or stability of an installation or structure or any part thereof and endanger any person employed, all practicable precautions shall be taken by shoring or otherwise to prevent collapse of structure or fall of any part thereof and thus remove the cause of danger to such structures and the persons employed.

1.22 For person engaged in handling of corrosive materials, adequate equipment shall be provided.

1.23 Where, in connection with any grinding, cleaning, spraying or manipulation of any material, there is emission of any dust or fume of such character and to such extent as is likely to be injurious to the health of persons employed, all practical measures shall be taken by securing adequate ventilation or by the provision and use of suitable respirators or otherwise to prevent inhalation of such dust and fume.

1.24 In addition to instructions contained here-in-above the safety regulations contained in the following IS codes or the latest amendments thereof shall also apply wherever the provisions in the codes are exhaustive in nature.

i.	IS : 3764-1992	Safety code for excavation of work
ii.	IS : 4756 – 1978 (Reaffirmed 1991)	Safety code for Tunneling work
iii.	IS : 7293 – 1974 (Reaffirmed 1991)	Working with construction machinery
iv.	IS : 7969-1975 (Reaffirmed 1991)	Handling and storage of building material
v.	IS : 4081-1986 (Reaffirmed 1991)	Blasting and related drilling operations
vi.	IS : 3696-1987 (Part-I) (Reaffirmed 1991)	Scaffolds & Ladders (Pt. I Ladders)
vii.	IS : 3696-1991 (Part-II)	Scaffolds & Ladders (Pt. II Ladders)
viii.	IS : 4138-1977 (Reaffirmed 1991)	Working in compressed air (Ist revision)
ix.	IS : 4130-1991	Demolition of Buildings (Ist Revision)

Khorlochhu Hydro Power Ltd.

x.	IS: 5916 – 1970 (Reaffirmed 1990)	Construction involving use of Hot Bituminous materials
xi.	IS: 3016-1982	Fire protection in welding and cutting operations
xii.	IS: 5878-1971 (Reaffirmed 1990)	Code of Practice for Construction of Tunnels (Part – II Sec.2)

1.25 Notwithstanding the above provisions, the Engineer may require the Contractor to follow any other Act or Rules in force in Bhutan in respect of Safety Precautions so as to ensure the safety of the Workmen and the Constructional Plant and the Contractor shall promptly comply with such requirements.

AMOUNT OF PENALTY TO BE LEVIED ON NON-COMPLIANCE ORREPEATED FAILURE IN IMPLEMENTATION OF REQUISITE SAFETY MEASURE

Sl. No.	Violation of safety requirement	Penalty Amount
1	For not using personal protective equipment (Helmet, Shoes, Goggles, Gloves, Full body harness, Boiler suit etc.)	Nu. 250/- per day item/Person
2	Working without Permit/Clearance	Nu. 5,000/- per head per occasion
3	Degradation of environment (not confining toxic spills, spilling oil/lubricants, bentonite, etc. onto ground)	Nu. 3,000/- per occasion
4	Improper handling, storage & transportation of blasting material/equipment.	Nu. 3,000/- per occasion
5	Unsafe electrical practices (non-installation of ELCB, using poor joints of cables, using naked wire without top plug into socket, laying wire/cables on the roads electrical jobs by incompetent person).	Nu. 3,000/- per item per day
6	Working at height without full body harness using non-standard scaffolding and not arranging fall protection arrangement as required.	Nu. 3,000/- per item per day
7	Unsafe handling of compressed gas cylinders (no trolley, jubilee clips double gauge regulator, improper storage/handling).	Nu. 100/- per item per day
8	Use of domestic LPG for cutting purpose.	Nu. 1,000/- per occasion
9	Non-fencing barricading of excavated areas.	Nu. 1,000/- per occasion
10	Non-display of caution boards, list of hospitals, emergency services available at work locations.	Nu. 500/- per occasion
11	Non-providing shoring/shafting/proper slope and not keeping the excavated earth at least 1.5m away from excavated areas.	Nu. 5000/- per occasion
12	Traffic rules violations like over speeding of vehicles rash driving, wrong parking, not using seat belts, vehicles not fitted with reverse warning alarms, flashing sirens.	Nu. 5000/- per occasion
13	Absence of Contractor's top most executive at item in the safety meetings whenever called by Engineer/Employer	Nu. 1,000/- per meeting
14	Failure to maintain safety records like air quality monitoring reports, records of regular inspections of work areas, etc.	Nu. 1,000/- per occasion
15	Poor House keeping	Nu. 1,000/- per occasion

Sl. No.	Violation of safety requirement	Penalty Amount
16	Failure to report & follow up accident (including Near Miss)	Nu. 1,000/- per occasion
17	Violation of any other safety condition as per job plan, work permit and conditions of contract such as using crowbar on cable trenches, improper welding booth, not keeping fire extinguisher ready at hot work site, unsafe rigging etc.	Nu. 1,000/- per occasion
18	Any violation not covered above	To be decided by Engineer

Note: The penalties listed above are over and above the penalties that may be levied by the statutory authorities/local bodies.

Annexure - III of Appendix to Tender

(Refer GCC/PCC Sub-Clause – 6.4)

CONTRACTOR'S LABOUR REGULATIONS

2.1 SHORT TITLE

These regulations may be called the "the Contractor's Labour Regulations."

2.1 DEFINITIONS

In these regulations, unless otherwise expressed or indicated, the following words and expressions shall have the meaning hereby assigned to them respectively.

"Labour" means workers employed by the Contractor directly, or indirectly through a Subcontractoror other persons or by an agent on his behalf but shall not include supervisory staff like Section Officers etc. For the avoidance of doubt, the word 'Labourers' shall be construed accordingly.

"Fair Wage" means wage whether for time or piece work notified at the time of inviting tenders for the Works and where such wages have not been so notified, the wages prescribed by the Employer for the area in which the work is done. Such wages shall at no time be less than the minimum wages fixed by the Royal Government of Bhutan under applicable Law for that class of Labour engaged on the same type of work in the same area.

"Contractor" shall mean and include the Contractor and every person whether a Subcontractoror head-man or agent, employing Labour for the Works undertaken under the Contract.

2.1 DISPLAY OF NOTICE REGARDING WAGES, ETC.

The Contractor shall:

a) before he commences the work under the Contract, display and correctly maintain and continue to display and correctly maintain in a clean and legible condition in conspicuous place on the Site, notices in English and in Hindi and local language spoken by the majority of the Labour mentioning the rate of wages which have been certified by the Engineer as fair wage and the hours of work for which such wages are earned.

Normally the working hours of any Labourers should not exceed 9 (nine) hours a day. The working day shall be so arranged that inclusive of interval for rest, if any, it shall not spread over more than 12 (twelve) hours on any day.

2.1 PAYMENT OF WAGES

i) Wages due to each Labourer shall be paid to him directly.

ii) Arrears claimed after 3 months after the completion of the Works shall not be entertained by the Contractor.

iii) All wages shall be paid in current coin/currency.

2.1 FIXATION OF WAGE PERIODS

i) The Contractor shall fix the wage periods in respect of which the wages shall be payable.

ii) No wage period shall exceed one month.

iii) Wages of each Labourer employed on the Contract shall be paid;

a) in the case of establishment for whom wage period is one week, within 3 days from the end of the wage period; and

b) in the case of other establishments before the expiry of the 7th day and 10th day from the end of the wage period for the number of Labourers employed in such establishment not exceeding 1000 and exceeding 1000 respectively.

iv) When the employment to any Labourer is terminated by or on behalf of the Contractor, the wages earned by him shall be paid before the expiry of the day succeeding the one on which his employment is terminated.

v) All payments of wages shall be made on a working day except when the work is completed before the expiry of the wage period in which case final payment shall be made within 48 hours of the last working day at the Site and during the usual working time.

2.1 WAGE BOOK AND WAGE SLIPS ETC

i) The Contractor shall maintain a Wage Book of each Labourer in such forms as may be convenient at the place of Works; the same shall include inter alia the following particulars:

- Name of the Labourer.
- Rate of daily or monthly wages.
- Nature of work on which employed.
- Total number of days worked during each wage period.
- Dates and periods for which worked overtime.
- Gross wages payable for the work during each wage period.
- All deductions made from the wage with an indication in each case of the ground on account of which the deduction is made.
- Wages actually paid for each wage period.
- Signature or thumb impression of the Labourer.

ii) The Contractor shall also issue a wage slip containing the aforesaid particulars to each Labourer employed by him on the Works at least a day prior to the day of disbursement of wages.

iii) The Contractor shall also issue an employment card in the prescribed Form-I (attached) to each Labourer on the day of work or entry into his employment.

iv) The Contractor shall issue an attendance cum wage card as per Form-II to each Labourer on the day of entry into his employment.

2.1 REGISTER OF UNPAID WAGES

The Contractor shall maintain a register of unpaid wages in such form as may be convenient at the place of work but the same should include inter alia the following particulars.

- Full particulars of the Labourers whose wages have not been paid.
- Reference number of the muster roll and wage register.
- Rate of period.
- Wage period.
- Total amount not paid.

Khorlochhu Hydro Power Ltd.

- Reasons for not making payment.
- How the amount of unpaid wages was utilized.
- Acquaintance with dates.

2.1 REGISTER OF ACCIDENTS

The Contractor shall maintain a register of accidents in such form as may be convenient at the work place, but the same should include the following particulars;

- Full particulars of the worker(s) who met with accident.
- Rate of wages.
- Sex.
- Age.
- Nature of accident and cause of accident.
- Time and date of accident.
- Date and time when admitted in hospital.
- Date of discharge from the hospital.
- Period of treatment and result of treatment.
- Percentage of loss of earning capacity and disability assessed by medical officer.
- Compensation required to be paid.
- Date of payment of compensation.
- Amount paid with details of the person to whom the same was paid.
- Authority by whom the compensation was assessed.
- Remarks.

2.1 FINES AND DEDUCTIONS WHICH MAY BE MADE FROM WAGES

i) The wages of a Labourer shall be paid to him without any deductions of any kind except the following;

Fines

Deductions for absence from duty i.e. from the place or the places where, by the terms of his employment he is required to work. The amount of deduction shall be in proportion to the period during which he was absent.

Deduction for damage to or loss of goods expressly entrusted to the employed person for custody, or for loss of money or any other deduction which he is required to account, where such damage or loss is directly attributable to his neglect or default.

Deduction for recovery of advance or for adjustment of over payment of wages, advances granted shall be entered in a register.

Any other deduction which the Employer may from time to time allow.

ii) No fine should be imposed on any Labourer save in respect of such acts and omissions on his part as have been approved of by the Engineer.

iii) No fine shall be imposed on a Labourer and no deduction for damage or loss shall be made from his wages until the Labourer has been given an opportunity of showing cause against such fines or deductions.

2.1 REGISTER OF FINES ETC.

i) The Contractor shall maintain a register of fines and a register of deductions for damages or loss in Form Nos. III & IV respectively which should be kept at the places of work.

ii) The Contractor shall maintain both in English and in the local language, a list approved by the Engineer clearly stating the acts and omissions for which penalty or fine may be imposed on a Labourer and display it in a good condition in a conspicuous place of the work.

2.1 PRESERVATION OF REGISTER

The wage book, the wage slips, register of unpaid wages, the resister of accidents, the register of fines, deduction required to be maintained under these regulations shall be preserved for 12 months after the date of last entry made in them and shall be made available for inspection by the Engineer, Labour Officer or any other officer authorized by the Employer in this behalf.

2.1 POWERS OF LABOUR WELFARE OFFICERS TO MAKE INVESTIGATION OR ENQUIRY

The Labour Welfare Officer or any other person authorized by the Employer on its behalf shall have power to make enquiries with a view to ascertaining and enforcing due and proper observance of the fair wage clauses and the provisions of these regulations. He shall investigate into any complaint regarding the default made by the Contractor or Subcontractorin regard to such provision.

2.1 REPORT OF LABOUR WELFARE OFFICER

The Labour Welfare Officer or other persons authorized as aforesaid shall submit a report or result of his investigation or enquiry to the Engineer indicating the extent, if any, to which the default has been committed, with a note that necessary deductions from the Interim Pay Certificate of the Contractor be made and the wages and other dues be paid to the Labourer(s) concerned. In case an appeal is made by the Contractor under Para 1.14 of these regulations, actual payment to Labourer(s) will be made by the Engineer or authorized agent after the Employer has given its decision on such appeal.

The Engineer shall arrange payments to the Labourers concerned within 45 days from the receipt of the report from the Labour Welfare Officer.

2.1 APPEAL AGAINST THE DECISION OF LABOUR WELFARE OFFICER

Any person aggrieved by the decision and recommendations of the Labour Welfare Officer or other person so authorized may appeal such decision to the Engineer, within 30 days from the date of decision. The decision of the Engineer shall be final and binding upon the Contractor.

2.1 INSPECTION OF BOOKS AND SLIPS

The Contractor shall allow inspection of the wage books and the wage slips, register of unpaid wages, register of accidents, the register of finds and deductions to any of his Labourers or to his agent at a convenient time and place after due notice is received or to the Labour Welfare Officer or any other persons, authorized by the Engineer on his behalf.

2.1 SUBMISSION OF RETURNS

The Contractor shall submit periodical returns as may be specified from time to time.

2.1 AMENDMENTS

Khorlochhu Hydro Power Ltd.

The Employer may from time to time add to or amend the regulations and on any question as to the application, interpretation or effect of those regulations, the decision of the Engineer or of his authorized representative shall be final.



Form - I: Employment Card Regulation

Name & Sex of the worker	Age or date of birth
Father's Name	Identification marks
	(Particulars of next of kin wife and children, if any, or of dependent next to kin in case the worker has no wife or child)
Photograph	Name…….. Full address of dependents (Specify village, district, state and country).

Sl. No	Name and address of employer (Specify whether a contractor or Sub-contractor	Particulars of location work site and description of work done	Total period for which the worker is employer (from….to……)	Actual number of days worked	Leave taken (Number of days should be Specified)
1.	2.	3.	4.	5.	6.

FORM-I (Contd.)

(BACK SIDE OF THE CARD)

Nature of work done by the workers	Wage period	Wage rate (with particulars of unit in case of piece work)	Total wage earned by the worker during the period shown under column (5)	Remarks	Signature of the employer
7.	8.	9.	10.	11.	12.

Form - II: Attendance-Cum-Wage Card

[Referred to Para 1.6 (iv)]

Card No……..

Name of Contractor……

Name of work……

Name of worker…….

Address…….

Designation……

Rates of wages……..

Dates	Attendance	Signature of person making attendance	Remarks
1			
2			
3			
4			
5			
Etc.			

Wage period	Date on which overtime	Gross wage payable	Deductions if any	Actual wages paid	Date of payment	Signature of the Worker

Form – III: Register of Fines
(REGULATION 1.10 (i)

Sl. No.	Name	Father's / Husband Name	Sex	Department	Nature & Date of the offence for which fine imposed	Whether workmen showed cause against fine or not, if so, enter date	Rate of wages	Date and amount of fine imposed	Date on which fine Realized	Remarks
1	2	3	4	5	6	7	8	9	10	11

Form – IV: Register of Deductions for Damages or Loss Regulation 1.10 (i)

Sl. No.	Name	Father's / Husband Name	Sex	Department	Damage or loss caused with date	Whether worker showed cause against deduction if so, enter date	Date of amount of deduction imposed	Number of installments if any	Date on which total amount realized	Remarks
1	2	3	4	5	6	7	8	9	10	11

Annexure - IV to Appendix to Tender

Refer GCC/PCC Sub-Clause-6.7

HEALTH AND SANITARY ARRANGEMENTS FOR CONTRACTOR'S WORKMEN

1.1 APPLICATION

These rules shall apply to all construction works under the charge of the Employer

1.2 DEFINITIONS

i) "Work Place"/or work site means a place at which, at an average 50 or more workers are employed, in connection with construction work.

ii) "Large Work Place" or large work site means a place at which an average 500 or more workers are employed in connection with construction work.

1.3 FIRST AID

a) At every Work Place, there shall be maintained in a readily accessible place first aid appliances including an adequate supply of sterilized dressings and sterilized cotton wool. The appliances shall be placed in good order and in a Large Work Place, they shall be placed under the charge of a responsible person who shall be readily available during working hours.

b) At Large Work Places, where hospital facilities are not available within easy distance of the work, First Aid posts shall be established and run by trained compounders.

c) Where Large Work Places are remote from regular hospitals, an indoor ward shall be provided with one bed for every 250 employees.

d) Where Large Work Places are situated in cities/towns or in their suburbs and no beds are considered necessary owing to the proximity of city or town hospitals, suitable transport will be provided to facilitate removal of emergent cases to the hospitals. At other Work Places, some conveyance facilities such as car, shall be kept readily available to take injured person(s) or person(s) suddenly taken seriously ill, to the nearest hospital.

1.4 DRINKING WATER

a) In every Work Place, there shall be provided and maintained at suitable places easily accessible to labour, a sufficient supply of cold water fit for drinking.

b) Where drinking water is obtained from an intermittent public water supply, each Work Place shall be provided with storage where such drinking water shall be stored.

c) Every water supply storage shall be at distance of more than 15 meters from latrine, drain or any other source of pollution. Where water has to be drawn from an existing well which is within such proximity of latrine, drain or any other source of pollution, the well shall be properly chlorinated before water is drawn from it for drinking. All such wells shall be entirely closed in and be provided with a trap door which shall be dust and water proof.

d) A reliable pump shall be fitted to each covered well, the trap door shall be kept locked and opened for cleaning or inspection which shall be done at least once in a month.

1.5 WASHING AND BATHING PLACES

i) Adequate washing and bathing places shall be provided, separately for men & women.

ii) Such places shall be kept in a clean and drained condition.

1.6 LATRINES AND URINALS

There shall be provided within the precincts of every Work Place adequate number of latrines and urinals in an accessible place. If women are employed, separate urinals and latrines shall be provided for them. All these shall be cleaned regularly and kept in a good sanitary condition.

1.7 DISPOSAL OF EXCRETA

Unless otherwise arranged for by the local sanitary authority, arrangements for proper disposal of excreta by incineration at the Work Place shall be made by means of a suitable incinerator approved by the local health officer or Engineer. Alternatively, excreta may be disposed of by putting a layer of nightsoil at the bottom of pucca tank prepared for the purpose and covering it with a 150 mm layer of waste or refuse and then covering it with a layer of earth for a fortnight (when it will turn into manure).

1.8 PROVISION OF SHELTER FOR REST

At every work place there shall be provided free of cost, for the use of workers, two suitable sheds, one for meals and the other for rest.

1.9 CRECHES

At very Work Place, at which 50 of more women workers are ordinarily employed, there shall be provided a crèche for the use of children, belonging to such women.

1.10 CANTEEN

A hygienic cooked food canteen on a moderate scale shall be provided for the benefit of workers wherever it is considered expedient.

Annexure - V of Appendix to Tender

(Refer GCC/PCC Sub-Clause-8.7)

DELAY DAMAGES FOR INTERDEPENDENT MILESTONES

Milestone No.	Description of Interdependent Milestones	Completion in Days from Commencement Date	Amount of Delay Damages per Day for the part of Works covered by each Milestone Date
MD-1	Submission of Basic Design Drawings of all electrical and mechanical equipment, including the loads and forces to be considered for in the structural design of the civil works, including earthing facilities, including all steel parts and everything else, which has to be embedded in first and second stage concrete and which has to be considered in the design of civil works	180	0.05% of Accepted Contract Amount per day of Delay limited to maximum of 1.0% of Accepted Contract Amount.
MD-2	Completion of setting up of fabrication workshop at site and start of fabrication of steel liners	300	0.05% of Accepted Contract Amount per day of Delay limited to maximum of 2.0% of Accepted Contract Amount.
MD-3	Erection of 20% of Pressure Shaft Steel Liner	540	0.05% of Accepted Contract Amount per day of Delay limited to maximum of 3.0% of Accepted Contract Amount.
MD-4	a) Completion of Delivery of two (2) numbers of Spillway Radial Gates at site. b) Erection of 50% of Pressure Shaft Steel Liner	760	0.05% of Accepted Contract Amount per day of Delay limited to maximum of 4.0% of Accepted Contract Amount.
MD-5	a) Completion of all Gates at site. b) Erection of 100% of Pressure Shaft Steel Liner.	1170	0.05% of Accepted Contract Amount per day of Delay limited to maximum of 7.0% of Accepted Contract Amount.

Milestone No.	Description of Interdependent Milestones	Completion in Days from Commencement Date	Amount of Delay Damages per Day for the part of Works covered by each Milestone Date
MD-6	**Completion of Works in all respect**	1280	0.10% of Accepted Contract Amount per day of Delay limited to maximum of 10.0% of Accepted Contract Amount.
These listed Milestone Dates shall be considered by the Contractor for submission of detailed Programme, which shall be a part of the Bidding Document.			



Annexure – VI of Appendix to Tender

(Refer GCC/PCC Sub-Clause-13.8)

WEIGHTAGES FOR PRICE ADJUSTMENT FORMULA

Components	Fixed Portion	Labour	Steel	HSD	M/C Tools
	A	PL	PS	F	E
a) For Supply Works	0.15	0.35	0.50	-	-
b) Erection, Testing & Commissioning	0.15	0.60	-	0.15	0.10

Annexure - VII of Appendix to Tender

(Refer GCC/PCC Sub-Clause-14.1)

Tax Guidelines 2024 for Khorlochhu Hydro Power Limited (KHPL)

1. Introduction

This Tax Guideline is issued to Khorlochhu Hydro Power Limited (KHPL) responsible for construction and commissioning of Khorlochhu under Trashi Yangtse to facilitate exemption and refund process.

This Tax Guideline which provides special privileges and facilities in terms of speedy clearance of Projects consignments shall be used as the basis to accord tax/duty exemption to the Projects. However, it shall cease upon commercial operation of the Project.

2. Effective date of implementation

This Tax Guideline shall come into effect from the date of approval accorded by DRC to implement the Tax Guidelines.

3. Decentralization of Authority to issue exemption certificate

In order to facilitate speedy clearance of the Projects consignments, the Authority to issue exemption certificates is hereby decentralized to ***Regional Revenue and Customs Office (RRCO) S/Jongkhar where the project's major plant and machinery and direct inputs shall enter.*** Therefore, all exemption and refund process must be routed through RRCO S/Jongkhar.

4. Exemption without having to go through refund process

In the event KHPL has appointed principal contractors to execute the project, the same privileges extended to the Project shall be provided subject to the fulfillment of the conditions for exemption specified under this Tax Guidelines.

5. Administrative responsibility and accountability

It shall be the responsibility of KHPL to ensure that there is strict compliance to the provisions of this Tax Guideline and that the facilities and privileges granted under this Tax Guideline are not misused in any form. In case of non-compliance and misuse, KHPL shall be liable for fines and penalties including prosecutions as per the relevant Tax Acts of the Kingdom of Bhutan. The KHPL and its principal contractors shall furnish additional information and documents, if required for effective implementation of this Tax Guidelines.

6. General Preliminary

i. The privileges and facilities of availing STEC and IDEC directly at source, prior to import, shall be available only to the principal contractors of the KHPL. Therefore, any subcontractors further appointed by principal

1

Khorlochhu Hydro Power Ltd.

contractors of the Project shall not be eligible for such privileges and facilities.

ii. Sub-contractors engaged by the Registered/Authorized Contractors shall import and declare in the name of Registered/Authorized Contractors only. Refunds for such imports shall be made only in the name of registered contractors and on verification and endorsement by the KHPL.

iii. Unless otherwise exempted, any contractor, sub-contractor or consultants recruited in connection with the Project including the KHPL and its employees and the Project per se shall be liable for Sales Tax and Customs Duty as per the Sales Tax, Customs & Excise Act of the Kingdom of Bhutan, 2000 & amendments thereof.

iv. Unless otherwise exempted, any contractor, sub-contractor or consultants recruited in connection with the project including KHPL and its employees and the project per se shall be liable for Health Contribution and Income Tax as per the Income Tax Act of the Kingdom of Bhutan, 2001 & amendments thereof.

v. Unless otherwise specified herein, contractors, sub-contractors or consultants recruited in connection with the Project including KHPL will be liable for income tax in keeping with the Income Tax Act of the Kingdom of Bhutan. Employees working under these contractors, subcontractors or consultancy firms and the KHPL are also liable for health contribution and income tax in keeping with the Income Tax Act of the Kingdom of Bhutan.

vi. All contractors, sub-contractors or consultants engaged for the project including the KHPL shall be responsible for deducting and remitting Tax Deducted at Source (TDS) in keeping with the provisions of the Income Tax Act of the Kingdom of Bhutan, 2001 & amendments thereof.

vii. Unless otherwise specified herein, any contractors, subcontractors or consultant recruited in connection with the project including the KHPL and the project per se and their employees shall be liable for Sales Tax, Green Tax and Customs Duty as per the Sales Tax, Customs and Excise Act of the Kingdom of Bhutan 2000 and amendment thereof.

viii. No duty, surcharge or any other forms of levies including Sales Tax will be charged by RGoB on the water use for the generation of Power (except for Royalty Energy) and on the sale of power by the company within Bhutan or on its export to India.

ix. No taxes, duties etc. shall be levied by RGoB on the initial transfer of ownership of the Project from RGoB to the Joint Venture Company for execution on BOOT basis and its transfer back to RGoB after completion of the concession period as specified in the agreement of the project.

x. After the commencement of the commercial operation the Joint Venture Company, the KHPL shall be liable for all types of taxes in keeping with the taxation laws of the Bhutan. In this regard, the Project Authority shall inform in advance to the concerned RRCO with the copy to Department of the Revenue and Customs.

Khorlochhu Hydro Power Ltd.

2

xi. Any procurement made under tax/duty exemption basis shall be liable to tax/duty payment as per the Tax Act of the Kingdom of Bhutan, if disposed off in Bhutan.

xii. Unless there is a prior approval, exempted goods shall not be sold or re-exported.

xiii. Proper inventory of all exempted goods must be maintained by principal contractors and the KHPL, which shall be subject to post audit at any point of time.

xiv. The KHPL prior to the import or availing exemption shall submit list of the **principal contractors along with the copy of the contract agreement** to the Department and concerned RRCO.

xv. The KHPL should provide an updated list of all principal Contractors with projects to the concerned RRCOs and DRC from time to time. The KHPL and its principal contractors shall furnish any additional documents as and when requested by DRC, HQ and its Regional Offices.

7. Sales Tax and Customs Duty Exemption

Basis for exemptions

The article 7.3 of the Intergovernmental Agreement between the Royal Government of Bhutan and the Government of India concerning the development of the four Joint Venture project signed on 22nd April 2014 serves as the basis for this exemption on the following items as provided below.

"...Plants, Construction materials, equipment, machineries and services imported for direct use in the construction of the project."

The construction of the project shall broadly cover the construction of the dam & power house, surge shaft & pressure shaft, headrace tunnel and chambers.

The exemptions specified herein shall be based on the documents such as the detailed project report (DPR), Bill of Quantities (BOQ), contract agreement and other relevant documents signed regarding the JV projects, which shall be submitted accordingly to the concerned RRCO for verification.

What are exempted?

The exemption shall be provided on plant and machinery, equipment and construction materials forming direct inputs including the professional services for the construction of the project.

In addition to the above direct inputs, the dumpers, tippers, transit mixers and their spare parts shall also be eligible for exemption. However, the principal contractors, through concerned JV company, will submit the list and quantity of dumpers, tippers, transit mixers, machineries, equipment and their spare parts

Khorlochhu Hydro Power Ltd.

required for the whole project on an annual basis to the Department of Energy and the concerned Regional Revenue &Customs Office (RRCO) to avail tax/duty exemptions;

What are NOT exempted?
The following items shall NOT be eligible for Sales Tax and Customs Duty exemptions:

i. Vehicles;
ii. Accessories and spare parts
iii. HSD/POL;
iv. Fuels;
v. Printing and stationeries
vi. Office equipments and furniture
vii. Household items
viii. Hardware items and materials used for construction of residential and non-residential buildings such as office, and labor camps, shed for storage, workshops, etc;
ix. Sports items and equipment;
x. Import for canteens;
xi. Items personal and consumable in nature such as toiletries, groceries, food, helmets; gumboots, TV and other electronics, tools;
xii. Any other goods and services that are not direct inputs to the Project; and
xiii. Sales Tax shall not be exempted at the Point of Sales (PoS) on services provided by hotels & restaurants, Cable TV services etc. for all users of the services.
xiv. Sales Tax and Green Tax on HSD and POL either imported or purchased from sources inside Bhutan shall not be eligible for refund.
xv. Any other items that may be a direct input but are consumable in nature shall not be eligible for exemption.

8. Green Tax exemption

i. Vehicles imported, for direct use in the construction of the project, on a temporary or re-export basis shall not be subject to Green Tax.
ii. Vehicles (other than imported on a temporary or re-export basis and the HSD/POL consumed by both the contractors and Project Authority shall be not be eligible for exemption and refund thereof.

9. Excess materials

Excess materials are defined as those materials in excess (surplus) of what is actually used for the Project, irrespective of the quantities specified in the DPR/BOQ.

It shall be the responsibility of the KHPL to ensure that no excess materials are imported by its principal contractors.

Khorlochhu Hydro Power Ltd.

i. In case of excess import, the project shall declare all excess materials imported by its principal contractors to the concerned RRCO for payment of applicable Sales Tax and Customs Duty.
ii. Non-declaration, mis-declaration or concealment by the project authority shall be liable for fines and penalties including prosecutions as per the Sales Tax, Customs & Excise Act of the Kingdom of Bhutan, 2000 & amendments thereof and Income Tax Act of the Kingdom of Bhutan, 2001 & amendments thereof.
iii. Approval shall be obtained from the concerned RRCO prior to disposal/sale of the excess materials, if any.
iv. Should there be substantive reasons for the deviations in quantities from DPR/BOQ, a prior approval shall be sought in writing to continue to avail exemptions.

9. Requirement of license (s) and TPN by the principal contractors

The KHPL shall submit a list of principal contractors along with the copy of their licenses issued by the concerned agency to the concerned RRCOs. This is required in order to issue Taxpayer Number (TPN) (if the principal contractors are new) to facilitate imports of Project consignments.

10. General procedures for availing exemption for import of goods other than vehicles

i. All applications for exemptions must be submitted in advance, i.e. prior to import to the concerned RRCOs through **electronic and Customs Management System (eCMS).**
ii. All applications for exemptions shall be accompanied by forwarding letter signed by the authorized persons/liaison officers of the project.
iii. An explanatory note on the usage of items should be attached or uploaded along with the application for clear understanding of the items imported.
iv. The following documents should be submitted:
v. A copy of commercial invoice/bills;
vi. An import license (in ORIGINAL) issued by the concerned agency of RGoB in case of import from other than India; and

The concerned RRCO shall verify the application in terms of the eligibility and ineligibility of exemptions as per this Guideline and accord approval accordingly.

Exemption application for used or second hand goods shall be accompanied by special permit/clearance (in original) issued by the Ministry of Industry, Commerce & Employment or concerned organization as per the existing rule.

11. General Refund Procedures

i. In the event taxes/duties have been paid on exempted goods, the refund shall be allowed subject to fulfillment of the following refund conditions and procedures:

5

Khorlochhu Hydro Power Ltd.

ii. All applications for refund must be submitted to the concerned RRCO where taxes/duties have been originally paid.
iii. All applications for refund must be routed through the KHPL.
iv. The following documents should be submitted for the purpose of refund:
v. Refund Application Form;
vi. Money receipt of taxes/duties paid in ORIGINAL such as RGR money receipt or computer generated money receipt or advance adjustment voucher, where applicable;
vii. A copy of supplier's invoice such commercial invoice, excise invoice/bill;
viii. A copy of import declaration form, import bill etc. and
ix. Copy of STEC/IDEC issued by the issuing RRCO.
x. All applications for refund must be submitted within one year from the date of payment of taxes/duties failing which shall not be entertained.
xi. Refund in the form of "account payee cheque" shall be made directly to KHPL's bank account or to the principal contractor.
xii. (Note: Refunds not covered by this Tax Guideline shall be made in accordance with the existing refund manual/procedures.)

12. Import declaration & documents required

All imports made by the KHPL and its principal contractors, be it from India or 3rd countries, shall be declared at the point of importation/entry like any normal goods as per the existing Act and Rules in force.

All exemption prior to import shall be processed through ***eCMS and submit to the respective regional office for approval.***

Documents required for import from India

i. The following documents shall be submitted for the purpose of declaration for imports made from India.
ii. Covering/forwarding letter from the KHPL indicating that goods are meant for the projects.
iii. Invoices or bills.
iv. Excise invoice for direct procurement from a factory or authorized dealer.
v. Import permit from relevant agencies in case of restricted goods.
vi. Any other relevant documents.

Documents required from other than India

The following documents shall be submitted for the purpose of declaration for imports made from countries other than India:

i. Import License
ii. Pro-forma Invoice
iii. Commercial Invoice
iv. Packing list
v. Certificate of origin
vi. Bill of lading/Airway bill
vii. Marine/Air/Transit insurance policy

6

Khorlochhu Hydro Power Ltd.

viii. Freight bill
ix. Import permit from relevant agencies in case of restricted goods.

13. Temporary import of goods without payment of Sales Tax and Customs Duty

What are allowed to be imported on a temporary or re-export basis?

Those machines and equipment that are capital in nature (durable assets) and verifiable in terms of serial numbers such as registration number, make & model numbers and approved purposes/uses, etc. shall be allowed to be imported on a temporary basis without payment of Sales Tax and Customs Duty.

What are NOT allowed to be imported on a temporary or re-export basis?

The category of goods for civil, electrical, and plumbing works, and other materials used for installation or housing the machinery & equipment including spares, accessories, tools, kits, consumables and the like, office equipment and furniture, irrespective of the nature of the Project, shall NOT be allowed to be imported on a temporary basis without payment of Sales Tax and Customs Duty.

14. Applicability of Sales Tax/Customs Duty for used or second hand goods imported on a temporary or re-export basis

Import of all used or second hand goods shall be accompanied by a special permit (in original) issued by the relevant agency as per the existing rule. However, if such used or second hand goods are not eligible to be imported on a temporary basis as per Clause No 14. (b) above, it shall attract applicable Sales Tax and Customs Duty.

15. General Procedures for import of goods on a temporary or re-export basis

i. The authority to renew applications for temporary import is hereby decentralized to the concerned RRCO.
ii. All the application for temporary import and renewal thereof shall be submitted on time to the concerned RRCO.
iii. All applications for temporary import shall be routed through the project authority or its liaison officers, who shall ensure re-export of the goods to the country of origin.
iv. Sales Tax & Customs clearance shall be obtained from the concerned RRCO by the KHPL before releasing the security money of its contractors, if any, in order to ensure that goods on a temporary basis are re-exported to the country of origin. Security money shall be forfeited by the project authority in the event of non-compliance

Khorlochhu Hydro Power Ltd.

v. All temporary import of machinery & equipment shall be cleared against a 'letter of undertaking' affixed with legal stamp, duly sealed, named and signed by the importer.

vi. The RRCO concerned shall accord approval of temporary import initially for a maximum period of 3 months in keeping with the provision of the Sales Tax, Customs & Excise Act, 2000. Thereafter, the renewal shall be made only for a maximum period of one year at a time, unlike in the past wherein renewal was granted until the completion of the Project. This is, in order to ensure timely monitoring of the goods imported on a temporary basis.

vii. All applications for temporary import of second hand or used machinery and equipment and the like shall be accompanied by a special permit (in original) issued by the Ministry of Industry, Commerce and Employment as per the existing rule.

viii. All the documents issued at the time of temporary import shall be produced at the customs check post at the time of re-export.

ix. Vehicles that are to be imported on a temporary basis shall be allowed subject to import permit/clearance from the Ministry of Industry, Commerce & Employment.

x. Vehicles imported for direct use in the construction of the project on a temporary or re-export basis shall not be subject to Sales Tax and Customs Duty.

xi. Vehicles other than the above import and HSD/POL consumed by both contractors and project authority shall be subject to Sales Tax, Green Tax and Customs Duty.

16. Procedures for disposal/sale of exempted goods

Goods imported for temporary use or on an exempt basis above shall not be disposed of or sold off without prior approval.

It shall be the responsibility of the KHPL to inform in writing to the DRC or its Regional Offices if any goods imported for temporary use or on an exempt basis are disposed of or sold off before or after the completion of the Project.

If approval is granted by DRC, HQ to dispose or sell such goods to a non-privileged person, it shall be liable for Sales Tax/Customs Duty/Green Tax, where applicable.

17. Others

i. All matters related to the Project must be routed through the office of the KHPL.

ii. All other procedures not covered by this Guideline shall be dealt with as per the existing Act and Rules thereto. In this regard, the KHPL and its contractors shall seek clarification, if any, in writing with the DRC, HQ.

iii. The KHPL and its contractors is requested to familiarize with the following documents for additional information:

iv. Sales Tax, Customs & Excise Act of the Kingdom of Bhutan, 2000 and amendments thereof.

8

Khorlochhu Hydro Power Ltd.

v. Rules on the Sales Tax, Customs & Excise Act of the Kingdom of Bhutan, 2000 and amendments thereof.
vi. Customs Act of Bhutan 2017.
vii. Customs Rules and Regulations of Bhutan 2017.
viii. Income Tax Act of the Kingdom of Bhutan, 2001 and amendments thereof.
ix. Rules Income Tax Act of the Kingdom of Bhutan, 2001 and amendments thereof.
x. Bhutan Trade Classification Customs Tariff and Sales Tax Schedule 2022 and amendments thereof.

9

SECTION -5

Forms & Procedures



SECTION-5: Forms & Procedures

Form - 1: Letter of Tender

{Refer ITB Clause-13.1, 14 & 21.2 (a)}

Name of Contract.....

To: (Name and Address of Employer)

Sir,

1.0 Having examined the Bid Documents, including Addenda Nos. *(Insert Numbers)*, the receipt of which is hereby acknowledged, we the undersigned, offer to construct and install such Works and remedy the defects therein in conformity with the Conditions of Contract, Specifications, Drawings, Bill of Quantities, Appendix to Tender and addenda (if any) for the sum of :

..... ***(Prices to be left blank in Envelope – I*** (Insert amounts in words)**)** ……

.....(.....)

(Amount in Figures)

as specified in the Appendix to Tender or such other sums as may be determined in accordance with the terms and conditions of the Contract.

Percentage of discount/rebate offered (if any) on aforesaid price: _____ % (***to be left blank in Envelope - I)***.

2.0 **Attachments to the Letter of Tender:**

In line with the requirement of the Bid Documents we enclose herewith the following Attachments to the Letter of Tender:

a. **Attachment 1:** Bid Security in the form of Bank Guarantee (in original) No.---------- dated---------- issued by ----------[Name and address of the Bank] for a sum of ..... *(Name of currency and amounts in words & figures)* valid up to and including [date 90 days after the period of bid validity].

b. **Attachment 2:** A power of attorney complying with the requirement of ITB Clause No. 5.1(a) indicating that the person(s) signing the bid have the authority to sign the bid and thus that the bid is binding upon us during the full period of its validity in accordance with the ITB Clause 17.

c. **Attachment 3:** The documentary evidence establishing in accordance with ITB Clause 3 that we are eligible to bid and in terms of ITB Clause 5.1(e). Our bid is strictly in conforming to the documents issued by the Employer. The updated qualification details have been furnished as per your format enclosed with the bid documents.

d. **Attachment 4**: Bidders Appreciation of the project.

It should include a report on the site inspection, awareness and understanding of all the principal, technical and logistic problems related to transportation and erection of the construction equipment, materials, availability of land, infrastructure, local taxes & laws and construction of works (ITB clause no. 8).

e. **Attachment-5**: Integrity Pact.

Integrity Pact Duly signed between Employer and the Bidder in accordance with Sub-Clause-3.3 of ITB.

f. **Attachment-6**: Undertaking by the parent/ holding company:

The commitment by the parent/holding company to sign a separate agreement with Employer in compliance to ITB Clause 5.3(i) (if awarded the work).

g. **Attachment-7**: Joint Venture / Consortium Agreement:

A joint Venture / Consortium Agreement furnished in accordance with ITB Clause 6.2(v)

h. **Attachment-8**: Undertaking by the Sub-contractor(s):

The commitment by the Subcontractorto submit the Joint Deed of Undertaking in compliance to ITB Clause 5.4(ii) (if awarded the work).

i. **Attachment-9**: We agree and accept the names of approved Subcontractors/manufacturers/vendors mentioned in Attachement-9(i). We also propose additional Subcontractors/manufacturers/vendors, who meet the specific qualification criteria of the respective equipment/item mentioned in Attachment-9(ii) and Attachment – 9(iii) and furnish the details of the name, nationality and documentary evidences in support of such additional Subcontractors/manufacturers/vendors meeting the specific qualifications. Further, we understand that the inclusion of additional Subcontractors/Manufacturers/Vendors in the list of approved Subcontractors/Manufacturers/Vendors shall be governed under PCC Clause no. 4.4 of Bid documents.

……

 # (Any other attachment, if required shall be added here)

All other bidding documents issued by KHPL except Price Schedule not covered above duly stamped and signed on each page by the authorized signatory(ies) to the bid.

3.0 **Price Schedules:**

3.1 In line with the requirements of the Bid Documents, we enclose herewith the Price Schedule, duly filled-in as per your proforma.

@ Any other Schedule if required, shall be added here.

3.2 We are aware that the Bill of Quantities do not generally give a full description of the work to be performed under each item and we shall be deemed to have read the Technical Specifications and other Bid Documents and Drawings to ascertain the full scope of work included in each item while filling-in rates and prices. We agree that entered rates and prices shall be deemed to include for the full scope as aforesaid, including applicable taxes, duties, royalties, octroi, cess & levies etc. and overhead and profit.

3.3 We declare that as specified in General Condition of Contract (Clause13.7 & 13.8) and Particular Condition of Contract (Sub Clause 13.7 &13.8), the Price Schedule shall be subject to adjustment. Our prices are inclusive of all the applicable taxes, duties, levies, cess, royalties and octroi for the performance of the Contract.

3.4 We confirm that we have examined and are aware of the conditions and adequacy of infrastructural facilities, Construction Equipment and related spares, services lines, partially completed works etc. to be handed over by the Employer for performance of Contract.

Khorlochhu Hydro Power Ltd.

3.5 We confirm that we shall get registered with the concerned Sales Tax/Department of Trade & Industry, RGoB, in the country where the project is located. We also confirm that we shall produce the Tax Payer Number (TPN) issued by concerned authorities in Bhutan to the Engineer, before receiving the first payment under the Contract, if the work is awarded to us.

3.6 We confirm that no Sales Tax/Entry tax/Levies in any form shall be payable by you for the bought out items which are dispatched directly by us/our Assignee to the project site. However, you will issue requisite Sales Tax declaration forms in respect of such bought out items, on production of documentary evidence of registration with the concerned Sales Tax Authorities.

3.7 We undertake, if our bid is accepted, to commence the work immediately upon your Letter of Acceptance to us, and to achieve Completion of Works within the time stated in the Bid Documents.

3.8 If our bid is accepted, we undertake to provide a Performance Security in the form and amounts, and within the time specified in the Bid Documents.

3.9 We agree to abide by this bid for a period of 180 days from the date of opening of Technical bid as stipulated in the Bid Documents, and it shall remain binding upon us and may be accepted by you at any time before the expiration of that period.

3.10 Until a formal Contract is prepared and executed between us, this bid, together with your written acceptance thereof in the form of your Letter of Acceptance shall constitute a binding contract between us.

3.11 We understand that you are not bound to accept the lowest or any bid you may receive. We acknowledge the right of the Employer to reject our Bid without assigning any reason or otherwise and hereby waive our right to challenge the same on any account whatsoever.

3.12 All information provided in my/our Bid and attachments thereof is true and correct and all documents copies of which are attached with our Bid as attachments are true copies of their respective originals.

3.13 I/We hereby certify that we have not been banned/ de-listed/ black listed/ debarred from business by the Employer or any Government institution or public sector enterprise or any government, Central or State or any statutory authority in India or Bhutan during last 03 (three) years on grounds of corrupt/fraudulent practices.

3.14 I/We hereby declare that only the persons or firms interested in this proposal as principals are named in our Bid and that no other person or firm or company other than those mentioned in our Bid has any interest in this bid submission or in the Contract to be entered into and in good faith, without collusion or fraud, if our Bid is accepted as evidenced by issue of Letter of Acceptance to us.

3.15 We understand that you may annul the bidding process and reject all bids or accept or reject any of the bids at any time and that you are neither bound to accept any bid that you may receive nor to invite the Bidders to bid for Works, without incurring any liability to all or any of the Bidders.

3.16 We believe that we continue to satisfy the eligibility criteria and meet(s) the requirements as specified in the Bid Documents and are qualified to submit a Bid in accordance therewith.

3.17 We have studied all the Bid Documents carefully and also surveyed the Works Site and understood all local and site conditions affecting the execution of the Works. We understand that except to the extent as expressly set forth in the Contract, we shall have no claim, right or title arising out of any documents or information provided to us by the

Khorlochhu Hydro Power Ltd.

Employer or in respect of any matter arising out of or concerning or relating to the bidding process including the award of Works to the selected bidder.

3.18 We acknowledge and confirm that upon issue of Letter of Acceptance to us consequent to acceptance of our Bid, a binding contract for execution of the Works shall come into existence on the terms set forth in our Bid together with your Letter of Acceptance. We undertake to commence the work upon issue of your said Letter of Acceptance, and to achieve Completion within the time stipulated in the Bid Documents.

3.19 We agree and understand that the Bid is subject to the provisions of the Bid Documents. In no case, we shall have any claim or right of whatsoever nature if the Works is not awarded to us or our Bid is not opened.

3.20 We, hereby, declare that only the persons or firms interested in this proposal as principals are named here and that no other persons or firms other than those mentioned herein have any interest in this proposal or in the Contract to be entered into, if the award is made on us, that this proposal is made without any connection with any other person, firm or party likewise submitting a proposal is in all respects for and in good faith, without corrupt/fraudulent/collusive/coercive practice.

Dated this.....day of.....20….

Thanking you, we remain,

Yours faithfully,

(Signature)

(Printed Name)

(Designation)

(Common Seal)

Date :

Place :

Business Address:

Country of Incorporation:

(State or Province to be indicated)

Name & Address of the Principal Officer:



Attachment - 1:

{Refer ITB Clause-18}

(To be executed on non-judicial Stamp papers/Legal Stamp of Appropriate value)

BID SECURITY FORM

Bank Guarantee

Date:_____

(Name of Contract)

To: (Name and address of Employer)

WHEREAS (name of Bidder) (hereinafter called "the Bidder") has submitted its Bid dated (date of bid) for the performance of the above-named Contract (hereinafter called "the Bid")

KNOW ALL PERSONS by these present that WE (name of Bank) of (address of bank) (hereinafter called "the Bank"), are bound unto (name of Employer) (hereinafter called "the Employer") for the sum of: (amount), for which payment well and truly to be made to the said Employer, the Bank binds itself, its successors and assigns by these presents.

THE CONDITIONS of this obligation are as follows:

1. If the Bidder withdraws its Bid during the period of bid validity specified by the Bidder in the Letter of Tender, or adopts corrupt or collusive or coercive or fraudulent practices or default under Integrity Pact.
2. If the Bidder, having been notified of the acceptance of its Bid by the Employer during the period of bid validity.
   a) If the Bidder, fails or refuses to sign the Contract Agreement when required, or
   b) If the Bidder, fails or refuses to submit the performance security in accordance with the bid documents.

WE undertake to pay to the Employer up to the above amount upon receipt of its first written demand, without the Employer having to substantiate its demand, provided that in its demand the Employer will mention that the amount claimed by it is due, owing to the occurrence of one or both of the two above-named CONDITIONS, and specifying the occurred condition or conditions.

This guarantee will remain in force up to and including (date 90 days after the period of bid validity), and any demand in respect thereof must reach the Bank not later than the above date.

For and on behalf of the Bank

_____

in the capacity of

_____

Common Seal of the Bank



Instructions for execution of Bank Guarantee for Bid Security

1. *Bank Guarantee for Earnest Money Deposit should be executed on non-judicial Stamp papers/Legal Stamp of requisite value in accordance with the stamp Act if applicable to that particular state of Indian Union/country of executing Bank, where executed.*
2. *The executing officers of the Bank Guarantee for Earnest Money/Bid Security shall clearly indicate in (block letters) his name, designation, Power of Attorney No. / Signing Power No. as well as telephone/ fax numbers with full correspondence address of the issuing Guarantee etc.*
3. *Each page of the Bank guarantee for Earnest Money Deposit shall be duly signed/initialed by the executing officers and the last page shall be signed in full, indicating the particulars as aforesaid (sub-para 2) under the seal of the Bank.*
4. *Stamp paper shall be purchased in the name of Bank issuing the Bank Guarantee, after the date of 'Notice Inviting Tender', not more than six (6) months prior to execution/ issuance of the Bank Guarantee. The name of the purchaser should appear at the back side of stamp paper in the Vendors Stamp. The issuing Bank shall be requested independently for verification/confirmation of the Bank Guarantee issued, non-confirmation of which may lead to rejection of 'Bid Security'.*
5. *Bank Guarantee for Bid security in original shall be submitted along with the Bid. However, the issuing Bank shall submit an unstamped duplicate copy of Bank Guarantee directly by registered post (A.D.) to the Employer (authority inviting tenders) with a forwarding letter.*



Attachment - 2

{Refer ITB Sub- Clause-5.1 a)}

POWER OF ATTORNEY

(On non-judicial Stamp papers/Legal Stamp of Appropriate value)

KNOW ALL MEN BY THESE PRESENTS THAT WE M/S ……., A COMPANY ORGANISED AND EXISTING UNDER THE LAWS OF (NAME OF COUNTRY ……..……) AND HAVING ITS REGISTERED/PRINCIPAL OFFICE /PLACE OF BUSINESS AT……..…REPRESENTED BY (NAME OF PERSONS) (THE "EXECUTANT") DO HEREBY NOMINATE, CONSTITUTE, AUTHORIZE AND APPOINT MR. […….*Name of Attorney*……] , SON OF [……..…], RESIDENT OF [……] AND PRESENTLY EMPLOYED WITH], A COMPANY/ CORPORATION ORGANISED AND EXISTING UNDER THE LAWS OF ……. (NAME OF THE COUNTRY) AND HAVING ITS REGISTERED OFFICE/PRINCIPAL PLACE OF BUSINESS AT ……..……. AS OUR TRUE AND LAWFUL ATTORNEY (THE "ATTORNEY") TO DO IN OUR NAME AND ON OUR BEHALF ALL OR ANY OF THE FOLLOWING ACTS, DEEDS AND THINGS IN CONNECTION WITH OR IN RESPECT OF OR RELATING TO THE NOTICE INVITING TENDER NO. …… DATED ……. (THE "NIT") ISSUED BY _____, A COMPANY ORGANISED AND EXISTING UNDER THE LAWS OF _____ AND HAVING ITS REGISTERED OFFICE (UNDER THE COMPANIES ACT, _____) (AT _____ (THE "EMPLOYER") FOR THE EXECUTION, CONSTRUCTION AND DEVELOPMENT OF THE WORKS DESCRIBED IN THE NOTICE INVITING TENDER (NIT) (THE "WORKS") THAT IS TO SAY:

1. TO PREPARE, OFFER, SIGN, SUBMIT AND DELIVER TO THE EMPLOYER THE EXECUTANT'S BID FOR THE WORKS PURSUANT TO THE NIT (THE "BID") INCLUDING TO MAKE, SIGN (JV/Consortium Agreement), SUBMIT, DELIVER, EXECUTE, AND ACCEPT ALL DOCUMENTS, INCLUDING JOINT VENTURE/CONSORTIUM AGREEMENT, INFORMATION, APPLICATIONS AND OTHER WRITINGS NECESSARY FOR OR INCIDENTAL TO THE SIGNING, SUBMISSION AND DELIVERY OF THE BID TO THE EMPLOYER;
2. TO NEGOTIATE, ENTER IN AND ALL, SIGN AND EXECUTE, ACCEPT AND DELIVER THE CONTRACTS UNDERTAKINGS, ACCEPTANCES AND OTHER WRITINGS CONSEQUENT UPON ACCEPTANCE OF THE EXECUTANT'S BID;
3. PARTICIPATE IN BIDDERS' AND OTHER CONFERENCES AND PROVIDE ALL INFORMATION REQUIRED BY THE EMPLOYER AND TO FURNISH/SEEK CLARIFICATIONS ARISING OUT OF OR RELATING TO THE NIT AND, UPON AWARD OF THE CONTRACT CONSEQUENT TO THE ACCEPTANCE OF THE EXECUTANT'S BID BY THE EMPLOYER;
4. TO REPRESENT AND ACT ON BEHALF OF THE EXECUTANT IN RESPECT OF ALL MATTERS BEFORE THE EMPLOYER RELATING TO THE EXECUTANT TO BID AND UPON THE ACCEPTANCE OF THE EXECUTANT'S BID BY THE EMPLOYER INCLUDING THE RESULTANT CONTRACT ON SUCH THE ACCEPTANCE OF THE EXECUTANT'S BID (THE "CONTRACT") IN RESPECT OF ALL MATTERS RELATING TO OR ARISING OUT OF OR CONCERNING THE CONTRACT AND TO GENERALLY DEAL WITH THE EMPLOYER ON BEHALF OF THE EXECUTANT IN ALL MATTERS ARISING OUT OF OR IN CONNECTION WITH OR RELATING TO OR ARISING OUT

OF THE EXECUTANT'S BID. THE NIT AND THE CONTRACT IN THE EVENT OF ACCEPTANCE OF THE EXECUTANT'S BID BY THE EMPLOYER;

5. AND GENERALLY TO DO ANY AND ALL OTHER AND FURTHER ACTS, DEEDS AND THINGS WHICH ARE NECESSARY FOR OR INCIDENTAL TO OR DEEMED APPROPRIATE FOR MORE EFFECTUAL EXERCISE OF THE POWERS HEREBY CONFERRED.

AND We, the Executant above named do hereby agree and undertake to ratify and confirm and do hereby ratify and confirm all acts, deeds and things lawfully done or caused to be done by our said Attorney pursuant to and in exercise of the powers hereby conferred and all acts, deeds and things done or caused to be done by our said Attorney pursuant hereto shall always be deemed to be the acts, deeds and things done by the Company itself.

IN WITNESS WHEREOF, THIS POWER OF ATTORNEY ON THIS [……] DAY OF [……..], [20…..]……. ……. has been executed under the common seal of the Company, at ----------(name of place).

For [Name of the Executant]

By …….
(Name of Officer)

Title

WITNESSES

1.

2.

Notes:

i) The mode of execution of the Power of Attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executant(s) and when it is so required, the same should be under common seal affixed in accordance with the required procedure.

ii) The Bidder should submit for verification the extract of the charter documents and documents such as a resolution of its Board of Director/ power of attorney in favour of the person executing this Power of Attorney for delegation of power hereunder on behalf of the Bidder.



Attachment - 3
(Refer ITB Sub-clause 5.1.e)

FORM OF DECLARATION

A DECLARATION IN RESPECT OF THE SUBMITTED BID DOCUMENTS/ PROPOSALS

Subject: In respect of execution of Main Hydro-Mechanical Package (KHM) of Khorlochhu Hydropower Project; it is declared without any reservation whatsoever that:

1) the submitted Techno-Commercial/Price Bid proposals are without any deviations and are strictly in conformity with the documents issued by the Employer.
2) in case any deviations are noticed which might have crept inadvertently, such deviations without reservation of any kind are automatically deemed to have been withdrawn by us.
3) We are familiar with all the requirements of the Contract and have not been influenced by any statement or promise of any person of the Employer.
4) We are experienced and competent Bidder to perform the Contract to the satisfaction of Employer and are familiar with all general and special laws, acts, ordinances, rules and regulations of the Government of Bhutan that may affect the work, its performance or personnel employed therein.
5) We hereby authorize the Employer to seek reference from our bankers for its financial position and undertake to abide by all labour welfare legislations.
6) We have not been banned/ de-listed/ blacklisted/ debarred from business by the Employer or any Government institution or public sector enterprise or any government, Central or State or any statutory authority in India or Bhutan as on the time of bid submission deadline on grounds of corrupt/fraudulent practices in terms of ITB 3.2.
7) We do not and shall not appoint **local agents** in Bhutan in terms of ITB 3.4
8) The above statement submitted by us is true and correct to our best knowledge.

Date : (Signature)

Place : (Printed Name)

(Designation)

(Common Seal)

N.B: WITHOUT THIS CERTIFICATE BID IS LIABLE TO BE REJECTED.



Attachment - 4

{Refer ITB Clause-8.0}

BIDDER'S APPRECIATION OF THE PROJECT

It should include a report on the site inspection, awareness and understanding of all the principal, technical and logistic problems related to transportation and installation/handling of the construction equipment/ materials, availability of land, infrastructure, local taxes & laws and construction of works (ITB Clause No. 8).

Date :

Place :

(Signature)

(Printed Name)

(Designation)

(Common Seal)

Attachment - 5

(Refer ITB Clauses/Sub-Clauses – 3.3, 13.2, 18.6,35)

(To be executed on plain paper at the time of submission of bid affixed with legal stamp and on legal paper of appropriate value by successful bidder (Contractor) prior to signing of Contract Agreement)

INTEGRITY PACT

1. General:

Whereas, **Mr. Sonam Rixin, General Manager, Contracts & Procurement Division**, representing the Khorlochhu Hydro Power Limited (KHPL), herein after referred to as the Employer on one part, and *(Name of person)* representing the (*Name of Bidder or his/her authorized representative, with power of attorney*) representing (*Name of firm*) as the "Bidder" on the other part hereby execute this agreement as follows:

This agreement should be a part of the standard bidding document, which shall be signed by both the parties at the time of purchase of bidding documents and submitted along with the tender document. The head of the employing agency/or his authorized representative should be the signing authority. For the bidders, the bidder himself or his authorized representative must sign the Integrity Pact (IP). If the winning bidder had not signed during the submission of the bid, the tender shall be cancelled.

2. Objectives:

Whereas, the Employer and the Bidder agree to enter into this agreement, hereinafter referred to as IP, to avoid all forms of corruption or deceptive practice by following a system that is fair, transparent and free from any influence/unprejudiced dealings in the **bidding process**[1] and **contract administration**[2], with a view to:

2.1. Enabling the Employer to obtain the desired contract at a reasonable and competitive price in conformity to the defined specifications of the works, goods and services; and

2.2. Enabling bidders to abstain from bribing or any corrupt practice in order to secure the contract by providing assurance to them that their competitors will also refrain from bribing and other corrupt practices.

3. Scope:

The validity of this IP shall cover the bidding process and contract administration period.

4. Commitments of the Employer

The Employer commits itself to the following:

4.1. The Employer hereby undertakes that no official of the Employer, connected directly or indirectly with the contract, will demand, take a promise for or accept, directly or through intermediaries, any bribe, consideration, gift, reward, favour or any material or immaterial benefit or any other advantage from the Bidder, either for themselves or for any person, organization or third party related to the contract in exchange for an advantage in the bidding process and contract administration.

---

[1] Bidding process, for the purpose of this IP, shall mean the procedures covering tendering process starting from bid preparation, bid submission, bid processing, and bid evaluation.

[2] Contract administration, for the purpose of this IP, shall mean contract award, contract implementation, un-authorized sub-contracting and contract handing/taking over.

4.2. The Employer further confirms that its officials shall not favor any prospective bidder in any form that could afford an undue advantage to that particular bidder during the bidding process and contract administration and will treat all Bidders alike.

4.3. Officials of the Employer, who may have observed or noticed or have reasonable suspicion shall report to the head of the employing agency or an appropriate government office any violation or attempted violation of clause 4.1 and 4.2.

4.4. Following report on violation of clauses 4.1 and 4.2 by official (s), through any source, necessary disciplinary proceedings, or any other action as deemed fit, including criminal proceedings shall be initiated by the Employer and such a person shall be debarred from further dealings related to the bidding process and contract administration.

5. Commitments of Bidders:

The Bidder commits himself to take all measures necessary to prevent corrupt practices, unfair means and illegal activities during any stage of the bidding process and contract administration in order to secure the contract or in furtherance to secure it and in particular commits himself to the following:

5.1. The Bidder will not offer, directly or through intermediaries, any bribe, gift, consideration, reward, favour, any material or immaterial benefit or other advantage, commission, fees, brokerage or inducement to any official of the Employer, connected directly or indirectly with the bidding process and contract administration, or to any person, organization or third party related to the contract in exchange for any advantage in the bidding process and contract administration.

5.2. The Bidder will not collude with other parties interested in the contract to manipulate in whatsoever form or manner, the bidding process and contract administration.

5.3. If the bidder(s) have observed or noticed or have reasonable suspicion that the provisions of the IP have been violated by the procuring agency or other bidders, the bidder shall report such violations to the head of the procuring agency.

6. Sanctions for Violation:

The breach of any aforesaid provisions shall result in administrative charges or penal actions as per the relevant rules and laws.

6.1. The breach of the IP or commission of any offense (forgery, providing false information, mis-representation, providing false/fake documents, bid rigging, bid steering or coercion) by the Bidder, or any one employed by him, or acting on his/her behalf (whether with or without the knowledge of the Bidder), shall be dealt with as per the terms and conditions of the contract and other provisions of the relevant laws, including De-barment Rules.

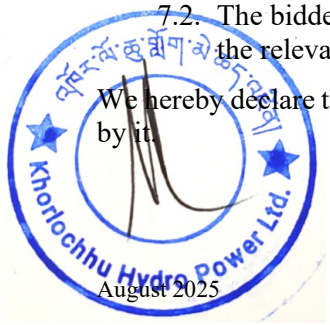
6.2. The breach of the IP or commission of any offence by the officials of the procuring agency shall be dealt with as per the rules and laws of the land in vogue.

7. Monitoring and Administration:

7.1. The respective procuring agency shall be responsible for administration and monitoring of the IP as per the relevant laws.

7.2. The bidder shall have the right to appeal as per the arbitration mechanism contained in the relevant rules.

We hereby declare that we have read and understood the clauses of this agreement and shall abide by it.



The parties hereby sign this Integrity Pact at _____ on_____

Affix Legal Stamp

EMPLOYER	BIDDER/REPRESENTATIVE
CID: 1 1 1 0 7 0 0 6 5 7 7	CID:
Witness: _____	Witness: _____
Name:	Name:
CID: 1 1 6 0 5 0 0 0 2 0 3	CID:

Attachment - 6

{Refer ITB Sub- Clause-5.3 i)}

UNDERTAKING BY THE PARENT/HOLDING COMPANY

(On letter head of Parent / Holding Company)

No: …… Date:……..

To,
The General Manager,
Contracts and Procurement Division,
Khorlochhu Hydro Power Limited,
Doksum New Township, Trashiyangste, BHUTAN

Sub: Invitation for Bidding for Package…… of Khorlochhu Hydropower Project, ……

Dear Sir(s),

We, M/s …….. (Name of the Parent/Holding Company) having registered office at …… (Address of the Parent/Holding Company) ……. do hereby undertake that in case work of Construction of Package - ……, …… H.P. Project is awarded to M/s …… (Name of the Bidder), who is participating in your subject Tender as a Sole Bidder/Consortium partner, which is our subsidiary company, we on our strength/strength of …… (name of group company(ies)) under our control shall provide the full support for technical and financial requirements for the work "……..." (the scope of work of subsidiary company) and we shall be responsible for successful completion of the job covered under the scope of M/s ……. (Name of Subsidiary company).

In case the Bidder, M/s …… (Name of Subsidiary company) gets qualified/techno commercially responsive and awarded the work, we do hereby undertake;

(i) to enter into a separate agreement with the Employer as per the Employer's approved format included in the Bid documents.

(ii) to furnish an additional performance Bank guarantee of value equivalent to five (5%) percent of the Accepted Contract Amount or the portion of work (where the Subsidiary Company is a Joint Venture Partner/Consortium Bidder) as the case may be, if the subsidiary Company is qualified on the strength of Parent Company or group company(ies) under the control of Parent/Holding Company.

We do hereby also confirm that we are not participating either as a sole Bidder or as a subcontractor against the above Invitation.

Yours faithfully,

For & on behalf of M/s. ……..
(Name & Address of the Parent/holding Company)

(Office Seal)

Station:

Date:

Notes:

- *This letter of authorization should be on the letterhead of the Parent/Holding Company and should be signed by a person competent and having the Power of attorney to bind the Parent/Holding Company. Power of Attorney in favour of this person to do so be enclosed with this Letter of Undertaking.*



Attachment - 7

{Refer ITB Sub- Clause-5.4 (i)}

UNDERTAKING FROM SUBCONTRACTOR

No: …… Date:……..

To,
The General Manager,
Contracts and Procurement Division,
Khorlochhu Hydro Power Limited,
Doksum New Township, Trashiyangste, BHUTAN

Dear Sir(s),

We, M/s …….. (Name of the Parent/Holding Company) having registered office at …… (Address of the Parent/Holding Company) ……. do hereby undertake that in case work ……(Name of the work) is awarded to M/s …… (Name of the Bidder), we shall execute the work of "_____" (the components of the work for which the Bidder has proposed to associate the subcontractor/manufacturer), as subcontractor/manufacturer to M/s ……..(Name of the Bidder) and we shall submit a joint Deed of Undertaking as per approved format of Employer included in the Bid Document and also agree to provide an additional Performance Bank Guarantee of 5% (five percent) of value of sub-let portion of works in addition to normal Performance Bank Guarantee, as per the format included in the Bid Document.

We do hereby also confirm that we are not participating either as a sole Bidder or as a partner of Joint Venture/consortium Bidder against the above Notice Inviting Tender.

Yours faithfully,

For & on behalf of M/s. ……..
(Name & Address of the Subcontractor/Manufacturer)
(Office Seal)

Station:

Date:

Notes:

i) This letter of authorization should be on the letterhead of the subcontractor and should be signed by a person competent and having the Power of attorney to bind the subcontractor. Power of Attorney in favour of this person to do so be enclosed with this Letter of Undertaking.

ii) In case a bidder has been qualified for any of the work on the credential of a proposed sub-contractor/manufacturer of the bidder, he shall be required to submit a joint deed of undertaking (as per agreed format) from the proposed subcontractor/manufacturer and bidder for joint and several responsibility of execution of Work sub-contracted to the subcontractor.

❖ *Strike out the form, if not applicable by the bidder.*

Attachment - 8

{Refer ITB Sub- Clause-4.4}

LIST OF APPROVED SUBCONTRACTORS/MANUFACTURERS/VENDORS

The following Subcontractors/Manufacturers/Sub-vendors are approved for carrying out the supply/work of items of the facilities indicated. Where more than one Subcontractors or Manufacturers or Sub-vendors are listed, the Contractor is free to choose between them.

Sl. No.	Description Of Equipment	Acceptable Make / Sub-Vendor
1	**Mechanical**	
1.1	Vertical lift gate and Rope drum hoist	(*) Precision Infratech - Ahmedabad (*) PES Engineers – Hyderabad (*) Om Metals – Delhi (*) P&R Infrastructure – Chandigarh ***(*) - Subject to meeting qualification criteria***
1.2	Pressure shaft steel liner	(*) PES Engineers – Hyderabad (*) Om Metals – Delhi (*) P&R Infrastructure – Chandigarh
1.3	Structural steel	SAIL – India; TATA – Jamshedpur; JSW – Mumbai; Essar – Hazira; RINL – Vizag; JSPL – India, JSL - India
1.4	ASTM A 517 Gr F And ASTM A 537 Class II	Nippon Steels - Japan
1.5	Rolled section (ISA, ISMC, ISMB)	SAIL – India; TATA – Jamshedpur; JSW – Mumbai; RINL – Vizag; JSPL – India,
1.6	Self-Lubricating Bush / Bearing for Trunnion (radial gate)	Lubrite – USA, Devaglide – Germany, INA - Germany
1.7	Hydraulic Cylinder	Rexroth Hydrodyne – Netherlands, Hunger – Germany, Montan - Germany
1.8	Hydraulic Power packs (With axial piston pump)	Rexroth (India), Vicker (India), Montan (India)
1.9	Spherical / Roller / Cylinder Clevis Bearing	SKF (Germany/India), FAG (Germany/India), NTN (India), INA (India)
1.10	Gasoline Engine for portable Power Pack	Kohler (Germany), Honda (Japan), Yamaha (Japan)
1.11	Trash Rack Cleaning machine (TRCM)	Kuenz (Austria), MUHR (Germany)
1.12	Fine screen Cleaning machine (FSCM)	Kuenz (Austria), MUHR (Germany) Braun (Germany) Jash (India)
1.13	Knife Edge Gate Valve	L&T Valves Fouress Kirloskar Brothers Orbinox
1.14	Fittings	True Forge Tube products

Khorlochhu Hydro Power Ltd.

Sl. No.	Description Of Equipment	Acceptable Make / Sub-Vendor
		Siddharth and Gautam Pipe fit
1.15	Electrical Hoist	FAFECO Mukand WMI Kone Cranes Anupam Industries Eddy Cranes
1.16	Actuators for Screw hoist	Auma Honeywell Emerson
1.17	Hydraulic Oil	Servo
1.18	Oil filtration & degasification unit	Klarol oil cleaning system, Hydac, Ferrocare ELC 50.
1.19	Solenoid valve	Rexroth (India), Vicker (India), Montan (India)
2	**Electrical**	
2.1	LV Switchgear / Distribution board	• L&T • Siemens • Schneider Electric • ABB • Hitachi • GE • C&S
2.2	Lightning DB's	• Philips • Bajaj Electricals • CGL • GE • Wipro • L&T • MDS • Havells • C&S
2.3	Lighting Fixture	• Philips • Bajaj Electricals • CGL • GE • Wipro
2.4	LV Power Cables	• Finolex • Universal Cables • Nicco Corporation • Polycab • KEC/RPG • Cable Corporation • KEI Cables • Torrent
2.5	LV Motors	• ABB • CGL • Siemens • Kirloskar Electric • BHEL • Marathon Motors

Khorlochhu Hydro Power Ltd.

Sl. No.	Description Of Equipment	Acceptable Make / Sub-Vendor
		• Bharat Bijlee
2.6	Cable Trays & Accessories	• INDIANA • PATNI • RELIANCE • SADHNA • STERLITE
2.7	Cable termination / Jointing kits	• Raychem • 3M • Denson
2.8	Panel Enclosures and Local Push Button Stations	• Rittal • Pyrotech
3	**Instrumentation & control**	
3.1	Speed/Proximity switches	• IFM Electronic • BALLUFF • Turck India Automation Pvt.Ltd.
3.2	Gate position indicator (Radial Gate)	• Rittmeyer • Honeywell Automation India Ltd.
3.3	Trash rack differential pressure Measurement	• Rittmeyer • Honeywell Automation India Ltd.
3.4	Temperature elements (sensors-RTD, T/C) with Thermowell	• Pyro Electric Instruments Pvt. Ltd. • Detriv Instrumentation & Electronics • Tempsens • Pyrotech Controls (I) Pvt. Ltd.
3.5	Ultrasonic Flowmeter	• Rittmeyer • Ductus (credentials to be shared along with Bid) • Flexim (credentials to be shared along with Bid) • Any other vendor subject to credential submission & approval during Bid stage
3.6	Transmitters (Level, & Differential Pressure) Radar Type (reservoir level)	• Emerson Process Management • Endress+Hauser (India) Pvt Ltd • Honeywell Automation India Ltd.
3.7	Limit Switches	• BALLUFF • Masibus Process Instruments Pvt. Ltd. • Omron automation private limited • OSNA Electronics Pvt. Ltd
3.8	Position Transmitter (Vertical Gate)	• Endress & Hauser • Siemens
3.9	Junction boxes	• Rittal • HENSEL electric India Pvt. Ltd • Baliga
3.10	Control Panels	• Rittal • Pyrotech Controls (I) Pvt. Ltd. • Industrial & Commercial Enterprises • Positronics Pvt. Ltd.
3.11	Push Button, Selector Switch, Lamp	• Siemens • Telemecanique • TECNIK

Khorlochhu Hydro Power Ltd

Sl. No.	Description Of Equipment	Acceptable Make / Sub-Vendor
3.12	Terminals	• Connectwell • Phoenix contacts (India) Pvt. Ltd. • WEIDMULLER
3.13	Panel digital indicators	• YOKOGAWA • MTL
3.14	I&C Cables	• Cords Cable Industries Pvt. Ltd. • Delton Cables • Polycab
3.15	Fiber Optic Cables	• Corning India • Finolex Cables Ltd. • Lapp India • Rosenberger



Attachment - 9

{Refer ITB Sub- Clause-4.4}

NAME OF PROPOSED SUBCONTRACTORS/VENDORS PROPOSED BY THE BIDDER

Bidders can also suggest alternate names for inclusion into the list fulfilling the specific qualification criteria listed against those items. Bidder is also required to certify regarding financial soundness, technical capability of proposed subcontractors/manufacturers/sub-vendors. Bidders are free to propose more than one for each item.

Sl. No.	Description of Equipment	Proposed Make / Sub-Vendor

Attachment - 10

(Refer Sub-Clause 4.4 of GCC/PCC)

NAME OF PROPOSED SUBCONTRACTORS FOR ERECTION, TESTING AND COMMISSIONING

Bidders shall propose the list of Subcontractors for erection, testing and commissioning of the works if applicable fulfilling the specific qualification criteria. Bidder is also required to certify regarding the financial soundness, technical capability of proposed Subcontractors. Bidders are free to propose more than one.

Sl. No.	Items of Works	Name of Subcontractors / Vendors and Nationality	Specific Qualification Criteria
1.	Erection, Testing and Commissioning Works		The Sub-contractor: i) Should have executed similar work of comparable size earlier during last ten (15) years. ii) Works performed should have been successfully commissioned in at least at three installations. iii) Engineers and Technicians must have at least fifteen (15) years of experience in comparable sizes. Documentary evidence & satisfactory performance report along with the complete details of the company profile be furnished.

Form - 2: Form of Contract Agreement

(Refer Sub-clause 1.6 of GCC/PCC)

(To be executed on legal paper of appropriate value)

AGREEMENT

This agreement is made on _____ day of _____ Two Thousand ------- between the _____, registered and existing under the Laws of _____ and having its registered Office at _____ (hereinafter referred to as the "Employer" which expression shall unless repugnant to the context or meaning thereof include its successors and assigns) of the one part and M/s _____ registered under the _____ Act and having its principal / registered office at _____(herein after called "the Contractor" which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns) of the other part.

WHEREAS the Employer is desirous that the Works known as _____should be executed by the Contractor, and has accepted a Tender by the Contractor for the execution and completion of such Works and the remedying of any defects therein at the cost of ------- (Rupees----------).

NOW THIS AGREEMENT WITNESSETH as follows:

1. In this Agreement, words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.
2. The following documents shall be deemed to form and be read and construed as part of this Agreement, viz:
    i) the Letter of Acceptance;
    ii) the Letter of Tender;
    iii) the Particular Conditions of the Contract and the Appendix to Tender;
    iv) the General Conditions of the Contract (FIDIC), First Edition 1999;
    v) the Technical Specifications;
    vi) the Tender Drawings;
    vii) the Price Schedules;
    viii) Data Sheets;
    ix) Information for Bidders;
    x) any other documents forming part of the Contract.
3. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy the defects therein in conformity in all respect in accordance 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 remedying of defects therein the Contract Price or such other sum as may become payable under the provisions of the Contract at the time and in the manner prescribed by the Contract.

In Witness whereof the parties hereto have caused this Agreement to be executed the day and year first before written, at ---------- (name of place).



The Common Seal of_____
was hereunto affixed in the presence of:

For and on behalf of the Contractor	For and on behalf of Employer
Signature----------	Signature----------
(Designation)----------	(Designation)----------
Place:	Place:
Witnessed by:	Witnessed by:
1. Name & Address	1. Name & Address
2. Name & Address	2. Name & Address



Form – 3: Performance Security Form

(Refer Sub-clause 34 of ITB)

(To be submitted by the Contractor)

Bank Guarantee

(To be stamped in accordance with Stamp Act if any, of the Country of the Issuing Bank)

Bank Guarantee No.....
Date.....

To,

[Employer's Name & Address]

Dear Sirs,

In consideration of the ... *[Employer's Name]*..... (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators and assigns) having awarded to M/s .....*[Contractor's Name]*..... with its Registered/Head Office at ..... (hereinafter referred to as the 'Contractor', which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns), a Contract by issue of Employer's Letter of Acceptance No..... dated..... and the same having been acknowledged by the Contractor, for ----------[Contract sum in figures and words] for ……*[Name of the work]* and the Contractor having agreed to provide a Contract Performance Guarantee for the faithful performance of the entire Contract equivalent to .....(*).....of the said value of the aforesaid work under the Contract to the Employer.

We.....*[Name & Address of the Bank]*.....having its Head Office at ..... (hereinafter referred to as the 'Bank', which expression shall, unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns) do hereby guarantee and undertake to pay the Employer, on demand any and all monies payable by the Contractor to the extent of .....(*)..... as aforesaid at any time upto .....(@)..... *[days/month/year]* without any demur, reservation, contest, recourse or protest and/or without any reference to the Contractor. Any such demand made by the Employer on the Bank shall be conclusive and binding notwithstanding any difference between the Employer and the Contractor or any dispute pending before any Court, Tribunal, Arbitrator or any other authority. The Bank undertakes not to revoke this guarantee during its currency without previous consent of the Employer and further agrees that the guarantees herein contained shall continue to be enforceable till the Employer discharges this guarantee or till ……(+)…….. *[days/month/year]* whichever is earlier.

(**)

The Employer shall have the fullest liberty, without affecting in any way the liability of the Bank under this guarantee, from time to time to extend the time for performance of the Contract by the Contractor. The Employer shall have the fullest liberty, without affecting this guarantee, to postpone from time to time the exercise of any powers vested in them or of any right which they might have against the Contractor, and to exercise the same at any time in any manner, and either to enforce or to forbear to enforce any covenants, contained or implied, in the Contract between the Employer and the Contractor or any other course or remedy or security available to the Employer. The Bank shall not be released of its obligations under these presents by any exercise by the Employer of its liberty with reference to the matters

aforesaid or any of them or by reason of any other act or forbearance or other acts of omission or commission on the part of the Employer or any other indulgence shown by the Employer or by any other matter or thing whatsoever which under the law would, but for this provision have the effect of relieving the Bank.

The Bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Contractor and notwithstanding any security or other guarantee the Employer may have in relation to the Contractor's liabilities.

i) Our liability under this Bank Guarantee shall not exceed _____(*)_____.

ii) This Bank Guarantee shall be valid up to _____(+)_____.

iii) We are liable to pay the guaranteed amount or any part thereof under this Bank Guarantee only and only if Employer serves upon Bank a written claim or demand on or before (@)_____

Dated this .....day of .....20_.....at.....

WITNESS

(Signature)..... (Signature).....

(Name)…….. (Name).....

…….. …….

(Official Address) (Designation with Bank Stamp)/with staff Authority no.

Complete Address of the Bank with Tele-Fax

Notes:

1. *(*) This sum shall be ten percent (5%) of the Contract Price denominated in the types and proportions of currencies.*

   (@) This date will be Ninety (90) days beyond the Defects Notification period as specified in the Contract.

   (+) This date will be 90 days beyond the Defect Notification Period.

   (**) Employer may also present any of his demands at the counters of the …… (Name and branch of the Bank in Bhutan)…….for further relay to us. (To be inserted in case of a foreign currency bank guarantee issued by an overseas bank outside Bhutan)

2. *Bank Guarantee should be executed on appropriate stamp paper of requisite value, such stamp paper should be purchased in the name of Issuing Bank, not more than six (6) months prior to execution / issuance of Bank Guarantee. The name of the purchaser should appear at the back side of stamp paper in the Vendors Stamp. Bank guarantee should contain rubber stamp of the authorized signatory of the bank indicating the name, designation and signature/ power of attorney number as well as telephone/ fax numbers with full correspondence address of the Bank.*

3. *Bank Guarantee is required to be submitted directly to the Employer by the issuing bank (on behalf of Contractor) under registered post (A.D). The Contractor can submit an advance copy of Bank Guarantee to the Engineer.*

4. *The issuing bank shall write the name of bank's controlling branch/ Head Office along with contact details like telephone/ fax and full correspondence address in order to get the confirmation of BG from that branch/ Head office, if so required.*

Khorlochhu Hydro Power Ltd.

Form - 3: Bank Guarantee for Performance Security

(Refer Sub-Clause 34 of ITB)

(To be submitted by the Contractor)

Bank Guarantee

(To be stamped in accordance with Stamp Act if any, of the Country of the Issuing Bank)

Bank Guarantee No..... Date.....

To,

[Employer's Name & Address]

Dear Sirs,

In consideration of the ... *[Employer's Name]*..... (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators and assigns) having awarded to M/s .....*[Contractor's Name]*..... with its Registered/Head Office at ..... (hereinafter referred to as the 'Contractor', which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns), a Contract by issue of Employer's Letter of Acceptance No..... dated..... and the same having been acknowledged by the Contractor, for ----------[Contract sum in figures and words] for ……*[Name of the work]* and the Contractor having agreed to provide a Contract Performance Guarantee for the faithful performance of the entire Contract equivalent to .....(*).....of the said value of the aforesaid work under the Contract to the Employer.

We .....*[Name & Address of the Bank]*.....having its Head Office at.....(hereinafter referred to as the 'Bank', which expression shall, unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns) do hereby guarantee and undertake to pay the Employer, on demand any and all monies payable by the Contractor to the extent of .....(*)..... as aforesaid at any time upto .....(@)..... *[days/month/year]* without any demur, reservation, contest, recourse or protest and/or without any reference to the Contractor. Any such demand made by the Employer on the Bank shall be conclusive and binding notwithstanding any difference between the Employer and the Contractor or any dispute pending before any Court, Tribunal, Arbitrator or any other authority. The Bank undertakes not to revoke this guarantee during its currency without previous consent of the Employer and further agrees that the guarantees herein contained shall continue to be enforceable till the Employer discharges this guarantee or till ……(+)…….. *[days/month/year]* whichever is earlier.

(**)

The Employer shall have the fullest liberty, without affecting in any way the liability of the Bank under this guarantee, from time to time to extend the time for performance of the Contract by the Contractor. The Employer shall have the fullest liberty, without affecting this guarantee, to postpone from time to time the exercise of any powers vested in them or of any right which they might have against the Contractor, and to exercise the same at any time in any manner, and either to enforce or to forbear to enforce any covenants, contained or implied, in the Contract between the Employer and the Contractor or any other course or remedy or security available to the Employer. The Bank shall not be released of its obligations under these presents by any exercise by the Employer of its liberty with reference to the matters aforesaid or any of them or by reason of any other act or forbearance or other acts of omission or commission on the part of the Employer

Khorlochhu Hydro Power Ltd.

or any other indulgence shown by the Employer or by any other matter or thing whatsoever which under the law would, but for this provision have the effect of relieving the Bank.

The Bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Contractor and notwithstanding any security or other guarantee the Employer may have in relation to the Contractor's liabilities.

i) Our liability under this Bank Guarantee shall not exceed _____(*)_____.

ii) This Bank Guarantee shall be valid up to _____(+)_____.

iii) We are liable to pay the guaranteed amount or any part thereof under this Bank Guarantee only and only if Employer serves upon Bank a written claim or demand on or before (@)_____

Dated this .....day of .....20_.....at.....

WITNESS

(Signature)..... (Signature).....

(Name) (Name).....

(Official Address) (Designation with Bank Stamp)/with staff Authority no.

Complete Address of the Bank with Tele-Fax

Notes :

1. *(*) This sum shall be ten percent (1o%) of the Accepted Contract Amount denominated in the types and proportions of currencies.*

   (@) This date will be Ninety (90) days beyond the Defects Notification period as specified in the Contract.

   (+) This date will be 90 days beyond the Defect Notification Period.

   (**) Employer may also present any of his demands at the counters of the .....(Name and branch of the Bank in Bhutan)..... for further relay to us. (To be inserted in case of a foreign currency bank guarantee issued by an overseas bank outside Bhutan)

1. *Bank Guarantee should be executed on appropriate stamp paper of requisite value, such stamp paper should be purchased in the name of Issuing Bank, not more than six (6) months prior to execution / issuance of Bank Guarantee. The name of the purchaser should appear at the back side of stamp paper in the Vendors Stamp. Bank guarantee should contain rubber stamp of the authorized signatory of the bank indicating the name, designation and signature/ power of attorney number as well as telephone/ fax numbers with full correspondence address of the Bank.*
2. *The issuing bank shall write the name of bank's controlling branch/ Head Office along with contact details like telephone/ fax and full correspondence address in order to get the confirmation of BG from that branch/ Head office, if so required.*



Form - 4: Bank Guarantee for Advance Payment

(Refer Sub-clause 14.2 of GCC/PCC)

(To be stamped in accordance with Stamp Act if any, of the Country of the Issuing Bank)

Bank Guarantee No..... Date.....

To,

[Employer's Name & Address]

Dear Sir,

In consideration of the *[Employer's Name]*..... (hereinafter referred to as the 'Employer', which expression shall, unless repugnant to the context or meaning thereof include its successors, administrators and assigns) having awarded to M/s.....*[Contractor's Name]*..... with its Registered/Head Office at ..... (hereinafter referred to as the 'Contractor' which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns), a Contract, by issue of Employer's Letter of Acceptance No. ..... dated ..... and the same having been acknowledged by the Contractor, resulting into a Contract bearing No. .....dated.....valued at..... …….for .....*[Name of Contract*] .....(hereinafter called the 'Contract') and the Employer having agreed to make an advance payment to the Contractor for performance of the above Contract amounting ..... (in words and figures) as an Advance against Bank Guarantee to be furnished by the Contractor.

We.....*[Name and address of the Bank]*..... having its Head Office at ..... (hereinafter referred to as the 'Bank', which expression shall, unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns) do hereby guarantee and undertake to pay the Employer, immediately on demand any or, all monies payable by the Contractor to the extent of .....*[advance amount]*..... as aforesaid at any time up to .....(@)..... without any demur, reservation, contest, recourse or protest and/ or without any reference to the Contractor. Any such demand made by the Employer on the Bank shall be conclusive and binding notwithstanding any difference between the Employer and the Contractor or any dispute pending before any Court, Tribunal, Arbitrator or any other authority. We agree that the guarantee herein contained shall be irrevocable and shall continue to be enforceable till the Employer discharges this guarantee. This guarantee may be progressively reduced by amount repaid by the Contractor.

(**)

The Employer shall have the fullest liberty without affecting in any way the liability of the Bank under this guarantee, from time to time to vary the advance or to extend the time for performance of the Contract by the Contractor. The Employer shall have the fullest liberty without affecting this guarantee, to postpone from time to time the exercise of any powers vested in them or of any right which they might have against the Contractor, and to exercise the same at any time in any manner, and either to enforce or to forbear to enforce any covenants, contained or implied, in the Contract between the Employer and the Contractor or any other course or remedy or security available to the Employer. The Bank shall not be released of its obligations under these presents by any exercise by the Employer of its liberty with reference to the matters aforesaid or any of them or by reason of any other act or forbearance or other acts of omission or commission on the part of the Employer or any other

Khorlochhu Hydro Power Ltd.

indulgence shown by the Employer or by any other matter or thing whatsoever which under law would but for this provision have the effect of relieving the Bank.

The Bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Contractor and notwithstanding any security or other guarantee that the Employer may have in relation to the Contractor's liabilities.

Notwithstanding anything contained herein:

i) Our liability under this Bank Guarantee shall not exceed_____.

ii) This Bank Guarantee shall be valid up to _____@_____.

iii) We are liable to pay the guaranteed amount or any part thereof under this Bank Guarantee only and only if Employer serve upon Bank a written claim or demand on or before (@)_____

Dated this ..... day of .....(month).....(year)..... at ..... .

WITNESS

(Signature)..... (Signature).....

(Name)…… (Name).....

....

(Official Address) (Designation with Bank Stamp)/Staff Authority No.

Complete Address of the Bank with Tele-Fax

Notes:

1. *(@) This date shall be ninety (90) days beyond the date of completion of delivery of goods at site as detailed in accordance with GCC Sub-Clause 8.3 [Programme].*

   (**) Employer may also present any of his demands at the counters of the..... (Name and branch of the Bank in Bhutan)..... for further relay to us. (To be inserted in case of a foreign currency bank guarantee issued by an overseas bank outside Bhutan)

2. *Bank Guarantee should be executed on appropriate stamp paper of requisite value, such stamp paper should be purchased in the name of Issuing Bank, not more than six (6) months prior to execution / issuance of Bank Guarantee. The name of the purchaser should appear at the back side of stamp paper in the Vendors Stamp. Bank guarantee should contain rubber stamp of the authorized signatory of the bank indicating the name, designation and signature/ power of attorney number as well as telephone/ fax numbers with full correspondence address of the Bank.*

3. *Bank Guarantee is required to be submitted directly to the Employer by the issuing bank (on behalf of Contractor) under registered post (A.D.). The Contractor can submit an advance copy of Bank Guarantee to the Engineer.*

4. *The issuing bank shall write the name of bank's controlling branch/ Head Office along with contact details like telephone/ fax and full correspondence address in order to get the confirmation of BG from that branch/ Head office, if so required.*

Form – 5: Form of Taking-Over Certificate

Date:_____

[*Name of Contract]*

To: *[Name and address of Contractor]*

Dear Sir,

Pursuant to General **Conditions of the Contract, Clause- 10** ***(Taking-Over Certificate)*** of the Conditions of the Contract entered into between yourselves and the Employer dated *[date]*, relating to the *[brief description of the Works],* following part(s) of the Works was (were) complete on the date specified below, and that, in accordance with the terms of the Contract, the Employer hereby takes over the said part(s) of the Works, together with the responsibility for care and custody and the risk of loss thereof on the date mentioned below;

1. Description of the Works or part thereof: *[description]*
2. Date of Completion: *[date]*

However, you are required to complete the outstanding items listed in the attachment hereto as soon as practicable.

This letter does not relieve you of your obligation to complete the execution of the Works in accordance with the Contract nor of your obligations during the Defects Notification Period.

Very truly yours,

Title

(Engineer)



Form – 6: Bank Guarantee Form for Release/Payment of Retention Money

(Refer Sub-clause 14.9 of GCC/PCC)

(To be stamped in accordance with Stamp Act if any, of the Country of the Issuing Bank)

Bank Guarantee No..... Date.....

To,

[Employer's Name & Address]

1. We.....*[Name and address of the Bank]* ..... having our Registered/Head Office at ..... (hereinafter referred to as the 'Bank', which expression shall, unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns) do hereby undertake and agree to indemnify and keep indemnified the……..*[Employer's Name]* ……..... (hereinafter referred to as "the Employer " which expression shall, unless repugnant to the subject or context, include its administrators, successors and assigns), to the extent of .....*[amount]*..... on behalf of M/s.....*[Contractor's Name]*..... with its Registered/Head Office at..... (hereinafter referred to as "the Contractor) in lieu of an equal cash amount of Retention Money deposited by the Contractor and/or deducted by the Employer from the bills of the Contractor and which the Employer has agreed to substitute with a bank guarantee as hereunder, under the provisions of Contract No. .....Dated. ….....which the Contractor has entered into with the Employer in connection with the construction of.....…. (*Name of Work*) at a total cost of..... (*Contract Sum*) (hereinafter called the ` Contract').
2. We, the Bank also do hereby agree to pay unequivocally and unconditionally within 48 hours on demand, in writing, from the Employer, of any amount up to and not exceeding .....*[amount]*..... to the Employer for any purpose or cause or on any account whatsoever under the provisions of the Contract in which respect the decision of the Employer shall be final and binding on us.

   (**)
3. Provided that it shall not be necessary for the Employer to proceed against the Contractor before proceeding against us and the guarantee herein contained shall be enforceable against us, notwithstanding any security which the Employer may have obtained or obtain from the Contractor shall, at the time when proceedings are taken against us as hereunder, be outstanding or unrealised.
4. We, the Bank, further agree that this guarantee shall be valid and binding on us up to and including .....(@).....and shall not be terminable by notice or any change in the constitution of the said Bank or the Contractor or by any other reasons whatsoever and our liability hereunder shall not be impaired or discharged by any extension of time or variations made, given, conceded, or agreed with or without our knowledge or consent, by or between the parties to the Contract.
5. We also undertake not to revoke this guarantee during its currency except with the previous consent, in writing, of the Employer.
6. Our liability under this guarantee is restricted to ……..*[amount]*..... Our guarantee shall remain in force until .....(@) .....unless a suit or action to enforce a claim under the guarantee is filed against us within 90 days from that date, all your rights under this

guarantee shall be forfeited and we shall be relieved and discharged from all liabilities thereunder:

In the presence of

Witness For and on behalf of the Bank

..... Bank's common seal

Dated this.....day of .....(month)……..(year)

The above Guarantee is accepted by the Employer

For and on behalf of the Employer

Signature.....

Name and designation.....

Name of Project/Unit.....

Date.....

Notes:

1. *(@) This date will be Ninety (90) days beyond the Defects Notification period as specified in the Contract.*

   (**) Employer may also present any of his demands at the counters of the .....(Name and branch of the Bank in Bhutan)..... for further relay to us. (To be inserted in case of a foreign currency bank guarantee issued by an overseas bank outside Bhutan)
2. *Bank Guarantee should be executed on appropriate stamp paper of requisite value, such stamp paper should be purchased in the name of Issuing Bank, not more than six (6) months prior to execution / issuance of Bank Guarantee. The name of the purchaser should appear at the back side of stamp paper in the Vendors Stamp. Bank guarantee should contain rubber stamp of the authorized signatory of the bank indicating the name, designation and signature/ power of attorney number as well as telephone/ fax numbers with full correspondence address of the Bank.*
3. *Bank Guarantee is required to be submitted directly to the Employer by the issuing bank (on behalf of Contractor) under registered post (A.D.). The Contractor can submit an advance copy of Bank Guarantee to the Engineer.*
4. *The issuing bank shall write the name of bank's controlling branch/ Head Office along with contact details like telephone/ fax and full correspondence address in order to get the confirmation of BG from that branch/ Head office, if so required.*

Form – 7: Hindrance Register

(Refer sub clause 4.21 of GCC/PCC)

Name of Project: ----------

1. Name of Work: ----------

2. Agreement No.: ----------

3. Executing Agency: ----------

Sl. No.	Nature/ Reason of Hindrance	Item /Component of works which could not be executed on account of this Hindrance	Date of start of Hindrance	Date of removal of Hindrance	Hindrances due to Interface Activities	Overlapping Period (if any)	Details of Idle Equipment & Manpower	Net Hindrances in days	Signature of Engineer	Signature of Contractor	Remarks
1	2	3	4	5	6	7	8	9	10	11	12

Form – 8: Dispute Adjudication Agreement

(Refer Sub-Clause 20.2 of GCC)

[for each member of a three-person DAB]

(*To be executed on non-judicial Stamp papers/Legal Stamp of appropriate value)*

Name and address of the Employer:

Name and address of Contractor :

Name and address of Member:

Whereas the Employer and the Contractor have entered into the Contract and desire jointly to appoint the Member to act as one of the three persons who are jointly called the "DAB" *{and desire the Member to act as chairman of the DAB}*.

The Employer, Contractor and Member jointly agree as follows:

1. The conditions of this Dispute Adjudication Agreement comprise the "General Conditions of Dispute Adjudication Agreement"., which is appended to the General Conditions of the "Conditions of Contract for Construction" First Edition 1999 published by the Federation Internationale des Ingenieurs-Conseils (FIDIC), and the following provisions. In these provisions, which include amendments and additions to the General Conditions of Dispute Adjudication Agreement, words and expressions shall have the same meanings as are assigned to them in the General Conditions of Dispute Adjudication Agreement.
2. *[Details of amendments to the General Conditions of Dispute Adjudication Agreement, if any, For example:*

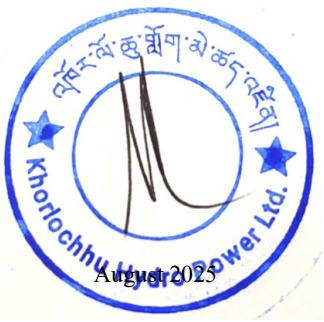
   In the procedural rules annexed to the General Conditions of Dispute Adjudication Agreement, Rule _ is deleted and replaced by: "……"].
3. In accordance with Clause 6 of the General Conditions of Dispute Adjudication Agreement, the member shall be paid as follows:

   A retainer fee of, Nu./Rs.----------/- per calendar month, plus a daily fee of Nu./Rs.---------- per day.
4. In consideration of these fees and other payments to be made by the Employer and the Contractor in accordance with Clause 6 of the General Conditions of Dispute Adjudication Agreement, the Member undertakes to serve, as described in this Dispute Adjudication Agreement, as one of the three persons who are jointly to act as the DAB.
5. The Employer and the Contractor jointly and severally undertake to pay the Member, in consideration of the carrying out of these services, in accordance with Clause 6 of the General Conditions of Dispute Adjudication Agreement.
6. This Dispute Adjudication Agreement shall be governed by the law of ------

SIGNED BY:	SIGNED BY:	SIGNED BY:
for and on behalf of the Employer in the presence of	for and on behalf of the Contractor in the presence of	Member in the presence of

Witness:	Witness:	Witness
Name:	Name:	Name:
Address:	Address:	Address:
Date:	Date:	Date:

[A brief description or name of dispute to be added]*



Form - 9: Parent/Holding Company Agreement

(Refer ITB Sub - Clause 5.3 ii)

(To be executed on non-judicial Stamp papers/Legal Stamp of Appropriate value)

(For sole Bidder)

THIS AGREEMENT IS MADE on this the …….. day of …… between the ……., a company incorporated under the laws of Bhutan and having its Registered and Corporate Office at ……. (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the subject or context or meaning thereof include its successors, administrators, executors and assigns) of the one part; and …… (name of Parent/holding Company) a company organized and existing under the laws of ……. and having its Principal Office at ……. (Hereinafter referred to as the "Parent/holding Company" which expression shall unless repugnant to the subject or context or meaning thereof include its successors, administrators, executors and assigns) of the other part;

WHEREAS on the Parent/holding Company's commitment to provide full support for technical and financial requirements and be responsible and liable for successful completion of the works being awarded to M/s ……. (name of Subsidiary Company) and further agreeing to enter into a separate agreement with the Employer besides furnishing an additional Performance Bank Guarantee of value equivalent to 5% of the Accepted Contract Amount, the Employer has entered into a Contract with M/s ……. (hereinafter referred to as the "Bidder" which expression shall unless repugnant to the subject or context or meaning thereof include its successors, administrators, executors and permitted assigns) for the execution of Package - ……, …… H.E. Project. (hereinafter referred to as the "Contract").

And whereas, in consideration of the aforesaid commitment, the Parent/holding Company hereby enters into this agreement with the Employer for providing full support for technical and financial requirements to the Bidder and be responsible and liable for successful performance and completion of the works described in the said Contract on the following terms and conditions:

NOW THEREFORE THE PARTIES HERETO HEREBY AGREE AND THIS AGREEMENT WITNESSETH AS FOLLOWS:

1. In this Agreement except where the context otherwise requires, the following expressions shall have the meaning hereinafter respectively assigned to them:

2. "Contract" shall mean the Contract dated …… entered into between the Employer and the Bidder for the execution of the Work described therein for Package - ……., ……. H.E. Project.

3.1 The Parent/holding Company hereby agrees to the Employer to ensure due and faithful performance of the obligations and liabilities by the Bidder under the Contract and remain responsible to irrevocably and unconditionally provide full technical and financial support to the Bidder for completion of the works covered under the Contract. The provisions of Contract shall mutatis-mutandis apply to the Parent/holding Company.

3.2 In the event of breach and/ or failure on the part of the Bidder to perform or fulfill any of its obligations and liabilities under the Contract, the Employer may at its discretion call upon the Parent/holding Company and the Parent/holding Company shall be obliged to execute and perform or cause to be executed and performed and to satisfy the obligations and liabilities of the Bidder under the Contract in accordance with the terms and conditions thereof without prejudice to any other right or remedy, besides encashing the Bank guarantee(s).

3.3 The Parent/holding Company shall indemnify and keep indemnified and harmless the Employer at all times against any loss, damage, cost charge and expense whatsoever that may be suffered or incurred by or caused to the Employer on account of such breach.

3.4 It shall not be necessary for the Employer to proceed against the Bidder before proceeding against the Parent/holding Company and the Parent/holding Company shall be liable to fulfill its obligations and liabilities hereunder notwithstanding the Employer having undertaken any proceedings and/or obtaining any security from the Bidder for the performance of its obligations under the Contract. In order to give affect to this Agreement, the Employer may at its option be entitled to act as if the Parent/holding Company was the Bidder for successful completion of the works.

In the event, qualification of the Bidder/Subsidiary Company is considered on the credentials of another Subsidiary/Group Company under the same Apex 'Parent/holding Company' and due to any reason whatsoever, 'Parent/holding Company' or any other Group Company wants to divest its investment in the direct or indirect subsidiary (ies) as a result of which any of these companies may not remain subsidiary (ies) of the 'Parent/holding Company' then the 'Parent/holding Company' undertakes to ensure the performance of the works by arranging the required inputs in case of failure of Subsidiary Company.

3.5 However, where the Bidder disputes the occurrence of a breach under the Contract and if such dispute is referred to arbitration in terms of Conditions of the Contract, the Bidder is obliged to carry on the works under the Contract. In case, during the pendency of the dispute in arbitration, the Bidder does not carry on the work satisfactorily, the Employer by notice to the Parent/holding Company shall be entitled to invoke this Agreement, as if a breach had occurred for the purpose of Clause 3(b) hereinabove.

4. It is agreed that the obligations undertaken by the Parent/holding Company hereunder shall be performed by it notwithstanding any difference or dispute between the Employer and the Bidder pending before any court, tribunal, arbitration or any other authority or forum.

5. This Agreement shall come into force and effect upon the Commencement Date of the Contract/issuance of 'Letter of Acceptance' and shall remain in force and effective till the date of expiry of the Defects Notification Period by the Employer pursuant to the Conditions for the Contract.

6. This guarantee is in addition to and without prejudice to the securities offered by and on behalf of Bidder to the Employer and all rights and remedies in respect thereof be reserved. This guarantee shall be a continuing guarantee and be in force notwithstanding discharge of Bidder by operation of any law or insolvency/bankruptcy /winding up/dissolution of the Bidder.

7. The Employer shall have the full liberty from time to time to vary any of the terms and conditions of the Contract by mutual agreement between the Employer and the Bidder and to extend time for performance thereunder by the Bidder or any other party thereto in accordance with the terms of the Contract and / or to postpone for any time and from time to time any of the powers exercisable by the Employer against the Bidder and either to enforce or forebear from enforcing any of the terms and conditions of the Contract and/or the securities available to the Employer from the Bidder and the Parent/holding Company shall not be released from its obligations and liabilities under this Agreement in any manner whatsoever by any exercise by the Employer of the liberty and / or the rights with reference to the matters as aforesaid or by reason of time being given to the Bidder or any other act of forbearance, waiver or omission on the part of Employer or any indulgence by the Employer to the Bidder or of any other matter or thing whatsoever which under the law relating to sureties would but for this provision have the effect of releasing the Parent/holding Company from its obligations and liabilities hereunder.

8. Nothing contained in this Agreement shall be construed or interpreted in any way as modifying or amending or relieving in any manner whatsoever the Bidder from their obligations under the Contract.
9. This Agreement shall be interpreted and be governed under the Law of Bhutan.
10. Any dispute or difference which may arise between the parties out of or in connection with this Agreement and which the Parties are unable to settle amicably shall be settled by reference to arbitration as per General/Particular Conditions of Contract. The venue of arbitration shall be Bhutan and the arbitration shall be conducted in accordance with the Alternative Dispute Resolution Act of Bhutan 2013. The courts of Bhutan shall have exclusive jurisdiction provided however that any award made in such arbitration shall be enforceable in any court of competent jurisdiction.

IN WITNESS WHEREOF THE PARTIES HERETO HAVE PUT THEIR HANDS HEREUNTO ON THE …… DAY …… MONTH AND ….. YEAR FIRST ABOVE WRITTEN AT ……..

For and on behalf of the Employer Company
(through authorized representative)

Witnesses:

1. _____(Signatures)
(Name & Address)

2. _____(Signatures)
(Name & Address)

For and on behalf of the Parent/holding

(through duly authorized representative)

Witnesses:

1._____(Signatures)
(Name & Address)

2._____(Signatures)
(Name & Address)

Form - 10: Proforma of Joint Deed of Undertaking by Subcontractor and Bidder/Contractor

(Refer ITB Sub - Clause 5.3 ii)

(To be executed on non-judicial Stamp papers/Legal Stamp of Appropriate value)

THIS DEED OF UNDERTAKING executed this ……...day of……. Two Thousand and …… by M/s. ……..., a Company incorporated under the laws of ……..
and having its Registered Office at …….. (hereinafter called the "Subcontractor" which expression shall include its successors, executors and permitted assigns), and M/s.……., a Company incorporated under the laws of ……. having its Registered Office at ……. (hereinafter called the "Bidder" which expression shall include its successors, executors and permitted/ assigns) in favour of _____, a Company reregistered under the Companies Act, 1956 having its Registered Office at _____ (hereinafter called the "Employer" which expression shall include its successors, executors and permitted assigns)

WHEREAS the "Employer" invited Bids vide its Invitation No. …… for Construction of _____.

AND WHEREAS ITB Clause No. 5.4(ii) of, Vol.–1 forming part of the Bid Documents inter-alia stipulates that a in order to ensure serious participation of the Subcontractor(s) for work proposed to be executed by the Subcontractor(s), a Joint Deed of Undertaking shall be required to be submitted by the Contractor and Subcontractor(s)

AND WHEREAS the Bidder has submitted its Bid to the Employer vide Reference No. ……..…..…… dated ……. based on the association of the Subcontractor.

NOW THEREFORE THIS UNDERTAKING WITNESSETH as under:

1. In consideration of the award of Contract by the Employer to the Bidder (hereinafter referred to as the "Contractor") we, the Subcontractor and the Bidder/Contractor do hereby declare that we shall be jointly and severally bound to the Employer, for the successful performance of the * (proposed sub-let works) in accordance with the Contract.
2. Without in any way affecting the generality and total responsibility in terms of this Deed of Undertaking, the Subcontractor in particular hereby agrees to deploy and depute its technical personnel, equipment, manpower and/or other resources on continual basis throughout the construction period of the proposed sub-let works until its completion to discharge the obligations of the Contractor under the Contract.
3. This Deed of Undertaking shall be construed and interpreted in accordance with the laws of _____ and the Courts in _____ shall have exclusive jurisdiction in all matters arising under the Undertaking.
4. Apart from the Contractor's Performance Guarantee, the Subcontractor shall furnish as security, a Contract Performance Guarantee from its Bank in favour of the Employer in a form acceptable to the Employer. The value of such guarantee shall be equivalent to 5% (five percent) of value of the proposed sub-let works as identified in the Contract awarded by the Employer to the Bidder/Contractor and it shall be an additional guarantee for faithful performance/compliance of this Deed of Undertaking in terms of the Contract. The guarantee shall be unconditional, irrevocable and valid till the completion of the part of the Works

executed by the Subcontractor. The Bank Guarantee amount shall be payable to the Employer on demand without any reservation or demur.

5. We, the Subcontractor and the Bidder/Contractor agree that this Undertaking shall be irrevocable and shall form an integral part of the Contract and further agree that this Undertaking shall continue to be enforceable till it is discharged by the Employer. It shall become operative from the Commencement Date of the Contract.

IN WITNESS WHEREOF, the Subcontractor and the Bidder/Contractor have through their Authorised Representatives executed these presents and affixed Common seals of their respective Companies, on the day, month and year first above mentioned, at ---------- (name of place).

WITNESS	For Subcontractor
1. ……	Signature of Authorized
(Signature)	(Representative
(Name in Block Letter	Name ……
(Office Address	Common Seal of Company
	……..
	For Bidder/Contractor
2. ……	Signature of Authorized
(Signature)	(Representative
(Name in Block Letter	Name ……
(Office Address	Common Seal of Company
	……..

This Joint Undertaking is to be given if the Contractor qualifies on the strength of Subcontractor.

(To be Notarized by Notary Public)

KHORLOCHHU HYDRO POWER LIMITED

4x150 MW KHORLOCHHU HYDROPOWER PROJECT

TRASHIYANGTSE; BHUTAN

BIDDING DOCUMENT

FOR

CONTRACT PACKAGE: KHM

DESIGN, MANUFACTURING, SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF HYDRO-MECHANICAL WORKS

VOLUME - 3

PRICE SCHEDULES

International Competitive Bidding

These documents are meant for the exclusive purpose of bidding against this NIT and shall not be transferred, reproduced or otherwise used for purposes other than that for which they are specifically issued.

Tender Ref. No. KHPL/C&PD/TENDER:KHM/2025/11534 dt. 07.08.2025

LAYOUT OF BIDDING DOCUMENTS

CONTRACT PACKAGE: KHM

Design, Manufacturing, Supply, Installation, Testing and Commissioning of Hydro-Mechanical Works

Volume - 1: Instructions to Bidders (ITB)

- Section - 1 Abridged Notice Inviting Tender and Notice Inviting Tender (NIT)
- Section - 2 Instructions to Bidders (ITB), Bid Data, Qualification Forms, Information for Bidders (IFB) and Work Schedule

Volume - 2: General Conditions of Contract (GCC) and Particular Conditions of Contract (PCC)

- Section - 3 FIDIC General Conditions of Contract (GCC) for Plant and Design-Build Contract (First Edition 1999)
- Section - 4 Particular Conditions of Contract (PCC)
- Section - 5 Forms and Procedures
  - Form-1: Letter of Tender
  - Form-2: Form of Contract Agreement
  - Form-3: Bank Guarantee Form for Performance Security
  - Form-4: Bank Guarantee Form for Advance Payment
  - Form-5: Form of Taking Over Certificate
  - Form-6: Bank Guarantee Form for Release of Retention Money
  - Form-7: Hindrance Register
  - Form-8: Dispute Adjudication Agreement
  - Form-9: Parent/Holding Company Agreement
  - Form-10: Proforma for Joint Deed of Undertaking

Volume-3: Price Schedules

Volume-4: Employer's Requirements

- Section - 6 General Technical Specifications (GTS)
- Section - 7 Particular Technical Specifications (PTS)
- Section - 8 Quality Assurance Plan (QAP)

Volume-5: Tender Drawings

Volume-6: Technical Data Sheets



TABLE OF CONTENTS

PRICE SCHEDULES 1

Bid Prices 1

ABSTRACT OF PRICE 1

Plant and Equipment Supplied from Bhutan and India 1

Steel Liner Works 1

Mandatory Spares supplied from Bhutan and India 1

Mandatory Spares supplied from Country other than Bhutan and India 1

O&M Spares supplied from Bhutan and India 1

O&M Spares supplied from Country other than Bhutan and India 1

PRICE SCHEDULE-1 2

1.1 Plant and Equipment Supplied from Bhutan and India 2

1.2 Plant and Equipment Supplied from Country other than Bhutan and India 13

PRICE SCHEDULE-2 24

2.1 Steel Liner Works 24

PRICE SCHEDULE-3 28

3.1 Mandatory Spares supplied from Bhutan and India 28

3.2 Mandatory Spares supplied from Country other than Bhutan and India 39

PRICE SCHEDULE-4 50

4.1 O&M Spares supplied from Bhutan and India 50

4.2 O&M Spares supplied from Country other than Bhutan and India 53

PRICE SCHEDULE-5 56

5.1 Installation, Testing, Commissioning (Inclusive of Loading, Transportation from Site Store to Place of Installation, Unloading), Insurance and Site Storage 56

PRICE SCHEDULE–6 68

RECOMMENDED SPARE PARTS AND TOOLS & INSTRUMENTS 68



PRICE SCHEDULES

The Bidder shall complete the Price Schedules furnished and as indicated in the bidding documents

Bid Prices

1. Unless otherwise specified in the Technical Specifications, Bidders shall quote for the entire Facilities on a "single responsibility" basis such that the total bid price covers all the Contractor's obligations mentioned in or to be reasonably inferred from the bidding documents in respect of the design, manufacture, factory testing including procurement and subcontracting (if any), delivery, site storage, insurance, construction, installation and completion of the Facilities including supply of Tools & Instruments, Specified spares and recommended tools & spares (if any). This includes all requirements under the Contractor's responsibilities for testing, pre-commissioning and commissioning of the Facilities and, where so required by the bidding documents, the acquisition of all permits, approvals and licenses, etc., training services and such other items and services as may be specified in the bidding documents, all in accordance with the requirements of the General & Particular Conditions of Contract and Technical specifications.

2. Bidders are required to quote the price for the commercial, contractual and technical obligations outlined in the bidding documents.

3. The storage facilities shall be constructed at site as per manufacturer's instruction for equipment storage or other relevant standard. The manufacturer's guidelines or relevant standard for site storages shall be furnished to the Employer prior to the construction of the site storage facilities. The interim payment shall be released only after the approval and construction of the site storage facilities. The Contractors shall consider the cost of such facilities in their price bid.

4. Bidders shall give a breakdown of the prices in the manner and detail called for in the Price Schedules.

   Separate numbered Price Schedules shall be used for each of the following elements. The total amount from each Price Schedule (1 to 5) shall be summarized in Abstract of Price giving the total bid price(s) to be entered in the Bid Form.

Abstract of Price	
Price Schedule-1	Supply of Plant and Equipment
Price Schedule-1.1	Plant and Equipment Supplied from Bhutan and India
Price Schedule-1.2	Plant and Equipment Supplied from Country other than Bhutan and India
Price Schedule 2(2.1)	Steel Liner Works
Price Schedule 3	Mandatory Spares
Price Schedule 3.1	Mandatory Spares supplied from Bhutan and India supplied from Bhutan and India
Price Schedule 3.1	Mandatory Spares supplied from Bhutan and India supplied from Bhutan and India
Price Schedule 4	O&M Spares
Price Schedule 4.1	O&M Spares supplied from Bhutan and India
Price Schedule 4.2	O&M Spares supplied from Country other than Bhutan and India

Khorlochhu Hydro Power Ltd.

Price Schedule-5 (5.1)	Installation, Testing and Commissioning (inclusive of loading, transportation from site store to place of installation, unloading), Insurance (during storage, erection, testing, commissioning and up to defect liability period) and Site Storage.
Price Schedule-6	Recommended Spare Parts and Tools & Instruments

Bidders shall note that the plant and equipment included in Price Schedules-1 above exclude materials used for civil, building and other construction works. All materials, construction of site stores including consumables required for site storage, erection, testing, pre-commissioning and commissioning activities shall be included and priced under Price Schedule-5: Installation, Insurance (other than Transit Insurance) and Other Services.

5. In the Price Schedules, Bidders shall give the required details and a breakdown of their prices as follows:

a) Plant and equipment including specified Spares and Tools & Tackles manufactured or fabricated shall be quoted on an EXW (ex-factory, ex-works, ex-warehouse or off-the-shelf, as applicable) basis. The prices shall be inclusive of all costs, as well as duties and taxes paid or payable on all inputs utilized for manufacture/ fabrication of these supplies.

b) Export of Goods or Services to Bhutan are considered as "zero rated supply" under "THE INTEGRATED GOODS AND SERVICES TAX ACT, 2017" (IGST) & subsequent notifications related to IGST, and will also qualify for all the benefits available to Zero Rated Supplies under the GST regime, provided the payment for such service has been received by the supplier/contractor of service in convertible foreign exchange or in Indian rupees wherever permitted by the Reserve Bank of India.

In order to avail the benefits of input tax reimbursement as permissible in case Zero Rated Supplies under the GST regime in India, if the Contractor desires to receive payment in Indian Rupees, the same shall be made by the Employer against the request of the Contractor for those items only for which Contractor wants to avail benefits of input tax reimbursement. All other activities related to input tax reimbursement from concerned GST Department in India shall be the responsibility of Contractor. The Contractor shall solely be responsible for obtaining above benefits, which they have considered in their bid and in case of failure to receive such benefits; the Employer will not compensate the Contractor.

c) Transportation, transit insurance, port clearance and port charges and other costs incidental to delivery of the Plant and equipment including specified spares and Tools & Instruments shall be included in Price Schedule -1. Rates quoted in this Price Schedule shall be inclusive of all taxes, duties, levies and charges payable including GST etc., if applicable, in India/Bhutan as of twenty-eight (28) days prior to deadline for submission of Price bids. The Employer, as an importer, shall furnish promptly necessary certifications and documents as may be required to be furnished by the importer for the purpose of customs clearance.

d) Installation Services shall be quoted separately (Price Schedule-5) and shall include rates or prices for all labour, contractor's equipment, temporary works, materials, consumables and all matters and things of whatsoever nature, the provision of operations and maintenance manuals, training, etc., where identified in the bidding

Khorlochhu Hydro Power Ltd.

documents, as necessary for the proper execution of the Installation Services, including all taxes, duties, levies and charges payable including GST etc., if applicable, in India/Bhutan as of twenty-eight (28) days prior to the deadline for submission of bids.

6. The terms EXW, CIP etc. shall be governed by the rules prescribed in the current edition of INCOTERMS, published by the International Chamber of Commerce, 38 Cours Albert 1er, 75008 Paris, France.

7. Price Shall be quoted in Ngultrum/Indian Rupee (BTN/INR) or Euro (EUR). However, part payment in Indian Rupees may be allowed as per Sub-Clause 5(b) above.

8. The price of Recommended Spares Parts, Recommended Special Tools and Transportation (Including Port Clearance & Port Charges, if applicable) & Transit Insurance for Recommended Spares Parts & Recommended Special Tools quoted in Price Schedules No.4 shall not be considered for evaluation.

9. The package shall be evaluated as a whole and the evaluation of the bids shall be done on total quoted prices for the total Package as per Price Schedules. In case the Bidder has not quoted for any of the items, the price of all such item(s) against which Bidder has not quoted rates/ amount (viz. items left blank or Zero) in the Price Schedules will be deemed to have been included in other item(s)/ Total Quoted amount.

10. The Price Schedule do not generally give a full description of the plant to be supplied and the services to be performed under each item. Bidders shall be deemed to have read the Employer's Requirements and other sections of the Bidding Document and reviewed the Drawings to ascertain the full scope of the requirements included in each item prior to filling in the rates and prices. The entered rates and prices shall be deemed to cover the full scope as aforesaid, including overheads and profit.

11. If Bidders are unclear or uncertain as to the scope of any item, they shall seek clarification in accordance with ITB 10 prior to submitting their bid.

12. Price shall be filled in indelible ink, and any alterations necessary due to errors, etc., shall be initialed by the Bidder.

13. When requested by the Employer for the purposes of making payment or part payments, valuing variations or evaluating claims, or for such other purposes as the employer may reasonably require, the Contractor shall provide the Employer with a breakdown of any composite or lump sum items included in the Price Schedule.



ABSTRACT OF PRICE

PS No.	Description	Total Price in figures (BTN/INR)	Total Price in figures (EUR)
Price Schedule 1: Supply of Plant and Equipment			
1.1	Plant and Equipment Supplied from Bhutan and India		
1.2	Plant and Equipment Supplied from Country other than Bhutan and India		
Price Schedule 2: Steel Liner Works			
2.1	Steel Liner Works		
Price Schedule 3: Mandatory Spares supplied from Bhutan and India			
3.1	Mandatory Spares supplied from Bhutan and India		
3.2	Mandatory Spares supplied from Country other than Bhutan and India		
Price Schedule 4: O & M Spares supplied from Bhutan and India			
4.1	O&M Spares supplied from Bhutan and India		
4.2	O&M Spares supplied from Country other than Bhutan and India		
Price Schedule 5: Services			
5.1	Installation, Testing, Commissioning (Inclusive of Loading, Transportation from Site Store to Place of Installation, Unloading), Insurance And Site Storage		
	Grand Total		

Total Amount in words……..

Khorlochhu Hydro Power Ltd.

Seal/Signature of Bidder…..……

PRICE SCHEDULE-1

1.1 Plant and Equipment Supplied from Bhutan and India

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (BTN/INR)				Total Cost upto Project Site (BTN/INR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
1.0	**Spillway Radial Gates with Hydraulic Hoist**							
1.1	Submerged Radial Gates (6.80 m x 12.9m opening size) complete in all respect including 3mm Stainless Steel cladding (AISI 304) on skin plate, girders, arms, trunnions, guide rollers etc.		5 Nos.					
1.2	First Stage Embedded Parts for item no. 1.1		5 Set					
1.3	Second Stage Embedded Parts including sill beam, wall plates, steel liners for Spillway crest/ glacis, bottom of breast wall & side wall/pier, hoist supporting structure, trunnion brackets, dogging etc. for item no. 1.1		5 Set					
1.4	Hydraulic cylinders of capacity not less than 180T for radial gate operation complete in all respect incl. suitable arrangement for gate position indication		10 Nos.					
1.5	Hydraulic Power pack for gate operation complete in all respect including Piping, Electrical Control Panels with and position indicator etc.		5 Set					
1.6	Gasoline engine operated portable power pack unit for hoist cylinder complete in all respect		1 Set					

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (BTN/INR)				Total Cost upto Project Site (BTN/INR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
1.7	Oil Filtering Unit complete in all respect for online filtering of power pack hydraulic oil along with contamination checking kit		1 Set					
1.8	Low Vacuum dehydration & degasification Unit		1 Set					
	Sub-Total of 1 (1.1 to 1.8)							
2.0	**Spillway Stop logs & Gantry Crane**							
2.1	Stoplog Gates (Slide type), 8 units		1 Set					
2.2	First Stage Embedded Parts for Item no. 2.1		5 Set					
2.3	Second Stage Embedded Parts including dogging arrangement and provision for air water jet cleaning system for item no. 2.1		5 Set					
2.4	Embedded parts for Stoplog storage groove including dogging arrangement and suitable steel cover/gratings etc.		3 Set					
2.5	Air vent pipe 300 dia.		5 Set					
2.6	Lifting Beam including probe mechanism		1 Set					
2.7	Gantry Crane of capacity not less than 45T, complete in all respect including cable reeling drum, Rails and fixtures etc.		1 Set					
	Sub-Total of 2 (2.1 to 2.7)							
3.0	**Overflow Spillway Service Gates and Motorized Screw hoist**							
3.1	Overflow Spillway Service Gate (4.0 x 5.0 - Fixed wheel type)		1 No.					
3.2	First Stage Embedded Parts for item no. 3.1		1 Set					
3.3	Second Stage Embedded Parts including dogging devices etc. for item no. 3.1		1 Set					

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (BTN/INR)				Total Cost upto Project Site (BTN/INR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
3.4	Motorized screw hoist of not less than 15MT capacity including hoist support structure for operation of spillway overflow gate complete in all respect and control equipment		1 Set					
	Sub-Total of 3 (3.1 to 3.4)							
4.0	**HRT Intake Trash Rack**							
4.1	Trash racks for complete intake openings comprising suitable nos. trash rack panels and sizes. Three (3) vents for each of the Two (2) intakes.		2 Set					
4.2	First stage Embedded parts for item no 4.1		2 Set					
4.3	Second stage embedded parts including guide and bottom base etc. for item no. 4.1		2 Set					
	Sub-Total of 4 (4.1 to 4.3)							
5.0	**Trash Rack Cleaning Machine (TRCM) and Disposal Vehicle Tripper**							
5.1	TRCM complete in all respect along with rail, bucket, control devices, grapple device, cable reeling drum along with tools kits.		1 Set					
5.2	Prime mover operated self-unloading trash disposal vehicle Tipper type [Volume 3.5 m3(min) and capacity 5MT (min)]		1Set					
	Sub-Total of 5 (5.1 to 5.2)							
6.0	**HRT Intake Gate and Rope Drum Hoist**							
6.1	Intake gate (4.25 x 4.7 - Fixed wheel Gate)		2 Set					
6.2	First Stage Embedded Parts for item no. 6.1		2 Set					

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (BTN/INR)				Total Cost upto Project Site (BTN/INR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
6.3	Second Stage Embedded Parts including dogging, provision for air water jet cleaning system etc. for item no.6.1		2 Set					
6.4	Air Vent Pipe 300 dia.		2 Set					
6.5	Rope Drum Hoist of capacity not less than 40T, complete in all respect including hoist support structure and control equipment for item no. 6.1		2 Set					
	Sub-Total of 6 (6.1 to 6.5)							
7.0	**Intake Bulkhead Gate and Gantry Crane**							
7.1	Intake Bulkhead Gate (4.25 x 4.7 - Slide type)		1 No.					
7.2	First Stage Embedded Parts for item no. 7.1		2 Set					
7.3	Second Stage Embedded Parts including dogging etc. for item no. 7.1		2 Set					
7.4	Lifting Beam (Automatic engaging/disengaging type)		1 Set					
7.5	Gantry Crane of Capacity not less than 35T, complete in all respects including cable reeling drum, Rails and fixtures		1 Set					
	Sub-Total of 7 (7.1 to 7.5)							
8.0	**Downstream Desilting Chamber Gate and EOT/Gantry**							
8.1	Downstream desilting chamber Gate (4.7m x 4.7m-Fixed wheel type)		2 Set					
8.2	First Stage Embedded Parts for Item no.8.1		2 Set					
8.3	Air vent pipe 300 dia.		2 Set					
8.4	Second Stage Embedded Parts including dogging devices etc. for item no. 8.1		2 Set					

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (BTN/INR)				Total Cost upto Project Site (BTN/INR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
8.5	Rope Drum Hoist of capacity not less than 35T, complete in all respect including hoist support structure and control equipment.		2 Set					
	Sub-Total of 8 (8.1 to 8.5)							
9.0	**Silt Flushing Service Gates & Hydraulic Hoists**							
9.1	Silt Flushing Tunnel Service Gate		2 Set					
9.2	Steel liners including stiffeners and anchorage, gate embedded parts, guides etc. for Service gates.		2 Set					
9.3	Hydraulic Hoists (double acting) for Service Gates of capacity not less than 150T/120T		2 Set					
9.4	Hoist supporting structure and dogging arrangement incl. bonnet, bonnet covers etc. for Service Gates		2 Set					
9.5	Air vent pipe (500mm dia.)		2 Set					
	Sub-Total of 9 (9.1 to 9.5)							
10.0	**Silt Flushing Emergency Gates & Hydraulic Hoists**							
10.1	Silt Flushing Tunnel Emergency Gate		2 Set					
10.2	Steel liners including stiffeners and anchorage, gate embedded parts, guides etc. for Emergency gates.		2 Set					
10.3	Hydraulic Hoists (double acting) for Emergency Gates of capacity not less than 150T/120T		2 Set					
10.4	Hoist supporting structure and dogging arrangement incl. bonnet, bonnet covers etc. for Emergency Gates		2 Set					

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (BTN/INR)				Total Cost upto Project Site (BTN/INR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
10.5	Common Hydraulic Power Pack for SFT Service and Emergency Gates (One set for each tunnel) complete in all respect including piping, electrical control panels with and position indicator		2 Set					
	Sub-Total of 10 (10.1 to 10.5)							
11.0	**Surge Shaft Gate & Rope Drum Hoists**							
11.1	Surge Shaft Gate (2.75 x 5.22 – Slide type)		2 Nos.					
11.2	First Stage Embedded Parts for item no. 11.1		2 Set					
11.3	Air vent Pipe 300 dia.		2 Set					
11.4	Second Stage Embedded Parts including dogging arrangement etc. for item no. 11.1		2 Set					
11.5	Rope Drum Hoist complete of capacity not less than 70 T, complete in all respect including hoist support structure and control equipment for item no 11.1		2 Set					
	Sub-Total of 11 (11.1 to 11.5)							
12.0	**Tailrace Gates & Gantry Crane**							
12.1	Tailrace gate (4.0 x 4.5 m - Wheel type)		2 Nos.					
12.2	First Stage Embedded Parts for Item no. 12.1		4 Set					
12.3	Air Vent pipe 300 dia.		4 Set					
12.4	Second Stage Embedded Parts including dogging etc. for item no.1		1 Set					
12.5	Lifting beam (Automatic engaging/disengaging type)		1 Set					

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (BTN/INR)				Total Cost upto Project Site (BTN/INR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
12.6	Gantry Crane of capacity not less than 20T, complete in all respect including cable reeling drum, Rails and fixtures		1 Set					
	Sub-Total of 12 (12.1 to 12.6)							
13.0	**TRT Outfall Gate & Rope Drum Hoists**							
13.1	TRT outfall Gate (6.5 x 6.5 m - Wheel type)		1 Nos.					
13.2	First Stage Embedded Parts for item no. 13.1		1 Set					
13.3	Second Stage Embedded Parts including dogging etc. for item no.13.1		1 Set					
13.4	Rope Drum Hoist of capacity no less than 60T, complete in all respect including hoist support structure and control equipment for item no. 13.1		1 Set					
	Sub-Total of 13 (13.1 to 13.4)							
14.0	**Adit Gates for HRT Adit No-2 & Adit No-5**							
14.1	Adit Gate size 2.5 m wide x 2.5 m high		2 Nos.					
14.2	First Stage Embedded Parts for 15.1		2 Set					
14.3	Second Stage Embedded Parts for 14.1 including dewatering pipe and valves		2 Set					
14.4	Two Gate Valve and Pressure Gauge with piping		1 Set					
	Sub-Total of 14 (14.1 to 14.4)							
15.0	**Chaplangchhu Trash Screen & Its Embedded Parts**							
15.1	Horizontal Trash screens		1 Set					
15.2	Embedded frame for trash screens		1 Set					
	Sub-Total of 15 (15.1 to 15.2)							

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (BTN/INR)				Total Cost upto Project Site (BTN/INR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
16.0	**Chaplangchhu Intake Gate and Motorized Screw Hoist**							
16.1	Chaplangchhu Intake Gate (2.0 m x 2.5 m - Fixed wheel type)		1 Set					
16.2	First Stage Embedded Parts for item no. 16.1		1 Set					
16.3	Second Stage Embedded Parts including dogging devices etc. for item no. 16.1		1 Set					
16.4	Motorized screw hoist of adequate capacity including hoist support structure complete in all respect and control equipment		1 Set					
	Sub-Total of 16 (16.1 to 16.4)							
17.0	**Chaplangchhu Desilting chamber Outlet Gate and Hoist**							
17.1	Desilting Chamber Gate (1.8m x 2.1m - Slide type)		1 Set					
17.2	First Stage Embedded Parts for item no. 17.1		1 Set					
17.3	Second Stage Embedded Parts including dogging devices etc. for item no. 17.1		1 Set					
17.4	Motorized screw hoist of adequate capacity including hoist support structure complete in all respect and control equipment		1 Set					
	Sub-Total of 17 (17.1 to 17.4)							
18.0	**Chaplangchhu Silt Flushing Tunnel (SFT) Gate and Hydraulic Hoist**							
18.1	SFT Gates (0.6 m x 0.6 m- Slide type)		1 Set					
18.2	First Stage Embedded Parts for Item no. 18.1		1 Set					

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (BTN/INR)				Total Cost upto Project Site (BTN/INR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
18.3	Second Stage Embedded Parts including dogging devices etc. for item no. 18.1		1 Set					
18.4	Hoist supporting structure, and dogging arrangement for SFT gate		1 Set					
18.5	Hydraulic Hoists (double acting) of capacity not less than 10T/8T complete in all respect along with arrangement for gate position indication.		1 Set					
	Sub-Total of 18 (18.1 to 18.5)							
19.0	**Chaplangchhu De-gravelling Gate and Hoist**							
19.1	De-gravelling gate (2.0 m x 2.0 m (Slide type)		1 Set					
19.2	First Stage Embedded Parts for Item no. 19.1		1 Set					
19.3	Second Stage Embedded Parts including dogging devices etc. for item no. 19.1		1 Set					
19.4	Hoist supporting structure, and dogging arrangement for De-graveling gate		1 Set					
19.5	Hydraulic Hoists (double acting) of capacity not less than 10T/8T complete in all respect along with arrangement for gate position indication.		1 Set					
19.6	Common Hydraulic Power Pack for Chaplangchhu SFT Gate and De-gravelling Gate complete in all respect including piping, electrical control panels and position indicator.		1 Set					
	Sub-Total of 19 (19.1 to 19.6)							

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (BTN/INR)				Total Cost upto Project Site (BTN/INR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
20.0	**Aquatic Life Discharge Piping with Valves**							
20.1	600mm dia. Stainless steel pipe of not less than 15mm thickness, pipe bends, transition piece, flange connections, dismantling joint etc. complete with all other accessories and appurtenance		2 Set					
20.2	Electro mechanically actuated Knife edge gate valves (2 services and 2 emergency) suitable for 600mm dia. stainless steel pipe complete with all respect including control equipment		4 Set					
	Sub-Total of 20 (20.1 to 20.2)							
21.0	**Instrumentation**							
	Following Instruments, Field Devices and Local Equipment shall be provided complete in all respect.							
21.1	Water level measuring and indication Equipment (non-contacting microwave type) for dam area with electronic water level transmitter		2 Sets					
21.2	Water level measuring system at dam area spillway gates.		5 Sets					
21.3	Water level measurement system to indicate balance head condition of Intake gates.		2 Sets					
21.4	Head loss equipment for intake gates		2 Sets					
21.5	Water level measuring system to indicate balance head condition of desilting basin downstream gates.		2 Sets					
21.6	Water level measuring system to indicate balance head condition of surge shaft gates		2 Sets					

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (BTN/INR)				Total Cost upto Project Site (BTN/INR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
21.7	Water level measurement system to indicate balance head condition of TRT outfall gate		1 Set					
21.8	Gravel Level Sensors/Transmitter for Chaplangchhu Diversion Scheme.		2 Set					
21.9	Water level measuring and indication Equipment at Chaplangchhu Intake area along with necessary alarms.		2 Sets					
21.10	Individual distribution board & feeder pillar for all HM equipment complete in all respect as described in GTS/PTS		1 Set					
	Sub-Total of 21 (21.1 to 21.10)							
22.0	**Any other items/systems not mentioned above, but required for completeness of the scope of entire work and satisfactory performance /operation of the project.**							
	Total (1 to 22) of Price Schedule-1.1							

(Total Amount in words……..)

Note:

1. The items of Equipment in this Proforma are as per Employer's preliminary Design and as per relevant provisions of specification. The same may be modified/altered to suite Bidder's Planning, Design & Engineering, resulting in economizing cost to the extent possible and quote accordingly. The bidder may include any other items omitted by owner which are required for completeness and satisfactory operation/performance of the project.
2. **Specify currency in accordance with ITB 19**. The quoted prices shall be inclusive of all taxes and duties as per GCC Cl.14.
3. The bidder shall indicate the unit prices in words as well as in figures as stipulated in the table.

Khorlochhu Hydro Power Ltd.

Seal/Signature of Bidder: …..……..

1.2 Plant and Equipment Supplied from Country other than Bhutan and India

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (EUR)				Total Cost upto Project Site (EUR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
1.0	**Spillway Radial Gates with Hydraulic Hoist**							
1.1	Submerged Radial Gates (6.80 m x 12.9m opening size) complete in all respect including 3mm Stainless Steel cladding (AISI 304) on skin plate, girders, arms, trunnions, guide rollers etc.		5 Nos.					
1.2	First Stage Embedded Parts for item no. 1.1		5 Set					
1.3	Second Stage Embedded Parts including sill beam, wall plates, steel liners for Spillway crest/ glacis, bottom of breast wall & side wall/pier, hoist supporting structure, trunnion brackets, dogging etc. for item no. 1.1		5 Set					
1.4	Hydraulic cylinders of capacity not less than 180T for radial gate operation complete in all respect incl. suitable arrangement for gate position indication		10 Nos.					
1.5	Hydraulic Power pack for gate operation complete in all respect including Piping, Electrical Control Panels with and position indicator etc.		5 Set					
1.6	Gasoline engine operated portable power pack unit for hoist cylinder complete in all respect		1 Set					
1.7	Oil Filtering Unit complete in all respect for online filtering of power pack hydraulic oil along with contamination checking kit		1 Set					

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (EUR)				Total Cost upto Project Site (EUR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
1.8	Low Vacuum dehydration & degasification Unit		1 Set					
	Sub-Total of 1 (1.1 to 1.8)							
2.0	**Spillway Stop logs & Gantry Crane**							
2.1	Stoplog Gates (Slide type), 8 units		1 Set					
2.2	First Stage Embedded Parts for Item no. 2.1		5 Set					
2.3	Second Stage Embedded Parts including dogging arrangement and provision for air water jet cleaning system for item no. 2.1		5 Set					
2.4	Embedded parts for Stoplog storage groove including dogging arrangement and suitable steel cover/gratings etc.		3 Set					
2.5	Air vent pipe 300 dia.		5 Set					
2.6	Lifting Beam including probe mechanism		1 Set					
2.7	Gantry Crane of capacity not less than 45T, complete in all respect including cable reeling drum, Rails and fixtures etc.		1 Set					
	Sub-Total of 2 (2.1 to 2.7)							
3.0	**Overflow Spillway Service Gates and Motorized Screw hoist**							
3.1	Overflow Spillway Service Gate (4.0 x 5.0 - Fixed wheel type)		1 No.					
3.2	First Stage Embedded Parts for item no. 3.1		1 Set					
3.3	Second Stage Embedded Parts including dogging devices etc. for item no. 3.1		1 Set					
3.4	Motorized screw hoist of not less than 15MT capacity including hoist support structure for operation of spillway overflow		1 Set					

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (EUR)				Total Cost upto Project Site (EUR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
	gate complete in all respect and control equipment							
	Sub-Total of 3 (3.1 to 3.4)							
4.0	**HRT Intake Trash Rack**							
4.1	Trash racks for complete intake openings comprising suitable nos. trash rack panels and sizes. Three (3) vents for each of the Two (2) intakes.		2 Set					
4.2	First stage Embedded parts for item no 4.1		2 Set					
4.3	Second stage embedded parts including guide and bottom base etc. for item no. 4.1		2 Set					
	Sub-Total of 4 (4.1 to 4.3)							
5.0	**Trash Rack Cleaning Machine (TRCM) and Disposal Vehicle Tripper**							
5.1	TRCM complete in all respect along with rail, bucket, control devices, grapple device, cable reeling drum along with tools kits.		1 Set					
5.2	Prime mover operated self-unloading trash disposal vehicle Tipper type [Volume 3.5 m3(min) and capacity 5MT (min)]		1Set					
	Sub-Total of 5 (5.1 to 5.2)							
6.0	**HRT Intake Gate and Rope Drum Hoist**							
6.1	Intake gate (4.25 x 4.7 - Fixed wheel Gate)		2 Set					
6.2	First Stage Embedded Parts for item no. 6.1		2 Set					
6.3	Second Stage Embedded Parts including dogging, provision for air water jet cleaning system etc. for item no.6.1		2 Set					
6.4	Air Vent Pipe 300 dia.		2 Set					

Khorlochhu Hydro Power Ltd.

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (EUR)				Total Cost upto Project Site (EUR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
6.5	Rope Drum Hoist of capacity not less than 40T, complete in all respect including hoist support structure and control equipment for item no. 6.1		2 Set					
	Sub-Total of 6 (6.1 to 6.5)							
7.0	**Intake Bulkhead Gate and Gantry Crane**							
7.1	Intake Bulkhead Gate (4.25 x 4.7 - Slide type)		1 No.					
7.2	First Stage Embedded Parts for item no. 7.1		2 Set					
7.3	Second Stage Embedded Parts including dogging etc. for item no. 7.1		2 Set					
7.4	Lifting Beam (Automatic engaging/disengaging type)		1 Set					
7.5	Gantry Crane of Capacity not less than 35T, complete in all respects including cable reeling drum, Rails and fixtures		1 Set					
	Sub-Total of 7 (7.1 to 7.5)							
8.0	**Downstream Desilting Chamber Gate and EOT/Gantry**							
8.1	Downstream desilting chamber Gate (4.7m x 4.7m-Fixed wheel type)		2 Set					
8.2	First Stage Embedded Parts for Item no.8.1		2 Set					
8.3	Air vent pipe 300 dia.		2 Set					
8.4	Second Stage Embedded Parts including dogging devices etc. for item no. 8.1		2 Set					
8.5	Rope Drum Hoist of capacity not less than 35T, complete in all respect including hoist support structure and control equipment.		2 Set					
	Sub-Total of 8 (8.1 to 8.5)							

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (EUR)				Total Cost upto Project Site (EUR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
9.0	**Silt Flushing Service Gates & Hydraulic Hoists**							
9.1	Silt Flushing Tunnel Service Gate		2 Set					
9.2	Steel liners including stiffeners and anchorage, gate embedded parts, guides etc. for Service gates.		2 Set					
9.3	Hydraulic Hoists (double acting) for Service Gates of capacity not less than 150T/120T		2 Set					
9.4	Hoist supporting structure and dogging arrangement incl. bonnet, bonnet covers etc. for Service Gates		2 Set					
9.5	Air vent pipe (500mm dia.)		2 Set					
	Sub-Total of 9 (9.1 to 9.5)							
10.0	**Silt Flushing Emergency Gates & Hydraulic Hoists**							
10.1	Silt Flushing Tunnel Emergency Gate		2 Set					
10.2	Steel liners including stiffeners and anchorage, gate embedded parts, guides etc. for Emergency gates.		2 Set					
10.3	Hydraulic Hoists (double acting) for Emergency Gates of capacity not less than 150T/120T		2 Set					
10.4	Hoist supporting structure and dogging arrangement incl. bonnet, bonnet covers etc. for Emergency Gates		2 Set					
10.5	Common Hydraulic Power Pack for SFT Service and Emergency Gates (One set for each tunnel) complete in all respect including piping, electrical control panels with and position indicator		2 Set					

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (EUR)				Total Cost upto Project Site (EUR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
	Sub-Total of 10 (10.1 to 10.5)							
11.0	**Surge Shaft Gate & Rope Drum Hoists**							
11.1	Surge Shaft Gate (2.75 x 5.22 – Slide type)		2 Nos.					
11.2	First Stage Embedded Parts for item no. 11.1		2 Set					
11.3	Air vent Pipe 300 dia.		2 Set					
11.4	Second Stage Embedded Parts including dogging arrangement etc. for item no. 11.1		2 Set					
11.5	Rope Drum Hoist complete of capacity not less than 70 T, complete in all respect including hoist support structure and control equipment for item no 11.1		2 Set					
	Sub-Total of 11 (11.1 to 11.5)							
12.0	**Tailrace Gates & Gantry Crane**							
12.1	Tailrace gate (4.0 x 4.5 m - Wheel type)		2 Nos.					
12.2	First Stage Embedded Parts for Item no. 12.1		4 Set					
12.3	Air Vent pipe 300 dia.		4 Set					
12.4	Second Stage Embedded Parts including dogging etc. for item no.1		1 Set					
12.5	Lifting beam (Automatic engaging/disengaging type)		1 Set					
12.6	Gantry Crane of capacity not less than 20T, complete in all respect including cable reeling drum, Rails and fixtures		1 Set					
	Sub-Total of 12 (12.1 to 12.6)							
13.0	**TRT Outfall Gate & Rope Drum Hoists**							
13.1	TRT outfall Gate (6.5 x 6.5 m - Wheel type)		1 Nos.					

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (EUR)				Total Cost upto Project Site (EUR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
13.2	First Stage Embedded Parts for item no. 13.1		1 Set					
13.3	Second Stage Embedded Parts including dogging etc. for item no.13.1		1 Set					
13.4	Rope Drum Hoist of capacity no less than 60T, complete in all respect including hoist support structure and control equipment for item no. 13.1		1 Set					
	Sub-Total of 13 (13.1 to 13.4)							
14.0	**Adit Gates for HRT Adit No-2 & Adit No-5**							
14.1	Adit Gate size 2.5 m wide x 2.5 m high		2 Nos.					
14.2	First Stage Embedded Parts for 15.1		2 Set					
14.3	Second Stage Embedded Parts for 14.1 including dewatering pipe and valves		2 Set					
14.4	Two Gate Valve and Pressure Gauge with piping		1 Set					
	Sub-Total of 14 (14.1 to 14.4)							
15.0	**Chaplangchhu Trash Screen & Its Embedded Parts**							
15.1	Horizontal Trash screens		1 Set					
15.2	Embedded frame for trash screens		1 Set					
	Sub-Total of 15 (15.1 to 15.2)							
16.0	**Chaplangchhu Intake Gate and Motorized Screw Hoist**							
16.1	Chaplangchhu Intake Gate (2.0 m x 2.5 m - Fixed wheel type)		1 Set					
16.2	First Stage Embedded Parts for item no. 16.1		1 Set					
16.3	Second Stage Embedded Parts including dogging devices etc. for item no. 16.1		1 Set					

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (EUR)				Total Cost upto Project Site (EUR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
16.4	Motorized screw hoist of adequate capacity including hoist support structure complete in all respect and control equipment		1 Set					
	Sub-Total of 16 (16.1 to 16.4)							
17.0	**Chaplangchhu Desilting chamber Outlet Gate and Hoist**							
17.1	Desilting Chamber Gate (1.8m x 2.1m - Slide type)		1 Set					
17.2	First Stage Embedded Parts for item no. 17.1		1 Set					
17.3	Second Stage Embedded Parts including dogging devices etc. for item no. 17.1		1 Set					
17.4	Motorized screw hoist of adequate capacity including hoist support structure complete in all respect and control equipment		1 Set					
	Sub-Total of 17 (17.1 to 17.4)							
18.0	**Chaplangchhu Silt Flushing Tunnel (SFT) Gate and Hydraulic Hoist**							
18.1	SFT Gates (0.6 m x 0.6 m- Slide type)		1 Set					
18.2	First Stage Embedded Parts for Item no. 18.1		1 Set					
18.3	Second Stage Embedded Parts including dogging devices etc. for item no. 18.1		1 Set					
18.4	Hoist supporting structure, and dogging arrangement for SFT gate		1 Set					
18.5	Hydraulic Hoists (double acting) of capacity not less than 10T/8T complete in all respect along with arrangement for gate position indication.		1 Set					

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (EUR)				Total Cost upto Project Site (EUR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
	Sub-Total of 18 (18.1 to 18.5)							
19.0	**Chaplangchhu De-gravelling Gate and Hoist**							
19.1	De-gravelling gate (2.0 m x 2.0 m (Slide type)		1 Set					
19.2	First Stage Embedded Parts for Item no. 19.1		1 Set					
19.3	Second Stage Embedded Parts including dogging devices etc. for item no. 19.1		1 Set					
19.4	Hoist supporting structure, and dogging arrangement for De-graveling gate		1 Set					
19.5	Hydraulic Hoists (double acting) of capacity not less than 10T/8T complete in all respect along with arrangement for gate position indication.		1 Set					
19.6	Common Hydraulic Power Pack for Chaplangchhu SFT Gate and De-gravelling Gate complete in all respect including piping, electrical control panels and position indicator.		1 Set					
	Sub-Total of 19 (19.1 to 19.6)							
20.0	**Aquatic Life Discharge Piping with Valves**							
20.1	600mm dia. Stainless steel pipe of not less than 15mm thickness, pipe bends, transition piece, flange connections, dismantling joint etc. complete with all other accessories and appurtenance		2 Set					
20.2	Electro mechanically actuated Knife edge gate valves (2 services and 2 emergency) suitable for 600mm dia. stainless steel pipe		4 Set					

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (EUR)				Total Cost upto Project Site (EUR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
	complete with all respect including control equipment							
	Sub-Total of 20 (20.1 to 20.2)							
21.0	**Instrumentation**							
	Following Instruments, Field Devices and Local Equipment shall be provided complete in all respect.							
21.1	Water level measuring and indication Equipment (non-contacting microwave type) for dam area with electronic water level transmitter		2 Sets					
21.2	Water level measuring system at dam area spillway gates.		5 Sets					
21.3	Water level measurement system to indicate balance head condition of Intake gates.		2 Sets					
21.4	Head loss equipment for intake gates		2 Sets					
21.5	Water level measuring system to indicate balance head condition of desilting basin downstream gates.		2 Sets					
21.6	Water level measuring system to indicate balance head condition of surge shaft gates		2 Sets					
21.7	Water level measurement system to indicate balance head condition of TRT outfall gate		1 Set					
21.8	Gravel Level Sensors/Transmitter for Chaplangchhu Diversion Scheme.		2 Set					
21.9	Water level measuring and indication Equipment at Chaplangchhu Intake area along with necessary alarms.		2 Sets					
21.10	Individual distribution board & feeder pillar for all HM equipment complete in all respect as described in GTS/PTS		1 Set					

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (EUR)				Total Cost upto Project Site (EUR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
	Sub-Total of 21 (21.1 to 21.10)							
22.0	**Any other items/systems not mentioned above, but required for completeness of the scope of entire work and satisfactory performance /operation of the project.**							
	Total (1 to 22) of Price Schedule-1.1							

(Total Amount in words……..)

Note:

1. The items of Equipment in this Proforma are as per Employer's preliminary Design and as per relevant provisions of specification. The same may be modified/altered to suite Bidder's Planning, Design & Engineering, resulting in economizing cost to the extent possible and quote accordingly. The bidder may include any other items omitted by owner which are required for completeness and satisfactory operation/performance of the project.
2. **Specify currency in accordance with ITB 19**. The quoted prices shall be inclusive of all taxes and duties as per GCC Cl.14.
3. The bidder shall indicate the unit prices in words as well as in figures as stipulated in the table.

Seal/Signature of Bidder: …..……..

PRICE SCHEDULE-2

2.1 STEEL LINER WORKS

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (BTN/INR)				Total Cost upto Project Site (BTN/INR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
1.0	Providing, fabricating, erecting and fixing in position stainless steel **[ASTM A 537 Cl.2]** for penstock, pressure shaft, pressure tunnel, etc., including transition , straight ferrule , bends , reducers , bifurcations ,stiffener rings, backing strips, manholes, bulkheads etc. as per details/drawings including cost of all materials, cost of furnishing all plants , machinery, equipment's, labour, cutting, bending, grinding , welding, testing, painting , transportation , staging, hauling and storage facilities and services, lighting, ventilation, drainage, supporting arrangement required for erection, testing site, professional and technical services and all other ancillary operations, etc. along with all accessories complete in all respects as per drawings, specifications and instructions of Owner/Project Manager with all lifts/depths and leads.		3153 MT					

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (BTN/INR)				Total Cost upto Project Site (BTN/INR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
2.0	Providing, fabricating, erecting and fixing in position structural steel **[ASTM A 517 Gr. F]** for penstock, pressure shaft, pressure tunnel, etc., including transition , straight ferrule , bends , reducers , bifurcations ,stiffener rings, backing strips, manholes, bulkheads etc. as per details/drawings including cost of all materials, cost of furnishing all plants , machinery, equipment's, labour, cutting, bending, grinding , welding, testing, painting , transportation , staging, hauling and storage facilities and services, lighting, ventilation, drainage, supporting arrangement required for erection, testing site, professional and technical services and all other ancillary operations, etc. complete in all respects as per drawings, specifications and instructions of Owner/Project Manager with all lifts/depths and leads.		7872 MT					

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (BTN/INR)				Total Cost upto Project Site (BTN/INR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
3.0	Providing, fabricating, erecting and fixing in position stainless steel **[ASTM A 537 Cl.2]** for HRT liner including transition , straight ferrule , bends , stiffener rings, backing strips etc. as per details/drawings including cost of all materials, cost of furnishing all plants , machinery, equipment's, labour, cutting, bending, grinding , welding, testing, painting , transportation , staging, hauling and storage facilities and services, lighting, ventilation, drainage, supporting arrangement required for erection, testing site, professional and technical services and all other ancillary operations, etc. along with all accessories complete in all respects as per drawings, specifications and instructions of Owner/Project Manager with all lifts/depths and leads.		940 MT					
4.0	**Inspection Trolley:** Design and supply/construction/erection of 1 No. inspection trolley as per technical specification complete in all respects as per instruction of Owner/Project Manager. The trolley shall be capable of being dismantled and taken through the minimum 800 mm Ø manhole and assembled inside the pressure shaft. The trolley shall have a capacity to carry 5 tones load.		1 SET					
	Total (1 to 4) of Price Schedule-2.1							

Item No.	Description of Items	Make/ Country of Origin	Qty.	Unit Price (BTN/INR)				Total Cost upto Project Site (BTN/INR)
				Ex-works Price inclusive of packing and forwarding		Transportation Charges up to Project Site including CIP		
				(In figures)	(In Words)	(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)		(6)		(7 = 4x (5+6))
	Total of Schedule-2							

(Total Amount in words……..)

Note:

1. The items of Equipment in this Proforma are as per Employer's preliminary Design and as per relevant provisions of specification. The same may be modified/altered to suite Bidder's Planning, Design & Engineering, resulting in economizing cost to the extent possible and quote accordingly. The bidder may include any other items omitted by owner which are required for completeness and satisfactory operation/performance of the project.
2. **Specify currency in accordance with ITB 19**. The quoted prices shall be inclusive of all taxes and duties as per GCC Cl.14.
3. The bidder shall indicate the unit prices in words as well as in figures as stipulated in the table.

Seal/Signature of Bidder: …..……..

PRICE SCHEDULE-3

3.1 Mandatory Spares supplied from Bhutan and India

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR) CIP to project site		Total Price (BTN/INR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
1.0	**Spillway Radial Gates with Hydraulic Hoists**					
1.1	Rubber seals including fasteners and clamp plates for radial gates	Set	5			
1.2	Complete sets of bearing/bush and washers with one set comprising of all bearing/bush and washers installed on one trunnion assembly.	Set	5			
1.3	Bush and washers for guide roller assembly of radial gates	Set	5			
1.4	Seals for hydraulic hoist cylinder	Set	10			
1.5	Bearings/bushes for electric motors of hydraulic unit	Set	5			
1.6	Clevis ends bearings of hydraulic unit	Set	10			
1.7	Gaskets (O-rings) for each hydraulic unit.	Set	10			
1.8	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, relays and limit switches, timer /delays for hydraulic hoist	Set	10			
1.9	Filters for radial gate hydraulic hoist	Set	10			
1.1	Control valves, pressure gauge, pressure switches for radial gate for hydraulic unit	Set	5			
1.11	Filters for gasoline engine operated hydraulic unit	Sets	2			
1.12	Control valves, pressure gauge, pressure switches Fuses, auxiliary contactors, push-buttons, indication lamps etc. for gasoline engine operated hydraulic unit	Set	1			
1.13	Bearings/bushes for electric motors of portable oil filter unit	Set	1			
1.14	Filters / papers for portable oil filter unit.	Set	4			

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR) CIP to project site		Total Price (BTN/INR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
1.15	Fuses, auxiliary contactors, push buttons, indication lamps etc. for portable oil filter & Low vacuum dehydration & degasification unit	Set	2			
	Sub-Total of Item No. 1.0 (1.1 to 1.15)					
2.0	**Spillway Stop logs & Gantry Crane**					
2.1	Complete set of rubber seals including fasteners for spillway stop logs	Set	1			
2.2	Brake shoe for different brakes of gantry crane	Set	2			
2.3	Bearings/bushes for gantry crane	Set	1			
2.4	Fuses, auxiliary contactors, push-buttons, indication lamps, switches and limit switches for gantry crane	Set	1			
2.5	Bush/bearings for electric motors for gantry crane	Set	2			
2.6	All types of grease nipples	Set	1			
2.7	Guide Roller Assembly including fasteners	Set	2			
	Sub-Total of Item No. 2.0 (2.1 to 2.6)					
3.0	**Overflow Spillway Service Gates and Motorized Screw Hoists**					
3.1	Rubber seal along with fasteners for Overflow spillway service gate	Set	1			
3.2	Complete wheel assembly for Overflow spillway service gate	Set	1			
3.3	Bearings/bushes for electric motors of screw hoist of Overflow spillway Service gate	Set	1			
3.4	Brake shoes for each type of Hoist brakes for screw Hoist	Set	1			
3.5	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, limit switches and relays for screw hoist for service gate	Set	1			

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR) CIP to project site		Total Price (BTN/INR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
3.6	Control valves, pressure gauge, pressure switches for screw hoist	Sets	1			
	Sub-Total of Item No. 3.0 (3.1 to 3.6)					
4.0	**Trash Rack Cleaning Machine (TRCM)**					
4.1	Detachable stainless steel/high strength, polypropylene sheet combing rake teeth strip with fasteners	Set	1			
4.2	Control relays	Set	1			
4.3	Terminal Switch	Set	1			
4.4	Limit Switch	Set	1			
4.5	Push Button	Set	1			
4.6	Brake linings for each type of brakes	Set	1			
4.7	Motor Carbon brushes	Set	1			
4.8	Fuse elements	Set	2			
4.9	10% of all nuts , bolts & washers	Set	2			
4.10	All types of grease nipples	Set	1			
4.11	Solenoid valves, pressure gauge, pressure switch of each type	Set	1			
4.12	Oil filter	Set	2			
	Sub-Total of Item No. 4.0 (4.1 to 4.12)					
5.0	**Intake Gate and Rope Drum Hoist**					
5.1	Rubber seal along with fasteners for intake gate	Sets	2			
5.2	Complete Wheel assembly for intake gate	Sets	2			
5.3	Bearings for electric motors of rope drum hoist of intake gate	Set	1			
5.4	Brake shoes for rope drum hoist for intake gate	Set	2			
5.5	Bearings/bushes for Rope drum Hoist	Set	1			

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR) CIP to project site		Total Price (BTN/INR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
5.6	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, limit switches and relays for rope drum hoist for intake gate	Set	1			
5.7	Bush and washers of guide roller assembly of intake gate	Sets	2			
	Sub-Total of Item No. 5.0 (5.1 to 5.7)					
6.0	**Intake Bulkhead Gate and Gantry Crane**					
6.1	Rubber seal along with fasteners for intake bulkhead gate	Set	1			
6.2	Brake shoe for different brakes of gantry crane	Set	1			
6.3	Bearings/bushes for gantry crane	Set	1			
6.4	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, limit switches and relays for gantry crane	Set	1			
6.5	Bush/bearings for electric motors for gantry crane	Set	1			
6.6	Bush and washers of guide roller assembly of bulkhead gate	Set	1			
	Sub-Total of Item No. 6.0 (6.1 to 6.6)					
7.0	**Downstream Desilting Basin Gate and EOT/Gantry**					
7.1	Rubber seal along with fasteners for Downstream desilting basin fixed wheel gate	Set	1			
7.2	Complete Wheel assembly for Downstream desilting basin gate	Set	2			
7.3	Bearings/bushes for electric motors of rope drum hoist of Downstream desilting basin Gates	Set	1			
7.4	Brake shoes for each type of Hoist brakes for rope drum Hoist	Set	1			
7.5	Bearings/bushes for Rope drum Hoist	Set	1			

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR) CIP to project site		Total Price (BTN/INR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
7.6	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, limit switches and relays for rope drum hoist for Downstream desilting basin gate	Set	1			
7.7	Bush and washers for guide roller assembly of Downstream desilting chamber gate	Sets	2			
	Sub-Total of Item No. 7.0 (7.1 to 7.7)					
8.0	**Silt Flushing Service Gates & Hydraulic Hoists**					
8.1	Rubber seal along with fasteners for flushing tunnel service gate	Sets	2			
8.2	Hoist cylinder seals	Sets	2			
8.3	Hydraulic hoist motor bushes/bearings	Sets	2			
8.4	Clevis end bearings for hydraulic hoist	Sets	2			
8.5	Gaskets (O-rings) for bonnet covers	Sets	2			
8.6	Sealing for piston rods gland box	Set	2			
8.7	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, relays and limit switches, timer /delays for hydraulic hoist	Sets	2			
8.8	Filters, control valves, pressure gauge and pressure switch of hydraulic power pack	Sets	2			
	Sub-Total of Item No. 8.0 (8.1 to 8.8)					
9.0	**Silt Flushing Emergency Gates & Hydraulic Hoists**					
9.1	Rubber seal along with fasteners for flushing tunnel emergency gate	Sets	2			
9.2	Hoist cylinder seals	Set	1			
9.3	Hydraulic hoist motor bushes/bearings	Set	1			
9.4	Clevis end bearings for hydraulic hoist	Set	1			
9.5	Gaskets (O-rings) for bonnet covers	Sets	2			
9.6	Sealing for piston rods gland box	Set	2			

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR) CIP to project site		Total Price (BTN/INR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
	Sub-Total of Item No. 9.0 (9.1 to 9.6)					
10.0	**Surge Shaft Gate & Rope Drum Hoists**					
10.1	Rubber seal along with fasteners for surge shaft gate	Set	2			
10.2	Bearings for electric motors of rope drum hoist of surge shaft gate	Set	2			
10.3	Brake shoes for each type of Hoist brakes for rope drum Hoist	Set	2			
10.4	Bearings/bushes for Rope drum hoist	Set	2			
10.5	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, limit switches and relays for rope drum hoist for surge shaft gate	Set	1			
	Sub-Total of Item No. 10.0 (10.1 to 10.5)					
11.0	**Tailrace Gates & Gantry Crane**					
11.1	Rubber seal along with fasteners for Tail race gate	Set	1			
11.2	Brake shoe for different brakes of gantry crane	Set	1			
11.3	Bearings/bushes for gantry crane	Set	1			
11.4	Fuses, auxiliary contactors, push-buttons, indication lamps, switches and limit switches for gantry crane	Set	1			
11.5	Bush/bearings for electric motors of gantry crane	Set	1			
11.6	Bush and washers of guide roller assembly of Tail race gate	Set	1			
	Sub-Total of Item No. 11.0 (11.1 to 11.6)					
12.0	**TRT Outfall Gate & Rope Drum Hoists**					
12.1	Rubber seal along with fasteners for TRT outfall gate	Sets	1			
12.2	Complete Wheel assembly for TRT outfall gate	Set	1			
12.3	Bearings for electric motors of rope drum hoist of TRT outfall gate	Set	1			

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR) CIP to project site		Total Price (BTN/INR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
12.4	Brake shoes for each type of Hoist brakes for rope drum Hoist	Set	1			
12.5	Bearings/bushes for Rope drum Hoist	Set	1			
12.6	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, limit switches and relays for rope drum hoist for TRT outfall gate	Set	1			
12.7	Bush and washers of guide roller assembly of TRT outfall gate	Set	2			
	Sub-Total of Item No. 12.0 (12.1 to 12.7)					
13.0	**Adit Gates for HRT Adit No-2 & Adit No-5**					
13.1	Rubber seals assembly along with fasteners etc. for Adit inspection gate.	Set	2			
	Sub-Total of Item No. 13.0 (13.1)					
14.0	**(Schedule 2(i) Part B) Pressure Shaft Steel Liners**					
14.1	Manhole gaskets	Set	6			
	Sub-Total of Item No. 14.0 (14.1)					
15.0	**Chaplangchhu Intake Gate and Motorized screw hoist**					
15.1	Rubber seal along with fasteners for Chaplangchhu Intake gate	Set	1			
15.2	Complete Wheel assembly for Chaplangchhu Intake gate	Set	1			
15.3	Bearings/bush for electric motors of screw hoist	Set	1			
15.4	Brake shoes for each type of Hoist brakes for motorized screw Hoist	Set	1			
15.5	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, limit switches and relays for screw hoist for Chaplangchhu Intake gate	Set	1			

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR) CIP to project site		Total Price (BTN/INR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
15.6	Control valves, pressure gauge, pressure switches for screw hoist	Set	1			
	Sub-Total of Item No. 15.0 (15.1 to 15.6)					
16.0	**Chaplangchhu Desilting Chamber Gate and Motorized screw hoist**					
16.1	Rubber seal along with fasteners for Desilting gate	Set	1			
16.2	Bearings/bush for electric motors of screw hoist	Set	1			
16.3	Brake shoes for each type of Hoist brakes for motorized screw Hoist	Set	1			
16.4	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, limit switches and relays for screw hoist for Chaplangchhu Intake gate	Set	1			
16.5	Control valves, pressure gauge, pressure switches for screw hoist	Set	1			
	Sub-Total of Item No. 16.0 (16.1 to 16.5)					
17.0	**Chaplangchhu Silt Flushing Tunnel Gate and Hydraulic Hoist**					
17.1	Rubber seal along with fasteners for Silt flushing tunnel gate	Set	1			
17.2	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, relays and limit switches, timer /delays for hydraulic hoist	Set	1			
17.3	Filters, control valves, pressure gauge and pressure switch of hydraulic power pack	Set	1			
17.4	Hydraulic hoist motor bushes/bearings	Set	1			
17.5	Hydraulic cylinder seals	Set	1			
17.6	Clevis end bearings for hydraulic hoist	Set	1			
17.7	Gasket (O-rings) for bonnet covers	Set	1			
17.8	Sealing for piston rods gland box	Set	1			
	Sub-Total of Item No. 17.0 (17.1 to 17.8)					

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR) CIP to project site		Total Price (BTN/INR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
18.0	**Chaplangchhu De-gravelling Gate and Hydraulic Hoist**					
18.1	Rubber seal along with fasteners for Gates	Set	1			
18.2	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, relays and limit switches, timer /delays for hydraulic hoist	Set	1			
18.3	Filters, control valves, pressure gauge and pressure switch of hydraulic power pack	Set	1			
18.4	Hydraulic hoist motor bushes/bearings	Set	1			
18.5	Hydraulic cylinder seals	Set	1			
18.6	Clevis end bearings for hydraulic hoist	Set	1			
18.7	Gasket (O-rings) for bonnet covers	Set	1			
18.8	Sealing for piston rods gland box	Set	1			
	Sub-Total of Item No. 18.0 (18.1 to 18.8)					
19.0	**Aquatic Life Discharge Piping with Valves**					
19.1	Stainless steel knife plate for knife-edge gate valve	Sets	2			
19.2	Gland packing for knife-edge gate valve	Sets	2			
19.3	Stainless steel stem for knife-edge gate valve	Sets	2			
19.4	Key for knife-edge gate valve	Sets	2			
19.5	Thrust ring/Thrust bearing	Sets	2			
19.6	Rubber seat ring for knife-edge gate valve	Sets	2			
19.7	Teflon sheet ring for knife-edge gate valve	Sets	2			
19.8	Fuse for valve control panel.	Sets	2			
	Sub-Total of Item No. 19.0 (19.1 to 19.8)					
20.0	**Instrumentation**					
20.1	Each type of contacts	Nos.	10			
20.2	Each set of fuse elements	Nos.	10			
20.3	Position transmitter for spillway radial gates	Sets	3			

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR) CIP to project site		Total Price (BTN/INR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
20.4	Position transmitter for intake gate	Sets	2			
20.5	Position transmitter for silt flushing gates	Sets	2			
20.6	Digital position indicator for spillway radial gates	Sets	3			
20.7	Digital position indicator for intake gate	Sets	2			
20.8	Digital position indicator for silt flushing gate	Sets	2			
20.9	Differential pressure instrument for trash rack	Sets	2			
20.10	Gravel Level sensors and Transmitter for Chaplangchhu diversion Scheme	Sets	2			
20.11	**Individual Distribution Panel**					
i)	MCCB of each type of used.	Nos.	2			
ii)	MCB of each type of used.	Nos.	2			
iii)	Current transformer Each type of used	Nos.	2			
iv)	Voltmeter Each type of used	Nos.	2			
v)	Indication lamps used including assemblies. Each type of used	Nos.	10			
vi)	Fuses of each type of used.	Nos.	10			
vii)	Control and instrumentation switch each type of used.	No.	2			
viii)	Contactors of each type of used.	Nos.	2			
ix)	indicating instruments each type of used.	Nos.	2			
x)	Buzzer /siren each type of used.	Nos.	2			
xi)	Timer each type of used.	Nos.	2			
	Sub-Total of Item No. 20.0 (20.1 to 20.11)					
	Total of Schedule-3.1					

(Total Amount in words……..)

Note:

1. The items of Equipment in this Proforma are as per Employer's preliminary Design and as per relevant provisions of specification. The same may be modified/altered to suite Bidder's Planning, Design & Engineering, resulting in economizing cost to the extent possible and quote accordingly. The bidder may include any other items omitted by owner which are required for completeness and satisfactory operation/performance of the project.
2. **Specify currency in accordance with ITB 19**. The quoted prices shall be inclusive of all taxes and duties as per GCC Cl.14.
3. The bidder shall indicate the unit prices in words as well as in figures as stipulated in the table.

Seal/Signature of Bidder: …..……..



3.2 Mandatory Spares supplied from Country other than Bhutan and India

Item No.	Description of Items	Unit	Qty.	Unit Price (EUR) CIP to project site		Total Price (EUR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
1.0	**Spillway Radial Gates with Hydraulic Hoists**					
1.1	Rubber seals including fasteners and clamp plates for radial gates	Set	5			
1.2	Complete sets of bearing/bush and washers with one set comprising of all bearing/bush and washers installed on one trunnion assembly.	Set	5			
1.3	Bush and washers for guide roller assembly of radial gates	Set	5			
1.4	Seals for hydraulic hoist cylinder	Set	10			
1.5	Bearings/bushes for electric motors of hydraulic unit	Set	5			
1.6	Clevis ends bearings of hydraulic unit	Set	10			
1.7	Gaskets (O-rings) for each hydraulic unit.	Set	10			
1.8	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, relays and limit switches, timer /delays for hydraulic hoist	Set	10			
1.9	Filters for radial gate hydraulic hoist	Set	10			
1.1	Control valves, pressure gauge, pressure switches for radial gate for hydraulic unit	Set	5			
1.11	Filters for gasoline engine operated hydraulic unit	Sets	2			
1.12	Control valves, pressure gauge, pressure switches Fuses, auxiliary contactors, push-buttons, indication lamps etc. for gasoline engine operated hydraulic unit	Set	1			
1.13	Bearings/bushes for electric motors of portable oil filter unit	Set	1			
1.14	Filters / papers for portable oil filter unit.	Set	4			

Item No.	Description of Items	Unit	Qty.	Unit Price (EUR) CIP to project site		Total Price (EUR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
1.15	Fuses, auxiliary contactors, push buttons, indication lamps etc. for portable oil filter & Low vacuum dehydration & degasification unit	Set	2			
	Sub-Total of Item No. 1.0 (1.1 to 1.15)					
2.0	**Spillway Stop logs & Gantry Crane**					
2.1	Complete set of rubber seals including fasteners for spillway stop logs	Set	1			
2.2	Brake shoe for different brakes of gantry crane	Set	2			
2.3	Bearings/bushes for gantry crane	Set	1			
2.4	Fuses, auxiliary contactors, push-buttons, indication lamps, switches and limit switches for gantry crane	Set	1			
2.5	Bush/bearings for electric motors for gantry crane	Set	2			
2.6	All types of grease nipples	Set	1			
2.7	Guide Roller Assembly including fasteners	Set	2			
	Sub-Total of Item No. 2.0 (2.1 to 2.6)					
3.0	**Overflow Spillway Service Gates and Motorized Screw Hoists**					
3.1	Rubber seal along with fasteners for Overflow spillway service gate	Set	1			
3.2	Complete wheel assembly for Overflow spillway service gate	Set	1			
3.3	Bearings/bushes for electric motors of screw hoist of Overflow spillway Service gate	Set	1			
3.4	Brake shoes for each type of Hoist brakes for screw Hoist	Set	1			
3.5	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, limit switches and relays for screw hoist for service gate	Set	1			

Item No.	Description of Items	Unit	Qty.	Unit Price (EUR) CIP to project site		Total Price (EUR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
3.6	Control valves, pressure gauge, pressure switches for screw hoist	Sets	1			
	Sub-Total of Item No. 3.0 (3.1 to 3.6)					
4.0	**Trash Rack Cleaning Machine (TRCM)**					
4.1	Detachable stainless steel/high strength, polypropylene sheet combing rake teeth strip with fasteners	Set	1			
4.2	Control relays	Set	1			
4.3	Terminal Switch	Set	1			
4.4	Limit Switch	Set	1			
4.5	Push Button	Set	1			
4.6	Brake linings for each type of brakes	Set	1			
4.7	Motor Carbon brushes	Set	1			
4.8	Fuse elements	Set	2			
4.9	10% of all nuts , bolts & washers	Set	2			
4.10	All types of grease nipples	Set	1			
4.11	Solenoid valves, pressure gauge, pressure switch of each type	Set	1			
4.12	Oil filter	Set	2			
	Sub-Total of Item No. 4.0 (4.1 to 4.12)					
5.0	**Intake Gate and Rope Drum Hoist**					
5.1	Rubber seal along with fasteners for intake gate	Sets	2			
5.2	Complete Wheel assembly for intake gate	Sets	2			
5.3	Bearings for electric motors of rope drum hoist of intake gate	Set	1			
5.4	Brake shoes for rope drum hoist for intake gate	Set	2			
5.5	Bearings/bushes for Rope drum Hoist	Set	1			

Item No.	Description of Items	Unit	Qty.	Unit Price (EUR) CIP to project site		Total Price (EUR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
5.6	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, limit switches and relays for rope drum hoist for intake gate	Set	1			
5.7	Bush and washers of guide roller assembly of intake gate	Sets	2			
	Sub-Total of Item No. 5.0 (5.1 to 5.7)					
6.0	**Intake Bulkhead Gate and Gantry Crane**					
6.1	Rubber seal along with fasteners for intake bulkhead gate	Set	1			
6.2	Brake shoe for different brakes of gantry crane	Set	1			
6.3	Bearings/bushes for gantry crane	Set	1			
6.4	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, limit switches and relays for gantry crane	Set	1			
6.5	Bush/bearings for electric motors for gantry crane	Set	1			
6.6	Bush and washers of guide roller assembly of bulkhead gate	Set	1			
	Sub-Total of Item No. 6.0 (6.1 to 6.6)					
7.0	**Downstream Desilting Basin Gate and EOT/Gantry**					
7.1	Rubber seal along with fasteners for Downstream desilting basin fixed wheel gate	Set	1			
7.2	Complete Wheel assembly for Downstream desilting basin gate	Set	2			
7.3	Bearings/bushes for electric motors of rope drum hoist of Downstream desilting basin Gates	Set	1			
7.4	Brake shoes for each type of Hoist brakes for rope drum Hoist	Set	1			
7.5	Bearings/bushes for Rope drum Hoist	Set	1			

Item No.	Description of Items	Unit	Qty.	Unit Price (EUR) CIP to project site		Total Price (EUR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
7.6	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, limit switches and relays for rope drum hoist for Downstream desilting basin gate	Set	1			
7.7	Bush and washers for guide roller assembly of Downstream desilting chamber gate	Sets	2			
	Sub-Total of Item No. 7.0 (7.1 to 7.7)					
8.0	**Silt Flushing Service Gates & Hydraulic Hoists**					
8.1	Rubber seal along with fasteners for flushing tunnel service gate	Sets	2			
8.2	Hoist cylinder seals	Sets	2			
8.3	Hydraulic hoist motor bushes/bearings	Sets	2			
8.4	Clevis end bearings for hydraulic hoist	Sets	2			
8.5	Gaskets (O-rings) for bonnet covers	Sets	2			
8.6	Sealing for piston rods gland box	Set	2			
8.7	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, relays and limit switches, timer /delays for hydraulic hoist	Sets	2			
8.8	Filters, control valves, pressure gauge and pressure switch of hydraulic power pack	Sets	2			
	Sub-Total of Item No. 8.0 (8.1 to 8.8)					
9.0	**Silt Flushing Emergency Gates & Hydraulic Hoists**					
9.1	Rubber seal along with fasteners for flushing tunnel emergency gate	Sets	2			
9.2	Hoist cylinder seals	Set	1			
9.3	Hydraulic hoist motor bushes/bearings	Set	1			
9.4	Clevis end bearings for hydraulic hoist	Set	1			
9.5	Gaskets (O-rings) for bonnet covers	Sets	2			
9.6	Sealing for piston rods gland box	Set	2			

Item No.	Description of Items	Unit	Qty.	Unit Price (EUR) CIP to project site		Total Price (EUR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
	Sub-Total of Item No. 9.0 (9.1 to 9.6)					
10.0	**Surge Shaft Gate & Rope Drum Hoists**					
10.1	Rubber seal along with fasteners for surge shaft gate	Set	2			
10.2	Bearings for electric motors of rope drum hoist of surge shaft gate	Set	2			
10.3	Brake shoes for each type of Hoist brakes for rope drum Hoist	Set	2			
10.4	Bearings/bushes for Rope drum hoist	Set	2			
10.5	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, limit switches and relays for rope drum hoist for surge shaft gate	Set	1			
	Sub-Total of Item No. 10.0 (10.1 to 10.5)					
11.0	**Tailrace Gates & Gantry Crane**					
11.1	Rubber seal along with fasteners for Tail race gate	Set	1			
11.2	Brake shoe for different brakes of gantry crane	Set	1			
11.3	Bearings/bushes for gantry crane	Set	1			
11.4	Fuses, auxiliary contactors, push-buttons, indication lamps, switches and limit switches for gantry crane	Set	1			
11.5	Bush/bearings for electric motors of gantry crane	Set	1			
11.6	Bush and washers of guide roller assembly of Tail race gate	Set	1			
	Sub-Total of Item No. 11.0 (11.1 to 11.6)					
12.0	**TRT Outfall Gate & Rope Drum Hoists**					
12.1	Rubber seal along with fasteners for TRT outfall gate	Sets	1			
12.2	Complete Wheel assembly for TRT outfall gate	Set	1			
12.3	Bearings for electric motors of rope drum hoist of TRT outfall gate	Set	1			

Item No.	Description of Items	Unit	Qty.	Unit Price (EUR) CIP to project site		Total Price (EUR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
12.4	Brake shoes for each type of Hoist brakes for rope drum Hoist	Set	1			
12.5	Bearings/bushes for Rope drum Hoist	Set	1			
12.6	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, limit switches and relays for rope drum hoist for TRT outfall gate	Set	1			
12.7	Bush and washers of guide roller assembly of TRT outfall gate	Set	2			
	Sub-Total of Item No. 12.0 (12.1 to 12.7)					
13.0	**Adit Gates for HRT Adit No-2 & Adit No-5**					
13.1	Rubber seals assembly along with fasteners etc. for Adit inspection gate.	Set	2			
	Sub-Total of Item No. 13.0 (13.1)					
14.0	**(Schedule 2(i) Part B) Pressure Shaft Steel Liners**					
14.1	Manhole gaskets	Set	6			
	Sub-Total of Item No. 14.0 (14.1)					
15.0	**Chaplangchhu Intake Gate and Motorized screw hoist**					
15.1	Rubber seal along with fasteners for Chaplangchhu Intake gate	Set	1			
15.2	Complete Wheel assembly for Chaplangchhu Intake gate	Set	1			
15.3	Bearings/bush for electric motors of screw hoist	Set	1			
15.4	Brake shoes for each type of Hoist brakes for motorized screw Hoist	Set	1			
15.5	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, limit switches and relays for screw hoist for Chaplangchhu Intake gate	Set	1			

Item No.	Description of Items	Unit	Qty.	Unit Price (EUR) CIP to project site		Total Price (EUR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
15.6	Control valves, pressure gauge, pressure switches for screw hoist	Set	1			
	Sub-Total of Item No. 15.0 (15.1 to 15.6)					
16.0	**Chaplangchhu Desilting Chamber Gate and Motorized screw hoist**					
16.1	Rubber seal along with fasteners for Desilting gate	Set	1			
16.2	Bearings/bush for electric motors of screw hoist	Set	1			
16.3	Brake shoes for each type of Hoist brakes for motorized screw Hoist	Set	1			
16.4	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, limit switches and relays for screw hoist for Chaplangchhu Intake gate	Set	1			
16.5	Control valves, pressure gauge, pressure switches for screw hoist	Set	1			
	Sub-Total of Item No. 16.0 (16.1 to 16.5)					
17.0	**Chaplangchhu Silt Flushing Tunnel Gate and Hydraulic Hoist**					
17.1	Rubber seal along with fasteners for Silt flushing tunnel gate	Set	1			
17.2	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, relays and limit switches, timer /delays for hydraulic hoist	Set	1			
17.3	Filters, control valves, pressure gauge and pressure switch of hydraulic power pack	Set	1			
17.4	Hydraulic hoist motor bushes/bearings	Set	1			
17.5	Hydraulic cylinder seals	Set	1			
17.6	Clevis end bearings for hydraulic hoist	Set	1			
17.7	Gasket (O-rings) for bonnet covers	Set	1			
17.8	Sealing for piston rods gland box	Set	1			
	Sub-Total of Item No. 17.0 (17.1 to 17.8)					

Item No.	Description of Items	Unit	Qty.	Unit Price (EUR) CIP to project site		Total Price (EUR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
18.0	**Chaplangchhu De-gravelling Gate and Hydraulic Hoist**					
18.1	Rubber seal along with fasteners for Gates	Set	1			
18.2	Fuses, auxiliary contactors, push-buttons, indication lamps, switches, relays and limit switches, timer /delays for hydraulic hoist	Set	1			
18.3	Filters, control valves, pressure gauge and pressure switch of hydraulic power pack	Set	1			
18.4	Hydraulic hoist motor bushes/bearings	Set	1			
18.5	Hydraulic cylinder seals	Set	1			
18.6	Clevis end bearings for hydraulic hoist	Set	1			
18.7	Gasket (O-rings) for bonnet covers	Set	1			
18.8	Sealing for piston rods gland box	Set	1			
	Sub-Total of Item No. 18.0 (18.1 to 18.8)					
19.0	**Aquatic Life Discharge Piping with Valves**					
19.1	Stainless steel knife plate for knife-edge gate valve	Sets	2			
19.2	Gland packing for knife-edge gate valve	Sets	2			
19.3	Stainless steel stem for knife-edge gate valve	Sets	2			
19.4	Key for knife-edge gate valve	Sets	2			
19.5	Thrust ring/Thrust bearing	Sets	2			
19.6	Rubber seat ring for knife-edge gate valve	Sets	2			
19.7	Teflon sheet ring for knife-edge gate valve	Sets	2			
19.8	Fuse for valve control panel.	Sets	2			
	Sub-Total of Item No. 19.0 (19.1 to 19.8)					
20.0	**Instrumentation**					
20.1	Each type of contacts	Nos.	10			
20.2	Each set of fuse elements	Nos.	10			
20.3	Position transmitter for spillway radial gates	Sets	3			

Item No.	Description of Items	Unit	Qty.	Unit Price (EUR) CIP to project site		Total Price (EUR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
20.4	Position transmitter for intake gate	Sets	2			
20.5	Position transmitter for silt flushing gates	Sets	2			
20.6	Digital position indicator for spillway radial gates	Sets	3			
20.7	Digital position indicator for intake gate	Sets	2			
20.8	Digital position indicator for silt flushing gate	Sets	2			
20.9	Differential pressure instrument for trash rack	Sets	2			
20.10	Gravel Level sensors and Transmitter for Chaplangchhu diversion Scheme	Sets	2			
20.11	**Individual Distribution Panel**					
i)	MCCB of each type of used.	Nos.	2			
ii)	MCB of each type of used.	Nos.	2			
iii)	Current transformer Each type of used	Nos.	2			
iv)	Voltmeter Each type of used	Nos.	2			
v)	Indication lamps used including assemblies. Each type of used	Nos.	10			
vi)	Fuses of each type of used.	Nos.	10			
vii)	Control and instrumentation switch each type of used.	No.	2			
viii)	Contactors of each type of used.	Nos.	2			
ix)	indicating instruments each type of used.	Nos.	2			
x)	Buzzer /siren each type of used.	Nos.	2			
xi)	Timer each type of used.	Nos.	2			
	Sub-Total of Item No. 20.0 (20.1 to 20.11)					
	Total of Schedule-3.1					

(Total Amount in words……..)

Note:

1. The items of Equipment in this Proforma are as per Employer's preliminary Design and as per relevant provisions of specification. The same may be modified/altered to suite Bidder's Planning, Design & Engineering, resulting in economizing cost to the extent possible and quote accordingly. The bidder may include any other items omitted by owner which are required for completeness and satisfactory operation/performance of the project.
2. **Specify currency in accordance with ITB 19**. The quoted prices shall be inclusive of all taxes and duties as per GCC Cl.14.
3. The bidder shall indicate the unit prices in words as well as in figures as stipulated in the table.

Seal/Signature of Bidder: …..……..



PRICE SCHEDULE-4

4.1 O&M Spares supplied from Bhutan and India

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR) CIP to project site		Total Price (BTN/INR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
1.0	**Two Sets and Each Set comprising of following items/ instruments/ equipment**					
1.1	Torque wrench (0-150 inch pounds) 3/8 inch square drive with socket of size 6-30mm.	Nos.	2			
1.2	Pipe wrench 12, 14, 18 & 24 inches)	Nos.	2			
1.3	3/8 inch to 1/2 inch square drive reducer.	Nos.	2			
1.4	Screw driver socket 1/2 inch square drive	Nos.	2			
1.5	Sockets 1/2 inch square drive (8-24 mm)	Sets	2			
1.6	Extensions 1/2 inch square drive					
i)	2 inches	Nos.	2			
ii)	5 inches	Nos.	2			
1.7	Combination wrench one end ring and one end open (6-30 mm)	Sets	2			
1.8	Screw drivers					
i)	4 inches	Nos.	2			
ii)	6 inches	Nos.	2			
iii)	8 inches	Nos.	2			
iv)	12 inches	Nos.	2			
v)	15 inches	Nos.	2			
1.9	Feeler gauge 4 inches long consisting of many strips	Nos.	2			
1.10	Nose pliers – 150 mm	Nos.	2			
1.11	Circlip removing pliers 200mm	Nos.	2			
1.12	Combination pliers 200 mm	Nos.	2			
1.13	Cutting Pliers	Nos.	2			
1.14	Heavy duty insulated pliers	Nos.	2			
1.15	Tweezers (small)	Nos.	2			
1.16	Plastic hammer (15, 21 & 30 mm)	Sets	2			

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR) CIP to project site		Total Price (BTN/INR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
1.17	Half-moon spanner 3/8 inch x 5/8 inch	Nos.	2			
1.18	Allen key set (1.5 - 20 mm)	Sets	2			
1.19	Ball-peen Hammer 2 lb.	Nos.	2			
1.20	Hammer 5 lb.	Nos.	2			
1.21	Mallet (Wooden Hammer)	Set	2			
1.22	D.E. spanner set 6mm to 32 mm	Set	2			
1.23	Ring spanner set 6 mm to 32 mm	Set	2			
1.24	Box spanner with handle	Nos.	2			
1.25	Adjustable spanner 12 inches	Nos.	2			
1.26	Adjustable spanner 6 inches	Nos.	2			
1.27	Socket spanner set 8 mm to 32 mm	Set	2			
1.28	Lineman's pliers 8 inch	Nos.	2			
1.29	Spirit level	Nos.	2			
1.30	Soldering iron **15W**	Nos.	2			
1.31	Wire stripper cum crimpling tool	Nos.	2			
	Sub-Total of 1 (1.1 to 1.31)					
	Remark: *All items 1.1 to 1.31, shall be of Taparia / Jhalani / Cutler hammer/ any other make only after approval of concerned authority.*					
2.0	**One set comprising of following items / instruments / equipment**					
2.1	Digital clamp meter 500V AC/DC, 20Amp AC/DC including Continuity tester and line tester	Nos.	1			
2.2	D Shackle 1t capacity	Nos.	1			
2.3	D Shackle 2t capacity	Nos.	1			
2.4	Chain Pulley block 2t capacity	Nos.	1			
2.5	Chain Pulley block 5t capacity	Nos.	1			
2.6	Bearing puller	Nos.	1			

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR) CIP to project site		Total Price (BTN/INR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
	Sub-Total of 2 (2.1 to 2.6)					
	Remark: *Item 2.1 shall be of Fluke / MECO / any other make only and Items 2.2 to 2.5 shall be of INDEF / any other make and Item 2.6 shall be of SKF/ any other make to be approved by concerned Authority.*					
3.0	**Tool boxes for above Item No. 1.0 & 2.0 shall be of good quality**	Nos.	2			
	Total of Schedule-4.1 (1.0 to 3.0)					

(Total Amount in words……..)

Note:

1. The items of Equipment in this Proforma are as per Employer's preliminary Design and as per relevant provisions of specification. The same may be modified/altered to suite Bidder's Planning, Design & Engineering, resulting in economizing cost to the extent possible and quote accordingly. The bidder may include any other items omitted by owner which are required for completeness and satisfactory operation/performance of the project.
2. **Specify currency in accordance with ITB 19**. The quoted prices shall be inclusive of all taxes and duties as per GCC Cl.14.
3. The bidder shall indicate the unit prices in words as well as in figures as stipulated in the table.

Seal/Signature of Bidder: …..……..

4.2 O&M Spares supplied from Country other than Bhutan and India

Item No.	Description of Items	Unit	Qty.	Unit Price (EUR) CIP to project site		Total Price (EUR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
1.0	**Two Sets and Each Set comprising of following items/ instruments/ equipment**					
1.1	Torque wrench (0-150 inch pounds) 3/8 inch square drive with socket of size 6-30mm.	Nos.	2			
1.2	Pipe wrench 12, 14, 18 & 24 inches)	Nos.	2			
1.3	3/8 inch to 1/2 inch square drive reducer.	Nos.	2			
1.4	Screw driver socket 1/2 inch square drive	Nos.	2			
1.5	Sockets 1/2 inch square drive (8-24 mm)	Sets	2			
1.6	Extensions 1/2 inch square drive					
i)	2 inches	Nos.	2			
ii)	5 inches	Nos.	2			
1.7	Combination wrench one end ring and one end open (6-30 mm)	Sets	2			
1.8	Screw drivers					
i)	4 inches	Nos.	2			
ii)	6 inches	Nos.	2			
iii)	8 inches	Nos.	2			
iv)	12 inches	Nos.	2			
v)	15 inches	Nos.	2			
1.9	Feeler gauge 4 inches long consisting of many strips	Nos.	2			
1.10	Nose pliers – 150 mm	Nos.	2			
1.11	Circlip removing pliers 200mm	Nos.	2			
1.12	Combination pliers 200 mm	Nos.	2			
1.13	Cutting Pliers	Nos.	2			
1.14	Heavy duty insulated pliers	Nos.	2			
1.15	Tweezers (small)	Nos.	2			
1.16	Plastic hammer (15, 21 & 30 mm)	Sets	2			
1.17	Half-moon spanner 3/8 inch x 5/8 inch	Nos.	2			

Item No.	Description of Items	Unit	Qty.	Unit Price (EUR) CIP to project site (In figures)	Unit Price (EUR) CIP to project site (In Words)	Total Price (EUR)
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
1.18	Allen key set (1.5 - 20 mm)	Sets	2			
1.19	Ball-peen Hammer 2 lb.	Nos.	2			
1.20	Hammer 5 lb.	Nos.	2			
1.21	Mallet (Wooden Hammer)	Set	2			
1.22	D.E. spanner set 6mm to 32 mm	Set	2			
1.23	Ring spanner set 6 mm to 32 mm	Set	2			
1.24	Box spanner with handle	Nos.	2			
1.25	Adjustable spanner 12 inches	Nos.	2			
1.26	Adjustable spanner 6 inches	Nos.	2			
1.27	Socket spanner set 8 mm to 32 mm	Set	2			
1.28	Lineman's pliers 8 inch	Nos.	2			
1.29	Spirit level	Nos.	2			
1.30	Soldering iron **15W**	Nos.	2			
1.31	Wire stripper cum crimpling tool	Nos.	2			
	Sub-Total of 1 (1.1 to 1.31)					
	Remark: *All items 1.1 to 1.31, shall be of Taparia / Jhalani / Cutler hammer/ any other make only after approval of concerned authority.*					
2.0	**One set comprising of following items / instruments / equipment**					
2.1	Digital clamp meter 500V AC/DC, 20Amp AC/DC including Continuity tester and line tester	Nos.	1			
2.2	D Shackle 1t capacity	Nos.	1			
2.3	D Shackle 2t capacity	Nos.	1			
2.4	Chain Pulley block 2t capacity	Nos.	1			
2.5	Chain Pulley block 5t capacity	Nos.	1			
2.6	Bearing puller	Nos.	1			
	Sub-Total of 2 (2.1 to 2.6)					

Item No.	Description of Items	Unit	Qty.	Unit Price (EUR) CIP to project site		Total Price (EUR)
				(In figures)	(In Words)	
(1)	(2)	(3)	(4)	(5)	(6)	(7=4x5)
	Remark: *Item 2.1 shall be of Fluke / MECO / any other make only and Items 2.2 to 2.5 shall be of INDEF / any other make and Item 2.6 shall be of SKF/ any other make to be approved by concerned Authority.*					
3.0	**Tool boxes for above Item No. 1.0 & 2.0 shall be of good quality**	Nos.	2			
	Total of Schedule-4.1 (1.0 to 3.0)					

(Total Amount in words……..)

Note:

1. The items of Equipment in this Proforma are as per Employer's preliminary Design and as per relevant provisions of specification. The same may be modified/altered to suite Bidder's Planning, Design & Engineering, resulting in economizing cost to the extent possible and quote accordingly. The bidder may include any other items omitted by owner which are required for completeness and satisfactory operation/performance of the project.
2. **Specify currency in accordance with ITB 19**. The quoted prices shall be inclusive of all taxes and duties as per GCC Cl.14.
3. The bidder shall indicate the unit prices in words as well as in figures as stipulated in the table.

Seal/Signature of Bidder: …..……..



PRICE SCHEDULE-5

5.1 INSTALLATION, TESTING, COMMISSIONING (INCLUSIVE OF LOADING, TRANSPORTATION FROM SITE STORE TO PLACE OF INSTALLATION, UNLOADING), INSURANCE AND SITE STORAGE

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR)			Total Price (BTN/INR)
				Erection, Testing and Commissioning Charges	Insurance Charges during Storage, Erection, Testing & Commissioning	Charges for Site Storage, loading, Unloading and Transportation from store to place of Installation	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	8=4x(5+6+7)
1.0	**Spillway Radial Gates with Hydraulic Hoist**						
1.1	Submerged Radial Gates (6.80 m x 12.9m opening size) complete in all respect including 3mm Stainless Steel cladding (AISI 304) on skin plate, girders, arms, trunnions, guide rollers etc.	Nos.	5				
1.2	First Stage Embedded Parts for item no. 1.1	Set	5				
1.3	Second Stage Embedded Parts including sill beam, wall plates, steel liners for Spillway crest/ glacis, bottom of breast wall & side wall/pier, hoist supporting structure, trunnion brackets, dogging etc. for item no. 1.1	Set	5				
1.4	Hydraulic cylinders of capacity not less than 180T for radial gate operation complete in all respect incl. suitable arrangement for gate position indication	Nos.	10				
1.5	Hydraulic Power pack for gate operation complete in all respect including Piping, Electrical Control Panels with and position indicator etc.	Set	5				
1.6	Gasoline engine operated portable power pack unit for hoist cylinder complete in all respect	Set	1				

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR)			Total Price (BTN/INR)
				Erection, Testing and Commissioning Charges	Insurance Charges during Storage, Erection, Testing & Commissioning	Charges for Site Storage, loading, Unloading and Transportation from store to place of Installation	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	8=4x(5+6+7)
1.7	Oil Filtering Unit complete in all respect for online filtering of power pack hydraulic oil along with contamination checking kit	Set	1				
1.8	Low Vacuum dehydration & degasification Unit	Set	1				
	Sub-Total of 1 (1.1 to 1.8)						
2.0	**Spillway Stop logs & Gantry Crane**						
2.1	Stoplog Gates (Slide type), 8 units	Set	1				
2.2	First Stage Embedded Parts for Item no. 2.1	Set	5				
2.3	Second Stage Embedded Parts including dogging arrangement and provision for air water jet cleaning system for item no. 2.1	Set	5				
2.4	Embedded parts for Stoplog storage groove including dogging arrangement and suitable steel cover/gratings etc.	Set	3				
2.5	Air vent pipe 300 dia.	Set	5				
2.6	Lifting Beam including probe mechanism	Set	1				
2.7	Gantry Crane of capacity not less than 45T, complete in all respect including cable reeling drum, Rails and fixtures etc.	Set	1				
	Sub-Total of 2 (2.1 to 2.7)						
3.0	**Overflow Spillway Service Gates and Motorized Screw hoist**						
3.1	Overflow Spillway Service Gate (4.0 x 5.0 - Fixed wheel type)	No.	1				
3.2	First Stage Embedded Parts for item no. 3.1	Set	1				
3.3	Second Stage Embedded Parts including dogging devices etc. for item no. 3.1	Set	1				

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR)			Total Price (BTN/INR)
				Erection, Testing and Commissioning Charges	Insurance Charges during Storage, Erection, Testing & Commissioning	Charges for Site Storage, loading, Unloading and Transportation from store to place of Installation	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	8=4x(5+6+7)
3.4	Motorized screw hoist of not less than 15MT capacity including hoist support structure for operation of spillway overflow gate complete in all respect and control equipment	Set	1				
	Sub-Total of 3 (3.1 to 3.4)						
4.0	**Overflow Spillway Emergency Gate and Motorized Screw hoist**						
4.1	Overflow Spillway Emergency Gate (4.0m x 5.0m Slide type)	No.	1				
4.2	First Stage Embedded Parts for item no. 4.1	Set	1				
4.3	Second Stage Embedded Parts including dogging devices etc. for item no. 4.1	Set	1				
4.4	Motorized screw hoist of not less than 15MT capacity including hoist support structure for operation of spillway overflow gate complete in all respect and control equipment	Set	1				
4.5	Common Hoist support structure & Trestle etc. for overflow service gate & emergency gate for item no. 3.1 and 4.1	Set	1				
	Sub-Total of 4 (4.1 to 4.5)						
5.0	**HRT Intake Trash Rack**						
5.1	Trash racks for complete intake openings comprising suitable nos. trash rack panels with and sizes. Three (3) vents for each of the Two (2) intakes.	Set	2				
5.2	First stage Embedded parts for item no 5.1	Set	2				
5.3	Second stage embedded parts including guide and bottom base etc. for item no. 5.1	Set	2				

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR)			Total Price (BTN/INR)
				Erection, Testing and Commissioning Charges	Insurance Charges during Storage, Erection, Testing & Commissioning	Charges for Site Storage, loading, Unloading and Transportation from store to place of Installation	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	8=4x(5+6+7)
	Sub-Total of 5 (5.1 to 5.3)						
6.0	**Trash Rack Cleaning Machine (TRCM) and Disposal Vehicle Tripper**						
6.1	TRCM complete in all respect along with rail, bucket, control devices, grapple device, cable reeling drum along with tools kits.	Set	1				
6.2	Prime mover operated self-unloading trash disposal vehicle Tipper type [Volume 3.5 m3(min) and capacity 5MT (min)]	Sets	2				
	Sub-Total of 6 (6.1 to 6.2)						
7.0	**HRT Intake Gate and Rope Drum Hoist**						
7.1	Intake gate (4.25 x 4.7 - Fixed wheel Gate)	Set	2				
7.2	First Stage Embedded Parts for item no. 7.1	Set	2				
7.3	Second Stage Embedded Parts including dogging, provision for air water jet cleaning system etc. for item no.7.1	Set	2				
7.4	Air Vent Pipe 300 dia.	Set	2				
7.5	Rope Drum Hoist of capacity not less than 40T, complete in all respect including hoist support structure and control equipment for item no. 7.1	Set	2				
	Sub-Total of 7 (7.1 to 7.5)						
8.0	**Intake Bulkhead Gate and Gantry Crane**						
8.1	Intake Bulkhead Gate (4.25 x 4.7 - Slide type)	No.	1				
8.2	First Stage Embedded Parts for item no. 8.1	Set	2				
8.4	Second Stage Embedded Parts including dogging etc. for item no. 8.1	Set	2				

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR)			Total Price (BTN/INR)
				Erection, Testing and Commissioning Charges	Insurance Charges during Storage, Erection, Testing & Commissioning	Charges for Site Storage, loading, Unloading and Transportation from store to place of Installation	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	8=4x(5+6+7)
8.5	Lifting Beam (Automatic engaging/disengaging type)	Set	1				
8.6	Gantry Crane of Capacity not less than 35T, complete in all respect including cable reeling drum, Rails and fixtures	Set	1				
	Sub-Total of 8 (8.1 to 8.6)						
9.0	**Downstream Desilting Chamber Gate and Rope Drum Hoists**						
9.1	Downstream desilting chamber Gate (4.7m x 4.7m-Fixed wheel type)	Set	2				
9.2	First Stage Embedded Parts for Item no.9.1	Set	2				
9.3	Air vent pipe 300 dia.	Set	2				
9.4	Second Stage Embedded Parts including dogging devices etc. for item no. 9.1	Set	2				
9.5	Rope Drum Hoist of capacity not less than 35T, complete in all respect including hoist support structure and control equipment.	Set	2				
	Sub-Total of 9 (9.1 to 9.5)						
10.0	**Silt Flushing Service Gates & Hydraulic Hoists**						
10.1	Silt Flushing Tunnel Service Gate	Set	2				
10.2	Steel liners including stiffeners and anchorage, gate embedded parts, guides etc. for Service gates.	Set	2				
10.3	Hydraulic Hoists (double acting) for Service Gates of capacity not less than 150T/120T	Set	2				
10.4	Hoist supporting structure and dogging arrangement incl. bonnet, bonnet covers etc. for Service Gates	Set	2				

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR)			Total Price (BTN/INR)
				Erection, Testing and Commissioning Charges	Insurance Charges during Storage, Erection, Testing & Commissioning	Charges for Site Storage, loading, Unloading and Transportation from store to place of Installation	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	8=4x(5+6+7)
10.5	Air vent pipe (500mm dia.)	Set	2				
	Sub-Total of 10 (10.1 to 10.5)						
11.0	**Silt Flushing Emergency Gates & Hydraulic Hoists**						
11.1	Silt Flushing Tunnel Emergency Gate	Set	2				
11.2	Steel liners including stiffeners and anchorage, gate embedded parts, guides etc. for Emergency gates.	Set	2				
11.3	Hydraulic Hoists (double acting) for Emergency Gates of capacity not less than 150T/120T	Set	2				
11.4	Hoist supporting structure and dogging arrangement incl. bonnet, bonnet covers etc. for Emergency Gates	Set	2				
11.5	Common Hydraulic Power Pack for SFT Service and Emergency Gates (One set for each tunnel) complete in all respect including piping, electrical control panels with and position indicator	Set	2				
	Sub-Total of 11 (11.1 to 11.5)						
12.0	**Surge Shaft Gate & Rope Drum Hoists**						
12.1	Surge Shaft Gate (2.75 x 5.22 – Slide type)	Nos.	2				
12.2	First Stage Embedded Parts for item no. 12.1	Set	2				
12.3	Air vent Pipe 300 dia.	Set	2				
12.4	Second Stage Embedded Parts including dogging arrangement etc. for item no. 12.1	Set	2				
12.5	Rope Drum Hoist complete of capacity not less than 70 T, complete in all respect including hoist	Set	2				

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR)			Total Price (BTN/INR)
				Erection, Testing and Commissioning Charges	Insurance Charges during Storage, Erection, Testing & Commissioning	Charges for Site Storage, loading, Unloading and Transportation from store to place of Installation	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	8=4x(5+6+7)
	support structure and control equipment for item no 12.1						
	Sub-Total of 12 (12.1 to 12.5)						
13.0	**Tailrace Gates & Gantry Crane**						
13.1	Tailrace gate (4.0 x 4.5 m - Wheel type)	Nos.	1				
13.2	First Stage Embedded Parts for Item no. 13.1	Set	1				
13.3	Air Vent pipe 300 dia.	Set	1				
13.4	Second Stage Embedded Parts including dogging etc. for item no.1	Set	1				
13.5	Lifting beam (Automatic engaging/disengaging type)	Set	1				
13.6	Gantry Crane of capacity not less than 20T, complete in all respect including cable reeling drum, Rails and fixtures	Set	1				
	Sub-Total of 13 (13.1 to 13.6)						
14.0	**TRT Outfall Gate & Rope Drum Hoists**						
14.1	TRT outfall Gate (6.5 x 6.5 m - Wheel type)	Nos.	1				
14.2	First Stage Embedded Parts for item no. 14.1	Set	1				
14.3	Second Stage Embedded Parts including dogging etc. for item no.14.1	Set	1				
14.4	Rope Drum Hoist of capacity no less than 60T, complete in all respect including hoist support structure and control equipment for item no. 14.1	Set	1				
	Sub-Total of 14 (14.1 to 14.4)						
15.0	**Adit Gates for HRT Adit No-2 & Adit No-5**						

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR)			Total Price (BTN/INR)
				Erection, Testing and Commissioning Charges	Insurance Charges during Storage, Erection, Testing & Commissioning	Charges for Site Storage, loading, Unloading and Transportation from store to place of Installation	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	8=4x(5+6+7)
15.1	Adit Gate size 2.5 m wide x 2.5 m high	Nos.	2				
15.2	First Stage Embedded Parts for 15.1	Set	2				
15.3	Second Stage Embedded Parts for 15.1 including dewatering pipe and valves	Set	2				
15.4	Two Gate Valve and Pressure Gauge with piping	Set	1				
	Sub-Total of 15 (15.1 to 15.4)						
16.0	**Chaplangchhu Trash Screen & Its Embedded Parts**						
16.1	Horizontal Trash screens	Set	1				
16.2	Embedded frame for trash screens	Set	1				
	Sub-Total of 16 (16.1 to 16.2)						
17.0	**Chaplangchhu Intake Gate and Motorized Screw Hoist**						
17.1	Chaplangchhu Intake Gate (2.0 m x 2.5 m - Fixed wheel type)	Set	1				
17.2	First Stage Embedded Parts for item no. 18.1	Set	1				
17.3	Second Stage Embedded Parts including dogging devices etc. for item no. 18.1	Set	1				
17.4	Motorized screw hoist of adequate capacity including hoist support structure complete in all respect and control equipment	Set	1				
	Sub-Total of 17 (17.1 to 17.4)						
18.0	**Chaplangchhu Desilting chamber Outlet Gate and Hoist**						
18.1	Desilting Chamber Gate (1..8m x 2.1m -Slide type)	Set	1				
18.2	First Stage Embedded Parts for item no. 19.1	Set	1				

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR)			Total Price (BTN/INR)
				Erection, Testing and Commissioning Charges	Insurance Charges during Storage, Erection, Testing & Commissioning	Charges for Site Storage, loading, Unloading and Transportation from store to place of Installation	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	8=4x(5+6+7)
18.3	Second Stage Embedded Parts including dogging devices etc. for item no. 19.1	Set	1				
18.4	Motorized screw hoist of adequate capacity including hoist support structure complete in all respect and control equipment	Set	1				
	Sub-Total of 18 (18.1 to 18.4)						
19.0	**Mechanical Fine Screen and Cleaning Machine**						
19.1	Fine Screen for Chapplangchhu Desilting outlet opening u/s of desilting basin outlet gate comprising of suitable nos. of panels and sizes complete in all respect as per Technical Specifications and approved drawings	Set	2				
19.2	Embedded Parts	Set	2				
19.3	Fine Screen Cleaning Machine	Set	1				
	Sub-Total of 19 (19.1 to 19.3)						
20.0	**Chaplangchhu Silt Flushing Tunnel (SFT) Gate and Hydraulic Hoist**						
20.1	SFT Gates (0.6 m x 0.6 m- Slide type)	Set	1				
20.2	First Stage Embedded Parts for Item no. 21.1	Set	1				
20.3	Second Stage Embedded Parts including dogging devices etc. for item no. 21.1	Set	1				
20.4	Hoist supporting structure, and dogging arrangement for SFT gate	Set	1				
20.5	Hydraulic Hoists (double acting) of capacity not less than 10T/8T complete in all respect along with arrangement for gate position indication.	Set	1				
20.6	Hydraulic Power pack complete in all respect including Electrical Control, piping etc.	Set	1				

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR)			Total Price (BTN/INR)
				Erection, Testing and Commissioning Charges	Insurance Charges during Storage, Erection, Testing & Commissioning	Charges for Site Storage, loading, Unloading and Transportation from store to place of Installation	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	8=4x(5+6+7)
	Sub-Total of 20 (20.1 to 20.6)						
21.0	**Chaplangchhu De-gravelling Gate and Hoist**						
21.1	De-gravelling gate (2.0 m x 2.0 m (Slide type)	Set	1				
21.2	First Stage Embedded Parts for Item no. 21.1	Set	1				
21.3	Second Stage Embedded Parts including dogging devices etc. for item no. 22.1	Set	1				
21.4	Hoist supporting structure, and dogging arrangement for De-graveling gate	Set	1				
21.5	Hydraulic Hoists (double acting) of capacity not less than 10T/8T complete in all respect along with arrangement for gate position indication	Set	1				
21.6	Hydraulic Power pack complete in all respect including Electrical Control, piping etc.	Set	1				
	Sub-Total of 21 (21.1 to 21.6)						
22.0	**Aquatic Life Discharge Piping with Valves**						
22.1	600mm dia. Stainless steel pipe of not less than 15mm thickness, pipe bends, transition piece, flange connections, dismantling joint etc. complete with all other accessories and appurtenance	Set	2				
22.2	Electro mechanically actuated Knife edge gate valves (2 services and 2 emergency) suitable for 600mm dia. stainless steel pipe complete with all respect including control equipment	Set	4				
	Sub-Total of 22 (22.1 to 22.2)						
23.0	**Instrumentation and Remote Control System**						

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR)			Total Price (BTN/INR)
				Erection, Testing and Commissioning Charges	Insurance Charges during Storage, Erection, Testing & Commissioning	Charges for Site Storage, loading, Unloading and Transportation from store to place of Installation	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	8=4x(5+6+7)
23.1	Remote Control and Automatic Control System in Dam control room with provision for remote control operation from Powerhouse Control room complete in all respects as described in GTS/PTS	Set	1				
23.2	Following instruments shall also be provided at their respective locations complete in all respect.						
i)	Water level measuring system at dam area spillway gates.	Sets	5				
ii)	Water level measurement system to indicate balance head condition of Intake gates.	Sets	2				
iii)	Head loss equipment for intake gates	Sets	2				
iv)	Water level measuring system to indicate balance head condition of desilting basin downstream gates.	Sets	2				
v)	Water level measuring system to indicate balance head condition of surge shaft gates	Sets	2				
vi)	Water level measurement system to indicate balance head condition of Tail race tunnel gates	Sets	4				
vii)	Water level measurement system to indicate balance head condition of TRT outfall gate	Set	1				
viii)	Gravel Level Sensors/Transmitter for Chaplangchhu Diversion Scheme.	Set	2				
23.3	Individual Distribution board & feeder pillar for all HM equipment complete in all respect as described in GTS/PTS	Set	1				

Item No.	Description of Items	Unit	Qty.	Unit Price (BTN/INR)			Total Price (BTN/INR)
				Erection, Testing and Commissioning Charges	Insurance Charges during Storage, Erection, Testing & Commissioning	Charges for Site Storage, loading, Unloading and Transportation from store to place of Installation	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	8=4x(5+6+7)
	Sub-Total of 23 (23.1 to 23.3)						
24.0	Any other items/systems not mentioned above but required for completeness of the scope of entire work and satisfactory performance /operation of the project.						
	Total (1.0 to 24.0) of Price Schedule-5						

(Total Amount in words……..)

Seal/Signature of Bidder……..

PRICE SCHEDULE–6

RECOMMENDED SPARE PARTS AND TOOLS & INSTRUMENTS

Item No.	Description	Unit	Qty.	Ex-Works Price inclusive of packing & forwarding charges Unit Rate (BTN/INR) or (EUR)	Total Ex-Works Price inclusive of packing & forwarding charges (BTN/INR) or (EUR)	Transportation Charges and inland Insurance charges upto Project Site including handling, storage & preservation and Insurance charges upto Defect Notification Period (BTN/INR) or (EUR)	Applicable Taxes/Duties/ Levies (BTN/INR) or (EUR)
1	2	3	4	5	6=4x5	7	8
TOTAL							

Total Amount in words……..)

Note:

1. The purchase of recommended Spares, Tools and Instruments etc. required during the O&M shall be exclusively at Purchaser's option.
2. List & item wise prices of the recommended spares, tools, tackles & testing equipment etc. shall be given by the bidder.
3. The Bidder shall indicate the prices in words as well as in figures.
4. This Price Schedule shall not be considered in Bid evaluation

Seal/Signature of Bidder……..

KHORLOCHHU HYDRO POWER LIMITED

4x150 MW KHORLOCHHU HYDROPOWER PROJECT

TRASHIYANGTSE; BHUTAN

BIDDING DOCUMENT

FOR

CONTRACT PACKAGE: KHM

DESIGN, MANUFACTURING, SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF HYDRO-MECHANICAL WORKS

VOLUME - 4

GENERAL TECHNICAL SPECIFICATIONS, PARTICULAR TECHNICAL SPECIFICATIONS AND QUALITY ASSURANCE PLAN

International Competitive Bidding

These documents are meant for the exclusive purpose of bidding against this NIT and shall not be transferred, reproduced or otherwise used for purposes other than that for which they are specifically issued.

Tender Ref. No. KHPL/C&PD/TENDER:KHM/2025/11534 dt. 07.08.2025

LAYOUT OF BIDDING DOCUMENTS

CONTRACT PACKAGE: KHM

Design, Manufacturing, Supply, Installation, Testing and Commissioning of Hydro-Mechanical Works

Volume - 1: **Instructions to Bidders (ITB)**

- **Section - 1** Abridged Notice Inviting Tender and Notice Inviting Tender (NIT)
- **Section - 2** Instructions to Bidders (ITB), Bid Data, Qualification Forms, Information for Bidders (IFB) and Work Schedule

Volume - 2: **General Conditions of Contract (GCC) and Particular Conditions of Contract (PCC)**

- Section - 3 FIDIC General Conditions of Contract (GCC) for Plant and Design-Build Contract (First Edition 1999)
- Section - 4 Particular Conditions of Contract (PCC)
- Section - 5 Forms and Procedures
  - Form-1: Letter of Tender
  - Form-2: Form of Contract Agreement
  - Form-3: Bank Guarantee Form for Performance Security
  - Form-4: Bank Guarantee Form for Advance Payment
  - Form-5: Form of Taking Over Certificate
  - Form-6: Bank Guarantee Form for Release of Retention Money
  - Form-7: Hindrance Register
  - Form-8: Dispute Adjudication Agreement
  - Form-9: Parent/Holding Company Agreement
  - **Form-10: Proforma for Joint Deed of Undertaking**

Volume-3: **Price Schedules**

Volume-4: **Employer's Requirements**

- Section - 6 General Technical Specifications (GTS)
- Section - 7 Particular Technical Specifications (PTS)
- Section - 8 Quality Assurance Plan (QAP)

Volume-5: **Tender Drawings**

Volume-6: **Technical Data Sheets**



TABLE OF CONTENTS

SECTION - 6 1
SECTION-6: GENERAL TECHNICAL SPECIFICATIONS 1
1. GENERAL DESCRIPTION 1
2. STANDARDS 13
3. TECHNICAL DOCUMENTS 24
4. SPARE PARTS AND TOOLS 34
5. DESIGN AND MANUFACTURE 35
6. FABRICATION 51
7. ELECTRICAL WORKS 60
8. TRANSPORT, PACKAGING AND STORAGE 71
9. INSPECTION AND TESTS 72
10. TRAINING OF EMPLOYER'S PERSONNEL 84
11. QUALITY CONTROL AND ASSURANCE 86
12. COMPLETENESS OF SYSTEM/EQUIPMENT/ITEMS 87
SECTION-7: PARTICULAR TECHNICAL SPECIFICATION 89
13. GENERAL 89
14. SPILLWAY RADIAL GATES AND HYDRAULIC HOISTS 89
15. SPILLWAY STOP LOGS AND GANTRY CRANE 96
16. OVERFLOW SPILLWAY SERVICE GATE AND HOIST 103
17. POWER INTAKE TRASH RACK, TRCM, INTAKE GATE, INTAKE BULKHEAD GATES, HOISTS AND GANTRY CRANE 106
18. DOWNSTREAM DESILTING CHAMBER GATE & ROPE DRUM HOISTS 121
19. SILT FLUSHING TUNNEL GATES AND HYDRAULIC HOISTS 125
20. SURGE SHAFT GATES & HOISTS 129
21. TAILRACE TUNNEL GATES & GANTRY CRANE 133
22. TRT OUTFALL GATE AND HOIST 139
23. ADIT INSPECTION GATES 142
24. PRESSURE SHAFT LINERS/PENSTOCK AND STEEL LINER IN HRT 143
25. CHAPLANGCHHU DIVERSION WORKS 150
26. AQUATIC LIFE DISCHARGE PIPING WITH VALVES 162
27. INSTRUMENTATION AND REMOTE-CONTROL SYSTEM 164
28. LOCAL CONTROL SYSTEMS 174
29. SPARE PARTS 175
30. DATA SHEETS 181
SECTION-8: QUALITY ASSURANCE PLAN 183



SECTION - 6

GENERAL TECHNICAL SPECIFICATION

(GTS)



SECTION-6: GENERAL TECHNICAL SPECIFICATIONS

1. GENERAL DESCRIPTION

1.1 Introduction

Khorlochhu HPP located in Trashiyangtse district of Bhutan envisages construction of 165m long and 95 m high concrete gravity Dam (above deepest foundation level), for diverting the river Khorlochhu through 2 number intake structures located on right bank, 2 numbers 350m long D-shaped desilting chambers, silt flushing tunnels, one 5.7m dia. and 15.77km long horse shoe shaped head race tunnel, 9.5m dia. and 162.80m high surge shaft, 2 numbers 1.535 Km long 3.3m dia. Steel lined pressure shaft/penstocks and 4 numbers 2.35m dia. penstocks feeding 4 numbers generating units each of 150MW in a underground powerhouse and 6.0 m dia. D-shape tailrace tunnel.

1.1.1 Location and Communication

The Khorlochhu HPP located in Trashiyangtse district of Bhutan, about 234 Km from Samdrup Jongkhar, the border town of Bhutan, which is about 110 Km from Guwahati, Assam. The Dam site is located near Buyang, 13 km downstream of Chorten Kora, Trashiyangtse Dzongkhag and the Powerhouse is located on the right bank of Drangmechhu (Gongrichhu) at Tshergom.

The approximate distance of Project dam site from different important towns is as below:

Guwahati to Samdrup Jongkhar/Daranga	= 110 Km
Samdrup Jongkhar to Trashigang	= 180 Km
Trashigang to Chazam	= 14 Km
Chazam to Powerhouse Location	= 10 Km
Chazam to Doksum	= 15 Km
Doksum to Dam Site Location	= 17 Km
Doksum to Trashiyangtse	= 30 Km

The nearest broad gauge railway station is Rangia (Assam), India from Powerhouse site. The nearest airport is at Guwahati (India).

1.1.2 Project Layout

Khorlochhu HPP, is a run of the river scheme with limited storage capacity for power generation on river Khorlochhu utilizing a gross head of **799.50m**.

The powerhouse will have an installed capacity of 600MW (4x 150MW). The project would generate 2568.88MU with 95% Machine availability.

The main features of the project are as under:

1. A 95.0 m conventional concrete gravity dam 165.0 m long at the top equipped with 5 spillway gates of 6.8m x 12.9 m size.
2. Water conductor system comprising of 2 No. gated intake structures with inclined trash rack and with 2 No. De-silting chambers of 13 m x 17.5 m size and length 350 m each.
3. A 15.77 km long 5.7m diameter horseshoe shape head race tunnel with six intermediate adits of 6.8 m size D shape.
4. One 9.5 m dia. 162.80 m high restricted orifice type surge shaft leading to two steel lined pressure shafts of 3.3 m diameter. Each bifurcating into two limbs of 2.35 m dia. to feed four units in the powerhouse.
5. An underground powerhouse of size 140.50m x 21m x 44.50m housing 4 Pelton wheel turbines and generators of 150 MW each.
6. A 130m x 16m x 24 m high transformer cum GIS cavern housing the generator transformers and the Switching and protection equipment.

Khorlochhu Hydro Power Ltd.

7. A 1.698 km long Horseshoe shape Tail Race tunnel directing the water back into the river.

1.1.3 Implementation of the Project

Khorlochhu Hydropower Project is being executed by Khorlochhu Hydro Power Limited (KHPL) which is a joint venture Company of Druk Green, Bhutan and Tata Power, India registered in Bhutan under Companies Act of Kingdom of Bhutan, 2000.

1.2 The Documents

The Contractor shall strictly observe this General Technical Specification in conjunction with the Particular Technical Specifications. He shall carry out all work in a skilled manner in compliance with modern methods of engineering. All design calculations, materials, works, manufacture and testing shall conform to the latest applicable standards.

In addition, the Contractor shall conform to all applicable regulations regarding the execution of construction and installation work and shall follow all instructions issued by the competent Authorities, and the Engineer.

The Particular Technical Specifications shall take precedence over the General Technical Specifications in case of any contradiction.

Clause number cross-reference refer to the volume in which they occur unless stated otherwise.

1.3 Scope of Work

It is not the intention of these specifications to specify the complete details of equipment; however, the contractor shall supply the equipment, which will meet in all respect, the requirements of the Employer regarding performance, durability and satisfactory operations. All the equipment supplied shall conform to the relevant Indian/specified Standards. Wherever the Indian Standards are not existent or silent, relevant ASTM, DIN, Japanese Industrial Standards (JIS) or BS standard shall be adopted.

The broad scope of the work for the equipment as specified in the following paragraphs shall include the following: -

Gates with its Operating systems, Pressure shaft & HRT liners and Aquatic life discharge piping with valves

Design, preparation of detailed fabrication, sub assembly and assembly drawings, procurement, fabrication/manufacturing, inspection, shop assembly, shop testing, painting, transportation, site storage & preservation, insurance, erection, testing and commissioning, performance testing including provision for all the required labour, plant & material for the above, training of employer's personnel, handing over to Employer, supply of necessary spares for 5 years trouble free operation for all gates and their operating systems, pressure shaft liner and Aquatic life discharge piping with valves. Supply and installation of all incidentals not specified but necessary for the proper completion and satisfactory functioning of works and guarantee of the permanent equipment, along with all auxiliary equipment in the designated location of the project as specified in the following sections of technical specifications, shall also be in the scope of work.

The scope of work shall include all special tools, as well as all special devices including lifting devices, ropes, etc. necessary for total assembly and disassembly (if required) of all parts of the supplied Works.

These works include coordination and preparation of the detailed drawings in cooperation with the concerned civil contractors, erection and installation drawings as well as

Khorlochhu Hydro Power Ltd.

calculations, material specifications, operation and maintenance instructions, etc., as detailed in the technical specifications.

The contractor shall design, manufacture, transport, erect, install, test and commission the above hydro-mechanical equipment in every respect with all necessary accessories for reliable continuous operation. This shall be done in accordance with the contractor's standard procedures. For pressure shaft liner apar from inspection trolley contractor shall manufacture, transport, erect, install and commission based on design and drawings supplied by employer.

These specifications include the performance of all works and the provision of all materials, permanent and temporary equipment, tools, accessories for transport to the installation sites including loading, unloading, if necessary, reloading, intermediate storages, protection and guarding of the equipment, cleaning, drying, complete installation, painting, testing and commissioning of all equipment and accessories.

The contractor shall nominate a project manager who will act as in-charge for the purpose of the project.

The contractor shall provide unskilled and skilled manpower including supervisors and engineers for carrying out services under the contract. The contractor shall also make competent and experienced staff available for the training and assistance of the operating staff during commissioning and trial operation and, if required by the employer, for a period after completion of the trial operation which shall be agreed separately. The contractor shall mandatorily & practically engage and supervise a pool of special Bhutanese crews administratively nominated by the Employer for erection, testing and commissioning of Hydro Mechanical related work under this scope.

The construction power for the project, water supply and access road up to the border of the civil camps/storage yards and civil working/site installation areas shall be under the scope of civil contractors. The contractor shall make his own arrangement for purchase of power from the Civil Contractor and able to connect other infrastructures as mentioned above. Although Employer has made elaborate arrangement for supply of construction power to the Civil Bidders, the Hydro Mechanical Bidder shall note that power reliability cannot be assured at all times. The Bidder shall take all necessary steps to execute the project as per the requirement stated above and also include other equipment and systems required for operation as per prudent industrial practices

Any other items not specifically mentioned above but included in various Chapters of the Bid Document shall be taken into accounts for satisfactory, efficient and reliable operation of the plant.

1.3.1 Spillway Radial Gates and Hydraulic Hoists

Five (5) numbers submerged radial gate for clear opening size of **6.8m x 12.9m** complete in all respect with skin plate, stiffeners, bracings, arms, girders, trunnion assemblies, trunnion brackets, trunnion anchorages, seal assemblies, guide roller assemblies, lifting attachments and other miscellaneous fittings i.e. walkways, hand railings, ladders etc. complete in all respect.

Five (5) sets of first stage inserts for lintel beam, sill beam, wall plates, steel liners for Spillway crest/ glacis, bottom of breast wall & side wall/pier, hoist supporting structure, trunnion brackets, dogging devices, hoist support structure etc.

Five (5) sets of 2nd stage embedded parts complete with lintel beam, sill beam, wall plates, steel liners for Spillway crest/ glacis, bottom of breast wall & side wall/pier, hoist supporting structure, trunnion brackets, dogging devices, hoist supporting structure including anchorage system etc.

Khorlochhu Hydro Power Ltd.

Five (5) pairs of single acting hydraulic cylinders of capacity not less than **360T** each with spherical self-lubricating plain bearings on either end, gate position indicators and other associated components required necessary for erection and commissioning etc.

Five (5) units of hydraulic power pack & Control system for the five gates to be operated individually or simultaneously including motor, pump, control panel, piping, pressure gauges, flow control valves, pressure switches, direction control valves etc. with controls, manual controls, limit switches, lightings and other fittings. Each power pack shall be standby for the adjacent unit for which inter linking shall be made.

One (1) number of Oil Filtering Unit (Electrostatic Liquid Cleaner) and **One (1)** Dehydration & Degasification Unit

One (1) number gasoline engine operated portable power pack capable of operating one radial gate at 100% of the rated operating speed from dam top.

1.3.2 Spillway Stop Logs and Gantry Crane

One (1) set of stoplogs consisting of **eight (8)** units for clear opening size of **6.8m x 17.7m** comprising of skin plate, vertical stiffeners, horizontal girders, end vertical girders, seal assemblies, filling-in-valves in top unit, lifting attachment, side guide roller assemblies, bumpers, pilot guide pins with matching receiving pipes, probe mechanism/ arrangement to ensure proper seating of stoplog units on sill/ on the lower unit etc.

Five (5) sets of first stage embedded parts insert, corner angles, 300mm diameter (not less than 8 mm thick) air vent pipe (2 nos. in each bay) etc.

Five (5) sets of second stage embedded parts complete with slide tracks, sill beam, lintel beam, side seal seats and bases, groove liner, side guides, anchors with nuts and washers etc.

Three (3) sets of stop log storage structure including its embedded parts comprising, side guides, dogging arrangement and removable steel groove covers suitable to cover hanging stop log unit on the dogging arrangement.

One (1) lifting beam with automatically engaging and disengaging hooks, lifting lugs and sheaves, side frames with guide rollers, pilot tubes, arrangement to ensure proper seating of lifting beam with the stoplogs gate.

One (1) electrically operated gantry crane of capacity not less than **45T**, having long travel and cross travel arrangement including rope drums, gears, reducers, motors, brakes, limit switches, wire ropes, sheaves, crane rails and embedment's, end stoppers, cable reeling/ trailing cable for all supply arrangement, operator's cabin, remote radio station, ladders, hand railings, walkways, lighting etc.

1.3.3 Overflow Spillway Service Gate and Hoist

One (1) number Wheel type service gate for overflow spillway with an opening size of **4.0m x 5.0m** comprising lifting attachment, skin plate, vertical stiffeners, horizontal girders, end vertical girders, wheel assemblies, seal assemblies and all other accessories and appurtenance.

One (1) sets of first stage embedded parts and corner angles etc. for service and emergency gates

One (1) set of second stage embedded parts complete with wheel tracks, sill beam, lintel beam, side seal seats and bases, groove liners, side guides, suitable dogging arrangements to hold the gates in open position, 2nd stage anchorages with nuts and washers etc. for service gate.

One (1) set of motorized screw hoist of adequate capacity but not less than 15T, for overflow spillway service gate including pedestals, stem, nut, couplings, gearing arrangement, brakes, motors, gate position indicator, limit switches, control panels, cables and wiring with fixing plates and covers, manual operating arrangements etc.

Khorlochhu Hydro Power

One (1) set of common hoists supporting structure accommodating the screw hoists with motors of Overflow spillway service & emergency gates including supporting structure, trestles, foundation anchors, staircase, chequered plates, grating, hand railings etc. complete in all respect.

1.3.4 Intake Gates and Hoists, Intake Bulkhead Gates & Hoists

i) Intake Gates and Hoists

Two (2) number of fixed wheel type intake gates for opening size **4.25m x 4.7m** including skin plate, vertical stiffeners, horizontal girders, bottom lip, end vertical girders, wheel assemblies, top, side and bottom seals, lifting attachments and all other accessories and appurtenances.

Two (2) sets of first stage embedded parts and corner angles, not less than 8 mm thick air vent pipe of 300 mm diameter, etc.

Two (2) sets of second stage embedded parts complete with sill beam, steel liner at bottom & side wall, lintel beam, side seal seats and bases, groove liners, side guides, wheel tracks and dogging devices to hold the gates in open position, 2nd stage anchorages with nuts and washers etc.

Two (2) sets of electrically operated fixed rope drum hoists of adequate capacity but not less than **40T**, including wire ropes, rope drums, couplings, shafts, gears, brakes, motors, gate position indicators, limit switches, control panels, cables and wiring, manual operating arrangements etc.

Two (2) sets of hoists supporting structure accommodating the rope drum hoists of Intake gates including supporting structure, trestles, foundation anchors, staircase, chequered plates, grating, hand railings etc. complete in all respect.

ii) Intake Bulkhead Gates and Gantry Crane

One (1) number of vertical slide type intake emergency gates for inspection and maintenance of intake gates and embedded parts for opening size of **4.25m x 4.7m** including skin plate, vertical stiffeners, horizontal girders, end vertical girders, slide block, guide rollers, seals assemblies and all other accessories and appurtenances etc.

Two (2) sets of first stage embedded parts and corner angles, etc.

Two (2) sets of second stage embedded parts complete with sill beam, lintel beam, slide tracks, seal seats and bases, side guides, suitable dogging arrangements, 2nd stage anchorages with nuts and washers etc.

One (1) lifting beam with automatically engaging and disengaging hooks, lifting lugs and sheaves, side frames with guide rollers, pilot tubes, arrangement to ensure proper seating of lifting beam with the bulkhead gate.

One (1) electrically operated gantry crane of capacity not less than **35T** with long travel arrangement including rope drums, gears, reducers, motors, brakes, limit switches, wire ropes, sheaves, crane rails and embedment's, end stoppers, cable reeling/ trailing cable for all supply arrangement, operator's cabin, ladders, hand railings, walkways, lighting etc.

1.3.5 Intake Trash Rack and Trash Raking Machine

i) Trash Rack

Two (2) sets of first stage inserts and embedded parts suitable for trash rack, one set for each opening of size **16.75m x 13.29m** and inclined at **10º** with vertical complete in all respect in accordance with these specifications.

One (1) complete set of trash rack panel inclined at **10º** with vertical and fabricated in **36** numbers of panels each of size **4.0m wide x 2.215m** high comprising of trash bars, framing channel/angles, vertical/ horizontal support members, rake guides along the trash rack steel

Khorlochhu Hydro Power Ltd.

panels complete and suitable for all two Intakes complete in all respect in accordance with these specifications.

ii) Trash Raking Machine

One (1) number trash rack cleaning machine equipped with trash raking mechanism for cleaning trash racks having a net trash handling capacity not less than **1.00T and minimum dead weight of raking bucket not less than 4.0T** consisting of ropes, pulleys, hoisting arrangement, stainless steel combing teeth, apron, trolley, hydraulic control, control panels, cable & cable reeling drums, operator's cabin, gantry rails, etc. **A revolving boom having a radius of minimum 5.0m with grapple devices of 1.0T** capacity also to be provided at suitable location in the raking machine for the removal of floating debris and logs likely to be accumulated in front of intake. Furthermore, **one (1)** prime mover operated self-unloading trash disposal vehicle Tipper type [Volume 3.5 m3(min) and capacity 5MT (min)] will also be provided.

1.3.6 Downstream Desilting Chamber Gate & Rope Drum Hoists

Two (2) numbers. Wheel type Downstream Desilting Chamber gate of **4.7m x 4.7m** opening size, comprising of skin plate, girders, Wheel assemblies, seal assemblies, lifting attachment, side guide rollers and all other accessories and appurtenances. The gate is proposed to be used under balance head condition for both desilting basin gate grooves using dedicated Rope Drum Hoist.

Two (2) sets of first stage embedded parts for downstream desilting basin grooves.

Two (2) sets of second stage embedded parts complete with guides, seal seat and bases, sill beam, lintel beam, wheel track, dogging device, anchors nuts and washers etc.

Two (2) sets of electrically operated fixed rope drum hoists of adequate capacity but not less than **35T**, including wire ropes, rope drums, couplings, shafts, gears, brakes, motors, gate position indicators, limit switches, control panels, cables and wiring, manual operating arrangements etc.

Two (2) sets of hoists supporting structure accommodating the rope drum hoists including supporting structure, foundation anchors, staircase, chequered plates, grating, hand railings etc. complete in all respect.

1.3.7 Silt Flushing Tunnel Gates & Hydraulic Hoists

Two (2) numbers slide type service gate for silt flushing tunnel with an opening size of **1.5m x 2.2m** comprising of skin plate, stiffeners, girders, lifting attachment, end vertical girders, slide block assemblies, seal assemblies and all other accessories and appurtenances.

Two (2) numbers slide type emergency gate for upstream grooves with an opening size of 1.5 m x 2.2m for each gate, comprising of skin plate, stiffeners, girders, lifting attachment, end vertical girders, slide block assemblies, seal assemblies and all other accessories and appurtenances

Four (4) sets of embedded parts complete with groove liners with anchorages, sill beam, lintel beam, slide track assemblies, side seal seats & bases, side guides, bonnets and bonnet cover, etc. for silt flushing tunnel service & emergency gate grooves including steel liner between both the grooves. The embedded parts and 300mm diameter air vent pipe shall be installed in first stage concrete itself as shown in the specification drawing.

Four (4) numbers double acting hydraulic hoists including hydraulic cylinders of adequate capacity but not less than **150/120T for pulling and pushing**.

Two (2) sets of power pack common for service & emergency gates and associated Control system including motors, pumps, control panel, piping, pressure gauges, flow control valves, pressure switches, direction control valves etc. with controls, limit switches and other miscellaneous fittings, lighting, etc.



Four (4) sets of hoists supporting structure load bearing anchors in first stage etc.

1.3.8 Surge Shaft Gates and Rope Drum Hoists

Two (2) numbers Slide type Surge Shaft gates for **2.75m x 5.22m** size opening leading to pressure shaft comprising of skin plate, horizontal girders, vertical stiffeners, top seal, side seals, bottom seal, side guide shoe assemblies, upstream bumpers, sliding blocks lifting attachments and filling-in-valves etc.

Two (2) sets of embedded parts including reception frames, track assemblies, side and top seal bases, sill beam, lintel beam, seal seats, side guide track as per specification drawings, 1st & 2nd stage embedded parts, inserts and 300mm diameter (not less than 8 mm thick) air vent pipe, side guide with second stage block outs. 1st and 2nd stage embedded parts for dogging device etc.

Two (2) sets of electrically operated fixed rope drum type hoist of adequate capacity but not less than **70T** each including wire rope, drums, shafts, couplings, gearings, motor, brakes, gate position indicator, limit switches, control panels, cables and wiring, rope overload limiting arrangement, manual operating arrangements etc.

Two (2) sets of hoist supporting structure including trestles, hoist cover, foundation anchors, stairway, walkway, chequered plates, grating, handrails, lighting, etc. complete in all respect.

1.3.9 Tailrace Tunnel Gates and Gantry Crane

Two (2) numbers of fixed wheel type Tailrace Tunnel Gates for opening size of **4.0m x 4.5m** comprising skin plate, horizontal girders, vertical stiffeners, top seal, side seals, bottom seal, side guide roller assemblies, wheel assemblies and suitable lifting attachments for filling-in- valves etc.

Four (4) sets of first stage embedded parts, inserts and 300mm diameter (not less than 8 mm thick) air vent pipe etc.

Four (4) sets of second stage embedded parts complete with track assemblies, side seal seat, bases, sill beam, lintel beam, side guide track, dogging devices, anchors with nut and washers etc.

One (1) lifting beam with automatically engaging and disengaging hooks, lifting lugs and sheaves, side frames with guide rollers, pilot tubes, arrangement to ensure proper seating of lifting beam with the tailrace tunnel gates.

One (1) electrically operated gantry crane of capacity not less than **20T** with long travel arrangement including rope drums, gears, reducers, motors, brakes, limit switches, wire ropes, sheaves, crane rails and embedment's, end stoppers, cable reeling/ trailing cable for all supply arrangement, operator's cabin, ladders, hand railings, walkways, lighting etc.

1.3.10 TRT Outfall Gates and Hoists

One (1) number fixed wheel type TRT outfall gates for opening size **6.5m x 6.5m** including skin plate, vertical stiffeners, horizontal girders, end vertical girders, wheel assemblies, top, side and bottom seals, lifting attachments and all other accessories and appurtenances.

One (1) set of first stage embedded parts and corner angles etc.

One (1) set of second stage embedded parts complete with sill beam, lintel beam, side seal seats and bases, groove liners, side guides, wheel tracks and dogging devices to hold the gates in open position, 2nd stage anchorages with nuts and washers etc.

One (1) set of electrically operated fixed rope drum hoists of adequate capacity but not less than **60T**, including wire ropes, rope drums, couplings, shafts, gears, brakes, motors, gate position indicators, limit switches, control panels, cables and wiring, manual operating arrangements etc.

Khorlochhu Hydro Power Ltd.

One (1) set of hoists supporting structure including supporting structure, trestles, foundation anchors, staircase, chequered plates, grating, hand railings etc. complete in all respect.

1.3.11 Adit Inspection Gates

Two (2) numbers hinged type Adit inspection gates, of **2.5m wide x 2.5m high** opening size at **Adit-2** and **Adit-5** including skin plate, horizontal girder, vertical stiffener, hinges, bearing pads, locking arrangement, outlet pipes, valves & pressure gauge for drainage purpose etc. with accessories and appurtenance.

Two (2) sets of first stage embedded parts, inserts, etc.

Two (2) sets of second stage embedded parts for all round bearing cum seal frames, hinges, locking bolts etc. including 2nd stage anchors with double nut and washers etc.

1.3.12 Pressure Shaft Liners / Penstock and Steel Liner in HRT

- **Two (2)** numbers Steel transition from **2.75m x 5.22m** rectangular section to **3.3m** circular in **3.3m** length starting from the d/s of surge shaft gate as per Pressure shaft liner drawings and specifications.
- **3.3m** diameter Steel lining of the top portion of **two (2)** numbers pressure shaft liner including plan bend, horizontal portion and Upper vertical bend UVB1.
- **Two (2)** numbers Steel lining of the vertical shaft of internal diameter **3.3m** with Lower vertical bend LVB-1.
- **Two (2)** numbers Steel lining of the horizontal shaft of internal diameter **3.3m** with upper vertical bend UVB-2.
- **Two (2)** numbers Steel lining of the vertical shaft of internal diameter **3.3m** with Lower vertical bend LVB-2.
- **Two (2)** numbers Steel lining of the horizontal shaft of internal diameter **3.3m** with upper vertical bend UVB-3.
- **Two (2)** numbers Steel lining of the vertical shaft of internal diameter **3.3m** with Lower vertical bend LVB-3.
- **Two (2)** numbers Steel lining, bottom horizontal portion of internal diameter **3.3m** bifurcate from **3.3m** dia. to **2.35m** dia. branch pipes, horizontal bend with horizontal portion of internal diameter **2.35** m up to MIV inside Powerhouse.
- **One number of inspection trolley capable of being dismantled and taken through minimum 800mm dia manhole and assembled inside the pressure shaft with minimum capacity of 5T.**

The general arrangement drawing of the steel liner of the pressure shaft is shown on drawing no. KHPP- HM-PS-GA- 6019 & 6020 (Sheet 1 of 2 & Sheet 2 of 2)

- **Miscellaneous items, Steel liner (ASTM A537 Cl 2)-370m (Headrace Tunnel)**
  A provision of 4.7m diameter, 370m long, and not less than 18mm steel liner of ASTM A537 Class II in the low cover zone has been envisaged.

1.3.13 Chaplangchhu Diversion Works

i) Intake Trash Rack

One (1) set of embedded frames including first stage anchors for horizontal trash racks of suitable size.

One (1) horizontal trash rack of steel construction for size as indicated in civil layout fabricated in suitable panels.

ii) Intake Gate

One (1) wheeled type gate for opening size of **2.0m x 2.5m** consisting of skin plate, stiffeners, girders, end vertical boxes, wheel assemblies, side guide rollers, lifting lugs, dogging brackets etc. complete in all respects.

Khorlochhu Hydro Power

One (1) set of first stage embedded parts and corner angles etc.

One (1) set of second stage embedded parts complete with wheel tracks, sill beam, lintel beam, side seal seats and bases, groove liners, side guides, suitable dogging/holding arrangements to hold the gates in open position, 2nd stage anchorages with nuts and washers etc.

One (1) set of motorized screw hoist of adequate capacity but not less than **15T** for intake gate including pedestals, stem, nut, couplings, gearing arrangement, brakes, motors, gate position indicator, limit switches, control panels, cables and wiring with fixing plates and covers, manual operating arrangements etc.

One (1) set of supporting structure for screw hoist comprising of trestles, foundation anchors, stairway walkway, (chequered plates, grating and removable hatch covers) handrails, etc. complete in all respect in accordance with the specification.

iii) Desilting Chamber Outlet Gate

One (1) number fixed Slide type gate for opening size **1.8m** wide x **2.1m** including skin plate, stiffeners, girders, end vertical girders, sliding blocks, guide rollers assemblies, top, side and bottom seals, lifting attachments and all other accessories and appurtenance.

One (1) set of first stage embedded parts and corner angles etc.

One (1) set of second stage embedded parts complete with slide tracks, sill beam, lintel beam, side seal seats and bases, groove liners, side guides, suitable dogging/holding arrangements to hold the gates in open position, 2nd stage anchorages with nuts and washers etc.

One (1) set of motorized screw hoist of adequate capacity but not less than **15T** for intake gate including pedestals, stem, nut, couplings, gearing arrangement, brakes, motors, gate position indicator, limit switches, control panels, cables and wiring with fixing plates and covers, manual operating arrangements etc.

One (1) set of hoist supporting structure, foundation anchors, stairway, walkways, (chequered plates, grating and removable hatch covers) hand railings, etc. complete in all respect in accordance with the specification.

iv) Silt Flushing Tunnel (SFT) Gate

One (1) number slide type gate for silt flushing tunnel with an opening size of **0.6 m x 0.6 m** comprising of skin plate, stiffeners, girders, lifting attachment, end vertical girders, slide block assemblies, seal assemblies and all other accessories and appurtenances

One (1) set of embedded parts complete with groove liners with anchorages, sill beam, lintel beam, slide track assemblies, side seal seats & bases, side guides, bonnets and bonnet covers, etc. for silt flushing tunnel gate grooves including steel liners. The embedded parts shall be installed in first stage concrete itself as shown in the specification drawing.

One (1) number double acting hydraulic hoists including hydraulic cylinders of adequate capacity but not less than **10/8T for pulling and pushing**.

One (1) set of power pack and associated Control system including motors, pumps, control panel, piping, pressure gauges, flow control valves, pressure switches, direction control valves etc. with controls, limit switches and other miscellaneous fittings, lighting, etc.

One (1) set of hoist supporting structure load bearing anchors in first stage etc.

v) De-gravelling Gate

One (1) number fixed Slide type gate for opening size **2.0m x 2.0m** including skin plate, stiffeners, girders, end vertical girders, sliding blocks, guide rollers/shoe assemblies, top, side and bottom seals, lifting attachments and all other accessories and appurtenance.

One (1) set of first stage embedded parts and corner angles etc.

Khorlochhu Hydro Power Ltd.

One (1) set of second stage embedded parts complete with slide tracks, sill beam, lintel beam, side seal seats and bases, groove liners, side guides, suitable dogging/holding arrangements to hold the gates in open position, 2nd stage anchorages with nuts and washers etc.

One (1) number double acting hydraulic hoists including hydraulic cylinders of adequate capacity but not less than **10/8T for pulling and pushing**.

One (1) set of power pack and associated Control system including motors, pumps, control panel, piping, pressure gauges, flow control valves, pressure switches, direction control valves etc. with controls, limit switches and other miscellaneous fittings, lighting, etc.

One (1) set of hoist supporting structure load bearing anchors in first stage etc.

1.3.14 Aquatic Life Discharge Piping with Valves

Two (2) set of aquatic life discharge piping comprising of **two (2) numbers** Stainless Steel pipe of **600 mm** diameter including **four (4)** number of knife edge gate valves of **600 mm** diameter (two services & two emergency) along with transition piece, supports, dismantling joints etc. complete with all other accessories and appurtenance. These pipings shall be embedded in spillway pier to release water during lean season downstream of river for aquatic life.

1.3.15 Instruments and Remote-Control System

PLC based Remote Control System shall be within the scope of Electro-mechanical Package. However, all instruments, field deceives, local control panels and cabling related to the above scope of works (Clause no. 1.3.1 to 1.3.14) shall fall under the scope of this package, which shall envisage the following control functions and indications.

i) Individual control and operation of spillway radial gates, overflow spillway gates, intake gates and silt flushing tunnel gates.

ii) Group control for raising and lowering of spillway gates.

iii) Individual gate height indications of spillway radial gates, overflow spillway gates, Intake gates & silt flushing tunnel gates.

iv) Auto/manual operation indication.

v) Gate opening/ closing flash lamp indication with suitable audible alarm for spillway radial gate and silt flushing gate.

vi) Reservoir water level indication on continuous display mode in digital form with alarm where water level starts exceeding FRL and when water level starts receding.

vii) **Two (2)** sets of water level measuring and indication Equipment at dam area along with necessary alarms.

viii) Control and operation of Intake gate, de-gravelling gate and silt flushing tunnel gate of Chaplangchhu from Dam Control Room.

i) Following instruments shall also be provided at their respective locations complete in all respect and is not part of PLC system: -

i) **Five (5)** sets of water level measuring system to indicate balance head condition of spillway stop logs.

ii) **Two (2)** sets of Differential pressure measurement and indication equipment across intake trash rack.

iii) **Two (2)** sets of water level measuring system to indicate balance head condition of Intake bulk head gates.

iv) **Two (2)** sets of water level measuring system to indicate balance head condition of desilting chamber gates.

Khorlochhu Hydro Power Ltd.

v) **Two (2)** sets of water level measuring system to indicate balance head condition of surge shaft gate.

vi) **Two (2)** sets of gravel level measurement system for Chaplangchhu Diversion Scheme

ii) Distribution board & feeder pillar for all HM equipment

i) Main distribution board/ Switchgear (not in the scope of HM vendor) shall be provided at dam site near Diesel Generating Room for 415/230V AC power supply for Spillway Equipment, Intake equipment, Desilting Chamber Gates and Silt Flushing Gates. Feeder pillars / individual distribution boards (if required) shall be provided in the vicinity of respective local control panels of above equipment and shall be within the scope of HM vendor. Cables between main distribution board and above feeder pillars shall also be part of the HM vendor's scope.

ii) Feeder pillars (if required) shall be provided for Surge Shaft gates, Tail Race Tunnel gates, TRT outfall gate and all the Chaplangchhu Gates in the vicinity of respective local control panels.

The Works shall be complete with all necessary auxiliaries such as primary elements (position transmitters, limit switches etc.), hardware, software, modules, transducers, cabling etc. as well as frames, built-in and embedded parts including all spare parts and special tools required. All the Equipment shall be standard type of well-known manufacturers.

1.3.16 Mandatory Spare Parts

Mandatory spare parts for all the gates, hoists and cranes, remote control system, TRCM, knife-edge gate valve etc. as per list.

1.3.17 Mandatory Tools and Tackles

Supply of Mandatory Tools & Tackles as per list.

1.3.18 Design/Drawings and Operation and Maintenance Manuals

The scope of work shall also include submission of following documents:

Design and Drawings

i) **Four (4)** sets of all approved design and **Eight (8)** prints of all approved drawings & Six **(6)** prints of all approved "As Built Drawing" **properly bound & placed in folder**.

ii) **Soft copies of four (4) sets of design & drawings on good quality DVD/Pen Drive/ external hard disk suitable for editing and printing.**

iii) Two (2) electronic copies/ soft copies of as built drawings (out of which one electronic copy shall be in source format/software in editable form of each as built drawing).

Operation and Maintenance Manual

i) **Eight (8)** sets of operation and maintenance manual containing drawings, all related catalogues and brochures for plants and machinery, handling procedures for assemblies & sub-assemblies of all equipment covered under this specification properly bound & placed in folder.

ii) Soft copies of above manuals on good quality external drive suitable for editing and printing.

1.3.19 Scope of HAZOP / HAZID Study

i) The primary objective of a Hazard identification (HAZID) study is to relate Internal and External hazards which could impact the arrangement of process units and other adjacent facilities. HAZID study is carried out to identify the potential hazards and to reduce the likelihood and consequences of an incident at site that would have a

Khorlochhu Hydro Power Ltd.

harmful impact to the personnel, asset(s) and environment so that hazards can be assessed or eliminated at source, if possible, prevented or mitigated otherwise.

ii) Hazard and Operability (HAZOP) study is a detailed process which need to be carried out to identify risk and operability problems. HAZOP deals with identification of potential deviation from design intent, examination of causes and assessment of consequences.

iii) The Bidder shall carry out study of all the major hazards associated under this scope of works to demonstrate that the system and its associated ancillaries shall be satisfactorily controlled. Bidder to also execute a Hazard and Operability Study (HAZOP) of the potentially hazardous process systems in accordance with IEC61882 (Hazard and Operability Studies (HAZOP Studies) Application Guide) and IEC 61882 & appoint the HAZOP leader & recorder.

iv) The HAZOP shall be carried out once the design is nearly firm and documented (i.e. once the P&IDs are finalized along with proper control and operation philosophy). All modes of operation shall be included in the HAZOP study but not limited to start, stop, trips of any plant items, transient operation and normal operation. Based on the results obtained from HAZOP Studies, risk ranking shall be obtained. Then the necessary changes /modifications/additional instruments/corrections to the Bidder's design under this scope of works and its ancillaries shall be undertaken by Bidder at no additional cost to the Owner and without affecting the Take Over Date.

v) HAZID & HAZOP study to be conducted in totality for entire project keeping in view Hydro Mechanical aspects ***including Electrical Power distribution related risk assessment study in their scope of work.***

In short, the main objective of the HAZOP study is:

i) To identify safety related hazards and significant operability problems related to the design and operation of the systems.

ii) To determine the seriousness of the consequences for the identified problems.

iii) To identify existing engineering and procedural safeguards that will reduce the consequences related to the hazards.

iv) To evaluate the adequacy of existing engineering and procedural safeguards.

v) To recommend additional safeguards and improvements as necessary

Mainly the HAZOP study includes the following steps:

vi) Select the system/subsystem/equipment then frame the intention of the system.

vii) Identify the parameter (guide word) then indicate the deviation in the parameter.

viii) Based on deviation, predict the cause then examine the consequence and detect the HAZARD.

ix) Take the action for safeguarding the engineered system or administrative controls designed to prevent the cause or mitigate the consequences of deviations.

x) Repeat procedure for particular parameter (guide word) selected until the risk mitigates.

xi) Identify remaining parameters (guide word) and follow the above procedure.

xii) Once all parameters (guide words) are corrected/finished then mark the system as completed.

Based on the above procedure, the study shall be recorded and completed with corrective actions.

The Bidder shall appoint an independent specialist to undertake the HAZID & HAZOP study. The Owner and Owner's consultant shall be invited to attend all HAZID & HAZOP meetings.

Khorlochhu Hydro Power Ltd.

2. STANDARDS

Latest Indian Standards for design, testing, workmanship, material and Works have been selected mostly in these specifications as a basis of reference. Except where modified by this specification, works and materials shall be in accordance with INDIAN STANDARD. If relevant Indian Standards are not available in any case or cases, then relevant International Standards shall be proposed by the Contractor for approval by the Engineer.

When IEC or ISO Recommendations or other Standards are referred to, the edition shall be that current at the time of issue of Tender Documents, together with any amendments issued to that date.

If requested by the Engineer, the Contractor shall supply at his own expense three copies in English of latest edition and one in the original language of any national standards, which are applicable to the Contract.

1.4 Operation Philosophy- Gate Control Panel

Overview:

The Local Control Panel (LCP) is designed to facilitate the safe and efficient operation of dam gates through three distinct modes: **Local, Manual,** and **Remote.** The LCP is equipped with **RDOL (Reversing Direct-On-Line) starters**, and the switchgear components are selected based on **Type-2 coordination**.

a) Local Mode (Electrical Operation from LCP Push Buttons):

- In this mode, the dam gate motor can be operated electrically from the LCP.
- Push buttons provided on the panel (e.g., OPEN, CLOSE, STOP) control gate movement.
- Limit switches and interlocks ensure that the gate does not exceed travel limits.
- This mode is selected via a 3-position mode selector switch (Local/Manual/Remote).
- Motor protection is ensured via:
  - Thermal overload relays
  - Short circuit protection (MCB/MCCB)
  - Contactor coordination (Type-2 compliant).

b) Manual Mode (No Power – Hand Operation):

- In the event of power failure or motor fault, gates can be operated manually.
- Manual operation is achieved through a hand crank or mechanical override system.
- In this mode:
  - All electrical controls are disabled.
  - The motor starter remains de-energized.
- This is a fail-safe backup for emergency or maintenance use.

c) Remote Mode (SCADA / Control Room Operation):

- Enables gate operation from the Dam Control Room 19" HMI Panel mounted.
- Enables gate operation from the emote SCADA of powerhouse Control Room.

- Commands (Open/Close/Stop) are sent over a communication link .
- Feedback signals (gate position, motor status, faults) are transmitted back to SCADA.
- Interlocks are in place to prevent simultaneous operation from multiple sources.
- Local-Remote logic ensures that only one mode is active at a time to avoid conflicts.

d) Control & Protection Highlights:

- Starter Type: RDOL (Reversing Direct-On-Line)
- Motor Rating: Designed per gate specification
- Switchgear Coordination: Selected as per IEC Type-2 Coordination Charts, ensuring:
  - No damage to contactors in case of short circuit
  - Minimal downtime post-fault
- Indication Lamps: Mode status, motor run status, fault indication
- Interlocks:
  - Mechanical and electrical interlocking between modes
  - Limit switch-based travel limits
  - Motor thermal/fault feedback.

1.4.1 Local Control Panel for Gates

- One Local control panel is provided on hoist bridge for the operation of each Gate.
- Each LCP is provided with **MCCB , **Power contactors, **overload relay (OLR), Auxiliary Contactors, 3Nos of Push Buttons,**VA Control Transformer, Multifunction Meter, set of indicating lamps and MCB's.
- LCP is provided with selector switch to select Manual/Local/Remote operation of gate.
- Incoming power supply is in client's scope through 3.5Cx **Sqmm Al Ar. FRLS XLPE Cable.

1) Gate UP/Raising Operation

2) Gate Down/Lowering operation

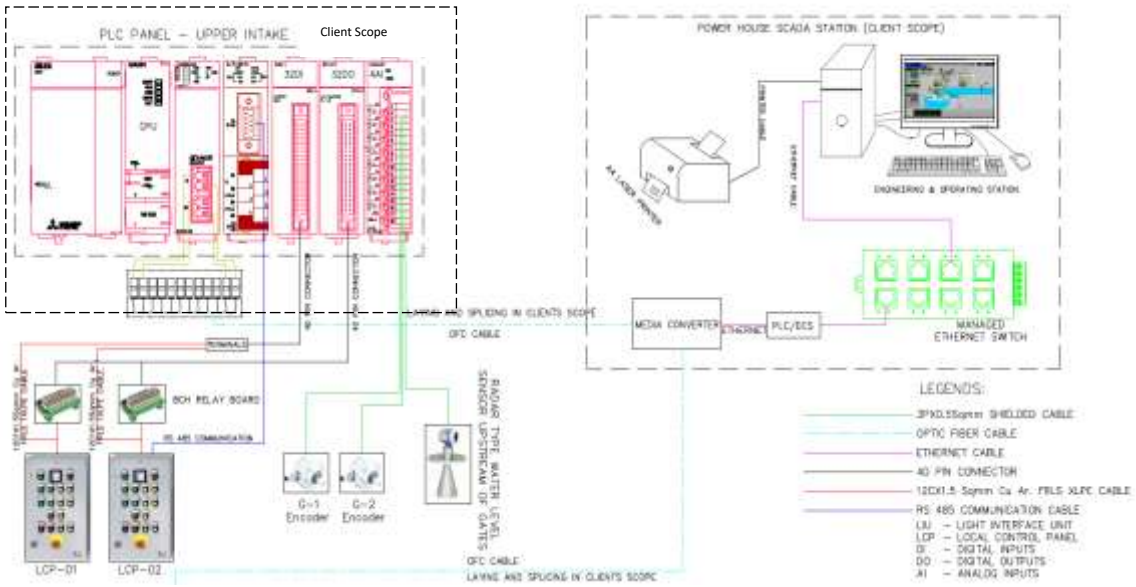
3) Manual operation

- In the event of a power failure, the dam gate can be operated manually under emergency conditions. To initiate manual operation:
  - Turn the mode selector switch to "Manual" on the Local Control Panel (LCP). This selection isolates the power supply within the LCP, ensuring safe manual operation.
  - Insert the manual operating handle into the shaft and rotate it to raise or lower the gate as required.

Khorlochhu Hydro Power Ltd.

- This process allows for safe, controlled movement of the gate without electrical power.
- After completing the manual operation:
  - Turn the selector switch back to "Local" mode to restore electrical control.
  - Manual handle must be removed from the shaft. This ensures the system is restored to its normal state and ready for electrical operation via the Local or Remote modes.

GENERAL ARRANGEMENT OF CONTROL SYSTEM FOR HM EQUIPMENTS



1.5 Standard for General Applications

Standard publications issued by the following organizations of standardization are considered being approved standards for the works with a priority to use Indian standards.

BIS	:	Bureau of Indian Standards.
ASTM	:	American society for testing & material.
ASME	:	American society of mechanical Engineers.
DIN	:	Deutsches Institute fur Normung.
BS	:	British standard.
IEC	:	International electromechanical Commission.
JIS	:	Japanese Industrial Standard.
EN	:	European standard

1.6 Standards for Design and Testing

Following is the list of Indian Standard Specifications, which shall be followed wherever the detailed requirements have not been outlined in these specifications:

S. No	Description	Standard
1.	Recommendation of structural design of Fixed wheel gates	IS: 4622
2.	Recommendation of structural design of Radial gates.	IS: 4623
3.	Recommendations for structural design Criteria for low head slide gates.	IS:5620

Khorlochhu Hydro Power Ltd.

4.	Recommendation for structural design of medium & high head slide gates.	IS: 9349
5.	Code of practice for design of rope drum and chain hoists for hydraulic gates.	IS: 6938
6.	Code of practice for electric overhead Traveling cranes and gantry cranes other than steel work cranes	IS: 3177
7.	Code of practice for design, manufacture erection & testing of cranes & hoists.	IS: 807
8.	Code of practice for use of structural steel in general building construction.	IS: 800
9.	Design criteria of hydraulic hoists for Gates.	
a.	Hoist capacity, Design of hoist components like hydraulic cylinder, cylinder head, stem, Piston etc.	IS: 10210
b.	Hydraulic operating system (Power Pack) and Its components like oil tank, pump and motor, Valves, piping etc.	DIN: 19704
10.	Recommendation for inspection, testing & maintenance of fixed wheel & slide gates.	IS: 7718
11.	Recommendation for Inspection, testing & maintenance of Radial gates & their hoist.	IS: 10096(Part I)
12.	Recommendation for Inspection, testing & maintenance of Radial gates & their hoists	IS:10096 (Part III)
13.	Approval test for welding procedures	IS: 7307 (Part I)
14.	Approval testing of welders working to approved welding procedures (Part I)	IS: 7310(Part l)
15.	Approval tests for welders when welding Procedures approval is not required.	IS: 7318
16.	Code of practice for Liquid penetrant flow detector.	IS: 3658
17.	Code of practice for Ultrasonic tube Echo testing by contact and immersion methods.	IS: 3664
18.	Code of practice for magnetic flow detector.	IS: 3703
19.	Code for unfired pressure vessels	IS: 2825
21.	Code of practice for radiographic testing.	IS: 2595
22.	Code of practice for structural safety of buildings loading Std.	IS: 875
23.	Code of practice for plain & reinforced concrete.	IS: 456
24.	Sluice valves & Gate valve.	IS: 780
25.	Criteria for Earthquake resistant design of structures	IS: 1893
26.	Recommendations for design of Trash racks	IS: 11388
27.	Structural design of Penstock-Criteria buried/Embedded penstocks in rock	IS:11639 (part2)
28.	Structural design of Penstock-Criteria specials for penstocks	IS: 11639 (part3)
29.	Steel pipes for water and Sewage	IS: 3589
30.	Specification for steel pipe Flanges	IS: 6392
31.	Recommendations for Design of Screw Hoists for Hydraulic Gates	IS: 11228

Khorlochhu Hydro Power Ltd.

Reference should be made only to the relevant Indian Standard Specification. However, where such code is silent on certain specific provision, reference may be made to other appropriate & relevant ASTM, ASME, DIN, JIS or BS.

Standards other than those stipulated in the Bid documents shall be acceptable after scrutiny provided they ensure equal or higher quality than those specified in the specifications. The contractor shall submit for approval the detailed standards, which he proposes to use.

It shall be confirmed by the contractor that in case the standards proposed by him are not found acceptable by Employer during engineering, conformance of the offered equipment to the respective standards as specified in the bid documents shall be ensured by him at no extra cost to the Employer.

If these specifications conflict in any way with any of the above standards or codes, these specifications and drawings shall take precedence.

1.7 Material Standards

All material used for the fabrication of the equipment shall conform to relevant Indian standard or equivalent International standard as DIN, ASTM, or BS unless otherwise specified.

1.7.1 Materials for Gates, Stoplogs, Embedded Parts, Lifting Beam, Trash Racks, Piping etc.

Sl. No.	Component Part	Recommended Material /Make	Code reference
i.	a) Structural parts of gate leaf including skin plate, stiffeners, horizontal girders, diaphragms, track base, seal base, seal seat base, liners, seal clamp, lifting lugs, structural parts of lifting beam, guide, Structural parts of trash racks, anchor bolts, anchors etc.	Structural steel/ High strength structural steel	IS 2062
	b) 3mm Stainless Steel (AISI 304) shall be cladded over structural steel	Structural steel + 3 mm Stainless Steel (AISI 304)	IS 2062 / IS1570 (Part-V) X04Cr. 19Ni9
ii.	a) Wheels	Cast steel / forged steel	IS 1030 Gr. 340-570 IS 2004 Cl. IV (BHN=175)
	b) Self-aligning spherical roller bearings/ antifriction bearings	SKF, FAG, INA, NTN	
	c) Wheel pins	Corrosion resistant steel	IS 1570 (Part V) Gr.20 Cr.13
	d) Retainers	Structural steel	IS 2062
	e) Sleeves for pin (Distant piece)	Corrosion resistant steel	IS 1570 (Part - V) Gr.04Cr19Ni9
	f) Trunnion pin	Corrosion resistant Steel/ Forged stainless steel with chrome plating	IS:1570 (part-V) Gr 20 Cr 13/ IS 2004 Cl-V
	g) Trunnion hub/ bracket	Cast Steel/ Structural Steel	IS:1030 / IS: 2062
	h) Trunnion bushing	Self-lubricating	ASTM B-22/271 C86300,
iii.	a) Guide roller	Cast steel	IS 1030

Sl. No.	Component Part	Recommended Material /Make	Code reference
	b) Guide roller pin, lifting pin, Connecting pin	Stainless steel	IS: 1570 (Part-V) Gr.20 Cr.13 OR AISI 420
	c) Bushing (other than radial Gate trunnion bushing)	i) Self-lubricating bush ii) Al. Bronze (for lifting beam links)	Tenmat/ Standard repute IS: 305, Gr-AB-2 IS: 318, Gr-LTB-1
iv.	Seals	Rubber	IS: 11855
v.	Track & wall plate	Corrosion resistant steel	IS: 1570 (Part-V) Gr.20 Cr.13 or Gr.30Cr.13 or Gr. 04 Cr. 19 Ni9.
vi.	Seals seat	Stainless steel	IS 1570 Gr. 04 Cr. 19 Ni9
vii.	Seal fasteners	Stainless steel	IS 1570 Gr. 04 Cr. 19 Ni9
viii.	Ballast if any	Cast Iron/ Structural steel	IS: 210/ IS:2062
ix.	Lifting hooks (for lifting beam)	Forged steel / High strength structural steel	IS: 2004 Cl.-V / IS : 2062
x.	Lifting Pins	Corrosion resistant steel	IS: 1570 (Part-V) Gr.20 Cr.13
xi.	Material for filling-in-valve a) Spring b) Seal c) Stem	• Spring steel • Rubber • Corrosion resistant steel	EN-45 IS 11855 IS 1570 (Part-V)
xii.	Miscellaneous Piping work like air vent pipe etc.	Structural Steel	IS: 2062

1.7.2 **Material for components of Hoist Bridges, Hoist Support, Trestles, Walkways, Railings, Gantry Grider, Dogging Devices etc.**

Sl. No.	Materials component	Material	Code Reference
i.	Base plate, anchors, columns, stiffeners, bracings, lugs, gantry-griders etc.	Structural steel	IS: 2062 Rolled sections IS:808
ii.	Walkway	Galvanized Chequered Plate	Standard or IS:3502
iii.	Bridge bearings	Neoprene or Standard Plate bronze	IS: 305/ IS:318
iv.	Handrails & Posts	M S Black Pipe heavy duty (Handrails shall be galvanized stainless steel as per cl.5.13.2)	IS 1239 and as per cl. 5.13.2

Khorlochhu Hydro Power Ltd.

1.7.3 Materials for Hydraulic Hoist

Sl. No.	Materials component	Material	Specifications
i.	Hoist Cylinder	Type MW 450N	DIN designation: 20MNV6, Mat. No. 1.5217
ii.	Upper & Lower-Cylinder head	Type St 52-3 / S355J2G3	Standard DIN 17100
iii.	Stem Rod	Carbon steel with ceramic coating of 250 micron minimum or Stainless steel with chrome plating not less than 50 microns	42 Cr Mo4 DIN 1.7225/EN 10083, X17Cr Ni 16.2, DIN17440, Mat No. 1.4057 or any other eqvt. Material
iv.	Piston	Carbon steel	42 Cr Mo4 DIN 1.7225/EN 10083
v.	Clevis, Trunnion, Piston part, sealing flange etc.	Type St 52-3 / S355J2G3	DIN 17100
vi.	Hydraulic Piping	X 6 Cr Ni Mo Ti17 12.2	DIN 17440, Mat. No. 1.4571
vii.	Hydraulic oil Tank	Stainless steel	IS 1570 Gr. 04 Cr. 19 Ni9

1.7.4 Materials for Rope Hoists and Cranes

Sl. No.	Materials component	Material	Code Reference
i. a.	Wire rope	Steel Improved plow	IS:2266
b.	Drums	Cast steel/ M.S.	IS: 1030/IS: 2062
c.	Gears	Cast steel/ Structural steel	IS:1030 IS:2062/ IS: 2707
d.	Pinions	Carbon steel Structural Steel Forged Steel	IS: 1570C40 IS: 2062 IS: 2004 CI. IV
ii.	Sheaves and pulleys	Cast steel	IS:1030
iii.	Shafts	Forged steel Carbon steel	IS:2004 CI.IV IS:1570 C40
iv.	Electromagnetic brakes, Thruster brakes, Limit Switches, Control equipment, Electrical bought out items etc.		Standard reputed MAKE
v.	Wheels	Forged Steel/ Cast Steel	IS: 2004 Cl.-IV IS: 1030
vi.	Pins	Forged steel/ Carbon steel	IS: 2004/ IS: 1570-C40
vii.	Bushing	Bronze/Al-Bronze	IS: 305/ IS: 318
viii.	Steel for shrunk fit Gear rims	Forged steel/ Carbon steel/ Structural steel	IS: 2004 IS: 1570-C40 IS: 2062

Sl. No.	Materials component	Material	Code Reference
ix.	Threaded fasteners	IS: 1363	IS: 1367

1.7.5 Hydraulic Oil

Sl. No.	Description	Material	Code Reference
i.	Hydraulic Oil	Oil	ISO Grade

1.7.6 Material for Trash Rack Cleaning Machine

Sl. No.	Materials component	Recommended Material/Make	Specifications
i.	Structural parts, steel Apron, rake, guiding chute.	Structural steel	IS: 2062
ii.	Self-unloading Trash disposal vehicle	Standard reputed MAKE	
iii.	Hydraulic actuator	Standard reputed MAKE	
iv.	Power Pack	Standard reputed MAKE	
v.	Rake comb	Stainless/ Corrosion Resistant steel/ High strength poly Propylene sheet	IS 1570 (Part-V)-Gr.30 Cr 13
vi.	Fasteners	Stainless/Corrosion Resistant steel	IS 1570 (Part-V)
vii.	Rake wheels		Cast steel IS 1030

1.7.7 Materials for Pressure Shaft Liners

Sl. No.	Component Part	Recommended Materials	Code Reference
i.	Pressure shaft liners Ferrule, Bends bifurcation, Trust collar & Stiffeners rings	Boilers quality/pressure vessels quality steel	ASTMA537 Class1/ ASTMA517 Gr-F
ii.	Bond Breaking Material	Mixture of high-quality polyethylene copolymer with amorphous bitumen having following properties: Density: 0.97 g/cm^3 Modulus of rigidity: 130 Mpa Shrinkage reduction: 30%	DIN: 16729

1.7.8 Aquatic Life Discharge Piping with Knife Edge Gate Valve Material

Sl. No.	Component Part	Recommended Materials	Code Reference
i.	Knife edge plate	Stainless steel	IS 1570 Part-V
ii.	Valve sheet	Stainless steel	IS 1570 Part-V
iii.	Body	Carbon Steel	IS 2062 Grade B
iv.	Body Lining	Stainless steel	IS 1570 Part-V

Khorlochhu Hydro Power Ltd.

Sl. No.	Component Part	Recommended Materials	Code Reference
v.	Piping and bends	Heavy duty Seamless Stainless steel	ASTM 304

1.7.9 Substitute Material

In case the material specification of any component(s) proposed by the contractor is not in accordance with the technical specification, data in respect of those materials shall be submitted for assessing the suitability of the same. However, the bidder shall confirm that in case the materials proposed by him are not found acceptable, he shall abide by the materials specified in the specifications without any extra financial implications to the Employer

1.7.10 Workshop and Stacking yard at Site

Bidder shall also forward workshop layout drawing detailing out necessary requirement of equipment like Bending roll, SAW machine, Edge preparation profile cutting machine, Hydraulic press, Plate cutting sets, Manual welding machines, NDT testing Machines, Gamma rays source, DG sets required, Gantry crane, Hydra, shot blasting and Painting workshop etc. required for Penstock work and Gate works at site along with area required for workshop, storage etc. Bidder also shall submit penstock stacking area requirement at the start of the project.

1.7.11 Sub-Contractor/Vendor

The bidder shall include details of proposed sub-contractors including vendors for items of supply or services, it proposes to sublet or procure bought out items. The capabilities of sub-contractors and vendors shall be evaluated for acceptability based on previous references/ experience credentials etc. to be furnished by the bidder along with tender.

If required, the bidder may substitute an acceptable sub-contractor or vendor without any change in the bid price.

1.8 Permissible Stresses

1.8.1 Permissible Stresses for Gates:

a) Permissible Stresses for spillway Radial Gates, Overflow Spillway Service Gate, Intake Service Gate, TRT Outfall Fixed Wheel Gates, Chaplangchhu Intake Gate & their embedded parts:

Structural steel

i)	Direct compression and compression in bending	0.45 Y.P.
ii)	Direct tension & tension in bending	0.45 Y.P.
iii)	Sheer stress	0.35 Y.P.
iv)	Combined stress	0.60 Y.P.
v)	Bearing stress	0.65 Y.P.

b) Permissible Stresses for Gates & Embedded parts which are subjected to Wet & Inaccessible condition like Adit gates, Silt flushing tunnel gates & their embedded parts:

Structural steel

i)	Direct compression and compression in bending	0.40 Y.P.
ii)	Direct tension & tension in bending	0.40 Y.P.
iii)	Sheer stress	0.30 Y.P.
iv)	Combined stress	0.50 Y.P.
v)	Bearing stress	0.45 Y.P.

Khorlochhu Hydro Power Ltd.

c) Permissible Stresses for Spillway stop log, Overflow Spillway Emergency gate, Intake bulkhead gates, Downstream Desilting Chamber gates, Surge shaft gates & Tailrace tunnel gates, which are subjected to Dry & Accessible condition and Lifting Beam:

Structural steel

i)	Direct compression and compression in bending	0.55 Y.P
ii)	Direct tension & tension in bending	0.55 Y.P.
iii)	Sheer stress	0.40 Y.P.
iv)	Combined stress	0.75 Y.P.
v)	Bearing stress	0.75 Y.P.

d) Embedded parts for Spillway stop log, Overflow Spillway Emergency gate, Intake bulkhead gates, Downstream Desilting Chamber gates, Surge shaft gates & Tailrace tunnel gates:

Structural steel

i)	Direct compression and compression in bending	0.40 Y.P.
ii)	Direct tension & tension in bending	0.40 Y.P.
iii)	Sheer stress	0.30 Y.P.
iv)	Combined stress	0.50 Y.P.
v)	Bearing stress	0.45 Y.P.

e) Bearing Stresses

i)	Bearing stress in concrete	0.25 x (28 days) characteristics strength of concrete
ii)	Bearing stress in bronze	0.035 U.T.S. Y.P.

f) Wheel

i)	Contact stress (line contact)	1.6 U.T.S.
ii)	Point contacts	2.4 U.T.S
iii)	Wheel bearings (F.O.S)	1.5 x static capacity

g) Wheel Pin

i)	Bearing	0.35 U.T.S
ii)	Sheer	0.30 Y.P
iii)	Bending	0.5 Y.P or 0.2 U.T.S (Whichever is less)

h) Stresses under occasional Forces:

The stresses in the various parts of the gate under the action of occasional force like earthquake effect, storm wind, Max. Surge level, break down Torque condition etc. **shall not exceed 133 per cent of the permissible stresses mentioned above (125% in case of fasteners) subject to the maximum of 80% of the yield stress.**

i) Corrosion allowance of **1.5 mm** for the skin plate of gate and stop log except in case of submerge type radial gate is to be considered.

1.8.2 Permissible Stresses for Rope Hoist Equipment

As per IS: 6938, if not specified otherwise:

a) Drum

Permissible compressive stresses for various materials are:

- Cast steel (IS 1030) 0.2 U.T.S
- Structural steel (IS 2062) 0.17 U.T.S

b) Gears

Allowable stress 0.2 U.T.S

c) Shafts

i)	Maximum allowable bending stress	0.5 Y.P or 0.2 U.T.S (Whichever is less)
ii)	Maximum allowable torsional shear stress (τ)	0.3 Y.P
iii)	Combined stress	0.24 U.T.S
iv)	Allowable stress for shafts with keys will be 75% of the above value	
v)	Equivalent bending or twisting stress shall not exceed 1.2 times maximum allowable bending stress/shear stress at (i) and (ii) above.	

1.8.3 Permissible Stresses for Hoist Bridge, Hoist Support, Trestles & Hand Railing (Clearly above Water)

As per IS 800, if not specified otherwise

1.8.4 Permissible Stresses for Trash racks

The permissible stresses for trash racks shall be as specified in IS: 11388.

1.8.5 Permissible Stresses for Hydraulic Cylinder and their components

The calculation of cylinder working pressure and various frictional losses shall be as per DIN 19704-1. However, maximum theoretical working pressure at cylinder rod end shall be restricted to 20MPa. Relief valve at cylinder side may be adjusted at 10% (maximum) higher than the cylinder working pressure. The permissible stresses of various components of hydraulic Cylinder shall be as per table 1 of latest edition of IS: 10210.

1.8.6 Permissible Stresses and design of Power Pack for Hydraulic Cylinder

The Design of various components of power pack, Piping, Tank etc. shall be as per DIN: 19704. The hydraulic power unit shall be designed for a maximum design pressure at pump restricted to 22.5Mpa at pump. However, relief valve at pump side may be adjusted at 10% (maximum) higher than the design pressure. The allowable stresses of hydraulic pipes shall be as per Appendix A of latest edition of IS: 6631.

1.8.7 Permissible Stress for Steel Pressure Shaft/Penstocks Lining and specials

Permissible stress for steel pressure shaft/penstocks lining and specials shall be as per following standards:

IS: 11639 (part2)	:	Structural design of Penstock-Criteria buried/ embedded penstocks in rock
IS: 11639(part3)	:	Structural design of Penstock-Criteria specials for Penstocks.
IS: 2825	:	Code for unfired pressure vessels
ASCE EP 79	:	Steel Penstock manual

1.8.8 Permissible Stress for Aquatic Life Discharge Piping with Valves

- The piping & bends shall be designed for a head of 24m (approx.) water column with a factor of safety of two on yield strength of material.
- The valve shall be designed for a head of 24m (approx.) water column with a factor of safety of two on yield strength of material.
- **Test Pressure:** The valves shall be tested for a test pressure of 1.5 times the maximum operating pressure.

1.8.9 Minimum thickness of Plate

Minimum thickness of plates to be adopted for load bearing members of gate & hoists supporting structure shall not be less than 10mm.

3. TECHNICAL DOCUMENTS

1.9 General

This Chapter specifies the general scope and gives a definition of the documents which, together with those listed in the Particular Specifications, shall be delivered by the Contractor to the Engineer within the periods, and in a number and quality as specified in the General and Special Conditions.

The Engineer reserves the right to request the Contractor additional documents as may be required for proper understanding and definition of constructional, operational, co-ordination or other matters.

The Contractor shall co-operate with other Contractors in the exchange of drawings, dimensions, data and all other information required to ensure proper co-ordination of the work. All documents to be supplied shall be submitted in accordance with the agreed program so that any comment and change requested by the Engineer can be taken into account before starting of the manufacturing in the workshop and/or erection or installation at the Site.

If the Contractor fails to submit such documents, then the later execution of changes requested by the Engineer and the resulting additional cost and/or delays shall be the Contractor's liability. The contractor shall not be released of his responsibility and guarantee after drawings and computations have been approved by the Engineer.

The preparation of drawings, computations or other technical documents shall not be subcontracted by the Contractor without the written authorization of the Engineer. In such a case of subcontracting the Contractor shall be fully responsible for such drawings, computations and other technical documents as if they were done by himself.

If required for proper understanding of the documents, additional descriptions/explanations shall be given on these documents or on separate sheets. All symbols, marks, abbreviations, etc., appearing on any document shall clearly be explained by a legend on the same document or on an attached sheet.

Each device appearing on any document (drawing, diagram, list, etc.) shall clearly be designated. The abbreviation mark used for an individual device shall be identical throughout the complete documentation so as to avoid confusion. All documents shall have a uniform title-block as outlined in the specification. Beginning with the very first submittal to the Engineer, the Contractor's drawings shall bear a serial number.

Revised technical documents replacing previously submitted documents shall be marked accordingly. Also, the revised part in the Document itself shall be marked clearly. The documents required to be supplied shall be clearly marked as regard to their status namely **"FOR APPROVAL" (A), or "FOR INFORMATION" (I),** respectively.

Any comment given by the Engineer on "I" type drawing shall have the same effect as if it were given on "A" type drawing.

1.10 Design and Drawing

Manufacturer shall submit design computations and drawings to the Engineer for approval/information (as per requirement listed under para (3.3), which shall include in sufficient detail to show:

- Design calculation for all components and parts in accordance with design criteria & specification to prove their adequacy supported by catalogues / technical literature of all bought out components with selection criteria & characteristics.
- Kinematic details in the form of line diagram/sketches/data of gate and hoist establishing and describing the working stroke, total stroke, reserve stroke on piston



end side and head end side of the cylinder, the cylinder location and position in gate fully closed and in gate fully open position etc.

- General assembly and sub-assembly arrangement and detailed dimensions of the parts of the equipment to be supplied under the contract.
- Blockout drawings dimensioning locations of anchors and IST stage concrete outlines.
- Material lists covering specifications, sizes, quantities, and weight of each component.
- For all larger pieces of works which, due to their dimensions and/ or weight and transport limitations, will require special means for their transportation, the contractor shall submit binding loading drawings indicating dimensions weights, etc. of the respective pieces of works and the necessary trailer for its transportation to the site.
- Weld details.
- Machining and assembly tolerances and fits;

Diagrams

- The circuit diagrams shall show the power circuits in all phases with the main apparatus as well as the pilot circuits (measuring and control circuits). It shall show in full the functioning of part or all installations, works or circuits with all required technical information. This shall show all technical blocks control cubicle, cable details, cable tracks etc.
- Electrical wiring diagrams of hoist, hydraulic circuit, piping / cable lay out drawings, performance curves, specifications and catalogue numbers of all motor control centres, control panels, motors and accessories.
- Automatic or manual lubrication system, controls, control panels, motors and accessories.
- All handling attachment for site assembly.
- Control & Indicators.

The Contractor shall submit details of estimated machinery-imposed loads on concrete structures, location of anchors, groove details and checks in structures constructed by others shall be provided within 90 days of award of Contract having interfacing with civil works.

All drawings shall be carefully checked by Manufacturer for accuracy, completeness and clarity before submission to Engineer. Manufacturer shall be responsible for correctness and adequacy of the design in relationship to the specifications.

The approval of drawings or design shall not relieve or absolve the contractor of his responsibilities regarding adequacy of design/ drawings and correctness of design/drawings.

The Engineer shall have the right to ask the contractor to make any change in the designs and drawings, which may be necessary in the opinion of the Engineer to make the equipment conform to the provisions and intent of those specifications without additional cost to the Employer.

The requirements of any such alterations requested by Engineer shall not be construed to mean that the drawings have been checked in detail. It shall not be accepted as justification for an extension of time and shall not relieve Manufacturer from responsibility for the adequacy of the designs and correctness of the drawing.

The Contractor shall carry out and be responsible for the design of works. Design shall be prepared by qualified designers who are engineers or other professionals and have experience and capability necessary for the design. The contractor undertakes that the designers shall be available to attend discussions with the Engineers at all reasonable times until the date of relevant Defect notification period.

Khorlochhu Hydro Power Ltd.

The Contractor shall prepare all Contractors' Documents and shall also prepare any other documents necessary to instruct the Contractor's Personnel. The Employer's Personnel shall have the right to inspect the preparation of all these documents, wherever they are being prepared.

Any approval or consent, or any review shall not relieve the Contractor from any obligation or responsibility.

1.11 Submissions

The documents/design computations/drawings required to be submitted to the Employer for approval or information is broadly listed hereunder: -

1.11.1 Design

a. Radial Gate

For approval	For review	For information
Design calculations of load bearing important components of radial gates including gate leaf, horizontal girders, Arms & bracings, Trunnion assembly, Trunnion bracket and embedment's, lifting attachments, Connection details between various members(welded/bolted), Hoist capacity calculation	Guide Roller Assembly	C.G. Calculation, Model study reports, Walkway/ hand railings/gratings and other details.

b. Hydraulic Hoist

For approval	For review	For information
Cylinder, Stem, Rod end clevis, Head end clevis/attachment. Kinematic details in form of line diagram/sketches /data of gate & hoist establishing & describing working stroke, total stroke, reserve stroke on both ends. Fully extended/ fully collapsed length of cylinder assembly.	Cylinder heads end connections(fasteners), piston, threads and connections among various mating components,	Details & specification of sealing and bearing components, position indicators, Details of all other components.

c. Power Pack / Portable Power Pack

For approval	For review	For information
Selection of Pump, motor tank capacity.	Selection of piping, filters, valves, gauges, controls, pressure switches, & other components of hydraulic & electric circuits.	Write-up of description of working of Power pack. Write-up of Description of Electric Circuit scheme with interlocks.

d. Overflow Spillway gates, Intake Gates, Intake bulkhead gates, Spillway Stoplogs, Desilting basin downstream gate, Silt flushing gates, Surge Shaft Gate, Tailrace gates, TRT outfall gate, Adit gates and all Chaplangchhu gates.

For approval	For review	For information

Khorlochhu Hydro Power Ltd.

Gate leaf with lifting attachments, Wheel Assembly / bearing block (on slide gates), Wheel Track/Bearing Track (For slide gates), Connection details (weld/bolt), Hoist capacity calculations	Dogging device, Filling-in-valve, Bumper arrangement	Guide shoes, Guide wheels, and Other components.

e. Rope Drum Hoist, Motorized Screw Hoist, Gantry Crane & their Supporting Structures

For approval	For review	For information
Rope drum, Reduction gearing, Shafts, Keys/keyways, Stem, Nut, supporting structure /Gantry/TRCM Frame structure, End carriage	Rope clamps, Couplings, Plummer blocks, Wire rope and attachments, Motors, Brakes, Support structure, Pulleys, sheaves & attachments, Rake, Rake operating arrangement, Apron operating arrangement,	limit switches, cabling and power supply arrangement, cabin, Walkway, ladders, handrails, grating/ chequered plate/ hatch covers, control panel hydraulic actuators, hydraulic control system other components

f. Lifting beam

For approval	For review	For information
Structure, Hooks and operating mechanism, connections	Probe mechanism, End guide frames/arrangement	Other details.

g. TRCM

For approval	For review	For information
Rope drum, Reduction gearing, Shafts, supporting structure /Gantry/TRCM Frame structure, End carriage	Rope clamps, Couplings, Plummer blocks, Wire rope and attachments, Motors, Brakes, Support structure, Pulleys, sheaves & attachments, Rake, Rake operating arrangement, Apron operating arrangement,	limit switches, cabling and power supply arrangement, cabin, Walkway, ladders, handrails, grating/ chequered plate/hatch covers, control panel hydraulic actuators, hydraulic control system other components

h. Trash Rack

For approval	For review	For information
Bar, Horizontal members Connections (weld/bolt)	Embedded frame, Guides	Other details

i. Pressure Shaft and HRT Liner

For approval	For review/ information
Detail design of all Pressure Shaft/HRT Liner/Penstock, their specials (like Bends, manholes, transitions, bifurcations with reinforcements, thrust collar etc.) and liner thickness including stiffeners, if any, and respective welding details.	A complete list of all technical data.

Khorlochhu Hydro Power Ltd.

Bifurcation shall also be checked by FEM analysis/solid modelling,	

j. Aquatic Life Discharge piping with valves

For approval	For review/ information
Detail design of piping, bends & Selection of Knife edge gate valves.	A complete list of all technical data.

k. Instrumentation and Remote-Control System

For approval	For review	For information
Design criteria schematic diagram, Detailed write-up of description and working methodology.	Specifications & characteristics of components with manufacturer's catalogue / literature.	Detailed drawings/catalogues of all components, Application software etc.

l. Oil Filter Unit

For approval	For information
Name of manufacturer, Operating characteristics, detailed specifications	Data/ parameters supported with manufacturer's catalogue / literature.

1.11.2 Drawings

i) Radial Gate

For approval	For review	For information
Gate leaf Assembly, Sealing arrangement assembly, Trunnion assembly & bracket assembly, Hoist suspension / support arrangement assembly, horizontal girder assembly, apron assembly	All types of sub-assembly drawings.	Detailed drawings of all components

ii) Overflow spillway gates, Intake Gates, Intake bulkhead gates, Spillway Stoplogs, Desilting basin downstream gate, Silt flushing gates, Surge Shaft Gate, Tailrace gates, TRT outfall gates, Adit gates and all Chaplangchhu gates.

For approval	For review	For information
2nd stage installation assembly drawing, Gate leaf assembly drawing, sealing arrangement assembly, Wheel assembly drawing, Splicing arrangement, first stage block out drawings	All types of sub-assembly drawings.	Detailed drawings of all components

iii) Lifting beam

For approval	For review	For information
Assembly drawing, Hook and operating mechanism	Probe mechanism, all types of sub-assembly drawings	Detailed drawings of all components

Khorlochhu Hydro Power Ltd.

iv) Trash rack

For approval	For review	For information
General arrangement/assembly drawing/blockout and first stage embedded parts, embedded parts installation	Probe mechanism, all types of sub-assembly drawings	Detailed drawings of all components

v) Trash Rack Cleaning Machine

For approval	For Review/information
General arrangement drawing indicating details of rake, long travel mechanism, hoisting mechanism & trash disposal unit	Functional description and Electrical and hydraulic circuit diagrams.

vi) Hydraulic Hoist

For approval	For review	For information
General arrangement and Kinematics, Cylinder assembly, Hydraulic circuit drawings, Functional electrical circuit drawings, Hydraulic piping arrangement, Power pack and control layout (block drawing with dimensions/clearances)	Cable schedule, Hydraulic control panel, Electrical control panel, Position indicator	All other detailed drawings

vii) Rope Drum Hoist, Motorized screw hoist, Gantry Crane & their Supporting Structures

For approval	For review	For information
General arrangement drawings of Hoist/LT/CT, lifting arrangement, G.A. drawings of structure, Wire rope reeving arrangement, Assembly drawings.	Wheel bogie, LT Drive Assembly, CT drive assembly, Drum Assembly, End gear assembly, central drive unit assembly.	Plummer blocks, Wheels Rail/attachments, Shafts, Gears, Couplings Structural detailed drawings, All components drawings, Structural sub-assembly drawings.

viii)Aquatic Life Discharge Piping with Valves.

For approval	For Review/ information
General arrangement drawing indicating pipe thickness and knife edge valve details	Transition piece, dismantling joints, supports including all types of sub-assembly drawings,

ix) Pressure Shaft and HRT Liners:

For approval	For Review/ information

General Arrangement Drawings showing outline drawings to scale, showing relation of the equipment components, materials, and accessories. Detail Drawings of all pressure shaft liner / penstock, their specials and liner thickness including stiffener dimensions, if any, and respective welding details. This shall include fabrication drawings of straight ferrules, fabrication and development drawings for transition, liner, bends, reducer cones, bifurcation etc. (Shall be provided by Employer)	A complete list of all drawings and technical data. All detailed fabrication drawings.
All details of equipment and materials required for fabrication and/or assembly and drawings to be cross-referenced to all other drawings	

1.11.3 Data/Qualification/ Certificates required to be submitted for Penstock Liner

The Contractor shall provide certain types of drawings and other technical data to the Engineer for approval, such as the following to the extent applicable:

i) A QA/QC plan as per ASME Section VIII, Division 2, or equal, shall be submitted. This plan shall also cover subcontract monitoring. The QA/QC plan shall ensure weld traceability to the welder (such that code stamping of welder identification on the weld will not be required, e.g. through the use of a weld map) both for field and shop weld,

The plan shall address frequency and scope of fabrication, shop audits and job site erection audits. Also, the plan shall define the procedure to be used to ensure that test coupon welding is representative of the actual procedure being executed,

ii) Welding procedure specifications with procedure qualification records & all other documents required by ASME Section IX,

iii) Material certification with all test results for approval. This also includes welding consumables and miscellaneous materials,

iv) All deviations from the Specifications and/or Drawings shall be clearly noted and submitted to the Engineer for approval,

v) Liner Certificates

The Contractor shall provide a certificate with the following information for each steel liner (penstock pipe) section and bifurcation:

- Identifying number of the plates used for the liner section,
- Heat number of the plates,
- Numbers of the appropriate acceptance certificates for the plates,
- Records and numbers of certificates relating to tests performed on plates and on the completed liner section,
- Theoretical weight of the complete liner section,
- Documentation for welder traceability, to welds,
- Measured dimensions including plate thickness, liners section length, circumference, two perpendicular diameters, one of which is measured through the longitudinal weld, ovality and out of roundness,
- Radiographs,
- Results of ultrasonic tests,

Khorlochhu Hydro Power Ltd.

- Results of surface examination, (MT or PT),
- Thermal treatment,
- Results of water pressure tests for wye piece,
- Special remarks,
- Number and dates of the relevant reports.

Each certificate shall show in sketch form the sequence of the welds, the position of the radiographs and repair locations. A sample certificate (with hypothetical entries) shall be submitted to the Engineer for review prior to liner shipments.

1.12 Installation and Commissioning Procedures

1.12.1 Installation Procedures

The installations procedures shall describe in sequential steps the erection of major equipment and shall contain sufficient details such as equipment preparation on erection bay, handling of large and heavy pieces, leveling, anchoring, site welding, site painting, erection checks, site pressure tests, site flushing and cleaning of hydraulic systems, alignment and run out checks to allow the engineer to plan and supervise the Works at site. The contractor may submit his proposals for such installation but shall have to obtain the approval of the Employer before acting. Detailed instruction to the installation of the gates shall be given by the Employer or his authorized representatives at site and shall be binding on the contractor.

1.12.2 Commissioning Procedures

The commissioning procedures shall sequentially and in sufficient detail describe activities and tests for all systems covered by the Contract Document.

1.13 Operation and Maintenance Manuals

1.13.1 Contents

In the Operation and Maintenance Manual, all activities related to maintenance of a specific equipment or group of equipment should be mentioned in order of their importance, indicating clearly the frequency of maintenance. The type of maintenance should be stated clearly as compulsory, recommended but not mandatory or those that only need to be carried out with the judgment of the maintenance professionals at site during O&M stage.

Three (3) copies of the draft operation and maintenance manuals shall be submitted in English for approval of Engineer within three (3) months after the final approval of the equipment. **Eight (8)** sets of copies properly bound and placed in folder shall be provided to Engineer along with **two (2)** electronic copies in source format/software in editable form on good quality DVD/Pen drive not later than thirty (30) days after receipt of approval.

The Operation and Maintenance Manuals, shall contain the following information in sufficient detail to enable the Employer to maintain, dismantle, reassemble, adjust and operate the plant with all its equipment and installations:

(a) Table of Contents

(b) List of Illustrations

(c) Introduction

The introduction shall contain:

- A general description of the equipment,
- A description of the use of the equipment,
- Definitions of technical terms used in subsequent graphs of the instruction book,

Khorlochhu Hydro Power Ltd.

- A complete list of all items used in accordance with the Plant Components Identification System.

(d) Detailed Description

The detailed description shall contain a complete and accurate description of the equipment, all components and ancillaries, their assembling and dismantling. An accurate list stating clearances, tolerances, temperatures, fits, etc. shall be included.

(e) Operating Principles and Characteristics

A summary of the technical operating principles of the equipment, including diagrams, circuit diagrams, sequence diagrams, piping, etc. shall be included. The instructions shall be accurate and easy to understand and shall contain the sequence of individual manipulations required for operation. The information shall be presented in such a manner that the contents of this paragraph can be used for instructing personnel in the operation of the equipment. Tables, lists and graphic presentations should be used whenever possible to make the description readily understandable. An appropriate trouble-shooting list shall be included in this chapter.

(f) Testing and Adjustment

The entire testing and adjustment procedure required for the plant after maintenance/ overhauls during operation shall be described.

(g) Maintenance Instructions

This section is divided into five parts:

i) Preventive maintenance, indicating the inspections required at regular intervals, the inspection procedure, the routine cleaning and lubricating operations, the regular safety checks and similar steps. The maintenance instructions shall include a tabular (or in other approved form) Summary of the required activities sorted according to

- Daily
- Weekly
- Monthly
- Quarterly
- Yearly
- (Or other) cycles as applicable.
- Procedures for determination of Residual Life Assessment of all installations.

The overhauling timeline and specific materials replacement requirements should be clearly mentioned

This document shall provide the maintenance engineer with brief and yet fully comprehensive information including all references to the applicable, detailed service and maintenance instructions.

ii) Repair and adjustment, describing the inspections, fitting and dismantling of parts, fault tracing as well as repair and adjustment procedures,

iii) Spare part lists, containing all the necessary data for ordering spare parts. These lists shall include all spare parts; those to be supplied and those not to be supplied under the present Contract. The prices for spare parts shall be indicated in the list,

iv) Tool lists, containing all necessary data for identification of tools to be supplied,

v) List of suppliers and alternative suppliers and addresses.

(h) As-build drawings provided in both hard and soft copies.

As built drawings shall be prepared and submitted for all works, equipment and components incorporating all changes made during execution of works till commissioning. The Contractor shall supply the Employer with six (6) hard copies and two (2) electronic copies in source format/software in editable form of each as-built drawings.

1.13.2 Structure of Manual

The Employer reserves the right to specify a uniform cover (loose Leaf binder) for all operating and maintenance manual prepared by various subcontractors/joint venture parties.

The Employer shall decide the final size of drawings for the Operation and Maintenance Manual. Catalogue sheets, illustrations, printed specifications etc., shall be checked and prepared by the contractor in such a way that figures, statements and data valid for the delivered sizes and types of equipment concerned are clearly marked. All figures, statement and data valid for sizes and types not delivered must be crossed out.

1.13.3 Revisions and supplements

The Contractor and Employer shall jointly check the completeness of the manuals during installation, testing, commissioning and trial operation.

If it becomes evident during the installation, trial operation and guarantee period of the equipment that the Operation and Maintenance Manuals are inadequate or incorrect, the Contractor shall immediately supply the necessary supplements and corrections. This shall be handled in the following manner:

- **Deletions**

  One sheet of errata printed shall be issued indicating the pages and date of issue of those pages, which are to be deleted, and are no longer valid.

- **Corrections, Revisions, Replacements:**

  A new sheet or sheets shall be issued to replace the relevant pages. Whenever a new sheet is added to the instruction manuals, this sheet shall be given the new date of issue and a revision symbol, and an indication" Substituted for…" and a marking of the corrected/revised items.

- **Insertions, Supplements:**

  A new respective "Table of Contents" page shall accompany insertions or supplements where the latter shall be handled as described above under Replacements. The revision and supplements requested by the Employer shall be made by the contractor, as far as possible, at the Site and shall be submitted in each case to the Employer for checking and decision as stated above.

Before issuing the "Taking-Over Certificate", the revised copies of the Operation and Maintenance Manual shall be submitted together with the specified number of complete sets of drawings of the Works as completed. The Works shall not be considered complete for purposes of taking over under the terms of the General Conditions of the Contract until the Contractor has supplied the above documents.

1.14 Progress Reports

1.14.1 Progress Reports during Design and Manufacturing

The Contractor shall monthly submit **four (4)** copies of the progress reports in a format acceptable to the Engineer, detailing the progress of the work during the preceding period. The report shall contain (but not be limited to) the following information.

- A general description of the Works performed during the reporting period on each main activity,

- Overall percentages of the works completed, with reference to the CPM programme,
- The percentages of each main work activity completed during the reported month with reference versus the scheduled programme,
- A list of activities scheduled to be started within the next period of three (3) months, with expected starting and completion dates. Any notable problems, differences, comments with reference to the schedule may be supported with appropriate documents.

1.14.2 Progress Reports during Installation at Site

During erection the Contractor shall, before the tenth (10th) day of each calendar month, submit four (4) copies of the monthly progress reports in a format acceptable to the Engineer, detailing the progress of the work during the preceding month. The report shall contain but are not be limited to the following information:

- A general description of the Works performed during the reporting period on each main activity,
- The total overall percentages of erection work completed, with reference to the CPM program,
- The percentages of each main work activity completed during the reported month with reference versus the scheduled program,
- A list of all activities of scheduled and actual progress during the reporting period including actual starting dates versus scheduled starting dates; and actual completion dates versus scheduled completion dates for each activity,
- A list of activities scheduled to be started within the next period of two (2) months, with expected starting and completion dates. If the expected starting and/or completion dates are different from those shown on the CPM program, an explanation shall be given,
- Contractor shall also briefly report the manpower strength and expatriate personnel employed, equipment etc. deployed during the reporting period,
- A statement concerning potential problems and recommendations on how they could be resolved.

1.15 Working on Wrench System

Bidder to follow the "Wrench System" for submission of documents and inspections/document review. The list of document and drawings (MDL-Master document list) to be submitted by Bidder during detailed engineering stage for owner's review/approval/information shall be mutually decided during Kick off meeting for this contract.

1.16 Submission of Native files and editable version of all drawings, documents & calculations:

All the drawings shall be submitted by Bidder in AutoCAD as well as in PDF format. All the reports shall be submitted by Bidder in PDF format to the owner for review as well as for record. Authorized and licensed version shall be used by the Bidder in case of AUTOCAD, MICROSOFT, and ADOBE All documents and drawings for this project shall be in clear and legible English language. All Native files and editable versions of all analysis, studies, drawings, documents & calculations shall be submitted.

4. SPARE PARTS AND TOOLS

1.17 Spare Parts

All spare parts to be supplied shall be interchangeable with the corresponding parts of all the Works supplied under these Specifications and shall be of the same material and

Khorlochhu Hydro Power Ltd.

workmanship. They shall be replaceable without cutting or destruction of adjacent components. Before issue of the Taking-Over Certificate the spare parts shall be checked and tested at the Site by the Contractor in presence of the Engineer.

Acceptance of any spare parts will not take place before the Contractor has submitted the complete final detailed list of all spare parts and tools.

All spare parts shall be protected against corrosion and shall be marked with identification labels in the Ruling Language. The identification shall be in accordance with the agreed Works Identification System.

All spare parts, tools and materials shall be delivered in marked boxes of sufficient sturdy construction to withstand long term storage.

1.17.1 Mandatory Spare Parts

The required specified spare parts are listed separately in the Particular Technical Specifications. The price for each listed spare part shall be quoted individually in the Price List; the total price of spares shall be included in the Total Tender Price.

1.17.2 Recommended Spare Parts

If any additional spare parts are recommended by the Bidder, these shall be stated in quantity and description in the technical particulars of Data Sheets and in price schedule for each item.

Orders for recommended spare parts shall be optional to purchase by the Employer for a period of five (5) years after the date of the completion of the project. However, recommended spare parts will not be considered in tender evaluation.

1.17.3 Mandatory Tools and Tackles

Tools and tackles required for maintenance of the specified equipment shall be quoted individually in the price list. The total price shall be included in the total tender price.

1.17.4 Recommended Tools and Tackles

If any additional tools and tackles are recommended by the tenderer for a period of 5 years trouble free operation, these shall be stated in quantity and description in the technical data sheets for each item.

5. DESIGN AND MANUFACTURE

1.18 Design and Construction Requirements

The following directions, information and technical requirements for layout, design and erection shall be observed as far as they are applicable to the Works to be offered. The technical requirements of the General Technical Specifications are valid for all parts of the Works except where they are varied by additional and/or special requirements, specified in the Particular Technical Specifications.

Whenever a Tenderer deviates from these Specifications, he shall furnish the data called for in the Technical Data Schedules and give a summary of and the reasons for all deviations in the "List of Technical Deviations from Specifications". Failure to accomplish this may cause the elimination of his Tender, especially when a major deviation is involved. Any changes of the design of any part of the Works, which may become necessary after signing the Contract have to be submitted in writing to the Engineer for approval, being sufficiently substantiated and justified.

Additional cost can only be accepted in case of a basic design change by the Engineer after award of Contract.

The Works shall be designed, manufactured, arranged and installed to provide functional design and neat appearance. All parts of the Works shall be arranged to facilitate

Khorlochhu Hydro Power Ltd.

surveillance, maintenance and operation. All control sequences shall be simple and rational.

The parts of the Works shall be designed and arranged so that they can be easily inspected, cleaned, erected and dismantled without involving large scale dismantling of other parts of the Works. They shall be designed and manufactured in accordance with the latest recognized rules of workmanship and modern engineering practice.

The regulations, standards and guidelines listed in these Specifications shall be observed in the design, calculation and manufacture of the Works.

All parts of the Works shall be suitable in every respect for continuous operation at maximum output under the climatic conditions and operating conditions prevailing at the Site.

Special attention shall be given to Works, parts of which are delivered by different manufacturers. Problems arising in this conjunction shall be solved by the Contractor and be defined in writing.

For individual items of the Works, materials and design are to be selected which are best suited for the operating conditions to which the parts in question will be subjected. Only such design and types of Works shall be offered which has confirmed its reliability in long-term continuous operation.

All live, moving and rotating parts shall be adequately secured in order to avoid danger to the operating staff. All electrical components shall be electrically earthed as per the latest practice.

Manufacturers shall take appropriate measure to prevent the ingress of dust into any Works (such as bearings, relays, control and measuring equipment etc.) which may be endangered thereby.

Suitable lifting eyes and backing-out bolts shall be provided where required or where they will be useful for erection and dismantling.

Pockets and depressions likely to hold water shall be avoided, and if not avoidable they shall be properly drained. Parts of the Works principally intended for standby purposes shall be protected from corrosion by careful choice of material and if necessary, by additional means these should not reduce their continuous standby readiness.

All design details and layout matters shall be discussed in periodic meetings with the Engineer. The first design meeting between the Contractor and the Engineer shall take place within 28 days after the Date of Commencement. Further design meetings shall take place as agreed between the participants until the design work is completed.

Lettering of the drawing shall be at least 3 mm high in block capitals. The sizes of Manufacturers drawings shall conform to International Organization for Standardization (ISO) sizes. All drawings shall bear the mutually agreed title block, and drawing number as per the coding and pattern available with the employer. All drawings shall be drawn in accordance with Indian Standards, to scale, and shall be legible. Wording on drawings shall be in English. Symbols shall be in accordance with Indian Standards. Manufacturer shall submit to the Engineer four (4) prints each of all documents / drawings for **approval/ information**. If revisions are required after a drawing has been submitted, manufacturer shall resubmit four (4) additional prints for **approval** after incorporating the comments. Fabrication shall not commence until Engineer has approved drawings and thereafter no change shall be made on any drawing without the approval of the Engineer.

After designs and drawings are completed and approved, the manufacturer shall supply four (04) sets of all the design and 8 prints of drawings & 6 prints of all approved "As Built Drawings". However, prior to completion of contract manufacturer shall supply 4 sets of design & drawings (soft copies) on good quality DVD/ Pen drive suitable for editing and printing.

Khorlochhu Hydro Power Ltd.

Drawings shall be submitted to Engineer for approval sufficiently in advance prior to the date on which they will be required to ensure that the work is carried out in compliance with approved schedule of work.

1.19 Design Criteria

The Works shall be designed for the worst possible combination of the following loading conditions as applicable:

i) All static and dynamic hydraulic loads,

ii) All loads due to dead weight and frictional forces,

iii) Seismic or wind loads, and

iv) Other loads.

The full reservoir level, maximum water level, sill elevation and design criteria are described in particular specification required for the design.

The basic wind load of 1500 N/m. sq. shall be applied on the vertical projected area of exposed equipment, multiplied by the form factors for the different type of structures in accordance with IS: 875.

The wind load for the stability check of gantry crane, etc. shall be 600 N/m sq. while operating and 1500 N/m sq. when out of service.

Other Loads

Load on the footpath, balcony floor, platform : 5000N/m^2.

Vertical load on steel roof structures : 2500N/m^2.

Vertical load on each part of ladder : 1800N/m^2.

1.20 Tolerance and Clearance

The following design clearance shall be submitted to the Engineer In-charge for approval:

- Clearance between end of main Roller housing (side of gate) and gate guide.
- Clearance between moving gate components with respect to face of concrete/steel lined grooves.

1.20.1 General Clearances

- Side guide to guide track : 6 mm in any direction
- Pre-compression of side and top seals : 3 mm
- Pre-compression of bottom wedge type seal : 5 mm
- Minimum clearance between gate/stoplog bottom face to dogging or deck/maintenance platform (whichever is higher) : 300 mm
- Minimum clearance from extreme top part of gate/stoplog to crane/hoist : 300 mm
- Minimum recess from concrete face to Extreme part of gate/ stoplog : 100 mm

1.20.2 Fabrication Tolerances

All components shall be fabricated in accordance with **IS 4622** except as noted below: -

- All dimensions under 400 mm shall be ±0.8 mm unless otherwise specified and are non-cumulative. All other dimensions shall be ±1.5 mm.

Khorlochhu Hydro Power Ltd.

- The machined sealing surface of the sill and lintel beams and side guides shall be straight within 0.5 mm and level within 1.0mm over the whole length with a straight edge.
- The roller path below the lintel shall be straight within 0.4 mm in any 3 m length and within 0.8 mm over the whole length and shall not deviate from a vertical line in any direction by more than 1.0 mm. Roller path faces for the same gate shall be in the same plane within 1.0 mm
- The roller path above the lintel shall not deviate from a vertical line in any direction by more than 2 mm and shall be straight within 2 mm over the full length.
- The side roller paths shall be straight within 1.0mm in any 3 m length and within 2mm over the full length. The side roller path shall not deviate from a vertical line in any direction by more than 2mm
- The distance between the side roller paths and the main roller paths shall not vary by more than 3mm.
- Radial run out of assembled roller shall not exceed 0.025mm of total indicator reading measured at the roller tread.
- The bearing surfaces of roller treads on an assembled gate section shall be straight within 0.1mm over the full height of the section. The roller axis shall be parallel to the machined top and side seal bases of the gate within 15 minutes.
- Wheel treads, seal bases (top and side), bearing faces and seal faces (side and top) on an assembled gate should be in a true plane.

1.20.3 Installation Tolerances

Installation tolerances shall not exceed 1.5 times the corresponding fabrication tolerance or the tolerances specified in the relevant IS codes whichever is the more stringent. Design and fabrication of the gates, hoist and embedded parts shall be suitable for the achievement of such tolerances during installation.

1.20.4 Alignment and Tolerances of Pressure Shaft Liner

The shell sections of the completed pressure shaft liners/penstock shall be circular within the limits defined hereunder. Measurement shall be made to the surface of the parent metal and not to a weld, fitting or other raised part. There shall be no flats or peaks at welded seams and the local departure from circularity shall be gradual.

Alignment: - Before any welding is commenced, it shall be ascertained that the chamfered edges are in alignment and that the defects in alignment at the surfaces of the plates are less than:

a) For plates of thickness 5mm or less than t/6 for a longitudinal seam and t/4 for circumferential seam subject to a maximum of 1mm.

b) For plates over 5mm in thickness before any welding is commenced it shall be ascertained that the prepared edges are in alignment to meet the requirements of the welding process and that the defects in alignment at the surface of the plates are not more than:

   i) 10 percent of the nominal plate thickness with a maximum of 3mm for longitudinal joint. However, for plate's upto and including 10mm thick a misalignment of 1mm is permitted.

   ii) 10 percent of the maximum nominal plate thickness plus 1mm with a maximum of 4mm for circumferential joints.

Circumference: - The circumference shall conform to para 6.6.3 of IS 2825-1969.

Out of roundness of vessel: - The difference between the maximum and minimum diameters at any cross section of the shell welded longitudinally shall not exceed 1% of the nominal internal diameter subject to a maximum of:

Khorlochhu Hydro Power Ltd.

$$\frac{D1 + 1250}{200}$$

Where D1 is internal diameter in mm.

The individual cylindrical shell shall be reasonably square and straight. The axis of the pipe sections shall be normal to the axis of the pipe within a tolerance of 2mm on the radius. The edges of the plates of each course shall be properly prepared for field welding. Unless otherwise specified the out of straightness of the shell shall not exceed 0.3 per cent both of the total cylindrical length on any 5m length (This tolerance may be omitted where the individual shell length does not exceed 2m).

Attachments and fittings: -

All lugs, brackets, saddle type nozzle, reinforcement around openings and other attachments shall conform reasonably to the curvature of the shell or surface to which they are attached.

1.21 Standardization of Works

Every effort shall be made to standardize parts and minimize costs throughout the Works in order to facilitate replacement, interchangeability, keeping stocks, maintenance etc.

The Engineer, therefore, reserves the right to request the different Contractors to use uniform types or makes of Works and materials. The Contractor shall not be entitled to claim extra payment due to this request. This request shall especially be applicable to small mechanical and electrical Works such as:

- seals,
- fasteners,
- oils and lubricants,
- valves,
- thermometers,
- pressure gauges,
- flow meters,
- water level gauges,
- terminals and terminal racks,
- indicating instruments and meters,
- auxiliary relays,
- contactors, fuses,
- motor protection switches,
- control devices,
- lights, bulbs, plugs, sockets.

The types or makes to be used shall be decided later by the Engineer. All instrument scales shall be written in the Ruling Language of the Contract.

1.22 Quality of Materials and Workmanship

For general requirements concerning the quality of materials and Works refer to the General Conditions of contract and the applicable sections of the "Particular Technical Specifications (PTS)' shall be referred.

All materials shall comply with the latest IS standards, or other Standards specified unless otherwise specified. The materials and workmanship throughout shall be the best of their respective kind and free from defects. The design of all equipment shall be such that installation, replacements and general maintenance may be undertaken with the minimum of time and expense. All fitted joints shall be machined and castings shall be spot faced for nuts. All components shall be built in accordance with approved drawings only. No patching plugging or other such means of overcoming defects, discrepancies or errors shall be done without written permission of Engineer.

Khorlochhu Hydro Power Ltd.

No welding, burning, filling or plugging of defective castings or any other components shall be permitted without the Engineer's agreement in writing.

Where stainless steel cladding consists of plates welded to mild steel sections, the welds shall be adequate to ensure that the stainless steel is securely fixed for all conditions of load and wear. Generally, all stainless-steel parts shall be welded with stainless electrodes. The thickness of the stainless-steel cladding shall not be less than 3 mm.

Similar parts shall be made to gauge where possible, to ensure that such parts are interchangeable one with the other.

The Contractor shall be responsible for the accurate manufacture and fabrication of equipment in accordance with the best modern practice in the manufacture and fabrication of materials of the types covered by these specifications notwithstanding the minor errors or omission therefrom.

Dimensions shown on the drawings shall be adhered to closely and the work shall in all cases be of high grade and carefully performed to the satisfaction of the Engineer-in-Charge. The contractor shall warrant all materials and workmanship furnished by him to be free from injurious defects. He shall replace free of cost any defective materials or workmanship discovered during erection or in guarantee period and shall pay the actual cost of the correction on the field of any errors for which he is responsible.

The Contractor shall supervise the leveling and adjustment of all parts of the equipment on the foundations and after each item is set up and the Engineer's approval obtained, grouting or concreting will be carried out by the civil works contractor's and verified by the Contractor. The Contractor shall be responsible for ensuring that such work is carried out to his satisfaction and that levels and adjustments made by him are not disturbed by the grouting operation. The Contractor shall be responsible for ensuring that the positions, levels and dimensions of the Works are correct according to the drawings notwithstanding that he may have been assisted by the Engineer in setting out the said position, levels and dimensions. **The Contractor shall use not more than five layers of shims for equipment foundation preparation and alignment of equipment.**

1.23 Works Identification System

An approved, uniform Works identification system shall be applied for all mechanical, electrical and Instrumentation and Control (I&C) Works to be agreed upon during detailed design.

1.24 Identification Plates

1.24.1 General

Each important part to be delivered under this Contract shall be equipped with permanent identification plates in readily visible locations. Whether a part shall be considered as important in this respect shall be decided by the Engineer.

The identification plates shall be protected during erection and especially during painting. Damaged or illegible identification plates shall be replaced by new ones. The identification plates of non-corroding, non-disintegrating material (except manufacturer's nameplates of small, standardized components) shall be inscribed in the Contractual language.

The inscription shall be printed, stenciled, or hand-written, but in any case, waterproof, oil-proof and wear-resistant. Works (machines, transformers, etc.) nameplates shall be either of the enameled type or be of stainless steel covered after stamping with a transparent paint. Wording, size and material of all labels and plates shall be subject to the Engineer’s approval.

1.24.2 Manufacturer's Nameplates

All equipment shall be provided by a securely fastened name plate showing the maker's name, model, serial numbers, year of manufacture, main characteristics data of the

Khorlochhu Hydro Power Ltd.

respective equipment and further relevant information specified in the applicable standards or necessary for the proper identification of the equipment involved.

1.24.3 Instruction Plates

All plates showing designations or instructions for operation, safety, lubrication, etc., shall have a uniform design. Instruction plates, sequence diagrams or instruction to operating staff shall be displayed on the inside of the front door of the control panel/switch board. All works inside cubicles, panels, boxes etc. shall be properly labeled with their item numbers. This number shall be the same as indicated in the wiring diagrams works lists, operation and maintenance manual.

All instruction plates displayed on the sub-assemblies like servomotors, power pack hoist etc. shall show operational parameters, safety, lubrication etc. which shall have a uniform format.

1.24.4 Warning Plates

Warning labels for safety of equipment as well as operating staff shall be provided and shall be of synthetic resin with letters engraved in the contract language.

1.25 Fabrication of Steel Works

Rounding's, Chamfers, Edges: The edges of surfaces to be painted shall be rounded (minimum radius 2 mm) or chamfered accordingly. This requirement must be stated in all shop drawings for the relevant parts.

Structural steel: Work shall conform to the requirement hereinafter specified, unless otherwise called for in these specifications or on the drawings. Finished members shall be free from twists, bends and open joints. Compression joints shall have surfaces truly faced so as to have full contact bearing when aligned and welded or bolted.

Straightening of materials: Before being laid off or worked, rolled material shall be straightened and shall be cleaned of all rust and dirt. If straightening is necessary, it shall be done by methods that will not be cause for rejection of the material.

Shearing and cutting: Shearing and cutting by torch shall be performed carefully and in all work which will be exposed to view after completing shall be finished neatly. Sheared or cut edges of plates more than 16mm thick which carry computed stresses shall be planned to a depth of 6mm. Re-entrant cuts shall be filleted before cutting.

Holes: Holes in structural steel members carrying calculated stresses shall be sub-punched to 3mm less than the nominal diameter and reamed to full size or drilled after assembly. All other members may be punched to full size. Main members shall be assembled in the shop prior to reaming or drilling holes for field connection.

Accuracy of punched holes: Holes shall be punched so accurately that after assembling the component parts of a member, a cylindrical pin 3mm smaller in diameter than the nominal diameter of the punched hole may be entered perpendicular to the face of the member, without drifting in not less than 75 per cent of any group of continuous holes in the same plane. All holes shall punch a pin 5 mm smaller in diameter than the nominal diameter of the holes.

Reaming: Reamed holes shall be cylindrical, perpendicular to the member, and not less than 1.5 mm nor more than 2.5 mm than the nominal diameter of the bolts. Built up members shall be assembled and firmly bolted together before any reaming is done. Reamed parts shall not be interchanged. Burrs and savings from reaming shall be removed and, if necessary, reamed pieces shall be taken apart before being joined and the shavings removed.

Drilling: Drilled holes shall be cylindrical perpendicular to the member and 1.5mm larger than the nominal diameter of the rivet.

Khorlochhu Hydro Power Ltd.

Accuracy of reamed and drilled holes: Holes shall be drilled and reamed so accurately after assembly that not less than 85 per cent of any group of continuous holes in the same plane shall show no off-set greater than 0.8mm between adjacent thicknesses of metal.

Removal of burrs: Burrs resulting from reaming or drilling shall be removed with a tool making a 1.5mm level.

1.26 Surface Finish

1.26.1 Finished Surfaces

Where the finish is not indicated or specified, the type of finish shall be that type which is most suitable for the surface to which it applies and shall be consistent with the class of fit required.

Surface finish shall be indicated on the shop drawings by symbols. Compliance with the specified surface shall be determined by the sense of feel and by visual inspection of the work compared to applicable "Standard Roughness Specimens", or with roughness feeler gauge instruments. Both "Standard Roughness Specimens" and feeler gauge instrument shall be provided by the Contractor at the request of the Engineer.

1.26.2 Unfinished Surfaces

As far as practicable, all work shall be laid out to secure proper matching of adjoining unfinished surfaces. Where there is a large discrepancy between adjoining unfinished surfaces, they shall be chipped and ground smooth, or machined to secure proper alignment.

Unfinished surfaces shall be true to the lines and dimensions shown on the drawings and shall be chipped or ground free of all projections and rough spots. Depressions or holes not affecting the strength or usefulness of the parts shall be filled in a manner approved by the Engineer.

1.26.3 Protection of Machined Surfaces

Machine-finished surfaces shall be thoroughly cleaned of foreign matter. Finished surfaces of large parts and other surfaces shall be protected with wooden pads or other suitable means. Unassembled pins or bolts shall be oiled or greased and wrapped with moisture-resistant paper or protected by other approved means.

1.27 Fasteners

Bolts, Studs, Nuts and Screws: They shall have standard threads and be of high quality steel. All standard size bolts, studs, nuts and screws (including their washers) shall be heavily protected against corrosion or made of stainless steel if so specified in the technical Specifications. Nuts and bolts heads shall be hexagonal in shape & truly faced. Nuts & bolts and screws which might become loose during operation shall be locked in fastened position by means approved by the Engineer.

All bolts shall have unified threads. Bolts in tension shall have a net section at root of thread, 15 percent in excess of the net section required in tension.

Field Jointing: All fasteners for field joint shall be supplied 5 per cent in excess of actual requirements. This should be indicated in the drawings/bill of material.

1.28 Welding

Members to be joined by welding shall be cut accurately to size, and where required, shall be rolled or pressed to proper curvature in accordance with the approved drawings. The dimensions and shape of edges to be joined shall be such as to allow thorough fusion and complete penetration and plates shall be planed if necessary, to accomplish this result. Members to be welded together shall be in sufficient intimate contact at the time of welding so that members will not be forced more closely together with the cooling of the weld, thus setting up additional strains and distortions in the weld and parent metal.

Khorlochhu Hydro Power Ltd.

The cut surface shall be free from all visible defects such as lamination, surface defects caused due to shearing or cutting or flame cutting operations. The surfaces of plates to be welded shall be free from dust, grease and scale for a distance of 12mm from the welding edge at the time of welding. Flame cutting may be used in the preparation of the various members provided the operation is performed carefully and the edge so cut are cleaned thoroughly after being cut so as to expose clean metal. Any contour irregularities at points of critical stress shall be removed by grinding.

All welding shall be carried out using a suitable welding sequence/procedure approved by the Engineer and in such a way that harmful effects of welding are avoided.

When the welding process has been approved by the Engineer, the contractor shall produce a record drawing to show the approved process. The drawing shall include details such as the form of edges to be welded, electrodes and other welding materials, welding sequence etc. Changes in the welding process after the welding method has been approved shall require the consent of the Engineer.

Additional copies of all records of all welding procedures, including preheating and stress relieving, chemical analysis and physical properties, shall be made available to the Engineer upon request.

Unless otherwise allowed by the Engineer all welded parts to be welded shall be manufactured of steel produced by open hearth or electric furnace with carbon content not more than 0.20 % and a Phosphorous content not more than 0.05%.

A welding process approved by the Engineer generally in accordance with the standards specified in the Technical Specification shall be followed. Approval of the welding procedure shall not relieve the Contractor of his responsibility for correct welding and correct selection of electrodes and minimizing of defects in the finished structure.

All welding shall be done by the electric arc method or by a process, which will exclude the atmosphere from the molten metal, except where otherwise specifically permitted. The welding electrodes shall be heavily coated type designed for all position welding. In assembling and during welding, the component parts of built up members shall be held in place by sufficient number of clamps or other adequate means to keep all parts in proper position.

The Contractor shall follow the steel manufacturers instructions/ recommendations concerning electrodes and other materials and post & preheat treatment. Notwithstanding the above, the suitability of electrodes to be used for welding for both shop and field welding shall be demonstrated by trials to the satisfaction of the Engineer.

The strength of welding of all equipment subject to high and/ or alternating stresses, vibrations etc. shall be at least equal to the strength of the parts being welded. Between plates and other sections where such stresses are to be transmitted only butt welds shall be permitted. At welded butt joints, where the weld material is required to be deposited on both sides of the joints, the weld shall be chipped thoroughly to obtain a clean surface prior to the application on the first head of the welding on the opposite side of the joint. Where fillet welds are used, the lapped sections shall fit closely and shall be held together during the welding operation. Surfaces to be welded shall be cleaned of loose scale, slag, rust, paint and other foreign matter, except that a thin coat of linseed oil need not be removed before welding. When weld metal is deposited in two or more layers, each layer shall be brushed with a wire brush or otherwise cleaned before subsequent layer is deposited. In welding precautions shall be taken to minimize stresses due to expansion or contraction by peening the welds while hot, or by other satisfactory methods. Correction of distortion by blows, after welding is completed and the place is cold, will not be permitted. Upon completion, the welds shall be brushed with wire brushes and shall show uniform section, smoothness of weld metal, feather edges without excessive overlaps and freedom from porosity and

Khorlochhu Hydro Power Ltd.

clinkers. Visual inspection at edges and ends of fillets and butt joints welds shall indicate good fusion and penetration into base metals.

The specification regarding welding including the technique of welding employed, the appearance and quality of welds made, and the methods used in testing of the welds, and in correcting defective work shall conform to relevant Indian Standard or other standards specified.

All shop and field welding performed on the work shall be subject to inspection by Engineer when welding plates, of which one or both exceed 25mm in thickness. Continuous areas of plates around the welding operation shall be preheated to not less than 700 C and kept at a substantially uniform temperature throughout the process. The temperature shall be measured by Tempil sticks or other approved means. Low hydrogen electrodes shall be used everywhere. Peening of multiple pass welds to control distortion or to minimize residual stresses may be carried out with light blows from a power hammer using an elongated round nosed tool. Peening shall be done after the weld has cooled to a temperature warm to the hand. Care shall be exercised to prevent scaling, flaking or rupturing of weld and base metal from over peening. Neither the first nor the last pass of a multiple pass weld shall be peened.

All welds on stress-carrying members shall be done in Manufacturer's shop unless otherwise agreed by Engineer. In general, only no-load- carrying seal welds will be permitted in the field. All field welding shall have prior agreement of Engineer. Tack welds shall be permitted only as a temporary weld required for assembly purposes.

The welding sequence shall be planned to control and minimize distortion and, where necessary, shall include stress relief to minimize residual stresses. Minimum stress-relieving requirements are specified in the appropriate sections of these specifications.

Welded components subject to vibration and stress reversals shall be fabricated with full-penetration welds.

For welding of principal stress carrying parts the standards of welding procedures, qualification of welders and welding accessories shall conform to relevant Indian Standards or equivalent to the requirements of the ASME Boiler and pressure vessel codes section VIII and IX, or DIN EN 287. All welders assigned to the work shall have passed a performance qualification test. If more than one year has elapsed since the welder passed his last test, then he shall be tested and qualified again.

Not withstand the above weld procedure for steel liner/ penstock must conform to section IX of the ASME code or relevant clauses of IS 2825.

1.28.1 Stress Relieving/Post Weld Heat Treatment

All penstock sections/ steel liners and parts must be given a post weld heat treatment at temperatures not less than those specified in the ASME code, section VIII, division 1 (Table UCS-56, UCS-56.1, UHA-32, and UHT-56) when the nominal thickness of any welded joint in the penstock section or parts exceeds the limit in those tables or as per Table 6.3 of IS 2825.

All forgings shall be normalized and all castings shall be annealed.

1.29 Corrosion Protection

1.29.1 Surface Treatment and Protection

The manufacturer shall provide as part of his work/supply the surface treatment, priming, corrosion protection and painting of the equipment furnished. Such work shall include the coating and painting work at the workshop and at the site unto and including the finish painting. Unless otherwise specified the coating and painting shall be carried out in accordance with the latest Indian Standards or International standards.

All priming and painting material shall satisfactorily fulfil the requirements imposed by the site conditions, as well as the stresses to which the respective equipment is subjected during

Khorlochhu Hydro Power Ltd.

operation of the works. Shades of the finishing coatings shall be as approved by the Engineer.

Each coat of primer and paint shall be compatible with the previous and subsequent coats. All pigmented primers and paints which will be used for priming and painting at the site shall be delivered in original and sealed containers packed by the manufacturer bearing brand name, colour designation, storage and handling instructions.

The manufacturer shall supply full details regarding the extent to which sand-blasting, priming and paintings will be carried out in his workshops (or his sub-contractors, as the case may be) at the site and after erection. A properly equipped paint shop shall be set up at the site using a specialist organization, experienced and skilled in the preparation and application or protective coatings at the conditions prevailing at the site.

Each coat shall be free from runs, drops, pinholes, waves, laps, sags and unnecessary brush marks and shall be allowed to dry or to harden before the succeeding coat is applied.

Machinery paint may be thinned, if necessary to permit satisfactory application, but the amount of thinner shall be kept to a minimum.

For removing rust and mill scale from structural steel, plate sheets, piping and other steel surfaces, as well as from other parts blast cleaning shall be carried out to clean bare metal. The average surface roughness after sand blasting shall not exceed 40 microns. Parts which cannot be blast- cleaned shall be cleaned free from rust and scale by power tool cleaning to the highest possible degree.

Stainless steel and bronze surfaces shall only be cleaned but not painted. All surfaces of the embedded parts which are to come in contact with concrete shall be cleaned as mentioned above and given two coats of cement latex to prevent rusting during shipment and while awaiting installation. All finished surfaces of the gates and stoplogs that will be exposed to atmosphere during shipment or while awaiting installation shall be given a coat of gasoline soluble rust preventive compound. For preservation of hydraulic cylinders during shipment and while awaiting installation these shall be filled minimum 10% with hydraulic oil suited to temperature range for the particular Project, and 2% VCI or equivalent corrosion inhibitor shall be added prior to dispatch to site .

1.29.2 Painting Systems

a. Gates, Stoplogs, Embedded parts, Lifting Beams, Trash Racks

Perfect cleaning of all surfaces, which are not to be covered with concrete, shall be carried out by sand blasting to the requirements of **Sa 2.5** of Swedish Standard.

Over the prepared surfaces one coat of inorganic zinc silicon by spray (preferably airless spray) should be applied giving a dry film thickness of **70 ± 5 microns**.

The interval between surface preparation and painting shall be as short as practicable and in no case longer than 4 hours. Over the primer, two coats of solvent-less coal tar epoxy paint shall be provided at an interval of about 24 hours. Each coat shall give a dry film thickness of 150 microns. The total dry film thickness of all the coats shall not be less than 350 microns.

Lifting Beams

The following painting system shall be adopted for lifting beams. Over the prepared surfaces by sand blasting, two coats of priming with primer conforming to IS 102, each coat giving a dry film thickness (DFT) of 40 microns shall be applied. The finished paint shall consist of two coats of micaceous iron oxide paint. Each coat of paint shall give a dry film thickness of 75 microns. The interval between coats shall be 24 hours. The total DFT of all the coats shall not be less than 210 microns.

Khorlochhu Hydro Power Ltd.

b. Hoists, Cranes and TRCM

i. **Structural components**: Cleaning of all the surfaces shall be done by sand blasting to **Sa 2½**. In such areas where it is not possible the parts shall be cleaned by brushing and scraping.

The parts after surface preparation shall be given one coat of zinc silicate/ zinc chromate primer paint conforming to IS: 102 in the shop before dispatch. One further coat of primer shall be applied after erection. The primer coats shall give a minimum dry film thickness of 40 microns per coat. The finish paint shall consist of two coats of micaceous iron oxide paint or synthetic enamel paint. Each coat of paint shall give a dry film thickness of 50 microns. The interval between coats of micaceous iron oxide paint or synthetic enamel paint shall be 24 hours. The total dry film thickness should not be less than 175 microns.

ii. **Machinery:** All surfaces of machinery (except machined surfaces) including motor, gearing, housing, shafting bearing pedestals shall be given two heavy duty chemically resistant epoxy coatings (thick), each of having thickness more than **60 microns** followed by another heavy duty chemically resistant epoxy coatings (thin) of thickness not less than **40 microns**. Total DFT of paint should not be less than **160 microns**. Unfinished interior surfaces of oil reservoir and gearboxes and unfinished surfaces of gears which will run in oil need not be painted.

c. Hydraulic Hoist & Power Pack

Cleaning of all the surfaces shall be done by sand blasting to Sa 2½ as per SSPC.

Power Pack

The **oil tank outside surface** shall be given one coat of epoxy zinc rich primer by spray giving a dry film thickness of 50 microns. Over the primer, one coat of epoxy primer zinc chromate paint to give a dry film thickness of 50 micron followed by one coat of epoxy to give a dry film thickness of 75 microns. The total DFT of all the coats shall not be less than 165 microns.

Hydraulic Hoist cylinder

The surfaces shall be given one coat of epoxy primer giving a dry film thickness of 50 microns. Over the surface, one intermediate epoxy coat giving a dry film thickness of 125 microns and topcoat of epoxy to give a dry film thickness of 60 microns to have end colour as mentioned in the technical specification. The total DFT of all the coats shall not be less than 225 microns.

d. Pressure Shaft Liners

i) Exterior

Before encasing/laying the Pressure shaft liner pressure shaft liner in concrete the outside surface of the lower and upper half of the Pressure shaft liner in area d/s of thrust collar shall be given suitable wrapping of bond breaking material like lucobit of thickness 10mm over the painted surface (refer painting schedule in the table). Remaining part of steel liner embedded in concrete shall be given two coats of cement latex after cleaning. The concrete encasement shall be poured in the portions shown in the drawings only after such inspections and approval. However, the embedment of timber supports in concrete will not be permitted at all. All internal bracings and foreign matter shall be removed from the inside of the pressure shaft liner after the liner have been erected and embedded in concrete.

Purpose	Surface Preparation	Prime Coat	Intermediate Coat	Finishing Coat	Total Depth
U/s of thrust Collar	Cleaned			2 coats of cement latex with 5% potassium	

Khorlochhu Hydro Power Ltd.

				dichromate	
D/s of thrust Collar	Cleaned	2 x zinc rich primer Dry film thickness: Nowhere less than 0.050 mm.	2 x coal tar epoxy Dry film thickness: Nowhere less than 0.200 mm.	Bond breaking material such as Lucobit wrapping not less than 10mm.	10.25mm

ii) Interior

All interior surfaces of the Pressure shaft steel liners shall be protected against corrosion. The contractor shall furnish prepare and apply all materials for cleaning, primer coating and painting of the liners. Cleaning, primer coating and painting shall be performed prior to, during or after installation of the penstocks subject to the approval of the Engineer, provided that the completed coatings shall in all respects conform to the detailed requirements of these specifications at the time of final acceptance by the Employer.

Primer and coal tar epoxy: Before the application of Zinc rich primer the surface shall be cleaned by surface blasting to Sa 2½ quality of Swedish standard or to any approved equivalent. Over the prepared surfaces, two coats of Zinc rich primer with epoxy resin, containing 90% zinc on the dry film shall be applied; each coat providing a dry film thickness of at least 25 microns. This shall be followed by application of two coats of coal tar epoxy paint; each coat providing a dry film thickness of 150 microns. The total dry film thickness of all the four coats shall not be less than 350 microns. Workmen skilled in the trade shall perform the application of zinc primer and epoxy paint and related operations under experienced supervision.

Purpose	Surface Preparation	Prime Coat	Intermediate Coat	Finishing Coat	Total Depth
Internal surfaces of Penstock, Bends and Transition.	Dry blast cleans according to ISO 8501-1 or Sand blasting (SA 2 ½ of Swedish standard)	2 x zinc rich primer Dry film thickness: Nowhere less than 0.050 mm.	1 x coal tar epoxy Dry film thickness: Nowhere less than 0.150 mm.	1 x coal tar epoxy Dry film thickness: Nowhere less than 0.150 mm.	0.350 mm.

iii) Machined Surfaces

Machined surfaces shall be protected with adhesive tapes/or other suitable means during the cleaning and painting operations. All machined surfaces of ferrous metal including screw threads, which will be exposed during shipment or while awaiting installation, shall be cleaned with solvent and coated with a gasoline soluble rust preventive compound.

1.29.3 Painting and Colour Scheme

The Contractor shall provide a complete, reliable coating system. Coating materials shall be standard products of a paint manufacturer with proven experience in the field of corrosion protection of the type of works to be supplied.

The Contractor shall submit for the Engineer's approval full details of the preparation, type of materials, methods and sequences he proposes to use to comply with the requirements for the protection of the Works.

Painting of the repainted surface shall be in accordance to the relevant standard and shall be detailed by the Bidder for Engineer acceptance

Khorlochhu Hydro Power Ltd.

Paint material shall be delivered in unopened original containers bearing the manufacturer's brand name and colour designation, storage directions and handling instructions. The entire paint material for a particular specified paint system shall be supplied by one manufacturer only, who shall guarantee the compatibility and quality of the paint material. A complete list of the proposed paint material shall be submitted to the Engineer. For multicoated painting systems each coat shall have a different colour.

The Colour Scheme shall be as shown in the following Table:

S.No.	Item	Colour/Scheme
1.	Embedded Parts, and other components immersed in water.	Black
2.	Super structure including columns, trestles, hoist platform, lifting beam, staircase etc.	Grey
3.	Hoist Machinery	Grey
4.	Trash rake/gantry Crane/TRCM	Orange
5.	Handrails	Black &white alternate
6.	Hydraulic cylinder & Oil tanks	Grey

1.29.4 Repair of Primer and Finish Coats

For touching up, the same paint shall be used as for the original painting work. Repaired finish coats shall be of identical appearance with the original and no difference in the colour shall occur. The Engineer may require severely damaged coatings to be removed and repainted.

1.29.5 Quality Control

The minimum dry-film thickness prescribed in these Specifications shall be observed. Of each 100 m^2, one area of 10 m^2 will be measured for dry-film thickness. No measured thickness shall be less than the specified thickness. Where the minimum thickness is not achieved, the coat shall be repaired to reach the specified minimum dry-film thickness.

Spot & random checking shall be carried out by Employer and the contractor shall offer for inspection accordingly.

The dry-film thickness shall be measured by approved gauges; the cost of two new electronic gauges shall be included in the Contract for use of the Engineer.

For checks on porosity, the Contractor shall furnish a D.C. variable high tension test instrument with built-in pore counter. The test voltage shall not exceed 2000 V. The tests shall not be performed within 0.5 m distance from uncovered, corrosion resistance surfaces.

The instruments purchased for quality control shall be handed over to Employer after commissioning of the Project without payment to the Contractor.

Upon completion of each coat, the painter shall make a detailed inspection of the painting finish and shall remove from adjoining work all spattering of paint material. He shall make good all damage that can be caused by such cleaning operations.

A detailed inspection of all painting work shall likewise be made, and all abraded, stained, or otherwise disfigured portions shall be touched up satisfactorily or refinished as required to produce a first-class job throughout and to leave the entire work in a clean and acceptable condition.

Khorlochhu Hydro Power Ltd.

1.29.6 Galvanizing

Unless otherwise specified, all structural steel including ladders, platforms, hand rails and the like and all exterior and interior steel surfaces of outdoor Works, as well as bolts and nuts associated with galvanized parts shall be hot-dip galvanized, electrolytically galvanized or sherardized, as may be appropriate to the particular case.

Galvanizing shall be performed in accordance with ASTM Specification A123/A123M-17 or equivalent standard

Material:

For galvanizing, only original blast furnace raw zinc shall be applied, which shall have a purity of 98.5%.

The thickness of the zinc coat shall be:

- For bolts and nuts, approx. 60 micrometers
- For all other parts, except for hydraulic steel structures or parts intermittently or permanently submerged in water, approx. 70 micrometers
- For hydraulic steel structures or parts intermittently or permanently submerged in water, approx. 140 micrometers, in accordance with "VDEW, Druckrohrleitungen - Association of German Electricity Utility Companies, Steel Penstocks".

Cleaning:

All material to be galvanized shall be cleaned carefully of rust, loose scale, dirt, oil, grease, and other foreign matters. Particular care shall be taken to clean slag from welded areas.

Galvanizing of plates and shapes:

Where pieces are of such lengths that they cannot be dipped in one operation, great care shall be exercised to prevent warping.

Finished compression members of steel structures shall not have lateral variations greater than one-thousandth of the axial length between the points, which are to be supported laterally. Finished tension members shall not have lateral variations exceeding 3 mm for each 1.50 m of length. Materials with sharp kinks or bends shall be rejected. All holes in material shall be free of excess spelter after galvanizing.

Galvanizing of hardware:

Bolts, nuts, washers, locknuts and similar hardware shall be galvanized in accordance with the relevant standards. Excess spelter shall be removed by centrifugal spinning.

Straightening after galvanizing:

All plates and shapes, which have been warped by the galvanizing process, shall be straightened by being re-rolled or pressed. The material shall not be hammered or otherwise straightened in a manner that will injure the protective coating. Materials that have been harmfully bent or warped in the process of fabrication or galvanizing shall be rejected.

Repair of galvanizing:

Material on which galvanizing has been damaged shall be re-dipped unless the damage is local and can be repaired by soldering or by applying a galvanizing repair compound; in this case, the compound shall be applied in accordance with the manufacturer's instructions.

Soldering shall be done with a soldering iron using 50/50% solder (tin and lead). Surplus flux or acid shall be washed off promptly and the work shall be performed so as not to damage the adjacent coating or the metal itself. Any member on which the galvanized coating becomes damaged after having been dipped twice shall be rejected.

Khorlochhu Hydro Power Ltd.

1.29.7 Painting Guarantee

The guarantee period for all painting shall be three (3) years, starting from the issue of the "Test on Completion Certificate". This painting guarantee period shall be effective regardless of any other guarantee periods for the project or parts of the project, or any "Defects Liability Certificate", issued prior to the elapse of the painting guarantee period.

At the end of the painting guarantee period the anti-corrosive protection of the painted or galvanized surfaces shall not have a degree of rusting higher than RE 1 (one) on the European scale of degree of rusting for anti-corrosive paints, (the corrosion committee of the Royal Swedish Academy of Engineering Sciences, Stockholm).

1.30 Metal Work

1.30.1 Embedded Metal Work

Unless otherwise specified, any foundations, wall and roof openings and coverings, concrete floor filling, sleeves in foundations and walls and trenches with floor plates for cables & hydraulic pipe will be provided by the Civil Contractor.

The Contractor shall supply all anchors, fasteners, embedded metalwork, piping, and sleeves associated with and required for the equipment to be installed under this Contract, except if otherwise mentioned in the Specifications.

As far as practicable, the supports shall be of consistent design throughout and preferably of an approved proprietary type.

Attachments to concrete shall wherever practicable be by means of embedded inserts of an approved proprietary type.

The Contractor will be responsible for the determination and details of all loads and forces exerted by his equipment and transferred to the foundation.

The Contractor shall show the location and full details of all embedded components on his drawings and shall be responsible for the completeness and accuracy of his drawings and the information supplied to others. Anchorages to be embedded in primary concrete will be installed by the civil contractor as per Contractor's drawings. The Contractor shall be responsible for the adequacy and accuracy of the location of all embedded components supplied by him whether installed by himself or by others.

All adjustments to foundation levels, embedment, bedding and grouting of Works on foundations and cementing into walls and floors will be carried out by the civil Contractor, but all levelling and adjusting of Works on foundations shall be carried out by the Contractor.

The grouting will be carried out by the civil contractor under the supervision of the Contractor and the mix and grouting pressure shall be approved by the Contractor. The Contractor shall satisfy himself that the grouting has been carried out to his entire satisfaction.

Any steel work which is to be built into the concrete foundations shall not be painted or coated unless otherwise approved or specified.

1.30.2 Miscellaneous Metal Work

Except where otherwise indicated elsewhere in the Particular Technical Specifications, the Bidder shall fabricate and supply the following:

- All platforms, walkway, ladders/staircases, guards and handrails necessary for easy and safe access to Works are supplied under the Contract. **Handrails shall be of tubular stainless-steel construction. All materials for platforms, guards, walkways and supports shall be double hot dipped galvanized steel,**

Khorlochhu Hydro Power Ltd.

- The use of ladders shall be kept to a practicable minimum. Where ladders are approved for use, they shall be of steel, have an inclination of 70^0 to the horizontal and a minimum width of 450 mm,
- Safety guards at each point where normal access provision would permit personnel to come within reach of any moving equipment to be provided under the Contract,
- All covers for pipe and cable trenches, required for completing the floors around and over Works supplied under the Contract will be supplied and installed by the Employer Unless otherwise approved, floor plates shall be of an angular pattern,
- Covers and curbing for dismantling hatches in main floors will be provided by the civil contractor.

6. FABRICATION

1.31 Gates and Stop Logs

The gates shall be of welded steel construction with dimensions as shown in drawings. All parts of the gate shall be fabricated in strict accordance with the Standards as per specification. Special care shall be taken in fabrication of parts affecting the strength, rigidity or water tightness of the gates. Caulking of rolled edge plates will not be permitted. All pockets or depressions shall be provided with drain holes to prevent collection of water.

The structural members of gates shall be securely connected by welding or by fit bolts. Highly important joints and connections which will be heavily stressed under load shall be made without flaw. These joints shall include the connection between horizontal girders and end girder box, splicing joints in gates and stoplogs. For welding of such connection only, the approved qualified welders shall be assigned. The splicing arrangement shall be designed to allow flexibility in the gate assembly to facilitate installation. **The lengths of the members shall be so selected to keep splice joints to a minimum subject to transportation limitations**. All splices shall be designed with watertight sealing arrangement. The welding procedure for the gate body shall be planned to control and minimize distortion. All welded connections shall be fully welded.

Care shall be taken that the side seals of gate bear evenly and with uniform pressure throughout their length on the side seal seats embedded in the faces of the piers and that the bottom seals bear evenly on the bottom seal seat (sill) embedded in crest. The roller axle supports and lifting connection shall be accurately line bored so that the axis of all such holes be perpendicular to the vertical centre line of the gate and shall lie in a common plane which shall be parallel to the finished surface for the seal bases. The wheel pins shall be finished to required surface finish. The sealing faces for the vertical seals, bearing bars and lintel seal shall be finished to required surface finish. The bolt holes for guide rollers shall be accurately bored only after the gate has been completely field assembled and position of guide rollers located in stoplogs/gates.

The structural members of radial gates shall be securely connected by welding or by fit bolts. Highly important joints and connections which will be heavily stressed under load shall be made without flaw. These joints shall include the connection between thrust block, rest beam and trunnion pedestal (Bracket), trunnion bearing hub and end arms, and arms and the horizontal girders and vertical stiffeners, splicing joints or welding of such connections only, the best qualified welders shall be assigned.

Trunnion bearing hub prior to matching of casting shall be stress relieved if welded.

1.32 Embedded Parts

All structures, parts of the gate frames anchorages shall be straight and free from twist. The bottom sill beam, seal seats etc., shall be fabricated as stainless steel plates, structural sections and shall be provided with suitable anchorage for rigid connection to the crest and the piers.

Khorlochhu Hydro Power Ltd.

Both faces of the track base flanges carrying the track shall be truly perpendicular to the web. The flange face shall be finished to provide a truly plane surface for the track. The faces of the seal seats shall be finished so as to lie in one place within permitted tolerances. The crowns of the track shall lie in a true vertical plane. **The splice length for embedded parts such as seal seats, track paths, guides etc. shall not be less than 6.0m.**

All structures, parts of the gate frames shall be straight and free from twist. Trunnion pedestal shall be stress relieved. The rest beam supporting the trunnion bearings shall be securely fastened to anchor bolts embedded in the piers. All the connections in the trunnion pedestal are heavily stressed under load and special precaution should therefore be taken to ensure that such joints are without flaw. The bottom sill beam, wall plates liners etc. shall be fabricated of steel plates, structural sections and shall be provided with suitable anchorages for rigid connection to the spillway crest breast wall and the piers.

1.33 Fabrication of Steel Liner

The fabrication of the steel liners for pressure shaft shall be in accordance with the specification, drawing and the corresponding approved design and fabrication drawings and latest version of Indian Standard for unfired pressure vessels (IS: 2825) or the equivalent standards specified under this Chapter. In case of any difference between the above the specification shall govern.

1.33.1 Preparation of Pipe Course

Each course of pipe shall be made with the minimum number of plates depending upon the availability of plate sizes or as directed by the Engineer.

Two plates of almost equal lengths are made available, the longitudinal joints shall be located at quarter points and staggered between sections. When two plates of equal lengths are not made available or when the course is made of a single plate, the longitudinal joints/joint shall be placed approximately at 90^{o} from the vertical centerline of the pipe and shall be staggered in adjoining course. The longitudinal welds shall be located so that they will not intersect the nozzles, manholes, or other outlets. The normal lengths of each course shall be limited to plate width available.

1.33.2 Cutting the Plates

Plates to be welded shall be cut to size and shaped by machining and/or flame cutting. Where the plate thickness does not exceed 25mm, cold shearing may be used provided that the sheared edge is cut back by machining or chipping for a distance one quarter of the plate thickness but in no case less than 3mm.

1.33.3 Preparation of Plates edge and Openings

Welding preparations and openings of the required shapes may be formed by the following methods: -

a) **Machining/chipping or grindings**: chipped surfaces, which are not covered with weld material, shall be ground smooth after chipping.

b) Plate cutting may include plasma arc, oxy-acetylene gas with or without flux injection or equivalent fusion cutting process. Any material damaged in the process of cutting plates to size or forming welding grooves shall be removed by machining, grinding or chipping back to sound metal. Surfaces which have been flame cut shall be cut back by machine grinding so as to remove all burnt metal, notches, slag and scale but slight discoloration of machine flame cut edges on mild steel shall not be regarded as detrimental.

After the edges of the plates have been prepared for welding they shall be given a thorough visual examination for flaws, cracks, laminations, slag inclusion or other defects. When plates are flame cut, the edges should be examined after this operation. Edges which have been flame cut by hand shall be cut back by machining or chipping for a distance of one quarter of plate thickness but in no case less than 3mm.

Khorlochhu Hydro Power Ltd.

Rust, scale, painting, oil slag etc. from the flame cutting or other contamination of the fusion pieces shall be removed before welding is commenced. The surfaces to be welded shall be free from foreign material such as grease, oil or marking paint for a distance of at least 25mm from the welding edges. Irregularities in fusion faces, which are likely to affect the quality of welding, shall be removed before welding is commenced. All plate edges after cutting and before carrying out further work upon them shall be examined for lamination and also to make certain that marks have not been caused by shearing. Plates for shell sections shall be formed to required shape by a process that does not impair the quality of the material. However, correction of curvature by blows will not be permitted. Cold-formed plates material shall not be subjected to a deformation of more than five percent, unless suitable heat treatment is carried out after such forming. Heat treatment shall, however, be carried out even when the deformation is less than 5 per cent if there is pronounced risk of brittleness through aging. The deformation expressed as a percentage is obtained from the formula:

$$\text{Deformation} = \frac{t\ x\ 100}{D}$$

Where t = thickness of plate
D= internal diameter to which the plate is being bent or formed.

Cold forming shall not be undertaken when the temperature of the metal is less than 0^0 C. If the forming or bending operation takes place in hot condition, no subsequent heat treatment is required, if the final shaping process terminates within the correct temperature limits for the particular material.

1.33.4 **Plates of unequal thickness**

Where two plates at a welded joint differ in thickness the thicker plates shall be trimmed to a smooth taper as per para 6.3.5 IS 2825 -1969.

1.33.5 Stiffener Rings

Stiffener rings shall be fabricated in not more than ten circumferential sections butt welded together and properly fitted and welded to the pipes, so that the plane of rings will be normal to the axis of the pipe.

1.33.6 Bends

Bends shall be made of short segment of pipe with mitered ends. Deflection angle between each successive segment shall not be more than 100. The segments shall be made with equal deflection angles except for the end ones, which shall be of smaller deflection angles than the other segments. The number of segment along with stiffener rings shall be adequate to take care of the loads.

1.33.7 Unit and Match Marking

Each part of the pressure shaft liner section, curvature of the shell or surface to which they are attached, or its auxiliary parts shall be legibly marked to show the unit of which it is a part and match marked to show its relative position in the finished structure to facilitate assembly in the field. To ensure proper matching of sections at the joints, expanding struts spiders may be used. Each section shall be marked struts to show top of vertical diameter and the direction of the flow. Unit marks and match marks shall be made with heavy stamps and with paints. The contractor shall prepare marking drawings of each penstock indicating clearly the location of each section and appurtenant parts in the completed structure and shall furnish to the Corporation such drawings.

If pressure shaft liner/penstock ferrules are transported for a long-distance necessary precaution shall be taken to provide bracing /spider to prevent deformation.

Khorlochhu Hydro Power Ltd.

1.33.8 Preheating and Thermal Stress Relieving

When preheating is the part of approved welding procedure, weld joints shall be preheated in accordance with the kind of steel materials and plate thickness as per the recommendation of the steel manufacturer. Maximum interpass temperature of preheating shall be 200 0C and preheating area shall be over more than four times of plate thickness for each side from the welding joints.

If welding work is made under the condition of ambient temperature less than 5˚C, steel materials on weld joints shall also be preheated even though application of preheating is not required due to the kind and thickness of the steel materials under normal welding condition.

The relations between the carbon equivalent and the preheating temperature in cases of manual welding, shall be as follows:

Carbon equivalent (C eq) %	Plate thickness (mm)	Preheating temperature for low hydrogen welding rods (˚C)
0 - 0.28	0 – 100	-
0.28 - 0.38	0 - 25	-
0.28 - 0.38	25 – 100	40 - 60
0.38 - 0.48	0 - 25	40 - 60
0.38 - 0.48	25 – 100	80 - 100
more than 0.48	0 – 100	100 - 150

Note: C eq (%) = C+1/6 Mn + 1/24 Si + 1/40 Ni + 1/5 Cr + 1/4 Mo + 1/14 V and Cu, P, etc., could be added as necessary.

Post weld thermal stress relieving shall be a part of approved welding procedure and shall be carried out in accordance with the relevant provisions of ASME boiler and pressure vessel code section –VIII division–2 or IS: 2825. The method statement procedure for conducting thermal stress relieving shall depend upon the particular structure, grade and composition of steel and thickness involved. The contractor shall obtain prior approval regarding the above from Engineer.

1.34 Installation

The assembling and installation of equipment are anticipated to be performed in parallel with the civil works under worst conditions and the bidder shall provide all protection against dusts, water, welding/painting, fume, etc. The Contractors shall consider the cost against such protection/arrangement in their price bid.

1.34.1 Installation of Gates and Stoplogs

The gate complete with the seal arrangement and guides shall be properly assembled and installed as per the drawings approved by the Engineer All these assemblies and installations have to be done in the most workmen like manner, to the specifications and tolerances etc. indicated in the drawings. After installation, it shall be checked that all the parts are smooth with no wavy surface. Each gate leaf transported in sub-assemblies and seal sub-assemblies shall be assembled and erected in strict compliance with the details shown on the final approved shop drawing and with manufacturer's instructions, special precautions have to be taken to ensure joints are made water tight where required. The side, top and bottom of gates shall be in true alignments so that Rubber seals when installed shall have tight and even bearing on the sealing surface of embedded frame.

1.34.2 Installation of Frame, Guide and Tracks

Assembly and Erection: Each set of frame, guides, tracks and seal seat arrangements shall be assembled in the respective block outs, brought to line, grade and plumb within the erection tolerance and secured in place by anchorage as shown on the drawings or otherwise, according to best modern practice and as necessary for successful functioning of

Khorlochhu Hydro Power Ltd.

these units. The erection tolerances for frames and guides will be as indicated on the drawings. Extreme care should be taken to ensure that their surfaces be in a true plane within the tolerances (as stated above) throughout their length, otherwise serious damage to the gate may result during operation. Assembly shall be by bolting and welding and connections to embedded anchorages shall be adjusted and firmly tightened to hold the frames and guides securely in position while concrete is being placed in the block outs.

1st stage inserts shall be embedded in primary concrete by the civil contractor if not mentioned otherwise.

Erection supports shall be suitably braced so that activities like chipping/ denting of 1st stage concreting, opening out of bent dowels & 2nd stage concreting operation does not in any way affect the alignment.

After the erection/installation of the second stage embedded parts, there is time gap during which the embedded parts remain un-concreted and have a tendency to get displaced/ misaligned due to some of the work activities going on in the vicinity of the embedded parts. It is therefore the responsibility of the manufacturer to ensure that the alignment of the embedded parts remain intact and does not get dislodged/displaced due to any activity in the neighborhood. To ensure this, the manufacturer may suitably brace the embedded parts by provision of additional steel members, if necessary. The cost of all labour, materials and use of tools and equipment for ensuring the same shall be included in the item rates of second stage embedded parts in the price schedule.

1.34.3 Erection of Pressure Shaft Liner

a. General

Before erection is started the Contractor shall supply eight complete sets of erection schedules, procedures and erection drawings to the Engineer for approval. The Contractor will be required to lay/erect the Penstock pressure shaft liners in place and do the welding of field joints. All civil works e.g. excavation, concrete and back-fill concrete shall be executed by the civil contractor if not mentioned otherwise.

b. Erection /Laying Procedure

The steel liners shall be assembled in the field in accordance with erection/laying drawings. The liners sections shall be installed in place accurately, to line and grade and embedded in concrete by stiffener rings and supporting brackets. When assembled and ready for welding, the distance between the ends of adjoining sections which are to be connected together with the field girth welds shall not be greater 3mm as per joint details and shall be of 6mm in case of joint with backing strips. Care shall be exercised to avoid excessive length, growth or shrinkage in pipe lengths.

The Contractor shall furnish and install such permanent structures, erection supports permanent or temporary including holding down straps and internal bracings as may be required to support the liners securely in place and prevent distortion during erection, welding and placing of concrete. Cost of all such structures including erection supports (permanent or temporary), rail tracks, trolley and winch (if used) shall be included in the unit rate of various items. The rails shall be left to be embedded in secondary concrete with approval of Engineer provided rails are supported in steel pieces. The cost shall be inclusive of provisions of provisions of air vents, dewatering arrangement, facilitating firefighting connection for manholes, pressure gauges, grouting plugs, provision of holes in liners and stiffener rings for facilitating grouting, replacement of any defective works etc. The girth seams shall then be welded as soon as practicable. After field welding by the electric arc method of girth seams the joints are to be tested ultrasonically/spot radiography as given under non-destructive examination, and if any joint is found defective the same shall be repaired to the satisfaction of Engineer. To ensure the matching of sections at the joints expanding struts or spiders may be used. Tack welds where used to hold the sections in line, shall be removed so that they may not become part of the joints. A clear space of **0.65m** at

Khorlochhu Hydro Power Ltd.

the bottom portion of pressure shaft from bottom bend to bifurcation shall be made available by the Engineer to enable the welding of girth joint and spot radiography etc. at erection site. The schedule of installation of pressure shaft liner on the supports and the field welding and embedment's in concrete have to be carefully synchronized with the works of civil contractor who shall be doing the concreting of pressure shaft. When the pressure shaft liner has been installed, with all structural supports, rods, wedges, etc. as may be required to hold the pipes securely in place while being embedded in concrete, all such work shall be inspected and approved by the Engineer. It shall be ensured by the Contractor that the provision of supports (permanent or temporary) and chairs are sufficient to prevent any misalignment of the pressure shaft due to buoyancy of wet concrete during concreting.

Butt Straps: - Butt Strap can only be used from outside in case of inaccessibility due to less annular space for in-situ welding of the tunnel lining. If the same is required due to less annular space then additional welding methodology incorporating following precautions shall be incorporated in the Welding Procedure Specification (WPS) as the butt straps provided from outside are integrated to the circumferential joint:

i) After carrying out the complete first pass welding, the same shall be grinded so as to achieve a U-shaped groove in the backing strip, to enable appropriate welding by 3.15mm electrode

ii) After completion of root run & subsequent passes, the weld shall be subjected to Dye penetration test for checking of surface defects needing rectification.

iii) After completion of full welding again Dye penetration test shall be done for checking of surface soundness.

iv) Full circumferential field weld shall then be checked by Ultra sonic test to 100% extent.

Contractor can offer an alternative procedure/methodology of the erection and field welding without sacrificing the soundness of weld and requirement of NDT in accordance with sound Engineering practice for approval of Engineer.

When erection, welding and inspection of the steel lining have been completed in accordance with these specifications, the steel lining, bifurcation, and branch pipes penstock shall be encased by concrete. The Contractor shall supply and install sufficient interior bracings in addition to that required for welding to maintain the roundness within the specified tolerances until the encasement is completed. The Contractor shall supply and install sufficient exterior bracings and anchor bands and bars to resist the loading due to the placing of concrete.

Contact Grouting Holes (Tunnel Liner):- Each 10m pipe section of the horizontal pipe section shall be provided with 50mm threaded grouting holes for void grouting between backfill concrete and rock at location and in number as follows:

- 2 holes located at 10 & 2 o'clock at the pipes upper section - 1.25m from the pipe end.
- 2 holes located at 10 & 2 o'clock at the pipes upper section - 6.25m from the same end.
- 1 hole - located at 12 o'clock, 3.75m from same end and another 8.75m from same end.
- Insert filler plugs prior to encasement concreting.
- Ensure that filler plugs do not adhere to the concrete.
- On completion of concreting, remove the filler plugs and insert the pipe sleeves.
- On completion of grouting and inspection, remove the pipe sleeves, redress any damaged grouting or inspection hole threads, insert the filler plugs, seal weld the plugs into position and grind flush with the internal surface of the liner.
- All filler plugs shall be inspected after seal welding and grinding flush by either magnetic method or by liquid penetrate method.

Khorlochhu Hydro Power

- No grouting or inspection hole shall be located within 150mm of a welded joint in the liners. To enable this condition to be met, a grouting or inspection hole may be positioned a maximum distance of 150mm from the dimensioned location as indicated on the drawing.

1.34.4 Placing Concrete in Blockout

Placement of concrete in block outs will be done by the Employer through Civil contractor and HM contractor shall give a detailed programme of fixing and aligning the embedded parts to the Employer for this purpose. Before placing the concrete in any one lift and between placements of successive lifts, alignment tolerances shall be checked and remedial action taken if any displacement has occurred. **The block out concrete will conform to the grade M-30 (minimum) unless otherwise specified on drawings**.

1.34.5 Hoists, Cranes & TRCM

Hoist bridge and hoist/crane sub-assemblies shall be assembled and erected in strict compliance with the details shown in the final approved shop drawing and with manufacturer's instructions. Special precautions shall be taken to ensure perfect alignment between mating components and for placements of the hoist drums so as to match with the center to center of lifting lugs of the gates.

For hoist and gantry crane/TRCM the contractor shall prepare a complete erection procedure which shall describe the sequence of operations to be carried out, the methods to be used, the measurements to be taken and the tolerances to be met, in the erection and alignment of the equipment.

1.35 Seals

Rubber seals shall be of the moulded type only. The materials used for rubber seals shall be compound of natural rubber, a copolymer of butadiene and styrene, or a blend of both, and shall contain reinforcing carbon black, zinc oxide, accelerators, antioxidants, vulcanizing agents and plasticizers. The contractor shall provide all seal with adequate temperature and age resistant properties which will provide, in the moulded form, suitable sealing properties.

The seals shall meet the properties as per IS: 11855

All corners shall be remoulded and have a suitable radius on the inside edge. All joints, shop and field, shall be located at reasonable distance from the corners and shall meet the following requirements:

a) All shop joints shall be vulcanized. Joint geometry shall be such as to avoid feather edges on the sealing surfaces.

b) Field joints shall be kept to a minimum and shall be accurately machine cut and carefully butted during assembly to an interference fit. The field joints shall be held with double fasteners on each side of the joint.

c) Vulcanized joints shall not break on tear when bent 180 degrees around a mandrel of a diameter equal to the maximum cross section thickness of the seal

d) The longitudinal strength in tension of vulcanized joints shall be not less than 71.4 kg/cm2 as verified by tests on a tensile specimen prepared from one joint in accordance with ASTM D15 Part C. The joint tested shall be located at the midpoint of the test specimen and its strength determined in accordance with ASTM D 412.

e) The joints in the rubber seal shall be vulcanized but joints and at right angle to the rubber seal. Oblique joints at the corner shall not be permitted in the rubber seal. Vertically placed strips of rubber seals shall be formed in one piece and no joints of any sort shall be permitted in them.

f) Sufficient quantity of seal jointing compound shall be supplied along with rubber seals for site requirements.

Khorlochhu Hydro Power Ltd.

Joints shall be water tight and seal materials shall have following physical properties as determined by tests made in accordance with the relevant Standards.

Description Property	Limits
Tensile strength	14.5 Mpa minimum
Ultimate elongation	450% minimum
Durometer hardness (Shore, Type A)	60 – 70
Specific gravity	1.1 to 1.3
Water absorption (700C for 48 hours)	5%by weight (max.)
Compression set	30% maximum
Tensile strength after oxygen bomb ageing (48 hours at 700C)	80% (min.) of tensile strength before ageing

1.36 Drives and Gears

All moving parts of machinery including shafts, couplings, collars, projecting key heads, gear wheels, rope/belt-drives shall be completely guarded to provide full protection. All set screws on revolving shafts shall be countersunk or suitably protected. The guards shall be of approved design and shall be fitted, where necessary, with inspection doors/openings. All guards shall be arranged so that they can be removed without disturbing the parts of the gears and Works, which they protect.

Gears shall be designed so that all stresses are within allowable limits when the maximum loads are being handled. All gears shall be designed and calculated in accordance with IS Standards or equivalent international standards, or widely approved methods and to the individual experience of the manufacturer. On request of the Engineer, the manufacturer shall submit the calculation of the gears.

Where worm gears are used as a direct drive, they shall have the same load and time rating as the motors driving them. The gears shall work in oil and the temperature rise of the oil bath shall not exceed 40^0C – 50^0C under normal working conditions at Site. The materials of the mating faces of worm wheel and worm shall be of a bronze/steel alloy.

Where practicable gear wheels shall be forced fit on the shaft and in addition, shall be keyed adequately to prevent any relative motion between the wheel and shaft. Where gears and couplings are secured in position by means of keys, they shall be easily accessible for tightening or removal. All keyways shall be machine cut. Couplings and collars shall be the shrouded or protected-type, free from projections of any kind.

All bearings shall be mounted in dustproof housings. Base of bearing supports shall be machined and shall rest on machined surfaces.

1.37 Lubrication, Lubricants and Oils

Efficient means of lubrication, suitable for use under Site conditions, shall be provided for all moving parts.

Self-lubricating types of bearings shall be given preference, unless otherwise specified or practicable.

The contamination of the air, water and soil by lubricants and fuel shall by all means be avoided by applying an appropriate design and layout of the Works in conformity with the latest recognized standards for modern engineering practice.

The number of different lubricants, transformer oils, oils for pressure systems, etc. used in the items of Works throughout the Works shall be limited to a minimum in order to facilitate keeping stocks and maintenance.

The Employer reserves the right to request the different Contractors to use certain types of lubricants, oils etc. The Contractor shall not be entitled to claim extra payment for this

Khorlochhu Hydro Power Ltd.

request. All different types of oils, lubricants, etc., shall be stated in the Tender and are subject to the written approval of the Engineer.

Unless otherwise stated in the Particular Technical Specifications, the first oil or grease filling for bearings, pressure oil systems, transformers, etc., including the necessary quantity for flushing and for the first oil change, shall be included in the Tender Price.

1.38 Oil Piping

Pipes shall be made of stainless steel. They shall be welded except at terminal points and as necessary for erection and future dismantling. The Contractor shall select the location of the weldments as to ensure sufficient access for adequate touch-up treatment for corrosion protection. Pipe connections larger than 50 mm in diameter shall be provided with steel-flanged connections.

All piping shall be hydrostatically tested at a pressure 150 % than the maximum working pressure for 30 minutes. The entire pipe arrangement shall be subjected to the pressure test after complete assembly at the site.

Oil pipes shall not be embedded in concrete. Oil pipes crossing civil structures shall be routed through sleeves embedded in the concrete.

All oil piping shall be acid-treated to guarantee clean surfaces, completely free from welding residues.

The piping can either be treated in an acid-bath or being completely filled with acid. The duration of the treatment shall be approx. 6 hours. After that the piping shall be neutralised, flushed and corrosion protected for final installation.

1.38.1 Pipe Supports and Hangers

All pipe work and accessories shall be mounted and supported in a safe and neat manner. All brackets, stays, frames, hangers and supports for carrying and staying the pipes, including their fasteners shall be included in the supply and completed by the Contractor at the Site. Pipes and fittings shall be supported at or near flanges wherever possible.

Supports and hangers shall be designed and arranged so that any pipe can be withdrawn without disturbing the others. Minimum spacing of piping supports shall be as per BS: 4575 Part-I.

All heavy valves and other mountings shall be supported independently of the pipes to which they connect, to the satisfaction of the Engineer.

The Contractor shall supply drawings showing the location of each major anchor and support and the weight to be carried by that support.

1.39 Mechanical Instruments

All mechanical parts of instruments shall be suitably protected against shocks and vibrations, heat, humidity and splash water etc.

Pressures gauges shall be provided with a damping liquid, e.g., glycerin, to compensate vibrations. Pressure gauges without damping means are not permitted, unless approved by the Engineer.

1.40 Hydraulic Servomotor Systems

Hydraulic tanks shall be designed, fabricated and tested in accordance with approved standards. The appropriate inspection certificates shall be furnished.

Oil sump tanks shall be provided with:

- suitable access openings
- fine mesh strainer combined with a magnetic filter through which all oil returning from the servomotors shall pass. The strainer shall be readily removable for cleaning.

Khorlochhu Hydro Power Ltd.

- dehumidifying air filter
- flush-mounted oil-level indicator
- filling connection with a suitable strainer
- Drain connection with hand operated shut-off valve.

Sump tanks shall be installed so that the bottom of the tank and the drain connection are at least 40 cm above the floor. The bottom of the tank shall be inclined in the direction of the drainage. The pumps shall be removable without the necessity of emptying the tank.

Servomotors shall be provided with suitable connections for pressure gauges on the pressure and suction sides of the piston.

Servomotor piston rods made-up of stainless steel with multi-layered chrome plating needs to satisfy the requirement of surface hardness not less than 320 BHN and surface finish ≤ 0.3 µm.

Servomotor piston rods made-up of carbon steel provided with ceramic coating not less than 250 microns shall have following requirements ensured by manufacturer:

Surface hardness	> 650 HV to 750 HV
Adhesion according ASTM C633	> 25 N/mm^2 to 50 N/mm^2
Impact to ASTM D 2794	> 50J to 100 J
Surface roughness of ceramic coating	> Ra 0.15 µm to 0.30 µm
Bending Stress	> 300 N/mm^2
The surface preparation for steel substrate	> 9 µm to 13 µm

7. ELECTRICAL WORKS

1.41 General

The electrical items of Works of any electrical or mechanical installation to be provided under this Contract according to the Particular Technical Specifications shall - if not stated otherwise therein-fulfil the requirements of this Section.

All components shall be of an approved and reliable design. The highest extent of uniformity and interchangeability shall be reached. The design shall facilitate maintenance and repair of the components.

The Works shall be pre-assembled to the highest possible extent in the Bidder or Sub-Bidder's workshop, complete with all devices and wired up to common terminal blocks.

Unless otherwise agreed, ratings of main electrical Works (in-feeds, bus- ties) as selected or proposed by the Bidder, whether originally specified or not, shall generally include a safety margin of 10% under consideration of the worst case to be met in service. Prior to approval of such basic characteristics, the Bidder shall submit all relevant information such as consumer lists, short circuit calculations, de-rating factors, etc.

Short-circuit calculations shall be evaluated giving full evidence that every electrical component can withstand the maximum stresses under fault conditions, for fault levels and durations obtained under the worst conditions, e.g., upon failure of the corresponding main protection device and time delayed fault clearing by the back-up protection device.

All Works shall be suitable for the prevailing climatic conditions.

Outdoor installations needing protections shall be protected against solar radiation by means of adequate covers, where required.

The Bidder shall ensure that all the supplied Works is insensitive to any signals emitted by wireless communication equipment.

Khorlochhu Hydro Power Ltd.

1.42 Distribution board, Feeder pillars & Local Control Panel

The above panels shall be an Indoor/ outdoor type (degree of protection of enclosure type IP-55) made of steel sheet of thickness not less than 2.5mm, containing all necessary equipment for the control, protection/safety and supervisory elements as required and shall be completely painted and wired. The panel frame structure shall be self-supporting, free standing on floor or suitable for wall/vertical post mounting. The doors and covers of the panels shall be braced adequately to avoid wobbling.

Cubicles and panels shall be vermin proof. Removable gland plates shall be supplied and located to provide adequate working clearance for the termination of cables. Under no circumstances shall the floor/ roof plate be used as a gland plate. The cables and wiring shall enter from bottom or top as approved by Engineer.

The cubicles and panels shall be adequately ventilated, if required, by vents or louvers, and shall be so placed as not to detract from the appearance. All ventilating openings shall be provided with corrosion resistant metal screens or a suitable filter to prevent entrance of insects or vermin. Space heating elements with thermostatic control shall be included in each panel.

Cubical/panel will be of sufficient size so as to neatly and methodically accommodate all the electrical power and control equipment. All panels and cubical shall be of standard dimensions having uniform appearance. Indicating lamps, push buttons, all the necessary relays, starters, fuses, limit switches, selector switches, terminal blocks, circuit breakers, contactors, current transformers, protection gears, Interlocks, alarms, measuring instruments including all wiring and all other accessories necessary for safety like LOTO System, control and operation of the hoist.

The controls, indicating lamps, push button, selector switches etc. will be installed flush mounted on the outside door of the control panel so as to give clear view of all the indicating lights, measuring instruments, position indicator so that the gate and hoist can be operated with the cabinet door closed. The remaining equipment will be installed inside the cabinet being accessible when the door is opened.

The panel door shall have close fitting, gasketed, hinged, swing off construction capable of being opened through 180 degrees. The doors shall be provided with integral lock and master key. A mechanical interlock shall be provided to ensure de-energization of the panel as soon as the door is opened. Suitable provision may, however, be made to bypass the above interlock under extraordinary requirements when manual energization of panel is necessary under open condition. Panel shall be provided with door switch operated illumination.

All terminals will be of block type. Wiring inside the control panel is made at least with 650 Volt insulation grade, 1.0 sq. mm. 1.5 Sq.mm. and 2.5 sq.mm. Control cable and required size of power cable. All cables shall be brought at terminal blocks mounted inside the control panels to facilitate connection with the external cables. All the metallic parts of the switch- boards and all the earth wires of the circuits shall be connected with the Earthing bus of not less than 25 sq. mm. copper conductors. All control cables and components will be marked in a systematic manner on drawings on the accordingly tagged cables and components in the control panel. All necessary auxiliary devices for connection to limit switch shall also be provided. The control equipment for rope drum hoist shall generally meet the requirements of Clause 6.6 of **IS: 6938-1989**.

1.43 Standards

The design, manufacture and testing of all Works and installations shall strictly comply with the latest edition of the relevant IEC publications.

Khorlochhu Hydro Power Ltd.

1.44 Colour Code

The manufacturer's painting systems shall be used to the maximum possible extent, but shall by all means be subject to the approval of the Employer. Final coats of paint shall be matching adjacent installations, where required.

1.45 Electric Motors

1.45.1 General

All motors shall be of approved manufacture and shall comply with the requirements of this Chapter. Motors of the same type and size shall be fully interchangeable and shall comply with Indian Standard and to IEC standard motor dimensions.

The general construction shall be stiff and rigid; no light metal alloy casings will be accepted. All precautions shall be taken to avoid any type of corrosion.

All motors shall be fitted with approved types of lifting hooks or eyebolts as suitable. AC motors shall have squirrel cage type rotors.

1.45.2 Ratings

The rating of motor other than Hydraulic Hoist motors shall be adequate to meet the requirement of its associated equipment. The service factor, being the ratio of the installed motor output to the required power at the shaft of the driven machine at its expected maximum power demand, shall be applied as follows:

Power Demand of Driven Machine	Service Factor
Up to 5 kW	1.2
More than 5 kW	1.1

AC motors shall be capable of operating continuously under rated output conditions at any frequency between 95% and 105% of the rated frequency and/or with any voltage variation between 90% and 110% of the nominal voltage. A transient over voltage of 130% of the nominal voltage shall as well be sustained.

Further, the motors shall be capable of maintaining stable operation when running at 70% nominal voltage for a period of 10 seconds. The pull-out torque for motors shall not be less than 225% of the rated torque.

1.45.3 Starting

A.C. motors shall be designed for Thyristors controlled/ direct on-line starting. They shall be capable of being switched on without damage to an infinite bus bar at 110% of the nominal voltage with an inherent residual voltage of 100% even in phase opposition. For starting the motors from the individual main and auxiliary bus bars, a momentary voltage drop of 20% referred to nominal voltage should be taken into consideration. With 85% of the nominal voltage applied to the motor terminals, each motor shall be capable of accelerating its associated load to full speed with a minimum accelerating torque of 5% of full load torque.

The maximum starting currents (without any tolerance) shall not exceed value 5 times of rated current for motors.

Generally, all motors shall be able to withstand three cold starts per hour, equally spaced. In addition, each motor shall be capable of enduring two successive starts with the motor initially at operating temperature under the same conditions or once every twenty minutes without detrimental heating.

Motors for frequent automatic starting shall have an adequate rating. In the motor list the Contractor shall state the frequency of starts permitted in compliance with the motor design.

Khorlochhu Hydro Power Ltd.

1.45.4 Windings and Insulation Class

The insulation of all motors shall be of class F but maintain in operation the temperature limits of class B materials. It shall be suitable for operation in damp locations, for occasional contact with corrosive gases and vapours and for considerable fluctuations in temperature.

The stator winding shall be suitably braced to withstand the forces due to thyristorised controlled/ direct-on-line starting and transfer conditions as mentioned before. The winding envelopment and tails shall be non-hygroscopic. The stator winding shall withstand the maximum fault current for the period determined by the associated protective devices.

The rotor winding (if applicable) shall be designed to give trouble-free continuous service including repeated thyristors/direct-on-line starting. The rotor shall be subjected to a 120% over speed test for 2 minutes without showing any winding dislocation.

1.45.5 Ventilation and Type of Enclosure

All motors shall be of the totally enclosed fan-cooled type, protection class IP 54 according to IEC Recommendation 144. Cable termination points shall be of class IP 55.

They shall have a closed internal cooling air circuit re-cooled by an external cooling air circuit drawn from the opposite side of the driving end.

Where motors are installed outdoors, a weatherproof design shall be chosen. Above shall be equipped with automatically controlled heating elements for protection against internal condensation of moisture during standstill periods.

Motors installed outdoors and directly subjected to solar radiation shall be rated such as not to exceed a maximum metal temperature of 85°C. Where necessary, such motors shall be provided with sun shields.

Vertical motors shall be provided with a top cover to prevent the ingress of dirt, etc.

1.45.6 Bearings

As far as possible, the motors shall have sealed ball or roller bearings lubricated for life. All other motors with ratings of about 1 kW and above shall be equipped with lubricators permitting greasing while the motor is running and preventing over-lubrication. Additionally, the bearings shall be fitted with grease nipples permitting the use of a universal grease gun.

Vertical motors shall have approved thrust bearings.

All bearings shall be easily controllable during operation or standstill without dismantling the bearings. The bearings shall further be protected and sealed against dust penetration and oil leakage.

In case of independent bearings, motor and bearing pedestals shall be fitted on a common base plate.

Suitable packing/special bearing inserts shall be provided to prevent damage during transport of motors equipped with ball or roller bearings.

Service hour meters shall be installed in the motor control centers if maintenance work such as re-greasing, oil change etc. depend on the operation time of the motors.

1.45.7 Shafts and Couplings

The motors shall be provided with a free shaft extension of cylindrical shape with key and keyway according to IEC Recommendation 72-1 and with the motor side coupling, which shall be pressed on the motor shaft and be balanced together with it. A coupling guard shall be provided.

Khorlochhu Hydro Power Ltd.

1.45.8 Terminal Boxes and Earthing

The terminal leads, terminals, terminal boxes and associated equipment shall be suitable for terminating the respective type of cables as specified in these General Technical Specifications and in the Particular Technical Specifications.

The terminal boxes shall be of ample size to enable connections to be made in a satisfactory manner. Supports shall be provided at terminal boxes as required for proper guidance and fixing of the incoming cable.

The terminal boxes with the cables installed shall be suitable for connection to supply systems with the short-circuit current and the fault clearance time determined by the motor protective devices.

A permanently attached connection diagram shall be mounted inside the terminal box cover. If motors are provided for only one direction of rotation, this shall be clearly indicated. Double body earthing arrangement should be there of Motor body earthing purpose

Terminal boxes shall be totally enclosed and designed to prevent the ingress of moisture and dust. All joints shall be flanged with gaskets of neoprene or similar material. For motors above 1 kW, the terminal box shall be sealed from the internal air circuit of the motor.

Depending on the size, the terminal box of L.V. motors shall be fitted either with an approved cable sealing-end or with a gland plate drilled as required and provided with suitable fittings for cable fixing and sealing. Such openings shall be temporarily plugged or sealed during transportation.

Terminal boxes of M.V. motors shall be fitted with an approved cable sealing end and a pressure relief diaphragm suitably located. For plastic insulated and sheathed cables filling with compound is not required.

The three neutral ends of the windings of M.V. motors shall be brought out to a separate terminal box.

For earthing purposes, each motor shall have adequately sized bolts with washers at the lower part of the frame. In addition, each terminal box shall contain one earthing screw. Each equipment/panel shall be earthed by at least two separate earthing strips.

1.45.9 Noise-Level and Vibrations

Under all operating conditions, the noise level of motors shall not exceed 85 dB (A).

In order to prevent undue and harmful vibrations, all motors shall be statically and dynamically balanced. Vibration displacements or velocity shall be measured in accordance with relevant IS for IEC motor sizes 80 to 315. The results for all motors shall be within the "R" (reduced) limits.

1.45.10 Tests

Each motor shall be factory tested and shall undergo a test at site. The following tests shall be performed under full responsibility of the Contractor.

(A) Workshop Tests:

i) Measurement of winding resistances,
ii) No-load and short-circuit measurements,
iii) Measurement of starting current and torque,
iv) Efficiency measurement (type test),
v) Heat test run,
vi) Dielectric test,
vii) Measurement of insulating resistance,
viii) Over speed test.

(B) Site Tests:

i) Measurement of insulation resistance,
ii) Measurement of motor vibrations,
iii) Measurement of starting time.
iv) Infrared Thermography Test

1.46 Auxiliary Works

1.46.1 Auxiliary Switches

Where appropriate, each item of Works shall be equipped with all necessary auxiliary switches, contactors and devices for indication, protection, metering, control, interlocking, supervision and other services. All auxiliary switches shall be wired up to terminal blocks on the fixed portion of the Works.

All auxiliary switches and mechanisms shall be mounted in approved accessible positions clear of the operating mechanism and are to be protected in an approved manner. The contacts of all auxiliary switches shall be strong and shall have a positive wiping action when closing.

Control Switches

Control switches for electrically operated circuit breakers shall be of the pistol grip or discrepancy type. They shall operate clockwise when closing the circuit breakers and anti-clockwise when opening them. The control switches shall be so designed as to prevent them from being operated inadvertently, and where switches of the discrepancy type are used they shall require two independent movements to effect operation. Control switches shall be so designed that when released by the operator, they return automatically to the neutral position after having been turned to the "closed" position and shall at the same time interrupt the control voltage supply to the operating mechanism of the circuit breaker.

Switches for other apparatus shall be operated by shrouded push buttons or have handles of the spade type, the pistol grip type shall be used for circuit breaker operation only.

Control, reversing, selector and test switches shall be so mounted, constructed and wired as to facilitate the maintenance of contacts without the necessity for disconnecting wiring.

1.46.2 Anti-Condensation Heaters

Each individual enclosure accommodating electrical Works which is liable to suffer from internal condensation due to atmospheric or load variations shall be fitted with heating devices suitable for electrical operation at the specified standard A.C. voltage, being of sufficient capacity to raise the internal temperature by about 150C above the ambient temperature. Heaters in motors and similar devices shall be switched on automatically upon opening of the motor starter, and vice-versa. Heaters in switchgear/MCC cubicles, control cubicles, panels, desks, etc., shall be controlled automatically by adjustable hydrostats (setting range about 50 - 100% relative humidity) The electrical apparatus so protected shall be of such design that the maximum permitted temperature is not exceeded if the heaters are energized while the apparatus is in operation.

Heaters shall be equipped with a suitable terminal box. All Works, whether fitted with a heating device or not, shall be provided with suitable drainage and be free from pockets in which moisture can collect.

1.46.3 Protection Devices

The main parts of the Works shall be protected and interlocked so as to prevent malfunctions and other fault occurrences, and to maintain safety during all operation phases.

Electric protection relays shall be the standard product of an experienced and reliable protection relay manufacturer. The relay shall be of digital numerical type, tropicalized type and be mounted in suitable dust proof and shock-absorbing casings. They shall not be

Khorlochhu Hydro Power Ltd.

affected by external magnetic fields or any other influence (radio, computer, signals, impulses, etc.) consistent with the place or method of mounting.

The protection relays shall be equipped with all necessary auxiliaries such as tripping unit, time relay, external resetting device (hand reset flag with seal-in operation). The relays shall provide easy access for testing and setting purposes.

Pre-warning alarms shall be initiated as early as possible before the protection system trips, in order to enable the operators to take precautions. Tripping of a protection system as well as the sources of the protective action shall be indicated and recorded as an alarm.

Unless otherwise required for special purposes, protection relays shall remain in the tripped position until the operator resets the relay manually. The protection and auxiliary relays shall be grouped and mounted on plug-in modules or stationery-mounted on swing frame with separate plugs and sockets to feature easy replacement and testing. The construction shall be sturdy and such that all parts are easily accessible for adjustment. Relays installed in switchboards shall be arranged in compartments separated from the switchgear.

Besides the mechanical-operated flag type indicator, all relays shall have sufficient contacts and/or auxiliary relay contacts to perform all the tripping, inter tripping, interlocking, indication and alarm functions required. Spare contacts (1 N.O.1 N.C.) shall be provided for later use. The contacts shall be silver-plated or of the seal-in type with the main contacts adjustable. The relay contact rating shall be for the specified standard voltage and for 200% of the nominal passing current. The relay coil shall be able to operate properly at voltage variations of -25% to +15%.

Relays shall be capable of withstanding at least one million operations without any defect.

Testing of the individual relays shall either be affected by stationary-mounted or portable testing devices.

1.47 Terminal Points

Contractor shall be provided the following electric power supply points as applicable:

i) 415/230V AC supply at the auxiliary distribution board located in dam for Spillway Equipment, Automatic remote-control system, Intake equipment, Overflow spillway gates, Chaplangchhu Intake Gate, Desilting Basin gate, Gantry crane and Silt Flushing Gates. Dam distribution board, auxiliary transformer and DG set are in EM package. Further distribution of LT power from this distribution board is under HM scope.

ii) 415/230 V A.C supply at Surge shaft top for Surge shaft Gate Hoists

iii) 415/230 V A.C supply at deck slab for Tailrace Tunnel gate Hoists.

iv) 415/230 V A.C supply at deck slap for TRT Outfall gate Hoist.

The electric service power provided by the Employer, or the other Contractors shall be as follows:

- 415/230 V, 50 Hz, three-phase system with earthed neutral for feeding three-phase and single- phase consumers (connected between neutral).
- 230 V, 50 Hz, permanent supply, single phase earthed.
- 48 V, D.C. systems isolated from earth, for the supply of electronic equipment, tele-control, telecommunications etc. wherever necessary shall be provided by the Contractor.

Supply Tolerances			
System	415/230 V	230 V	48 V, D.C.
Limits of the supply Voltage			

Khorlochhu Hydro Power Ltd.

a) Steady	+5/-10%	±2%	+10/-15%
b) Transient	+30%	±10%	
Limits of the frequency	±2%	±1%	

The Contractor shall supply and install all terminals, control boxes, cables, conduits, fittings including main distribution system comprising of Air Circuit Breaker (ACB), Moulded case circuit breaker (MCCB), Current Transformer (CT), Potential Transformer (PT), bus bars in sufficient capacity along with at least two nos. of spare MCCBs for operating units supplied by others from terminal points for the distribution of electric power supply to the electrical equipment and its controls including lighting to be supplied under this contract. The power supply cables shall be designed so that the voltage drop between the terminal points and the respective equipment shall be limited to within 2.5 % of the rated voltage. In MDS, the provision shall also be made for automatic changeover from mains to DG so that no time lag may be there.

1.48 Cables

1.48.1 General

The Contractor shall provide the relevant design and engineering of the relevant cable systems and, in close co-operation with the **Civil Contractor**, prepare the cable installation drawings with cable routing, connection diagrams, and cable lists, details, etc.

The power cables and control cables shall be of copper as per Indian Standards or IEC publications and the power cables shall be of minimum size 16 mm^2 and control cables shall be of minimum size 1.5 mm^2.

All cables and accessories shall be suitable for installation under site conditions (e.g. aggressive soil conditions, etc.).

The Contractor shall select the most suitable cable routes and raceways ensuring a minimum of interference with other installations.

1.48.2 Color Code

Live parts of electrical connections shall be color coded as follows.

Conductor Designation	**Coding Alphanumeric**	**Symbol**	**Color**
A.C. network	phase 1 phase 2 phase3 Neutral	L1 L2 L3 N	red yellow blue black
D: C: network	Positive Negative Neutral	L+ L- M	+white -black Blue
Protective earthed	neutral	PE/N	green/yellow
Earth		E	Grey

Colour Coding for Mimic Diagrams

Mimic diagrams to be arranged on switchgear cubicles, control panels/desks etc. shall be colour coded as bellow:

415 V	White
110 V.D.C	Violet

Khorlochhu Hydro Power Ltd.

1.48.3 Cable Laying

As appropriate for the various locations, the cables shall be installed in cable ducts, raceways, conduit-or tray systems, cable trenches, etc. Cables running inside buildings or concrete shall be laid on trays. The trays shall be of adequate strength and size to carry the specified number of cables, providing approximately 25% spare capacity. The design of such trays shall include a safety factor to avoid permanent distortion when supporting erection staff during cable installation. The trays shall be of suitable aluminum alloys or hot-dip galvanized steel standard materials

In chemically endangered areas all trays, supports, ladders, etc., shall be of hot-dip galvanized steel elements painted with suitable epoxy-resin paint or provided with a sintered coat of suitable material for protection against such chemical environment. Cable trays shall normally be of the ladder types consisting of bars with rungs, evenly spaced (max. 500 mm) according to requirements. All trays shall be rightly fixed on supporting steel structures, masonry or galvanized racks. Cable trays arrange one above the other should be at least 300 mm apart in case of power cables and 200 mm in case of control cables.

Cables laid on trays or racks shall be properly fixed or clamped. Supports and racks shall be arranged to facilitate removal or replacement of cables. Cables branched from general raceways and directed to the relevant equipment shall be suitable protected where required over their entire length by, e.g., galvanized steel conduits sealed at their ends against ingress of water. Conduits shall be fixed on steel structures, brickwork or be embedded in concrete floors or walls according to field requirements. Conduits embedded in concrete or block work shall be of suitable rigid PVC-type. Cables laid outdoors, across roads in concrete or foundations shall run in hard PVC Plastic pipes buried in the ground in a depth not less than 600 mm or embedded in concrete foundation at suitable depth.

The cross-section area of such ducts shall be utilized to 50% only. Pipe ducts shall terminate in concrete manholes before entering buildings. Manholes and pull-pits shall be provided where required to facilitate cable installation

Cables on brick walls or similar civil structure can be laid in conduits (painted galvanized steel conduits within the reach of persons or erection/maintenance devices, PVC conduits in other areas) or in prefabricated installation channels made of galvanized sheet metal or plastic. Unarmored cables shall be properly protected against mechanical damage when leaving ducts or covered trench works and the like.

Fire-partitions shall be provided when cables are passing through different fire zones or when entering cubicles and panels. Cable passage into buildings shall be sealed fire- and waterproof. Accessible cable galleries shall fire-barriers at suitable spacing including normally open fire doors, which are closed automatically in case of fire.

Cables directly buried in the ground shall be laid as follow:

a) Cable trenches shall be excavated approximately 110 cm deep; the width shall be appropriate to the quantity of cables.
b) The bottom of the trench shall be covered by a 10 cm layer of fine, clean material (preferably sand)
c) Cables shall be laid on this layer of fine material
d) Cables shall be covered by a 15 cm layer of fine, clean material (preferably sand)
e) Cable protection tiles shall be laid along the cables
f) Trench shall be carefully backfilled with excavation materials approx...20 cm high; the material shall be adequately compacted
g) Yellow plastic warning tape shall be laid on top of this layer

h) Trench shall be completely backfilled, materials compacted and surface reinstated- Excess material shall be removed.

A distance of at least 30 cm shall be kept to other services. Power and control cables shall be adequately spaced. Special precaution shall be taken to ensure that no magnetic circuits is formed around single core cables laid in single or trefoil formation, or around any cable liable to carry unbalanced currents. The pulling and fixing and terminating of cables shall be strictly in accordance with the manufacturer's instructions, using the recommended tools and appliances.

The following shall be applicable for cable installation in trenches:

- Cable trench covers shall be removed in sections, according to the progress of work.
- Removed covers shall be stored in such a way that they do not create a hazard to people or traffic at site.
- Cable lying in open trenches for more than two weeks shall be protected against sun radiation.
- Red warning tapes along both sides of the trench shall properly secure open trenches.
- Cable trenches shall be cleaned from dirt, etc., before closing.
- Trenches shall be closed as soon as possible.

1.48.4 Cable Terminations

For all terminations of wires and cables, the insulation shall be neatly stripped without nicking the strands of the conductors. Cable lugs for power cables shall be of adequate size. Cable glands or clamps shall be fitted to prevent stresses on conductors or terminals in all cases. It is important that the sealing compound and sleeving used in terminations is selected to suit the service conditions under which the cable is to operate.

No Cable terminations will be accepted if the insulation resistance reading after 24 hours are less than 100 mega-ohms using a standard 500 or 1000 V "Megger" (M.V. and H.V. cables only).

Some slack cable in a loop or other suitable form is to be allowed at a convenient place in the runs where required.

1.48.5 Illumination System

The contractor shall supply and install the lighting fixtures including industrial LED luminaries etc., to provide proper illumination over and under all the hoist equipment/gantry cranes etc. to enable the operator and O&M crew to work on the equipment being supplied at any time during 24 hrs.

1.49 Earthing System

All electrical system shall be properly earthed as per the latest ruling practice for the safety of the equipment, operating staff as well as the system. **All protection devices for the control equipment including grounding system/ pit wherever required shall be provided by the Contractor.**

Separate Earthing arrangement should be provided to all the Electronics related Equipment's

1.50 Labels and Plates

1.50.1 General

Labels and data plates shall be provided in accordance with applicable standards and as detailed hereunder.

The proposed material of the labels, size, exact label lettering and proposals for the arrangement of the labels shall be submitted to the Engineer for approval.

Khorlochhu Hydro Power Ltd.

Where applicable, designations in the selected local language shall appear above or to the right of the designation in the Contract language. The translations and writings in the local language shall be submitted for approval.

1.50.2 Equipment Labels and Instruction Plates

Labels written in the Contract language shall be provided for all instruments, relays, control switches, pushbuttons, indication lights, breakers, etc. In case of instruments, instrument switches and control switches, where the function is indicated on the device, no label is required. The label shall be fixed close to the devices in such a way that easy identification is possible. Fixing on the dial glass of instruments will not be accepted. The wording shall conform to the wording used in engineering documents.

Each separate construction unit (cubicle, panel, desk, box etc.) shall be identified by its Works identification number. Cubicles and similar units shall also bear this identification number on the rear side if rear access is possible. The overall designation of each unit shall be given in the Contract language and - if required - also in a selected local language. These labels shall be made of anodized aluminum with black engraved inscriptions, arranged at the top section of the units. Manufacturer's trade labels shall - if desired - appear in the bottom section of the units.

All Works inside cubicles, panels, boxes, etc., shall be properly labelled with their item number. This number shall be the same as indicated in the pertaining documents (wiring diagrams, Works list etc.).

Instruction plates sequence diagrams or instructions for maintenance shall be fitted on the inside of the front door of the electrical switchboards. These shall be in the contract language and if required in the selected local language.

1.50.3 Warning Labels

Warning labels shall be made of synthetic resin with letters engraved in the Contract language and in particular cases, where required, in the selected local language.

For indoor circuit-breakers, starter’s etc. transparent plastic material with suitably contrasting colors and engraved lettering would be acceptable.

1.50.4 Labels for Conduits etc.

The material shall be non-corrosive and the description be done with 4 mm high letters/figures.

1.50.5 Labels for Cables

Each cable when completely installed shall have permanently attached to each end and at intermediate positions as may be considered necessary by the Engineer, non-corrosive labels detailing identification number of the cable, voltage, and conductor size.

The cable identification numbers shall comply with those of the cable list.

All cables in cable pits and at the entry to buildings shall be labelled utilizing the aforementioned type of label.

1.50.6 Rating Plates

Works (hoists, machines, transformers etc.) rating plates and other technical data/informative plates shall either be of the enameled type or be of stainless steel suitably protected after engraving with a transparent paint resistant to aggressive atmosphere and solar radiation.

1.51 Key System for Electric Board

The locks or padlocks shall be coordinated for the different applications and shall be supplied with three keys. A key cabinet at the end of each board (distribution board, MCC, control cubicles etc.) shall be provided for storing the keys of that board. For all locks

Khorlochhu Hydro Power Ltd.

supplied there shall be six master keys to open any lock or padlock supplied. Each key shall have one identification label fixed above the key hanging hook inside the cabinet.

The cabinet door keys shall be similar and shall be six (6) in numbers.

8. TRANSPORT, PACKAGING AND STORAGE

1.52 General

Shipping, loading, transportation, unloading, storage, erection and test running shall be performed by the Contractor. An appropriate period for transportation shall be completed.

The general co-ordination of storage and erection work as well as the civil engineering work on site will be done by the Engineer.

The delivery dates, transportation and erection periods indicated in the Contract Documents shall be strictly adhered to.

From the time of manufacturing until commissioning all parts of the plant shall be protected against damage of any kind. Parts, which are damaged during transport, shall be replaced at the Contractor's expense.

The Contractor shall provide the Engineer with complete packing lists of each performed shipment.

1.53 Packing

After the workshop assembly and shop inspection and tests including witness inspection by the Engineer or his authorized representative wherever specified and prior to dismantling for shipment to the Site, all items shall be carefully marked to facilitate site erection. Wherever applicable, these markings shall be punched or painted so they are clearly visible.

Dismantling shall be done into convenient sections, so that the weights and sizes are suitable for transport to Site and for handling on the Site under the special conditions of the Project.

All individual pieces shall be marked with the correct designation shown on the Contractor's detailed drawings and other documents (packing lists, spare part lists, in Operating and Maintenance Instructions etc.).

Marking shall be done preferably by punching the marks into the metal before painting, galvanizing etc., and shall be clearly legible after painting, galvanizing etc. In labelling, the Contractor shall endeavor to use as few designations as possible, and each part of identical size and detail shall have the same designation, regardless of its final position in the plant.

All parts of the Works shall be packed at the place of manufacture the packing shall be suitable for shipment by sea and for all special requirements/limitations of the transportation to Site. Where necessary, double packing shall be used in order to prevent damage and corrosion during transportation, unloading, reloading or during intermediate storage.

All parts including electrical parts shall be suitably protected against corrosion, water, sand, heat, atmospheric conditions, shocks, impact, vibrations etc. by packing them into high pressure polyethylene foil.

The Engineer reserves the right to inspect and approve the packing before the items are dispatched but the Contractor shall be entirely responsible for ensuring that the packing is suitable for transit and such inspection will not exonerate the Contractor from any loss or damage due to faulty packing.

All packing costs shall be included in the scope of Work.

1.54 Marking

The Contractor shall mark all containers with the implementing document number pertinent to the shipment. Each shipping container shall also be clearly marked on at least two sides as follows:

Khorlochhu Hydro Power Ltd.

- Consignee : **Khorlochhu HPP**
  Located in Trashiyangtshe district of Eastern Bhutan
- Contact No. :
- Port of Destination :
- Item number (if applicable) :
- Package number, in sequence and: quantity per package
- Description of Works :
- Net and gross weight, volume :

1.55 Storage

The Contractor shall inform himself fully as to all relevant transport facilities and requirements, loading gauges and other limitations and shall ensure that the equipment as prepared for transport shall conform to such limitations. The Contractor shall also be responsible for obtaining from the railway or highway authorities any permit that may be required for the transport of loads exceeding the normal gauges.

The contractor shall be responsible for all Custom clearance of the consignments from the Indian port if by sea and or from airport if shipped as air cargo, local storage and further transportation to site.

The Contractor shall provide means for all unloading and reloading for all consignments of the plant, during transport to Site. Unloading on the Site will be provided for by the Contractor. Consignments shall be unloaded immediately on arrival at Site. The Contractor is required to take the necessary steps in order to provide the carriage, special supporting structures for heavy loads etc.

The contractor shall develop necessary storage facility for proper and safe storage of all the materials. The warehouses shall be waterproof, well-ventilated and of designated floor etc. **The storage facilities shall be constructed at site as per manufacturer's instruction for equipment storage or another relevant standard. The manufacturer's guidelines or relevant standard for site storages shall be furnished to the Employer prior to the construction of the site storage facilities. The interim payment shall be released only after the approval and construction of the site storage facilities. The Contractors shall consider the cost of such facilities in their price bid.**

If large parts are stored in the open air, they shall be provided with weather resistant and fire-resistant covers. Electrical parts which are not packed in heavy duty polyethylene foil and those so packed but whose packing has been damaged shall be kept in suitable places from the moment of storage to the moment of installation.

All insulation materials which will be taken from the warehouse for installation and which are stored temporarily in the station shall be protected from weather or humidity.

9. INSPECTION AND TESTS

1.56 General

In addition to the provisions established in the Conditions of Contract regarding general procedure of inspections and tests, terms and definitions, and time schedules for inspections and tests the following stipulations shall apply.

Approval of assemblies, tests, inspections, related procedures etc. and acceptance of pertinent test and inspection certificates, or waiving of inspections or tests, shall in no way

Khorlochhu Hydro Power Ltd.

relieve the Contractor of his contractual obligations for finishing the Works in accordance with the provisions of the Specifications.

Three (3) sets of all test records, test certificates, performance curves, tables etc. of all inspections and tests, whether or not attended by the Engineer shall be supplied soonest after performance of each inspection or test. **After completion of all testing two (2) sets of the above-mentioned documents shall be supplied properly bound in books along with two (2) electronic copies.**

All test certificates shall be endorsed with sufficient information for identification of the equipment and material to which the certificates refer.

In addition, the following references shall be entered in the top right-hand corner:

Contractor's name,

Project title,

Plant's (stage's) name,

Contractor's drawing No.

Date.

Inspection and testing of equipment shall include all inspections, tests, checks etc., whether mechanical, hydraulic or electrical, as required to ensure that the equipment supplied meets the requirements of the Specifications.

They shall comprise, but not be limited to the following:

- Chemical analysis of materials,
- Destructive and non-destructive tests of materials,
- Checks and examination of welds,
- Checks of fits and assemblies,
- Dimensional checks,
- Balancing tests,
- Inspection of paints and coatings (thickness and porosity),
- Hydrostatic pressure and tightness tests,
- Electrical tests,
- Running tests (incl. Measurement of sound level & Vibration),
- Functional tests,
- Performance tests,
- Load and overload tests,
- Infrared Thermography Test,
- Type tests,
- Acceptance Test.

The technique, equipment and instrumentation to be used for these tests, checks, inspections, examinations, etc. shall be in accordance with the pertinent and internationally accepted Standards, rules or Codes, in particular these mentioned in the specifications.

If in the Employer's Representative opinion instruments apparatus, devices, etc, used by the Contractor (or his Subcontractor) need calibration or recalibration, then such instruments, apparatus, devices etc. shall be calibrated at the contractor's cost by an independent authority or institute subject to approval by the Employer's Representative.

All inspections and tests shall be in accordance to the approved **"Quality Assurance Plan" of Bid Documents.**



The contractor shall be responsible to carry out and keep record of all inspection/tests during manufacture through his quality assurance group. This shall be supplemented by third party inspection by reputed Firms well versed in carrying out inspection activity in accordance with the approved Quality Assurance Plans namely **Lloyds/ Bureau Veritas** for all components under fabrication at manufacturer's/sub contractor's works. In addition, Employer's inspection representatives shall get associated for specific inspections as specified in the approved quality assurance plan.

The cost of third-party inspection shall be deemed to be included in the respective costs of the items of supply in schedule of prices. (No separate cost to be quoted.)

In case these parties do not operate in the region of the manufacturer, he may propose suitable alternative Inspection agencies of international repute furnishing their detailed particulars, previous references etc. The owner reserves the right to reject any or all of such proposed agencies. Manufacturer shall arrange the third party inspection through one of the above named agencies or the alternative approved agency, without any financial implication for the Employer.

The Contractor shall also be responsible for:

Implementation of quality assurance standards as per approved plans and procedures.

1.57 Workshop Inspections and Tests

As far as practicable, quality of materials, workmanship and performance of all items of the Works to be furnished under this Contract shall be inspected at the places of manufacture. Employer shall depute engineers for inspection of parts/component/systems covered under KHM package in the shop from time to time in accordance with the manufacturing schedule and particularly the Customer Hold Points (CHP) of approved Quality Assurance Plan.

When placing orders for major material and equipment with sub suppliers, the Contractor shall send unpriced copies of such orders in triplicate to the Engineer.

Where the Contractor desires to use stock material, not manufactured specifically for the Works, satisfactory evidence that such material conforms to the requirements of the Contract shall be submitted. Tests on these materials can be waived.

Arrangements shall be made for expediting the shop inspection by having all shop assemblies or pieces covering a single shipment ready at one time. Any painting work as well as transport to the site of the Works shall not be started before the approval of the Engineer has been obtained.

Free and unrestricted access to the Contractor's factory and shops (including those of his Subcontractors) shall be granted to the Engineer, and upon reasonable notice by the Engineer or others nominated by him if deemed necessary by the same for additional witnessing of assembly work or inspections and tests.

In case where international travel is required in connection with the witnessing of tests and training, Bidder shall make all arrangements for the air travel (from India/Bhutan & back), stay, transportation/conveyance of employer's representatives and also for their living allowance at US $ 160 per day. Such programmes shall be identified and listed separately in the bid.

For those of the witnessing of tests and training which shall take place in India, the Bidder shall make all arrangements for required accommodation and transportation of employer's representatives at place of works without any extra cost.

Should an agreed inspection not be carried out as proposed because of lack of preparation, obvious negligence or material and/or equipment being presented in a state, which does not correspond to the proposed procedure or is clearly not acceptable such an inspection shall be repeated. The cost incurred for all regular as well as repeated inspections shall be fully

Khorlochhu Hydro Power Ltd.

borne by the Contractor. The travel expenses for each additional or repeated inspection shall be borne by the contractor.

Inspection at manufacturer's works/vendor's works (for bought out items)

All the requirements of section 9.2.1 to 9.3.1 of the specifications shall be covered including the following:

- Inspection of materials with material verification test certificate,
- Inspection of bought out items/ components with manufacturer's test certificate,
- NDT for welding (Radiography, Ultrasonic, MPT, DPT),
- Inspection of shop assembly of embedded parts,
- Inspection of shop assembly of gates,
- Inspection of shop assembly of hoist/ operating equipment including operational tests (Gate manufacturer works or vendor's works),
- Inspection of shop assembly of hoist supporting structure.

The above inspections shall also include dimensional accuracy checks, tolerance check for critical dimensions.

1.57.1 Material Tests

Unless otherwise specified, the quality of materials shall be verified generally by:

- Chemical analysis,
- Mechanical tests (yield point, tensile strength, elongations, notch impact, Strength, etc.)
- Welding tests (welding procedure, welding material, welding tensile strength, welding bend test, welding reversed bend test, etc.)
- Non-destructive x-rays, ultrasonic, magnaflux, liquid penetration tests visual inspection, magnetic properties etc.)
- Electrical tests (voltage losses, tan-delta, insulation, magnetic properties)

Certified mill test reports of plates will be acceptable when these comply with the requirement for "Reports of Inspections and Tests" as stated in the Special Conditions. Test specimen and samples for analysis shall be plainly marked to indicate the materials they represent.

Castings and forgings shall be tested in the rough state in order to detect flaws in time thus avoiding delays. Magnetic particle inspection of important castings shall cover the whole surface of the casting. After partial machining further tests can be conducted. Important castings and forgings like Gate wheels, hoist drum gears, crane wheels etc. shall be ultrasonically tested. The acceptable limit for ultrasonic testing of castings shall be level I of SA-603 of ASME Section-5 and that of forgings shall be as per SA 388 of ASME Section-5. Load tests on crane hooks, steel wire ropes, chains, etc. shall be considered as material tests.

1.57.2 Checking of Dimensions

The dimensions, especially clearances and fits, (ISO 286) which are essential for operation and efficiency shall be carefully checked in an approved manner, as for example:

- Run-out and roundness tolerances of shafts, pistons etc., to be measured on single parts as well as (wherever possible) on the assembled components,
- Fits and clearances of gates, bearings, servomotor pistons, valves, guiding, distributing and actual actuating elements etc.
- accuracy, surface roughness and shape of sliding and guiding surfaces of seals, bearings, water passages in hydraulic machinery, valves etc.,

Khorlochhu Hydro Power Ltd.

- Dimensions of couplings or connections for assembly with other deliveries from the Contractor, Sub-contractors or other contractors.

1.57.3 Workshop Assembly

In addition to the quality and production control tests, the following shop assembly work and tests shall be made to check measurements, fitting and functioning.

Works to be furnished shall be shop assembled to a status sufficient to prove that the design and workmanship have been executed in accordance with the Specifications, that the delivery is complete, and that no work remains to be done at Site which reasonably can or should be done in the shop.

The metal work shall be shop-assembled to ensure that all parts are properly fitted and that the dimensional and tolerance requirements shown on the drawings have been obtained. All holes for field connections of parts furnished under these specifications shall be drilled or reamed as noted on the drawings, with the embedment so assembled. Members to be shop-bolted shall have all parts well pinned up and drawn together with bolts before bolting is commenced.

To commence the shop assembly of radial gates the gate arms shall be supported in their relative position at the same elevation properly spaced centre to centre and so that the machined pin holes have a common horizontal axis. With the arms in the position the gate leaf shall be erected between them. The vertical lift gates shall be assembled in a vertical position and holes for field connections carefully drilled or reamed. Connections which have to be dissembled for shipment shall be made by the use of erection pins, one size less in diameter than the designed size of temporary machine bolts.

Stoplog/gate & lifting beam shall be assembled in shop for checking all dimensions specifically critical dimensions as per final approved shop drawings and manufacturer's instructions. The lifting beam shall be checked for its verticality for the both the positions of counter weight and shall be checked for satisfactory operation of grappling and unwrapping of its hook with stoplog units.

The Hoist machinery / crane shall be completely assembled in the shop to ensure that all parts are properly fitted. Surfaces of metal which will be in contact shall be cleaned before the parts are assembled. The parts shall be adjusted to line and fit and shall be well pinned and bolted so that the surfaces are in close contact before reaming, drilling, bolting or welding is commenced. The field connections shall be fitted and checked in the shop to assure proper fit during field erection.

After shop assembly the Hoist machinery/crane shall be tested at manufacturer's workshop for functional tests.

Where applicable each item of the works shall be assembled completely prior to painting.

Field joints shall be temporarily connected.

All parts shall be properly match marked, identified and doweled where practicable, to facilitate correct and quick field assembly and alignment. Where necessary, suitable dowels shall be provided for insertion after field assembly and drilling. The holes for any fitted bolt shall be accurately reamed.

During workshop assembly all instruments, control devices and piping shall be fitted.

If the assembly shows defects in the design or manufacture or unforeseen difficulties in assembling and dismantling, these shall be eliminated. If required, design alterations or corrective measures can be executed provided that reliability of operation or interchangeability is not reduced and provided that the agreement of the Engineer has been obtained.

Khorlochhu Hydro Power Ltd.

If the corrections cannot be carried out in accordance with the terms mentioned above, the components concerned will be rejected. The decision on possible subsequent corrections is reserved exclusively to the Engineer. Faulty parts or Works shall by no means be delivered.

The assembled parts shall subsequently be subject to tests as per applicable standards or required by the Engineer.

1.57.4 Hydrostatic Pressure Tests

Before final machining, each of the hydraulic hoist cylinders shall be subjected to a one and a half times the design pressure or 3 kg/mm^2, whichever is more. The test pressure shall be held on each cylinder for a sufficient length of time to permit inspection of all joints. Any leakage in joints may be repaired by re-welding at the discretion of and, in a manner acceptable to the Employer. The Employer, at his discretion may require additional stress relieving and radiographic examination of the hoist cylinder that have been repaired by re-welding. All test heads and other equipment required for testing shall be furnished by the Contractor free of cost and will remain his property after the completion of the tests.

1.57.5 Functional Tests

Functional tests shall be defined as tests of the function of assemblies, sub-assemblies or parts of the Works under no load conditions. Functional tests shall be performed on all Works prior to the execution of operational tests.

1.57.6 Operational Tests

As far as practicable operational test shall be carried out on all Works, simulating operating conditions.

Parts to be delivered by sub suppliers shall be tested either at the premises of the sub supplier or of the Contractor, as agreed by the Engineer.

Before testing the Contractor shall submit a notice containing full information on the tests with detailed tables or graphs on the latest edition of the characteristic values of the Works to be tested and on the test facilities and equipment.

i) **Operational tests of Rope Drum Hoists**: in accordance to clause no.2.3 of IS: 10096 (Part 1/Sec 2): at least one rope drum hoist of each type shall be tested under no load condition at the shop & is also to be tested for designed forces coming on the rope drum corresponding to 125 percent of the hoist capacity.

ii) **Operational tests of Gantry crane**: in accordance to clause no.26.2 of IS: 3177: All electrical and mechanical equipment shall be tested in accordance with the appropriate Indian Standard at either the crane maker's or equipment manufacturer's works. The crane shall be tested at manufacturer's works under full load and 25 percent overload of hoisting and cross traverse motions. Travelling gear may be run light to check shaft and gear alignments.

The deflection test shall be carried out with the safe working load at rest.

1.57.7 Insulation Test

The following tests shall be carried out at shop as well as at site after erection:

i) After erection but before the hoist/crane is connected to the supply, the insulation of the electrical equipment shall be tested by a suitable instrument and any defects revealed shall be rectified. The voltage required for the insulation resistance test shall be d.c. voltage not less than twice the rated voltage,

ii) Any reading less than 0.5 mega ohm obtained with an insulation resistance tester of the un-regulated type shall be dis-regarded and the wiring under test shall be sub-divided until a reading higher than 0.5 mega ohm is obtained. Failure to obtain a higher reading shows an unsatisfactory state of insulation. If an installation has been sub-divided for test purposes, each sub-division shall meet the requirement,

Khorlochhu Hydro Power Ltd.

iii) The insulation resistance of each wiring circuit exclusive of connected apparatus shall be not less than 2 mega ohms. If necessary, it shall be permissible to disconnect individual items of equipment while making this test.

1.57.8 Electrical Tests

i) Electrical Works shall be tested in accordance with applicable Standards and agreed test programs and procedures. Testing of the electrical Works shall be performed in accordance with applicable Standards, they shall include but not be limited to tests or heating, loading, overloading, losses. However, before the complete installation is put to commercial service, tests shall be carried out to ascertain the following:

a) The satisfactory operation of each controller, switch, contactor, relay and other control devices and in particular the correct operation of all limit switches under the most unfavorable conditions,

b) The correctness of all circuits and interlocks and sequence of operation,

c) Satisfactory operation of all protective devices,

d) The satisfactory operation of each motion of the crane.

ii) The compliance of the crane with the specified performance requirement.

iii) Tolerances on specified speeds on full load shall be within 10%.

The measurement shall not be taken on the first application of the load.

1.58 Site Inspection and Tests

1.58.1 General

During erection, commissioning and trial operation the Contractor shall organize at suitable intervals all inspections and tests in the presence of the Engineer in order to prove the orderly execution of the works in accordance with the Contract.

Unless otherwise specified, all costs for testing at site and of the works and charges associated with it shall be borne by the Contractor. This includes the measuring devices, properly calibrated, and any pertinent accessories, which shall be made available by the Contractor for the entire duration of the tests. The Contractor shall delegate his experts to supervise the tests at site.

The tests, checks, examinations at site shall comprise but not be limited to:

- Checks and examinations of welds,
- Hydrostatic pressure test,
- Tightness tests,
- Dielectric tests,
- Functional checks (on all operating mechanism, on protective devices, automatic and manual controls, monitoring, supervisory equipment etc.),
- Running tests,
- Reliability tests,
- Performance tests and determination of characteristic data.

All such tests and checks shall be performed in the presence of the Employer's Representative. If not satisfied with the performance of the tests and checks the Employer's Representative shall have the liberty to ask for additional tests or repetition of same.

The testing at Site shall be complete in every respect to prove the successful performance and operation of all the works and Works supplied and erected under the Contract.

For the procedure of inspections and test at site, notice to the Engineer, reports, commissioning, trial runs and trial operation, and acceptance tests refer to General Conditions.

Khorlochhu Hydro Power

1.58.2 Inspection and Testing of Pressure Shaft Liner

i) During Fabrication, Laying and Erection

The Engineer or his duly authorized representative shall have at all reasonable times access to the Contractor's premises or works and shall have the power at all reasonable time to inspect and examine the materials and workmanship of the pressure shaft liner during its manufacture or laying and erection at Contractor's premises or works site. If part of the plant is being manufactured or erected in other premises or works, the Contractor shall obtain for the Engineer and for his duly authorized representative permission to inspect during fabrication and erection of the pressure shaft liner as if the plant of material were manufactured on the Contractor's own premises or works.

The Engineer shall, on giving seven days' notice in writing to the contractor setting out the grounds of objections which he may have in respect of the work, be at liberty to reject all or any materials plants or workmanship which is the subject of any of the said grounds of objection which in his opinion are not in accordance with the contract or are in his opinion defective for any reasons whatsoever provided that if such notice is not sent to the Contractor within reasonable time after the grounds upon which notice is based have come to the knowledge of the Engineer. He shall not be entitled to reject the said materials, plants or workmanship on such grounds, unless specifically provided otherwise, all tests shall be made at the Contractor's works before transport. The Contractor shall give the Engineer notice of any material being ready for testing, and the Engineer or his duly authorized representative shall, on giving twenty four hours previous notice in writing to the Contractor, attend at the Contractor's premises or works within twenty one days of the date on which the material is notified as being ready failing which, the Contractor may proceed with the tests, which shall be deemed to have been made in the Engineer's presence and he shall forthwith forward to the Engineer duly certified copies of the test certificates in duplicate.

ii) Testing at Contractor's Premises

In all cases, where the Contractor provides for test whether at his premises of work or of any of his Sub-contractor premises, the Contractor except where otherwise specified shall provide free of charges, such labour, material electricity, fuel, water, stores, apparatus and instruments as may reasonably be demanded to carry out efficiently such tests of the plant in accordance with the contract and shall give facilities to the Engineer or his authorized representative to accomplish such testing. If special tests other than those specified in the contract are required, the Corporation shall pay them for as "Variations". When the tests have been satisfactorily completed at the Contractor's /Sub Contractor's premises or works the Engineer shall issue a certificate to that effect and no plant shall be transported before such certificate has been issued. The satisfactory completion of these tests or the issue of the certificate shall not bind the Engineer to accept the plant so passed for dispatch, should it on further tests be found not to comply with the specifications.

iii) Testing at Site

Wherever possible all tests shall be carried out before dispatch. Should however, it is necessary for the final tests as to performance and guarantees to be held over until the plant is erected at site they shall be carried out in the presence of Contractor's representative within one month of the completion of erection. In all such cases except where otherwise specified, the Contractor shall provide free of charge all the facilities, equipment and material as may be required from time to time and as may reasonably be demanded for efficiently carrying out such tests of the pressure shaft liner, material, or workmanship in accordance with the contract. Should the results

Khorlochhu Hydro Power Ltd.

of test not come within the margin specified, then test shall, if required, be repeated within one month from the date of the steel lining being ready for re-test and Contractor shall repay to the Engineer all reasonable expense to which he may be put by such tests.

iv) Non-Destructive Examination of Pressure Shaft Liner

- **Radiographic examination**

  All longitudinal joints of liner including bends shall be subjected to 100% radiographic examination. Other circumferential joints shall be spot radiographed to 10%. In addition to this 100mm of circumferential joints on either side of longitudinal joints shall also be tested radiographically. All circumferential welds of bends shall also be subjected to 100% radiographic examination. All the longitudinal and circumferential joints of specials like Y piece shall be subjected to 100% radiographic examination. Field butt joints of wye pieces shall be radiographically tested and got accepted prior to jointing of stiffeners or sickle plates at appropriate locations. The procedure for the radiographic examination, the acceptable standards of welds, the repair of defective welds and the re-examination of repaired welds shall conform to the relevant section of IS: 2825, IS: 2595, IS: 1182 and IS: 4853. All repairs shall be fully radiographed.

- **Ultrasonic Examination**

  All field welds, wherever not spot radiographed or such joints which are inaccessible to radiographic examination shall be subjected to ultrasonic examination. The circumferential joints of pressure shaft liner not subjected to radiographic examination shall be tested ultrasonically to 100%. The procedure for the ultrasonic examination, the acceptance standards for welds etc. shall conform to the relevant articles of ASME Boiler and pressure vessel code-Section V.

- **Other Examination**

  Discontinuities such as cracks, seams, laps, cold shuts, laminations and porosity can be detected using other methods viz. Liquid Penetrant Examination and Magnetic Particle Examination

  All weld metal build up shall be examined over the full surface of the deposit by either liquid penetrant examination or by magnetic particle examination. All permanent hold down logs or devices welded to the steel penstock shall be examined by either of the above two methods. Removal of temporary logs and devices tack welded to the pressure shaft liner shell and subsequent dressing shall be followed by either of the above two examinations viz. LPE or MPE of the connection area.

v) Non-Destructive examination of HRT Steel Liner

Similar required tests, as in case of pressure shaft liner, shall be conducted in case of HRT Steel Liner as per instruction of the Engineer without any extra cost to the Employer.

The procedure and acceptance standards for the above methods shall conform to the relevant articles of ASME boiler and pressure vessel code -Section V. Hydrostatic test for wye piece shall be carried out as per article 13.4 & its related sub clause of ASCE manuals and report on engineering practice no. – 79 or any internationally accepted practice.

The notch toughness of welds and heat-affected zones shall be determined using charpy-V notch impact tests. Impact tests shall be in accordance with the requirement of article T-2 ASME code3, Sec. B, Div.2 and made on procedure qualification test plates and vessel test

Khorlochhu Hydro Power Ltd.

plates of the material to be fabricated. The cost of weld tests such as radiographic, ultrasonic, magnetic particle/ liquid penetrant examination shall be borne by the contractor and shall be included in the unit area of various items. Prior to making the radiographs of the welds the contractor shall place suitable identification markings adjacent to the welds. Such markings shall be so designed and located that the images will appear in the radiographs. The markers shall be painted, stamped or fastened to the shells as directed by the Engineer and shall not be removed until all the welds have been accepted. All X-ray films of the joints shall be the property of the Employer and shall be forwarded properly identified to the Engineer for record. Radiography by X-ray may be replaced by Gamma ray methods using Cobalt-60, Iridium-192 and Caesium-187. Records of all non-destructive tests including radiography, ultrasonic test, liquid-penetrant test, magnetic particle inspection shall be maintained in a suitable format to be evolved in consultation with the Engineer showing the unique identification of the weld, its location, size, extent of flow, if any and interpretation of the results of the non-destructive test along with the results of repairs, if any.

1.58.3 Inspection Schedule

To facilitate the Employer in planning its inspection activities, the Contractor shall submit during detailed engineering the details of the lots along with the time schedule in which the ordered materials shall be offered for inspection as also the places of inspection. These details shall be finalized and approved and form an integral part of the Contract.

1.58.4 Commissioning and Trial Run

After the contractor has notified the Employer's Representative and received his agreement that the equipment is ready for the **commissioning tests**, the Contractor shall start with the Tests as stipulated in the Conditions of Contracts.

The tests shall comprise the following stages:

a) Pre-commissioning Tests,

b) Commissioning Tests,

c) Trial Operation.

1.58.4.1 Pre-Commissioning Tests

Pre-commissioning tests shall include the appropriate inspections and (dry or cold) functional tests to demonstrate that each item of Plant can safely undertake the next stage (b).

i) Stage Inspection at Site

a) Requirement of IS 7718 shall be covered. Inspection of embedded parts duly assembled/ erected in location, fully aligned and adjusted including installation of sill beam, side guide members, lintel members, sill seats/ tracks/ bearing pads and hoist supporting structure. This inspection involves measurement of critical dimensions, verticality, co-planerness of sealing/ bearing surfaces and dimensional accuracy within permissible erection tolerances.

b) Prior to concreting, it shall be ensured that the embedded parts which have been erected/ aligned and inspected are supported by additional bracing etc. so that they do not get disturbed during concreting.

c) After concreting, critical dimensions of embedded parts shall again be inspected for clearance of any excess concreting requiring chipping etc.

d) Inspection of gate at site after its complete assembly and checking of dimensional accuracy, critical dimensions, co-planerness of skin plate and bearing / sealing faces.

Khorlochhu Hydro Power Ltd.

e) Inspection of structural components of hoist support, their dimensional accuracy, correct location and rigidity.

f) Inspection of lifting beam for proper matching with all units of stoplogs.

g) Inspection of hoist/Crane for exact location of hook/pulley block over the lifting point of the gate and for proper matching and connections.

ii) Final Checking and Testing at Site

1. General

After completion of various phases of works final checking of the entire work shall be done, by the contractor to ensure that all the equipment erection and wiring etc. have been done strictly according to the specification drawings and as approved by the Engineer. All the works shall be thoroughly inspected keeping in view the following main points:

a) Check for completion of all works in accordance with specifications and drawings,

b) Checking of alignment of all mating components,

c) Checks for correctness of connections, continuity check, insulation resistance test,

d) Checks, adjustment and characteristic test of all controls/ protective equipment in accordance with manufacturer's instructions,

e) Setting and calibration of components e.g. relays, control valves, pressure relief valves etc.

f) Checking of equipment for proper mechanical adjustment and proper operation,

g) All routine and pre-commissioning tests and any other special tests required to be conducted at site on each and every equipment as per relevant standards and manufacturer's instructions and recommendations,

h) All other tests as specified under relevant standards and codes of practice but not mentioned here,

i) Functional tests/checks for various components,

j) Tests & commissioning of control panels.

Proper record shall be maintained for all visual inspections, settings and checks carried out.

2. For Hydraulic Hoist

The following tests on hydraulic hoist shall be carried out by the hydraulic hoist manufacturer's representative:

a) Checking of fluid tank and piping for completion as per drawings as well as for cleanliness before filling the hydraulic fluid,

b) Checking of connections of individual actuators to hydraulic installations according to circuit diagram,

c) Aligning the pump and motor,

d) Filling of hydraulic fluid,

e) Commissioning of pump and motor,

f) Setting of pressure relief valves/safety valves, pressure switches, temperature controllers and pressure unloading valves to the prescribed value and locking,

g) Commissioning of control gear and actuators.

3. For Lifting Beam

a) Functional tests with all units.

4. For Gantry Crane / TRCM

a) Ensuring completion of all component parts in accordance with the drawings.

b) Ensuring proper lubrication of all components.

c) Functional test of various assemblies including hoist, LT drive, CT drive, etc.

iii) Dry Testing of Gate & Hoist

The dry testing of the gate and hoist shall be carried out generally in accordance with Cl. 8.1, 8.2, 8.3 and 8.4 of IS 7718. The gate & hoist shall be functionally operated, fully closed, fully opened and it shall be ensured that there is no obstruction during the operation, the movements are smooth without any jerks and no undue effort is required for operation. Contact between gate seals and seal seats shall be checked and pre-compression ensured by viewing the contact surface against a light source. The operation of the hoist shall be smooth without any undue noise/ excessive friction and without excessive vibrations in the gate, hoist and supporting structure. The operation of hydraulic hoist shall be without any increase in oil pressure beyond design limits and motor current shall be within design value.

IMPORTANT: Any 'Dry' testing movements should have Rubber seals & seal faces lubricated with WATER. (Do not use grease/ oil) For Metal to Metal sealing/ bearing surfaces grease be used.

1.58.4.2 Commissioning Test

Commissioning tests, which shall include the specified operational tests to demonstrate that the works or section can be operated safely and as specified, under all available operating conditions; and shall include:

- Satisfactory operation of all equipment, after erection,
- Satisfactory vibration and noise level during entire cycle of operation,
- The testing of gate and hoist for aspects as per Cl. 8.1 to 8.7 of IS: 7718 shall be performed with water pressure against the gate (preferably up to design head).
- The testing of radial gate and hoist as per IS: 10096 shall be performed.

Completion certificate shall be issued by the Engineer after successful commissioning of the facility as per above.

1.58.4.3 Trial Operation

After issue of completion certificate, trial operation shall commence which will demonstrate that the works or section perform safely & as specified with reliability during repeated operation and in accordance with the Contract.

During the trial operation period the Contractor may request any minor adjustments which do not in any way interfere with or prevent the use of the equipment by the Employer's or result in reducing the output or decreasing the efficiency.

If any failure or interruption occurs in any portion of the equipment covered by the Contract due to, or arising from, faulty design, materials, workmanship (but not otherwise sufficient to prevent full use of the equipment the trial operation period is to recommence after the Contractor has remedied the cause of defect.

A certificate of suitability for Operation shall be signed by an authorised representative of the Employer's Engineer and the Contractor.

This Certificate shall state:

- the conditions of commissioning,
- the names of the participants,
- the date of commencement of trial run,
- the list of minor defects, if any.

During the trial run the Contractor shall make familiar the Employer's personnel with the properties, the operation and maintenance of the Works and its auxiliaries to such extent that thereafter the duties can be assigned to the Employer's trained personnel.

The Test on Completion certificate shall be issued thereafter.

1.58.5 Acceptance

The taking-over testing of any part or section of the Permanent Works which can operate as an independent unit, shall be performed in accordance with the standards and regulations laid down in the "Particular Technical Specifications" and following the test procedure agreed upon between Engineer and Contractor.

Immediately upon termination of any such testing of a part or section of the permanent Works a "Protocol of Acceptance" shall be issued by the Engineer.

This document shall be signed by an authorised representative of the Employer, the Engineer and the Contractor and shall form an integral part of the later "Taking-Over Certificate".

The acceptance of the equipment will be based upon:

- Mutual acceptance of results of test between the contractor and the Employer,
- Acceptance of Inspection and test records/ Test certificate carried out at "Works" and at "Site".

This "Protocol of Acceptance" shall state:

- The date of testing,
- Statement of all minor defects and/or irregularities, which have to be corrected by the contractor,
- Confirmation that the guaranteed data have been proven,
- Confirmation that all contractual documents have been submitted,
- Confirmation that the Employer's personnel has been familiarised with the Works and that they will be able to operate and maintain the Works.

If any test for the verification of the guaranteed data could not be performed for operational reasons beyond the Contractor's responsibility, this part of the acceptance shall be stated in the "Protocol of Acceptance" and be postponed for a mutually agreed period.

10. TRAINING OF EMPLOYER'S PERSONNEL

The Bidder shall arrange training to familiarize the employer's personnel about constructional and O&M aspects of equipment wherever need of specialized training is felt during detail engineering. Cost of such training shall be borne by the Bidder. Travelling and living expenses of the personnel deputed on such training, however, shall be borne by the Employer.

Besides above, the Bidder shall hold training sessions to familiarize the Employer's personnel with all aspects of operation and maintenance of the equipment and sub-systems before the beginning of the dry tests on site. The technical documentation used in the training sessions shall include the Bidder's draft operation and maintenance manuals and test procedure descriptions approved by the Employer. The Bidder shall provide training for each phase of work as per details agreed at the time of award.

1.59 General Requirements of Training

The Bidder shall provide suitable instructors, training material and facilities (instruments, apparatus, simulators, documents, drawings, protective clothing, rooms, office supplies, etc.) for the personnel made available by the Employer for training.

Khorlochhu Hydro Power Ltd.

One month before the training start, the Employer will send the list of the trainees and any comments on the training program proposed by the Bidder. This program shall be adapted to the design and nature of the Works, and the needs of trainees. Trainees shall be suitably trained in the various aspects of design, manufacture, installation/erection, operation and maintenance, relevant to the training, of works similar to the Works

The Bidder shall supervise and provide direction to, and be liable for the acts or omissions, other than negligent or willful misconduct of such personnel, of the Employer's trainees.

The Bidder shall provide the training described hereafter in accordance with any further specific requirements stated in the Employer's Requirements.

The Bidder shall assist the Employer in obtaining any visas and other formalities for entering or leaving the territory on which the training is being provided.

The Bidder shall bear responsibility for ensuring the safety of the trainees during their stay in the country of the training. On their part, the trainees shall comply with the laws, regulations and customs of the country in which training is being provided.

In the event of illness or accident, the Bidder shall take all steps to provide the trainees with the appropriate medical care.

1.60 Training during Engineering/Manufacturing Phase

This shall cover all disciplines viz, Mechanical, Electrical, C&M & QA etc. and shall include all the related areas like design familiarization, training on product design features and product design software of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing, erection, welding etc. The training in areas of Operation and Maintenance shall take place preferably during end of manufacture/ tests.

1.61 Training during Erection/Installation/Testing & Commissioning

Independently from the supervision and inspection functions of the Employer's Representative, the Bidder shall authorize the Employer's Personnel to follow the erection/installation/testing & commissioning and site work at his site.

This onsite training shall cover each phase of erection/installation/testing & commissioning and shall be of sufficient duration.

The Bidder shall supply the information or measurements concerning the erection requested by the Employer's Representative or/and by the Employer's personnel. The Bidder shall also provide on the-job training in the operation and maintenance of the Works to the Employer's Operating Personnel. Such training shall start at least 30 days prior to commencement of Tests on Completion and continue until Taking Over. Its scope and quality shall be such as to provide the trainees with comprehensive understanding of all operational and maintenance aspects of the work. Such training shall also include safety and environmental protection aspects applicable to the work. The proposed training for various equipment and systems shall be minimum 3 man-month as per table below.

Sl. No.	Description	Batch	No. of Days	No. of Engineers and Technicians	Man Days
1	Hydraulic Cylinder complete in all respect including Power Pack	2	5	2 Engineers 2 Technicians	40

2	Trash rack cleaning machine	1	7	1 Engineers 3 Technicals	42

11. QUALITY CONTROL AND ASSURANCE

1.62 Quality Assurance Plan

An outline description of the Quality Assurance Program to be used by the Bidders shall be included in its Bid.

A quality assurance program of Bidder shall generally cover the following:

- Its organization structure for the management and implementation of the proposed quality assurance program;
- Engineering operation as per ISO 9000 with design planning, design reviews with Engineer, Design verification, validation.
- Site erection procedures by designers;
- Documentation control system;
- The procedure for purchasing of materials, parts, components and selecting of Sub-Contractor's Services including vendor analysis, source inspection, incoming raw material inspection/verification of materials purchased etc.
- System for shop manufacturing and site erection controls including process controls, fabrication and assembly controls.
- Control of non-conforming items and system for objective actions.
- Realization, Inspection and test procedures both for manufacture and field activities.
- Control of calibration for testing and measuring equipment.
- System for indication and appraisal of inspection status.
- System for quality audits.
- System for Maintenance of records.

The Contractor shall submit the detailed Quality Assurance Plan (QAP) for the complete equipment/materials during detailed engineering for approval and acceptance by the Employer in line with the requirement of model QAP. The approved QAP shall form integral part of the contract.

The QAP shall include inspection and tests proposed to be conducted on raw material/bought out items at the time of induction in the process of manufacturing and at final stage of assembly.

The Shop Assembly Test, Type/Routine Tests and Acceptance tests shall be witnessed by the representative of Employer as per requirement of approved Quality Assurance Plan and Contractor shall proceed for next stage of manufacturing after clearance/approval of previous stage of manufacturing.

The Contractor shall also furnish the field quality manuals for various field activities detailing the procedures and inspection check lists for transportation, storage/preservation, erection, pre-commissioning and commissioning activities. The field quality manuals shall indicate the various assembly/erection/operation tolerances and limits of deviations for each individual equipment and system.

After carrying out pre-dispatch inspection/tests satisfactorily, formal dispatch clearance/authorization for shipment shall be issued.

Khorlochhu Hydro Power Ltd.

Employer reserves the right to carry out quality audit and quality surveillance of the system and procedures. However, such audit or quality surveillance by Employer shall not relieve Contractor of any of its responsibilities under the terms of Contract.

1.63 Inspection Schedules

To facilitate the Employer in planning its inspection activities, the Contractor shall submit during detailed engineering the details of the lots along with the time schedule in which the ordered materials shall be offered for inspection as also the places of inspection. These details shall be finalized and approved and form an integral part of the Contract.

1.64 ISO Certification

In case the Contractor or his sub-contractor / vendor does not possess ISO-9000 series certification, he shall submit following details during detailed engineering for assessment of his capacity to supply quality equipment/materials/services under the contract.

- Contractor's quality system details
- Details of system for dealing with items not conforming to prescribed specification.
- Details of stage and final inspection and auditing.
- Contractor's system for calibration of testing and measuring equipment.
- Details of testing and measuring equipment available with Contractor.
- Details of important facility/equipment available with Contractor to produce reliable products having requisite standard.

12. COMPLETENESS OF SYSTEM/EQUIPMENT/ITEMS

Wherever the gate items\penstock are embedded, structural steel supports required to hold them in position and which are finally embedded in concrete shall be deemed to be included in the unit prices of various items mentioned. No separate payment shall be made for such supports or any other type of temporary or permanent supports. The unit price accepted for the various items shall be considered to include cost of all materials, transport, plant and equipment, labour, tools and tackles, fabrication, erection, non-destructive tests (both at shop and field), surface preparation, painting, protective coating, wrapping, machining, supervision, Supply, installation, testing and commissioning of equipment, etc. complete as required for all the operations specified herein above in addition to those specifically so provided or otherwise so specifically directed for particular item of work.

It is not the intent to specify herein all aspects of design and construction; nevertheless, the equipment and installation/works shall conform in all aspects to high standard of engineering, design and workmanship and shall be capable of performing in continuous commercial operation in a manner acceptable to the Employer, who will interpret the meaning of the specification and drawings and shall have a right to reject or accept any work or material which in his assessment is not complete to meet the requirements of this specification and/or applicable Indian / International standards mentioned elsewhere in this specification.

Any such system/equipment/items, which are not explicitly mentioned in specification but are functionally necessary/advisable as per best national/international practices for smooth operation of powerhouse, shall be deemed to be included in the scope of work and the Contractor shall provide the same without any extra cost to Employer.



SECTION–7

PARTICULAR TECHNICAL SPECIFICATION

(PTS)

SECTION-7: PARTICULAR TECHNICAL SPECIFICATION

13. General

The bidder shall provide all the equipment as per following description suitable for the operating duties as described and as per the requirement of civil and electromechanical design. **The General Assembly drawings based on preliminary design are to be submitted by the bidder along with the schedule for various activities for different items of hydro-mechanical equipment.**

14. Spillway Radial Gates and Hydraulic Hoists

1.65 Spillway Gates

Five (5) numbers submerged radial gates for spillway opening size of **6.8 m wide x 12.9 m** high (between crest and lintel) of welded steel construction with cylindrical upstream skin plates supported with vertical stiffeners, horizontal girders, arms and trunnion assemblies, lifting attachments etc., shall be provided. The trunnions shall be equipped with **self-lubricating bush bearings (make: -Lubrite/Devaglide).** The gate shall be provided with minimum 3 No. guide roller assemblies on each side. The gate trunnions shall be supported by trunnion brackets resting on trunnion concrete beams. Gate assembly shall be fitted with adjustable/ flexible side seals, double stem (leaf type) top seals and wedge type bottom seals. PTFE/fluorocarbon cladded seals shall be provided for sides and top but bottom 2 meter of side seals portion is of rubber without cladding. Fixed spring mounted PTFE/fluorocarbon cladded music note seal/anti-jet seal is provided at the lintel on the embedded part. **General arrangement of radial gate is as shown on drawing Nos. KHPP- HM-DAM-6007 & 6008 Sheet 1of 2 & 2 of 2**

There exists a possibility of change in the height of gate by about ±150 mm during detailed civil design/model studies, provision for which may be kept in the bid.

The gate shall be lifted from 2 points equidistant from centerline of the gate. The lifting lugs of adequate strength shall be provided on downstream of the gate for hoist cylinders connection. The location and layout of lifting lugs and hoists shall be such that the gates can be operated fully without any hindrance. The hoist supporting structure shall be designed to withstand the maximum force the hoist can exert without exceeding normal stresses.

The moving parts of gates may be divided into vertical/ horizontal joints for easy transportation. But the strength of assembly shall be same as if it were fabricated in one piece. Arms shall be suitably braced. HTFG bolts shall be used for joints between arms and horizontal girders and arms and trunnion assembly. The skin plate shall be finished smooth at bottom for proper seating on the sill beam. Upstream face of the skin plate will be finished smooth throughout so that the sealing is effective under partial opening of the gate.

Design of gate shall cater to the requirement of elastic shortening of radial Arms and effect of temperature variation from -5^0C to 35^0C on portal frame formed by arms. To prevent damage to bottom part of gate/lip/skin plate due to rolling of boulders/ impact of submerged logs/ debris and to prevent vibrations during partial operation of the gate, strengthening will be provided by way of:

- Thicker skin plate in the bottom part of the gate,
- Stronger bottom girder,
- Provision may be made to retract the bottom seal while gate in operation/opened condition, so that it does not interfere with flowing water,
- Provision of stiffener in the bottom part of skin plate/ lip and bottom most girder.

- All equipment, wherever applicable, shall include provisions for safe isolation, locking, and tagging of hazardous energy sources—such as electrical, mechanical, hydraulic, pneumatic, thermal, and stored energy. The systems must be capable of being secured in a fully de-energized and inoperable state during maintenance activities. The vendor shall ensure that all equipment supplied is designed, fabricated, and delivered with complete LOTO provisions, in accordance with applicable standards and best engineering practices

Platforms and ladders shall be provided to approach different parts of gate and hoist such as gate trunnions, gate arms and girders, gate seals and cylinder connection points etc.

The following sizes/ specifications shall be observed:

Skin plate	25mm structural Steel +3mm stainless steel cladding or complete 32mm Stainless steel.
Bottom skin plate	32mm structural Steel +3mm stainless steel cladding or complete 36mm Stainless steel (from bottom upto 1.0m above bottom most girder). Lip, stiffeners and sealing arrangement as per specification drawings.
Bottom seal	25mm thick wedge type rubber seal (5mm pre-compression).
Side seals	14mm thick stem music note type/other suitable shape rubber seal **(**PTFE/fluorocarbon **cladded**) 3mm pre-compression. Bottom 2m portion to be of rubber with no cladding.
Top seal	14mm thick double stem type (leaf) rubber seal 3mm pre- compression.
Embedded Top seal	14mm thick stem music note type (rubber spring/ belting loaded) rubber seal **(**PTFE/fluorocarbon **cladded**) 3mm pre- compression.
Seal clamps	16mm thick structural steel.
Fasteners	16mm dia. Stainless Steel.
Seal bases	12mm thick structural steel **(Machine finished surface).**
Trunnions Bearing	**Self-lubricating bush bearing (Lubrite/ Devaglide/INA).**
Cylinder upper & lower connection Bearing	Spherical Plain bearing (SKF/FAG/INA/NTN).
Splice bolts	HTFG bolts.
Trunnion Anchorage	Anchorage for holding trunnion brackets in concrete beams with the help of holding down anchors shall be provided through first stage up to trunnion bracket and alignment anchor/plate including shear keys as indicated in the specification drawings.

NOTE:

In case of cladded type skin plate, the cladding of stainless steel with base metal shall be done in the plate manufacturer's mill by suitable established metallurgical cladding process. Cladding by welding shall not be permitted.

Design stresses for trunnion bushing/bearing shall be 10% of YP over worst calculated value or have a factor of safety of 2 over the bush/bearing manufacturer's dynamic load specification, whichever is lower.

Khorlochhu Hydro Power Ltd.

1.65.1 Embedded Parts

The radial gate embedded parts shall consist of structural steel sill beam; lintel beam; steel liners of not less than 20mm thick (along with fasteners/anchors) for spillway crest/glacis, bottom of breast wall & side wall/piers and fabricated stainless steel faced radial guide wall plates to serve as guide roller path & sealing face.

To avoid concrete erosion near sill beam area, not less than 20mm thick steel liners on Spillway glacis along with side wall and bottom of breast wall have been proposed. The steel liners shall be placed on all the wet surfaces starting from start of the bell mouth in the upstream side of spillway radial gate. In the downstream side of spillway radial gate, the steel liners on spillway glacis & side wall/ piers shall be extended up to 15m on glacis & up to 2m height in the side wall.

The arrangement of sill beam should be such that easy replacement/building up of the beam is practical and the final surface of the sill beam is smooth and free of voids. The embedded parts shall also include the trunnion bracket foundation plates, anti-jet seal arrangement, trunnion anchorages, dogging devices, frames/supports for hydraulic hoist mounting etc. Anchor bolts & nuts for all beams, roller path, seal seat, and dogging devices including all first stage embedded parts shall be included in the embedded parts. The guide roller path shall be provided up to complete travel of the gate. Side seal path shall be extended at least up to 500mm above lintel seal center.

Erection supports shall be suitably braced so that activities like chipping/denting of 1st stage concreting, opening out of bent dowels & 2nd stage concreting operation doesn't in any way affect the alignment.

The following minimum sizes/ specifications shall be observed

Sill beam	Built-up section including stainless steel plate as per drawing. The sill beam should be such that easy replacement of the sill is possible.
Seal seats	Stainless steel 200mm wide x 20mm thick for lintel top. **(Machine finished surface).**
Wall plates	Stainless steel 20mm thick & width –650mm.
Anchor rods/studs	16mm dia. J /U shaped, spacing not more than 600mm c/c.

The surface of the sill beam and wall plate shall be made flush with surrounding concrete. Minimum 150mm recess shall be left on the faces of concrete for facilitating replacement of side seals. For dogging of gate, suitable arrangement shall be provided at the pier and on the gate.

1.65.2 Design consideration and operating requirements for gates

The radial gate and embedded parts shall be designed in accordance with the provisions of IS: 4623 in general and in accordance with the provisions specified in these specifications in particular.

The gate along with connected equipment shall be designed under FRL condition EL 1572.0m with normal allowable stresses as specified in General Technical Specifications. **The bottom girder of the gate shall be designed for 10% extra load over and above the computed worst loading to take care of impact force due to floating logs/ rolling boulders at normal allowable stresses.**

Earthquake effects shall also be considered and allowed in the design as per the stipulations in accordance with IS: 1893. **The design shall be checked for additional forces due to horizontal and vertical earthquake acceleration of 0.24g and 0.16g respectively with**

Khorlochhu Hydro Power Ltd.

water level at FRL. Permissible stresses under earthquake condition shall be as given in General Technical Specifications. The maximum deflection in the girders of the gate shall be limited to span/2000.

The gate trunnion brackets shall be designed to transfer worst combination of loading on the gate due to reservoir water head on the concrete trunnion beam spanning between piers. The loading shall be computed for different gate openings and for different water heads. Suitable Steel shear keys shall be provided behind the bracket plates to transfer vertical loads to concrete beam. Adequate anchorage in form of high strength steel rounds/anchors shall be provided for holding the bracket plate against concrete beam. The steel rounds/anchors shall be provided continuous through second and first stage up to trunnion brackets.

Suitable dogging device in the piers shall be provided to hold the gate in fully opened position. The dogging device shall be adequately designed to take the imposed dead weight of the gate structure with suitable impact load.

Suitable hoist supporting structure to hold the hydraulic cylinders shall be provided and installed in the piers/dam body. The hoist supporting structure shall be designed to withstand the maximum force the hoist can exert corresponding to the pressure setting of the pressure relief valve without exceeding the normal stresses as specified. The supporting structure shall transfer the load to concrete through anchors installed through first stage up to hoist supporting structure. Adequate alignment anchors shall be provided to erect the structure to the required precision and tolerances.

The gates shall usually remain closed to store water up to **FRL 1572.00m.** The gates are required to be opened to discharge excess water and flash floods when the water level in reservoir exceeds the FRL or as and when required based upon reservoir operation requirements.

The gate is required to be operated under unbalanced head conditions against water level up to **EL 1572.00M**. The gate when lowered against this head shall therefore, should be able to go down under its own weight (self-closing). For meeting this requirement, the closing moment provided by the moving parts of gate in any position shall always be greater than the moment of forces opposing the closure of gate by at least 25%. **In case the gate is not able to lower under its own weight, the contractor shall provide the double acting hoists without any extra cost.** The hoist capacity of the gate shall be calculated corresponding to upstream water head equal to **FRL EL. 1572.00M** considering worst combination of forces so as to ensure opening of gates under FRL condition, keeping a reserve capacity of 20%.

The gate shall satisfy the following requirements:

a) The gate shall be required to be operated (open or close) at a speed of 0.5m/min±5%,

b) In closed position the gate must be reasonably watertight with full pressure acting from upstream side and sealing must be reliable. Lintel seal arrangement should be suitable to prevent leakage. Embedded lintel seal should remain effective during partial opening of the gate and suitable arrangement shall be adopted to prevent jetting of water. Clamping arrangement of seals should be watertight and easily adjustable in all positions of travel,

c) The gate and its components shall be so designed that the stresses in different members due to imposed loads in the closed position do not exceed the permissible stresses. The gate and its components shall also be designed for the effect of sill pressure (due to self-weight of gate), hoist load, bending moment in arms (due to effect of temperature variation), friction between trunnion pin and bearing etc.

d) The gate shall also be designed for the following loads:

Khorlochhu Hydro Power Ltd.

i) The full hydrostatic load on u/s side of gate with water level at **EL 1572.0M** and gate closed,

ii) The total hydrostatic, hydro-dynamic, hoist loads and frictional forces occurring when the gates are raised, lowered or maintained partially open, with the u/s water level at any elevation between **EL 1572.0M** and crest level, and wind load on the gates in raised position,

iii) The dead weight of the gates.

The gates shall normally be capable of operation by alternative means in case of power supply failure.

1.66 Hydraulic Hoists and Power Pack

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable International Standards / Indian Standards (IS) as given below except where modified and/or supplemented by this specification.

Two pivoted hydraulic cylinders of capacity not less than **180 T each** shall be provided to operate each gate and shall be operated by one unit of power pack. **The design of cylinder shall provide for a minimum reserve stroke of 100mm on each end over the computed working stroke**. The cylinder walls shall be properly prepared to allow the piston to traverse smoothly and freely and to minimize the oil leakage past the piston. Piston rod shall be of following types:

Stainless steel with hard chrome plating of thickness not less than 50 microns or carbon steel with ceramic coating not less than **250 microns**.

The ceramic coating on piston rod shall be designed to rule out corrosion of the piston rod. It shall be homogeneous, scratch resistant, free of cracks & non-conductive.

The manufacturer shall be fully responsible for the adopted coating and shall provide the guaranty for satisfactory functioning of the same for a period of 5 years after installation/ commissioning for coating adopted.

The hydraulic hoist and power pack are to be sourced from a world-renowned designer cum manufacturer who has in-house facility of piston rod ceramic coatings/ chrome plating.

Each unit of power pack shall consist of two motors (one standby), two pumps (one standby), associated control & operating systems capable of operating the gates individually. Each of the power packs shall act as stand by for the adjacent gate in case the designated power pack is not in order and shall be capable of operating the two adjacent gates simultaneously at half of the designated speed.

1.66.1 Details of Power Pack and Other associated items

Hydraulic Power Unit: The hydraulic power unit shall include a hydraulic reservoir, two motors (one standby), two pumps (one standby), a manual pump, automatic controls, pressure switches, pressure relief, check, flow control and directional control valves, pressure and temperature gauges, fluid level switch, filters including pressure filter and strainers, piping and all accessories, appurtenances and wiring required to provide an operational fluid power system for the operation of the gates according to the requirements of these Specifications. The hydraulic power unit shall be designed in accordance with **DIN 19704** with **a maximum designed pressure at pump as 22.5 Mpa. However, relief valve at pump side may be adjusted at 10% (maximum) higher than the design pressure.**

Hydraulic piping: All hydraulic piping shall be of stainless steel, fastened with noise proofing plastic clamps, wherever necessary, the lines should be arranged in a concealed manner.

Khorlochhu Hydro Power Ltd.

Fittings and Flanges: All pipe fittings shall be of the socket-welding type conforming to the applicable requirements of relevant DIN/BIS. All pipe flanges shall be of the weld-neck type with O-rings conforming to the applicable requirements of relevant DIN/BIS. All threaded fittings shall be of standard one.

Flexible Connections: Flexible connections shall be provided, as required, to allow connection of the separately mounted hydraulic system components without alignment of parts and to facilitate expansion and contraction of rigid piping. Flexible hoses shall be Ryan braided rubber hose and shall be rated for a minimum working pressure of 20 Mpa. Minimum burst pressure shall be 100 Mpa. Rubber or synthetic rubber shall be selected for maximum compatibility with the hydraulic fluid specified for use in the system. Fittings shall be specifically designed for use with the hose selected. It shall be equivalently rated, and shall be of the type recommended by the hose manufacturer. Hoses shall be provided with a stainless steel braided outer cover.

Fluid Reservoir: The hydraulic fluid reservoir shall be constructed of stainless-steel material. The hydraulic fluid reservoir capacity shall conform to **IS: 10210**.

Hydraulic Working Fluid: Required quantity of hydraulic working fluid shall be supplied separately along with power packs. The hydraulic fluid shall conform to the relevant ISO. Under normal hoist operational conditions, fluid velocity in all parts of the system shall be limited to 4.5m/sec except in the pump suction lines where it shall be limited to 1.5m/sec.

Design Temperature: All hydraulic equipment shall be suitable for use at temperature down to -5°C and up to 35°C.

System Cleanliness: The hydraulic power unit shall be clean and free of all foreign matter, which occurs as result of manufacture, assembly, and transportation. All items shall be thoroughly cleaned before assembly and shall be suitably protected from dirt during transportation and storage at the site. Before filling the system with hydraulic fluid, the system flushing including chemical cleaning shall conform to appropriate standard.

Flushing: Procedures for flushing the hydraulic system (including the list of equipment to be supplied by the Contractor for this purpose and method to ensure cleanliness) shall be submitted as part of the installation instructions.

Flushing Fluid: Flushing fluid shall be supplied separately from the hydraulic working fluid to flush and clean the complete hydraulic system of each hoist. The flushing fluid shall be compatible with the hydraulic working fluid.

Manual Pump: The manual pump shall be arranged in parallel with the motor driven pump. The manual pump shall be of the lever-operated, piston type. The pump shall be mounted on the hydraulic fluid reservoir, shall be operable from a standing position, and shall not require more than 10Kg of force on the pump lever to reach nominal design system pressure.

The system shall be provided with operating panels for automatic, remote & manual operating modes. The hoist and the gate arrangement should be capable to close the gate even while one of the hoist cylinders malfunctions. Other accessories shall include limit switches, gate position indicators (Angular detector comprising of Gravity Actuated angle/current transmitter type "Rittmeyer make" or equivalent or Latest Cylinder Integrated Measuring System (CIMS)), **The hoist shall be designed in accordance with IS: 10210/ DIN: 19704.**

The hoist capacity shall be calculated corresponding to specified operating conditions for the gates in accordance with IS: 10210, keeping a reserve capacity of 20%.

The design of the hoist and controls shall be suitable to maintain the gate at any selected opening position between full open and full closed using a restoring device **if the creep of gate from original position exceeds 50 mm.** Provision shall also be made to have a buffer

Khorlochhu Hydro Power Ltd.

speed of 1/5th of the working speed during last 300 mm travel of the gate during lowering operation.

All equipment, wherever applicable, shall include provisions for safe isolation, locking, and tagging of hazardous energy sources—such as electrical, mechanical, hydraulic, pneumatic, thermal, and stored energy. The systems must be capable of being secured in a fully de-energized and inoperable state during maintenance activities. The vendor shall ensure that all equipment supplied is designed, fabricated, and delivered with complete LOTO provisions, in accordance with applicable standards and best engineering practices

1.67 Main Data

No. of gates	:	5
Clear span	:	6.8m
Clear height	:	12.9m (between crest and lintel) ±150mm
Crest level	:	1515.0M
Sill level	:	1514.431M (tentative)
Radius	:	18.50m (from inside of skin plate up to Centre of trunnion)
Dam bottom level	:	1479.65 M
Dam top level	:	1574.0 M
FRL	:	1572.0M
Trunnion level	:	1527.0m (tentative)
Type of hoist	:	Hydraulic
No. of cylinders	:	Two hydraulic cylinders & one power pack for each gate
Operating speed lowering	:	0.5m/min± 5% and 0.1m/min± 5% for last 300mm during
Power pack	:	Rexroth (India)/ Vickers (India) /Montan (India)
Hyd. Cylinder (Germany)	:	Hunger (Germany) / Rexroth (Netherland) / Montan
Max. Working pressure:		20 Mpa (Max.) at cylinder
Hoist capacity	:	As computed but not less than **360T (2x180T)** each single acting cylinder).

Value of earthquake accelerations

a) Horizontal	:	0.24g
b) Vertical	:	0.16g

1.68 Gasoline Engine Operated Portable Power Pack

One (1) number Gasoline engine operated portable (trolley mounted) power pack capable of operating one radial gate at **100%** of the rated operating speed from dam top shall be provided to operate radial gate in the event of mains power failure. The pumping set will be connected by hoses with quick connect/disconnect couplings to the main power pack tank and electrically to the local control panel. A battery of suitable capacity will be provided to start the engine when required and an inverter will be provided to provide 230 V supply to the local control panel for operating the solenoids of the power pack. Provision shall be made for charging the battery from normal A.C. mains to keep it in ready to use condition.

Make: Kohler (Germany), Honda (Japan), Yamaha (Japan)

Khorlochhu Hydro Power Ltd.

1.69 Oil Filtering Unit and Dehydration & Degasification Unit

One (1) number of oil purifier unit (Electrostatic Liquid Cleaner) for **spillway radial gate** power packs shall be provided to purify the hydraulic oil. It shall be complete in all respect including oil hoses (of sufficient length and size) and hose connector etc. to connect the oil purifier to various equipment/components/ systems. The hydraulic oil purifier shall be electrostatic liquid cleaner type. The capacity of purifier shall be 10-12 LPM. After purification the size of the suspended particle should not be more than **5µm**. The oil may contain suspended impurities such as cotton, waste, welding slag and spatters, metallic chips, small sand particles, iron fitting pebbles, dust and scale particles. The oil may also contain grease and kerosene, which shall be required to be removed. The offered equipment shall not be damaged by the flow of oil containing these impurities. Unit shall be supplied along with **(5 sets) paper and other consumable** required for 5 years of successful operation of machine.

One (1) number of Low vacuum dehydration & degasification unit for radial Gate and flushing tunnel gate power packs shall be provided to remove water and dissolved gases from the hydraulic oil. The oil may contain free and dissolved moisture of the order of 500 to 600 ppm initially, which needs to be reduced in the range of **50 ppm**. The capacity of the vaporizer shall not be less than 50 liters and capacity of vacuum pump shall not be less than 100 LPM.

One unit of contamination checking kit (for checking of contamination level) shall also be provided with the machine.

15. Spillway Stop Logs and Gantry Crane

1.70 Spillway Stop Logs

One (1) set of slide type stoplogs suitable for openings at the upstream face of spillway radial gates for maintenance/repairs & inspection of radial gates shall be provided. The stoplogs shall be of fabricated structural steel in 8 (eight) units of suitable size for **a opening of 6.8m width x 17.7m high. One (1) Top Non-Interchangeable Unit of size 6.8mx2.3m & seven (7) Interchangeable units of size 6.8mx2.2m. There exists a possibility of change in the height of gate by about ±150mm during detailed civil design/ model studies, provision for which may be kept in the bid**. Each unit shall have upstream skin plate, stiffeners, girders, seal assemblies, lifting attachments, bumpers and side guide roller etc. The stoplogs shall be designed to withstand against a u/s head corresponding to **FRL at 1572.0M** and suitable for lowering (under its own weight) and raising under balanced head in no flow conditions. However, frictional forces due to **0.30m differential head** shall be considered for computing hoist capacity.

Each Unit shall be provided with bottom seal on upstream and side seal elements on downstream with suitable connection between side and bottom seals, bearing blocks and guide roller assemblies while top unit shall have top seals on downstream and two numbers spring actuated filling in valves operated by lifting beam hooks. **The filling in valve will open by the initial lifting movement of the hoist lifting attachment by about 75mm to achieve the balance head condition**. The stoplog set shall consist of one top unit and seven interchangeable units. A probe mechanism to facilitate for release of hook and locking system only after the stoplog unit is properly seated on sill or on lower unit shall be incorporated in each stoplog unit and lifting beam. Lifting lugs shall be provided on each stoplog unit except in top unit where lifting lugs are provided on the filling in valves. Each stoplog unit shall be provided with two pilot bars and corresponding pilot tubes for proper matching/ guidance for correct placement and engagement. Suitable dogging brackets shall be provided on all the units.

Khorlochhu Hydro Power Ltd.

When not in use the stoplogs shall be stored in the stop log grooves and storage grooves provided at top of the dam. **The general arrangement of the stoplogs shall be as shown in the drawing nos. KHPP- HM-DAM-GA-6003 & 6004 Sheet 1of 2 & 2 of 2**

Not less than 8 mm thick steel air vent pipe of 300mm dia. (2 nos. in each bay) shall be provided in first stage concrete at the downstream side of each stop log groove for escape of air during filling operation.

All equipment, wherever applicable, shall include provisions for safe isolation, locking, and tagging of hazardous energy sources—such as electrical, mechanical, hydraulic, pneumatic, thermal, and stored energy. The systems must be capable of being secured in a fully de-energized and inoperable state during maintenance activities. The vendor shall ensure that all equipment supplied is designed, fabricated, and delivered with complete LOTO provisions, in accordance with applicable standards and best engineering practices

Deposition/accumulation of silt in the stoplog groove and on the bottom seal seats is likely to make the sitting of stoplog on the sill beam difficult. Sometimes, stoplog may not sit on sill properly due to pebbles and silt deposited thereon. Thus may result in severe leakage downstream and may also damage the bottom seals. To overcome this problem, the contractor shall propose, design and provide the air water jet cleaning system.

The following minimum sizes/ specifications shall be observed

Skin plate	25mm thick structural steel
Bottom seal	20mm thick wedge type rubber seal (5mm pre-compression)
Side seals	14mm thick stem music note type rubber seal (3mm pre-compression) - PTFE/fluorocarbon cladded
Top seal	14mm thick stem double stem type rubber seal (3mm pre- compression) - PTFE/fluorocarbon cladded.
Seal clamps	16mm thick structural steel
Fasteners	16mm dia. Stainless Steel, spacing not more than 5 times the dia. of fasteners.
Seal bases	12mm thick structural steel **(machine finished surface)**
Full depth stiffeners	12mm thick structural steel
End vertical girders	25mm thick structural steel

1.70.1 Embedded Parts

Five (5) sets of fabricated steel embedded parts for spillway stoplogs comprising of embedded guides complete with sliding tracks, lateral seal seats, sill beam, top seal seat, storage groove units, and anchorages for primary and secondary stage embedment, dogging devices etc. Side guides shall be provided up to EL1574.0M and shall be tapered at top for easy entry of stoplog units. Stop logs shall be provided with manually operated dogging devices.

Breast wall liners with stiffeners shall also be provided and embedded in first stage concrete between stop log lintel and radial gate lintel beam. The liner shall be extended into the side piers by at least 100mm each side.

Steel liners up to 1 m height above breast wall bottom profile in the spillway stoplogs groove shall be provided.

The embedded parts shall be provided up to following extents: -

- Tracks and seal paths from 300mm below sill level up to **EL 1535.00M**.
- Side guide from 300mm below sill level up to **EL 1574.0M**

- Dogging device/holding arrangement above deck level.

Erection supports shall be suitably braced so that activities like chipping/denting of 1st stage concreting, opening out of bent dowels & 2nd stage concreting operation doesn't in any way affect the alignment.

The following minimum sizes/ specifications shall be observed;

Sill beam	ISMB-300 or equivalent built up section
Seal seats	Stainless steel 160mm wide x 10mm thick for bottom, 250mm wide x 10mm thick with top 25mm chamfered for top and 100mm wide x 10mm thick for sides (Machine finished surface)
Track	Corrosion resistant steel 200mm x 20mm (Machine finished surface)
Breast wall liners	20mm thick structural steel
Side guides	150mm wide x 40mm thick flat/ Min.45 Kg/m weight Crane rail section
Anchor rods/studs	16mm dia. J or U type spacing not more than 600mm c/c.

1.70.2 Design considerations & operating requirements

The stoplogs and embedded parts shall be designed in accordance with the provision of **IS: 9349** in general and in accordance with this specification in particular. While designing the skin plate, corrosion allowance of 1.5mm should be considered. The edge distance of bearing flange of track base from groove face shall be determined on the basis of the following criteria:

a) The wider flange, in case of double-flanged track base, shall be considered as bearing flange for the purpose of transferring load from the track base to the concrete,

b) The minimum edge distance of the bearing plate flange shall in no case be less than 150mm,

c) The load shall be assumed to be distributed at 45^0 dispersion,

d) The width of loaded area at the interface of primary and secondary concrete shall fully lie in the primary concrete. Clear cover of the reinforcement is to be taken as 100mm.

The gate along with connected equipment shall be designed for FRL condition i.e. EL1572.0M with normal allowable stresses as specified in General Technical Specifications.

Earthquake effects shall also be considered and allowed in the design as per the stipulations in accordance with **IS: 1893**. The design shall be checked for additional forces due **to horizontal and vertical earthquake acceleration of 0.24g and 0.16g respectively**. The permissible stresses under earthquake condition shall be as specified in General Technical Specifications. **The maximum deflection of the gate shall be limited to span/1200 (i.e. C/C of track).**

The stop logs shall satisfy the following requirements: -

a) In closed position the stoplog shall be completely watertight with full water pressure acting from upstream side and sealing must be reliable. The stoplog units shall have u/s skin plate and down-stream sealing as shown in the drawing,

b) The stoplogs and its accessories shall be so designed that the stresses in the different members due to static load in the closed position do not exceed the permissible stresses,

Khorlochhu Hydro Power Ltd.

c) The stoplog units shall be required to be operated (raised or lowered) at a speed of 2.0m/min± 5%,

d) The following loads shall be considered: -

i) The full hydrostatic load on upstream side of stoplog with water level at **EL1572.0M,**

ii) The hydrodynamic loads due to seismic effect when the stoplogs are in the groove for u/s water level of **1572.0M,**

iii) The dead weight of the stoplogs,

iv) Wind loads as applicable.

1.71 Storage Groove

Three (3) number storage grooves are provided for storage of the 3 nos. stoplog units inside the storage grooves. The remaining five (5) numbers of stoplog units shall be stored on the respective top of **five (5)** stoplog groves with the help of suitable dogging arrangement. The storage groove shall have sufficient depth to accommodate the stoplog so that no portion shall remain protruding above the ground. The grooves shall be provided with side guides up to the full depth including the embedded parts required for the guides, bottom liner covering full width and depth of groove. Suitable drainage arrangement shall be provided for the storage groove. The size of the groove shall be sufficient so that the side of the stoplog shall not touch the sides of the groove. Necessary dogging device is required at the top of the groove in such a way the bottom seal of the stoplog shall not touch the sill and the top of stoplog shall remain below the removable groove cover. **The storage bay shall be covered with removable steel gratings.**

1.72 Spillway Stoplog Gantry Crane

One (1) number electrically operated traveling gantry crane complete in all respect shall be provided specifically for handling the spillway stoplog units with an automatic lifting beam and complete with rail track with necessary end stops and anchors. Additionally, the crane shall serve as well for transport of the stoplogs to the storage groove. The crane shall consist of gantry frames with traveling mechanism with machine house, hoisting and traveling equipment and cable reeling drum, operator's cabin, radio control station, rail safety clamps, controls, limit switches, wire ropes, outside lighting and all other necessary components for its safe, proper and efficient operation. The gantry frames shall be of welded construction, except that the high-tensile friction grip and/or fit bolts shall be used for all field connections.

The gantry crane shall be mounted on flat-bottomed rails at **EL.1574.0m** and shall have sufficient length for the crane to cover all openings. It is proposed that the crane shall be parked on either abutment when not in use. The rails shall be provided complete with all holding down bolts, fishplates, separators, stops, etc., and should have suitable gap near expansion joints in the concrete if any. On upstream and on all the bays on downstream side the rails shall be laid on the concrete**. Limit switches shall also be placed along the track so that the gantry may be accurately positioned over the openings**. A load plate showing the safe working load shall be fixed to the crane in a position to be easily legible from the operating level.

The capacity shall be adequate for the operation of the stoplog at worst loading condition. Electrical power for traveling and hoisting motions is provided through a traveling cable reeling drum arrangement. The operation of gantry crane shall be from an enclosed cabin with maximum unrestricted view. The gantry shall be provided with necessary brakes (viz. D.C. electromagnetic brakes, as well as thruster brakes), storm anchors, overload protection/slack rope prevention device (i.e. load cell type/spring actuated type etc) for hoisting motion, interlock devices, limit switches for extreme position of hoist, long travel,

Khorlochhu Hydro Power Ltd.

cross travel as well as centering the crane at the center line of each bay. All drives and hoist gearing will be fully enclosed and housed as appropriate. Additional inching controls shall be provided on the long travel (LT) drives. **The cross travel shall be proposed to cater for any transverse movement of the crane required for placement/ storage of stoplogs/ handling of any maintenance/ erection equipment on the dam top.**

Along with operator cabin, Gantry crane shall be provided with necessary radio controls. This radio control shall be in addition to the control provided from operator cabin with suitable interlocks so that only one control is available for use at any time to perform crane operation.

The design of various components of the crane shall be done in accordance with the provisions of Indian Standard specification IS: 3177 and IS: 807. Where the provisions of Indian Standard Codes conflict with the provisions of these specifications the provisions of these specifications shall govern.

The general arrangement of crane is shown in the drawing **No. KHPP- HM-DAM-GA-6005**

The mechanical parts of the hoist shall be designed for the specific loads with a factor of safety of five based on the ultimate strength of the materials. Under breakdown torque condition of the motor, stress in any portion of the hoist, hoist-bridge & trestles shall not exceed 80% of the yield point of the materials. The breakdown torque of the motor shall not be less than 225% of full load torque. The component shall be designed as per actual BDT of the motor. The rope shall have a factor of safety of **six (6)** for normal conditions and of **three (3)** for breakdown torque condition. Due to arrangement of equalizer the design load on the hoisting rope on each side of the gate shall be considered as 50% of the total hoisting load. The hoist mechanism shall be covered by suitable cover frames to protect it from dust, dirt and direct exposure to moisture. Provision shall be made for overload protection/slack rope prevention device (i.e. load cell type/spring actuated type etc.) for hoisting motion, limit switches, control panels, staircase to hoist platform, chequered plates/gratings, guard railings etc.

The Gantry Crane shall be equipped with a lighting system as follows:

- 400 W industrial LED luminary for gantry travel “headlights,” one on each side illuminating the rails ahead of the gantry.
- Two 400 W industrial LED luminaries for proper illumination of the working area of the stop log grooves.
- Sufficient LED lighting to properly illuminate the operator’s cabin, Hoist Bridge, access ladders and walkways.

Characteristics:

The crane will have the following characteristics:

i)	Class of crane	:	Class-II as per IS: 807 & M5 as per IS: 3177 outdoor electrically operated with rope drum hoist.
ii)	Rated Capacity	:	As computed but not less than **45T**
iii)	Centre to canter of track	:	4.0m (tentative)
iv)	Minimum wheelbase of crane	:	6.5m. (Tentative)
v)	Total length of rail track	:	**120.0m (approx.)**
vi)	Minimum cross travel	:	2.0m (1.00m on either side of lifting Centre)
vii)	Operating speeds (Loaded)		
	Hoist	:	0.5 m/min± 5%

Long travel	:	8 m/min± 10% with inching facility having 10% of normal speed
Cross travel	:	2m/min± 5% with inching facility having 10% of normal speed

viii) Minimum headroom over the deck: 7.0m

ix) Electrical details:

a) Power supply:

The power supply and terminal points shall be as defined in the General Technical Specifications.

b) Controllers: Controls in operator's cabin and radio remote unit.

The hoist and travel motions of gantry crane shall be cabin and radio remote control operated. The controllers shall be so located that they can easily be operated by one person and permit an unrestricted view of load. The controllers shall be designed to permit easy inspection, adjustment and replacement of parts. All electrical equipment shall be suitably enclosed so that live parts shall not be exposed to accidental contact under normal operation considerations. All master control switches, manually operated switches, circuit breakers, starters, contactors, limit switches and relays shall be clearly and permanently identified by attached nameplates.

Main components of radio control shall consist of the following:

a) A portable transmitter,

b) An antenna and receiver on the bridge,

c) Amplifiers and other associated electronic circuitry,

d) Each radio-controlled crane shall be equipped with a 100-W amber indicator lamp located beneath the center of one of the bridge girders. This light shall be energized whenever the crane is in the radio control mode and the crane's master contactor has been energized.

Reliability, dependability and ease of maintenance shall be prime considerations in the design and construction of all components and parts of the equipment, to ensure positive operation of the system under all conditions of dust, moisture, temperature, vibration and electrical interference.

Radio control should be so designed that if the control signal for crane motion becomes ineffective, that crane motion shall stop, and conversely signals received from any other source other than the transmitter shall not result in operation of any motion of the crane. The crane shall not take off on its own, respond to, or generate false commands. In case of power failure, the crane must stop.

Frequency ranges of 450-470 MHz shall be used for radio control communications.

The range of control shall be approx. 100 meters.

A key switch or equivalent security device on the transmitter, that can be used to prevent unauthorized use of the transmitter, shall be provided. Reduced maintenance requirements and long service shall be achieved through simplicity and use of conservatively rated, heavy-duty industrial type parts.

Khorlochhu Hydro Power Ltd.

The design of the equipment circuitry and the application of components shall represent the state of the art. Wherever practicable, replaceable modules with reliable plug-in connections shall be used. The system shall be designed so that no field tuning adjustments is required when replacing a faulty module and shall permit a field change of the operating frequency by replacement of plug-in type components with minimum adjustment.

The radio control equipment shall be the type accepted by and shall conform to all applicable Bhutan/Indian standards, rules and regulations. The Contractor shall perform a frequency search and shall obtain necessary operating license on behalf of the Employer.

A carrying harness, belt shoulder strap or lanyard shall be provided on the transmitter.

Different motion switches shall be with different shaped knobs so that the motion can be selected by feel and the operator's vision.

c) **Drives**:

Hoist Drive: thyristors-controlled motor, with D.C. Electromagnetic brake and thruster type brake, with limit switches for extreme positions of hook and for filling-in-valves opening position of the top unit.

Long travel: thyristors-controlled motors with D.C. electromagnetic brake as well as thruster brake, connected to at least one driving wheel on each side of end carriage, through gearing and shafting having synchronized operation having limit switches for extreme position of travel and corresponding to centre of each span with supply through cable reel.

Cross Travel: thyristors-controlled motor, with D.C. electromagnetic brake as well as thruster brake, connected to at least one driving wheel on each side of trolley through gearing and shafting having synchronized operation having limit switches for extreme positions of travel and also for exact locations over spillway stoplog groove so that the hook is exactly over the lifting points.

Suitable interlocks in control circuit shall be provided to prevent accidental hoist operation or LT motion when the transverse drive is under operation. The supply to trolley shall be through a festoon type trailing cable supported on suitable wire with movable hook.

d) A digital indicator shall be fitted in the operator's cabin for hoisting operation to show the position of lifting beam hooks. This indicator shall indicate the length of lowering of the lifting beam hooks with an overall accuracy of ± 20mm and shall register zero with the lifting beam hook in the top position.

e) **Interlocks**: In addition to usual protective gear the following interlocks shall be provided:

i) Suitable interlocks for preventing more than one drive to be in operation simultaneously.

ii) Interlock in LT Drives to prevent long travel unless the hook is in its highest position.

Hoist capacity: The hoist capacity of Gantry crane for operating stoplogs shall be computed for dead weight of stoplog unit, dead weight of lifting beam and its attachments. **Frictional forces due to 0.30m differential head on top unit shall be considered. A reserve of 20% over and above the computed value shall be provided however, it shall not be less than 45T.**

Khorlochhu Hydro Power Ltd.

1.73 Lifting Beam

The lifting beam shall be of fabricated steel construction, suitable for handling by gantry crane and equipped with two positively engaging and disengaging type hooks with lifting lugs of stoplogs. It shall be suitable for **automatic and manual** engaging and disengaging of the units by use of counterweight and lever mechanism. It shall be ensured that once hooks are engaged, they do not get unlocked due to excessive vibrations/lifting forces during raising or lowering operation. A probe and hook release mechanism as described under clause 3.1 shall be provided. Two number pilot tubes shall also be provided to facilitate guidance for engagement with corresponding guide stems provided on stoplog units. The lifting beam shall have suitable spring-loaded flanged rollers at both ends. Lifting beam sheave and Crane hoist sheave should have the similar bush/bearing.

Main data

Number of stoplogs	: 1 set consist of 8 units
No. of filling in valve	: 2 (Min.300mm dia.) (In top unit only)
Sill elevation	: **1515.00m** (tentative)
Full reservoir level	: **1572.0m**
Operation	: Through Gantry crane with lifting beam Under balanced head conditions

16. Overflow Spillway Service Gate and Hoist

1.74 Overflow Spillway Service Gate

One (1) number wheeled type gate for opening size of **4.0m x 5.0m** is envisaged for Overflow spillway. The sill of the gate is located EL 1567.0m. The gate is to be designed for a head corresponding to FRL i.e. **EL 1572.0m**. The gate will have an upstream skin plate and upstream sealing. The skin plate is to be supported by horizontal girders, vertical stiffeners, end vertical girders, wheels etc. Wheel pins shall be provided with suitable eccentricity (minimum ± 5mm) between centres of wheels and holes in vertical girders to facilitate adjustment in wheel alignment to have proper contact with the roller path. The gate shall be able to transfer the load on either side of the groove through wheel track.

The gate shall be lifted under unbalanced head conditions against upstream water level up to FRL i.e. EL1572.0 m. Gate shall be operated by means of a dedicated Motorized Screw Hoist of capacity not less than 15 T located on the hoist platform at EL 1574.00M. Suitable lifting attachments shall be provided in the gate body for lifting the gate. Drain holes have been provided in the web of horizontal girder. General arrangement of gate and its hoisting system is shown in **Drawing No. KHPP- HM-DAM-GA-6009 & 6010Sheet 1 of 2 and 2 of 2.**

All equipment, wherever applicable, shall include provisions for safe isolation, locking, and tagging of hazardous energy sources—such as electrical, mechanical, hydraulic, pneumatic, thermal, and stored energy. The systems must be capable of being secured in a fully de-energized and inoperable state during maintenance activities. The vendor shall ensure that all equipment supplied is designed, fabricated, and delivered with complete LOTO provisions, in accordance with applicable standards and best engineering practices

Following minimum sizes/specifications shall be observed:

Skin plate	:	10mm structural steel
End Vertical Girder	:	10mm structural steel
Bottom seal	:	20mm thick wedge type rubber seal (5mm pre-compression)

Khorlochhu Hydro Power Ltd.

Side seals	:	14mm thick stem music note type rubber seal (3mm pre-compression)
Seal clamps	:	16mm thick structural steel
Fasteners	:	16mm dia. Stainless Steel
Seal bases	:	12mm thick structural steel **(Machine finished surface)**
Full depth vertical Stiffeners	:	10mm thick structural steel
Splice bolts	:	Friction grip/ Fit bolts

1.74.1 Design consideration and operation requirements

The gate and embedded parts shall be designed in accordance with the provisions of the latest edition of IS: 4622 in general and in accordance with the provisions specified in these specifications in particular. While designing the skin plate, corrosion allowance of 1.5 mm should be considered. The deflection of the gate members shall be limited to span/ 800.

The gate along with connected equipment shall be designed against FRL condition i.e. EL1572.0m with normal allowable stresses as per Clause 2.4.1 of General Technical Specifications.

Earthquake effects shall also be considered and allowed in the design as per stipulations in accordance with IS: 1893. The design shall be checked for additional forces due to horizontal and vertical earthquake acceleration of 0**.24g and 0.16g** respectively with allowable stresses as per clause 2.4.1(h) of General Technical Specifications.

The gate shall be operated (raised or lowered) under unbalanced head conditions corresponding to FRL 1572.00m by Motorized Screw Hoists.

The gate shall satisfy the following requirements:

a) In close position, the gate must be completely watertight with full water pressure acting from upstream side; sealing must be reliable against water level up to FRL 1572.0m.

b) The gate and its accessories shall be so designed that the stresses in different members due to dynamic loads during closing and opening operations and static loads in the closed position do not exceed the specified permissible stresses.

1.74.2 Embedded Parts

One set of fabricated steel embedded parts for clear opening of gate 4.0m x 5.0m comprising of bottom sill beam, side guides extending up to the deck, slide track & sealing track, etc. shall be provided. The embedded frames and anchors along with adequate sealing arrangement for the gate height have been provided. The main members shall be provided with track path and backing frames suitable for transmitting the load due to the water pressure to civil structure.

The embedded parts shall be provided upto following extents: -

- Tracks from 150mm below sill level upto EL 1574.0m.
- Side guide from 150mm below sill level upto deck level i.e. EL 1574.0M.

Erection supports shall be suitably braced so that activities like chipping/denting of 1ststage concreting, opening out of bent dowels & 2nd stage concreting operation doesn't in any way affect the alignment.

The following minimum sizes/ specifications shall be observed:

Sill beam	:	ISMB-150
Wheel Track	:	Corrosion resistant steel 100mm x 10mm **(Machine finished surface)**

Khorlochhu Hydro Power Ltd.

Side & Bottom seal seat	:	Stainless steel 100mm wide x 10mm thick (Machine finished surface)
Side guides	:	50mm x 20 mm thick flat within gate groove and 100mm x 20mm above gate opening up to deck level
Groove liners	:	Min. 10mm thick
Anchor rods/studs	:	16mm dia. J or U type

1.75 Overflow Spillway Motorized screw hoist

Overflow spillway gate shall be operated by motor operated screw hoist. The hoist shall be designed to perform the intended function in accordance with the requirements of IS: 11228 in general. The hoists shall be designed at a rated capacity (Min 15MT) capable to lift or close the gates under all eventualities for which the gate has been designed. The hoist capacity shall be calculated taking into consideration the worst combination of all frictional forces, hydrodynamic loads, dead weights, silt load, seating pressure, etc. during both raising and lowering cycles, plus a reserve capacity of 20% over and above the worst combination of forces.

All the motor screw hoist on addition to its components such as stem, nut, gears, shafts, key, bearings, coupling, gear boxes will also be equipped with gate position indicator and all the required electrical equipment. All the hoist equipment that are permanently or occasionally submerged in water or that might be exposed to splash water or humid weather, shall be adequate to resist without damage the acting water pressure and the corrosive and other effects of submergence and exposure.

All the electrical equipment shall be suitably protected from moisture, corrosion, etc. by providing weatherproof covers and electrical heaters, wherever necessary.

Manual hoisting arrangement with clutch type engaging/disengaging arrangements shall be provided for operation during power failure. Suitable interlocks shall be provided to prevent operation by electrical power when the manual drive is engaged.

1.76 Hoist Supporting Structure for Overflow Spillway Service Gate

One (1) number common hoist supporting structure accommodating the screw hoists of service gate shall be provided. The hoist machinery for the overflow spillway gates shall be mounted on a structural steel hoist platform over structural steel column.

Staircase shall be provided to approach the hoist. The hoist bridge shall be fabricated of structural steel members adequately braced and stiffened. These shall be securely attached to the structural steel column. The mounting of hoist platform with the structural steel column should have one end fixed and one end free to take care of any thermal expansion/contraction of the platform.

The bridge shall be covered with Checker Plate and gratings. The Checker Plate shall be minimum 6mm size. The grating shall not have opening more than 50mm x 50mm. At the junction of checkered plate and grating no step shall be formed and it should be flush with each other. The platform shall be securely fenced with double-tiered guardrails and shall be of sufficient width to enable normal maintenance work to be undertaken safely. The hand railing shall be 1.0m high made from pipe (32 NB medium duty) with suitable spaced vertical posts.

Hoist Bridge and its supporting structure including first stage embedment shall be designed for the worst combination of the forces encountered during any of the operations on the gates. Besides dead weight of machinery, guard railing, load due to hoisting of gate, a crowd load of (500 kg per meter sq.) wind load, seismic load etc. shall also be considered for the design of Hoist Bridge. Hoist bridge and its supporting structure shall be designed in accordance with the provision of IS: 800. All structural parts and hoisting equipment

Khorlochhu Hydro Power

shall also have sufficient strength to resist the forces produced by the actual breakdown torque of the motors without exceeding 80% of yield point of materials.

Each Rope drum hoist shall be equipped with a lighting system as follows:

- Two (2) 400 W industrial LED light for proper illumination of the working area of the gate groove,
- Sufficient LED lighting to properly illuminate the Hoist Bridge, access ladders and walkways.

1.77 Main Data

Gates

Type of gate	:	Wheel type Service Gate
No. of gate	:	1
No. of Hoist	:	1
Clear Width of opening	:	4.0 m
Clear Height of gate	:	5.0 m
F.R.L.	:	1572.0m
Sill elevation	:	1567.0m.
Type of Hoist	:	Dedicated motorized screw hoists
Hoist Capacity	:	**As computed but not less than 15T**

17. Power Intake Trash Rack, TRCM, Intake Gate, Intake Bulkhead Gates, Hoists and Gantry Crane

1.78 Intake Trash Rack

In order to prevent the entry of trash and other extraneous matter in to the power tunnel, one complete set of removable type trash rack shall be fabricated in panels (36 nos. and each of size 4.0m wide x 2.215m high, inclined at 10^0 to vertical) suitable for covering the full intake opening consisting of two bays with each bay size 16.75m wide x 13.29m (inclined) approx. height shall be provided at the face of Intake.

The Contractor shall design, fabricate, supply and install trash rack panels, horizontal and vertical steel support members, guides and their embedded parts etc., as per details indicated in the tender drawings.

The screen bars of each panel shall be welded at horizontal beam members of the panels. These horizontal beam members are in turn supported on end vertical members, which are fixed to vertical and horizontal beams, end concrete faces / intermediate piers through bearing plates. Suitable block outs and first stage anchors are required to be left in the first stage concrete for enabling fixing of panels at horizontal and vertical members.

The trash rack panels shall be placed one above the other and side by side within the vertical /horizontal steel/concrete support members. To ensure proper placement/alignment of panels one above the other, suitable anchors have been provided in 2nd stage as indicated in drawings.

Trash rack shall be cleaned by a traveling semi automatically operated raking machine. Installation of rails shall be carried out based on the recommendations of TRCM manufacturer.

The upstream side of each steel bar shall be round shaped with a radius of 6 mm. Suitable guides shall be provided on the face to facilitate guiding of trash rake bucket.

Khorlochhu Hydro Power Ltd.

The contractor shall ensure that the raking machine rake teeth shall fit between the trash rack bars with sufficient clearance to ensure that they will not jam during operation.

All equipment, wherever applicable, shall include provisions for safe isolation, locking, and tagging of hazardous energy sources—such as electrical, mechanical, hydraulic, pneumatic, thermal, and stored energy. The systems must be capable of being secured in a fully de-energized and inoperable state during maintenance activities. The vendor shall ensure that all equipment supplied is designed, fabricated, and delivered with complete LOTO provisions, in accordance with applicable standards and best engineering practices

The arrangement of trash rack and its embedded parts are shown in tender drawing no **KHPP- -HM-INT-GA-6011 & 6012 (SHEET 1 OF 2 & SHEET 2 OF 2)**

1.78.1 Embedded Parts

Following embedded parts shall be provided by the contractor as per details shown in tender drawings.

- Required embedded anchor plates with anchors/studs in the concrete beams/ lower/ upper concrete faces and side concrete faces, intermediate piers to facilitate fixing of vertical / horizontal support members and placing of trash rack panels.
- Embedded parts required for fixing vertical guide members above intake openings upto Deck level i.e. **EL 1574.00m**
- All necessary anchors/studs for fixing of second stage with first stage parts should be carried out as shown in specification drawing.

1.78.2 Main data

The trash racks have been designed as per IS: 11388 and other details are as under:

Type	:	Removable type panels with lifting points
Quantity	:	36 panels to cater for full opening size
Clear width	:	33.5 m approx. for both intake opening
Vertical height	:	12.5m approx.
Inclination	:	10° with vertical
Bar spacing	:	72mm c/c
Clear spacing	:	60mm
Bar size approx.	:	12 x 75mm (min)
Minimum thickness of parts	:	10 mm

The design for trash rack shall also include an impact force by the raking machine, which run on its surface to clean up debris and trash.

1.78.3 Tolerances

In addition to the tolerances stated in General Technical Specifications, the limits as stipulated hereunder shall apply.

To be measured	Tolerance (mm)
Flatness of steel bars	± 2
Deviation in the distance between Steel bars	± 2
Straightness of steel bars	± 2

1.79 Trash Rack Cleaning Machine (TRCM) & Controls

One (1) complete traveling gantry type manual and semi-automatic raking machine shall be provided in front of the power intake to ensure removal of debris and trash from removable type trash rack of the intake. It shall include rake, lifting and dumping

mechanism, hydraulic grappler device, guide frame with guide rollers, trash disposal vehicle (tipper Type), gantry rails, end stoppers/buffers etc. and all other necessary accessories for proper operation of the raking machine to cater to the specified design considerations and operating requirements.

The intent of these specifications is not to bind firm configuration of the machine. Proposed configuration can be improved to meet the design/operating requirements. The trash rack-cleaning machine is to be sourced from a world-renowned designer cum manufacturer of heavy-duty trash rack cleaning machines.

Following names are given as reference:

1. **KUENZ (Austria)**
2. **MUHR (Germany)**

If the bidder proposes alternative sourcing from an equally reputed and expert trash rack cleaning machine manufacturer, he can propose the same with complete details, references, lists of successful heavy-duty machines. However, approval shall be taken from Employer before placement of order with any of the manufacturer.

1.79.1 Technical Data for TRCM

The trash rake shall be designed with the following nominal design parameters

Type	:	Traveling gantry type.
Quantity	:	One (1) set.
Operation	:	Manual and Semi-automatic
Centre to Centre of rail travel	:	4000mm (approx.).
Length of track	:	40.0m (approx.).
Minimum net trash handling capacity (at maximum depth)	:	1000 Kg.
Raking width of rake bucket	:	2.6 meters (approx.). (To suit arrangement of guide).
Rake bucket minimum opening	:	1 meter
Raking bucket lifting speed	:	24m/min± 10%.
Raking bucket lowering speed	:	48m/min± 10%.
Long travel speed (High)	:	20m/min± 10%.
Long travel speed (Low)	:	5m/min± 10%.
Minimum dead weight of rake head	:	4000 Kg.
Max. Hydraulic operating pressure	:	20 Mpa.
Prime mover operated self-unloading	:	Vol. 3.5m^3 (min.)
Trash disposal vehicle (Tipper Type)	:	Cap. 5MT (min.)

Technical Data of Hydraulic Grappler

Number of hydraulic boom	:	1
Minimum operating radius	:	7 meters approx.
Minimum operating angle	:	270° approx.
Lifting capacity of grappler	:	1000kg (Excluding the weight of grappler)
Clear lifting height up to deck	:	31 meters approx.
Hoisting/Lowering speed	:	5 meter/min.

No. Of grapples (hydraulically Operated with easy replace-ability)	:2 Nos. :One Multi-prong grapple matching human finger arrangement & one with two pairs of tongs parallel to each other suitable for grabbing of logs.

1.79.2 Design consideration and operating requirements

The proposed Trash rake cleaner shall ensure that the racks are clean of any floating and submerged debris and should be capable to either dislodge the solid debris caught in between the trash bars or its operation should not get affected by such solids wedged between trash bars.

The cleaning operation of bars should preferably be carried out both during lifting and lowering of rake head.

The weight of the rake head should be as high as possible so as to penetrate thick layers of floating debris.

The rake head should be designed such that the water head loss should be minimum.

The combing of rack should also dislodge sticking materials like polythene bags etc.

The hydraulic grapple attachment mounted on hydraulic boom should be able to lift floating debris from the water in front of Intake.

Following is the type of trash likely to be encountered:

- Tree stumps
- Root stocks
- Grass
- Weeds
- Plastic bags
- Animal Carcass, etc.
- Clothes and Rope pieces

The trash rake shall be suitable for the type of trash rack provided and shall be designed to clean the full width and full depth (as for as possible) of all trash racks. The trash so collected after each cleaning cycle shall be arranged to be discharged into a suitable trash disposal vehicle. The trash disposal vehicle shall be provided with suitable prime mover & hydraulically operated tipping arrangement to dispose the trash automatically at a suitable location. The trash disposal vehicle shall fit and operate with adequate clearance around all structures, equipment and devices. The manufacturer shall ensure that the raking machine rake teeth shall fit between the trash rack bars with sufficient clearance to ensure for free movement. All components, devices and assemblies shall be weatherproof, for outdoor use and designed for the site climatic condition. Exposed equipment shall be provided with Covers wherever required. All members, devices etc. which could otherwise trap water shall be provided with drain holes. All structural tubing and piping shall be seal welded to prevent entrapment of moisture. All motions including gantry, rake hoist and cable reel shall be controlled by hydraulic motors/thyristors-controlled squirrel cage motors. The supply to the equipment will be by cable reeling drum.

1.79.3 Details of Major Components of Raking Machine

a) **Rake Head:** The rake head shall be suspended by a hydraulically/ thyristors-controlled squirrel cage driven wire rope hoist and provided with teeth spaced to suit the trash rack bar spacing. Rack head should be provided with a base trolley so that

Khorlochhu Hydro Power Ltd.

the cleaning of the rake is to be done during lowering of the rake. The rope should be hot dipped galvanized to meet the underwater requirement. The shape of the cleaning rake should be in compliance with a tested design for high-water velocity and minimum water head loss. The rake should be fabricated out of sheet metal with proper reinforcing ribs etc. The toothed blade shall be made of stainless steel or high strength polypropylene sheet. It should be able to be adjusted and replaced and substituted with other type of blade accessories. The rollers should be provided with maintenance free bearings and axles should be made of stainless steel.

The cleaning rake and the toothed strip in particular should be adaptable to the material carried by the water. The weight and shape of the cleaning rake should permit cleaning even if there are thick coats of the deposited material. The rake shall be designed such that the rake head is not in contact with the racks while being lowered but swings inward such that the rake head is brought in contact with the racks at the bottom of the racks or at an intermediate depth for use at times when the majority of the trash is at the surface. Suitable provision shall be made in rake head to prevent opening of the rake during hoisting of the rake with trash. The rake shall be provided with load safety devices, which will automatically stop the raking operation if the hoisting rope either becomes slack or is overloaded beyond the maximum load carrying capacity of the rake or the ropes being excessively inclined and is not remaining parallel to the guides. An alarm shall sound (separate alarm for slack rope condition, overload condition and excessively inclined rope condition) if these conditions occur. Provision for smooth acceleration & de-acceleration of rake head during starting & stopping shall be kept. Also stopping of the rake head at highest as well as lowest position shall be ensured. In the highest position of the rake head, the rake assembly shall move transversely above the trash trough or trash skip where the rake shall open to unload the debris.

b) **Gantry**. The trash rake shall be mounted on a gantry structure and shall ride on fixed rails also to be provided by the manufacturer. The gantry shall be designed for smooth, accurate, and precise operation across the full length of the rails. The motion of the gantry shall be controlled hydraulically/electrically by Thyristorised controlled squirrel cage motor. The opening between the gantry legs shall be sufficient to pass trash disposal vehicle. The gantry shall be provided with bumpers, and hold-down devices, which should fit over the rails to prevent the gantry assembly from tipping. The hold-down device shall be designed for the maximum unbalanced force, including maximum lift on the rake head, seismic loading and shock loads. The seismic loading shall be **0.24g** horizontal and **0.16g** vertical. The gantry should remain stable during all operations by rake head, grapple and side comb. Proper anchoring arrangement should be provided to take care of the trash-raking machine during storm weather condition. Wind saving bolts should be provided for crane as well as chassis.

Switchgear cabinet and drives should be fastened with elastic dampening elements to avoid the structure borne noise.

The operator's cabin shall be located and provided with sufficient window area so as to allow easy visual monitoring of all raking operations and the entire intake deck. The cabin shall be provided with an interior light, electric heater, ventilating fan, padded revolving operator seat, and lockable door. The floor should be lined with insulating mats (Neoprene).

A digital indicator shall be fitted in the operator's cabin for raking operation to show the position of the raking machine. This indicator shall indicate the lengths of lowering of the trash rake with an overall accuracy of ±0.02 m and shall register zero with the rake in the top position.

Khorlochhu Hydro Power Ltd.

Special consideration shall be given to the arrangement of the rake when in its highest position so that the load can be easily discharged into the trash disposal vehicle.

It shall not be possible to travel whilst hoisting or lowering the trash rake. Limit switches shall be placed at each end of the rail track to limit gantry travel by protruding actuating ramps (for these limit switches shall not be used).

c) Hydraulic Power Unit: The hydraulic power unit shall include a hydraulic reservoir, an electric motor driven pump, a manual pump, automatic controls, pressure relief, check, flow control and directional control valves, pressure and temperature gauges, fluid level switch, Over temperature switch, minimum and maximum pressure switches, filters and strainers, piping and all accessories, appurtenances and wiring required to provide an operational fluid power system for the operation of the trash rake according to the requirements of these Specifications. The hydraulic power unit shall be designed in accordance with DIN 19704 with a maximum working pressure of 22.5Mpa.

For details of 'Hydraulic piping, Fittings and Flanges, Flexible connections, Fluid reservoir, Hydraulic working fluid, Design temperature, System Cleanliness, Flushing, Flushing fluid' refer to Clause 2.2.1 of Particular technical specifications.

d) Hydraulic Grapple Device

The cleaning machine shall be equipped with revolving hydraulic boom with hydraulically operated grabbing arrangements to remove debris material/ logs not exceeding a length of 2.5 m.

The grappling arrangements shall be on the side of the raking machine or at the top of the machine as shown in drawing in such a way, that work of trash cleaning is not obstructed.

Construction of the Hydraulically Operated Grappling Device

The grapple device shall be constructed and equipped as follows:

Portable Sturdy hydraulically collapsible/extendable tubular steel structure.

Operation of the Grapple

It shall be possible to perform all operations of the grapple from the operator's seat with complete visibility. The grappler shall be operated manually by hydraulic controls in the cabin.

All electric controls relating to the hydraulic system shall be capable of being shut-off by the use of key-operated switch situated on the control panel.

Operation of the grapple shall only be possible when the rack-cleaning machine is not in the operating mode.

1.79.4 Operation Modes for Raking Machine

The electrical controls for the raking machine shall allow the following modes of operation for the trash rake by means of a selector switch:

- Semi-automatic operation
- Manual operation

The modes of operation shall be as specified below:

a) Semi-Automatic Operation

Semi-automatic operation shall be initiated by an impulse given manually. The machine is moved from the parking bay to the first bay for cleaning and shall clean a single span of the trash rack chosen by the operator. After the trash is discharged, a

Khorlochhu Hydro Power Ltd.

second impulse shall cause the machine to move to the next span. It should have the facility to by-pass any bay at the operator's discretion, and so on.

b) Manual Operation

All operations of the rack-cleaning machine shall be capable of being performed manually.

1.79.5 Controls & Electrical System

The main control shall be from an operator control cabin situated on the gantry.

All electrical equipment shall be designed for use in a tropical climate. In order to avoid operational errors and accidents the trash rack cleaning machine shall be equipped with an **electrically operated "mushroom type" emergency stop** such that all operations of the machine are stopped on pushing of an emergency stop button. At least two such emergency stop buttons shall be provided at different locations.

During manual operation of the raking machine, during operation of the cleaning of trash, during lifting/lowering of the trash rack panels or during operation of the grappling device semi-automatic controls shall be automatically shut off.

Complete wiring of the machine and the control device with all cables shall be provided by the manufacturer.

1.79.6 Protection & Monitoring Equipment

Following protection & monitoring equipment shall be provided for the TRCM:

- Overload protection at lifting gear,
- Slack rope detection at lifting gear,
- Duty and emergency limit switches for lifting gear,
- Limit switches for traveling gear,
- Motor protecting switch and thermistor monitoring for all drives,
- Oil level minimum monitoring hydraulic system,
- Filter monitoring hydraulic system,
- Minimum and maximum pressure monitoring hydraulic system,
- Over temperature monitoring hydraulic system,
- Watchdog timer for cleaning rake, traveling gear, lifting gear in semiautomatic mode.

1.79.7 Electrical Equipment

Additional electrical equipment shall comprise the following:

- A motorized cable reeling drum with a junction box for the power supply and electrical control cables,
- A waterproof control box including a dehumidifying unit located on the machine,
- The control box shall house the following equipment:
  - ✓ A main selector switch (key operated) for the two modes of operation (semi-automatic and manual).
  - ✓ Controls comprising push buttons and relays for semi-automatic and manual operation.
  - ✓ A position indicator showing the exact position of the rake carriage.
  - ✓ Various alarms to indicate machine-operating faults.
  - ✓ A transformer for the control instruments with potential separation.

Khorlochhu Hydro Power Ltd.

In addition to all above necessary instrument required for control and measurement is to be provided by the supplier.

1.80 Intake Gate

Two (2) numbers 4.25m x 4.7m (opening size) fixed wheel type gates of structural steel construction with downstream skin plate and upstream seals, designed to withstand and seal against the unbalanced upstream head corresponding to full reservoir level is envisaged. The gate shall be provided with horizontal girders and vertical stiffeners, side guide roller assemblies, wheel assemblies etc. The gate shall be provided with bottom seal, side seal and lintel sealing elements.

The gate shall be fabricated in suitable number of units. Each unit of gate shall have 4 No. wheel assemblies, 2 on each side which shall share equal loads. These units shall be properly jointed to ensure water tightness. Wheel pins shall be provided with suitable eccentricity (minimum ± 5mm) between centers of wheels and holes in vertical girders to facilitate adjustment in wheel alignment to have proper contact with the roller path. Suitable gate lifting sheaves/lugs shall be provided for connecting to rope drum hoist. Full depth stiffeners shall be provided below the lifting sheaves/lugs for complete gate height.

PTFE/fluor carbon coated side and top rubber seals have been proposed in order to ensure self-lowering of gates against FRL condition and to reduce hoist capacity. The bottom seal is wedge type, made from normal rubber. Suitable bottom lip shall be provided to cater for crack opening of the gate.

Deposition/accumulation of silt in the gate groove and on the bottom seal seats is likely to make the sitting of gate on the sill beam difficult. Sometimes, gate may not sit on sill properly due to pebbles and silt deposited there on. Thus, may result in severe leakage downstream in the downstream of gate and may also damage the bottom seals. To overcome this problem, the contractor has to propose, design and provide the air water jet cleaning system.

The gates shall usually remain in raised position above the groove on dogging arrangements. Gates shall be operated by means of independent rope drum hoists with hoist capacity as computed but not less than **40T**. General arrangement of gate and its hoisting system are shown in drawing nos. **KHPP- HM-INT-6013 Sheet 1of 2 & 2of 2**

The following minimum sizes/ specifications shall be observed:

Skin plate	:	20mm structural steel
End Vertical Grider	:	25mm structural steel
Bottom seal	:	20mm thick wedge type rubber seal (5mm pre-compression)
Side seals	:	14mm thick stem music note type rubber seal (PTFE/fluorocarbon cladded) 3mm pre-compression
Top seals	:	14mm thick stem music note type rubber seal (PTFE/fluorocarbon cladded) 3mm pre-compression
Seal clamps	:	16mm thick structural steel
Fasteners	:	16mm dia. Stainless Steel
Seal bases	:	12mm thick structural steel **(Machine finished surface)**
Full depth vertical Stiffeners	:	12mm thick structural steel
Splice bolts	:	Friction grip/ Fit bolts

Khorlochhu Hydro Power Ltd.

1.80.1 Embedded Parts

Two (2) sets of fabricated steel embedded parts, one set for each opening of 4.25m x 4.7m comprising sill, side and top (lintel) members with side guides extending up to operating deck, dogging devices etc. all suitable for a fixed wheel gate of downstream sealing type. The main members shall be provided with roller path & backing frames suitable for transmitting the load due to water pressure to civil structures. Wheel track shall be provided for one gate height above lintel level. The secondary concrete block outs shall be designed for imposed wheel loads from the gate corresponding to design loads as envisaged.

Not less than 16 mm thickness Steel liners shall be provided between bottom sill of bulkhead gate & intake gate in the upstream side and 1.5 mm in the downstream side of the intake gate bottom sill. In these portions, steel liners will be extended upto 1m height on both sides of the walls.

Erection supports shall be suitably braced so that activities like chipping/ denting of 1st stage concreting, opening out of bent dowels & 2ndstage concreting operation does not in any way affect the alignment.

The track base shall be extended below the sill as per parabolic load distribution and the extension below the sill shall not be less than 300mm.

The embedded parts shall be provided up to following extents: -

- Roller Tracks from 300mm below sill up to 1556.2m
- Side guides from 300mm below sill up to deck level i.e.1574.0m
- Dogging device/holding arrangement above deck level.

Suitable dogging/holding arrangement to hold the gate in suspended vertical position above the gate groove shall be provided for allowing its inspection, maintenance, and repairs as well as normal storage while not in use.

The following minimum sizes/ specifications shall be observed:

Sill beam	:	ISMB-300 or equivalent built up section
Seal seats	:	Stainless steel 150mm wide x 10mm thick for bottom, 275mm wide x 10mm thick with top 25mm chamfered for top and 100mm wide x 10mm thick for sides **(Machine finished surface)**
Track	:	corrosion resistant steel 200mm x 20mm **(Machine finished surface)**
Side guides	:	Min.45Kg/m weight crane rail section / 150mm x 40mm thick flat
Anchor rods/studs	:	16mm dia. J or U type spacing not more than 600mm c/c

1.80.2 Design consideration and operation requirements

The gate shall be designed in accordance with the provision of latest edition of IS: 4622 in general & in accordance with provisions specified in these specifications in particular. While designing the skin plate, corrosion allowance of 1.5 mm should be considered. **A factor of safety of 1.5 shall be considered on the static capacity of bearings while selecting bearings**.

The gate and its connected equipment including all embedded parts shall be designed corresponding to **FRL 1572.0 m** against the normal allowable stresses.

Earthquake effects shall also be considered and allowed in the design as per stipulations in accordance with IS: 1893. Earthquake condition and maximum wind load shall not be assumed to occur simultaneously.

The gates shall be self-closing under flowing water corresponding to FRL 1572.0 m .The gate shall be designed to close under its own weight with a safety margin of 20% over all resisting forces including friction and uplift forces occurring during closure but excluding the down pull forces occurring during closure. For the above purpose ballast may be added if required. The lifting of the gate shall be under balanced head condition achieved by crack opening of the gate by about 150mm against upstream head corresponding to FRL. Hydrodynamic forces shall be estimated based on acceptable methods such as given in Eristic book (cl.8.4 of chapter 8).

The gates shall satisfy the following requirements:

a) The gates shall be required to be operated (open or closed) at a speed of 0.5m/min± 5%,

b) In closed position, the gates must be completely watertight with full pressure acting from upstream side and sealing must be reliable against water level up to EL 1572.0m,

c) The gates and its accessories shall be so designed that the stresses in different members due to dynamic loads during closing and opening operations and static loads in the closed position do not exceed the permissible stresses specified,

d) The sealing arrangement of the wheel assemblies should be suitable to prevent entry of water and silt into the wheel bearings to ensure trouble free operation,

e) The following loads shall be considered:

   i) Full hydro static load on U/s side of the gate with water level at EL 1572.0m,

   ii) Dead weight of the gate,

   iii) Effect of hoist force,

   iv) E.Q. forces.

1.81 Intake Rope Drum Hoist

The gate shall be operated by independent fixed rope drum type hoist. The operating equipment shall comprise of electrically operated motor to drive the rope drums through gearing, couplings. The rope drum hoist shall be mounted on hoist platform supported by columns above deck level. Hoist mechanism shall include ropes & attachments, intermediate shafting, Plummer blocks, D.C. electromagnetic brake, thruster type brake, emergency hand operation system with clutch type engaging/disengaging arrangement, overload protection/slack rope prevention device (i.e. load cell type/spring actuated type etc.) for hoisting motion, limit switches, sheaves, dial & digital type position indicator (along with potentiometer/ shaft encoder), electrical control panels including initiating contacts, contactors, safety provisions along with necessary cables etc. and any other mechanical or electrical component/attachment considered necessary for proper assembly and operation of the hoist. The rope drum assembly units and reduction units shall have minimum 3mm thick MS sheet covers with flat/angle iron framework to protect it from dust, dirt and direct exposure to moisture. The rotary type of double acting limit switch shall be provided for automatically and positively stopping the drive motor during hoisting/lowering of the gate as soon as either end of the gate travel is reached. Provision shall be provided for stopping the lifting of gate from sill level after lift of 150mm to achieve the balance head condition. A manual/ electrical interlock shall be provided in control circuit to cutoff power supply to motor, while operating manual drive. Protective device to automatically brake the hoist in case of power failure during operation shall be provided. On resumption of power supply the hoist shall start operation by pressing either `close' or `open' push buttons. Provision shall be made for normal maintenance and repairs of hoist without disconnecting rope from hoist drum and with gate resting on sill (fully closed). Provision shall be made for ladder, walkway, lighting and other necessary arrangements at

Khorlochhu Hydro Power Ltd.

hoist platform, checkered plates/gratings, guard railings etc. The top of hoist platform is so located as to raise the gate above deck level by at least 300mm in maximum raised position.

1.81.1 Design Criteria for Rope Drum Hoist

The hoists shall be designed in accordance with IS: 6938 and at a rated capacity capable to lift or close gates under all eventualities for which the gate has been designed. The hoist capacity shall be calculated taking into consideration the worst combination of all friction forces, hydrodynamic loads, dead weights etc. during both raising and lowering cycles, plus a reserve capacity of 20% over and above the worst combination of forces. The hoist capacity thus calculated shall not be less than **40T**. The various factors as enumerated in para 3.1 of IS 6938 shall be taken into consideration. While determining the hoist capacity, positive closure of gate under designed weight shall be ensured (seating force should be greater than 25% of opposing forces). The contractor shall submit detailed calculations in support of hoist capacity. The coefficient of friction used for working out hoist capacity shall not be less than those specified in IS: 4622.

The mechanical parts of the hoist shall be designed for the specific loads with a factor of safety of five based on the ultimate strength of the materials. Under breakdown torque condition of the motor stress in any portion of the hoist, hoist-bridge & trestles shall not exceed 80% of the yield point of the materials. The breakdown torque of the motor shall not be less than 225% of full load torque. The components shall be designed as per actual BDT of the motor. The rope shall have a factor of safety of six for normal conditions and of 3 for breakdown torque condition.

1.81.2 Hoist Supporting Structure

Two (2) numbers hoist supporting structure accommodating the rope drum hoists of Intake gates for each Intake shall be provided. The hoist machinery for gates shall be mounted on a structural steel hoist platform over structural steel columns.

Staircase shall be provided to approach the hoist. The hoist bridge shall be fabricated of structural steel members adequately braced and stiffened. This shall be securely attached to the structural steel column. The mounting of hoist platform with the structural steel column should have one end fixed and one end free to take care of any thermal expansion/contraction of the platform.

The bridge shall be covered with checkered plates and gratings. The checkered plate shall be minimum 6mm size. The grating shall not have opened more than 50mm x 50mm. At the junction of checkered plate and grating no step shall be formed and it should be flush with each other. Under the rope drums necessary opening for the hoist rope shall be provided. Rubber strips 10mm thick of the conveyor belt type shall be bolted in the periphery of this opening. The platform shall be securely fenced with double-tiered guardrails and shall be of sufficient width to enable normal maintenance work to be undertaken safely. The hand railing shall be 1.0m high made from pipe (40 NB medium duty) with suitable spaced vertical posts.

Hoist Bridge and its supporting structure including first stage embedment shall be designed for the worst combination of the forces encountered during any of the operations on the gates. Besides dead weight of machinery, guard railing, load due to hoisting of gate, a crowd load of (500 kg per meter sq.) wind load, seismic load etc. shall also be considered for the design of Hoist Bridge. Hoist bridge and its supporting structure shall be designed in accordance with the provision of IS: 800. All structural parts and hoisting equipment shall also have sufficient strength to resist the forces produced by the actual breakdown torque of the motors without exceeding 80% of yield point of materials.

The each Rope drum hoist shall be equipped with a lighting system as follows:

Khorlochhu Hydro Power Ltd.

- Two (2) 400 W industrial LED light for proper illumination of the working area of the gate groove.
- Sufficient LED lighting to properly illuminate the Hoist Bridge, access ladders and walkways.

Main data

No. of gates	:	2 (two)
Size of gates (clear opening)	:	4.25m width x 4.7m high
Sill elevation	:	1546.0m
Full reservoir level	:	1572.0m
Hoist	:	Rope drum hoist
Skin plate	:	Downstream
Sealing	:	Upstream

1.82 Intake Emergency Bulkhead Gate

One (1) number 4**.25m x 4.7m** (opening size) gantry crane operated slide type gate of structural steel construction with upstream skin plate and downstream sealing shall be provided for 2 No. intake bulkhead gate grooves located upstream of intake gate to facilitate inspection and maintenance of intake gate. The gate shall be provided with horizontal girders, vertical stiffeners, guide roller assemblies, filling-in-valves, dogging devices, slide block, bumpers etc. The gate shall be fabricated in suitable number of units. The gate is to be designed to withstand the head corresponding to FRL and for lowering under no flow condition and raising under balance head condition, which can be achieved through integral filling-in-valves. **The filling in valve will open by the initial lifting movement of the hoist lifting attachment by about 75mm**. The gate shall be fitted with side and lintel seal elements on the downstream side of gate unit and bottom seal on the upstream which will be connected to the side seal provided on the downstream suitably. Suitable gate lifting sheaves/lugs shall be provided for connecting to rope drum hoist. Full depth stiffeners shall be provided below the lifting sheaves/lugs for complete gate height. The gates shall be operated by means of Gantry crane of capacity as computed but not less than **35T**.

General arrangement of gate & hoist is as per drawing nos. **KHPP-HM-INT-GA-6014 Sheet 1of 2 & 2 of 2**

Double stem music notes type rubber seal for top and single stem music note type rubber seal for sides is provided and the bottom seal is of normal rubber wedge type.

The following minimum sizes/specifications shall be observed:

Skin plate	:	20mm structural steel
End Vertical Grinder	:	25mm structural steel
Bottom seal	:	20mm thick wedge type rubber seal (5mm pre-compression)
Side seals	:	14mm thick stem music note type rubber seal (3mm pre-compression) - PTFE/fluorocarbon cladded
Top seals	:	14mm thick stem music note type rubber seal (3mm pre-compression) - PTFE/fluorocarbon cladded
Seal clamps	:	16mm thick structural steel
Seal Fasteners	:	16mm dia. stainless steel, spacing not more than 5 times the dia. Of fasteners
Seal bases	:	12mm thick structural steel **(Machine finished surface)**

Khorlochhu Hydro Power Ltd.

Full depth vertical Stiffeners	:	12mm thick structural steel
Splice bolts	:	Friction grip/ Fit bolts

1.82.1 Embedded Parts

Two sets of fabricated steel embedded parts, one set each for opening of 4.25m x 4.7m, comprising of sill, side and top (lintel) members with side guides extending up to the deck, slide tracks and suitable dogging arrangement, all suitable for slide type gate with downstream sealing. The main members shall be provided with sliding path suitable for transmitting the load developed from the upstream head to the civil structures. Slide track shall be provided up to 0.50-meter height above lintel level. The dogging devices shall be provided on top of gate grooves.

The embedded parts shall be provided up to the following extents:-

- Slide tracks from 300mm below sill up to EL 1556.20m
- Side guides from 300mm below sill up to deck level i.e. EL 1574.0m
- Dogging device/holding arrangement above deck level.

Suitable Dogging/ holding arrangement to hold the gate in suspended vertical position above the gate groove shall be provided for allowing its inspection, maintenance and repairs as well as normal storage while not in use.

Following minimum sizes/specifications shall be observed:

Sill beam	:	ISMB-300 or equivalent built up section
Seal seats	:	Stainless steel 160mm wide x 10mm thick for bottom, 150mm wide x 10mm thick with top 25mm chamfered for top and 100mm wide x 10mm thick for sides **(Machine finished surface)**
Track	:	corrosion resistant steel 200mm x 20mm **(Machine finished surface)**
Side guides	:	Min.45Kg/m weight crane rail section / 150mm x 40mm thick flat
Anchor rods/studs	:	16mm dia. J or U type spacing not more than 600mm c/c

1.82.2 Design consideration and operation requirements

The gate and embedded parts shall be designed in accordance with the provisions of the latest edition of IS: 9349 in general and in accordance with the provisions specified in these specifications in particular. While designing the skin plate, corrosion allowance of 1.5 mm should be considered. The deflection of the gate members shall be limited to span/ 1200.

The gate along with connected equipment shall be designed against FRL condition i.e. EL1572.0m with normal allowable stresses as per Clause 2.4.1 of General Technical Specifications.

Earthquake effects shall also be considered and allowed in the design as per stipulations in accordance with IS: 1893. The design shall be checked for additional forces due to horizontal and vertical earthquake acceleration of **0.24g** and **0.16g** respectively with allowable stresses as per clause 2.4.1(h) of General Technical Specifications.

The gate shall usually remain in raised position above the groove. Two numbers of side guide rollers shall be provided on each side to restrict lateral movement of gate. The gate shall be designed for lowering under no flow condition and raising under balance head condition and close under its own weight with a safety margin of 20% over all resisting forces. Gate is operated for lowering under no flow condition and raising under balance head condition, which can be achieved through integral filling-in-valves. **However, a**

Khorlochhu Hydro Power

differential head of 0.3m shall be considered on gate from upstream side for the purpose of calculation of hoist capacity.

Not less than 8 mm thick Steel air vent pipe of 300mm dia. shall be provided in first stage concrete at the downstream side of each intake bulkhead gate groove for escape of air during filling operation.

The gate shall satisfy the following requirements:

a) In closed position, the gates shall be completely watertight with full water pressure acting from upstream side and sealing must be reliable against water level up to EL1572.0m,

b) The gates and its accessories shall be so designed that the stresses in different members due to operation of the gate and static loads in the closed position do not exceed the permissible stresses specified,

c) The gate shall be operated at a speed of 0.5m/min± 5%,

d) The gate shall be capable to withstand and transfer the load due to differential head of 0.5m while creating balance head conditions i.e. from upstream to downstream,

e) The following loads shall be considered:

   i) Full hydrostatic water thrust with water at FRL 1572.0m,

   ii) Dead weight of the gate and hoist,

   iii) Hoisting forces,

   iv) Wind and Earthquake forces,

1.83 Intake Bulkhead Gantry Crane

One (1) number electrically operated dedicated traveling gantry crane complete in all respect shall be provided specifically for handling the Intake Bulkhead gate complete with rail track with necessary end stops and anchors. The crane shall consist of gantry frames with traveling mechanism with machine house, hoisting and traveling equipment and cable reeling drum, operator's cabin, rail safety clamps, controls, limit switches, wire ropes, outside lighting and all other necessary components for its safe, proper and efficient operation. The gantry frames shall be of welded construction, except that the high-tensile friction grip and/or fit bolts shall be used for all field connections.

The gantry crane shall be mounted on flat-bottomed rails at **EL.1574.0m** and shall have sufficient length for the crane to cover both the bulkhead openings. The rails shall be provided complete with all holding down bolts, fishplates, separators, stops, etc. On upstream and on all the bays on downstream side the rails shall be laid on the concrete**. Limit switches shall also be placed along the track so that the gantry may be accurately positioned over the openings**. A load plate showing the safe working load shall be fixed to the crane in a position to be easily legible from the operating level.

The capacity shall be adequate for the operation of the bulkhead gate at worst loading condition. Electrical power for traveling and hoisting motions is provided through a traveling cable reeling drum arrangement. The operation of gantry crane shall be from an enclosed cabin with maximum unrestricted view. The gantry shall be provided with necessary brakes (viz. D.C. electromagnetic brakes, as well as thruster brakes), storm anchors, overload protection/slack rope prevention device (i.e. load cell type/spring actuated type etc) for hoisting motion, interlock devices, limit switches for extreme position of hoist, long travel, cross travel as well as centering the crane at the centre line of each bay. All drives and hoist gearing will be fully enclosed and housed as appropriate. Additional inching controls shall be provided on the long travel (LT) drives.

The design of various components of the crane shall be done in accordance with the provisions of Indian Standard specification IS: 3177 and IS: 807(latest Revision). Where

Khorlochhu Hydro Power Ltd.

the provisions of Indian Standard Codes conflict with the provisions of these specifications the provisions of these specifications shall govern.

The mechanical parts of the hoist shall be designed for the specific loads with a factor of safety of five based on the ultimate strength of the materials. Under breakdown torque condition of the motor, stress in any portion of the hoist, hoist-bridge & trestles shall not exceed 80% of the yield point of the materials. The breakdown torque of the motor shall not be less than 225% of full load torque. The component shall be designed as per actual BDT of the motor. The rope shall have a factor of safety of six for normal conditions and of 3 for breakdown torque condition. Due to arrangement of equalizer the design load on the hoisting rope on each side of the gate shall be considered as 50% of the total hoisting load. The hoist mechanism shall be covered by suitable cover frames to protect it from dust, dirt and direct exposure to moisture. Provision shall be made for overload protection/slack rope prevention device (i.e. load cell type/spring actuated type etc.) for hoisting motion, limit switches, control panels, staircase to hoist platform, chequered plates/gratings, guard railings etc.

The Gantry Crane shall be equipped with a lighting system as follows:

- 400 W industrial LED light for gantry travel "headlights," one on each side illuminating the rails ahead of the gantry.
- Two (2) 400 W industrial LED light for proper illumination of the working area of the stop log grooves.
- Sufficient LED lighting to properly illuminate the operator's cabin, Hoist Bridge, access ladders and walkways.

1.83.1 Characteristics

The crane will have the following characteristics:

i)	Class of crane	:	Class-II as per IS: 807 & M5 as per IS: 3177 outdoor electrically operated with rope drum hoist.
ii)	Rated Capacity	:	As computed but not less than 30T
iii)	Centre to centre of track	:	4.0m (tentative)
iv)	Minimum wheel base of crane	:	7.0m. (Tentative)
v)	Total length of rail track	:	90.0m (approx.)
vi)	Operating speeds (Loaded)		
	Hoist	:	0.5 m/min± 5%
	Long travel	:	8 m/min± 10% with inching facility having 10% of normal speed
vii)	Minimum headroom over the deck	:	7.0m

viii) Electrical details:

a) **Power supply:**

The power supply and terminal points shall be as defined in the General Technical Specifications.

b) **Control:** Controls in operator's cabin.

c) **Drives:**

i) **Hoist Drive**: thyristors-controlled motor, with D.C. Electromagnetic brake and thruster type brake, with limit switches for extreme positions of hook and for filling-in-valves opening position of the gate.

Khorlochhu Hydro Power Ltd.

ii) **Long travel:** thyristors-controlled motors with D.C. electromagnetic brake as well as thruster brake, connected to at least one driving wheel on each side of end carriage, through gearing and shafting having synchronized operation having limit switches for extreme position of travel and corresponding to center of each span with supply through cable reel.

Suitable interlocks in control circuit shall be provided to prevent accidental hoist operation or LT motion when the transverse drive is under operation. The supply to trolley shall be through a festoon type trailing cable supported on suitable wire with movable hook.

d) A digital indicator shall be fitted in the operator's cabin for hoisting operation to show the position of Bulkhead gate. This indicator shall indicate the length of lowering of the gate with an overall accuracy of ± 20mm and shall register zero with the gate in the top position.

e) **Interlocks:** In addition to usual protective gear the following interlocks shall be provided:

f) Interlock in LT Drives to prevent long travel unless the hook is in its highest position.

Hoist capacity: The hoist capacity of Gantry crane for operating intake bulkhead gate shall be computed for dead weight of bulkhead. **Frictional forces due to 0.30m differential head on bulkhead gate shall be considered. A reserve of 20% over and above the computed value shall be provided however, it shall not be less than 35T.**

1.83.2 Main data

Type of gate	:	Slide Type
No. of gates	:	1 No.
Size of Gates (Clear Opening)	:	4.25m x 4.7m
Sill of the gate	:	1546.0m
Skin plate	:	Upstream
Sealing	:	Downstream
Operation	:	Balanced head
Hoist	:	Gantry crane with lifting beam.

18. Downstream Desilting Chamber Gate & Rope Drum Hoists

1.84 Downstream Desilting Chamber Gate

In order to isolate individual desilting chamber from HRT for the purpose of inspection, cleaning and maintenance, wheeled type gate of size 4**.7m x 4.7m** (opening size) will be provided at its outlet. **Two (2)** numbers of gates will be provided for two desilting chambers. The gates will be operated through a dedicated rope drum hoist of hoist capacity as computed but not less than **35T** provided in the operation chamber. The gate shall be of structural steel construction with skin plate at the HRT side and sealing on the Desilting Chamber side supported by horizontal girders and vertical stiffeners, side guide rollers, filling-in-valve with lifting sheaves, wheels, bumpers etc. The gate should be able to transfer the load on concrete through embedded track. The gate shall be normally kept in dogged position at gate operation chamber level i.e. **1574.0m.**

The gate shall be operated under balanced head condition and shall be designed for a maximum head corresponding to **FRL 1572.0m**. **PTFE/ fluoro carbon coated side and top rubber seals have been proposed in order to ensure self-lowering of gates against FRL condition and to reduce hoist capacity**. General arrangement of gate and its hoisting system shall be as shown in drawing No: **KHPP-HM-DC-GA-6015**

All equipment, wherever applicable, shall include provisions for safe isolation, locking, and tagging of hazardous energy sources—such as electrical, mechanical, hydraulic, pneumatic, thermal, and stored energy. The systems must be capable of being secured in a fully de-energized and inoperable state during maintenance activities. The vendor shall ensure that all equipment supplied is designed, fabricated, and delivered with complete LOTO provisions, in accordance with applicable standards and best engineering practices

Following minimum sizes/specifications shall be observed:

Skin plate	:	20mm structural steel
End Vertical Grider	:	25mm structural steel
Bottom seal	:	20mm thick wedge type rubber seal (5mm pre-compression)- PTFE/fluorocarbon cladded
Side seals	:	14mm thick stem music note type rubber seal with 3mm pre-compression
Top seals	:	14mm thick double stem music note type rubber seal with 3mm pre-compression.
Seal clamps	:	16mm thick structural steel
Seal Fasteners	:	16mm dia. stainless steel, spacing not more than 5 times the dia. of fasteners
Seal bases	:	12mm thick structural steel **(Machine finished surface)**
Full depth vertical Stiffeners	:	12mm thick structural steel
Splice bolts	:	Friction grip/ Fit bolts

1.84.1 Design consideration and operation requirements

The Desilting basin gate shall be designed in accordance with the provisions of the latest edition of IS: 4622 in general and in accordance with the provisions specified in these specifications in particular. While designing the skin plate, corrosion allowance of 1.5 mm should be considered. The deflection of the gate members shall be limited to span/1200.

The gate shall be designed for head corresponding to water level of **1572.0m** against the normal allowable stresses.

The gates shall be lifted at two points equidistant from centre line of the gate by dedicated rope drum hoists in the Gate operation chamber. Lifting sheaves of adequate strength with full depth and full height stiffeners underneath shall be provided. Two numbers of side guide rollers shall be provided on each side to restrict lateral movement of the gate.

The lowering/raising of the gate shall be done under balance head conditions. Which can be achieved through integral filling-in-valves. **The filling-in-valve will open by the initial lifting movement of the hoist lifting attachment by about 75mm. However, 0.3m differential head may be considered for calculating hoist capacity.**

Not less than 8 mm thick steel air vent pipe of 300mm dia. shall be provided in first stage concrete at the upstream side of each desilting chamber outlet gate groove for escape of air during filling operation.

The gate shall satisfy the following requirements:

a) In close position, the gate must be completely watertight with full pressure acting from downstream side; sealing must be reliable against water level up to FRL 1572.0m.

b) The gate and its accessories shall be so designed that the stresses in different members due to static loads in the closed position do not exceed the specified permissible stresses.

Khorlochhu Hydro Power Ltd.

c) The gate shall be capable to withstand and transfer the load due to differential head of 0.3m while creating balanced head conditions through integral filling-in-valves i.e. from downstream to upstream.

d) The following loads shall be considered:

i) Full hydrostatic water thrust with water at FRL 1572.0m

ii) Dead weight of the gate and hoist.

iii) Hoisting forces.

1.84.2 Embedded Parts

The gate grooves shall be provided with first stage anchorage and second stage embedded parts consisting of fabricated steel embedded parts comprising of bottom and side seal seats, top seal seat, sill beam, lintel beam, side guides extending up to the deck, wheel tracks, and suitable dogging arrangement. Suitable fencing should be provided all around the gate grooves. The wheel tracks shall be provided at least up to 0.5m above the gate opening to take care of load transfer due to differential head. The dogging device will be provided on top of one of the gate groove.

Following minimum sizes/specifications shall be observed: -

Sill beam	:	ISMB-300 or equivalent built up section
Seal seats	:	Stainless steel 160mm wide x 10mm thick for bottom, 100mm wide x 10mm thick for sides and 150mm wide x 10mm thick with top 25mm chamfered for top **(Machine finished surface)**.
Track	:	corrosion resistant steel 200mm x 20mm **(Machine finished surface)**
Side guides	:	150mm x 40mm thick flat / rail section min.45kg/m
Anchor rods/studs	:	16mm dia. J or U type spacing not more than 600mm c/c

1.85 Downstream Desilting Chamber Rope Drum Hoist

The gates shall be operated by independent fixed rope drum type hoists. The operating equipment shall comprise of electrically operated motor to drive the rope drums through gearing, couplings. The rope drum hoist shall be mounted on hoist platform above deck level. Hoist mechanism shall include ropes & attachments, intermediate shafting, Plummer blocks, D.C. electromagnetic brake, thruster type brake, emergency hand operation system with clutch type engaging/disengaging arrangement, overload protection/slack rope prevention device (i.e. load cell type/spring actuated type etc.) for hoisting motion, limit switches, sheaves, dial & digital type position indicator (along with potentiometer/ shaft encoder), electrical control panels including initiating contacts, contactors, safety provisions along with necessary cables etc. and any other mechanical or electrical component/attachment considered necessary for proper assembly and operation of the hoist. The rope drum assembly units and reduction units shall have minimum 3mm thick MS sheet covers with flat/angle iron framework to protect it from dust, dirt and direct exposure to moisture. A manual/ electrical interlock shall be provided in control circuit to cutoff power supply to motor, while operating manual drive. Protective device to automatically break the hoist in case of power failure during operation shall be provided. On resumption of power supply, the hoist shall start operation by pressing either `close' or `open' push buttons. Provision shall be made for ladder, walkway, lighting and other necessary arrangements at hoist platform, checkered plates/gratings, guard railings etc.

Khorlochhu Hydro Power Ltd.

1.85.1 Design Criteria for Rope Drum Hoist

The hoists shall be designed in accordance with IS: 6938 and at a rated capacity capable to lift or close gates under all eventualities for which the gate has been designed. The hoist capacity shall be calculated taking into consideration the worst combination of all friction forces, hydrodynamic loads, dead weights etc. during both raising and lowering cycles, plus a reserve capacity of 20% over and above the worst combination of forces. The various factors as enumerated in para 3.1 of IS 6938 shall be taken into consideration. The contractor shall submit detailed calculations in support of hoist capacity. However, hoist capacity shall not be less than 35T. The coefficient of friction used for working out hoist capacity shall not be less than those specified in IS: 4622.

The mechanical parts of the hoist shall be designed for the specific loads with a factor of safety of five based on the ultimate strength of the materials. Under breakdown torque condition of the motor stress in any portion of the hoist, hoist-bridge & trestles shall not exceed 80% of the yield point of the materials. The breakdown torque of the motor shall not be less than 225% of full load torque. The components shall be designed as per actual BDT of the motor. The rope shall have a factor of safety of six for normal conditions and of 3 for breakdown torque condition.

1.85.2 Hoist Supporting Structure

Two (2) numbers hoist supporting structure accommodating the rope drum hoists of Intake gates for each Intake shall be provided. The hoist machinery for gates shall be mounted on a structural steel hoist platform over structural steel column.

Staircase shall be provided to approach the hoist. The hoist bridge shall be fabricated of structural steel members adequately braced and stiffened. This shall be securely attached to the structural steel column.

The bridge shall be covered with checkered plates and gratings. The checkered plate shall be minimum 6mm size. The grating shall not have opened more than 50mm x 50mm. At the junction of checkered plate and grating no step shall be formed and it should be flush with each other. The platform shall be securely fenced with double-tiered guardrails and shall be of sufficient width to enable normal maintenance work to be undertaken safely. The hand railing shall be 1.0m high made from pipe (32 NB medium duty) with suitable spaced vertical posts.

Hoist Bridge and its supporting structure including first stage embedment shall be designed for the worst combination of the forces encountered during any of the operations on the gates. Besides dead weight of machinery, guard railing, load due to hoisting of gate, a crowd load of (500 kg per meter sq.) wind load, seismic load etc. shall also be considered for the design of Hoist Bridge. Hoist bridge and its supporting structure shall be designed in accordance with the provision of IS: 800. All structural parts and hoisting equipment shall also have sufficient strength to resist the forces produced by the actual breakdown torque of the motors without exceeding 80% of yield point of materials.

Each Rope drum hoist shall be equipped with a lighting system as follows:

- Two (2) 400 W industrial LED light for proper illumination of the working area of the gate groove.
- Sufficient LED lighting to properly illuminate the Hoist Bridge, access ladders and walkways.

Main data

Type of gate	:	Wheeled type
Size of gate (clear opening)	:	4.7m x 4.7 m
No. Of gates	:	2

Khorlochhu Hydro Power

Sill level	: 1546.2 m
Deck level	: 1574.0 m
FRL	: 1572.0 m
Operation	: Balanced head
Sealing	: Desilting Chamber Side
Skin plate	: HRT Side
Type of Hoist	: Dedicated Rope Drum Hoist
Hoist Capacity	: As calculated but not less than 35T

19. Silt Flushing Tunnel Gates and Hydraulic Hoists

1.86 Silt Flushing Tunnel Gates

Two (2) set of silt flushing tunnel sliding type gates one set for each flushing tunnel comprising of one service gate (d/s) and one emergency gate (u/s) having a **clear opening of 1.5m (wide) x 2.2m (high)** with sill elevation at **1527.5m** have been proposed. The gate consists of upstream skin plate and upstream sealing. It is provided with horizontal girders, vertical stiffeners and end vertical plates. The gate is to be designed to withstand and seal against full upstream reservoir head. Silt loads up to one gate height shall be considered. Special care shall be taken for the wear resistance of the gate structure. Bottom seal and gate parts must be designed for high abrasion due to silt movement. **The bidder may propose high strength/abrasion resistant material for gate and liners to take care of wear/abrasion likely to take place due to high flow velocities and silt content in the flow**. The gates are proposed to be operated by means of hydraulic hoists provided at silt flushing gate operation gallery.

The gate shall be provided with bottom seal, side seals and lintel seal on the upstream side of the unit. The gate shall be provided with suitable bearing block assemblies and guide shoe. Suitable lifting lugs and dogging arrangement shall be provided to hold the gates in position for maintenance purpose. The bottom most girders of the gates shall be suitably located and designed to have best hydraulic performance for the operating conditions as envisaged for the gates. The d/s flange of the bottom most girders shall remain clear of water profile under all gate-opening positions.

All equipment, wherever applicable, shall include provisions for safe isolation, locking, and tagging of hazardous energy sources—such as electrical, mechanical, hydraulic, pneumatic, thermal, and stored energy. The systems must be capable of being secured in a fully de-energized and inoperable state during maintenance activities. The vendor shall ensure that all equipment supplied is designed, fabricated, and delivered with complete LOTO provisions, in accordance with applicable standards and best engineering practices

General arrangement of gates shall be as shown in drawing no. KHPP-HM-SFT-GA-6016

Following minimum sizes / specifications shall be observed

Skin plate	:	25mm structural steel
End Vertical girder	:	28mm structural steel
Bottom seal	:	25mm thick wedge type rubber seal (5mm pre-compression)
Side seals	:	14mm thick stem music note type rubber seal with 3mm pre-compression
Top seals	:	14mm thick double stem music note type rubber seal with 3mm pre-compression.

Khorlochhu Hydro Power Ltd.

Seal clamps	:	16mm thick structural steel
Fasteners	:	16mm dia. stainless steel, spacing not more than 5 times the dia. of fasteners
Seal bases	:	12mm thick structural steel **(Machine finished surface)**
Steel liners	:	25mm thick structural steel
Splice bolts	:	Friction grip/ Fit bolts

1.86.1 Embedded Parts

Four (4) sets (2 Nos. for service gate and 2 Nos. for Emergency gate) of fabricated steel embedded parts comprising of sill beam, lintel beam, side seal and lintel seal seats with side guides, dogging device including groove liners suitably stiffened and anchored (provided up to floor level of flushing gate operation gallery) suitable for receiving a slide type gate of clear span **1.5m (wide) x 2.2m (high).** The main members shall be provided with sliding path suitable for transmitting the load developed on the gate due to upstream head to the civil structure. The sliding track shall be provided up to at least one gate height above gate opening. **The side seal seats, and top seal seats shall be extended at least 0.80m above the gate opening to cater for partial operations. However, the liner shall be provided from sill level up to El. 1534.20 m (i.e. floor level of flushing gate operation gallery) for gate grooves.**

Bonnet covers for both the gate grooves and hoist supporting structures for both the gates are required to be provided at **El 1534.20m** to facilitate operation of gate from the flushing gate operation gallery. Provision shall be made for connecting u/s bonnet chamber with the d/s bonnet chamber through an air-vent piping and pressure relief valve at the operation floor level to allow for aeration during operation of the emergency gate. The pressure relief valve shall be kept closed during service gate operation and will be opened only while lowering or raising of emergency gate.

A working platform for the maintenance of cylinder shall be provided in the operation chamber. For access into the gate groove a manhole along with rung ladder is to be provided in both the bonnet covers. Suitable bolted type manhole cover with adequate sealing arrangement shall be provided. The manhole cover shall be provided with an air release valve.

All the embedded parts shall be installed in the first stage concrete itself. As such the design and fabrication shall be done in such a way to suit their installation in the first stage concrete.

The following minimum sizes/ specifications shall be observed:

Sill beam	:	ISMB-300 or equivalent built up section
Seal seats	:	Stainless steel 200mm wide x 25mm thick for bottom, 600mm high x 10mm thick for top and 100mm wide x 10mm thick for sides. **(Machine finished surface)**
Track	:	corrosion resistant steel 200mm x 25mm **(Machine finished surface)**
Side guides	:	50mm x 40mm thick flat
Anchor rods/studs	:	16mm dia. J or U type spacing not more than 450 c/c

Not less than 8 mm thick steel air vent pipe of 500mm dia. shall be provided in first stage concrete at the downstream side of each silt flushing service gate groove to fulfill the air demand during silt flushing operation.



1.86.2 Design consideration and operation requirements

The gates shall be designed in accordance with the provision of latest edition of IS: 9349 in general & in accordance with provisions specified in these specifications in particular. While designing the skin plate, corrosion allowance of 1.5 mm should be considered. The deflection of the gate members shall be limited to **span/2000**.

The gate and its connected equipment including all embedded parts shall be designed corresponding to water elevation of 1572.0 m against the normal allowable stresses. In addition, a silt load of one gate height shall be considered for both the gates against normal allowable stresses.

Earthquake effects shall also be considered and allowed in the design as per stipulations in accordance with IS: 1893. The design shall be checked for additional forces due to horizontal and vertical earthquake acceleration of 0.24g and 0.16g respectively with allowable stresses as per clause 2.4.1(h) of General Technical Specifications.

The service gate shall usually remain in closed position & shall be operated by means of hydraulic hoist. The service gate shall be designed for operation against full upstream head corresponding to FRL and shall be capable for regulating the discharge through flushing tunnel during desilting operation and shall be used for partial gate opening. The gate is to be designed/ checked under partial operation also against vibrations etc. The gate shall be capable of closure against full upstream head corresponding to FRL. The hydraulic hoist shall have adequate pushing capacity to ensure gate closure. The pushing capacity of the hoist shall be at least 50% more than resultant of all the forces acting on the gate during lowering operation. The gate lifting capacity shall be computed taking into consideration all frictional forces due to water and silt load, gate weight, down pull forces etc., including a reserve capacity of 50% above the calculated lifting force in accordance with IS: 10210. While calculating pushing force, down pull shall not be considered and for calculation of hoisting force, uplift on the gate shall be neglected.

The emergency gate operated through separate independent hydraulic cylinder (but common power pack) shall generally be kept open within the gate groove and shall be used to cater for maintenance requirements of service gate and its embedded parts. This gate shall generally be lowered under balanced head but shall be designed for the same operating condition as for service gate to cater for any eventuality. The hydraulic hoist for this gate shall have same capacity as for service gate.

The operation of the gates shall be from a local control panel with all the facilities. The operation shall also be through a Remote-Control System situated in the dam control room and Main Station Control Room located in Powerhouse, which shall enable the operation of the service gate as per the flushing requirements. Necessary selector switch for manual / remote mode shall be provided in the local control panel.

The gates shall be provided with bonnet & bonnet cover to avoid any ingress of water into the operation gallery. The bonnet, bonnet cover and liners shall be designed for the maximum external / internal water pressure acting on it and shall be self- sustaining (i.e. without considering any support from surrounding concrete). Hydraulic forces due to hydraulic hoist and water pressure shall be transferred by bonnet body into the concrete.

The gates shall satisfy the following requirements:

a) The gates shall be required to be operated (open or closed) at a speed of 0.5m/min± 5%,

b) In closed position, the gates must be completely watertight with full pressure acting from upstream side and sealing must be reliable against water level varying up to EL 1572.0m,

Khorlochhu Hydro Power Ltd.

c) The gates and its accessories shall be so designed that the stresses in different members due to dynamic loads during closing and opening operations and static loads in the closed position do not exceed the permissible stresses specified.

1.87 Hoists for Flushing Tunnel Gates

Each gate shall be operated by means of an independent double acting hydraulic cylinder connected with the gate through pin. The hydraulic hoist shall include hydraulic actuator complete in all respects including support beams, hydraulic piping and control valves and fixtures, hydraulic power packs, vents, hydraulic oil, height indicator and **hanger stud suitable for weight of gate and cylinder** and all other components required for satisfactory operation of the gates and hoists. **The hoist shall be designed in accordance to IS 10210. The hoist capacity shall be calculated considering the worst combination of all resisting forces viz. frictional force, dead weight including effects of silt load up to one gate height. The computed hoist capacity but not less than 150 T pulling force & 120 T pushing force shall be adopted for both the gates**.

The design of the hoist and controls shall be suitable to maintain the gate at any selected opening position between full open and full closed using a restoring device if **the creep of gate from original position exceeds 100mm**. Provision shall be made to have a buffer speed of $1/5^{th}$ of the working speed during last 300mm travel of the gate during lowering operation.

The cylinder design shall provide minimum reserve stroke of 100mm on each end over the computed working stroke. Cylinder stroke length of gate hoist shall be kept in such a way so that maintenance of gate including replacement of bottom seal can be carried out at maintenance platform.

The cylinder walls shall be properly prepared to allow the piston to traverse smoothly and freely and to minimize the oil leakage past the piston. Piston rod shall be of following types:

Stainless steel with hard chrome plating of thickness not less than 50 microns or carbon steel with ceramic coating not less than 250 microns.

The ceramic coating on piston rod shall be designed to rule out corrosion of the piston rod. It shall be homogeneous, scratch resistant, free of cracks & non-conductive.

The cylinders shall be provided with an **Integrated Measuring System/ Linear Displacement Transducer or similar arrangement for gate position indication**. In case of integrated measuring system or other similar arrangement, the position measuring system shall be based on serrated rod. An incremental encoder shall generate the position output. Position accuracy linearity shall be ±1mm. **The required powers supply of 24V D.C.± 20%max.250mA for MIMS shall also be arranged by the supplier.**

The hydraulic hoist and power pack are to be sourced from a world-renowned designer cum manufacturer who has in-house facility of piston rod ceramic coatings/ chrome plating.

One common power pack shall operate hydraulic cylinders for service as well as emergency gate of each flushing tunnel. The power pack shall consist of two pumps and two motors out of which one pump & one motor shall act as standby unit. Arrangement shall be made for inter connection of both the power packs to enable operation of adjacent service and/or emergency gate in case either of the power packs is under maintenance or out of order. One manual pump shall be provided on each power pack.

The system shall be provided with operating panels for automatic, remote & manual operating modes. **The hoist shall be designed in accordance with IS: 10210/ DIN: 19704.**

For details of other associated items of power pack like **hydraulic power unit, piping, fittings and flanges, flexible connections, fluid reservoir, hydraulic working fluid,**

Khorlochhu Hydro Power Ltd.

design temperature, system cleanliness, flushing and flushing fluid refer to Clause 3.3.1 of particular technical specification.

Main Data

a) Gates:

Type of gate	:	Slide type vertical gates
No. of gates	:	2 (two) Service gates & 2 (two) Emergency gates
Width of opening	:	1.50 m
Height of opening	:	2.20 m
Water level u/s	:	1572.0m
Sill elevation	:	1527.50 m
Silt load	:	Up to One gate height

b) Hoists:

Four (4) numbers Independent double acting Hydraulic cylinders and Two (2) numbers Power packs.

Operating speed	:	0.5m/min± 5%
Max. Working pressure	:	20 Mpa at cylinder
Hoist capacity	:	To be computed as per specified operating condition. However, capacity not less than **150T** for pulling and **120T** pushing for cylinder.

20. Surge Shaft Gates & Hoists

1.88 Surge Shaft Gate

Two (2) numbers of pressure shafts take off from the surge shaft. For isolating each pressure shaft, one number gate is provided at the inlet of each pressure shaft. It is a slide type gate of clear opening **2.75m x 5.22m**. The gate is located at sill elevation **El 1480.00 m**. The gate shall be of structural steel construction having downstream skin plate with downstream sealing. The gate shall be provided with stiffeners, girders, end vertical girders, side guide shoe assemblies, lifting stem cum filling-in-valves, dogging devices, slide block, u/s bumpers etc. The gate shall be designed as a single unit or in suitable units keeping in view the transportation / erection limitations. Each unit shall have two bearing pads one at each end.

The gate shall be designed against FRL condition i.e. **1572.0m** and shall also withstand against the full upstream water level corresponding to the surge level i.e. **EL 1499.00m**, when one gate is closed and **EL 1648.0m**, when both gates are opened. The gate shall be fitted with side and lintel seal elements on the downstream side of gate unit and bottom seal on the upstream which will be connected to the side seals provided on the downstream suitably. Suitable spring-loaded bumpers shall be provided on the u/s of the gate skin plate to bear on u/s face of groove liner to provide pre-compression to the seals. The gate shall be designed for lowering under no flow condition and raising under balanced head conditions, which can be achieved through integral filling-in-valves. The gate will be provided with two point lift connected to two filling-in-valves as shown in the specification drawing. Lifting stem cum filling-in-valve shall be of adequate strength with full depth and full height stiffeners provided equidistant from lifting center on the topmost girder & underneath the center line of lifting center up to bottom most girder web. Minimum 2 nos. of side guide shoe each side of the gate shall be provided.

Khorlochhu Hydro Power Ltd.

All equipment, wherever applicable, shall include provisions for safe isolation, locking, and tagging of hazardous energy sources—such as electrical, mechanical, hydraulic, pneumatic, thermal, and stored energy. The systems must be capable of being secured in a fully de-energized and inoperable state during maintenance activities. The vendor shall ensure that all equipment supplied is designed, fabricated, and delivered with complete LOTO provisions, in accordance with applicable standards and best engineering practices

The gate shall be normally kept dogged at EL **1640.0m**. Not less than 8 mm thick Steel air vent of **300 mm dia**. For each gate shall be provided in first stage concrete at the downstream side of gate for escape of air during filling of pressure shaft. General arrangement of gate is as per drawing no. **KHPP- HM-SS-GA-6018**

The following minimum sizes/specifications shall be observed:

Skin plate	:	25mm structural steel
End Vertical Grider	:	25mm structural steel
Bottom seal	:	20mm thick wedge type rubber seal (5mm pre-compression)
Side seals	:	14 mm thick stem double stem type rubber seal (3mm pre-compression) (PTFE/fluorocarbon cladded)
Top seals	:	14mm thick double stem type rubber seal (3mm pre-compression) PTFE/fluorocarbon cladded)
Seal clamps	:	16mm thick M.S
Seal Fasteners	:	16mm dia. stainless steel
Seal bases	:	12mm thick M.S **(Machine finished surface)**
Full depth vertical stiffeners	:	12mm thick structural steel
Splice joints	:	Welded/Bolted (Rigid connection)
Splice bolts	:	Friction grip/ Fit bolts
Air vent Pipe	:	Not less than 8 mm thick & 300 mm dia.

Care shall be taken so that side seals & top seal bear even and uniform pressure throughout the length on the side seal & top seal seats. The bottom seal should also bear uniformly on the sill beam. The side, top and bottom seals should have perfect leak proof jointing. The seal bases shall be machined after welding to the gate leaf. The seal clamps shall be shaped suitably to prevent any cutting or damage to the seals.

1.88.1 Embedded Parts

The surge shaft gate groove shall comprise fabricated steel guides and reception frames, the latter being provided with stainless steel sealing faces. The side members of the embedded frames will be fully steel lined and arranged for attachment to the adjacent linings and transition pieces in the downstream side of the gate. In the upstream side of the gate grove, steel liner shall be provided up to 600 mm in the bottom and side wall. In the upstream side, steel liner on the side wall shall be extended 500mm beyond top seal of the gate. The arrangement of the reception frames should be as per the technical specification drawings and the frame should extend up to EL 1487.00m. The side guide will extend up to EL 1640.00 m.

The reception frame up to EL 1487.00 m shall be erected by the gate contractor so as to be embedded in first stage concrete itself along with the pressure shaft steel transition. However, side guide above EL 1487.00 m up to top level shall be provided in second stage

Khorlochhu Hydro Power Ltd.

concrete. Suitable block out along with first stage anchors shall be provided for side guide above EL 1487.00 m and dogging device at EL **1640.0m**.

Following minimum sizes/specifications shall be observed:

Bottom liner cum Sill seat	:	As per drawing
Seal seats	:	Stainless Steel 150mm wide X 10mm thick for bottom, 150mm wide X 10mm thick with top 25mm chamfered for top **(Machine Finished surface)**
Track cum side seal seats	:	corrosion resistant steel 250mm x 20mm **(Machine finished surface)**
Top liner cum lintel beam	:	As per drawing
Groove liners	:	Min. 25 mm thick
Side guides	:	50mm x 40mm thick flat within reception frame and 150mm x 40mm above reception frame up to deck level
Anchor rods/studs	:	16mm dia. J or U type spacing not more than 600mm c/c

Erection supports shall be suitably braced so that activities like chipping/ denting of 1st stage concreting, opening out of bent dowels & 2nd stage concreting operation does not in any way affect the alignment.

1.88.2 Design consideration and operation requirements

The gate and embedded parts shall be designed in accordance with the provisions of the latest edition of IS: 9349 in general and in accordance with the provisions specified in these specifications. While designing the skin plate, corrosion allowance of 1.5 mm should be considered.

The gate and its connected equipment including all embedded parts shall be designed corresponding to FRL 1572.0m against the normal allowable stresses and check for surge level i.e. EL 1648.00m, when both gates are opened with increased permissible stresses by 33%. Earthquake effects shall also be considered and allowed in the design as per stipulations in accordance with IS: 1893. The design shall be checked for additional forces due to horizontal and vertical earthquake acceleration of 0.24g and 0.16g respectively with allowable stresses as per clause 2.4.1(h) of General Technical Specifications. However, earthquake and surge level will not be considered to act simultaneously. **The maximum deflection of the gate shall be limited to span/1200 (i.e. c/c of track)**.

The gate shall usually remain in open position in the groove when the water is being fed into pressure shaft. The gate shall be designed for lowering under no flow condition and raising under balance head condition. The balancing of the gate shall be created by filling in valve operation. A differential head of 0.5m shall be considered on gate from upstream side for the purpose of calculation of hoist capacity.

The gate shall satisfy the following requirements:

a) The gates shall be required to be operated (open or closed) at a speed of 2.0m/min± 5%,

b) In closed position, the gate shall be completely watertight with full water pressure acting from upstream side and sealing must be reliable against water level up to FRL i.e. EL.1572.0m

c) The gate and its accessories shall be so designed that the stresses in different members due to operation of the gate and static loads in the closed position do not exceed the permissible stresses specified.

Khorlochhu Hydro Power Ltd.

d) The gate shall be capable to withstand and transfer the load due to differential head of 0.5m while creating balance head conditions i.e. from upstream to downstream.

e) The following loads shall be considered:

i) Full hydrostatic water thrust with water at **FRL 1572.00m** & surge level i.e. EL **1648.0m**, when both gates are opened (with increased stresses),

ii) Dead weight of the gate and its attachments,

iii) Hoisting forces,

iv) Earthquake forces,

1.89 Surge Shaft Gate Hoist & Hoist Supporting Structure

The gate shall be operated by independent fixed rope drum type hoist. The operating equipment shall comprise of electrically operated motor to drive the rope drums through gearing, couplings. The rope drum hoist shall be mounted on hoist platform supported by columns above deck level. Hoist mechanism shall include ropes & attachments, intermediate shafting, Plummer blocks, D.C. electromagnetic brake, thruster type brake, emergency hand operation system with clutch type engaging/disengaging arrangement, overload protection/slack rope prevention device (i.e. load cell type/spring actuated type, etc.) for hoisting motion, limit switches, sheaves, dial & digital type position indicator, electrical control panels including initiating contacts, contactors, safety provisions along with necessary cables etc. and any other mechanical or electrical component/attachment considered necessary for proper assembly and operation of the hoist. The rope drum assembly units and reduction units shall have minimum 3mm thick MS sheet covers with flat/angle iron framework to protect it from dust, dirt and direct exposure to moisture. **Provision shall be provided for stopping the lifting movement of the hoist after open the 75mm filling in valve by the initial lifting movement of the hoist to achieve the balance head condition**. Protective device to automatically brake the hoist in case of power failure during operation shall be provided. On resumption of power supply the hoist shall start operation by pressing either `close' or `open' push buttons. Provision shall be made for normal maintenance and repairs of hoist without disconnecting rope from hoist drum and with gate resting on sill (fully closed). Provision shall be made for ladder, walkway, lighting and other necessary arrangements at hoist platform, chequered plates/gratings, guard railings etc. The top of hoist platform is so located as to raise the gate above deck level by at least 300mm in maximum raised position.

1.89.1 Design Criteria for Rope Drum Hoist

The hoists shall be designed in accordance with IS: 6938 and at a rated capacity capable to lift or close gates under all eventualities for which the gate has been designed. The hoist capacity shall be calculated taking into consideration the worst combination of all friction forces, hydrodynamic loads, dead weights etc. during both raising and lowering cycles, plus a reserve capacity of 20% over and above the worst combination of forces. The various factors as enumerated in para 3.1 of IS 6938 shall be taken into consideration. The contractor shall submit detailed calculations in support of hoist capacity. The coefficient of friction used for working out hoist capacity shall not be less than those specified in IS: 9349. **However, the computed hoist capacity shall not be less than 70 T.**

The mechanical parts of the hoist shall be designed for the specific loads with a factor of safety of five based on the ultimate strength of the materials. Under breakdown torque condition of the motor stress in any portion of the hoist, Hoist Bridge & trestles shall not exceed 80% of the yield point of the materials. The breakdown torque of the motor shall not be less than 225% of full load torque. The components shall be designed as per actual BDT of the motor. The rope shall have a factor of safety of six for normal conditions and of 3 for breakdown torque condition.

Khorlochhu Hydro Power Ltd.

1.89.2 Hoist Supporting Structure

The hoist machinery for gates shall be mounted on a structural steel hoist platform over structural steel column.

Staircase shall be provided to approach the hoist. The hoist bridge shall be fabricated of structural steel members adequately braced and stiffened. This shall be securely attached to the structural steel column. The mounting of hoist platform with the structural steel column should have one end fixed and one end free to take care of any thermal expansion/contraction of the platform.

The bridge shall be covered with checkered plates and gratings. The checkered plate shall be minimum 6mm size. The grating shall not have opened more than 50mm x 50mm. At the junction of checkered plate and grating no step shall be formed and it should be flush with each other. The platform shall be securely fenced with double-tiered guardrails and shall be of sufficient width to enable normal maintenance work to be undertaken safely. The hand railing shall be 1.0m high made from pipe (32 NB medium duty) with suitable spaced vertical posts.

Hoist Bridge and its supporting structure including first stage embedment shall be designed for the worst combination of the forces encountered during any of the operations on the gates. Besides dead weight of machinery, guard railing, load due to hoisting of gate, a crowd load of (500 kg per meter sq.) wind load, seismic load etc. shall also be considered for the design of Hoist Bridge. Hoist bridge and its supporting structure shall be designed in accordance with the provision of IS: 800. All structural parts and hoisting equipment shall also have sufficient strength to resist the forces produced by the actual breakdown torque of the motors without exceeding 80% of yield point of materials.

The Rope drum hoist shall be equipped with a lighting system as follows:

- Two (2) 400 W industrial LED light for proper illumination of the working area of the gate groove.
- Sufficient LED lighting to properly illuminate the Hoist Bridge, access ladders and walkways.

Main data

Type of gate	:	Slide Type
No. of gates	:	2 nos.
Size of gate (clear opening) on d/s	:	2.75 m x5.22 m
Sill of the gate	:	1480.0m
FRL	:	1572.0m
Maximum surge level	:	1499m when one gate is closed
	:	**1648m**, when both gates are opened
Skin plate	:	Downstream
Sealing	:	Downstream
Operation	:	Balanced head
Hoist	:	Rope drum hoist
Hoist capacity	:	Not less than **70T**

21. Tailrace Tunnel Gates & Gantry Crane

1.90 Tailrace Tunnel Gate (TRT)

To isolate turbines from the tailrace tunnel to cater to the inspection/maintenance requirements of turbines, **two (2)** numbers wheeled type tailrace tunnel gates of opening

size **4.0m x 4.5m** have been provided. The provision of two gates is based on the maximum requirement for isolating two units simultaneously, particularly when draining one of the pressure shafts, which is the worst-case situation next to a complete shutdown of the powerhouse (all four units). The gate is of structural steel construction having skin plate on Upstream (tailrace) side and sealing on the Upstream (tailrace) side. The gate shall be provided with horizontal girders, vertical stiffeners, end vertical girders, wheel assemblies, side guide roller assemblies, dogging devices, filling-in-valves cum lifting lugs, bumpers etc. The gate shall be designed for lowering under unbalanced head condition against tail water level EL.768.00m and raising under balanced head condition only, which can be achieved through integral filling-in-valves. If any case depth of water below the gate top, the lifting of the gate shall be under balanced head condition achieved by crack opening of the gate by about 150mm against the corresponding head.

Each gate shall be fabricated in suitable number of units and shall be joined together to form one piece and thereafter shall be handled as one unit for the purpose of lowering/ raising in the groove. These units shall be properly jointed to ensure water tightness. Each unit of gate shall have 4 wheel assemblies. Wheel pins shall be provided with suitable eccentricity (minimum ± 5mm) between centers of wheels and holes in vertical girders to facilitate adjustment in wheel alignment to have proper contact with the roller path.

Gate shall be lifted at two points equidistant from centre line of the gate. The gates will be operated under balanced head conditions by means of independent rope drum hoists supported on steel columns in the operation chamber. Full depth stiffeners shall be provided below the lifting lug for complete gate height. Additional lugs shall be provided on the gates to facilitate handling of gates during transportation, erection and subsequent operation of repair and maintenance etc.

Two numbers of side guide roller shall be provided on each side to check the side and lateral movement of the gate and to restrain the same with in specified limits. The guide roller should be adjustable (by providing shims). They shall travel on the embedded guides. The rollers have been provided with bronze bushes on fixed pins.

All equipment, wherever applicable, shall include provisions for safe isolation, locking, and tagging of hazardous energy sources—such as electrical, mechanical, hydraulic, pneumatic, thermal, and stored energy. The systems must be capable of being secured in a fully de-energized and inoperable state during maintenance activities. The vendor shall ensure that all equipment supplied is designed, fabricated, and delivered with complete LOTO provisions, in accordance with applicable standards and best engineering practices

These gates shall be generally kept in dogged position at deck level with suitable dogging arrangement. The gates shall usually remain in raised position. PTFE/fluorocarbon **cladded** music note type side rubber seal and PTFE/fluorocarbon **cladded** double stem type top rubber seals shall be used to reduce the hoist capacity. The bottom seal is of rubber wedge type. Gates shall be operated by means of gantry crane with hoist capacity as computed but not less than 20T. General arrangement of gate and its hoisting system is shown in drawing no.**KHPP-HM-TRT-GA-6021**

The following minimum sizes / specifications shall be observed:

Skin plate	:	16 mm thick
End Vertical Grider	:	20 mm thick
Bottom seal	:	20mm thick wedge type rubber seal (5mm pre-compression)
Side seals	:	14 mm thick stem music note type rubber seal (Minimum 3mm pre compression) (PTFE/fluorocarbon cladded)

Top seals	:	14mm thick double stem type rubber seal (3mm pre-compression) PTFE/fluorocarbon cladded)
Seal clamps	:	16 mm thick structural steel
Seal Fasteners	:	16 mm dia. stainless steel
Seal bases	:	12 mm thick M.S **(Machine finished surface)**
Vertical stiffeners	:	12 mm thick
Splice bolts	:	Friction grip/ Fit bolts

Care shall be taken so that side seals & top seal bear even and uniform pressure throughout the length on the side seal & top seal seats. The bottom seal should also bear uniformly on the sill beam. The side, top and bottom seals should have perfect leak proof jointing. The seal bases shall be machined after welding to the gate leaf. The seal clamps shall be shaped suitably to prevent any cutting or damage to the seals.

1.90.1 Embedded parts

Four (4) sets of fabricated steel embedded parts, one set for each opening of **4.0m x 4.5m** comprising sill, side and lintel members with side guides extending up to operating deck, dogging devices etc. all suitable for a fixed wheel type vertical lift gate of upstream (turbine side) sealing shall be provided. The structural/load bearing members shall be provided with wheel track & backing frames for transmitting the load due to water pressure to civil structures.

The embedded parts shall be provided up to following extents: -

- Wheel tracks members from 300mm below sill up to **EL.784.0m.**
- Side guides from 300mm below sill up to deck level i.e. **EL.784.0m.**
- Side seal base from 300mm below sill up to **EL. 784.0m.**

The following minimum sizes/ specifications have been observed:

Sill beam	:	ISMB-300
Seal seats	:	Stainless steel 150mm wide x 25mm thick for bottom, 250mm high x 10mm thick for top and 100mm wide x 10mm thick for sides. **(Machine finished surface)**
Track	:	corrosion resistant steel 200mm x 20mm **(Machine finished surface)**
Side guides	:	Min. 45kg/m weight crane rail section/150mm x 40mm thick flat
Anchor rods/studs	:	16mm dia. MS rod J or U

Erection supports shall be suitably braced so that activities like chipping/ denting of 1st stage concreting, opening out of bent dowels & 2nd stage concreting operation does not in any way affect the alignment.

Dogging shall be provided at **EL.784.00m** to hold the gate in suspended vertical position above the gate groove for allowing its inspection, maintenance and repairs as well as normal storage while not in use.

1.90.2 Design consideration and operation requirements

The gate and embedded parts shall be designed in accordance with the provisions of the latest edition of IS: 4622 in general and in accordance with the provisions specified in these specifications in particular. While designing the skin plate, corrosion allowance of 1.5 mm should be considered. **A factor of safety of 1.5 shall be considered on the static capacity of bearings while selecting bearings.**

Khorlochhu Hydro Power Ltd.

The gate and its connected equipment including all embedded parts shall be designed corresponding to Maximum tail water level EL.768.00m against the normal allowable stresses. Earthquake effects shall also be considered and allowed in the design as per stipulations in accordance with IS: 1893. The maximum deflection of the gate shall be limited to span/800 (i.e. c/c of wheels).

The gate shall usually remain in dogged position in the groove. The gate shall be designed for lowering under unbalanced head condition corresponding to tail water level EL.768.0m (In case of emergency) and raising under balance head condition only. The balancing of the gate shall be created by filling in valve operation.

Not less than 8 mm thick steel air vent pipe of 300mm dia. shall be provided in first stage concrete at the upstream side of each tailrace tunnel gate groove for escape of air during filling operation.

The gate shall satisfy the following requirements:

a) The gates shall be required to be operated (open or closed) at a speed of 0.5m/min± 5%,

b) In closed position, the gate shall be completely watertight with full water pressure acting from downstream side and sealing must be reliable against water level up to EL 780.0m,

c) The gate and its accessories shall be so designed that the stresses in different members due to operation of the gate and static loads in the closed position do not exceed the permissible stresses specified,

d) The following loads shall be considered:

e) Full hydrostatic water thrust with water at EL. 780.0 m.

   i) Dead weight of the gate and its attachments.

   ii) Hoisting forces.

   iii) Earthquake forces.

1.91 Tail Race Gantry Crane

One (1) number electrically operated dedicated traveling gantry crane complete in all respect shall be provided specifically for handling all four (4) TRT gates with an automatic lifting beam and complete with rail track with necessary end stops and anchors. The crane shall consist of gantry frames with traveling mechanism with machine house, hoisting and traveling equipment and cable reeling drum, operator's cabin, rail safety clamps, controls, limit switches, wire ropes, outside lighting and all other necessary components for its safe, proper and efficient operation. The gantry frames shall be of welded construction, except that the high-tensile friction grip and/or fit bolts shall be used for all field connections.

The gantry crane shall be mounted on flat-bottomed rails at **EL.784.0m** and shall have sufficient length for the crane to cover all four TRT gates opening. It is proposed that the crane shall be parked on either abutment when not in use. The rails shall be provided complete with all holding down bolts, fishplates, separators, stops, etc., and should have suitable gap near expansion joints in the concrete if any. On upstream and on all the bays on downstream side the rails shall be laid on the concrete. **Limit switches shall also be placed along the track so that the gantry may be accurately positioned over the openings**. A load plate showing the safe working load shall be fixed to the crane in a position to be easily legible from the operating level.

The capacity shall be adequate for the operation of the TRT gate at worst loading condition. Electrical power for traveling and hoisting motions is provided through a traveling cable reeling drum arrangement. The operation of gantry crane shall be from an enclosed cabin with maximum unrestricted view. The gantry shall be provided with necessary brakes (viz.

Khorlochhu Hydro Power Ltd.

D.C. electromagnetic brakes, as well as thruster brakes), overload protection/slack rope prevention device (i.e. load cell type/spring actuated type etc.) for hoisting motion, interlock devices, limit switches for extreme position of hoist, long travel, cross travel as well as centering the crane at the centre line of each bay. All drives and hoist gearing will be fully enclosed and housed as appropriate. Additional inching controls shall be provided on the long travel (LT) drives.

The design of various components of the crane shall be done in accordance with the provisions of Indian Standard specification IS: 3177 and IS: 807. Where the provisions of Indian Standard Codes conflict with the provisions of these specifications the provisions of these specifications shall govern.

The general arrangement of crane as shown in the drawing No. **KHPP-HM-TRT-GA-6021**

The mechanical parts of the hoist shall be designed for the specific loads with a factor of safety of five based on the ultimate strength of the materials. Under breakdown torque condition of the motor, stress in any portion of the hoist, hoist-bridge & trestles shall not exceed 80% of the yield point of the materials. The breakdown torque of the motor shall not be less than 225% of full load torque. The component shall be designed as per actual BDT of the motor. The rope shall have a factor of safety of six for normal conditions and of 3 for breakdown torque condition. Due to arrangement of equalizer the design load on the hoisting rope on each side of the gate shall be considered as 50% of the total hoisting load. The hoist mechanism shall be covered by suitable cover frames to protect it from dust, dirt and direct exposure to moisture. Provision shall be made for overload protection/slack rope prevention device (i.e. load cell type/spring actuated type etc.) for hoisting motion, limit switches, control panels, staircase to hoist platform, chequered plates/gratings, guard railings etc.

The Gantry Crane shall be equipped with a lighting system as follows:

- 400 W industrial LED lamps for gantry travel “headlights,” one on each side illuminating the rails ahead of the gantry,
- Two (2) 400 W Industrial LED lamps for proper illumination of the working area of the stop log grooves,
- Sufficient LED lighting to properly illuminate the operator’s cabin, Hoist Bridge, access ladders and walkways,

1.91.1 Characteristics

The crane will have the following characteristics:

i) Class of crane : Class-II as per IS: 807 & M5 as per IS: 3177 outdoor electrically operated with rope drum hoist.

ii) Rated Capacity : As computed but not less than 20T

iii) Centre to centre of track : 4.0m (tentative)

iv) Minimum wheel base of crane : 7.0m. (Tentative)

v) Total length of rail track : 130.0m (approx.).

vi) Operating speeds (Loaded)

Hoist : 0.5 m/min± 5%

Long travel : 8 m/min± 10% with inching facility having 10% of normal speed

vii) Minimum headroom over the deck : 7.0m

viii) Electrical details:

a) Power supply:

The power supply and terminal points shall be as defined in the General Technical Specifications.

b) Control: Controls in operator's cabin.

c) Drives:

- **Hoist Drive**: thyristors-controlled motor, with D.C. Electromagnetic brake and thruster type brake, with limit switches for extreme positions of hook and for filling-in-valves opening position of the gate.
- **Long travel**: thyristors-controlled motors with D.C. electromagnetic brake as well as thruster brake, connected to at least one driving wheel on each side of end carriage, through gearing and shafting having synchronized operation having limit switches for extreme position of travel and corresponding to center of each span with supply through cable reel.

  Suitable interlocks in control circuit shall be provided to prevent accidental hoist operation or LT motion when the transverse drive is under operation. The supply to trolley shall be through a festoon type trailing cable supported on suitable wire with movable hook.

d) A digital indicator shall be fitted in the operator's cabin for hoisting operation to show the position of lifting beam hooks. This indicator shall indicate the length of lowering of the lifting beam hooks with an overall accuracy of ± 20mm and shall register zero with the lifting beam hook in the top position.

e) Interlocks: In addition to usual protective gear the following interlocks shall be provided:

Interlock in LT Drives to prevent long travel unless the hook is in its highest position.

Hoist capacity: The hoist capacity of Gantry crane for operating TRT gates shall be computed for dead weight of gates, dead weight of lifting beam and its attachments. **Frictional forces due to 0.30m differential head on gate shall be considered. A reserve of 20% over and above the computed value shall be provided however, it shall not be less than 20T.**

Interlocking: Suitable interlocking shall be provided between tailrace tunnel gates & turbines to disallow the turbine operation until the gates are in fully open condition.

1.91.2 Main data

Type of gate	:	Wheel Type
No. of gates	:	2 nos.
Size of gate (clear opening)	:	4.0 m x 4.5m
Sill of the gate	:	764.65m
Maximum Tail Water level	:	768.00m
Skin plate	:	Upstream side (Tail Race side)
Sealing	:	Upstream side (Tail Race Side)
Operation	:	Balanced head
Hoist	:	Gantry Crane with lifting beam automatic engaging & disengaging
Hoist capacity	:	Not less than **20T**

Khorlochhu Hydro Power Ltd.

22. TRT Outfall Gate and Hoist

1.92 TRT Outfall Gate

One (1) number fixed wheel type gate for opening size **6.5m (w) x 6.5m (h)** shall be provided at outlet of the tailrace tunnel for inspection and maintenance of the tunnel. The gate shall also be used to close the tailrace tunnel in case of heavy flood, when the powerhouse is shut down so as to prevent entry of silt into the tunnel. The gate shall be designed to close under its own weight under balance head condition and shall be lifted under balanced head condition created by crack opening of gate against normal Tail water level i.e. **768.00m**. The gate shall be of structural steel construction having skin plate and sealing both on the riverside.

The gate shall be fabricated in **two (2)** units, which shall be connected at site to make it a single piece. These units shall be properly jointed to ensure water tightness. The gate shall be provided with horizontal girders and vertical stiffeners, side guide roller assemblies, lifting lugs, etc. The gate shall be operated by means of electrically operated rope drum hoist of capacity not less than **60T** located on the hoist platform installed over trestles at deck level **EL 768.506m**. Before raising, the balancing of water pressure shall be achieved by crack opening of gate by about 150mm against normal TWL **EL 768m.** Sufficient pre-compression on the rubber seals shall be provided so that the gate is watertight to have a dry pit when the machine is under repair/maintenance.

All equipment, wherever applicable, shall include provisions for safe isolation, locking, and tagging of hazardous energy sources—such as electrical, mechanical, hydraulic, pneumatic, thermal, and stored energy. The systems must be capable of being secured in a fully de-energized and inoperable state during maintenance activities. The vendor shall ensure that all equipment supplied is designed, fabricated, and delivered with complete LOTO provisions, in accordance with applicable standards and best engineering practices

Interlocks between the tailrace outlet gate and the turbine units shall be provided so that starting of turbine unit cannot be achieved unless the gate is fully raised. General Arrangement of the gate shall be as indicated in **drawing no. KHPP-HM-TRT-GA-6021**

1.92.1 Embedded Parts

One (1) set of fabricated steel embedded parts for opening of **6.5m(W) x 6.5m(H)** comprising sill, side and top (lintel) members with side guides extending up to operating deck, dogging devices etc. all suitable for a fixed wheel gate of upstream sealing type shall be provided. The main members shall be provided with wheel path & backing frames suitable for transmitting the load to civil structures. Wheel track shall be provided at least 0.5m above lintel level. First stage inserts (anchors with plates) shall be embedded in first stage concrete for providing suitable reference for erection of second stage embedded parts. Anchors with double nuts and washers shall be provided for aligning the second stage embedded parts.

Erection supports shall be suitably braced so that activities like chipping/denting of 1ststage concreting, opening out of bent dowels/installation of dowels in second stage in threaded head of first stage dowels & 2nd stage concreting operation doesn't in any way affect the alignment.

The track base shall be extended below the sill as per parabolic load distribution and the extension below the sill shall not be less than 300mm.

The embedded parts shall be provided up to following extents: -

- Roller Tracks from 300mm below sill up to **768.506m,**
- Side guides from 300mm below sill up to deck level i.e.**768.506m,**

- Dogging device/holding arrangement above deck level.

Suitable dogging/holding arrangement to hold the gate in suspended vertical position above the gate groove shall be provided for allowing its inspection, maintenance, and repairs as well as normal storage while not in use.

The following minimum sizes/ specifications shall be observed:

Sill beam	:	ISMB-300 or equivalent built up section
Seal seats	:	Stainless steel 160mm wide x 10mm thick for bottom, 275mm wide x 10mm thick with top 25mm chamfered for top and 100mm wide x 10mm thick for sides (**Machine finished surface)**
Track	:	corrosion resistant steel 200mm x 20mm **(Machine finished surface)**
Side guides	:	Min. 45kg/m weight crane rail section/150mm x 40mm thick flat
Anchor rods/studs	:	16mm dia. J or U type spacing not more than 600mm c/c.

1.92.2 Design consideration and operation requirements

The gate shall be designed in accordance with the provision of latest edition of IS: 4622 in general & in accordance with provisions specified in these specifications in particular. While designing the skin plate, corrosion allowance of 1.5 mm should be considered. **A factor of safety of 1.5 shall be considered on the static capacity of bearings while selecting bearings.**

The gate and its connected equipment including all embedded parts shall be designed corresponding to normal tail water level of EL 768.00m against the normal allowable stresses.

The gates shall be self-closing under flowing water corresponding to **TWL 768.00m**. The gate shall be designed to close under its own weight with a safety margin of 20% over all resisting forces including friction and uplift forces occurring during closure but excluding the down pull forces occurring during closure. For the above purpose ballast may be added if required. The lifting of the gate shall be under balanced head condition achieved by crack opening of the gate by about 150mm against upstream head corresponding to FRL.

The gates shall satisfy the following requirements:

a) The gates shall be required to be operated (open or closed) at a speed of 0.5m/min± 5%,

b) In closed position, the gates must be completely watertight with full pressure acting from upstream side and sealing must be reliable against water level up to EL 768.00m,

c) The gates and its accessories shall be so designed that the stresses in different members due to dynamic loads during closing and opening operations and static loads in the closed position do not exceed the permissible stresses specified,

d) The sealing arrangement of the wheel assemblies should be suitable to prevent entry of water and silt into the wheel bearings to ensure trouble free operation.

1.93 Rope Drum Hoist for TRT Outfall Gate

The gate shall be operated by independent rope drum type hoist. The operating equipment shall comprise of electrically operated motor to drive the rope drums through gearing, couplings. Hoist mechanism shall include ropes & attachments, intermediate shafting, Plummer blocks, electromagnetic brake as well as thruster brake, emergency hand operation system with clutch type engaging/disengaging arrangement, rope slackening and overload

Khorlochhu Hydro Power Ltd.

protection device, limit switches, sheaves, dial type position indicator, electrical control panels including initiating contacts, contactors, safety provisions along with necessary cables etc. and any other mechanical or electrical component / attachment considered necessary for proper assembly and operation of the hoist.

The rope drum assembly units and reduction units shall have minimum 3mm thick MS sheet covers with flat/angle iron framework to protect it from dust, dirt and direct exposure to moisture. The rotary type of double acting limit switch shall be provided for automatically and positively stopping the drive motor during hoisting/lowering of the gate as soon as either end of the gate travel is reached. A manual/ electrical interlock shall be provided in control circuit to cutoff power supply to motor, while operating manual drive. Protective device to automatically brake the hoist in case of power failure during operation shall be provided. On resumption of power supply the hoist shall start operation by pressing either `close' or `open' push buttons.

Provision shall be made for normal maintenance and repairs of hoist without disconnecting rope from hoist drum and with gate resting on sill (fully closed). Provision shall be made for ladder, walkway, lighting and other necessary arrangements at hoist platform, checkered plates/gratings, guard railings etc. The top of hoist platform shall be so located as to raise the gate above deck level by at least 500mm in maximum raised position

1.93.1 Design Criteria for Rope Drum Hoist

The hoists shall be designed in accordance with IS: 6938 for a rated capacity not less than **60T**. The gate shall be required to operate (for open or close) at a speed of 0.5m/min±5%.

The mechanical parts of the hoist shall be designed for the specific loads with a factor of safety of five based on the ultimate strength of the materials. The breakdown torque of the motor shall be taken as 225 % of rated load torque. The rope shall have a factor of safety of 6 for normal conditions and of 3 for breakdown torque condition. The hoist components shall be checked under BDT condition of the motor.

1.93.2 Hoist Supporting Structure

One no. hoist supporting structure for accommodating the rope drum hoist of tail race outfall gate is envisaged. The hoist machinery shall be mounted on a structural steel hoist platform over structural steel columns. Maintenance niche shall be provided at about 5m below the deck level i.e. at **EL 768.506m** (approx.) for carrying out the maintenance of gate.

Earthquake effects shall also be considered and allowed in the design as per stipulations in accordance with IS: 1893. The design shall be checked for additional forces due to horizontal and vertical earthquake acceleration of 0.24g and **0.16g** respectively with increased stresses as per clause 2.4.3 of General technical specifications. Earthquake condition and maximum wind load shall not be assumed to occur simultaneously.

Staircase shall be provided to approach the hoist. The hoist bridge shall be fabricated of structural steel members adequately braced and stiffened. This shall be securely attached to the structural steel column. The mounting of hoist platform with the structural steel column should have one end fixed and one end free to take care of any thermal expansion/contraction of the platform.

The bridge shall be covered with checkered plates and gratings. The checkered plate shall be minimum 6mm size. The grating shall not have opened more than 50mm x 50mm. At the junction of checkered plate and grating no step shall be formed and it should be flush with each other. The platform shall be securely fenced with double-tiered guardrails and shall be of sufficient width to enable normal maintenance work to be undertaken safely. The hand railing shall be 1.0m high made from pipe (32 NB medium duty) with suitable spaced vertical posts.

Khorlochhu Hydro Power Ltd.

Hoist trestles and its supporting structure including first stage embedment, shall be designed for specified hoist capacity and the loads arising out of different operating conditions of the gate combined appropriately with normal wind/ storm wind, earth quake loads, using appropriate allowable stresses in accordance with IS: 800. The hoist supporting structure shall be checked for BDT condition of the hoist motor.

Main Data

No. of gates	:	1 (One)
Size of gates (clear opening)	:	6.5m (W) x 6.5m (H)
Sill elevation	:	761.00m
Max. TWL	:	768.00m
Hoist	:	Rope drum hoist
Skin plate	:	Upstream (River side)
Sealing	:	Upstream (River side)
Hoist capacity	:	Not less than 60T

Interlocking: Suitable interlocking shall be provided between tailrace tunnel gates & turbines to disallow the turbine operation until the gates are in fully open condition.

23. Adit Inspection Gates

1.94 Gates

Hinged type gates of opening sizes of **2.5m wide x 2.5m high** shall be provided in the concrete plug at construction Adit nos. 2 and 5 respectively to give access to the head race tunnel in the event of any inspection, repair and maintenance in future. The gates will be operated manually. It shall be provided with skin plate on the tunnel side and seals on the Adit side. The gate shall be hinged to the gate frame embedded in concrete. The gate shall be provided with machined bearing blocks to transfer the water load to the civil structure through embedded parts. For sealing purpose suitable shaped seals shall be provided on the gate frame all around the periphery which shall bear against stainless steel embedded parts fixed in the concrete. The gate shall be held in position by fastening the bolts provided on the gate to the embedded frame from Adit end. Stainless steel piping of suitable size along with two number gate valves shall be provided in the bottom portion of the gate for dewatering purpose in all the Adit gates. A pressure gauge shall also be provided for measuring water pressure inside the HRT.

The gate, embedded parts and associated components shall be designed for Reservoir water level of 1572.0m at normal allowable stresses as given in General Technical Specifications. The gate and all related components shall be checked for maximum surge level water head corresponding to EL.1648.00m for Adit-5 with increased stresses as given in General Technical Specifications.

All equipment, wherever applicable, shall include provisions for safe isolation, locking, and tagging of hazardous energy sources—such as electrical, mechanical, hydraulic, pneumatic, thermal, and stored energy. The systems must be capable of being secured in a fully de-energized and inoperable state during maintenance activities. The vendor shall ensure that all equipment supplied is designed, fabricated, and delivered with complete LOTO provisions, in accordance with applicable standards and best engineering practices

General arrangement of gate shall be as shown on drawing No.**KHPP-HM-HRT-GA-6017**

1.94.1 Embedded parts

Fabricated steel embedded parts shall be provided for the opening of 2.5 m x 2.5m at Adit-2 & 5 for transferring the water load from gate to the civil structure and for sealing the gate

against water pressure. The corrosion resistant track frame shall bear against the machined bearing blocks provided on the gate to transfer the water load and against rubber seals fixed on the gate frame. Suitable embedded parts shall be provided for fixing Hinges to the gate on one side of the gate as indicated on the specification drawing. Embedded parts shall also be provided for locking of the gate at suitable location on the Adit side.

Main data

Type of gate	:	Hinged type
Clear opening	:	2.5m
Clear height of opening	:	2.5m
No. of gates	:	2 (At adit-2 and 5)
Invert level at HRT (Adit-2)	:	1506.41m
Invert level at HRT (Adit-5)	:	1480.00m
FRL	:	1572.0m.
Maximum Surge Level		
For Adit 5	:	1648.00m

24. Pressure Shaft Liners/Penstock and Steel Liner in HRT

1.95 Details of Pressure Shaft Liner/Penstock

The steel lined pressure shaft shall be fabricated and installed as per general layout drawing no. **KHPP-HM-PS-GA-6020 Sheet 1of 2 & 2 of 2**. However, the final layout and details shall be decided at the time of detail design. Detailed design/drawings for below sr. no. i) to sr. no. xxix) shall be provided by employers. Design/drawings of sr. no. xxx) (inspection trolley) shall be provided by bidder. The various items involved in the scope of work mentioned herein shall generally consist of the following but not necessarily be restricted to:

i) **Two (2)** numbers Steel transition from 2.75m x 5.2m rectangular section to 3.3m circular in 3.30m length starting from the just d/s of surge shaft gate (starting from surge shaft gate grove) as per Pressure shaft liner drawing and specifications.

ii) **Two (2)** numbers not less than 8 mm thick steel air vent pipes of diameter 300mm shall be provided on the top of transition liners for escape of air during filling of pressure shaft (i.e. this air vent pipes are already included with surge shaft gates).

iii) **Two (2)** numbers 3.3m diameter circular steel liner in the upper horizontal portion including 20m radius upper horizontal bends between surge shaft transition and the butterfly valve in the valve house. The limit of penstock manufacturer is mentioned in the drawing.

iv) Drain connection with flange in the invert of each straight piece of dia. 3.3m in the top horizontal portion to connect drainpipe of 200 mm upstream of butterfly valve to cater normal pressure of 10 bars. Location shall be finalized at the time of detailed design.

v) Two (2) numbers 3.3m diameter circular steel liner in the upper horizontal portion from downstream of the dismantling joint of the butterfly valve in the valve house up to upper vertical bend.

vi) 16.5m mean radius Upper steel vertical Bend UVB1 (2 sets) and internal diameter 3.3 m at C/L elevation EL.1481.65.

vii) Manhole (2 sets) of internal diameter 800mm at upper vertical bends with manhole cover, gasket, bolts and nuts etc. at EL.1481.65.

Khorlochhu Hydro Power Ltd.

viii) Pressure shaft steel liner (2 sets) in upper vertical shaft having an internal diameter of 3.3m from C/L elevation EL. 1481.65 m to C/L EL. 1230.00 m with lower vertical Bend LVB1 (2 sets) of mean radius 16.5m and internal diameter 3.3m as per drawing and specifications.

ix) Two sets. 3.3m diameter circular steel liner in the upper intermediate horizontal portion approx. 117.0m length at C/L EL. 1230.00 m.

x) 16.5m mean radius Upper intermediate steel vertical Bend UVB2 (2 sets) and internal diameter 3.3 m at C/L elevation EL.1230.00 m.

xi) Manhole (2 sets) of internal diameter 800mm with manhole cover, gasket, bolts and nuts etc. at EL.1230.00 m.

xii) Pressure shaft steel liner (2 sets) in intermediate vertical shaft having an internal diameter of 3.3m from C/L elevation EL. 1230.00 m to C/L EL. 980.00 m with lower vertical Bend LVB2 (2 sets) of mean radius 16.5m and internal diameter 3.3m as per drawing and specifications.

xiii) Two sets. 3.3m diameter circular steel liner in the lower intermediate horizontal portion approx. 217.0m length at C/L EL 980.0 m.

xiv) 16.5m mean radius Lower intermediate steel vertical Bend UVB3 (2 sets) and internal diameter 3.3 m at C/L elevation EL.980.00 m.

xv) Manhole (2 sets) of internal diameter 800mm with manhole cover, gasket, bolts and nuts etc. at EL.980.00 m.

xvi) Pressure shaft steel liner (2 sets) in lower vertical shaft having an internal diameter of 3.3m from C/L elevation EL. 980.00 m to C/L EL. 772.50 m with lower vertical Bend LVB3 (2 sets) of mean radius 16.5m and internal diameter 3.3m as per drawing and specifications.

xvii) Pressure shaft steel liner (2 sets) in horizontal shaft having an internal diameter of 3.3m at elevation EL.772.5m approx. **382.14 m** length upto bifurcation as per drawing and specifications.

xviii) Bifurcation (2 sets) with inlet diameter 3.3m bifurcating into branches of 2.35m diameter as per drawing and specifications with angle of bifurcation **80 deg** as shown in the drawing. The angle of bifurcation may undergo a change if so required, during the detailed design.

xix) **2.35m** Pressure shaft steel liners (4 sets) of length about **185.026m** (approx.) including Lower horizontal bends LHB-1 (2 sets) and LHB-2 (2 sets) of mean radius 12m after bifurcation up to the starting of transition in MIV valve .

xx) Anchor rings/ Thrust rings at suitable locations on the u/s of MIV details shall be finalized by contractor during detailed design with taken care of movement of MIV of ± 10mm due to expansion/contraction/transition. No grout holes shall be provided in the reach downstream of the thrust collar.

xxi) Extra piece of 2.35m diameter of length 200mm (approx.) for joining each horizontal portion of the penstock to reducer cone of MIV supplied by others in the power house.

xxii) Extra piece of 3.30m diameter of length 200mm (approx.) (2nos.) for joining horizontal portion of pressure shaft up stream & downstream of each butterfly valve in the valve house.

xxiii) Drain connection with flange in the invert of each straight piece of dia. 2.35m in the bottom horizontal portion to connect drainpipe of 200 mm to cater normal pressure of 74 bars. Location shall be finalized at the time of detailed design.

xxiv) Provision & locations of piezometric connection and drain holes etc. in each pressure shaft details shall finalized at detailed design stage.

xxv) Surface preparation, painting, application of bond breaking coating etc. shall be provided as per specifications and design requirement.

xxvi) Non - destructive test on welds including Radiographic, ultrasonic, magnetic particle and liquid penetrant testing of welds etc.

xxvii) Butt strap wherever required, erection supports (temporary or permanent).

xxviii) Grouting, sleeves and filler plugs shall be provided in liners for grouting purpose as per specification. Numbers and spacing shall be finalized at the time of detailed design.

xxix) External stiffener ring in portion of penstock as applicable which shall be determined during detailed design calculations.

xxx) 1 nos of Inspection trolley for facilitating inspection of complete pressure shaft from within during maintenance needs. However, suitable winch with rope arrangements shall be fixed for all three Galleries in UBV1, UBV2 & UBV3.

Work by others:

i. Welding of steel liners with butterfly valve attachment in the valve house with conical reducer section of the inlet valve in power house.

ii. Providing and fixing of piezometers.

iii. Concreting around steel liners and grouting.

1.96 General requirements

It is envisaged that plates conforming to ASTM A537 Cl-2 (for upper portions) and ASTM A517 Gr. F or approved equivalent (for other portions) will be used and shall be 100% ultrasonically pre-tested and certified by steel manufacturer. As such the pressure shaft ferrules and bends need not be subjected to hydrostatic testing except the bifurcation piece, which shall undergo hydrostatic test at site. All areas of weld on which repairs have been carried out shall be examined 100 percent by the method specified for the original weld. It is intended that all shop and field fastenings shall be of welded type unless otherwise specified. The fabrication method would preferably be automatic welding at site. The fabricator must, have in his shop, satisfactory facility for plate bending edge preparation and end milling of members as advised by Engineer. Fabrication of steel work shall be at fabricators shop to be set up by the contractor in the project areas demarcated by employer. Contractor has to Shop fabrication of heavy parts and other specials, requiring precision finishing such as bends shall be done in regular workshop. The contractor shall arrange at his own cost the transport of such materials from site as well as fabricated materials from his shop to the project site. Any loss or damage in transit on account of this shall be to the contractor's account.

All equipment, wherever applicable, shall include provisions for safe isolation, locking, and tagging of hazardous energy sources—such as electrical, mechanical, hydraulic, pneumatic, thermal, and stored energy. The systems must be capable of being secured in a fully de-energized and inoperable state during maintenance activities. The vendor shall ensure that all equipment supplied is designed, fabricated, and delivered with complete LOTO provisions, in accordance with applicable standards and best engineering practices

1.97 Layout

The contractor shall complete all preliminary works at site well before the arrival of pressure shaft liner such as keeping in readiness of electrical winches, mobile cranes, jig poles, all tools and tackles, welding sets etc. As part of this contract, and any other work that may be necessary to start erection immediately after the fabrication. The Contractor shall arrange

Khorlochhu Hydro Power Ltd.

for such number of erection equipment, supervision, labor and other arrangements so as to carry out the work efficiently.

The contractor shall be solely responsible for correctness of laying penstocks. The checking and approval by the Engineer will not absolve the contractor from the responsibility of erecting the penstocks in true alignment. Establishing and maintaining temporary benchmarks and connecting to the permanent benchmarks by double leveling shall be the responsibility of the Contractor. No extra payment shall be made to them.

1.98 Specification & Standard

The item wise specifications are intended for the general description of quality, workmanship etc. desired for the items covered in the general technical specification and scope of work. Specifications are not however, intended to cover all the minute details and the work shall be executed in accordance with the spirit of the tender specifications. In the absence of specifications for any item of work it shall be executed as per relevant IS code (latest revision) IS: 2825 i.e. Indian Standard Code for Unfired Pressure vessels. In case neither of the above-mentioned specification and code are available for any particular item of work, the work shall be executed as per section VIII ASME Unfired Pressure Vessel code and ASTM Standards or as directed by the engineer. These specifications shall be read in conjunction with the description of the items in the schedule of items.

1.99 Design Criteria

1.99.1 Objectives

The Steel lining of Penstock shall be designed with the following objectives:

- Internal water pressure corresponding to maximum surge in the upstream surge shaft i.e. EL. 1648.00m or static head along with maximum normal water hammer pressure at turbine inlet whichever is higher.
- External water pressure either corresponding to normal reservoir level i.e.EL.1572.0m or the ground level vertically above the penstock i.e. invert level whichever is less.
- The linings shall be able to stop the leakage to powerhouse.

Thickness shall be calculated on the basis of tentative water hammer head. These may be slightly altered after finalization of water hammer head and distributor setting by the supplier of the equipment.

The alignment of penstock as shown in drawings have been based on the available topographical and geological data. It is likely that these may alter due to additional data and information obtained due to subsequent investigations. The changes as necessary will be communicated in reasonable time in writing to the contractor by the Engineer. These changes in lengths in the penstock courses and bend angles and/or numbers shall be carried out by the Contractor. No claim on this account will be entertained except when already manufactured pieces are altered.

1.99.2 Loads to be considered

Loads arising during installation and concreting of the liners, due to self-weight of shell weight of shell between support and due to buoyancy forces resulting when concrete is placed around the liners. Installation supports (permanent/ temporary) shall be designed for the same.

The following shall be considered in the design of Penstock steel lining. The pressure rise due to normal flow variation at turbine inlet shall be 15% (tentative) of the static head at turbine inlet.

a) Normal Condition

- Internal water pressure corresponding to maximum surge in the upstream surge shaft i.e. 1648.00m or static head along with maximum normal water hammer pressure at turbine inlet whichever is higher.
- External water pressure either corresponding to normal reservoir level i.e.EL.1572.0m or the ground level vertically above the penstock i.e. invert level whichever is less.
- Load induced due to temperature variation of water from 4°C to 21°C (Tentative & shall be confirmed during detail design).
- Poisons effect associated with radial expansion of liner under internal water pressure.

b) Intermittent condition

- Intermittent condition includes those during filling and draining of penstock.
- Internal water pressure corresponding to maximum surge in the upstream surge shaft i.e. EL 1648.00m with pressure rise during normal water hammer at turbine inlet. The internal pressure shall be assumed to be linearly varying between surge shaft and turbine inlet for the above water head.
- External water pressure either corresponding to normal reservoir level i.e. EL.1572.0m or the ground level vertically above the penstock i.e. invert level whichever is less.
- Load included due to temperature variation of water from 4°C to 21°C (Tentative & shall be confirmed during detail design).
- Poisons effect associated with radial expansion of liner under internal water pressure.

c) Emergency condition

- This condition includes partial gate closure in critical time of penstock (2L/seconds) at maximum rate, and the cushioning stroke being inoperative in one unit.

d) Exceptional condition

- The dynamic pressure rise due to needle slam on loss of oil pressure or mechanical failure. As the needles are hydraulically balanced at mid-point turbine flow cut off shall be taken as instantaneous.

e) Rock Participation

- The Liner thickness shall be dimensioned for maximum internal pressure without considering rock participation and external water pressure.
- The liner thickness shall be calculated for maximum external water pressure from Amstutz relations or the method suggested by Jacobson whichever is conservative. Clearance or gap to be assumed for design between pipe and concrete shall be 0.0003 of R approximately.

f) Minimum corrosion allowance shall be taken as 1.5mm.

g) Miter Bend

Deflection angle between each successive segment shall not be more than10°.Bends shall be designed with consideration given to the concentration of hoop tension stresses along the inside of the bend. Following formula shall be used to check the stresses.

$$t=P\ D\ (D/3\ \tan Ø/2 + S/2)/S\ f$$

Where t = required elbow wall thickness, cm

P = design pressure, kg/cm2
f = allowable tensile stresses at design pressure, kg/cm2,
D = outside diameter of elbow, cm
S = segment length along inside of elbow
Ø = segment deflection angle, degree

h) Handling Consideration

Minimum handling thickness shall be provided for the rigidity of the structure during fabrication and handling during erection:

$t_o = (R+0.25)/200$

Where t_o = minimum handling thickness in m, and
R = radius of penstock in m.

1.99.3 Submittals

The Contractor shall submit design & drawings and other technical data to the Engineer for approval, as detailed in clause no. 3.3 of GTS.

1.100 Materials

i) All materials incorporated in the Work shall be of first-class quality, free from defects and imperfections and, where shown, of the classifications and grades designated. Materials not specifically designated herein shall be suitable for the purpose intended and shall, as far as practicable, comply with the latest specifications of the American Society for Testing Materials (ASTM) and the ASME Boiler and Pressure Vessel Code Section VIII, Division 2 or equivalent European Standard.

ii) Plate material for liners, bends and penstocks & bifurcation shall be ASTM A537 Cl. 2 and of ASTM A517 Gr. F or approved equal.

iii) Material certification and testing shall be per ASTM A20 manual and ASME Boiler and Pressure Vessel Code Section VIII, Division 2 and with Supplementary requirements as in the following paragraphs of ASTM A 20:

- S5 Charpy-V-Notch toughness tests as per table no. A1.15 of A20 of ASTM manual in transverse direction of each plate.
- S14 On total 3 plates of Y.P > 345/ 690 Mpa steel material

One bend test as follows:

- One on plate with most frequently used wall thickness
- One on plate with maximum wall thickness
- One on plate with an intermediate wall thickness.
- S8 Ultrasonic examination as per ASTM A435.

Complete mills test reports are to be submitted with above certification showing results of all mandatory and supplementary requirements.

iv) Steel Tubes Certification: the Contractor shall provide a certificate for each steel pipe section as stipulated in this clause.

v) Steel material of the same quality (ASTM A537 class 2/ ASTM A517 Gr. F) or equal shall be purchased from one manufacturer only.

vi) All material used, fabricated and welded to the liners and penstocks, which 1are not particularly specified above, shall be compatible in respect to chemical, mechanical and welding properties as defined by ASME Code.

vii) Welding consumables shall be as per AWS Filler Metal specifications as recommended by the steel manufacturer. Only "Low hydrogen welding consumables" shall be used for welding. Consumables shall be baked when

Khorlochhu Hydro Power Ltd.

necessary, as recommended by the consumable manufacturer to moisture levels required by the steel manufacturer. FCAW electrodes and SAW flux electrode combinations shall be certified by the manufacturer to meet the diffusible hydrogen limits given below. Diffusible hydrogen shall be determined in accordance with AWS A 4.3-86.

Specified weld metal strength	Max. Hydrogen, ml/100 g
485 MPa (70,000 psi)	15
760 MPa (110,000 psi)	5

Welding electrodes shall be conformed to reputed make like ESAB, D & H and ADANI. No other electrode shall be used except the reputed make given above.

viii) Temporary and embedded supports for securing liners and penstocks during concreting shall be of good quality and suitable for the intended purpose. In addition, the same precautions shall be exercised when any attachment is welded to the steel liners.

1.101 Miscellaneous items Steel Liner (ASTM A53Cl 2.)-300m (HRT).

Khorlochhu Head race tunnel has to pass through a low cover zone at Chaplangchhu Stream crossing. Development of in-situ stresses due to internal pressure of HRT in the weak rock surrounding may result in some amount hydro fracturing or hydro jacking phenomena.

To prevent development of cracks due to high stresses in the rock near the surface generated due to internal pressure of tunnel and any leakage through these cracks a steel liner has been envisaged in this reach. A provision of **4.7m** diameter, **300 m** long, and not less than **18mm** thickness steel liner of **ASTM A537 Class II** in the low cover zone has been envisaged with suitable collar at both end. The steel liner has to be designed for a pressure of **100M** water head **(1Mpa)**. By provision of steel liner a large ratio of internal pressure will be borne by steel pipe thus stresses transferred to surrounding rock will be very minimal. This will result in reduced pore-water pressures in the rock mass surrounding the tunnel, thereby minimizing the potential for development of the hydro fracturing or hydro jacking phenomena.

The Contractor shall submit design & drawings and other technical data including method statement for fabrication & erection to the Engineer for approval prior to execution of the work.

1.102 Inspection trolley

The trolley shall be capable of being dismantled and taken through the minimum 800 mm Ø manhole and assembled inside the pressure shaft. Each trolley shall have a capacity to carry 5 tones load. The design shall be with a factor of safety as may be agreeable to the "Employer" design organization. The trolleys shall be duly equipped with suitable lifting hooks or sheaves. The trolleys shall have arrangement like brackets for mounting battery-operated flash lamp having sufficient charging port/facility, O2 mask arrangement with 2 x 2 hour Oxygen storage cylinder, wireless Night vision digital camera with high power inbuilt transmitter, LED colored high-end smart TV, Portable floodlight Torch, Fluorescent Die Penetration test kit with UVG handheld torch, maintenance toolkit and Wireless Radio Intercom with minimum 2 KM underground range supported with mounting arrangement. Digital camera shall have a high-power transmitter built inside the camera housing. Color live video can be sent wirelessly over a long-distance minimum 2 Km to the included receiver which can be connected to TV, DVR, monitor, computer and so forth for instant viewing or recording for subsequent viewing within suitable frequency band. Contractor shall prepare and submit detailed design and drawings of the inspection trolleys to the Engineer for necessary approval. The work shall be carried out as per approved design. The Contractor shall install and give trial operation test of trolleys upon completion of pressure shafts as may be directed by the Employer.

Khorlochhu Hydro Power Ltd.

25. Chaplangchhu Diversion Works

1.103 Trash Rack

1.103.1 Horizontal Trash Racks

The horizontal trash racks for an opening size of 3m x 24m (with slope 1.10 with horizontal) consists of suitable number interchangeable trash rack units each of suitable size. These trash rack units shall be placed in the trash rack recess over the trench weir with a clearance of about 5 mm in between each trash rack unit. Each panel shall be provided with 2 numbers ISMB 150 at 600mm C/C while the balance area is provided with MS plate/flat of size 70 x12 at a spacing of 50mm C/C. Rail section is to be provided over the ISMB 150 section. Boulders greater than 520mm size will thus be rolling over these rails. The trash rack bars shall be provided with 70 x 12mm x 1000mm plate at both the ends and are welded to these trash bars. In addition, 20 mm dia. rods shall be fixed laterally to these bars at suitable spacing as. Holes shall be provided in the ISMB 150 web at 600mm from each end of the panel for handling purposes.

1.103.2 Embedded Frame

Embedded frame to support the trash rack panels shall be provided on top edge of the trench weir forming recess. The frame comprises of 2 number ISA 110 X 110 x12, 2 4 m long angles at a distance of 200 mm from the trench face shall be embedded in concrete. 2 numbers built up sections made from 90 x 12 mm MS plate, 12m long shall be embedded at the edge of the trench recess to act as edge protection. The angle frame and the edge protection frame shall be provided with suitable rod anchors to secure it to the concrete. The recess serves to securely receive the trash rack panels to serve as horizontal trash rack inclined at 1:10 to fill the trench with water while segregating boulders/ materials greater than 36mm size which will get retained over the trash rack and roll down with flowing water into the river.

Basic Data

Type	removable made of steel sections and secured in metallic frame embedded in concrete.
Quantity	One (1) set in suitable numbers of interchangeable units.
Clear width	3.0 m (along the riverbed parallel to flow)
Length	24m approximately (along the river width Perpendicular to flow)
Inclination of the structure	10H: IV (along the riverbed parallel to flow)
Clear bar spacing	36 mm
Bar size	12 mm x 70 mm

1.104 Chaplangchhu Intake Gate & Hoist

1.104.1 Chaplangchhu Intake Gate

One number wheeled type Intake gate for opening size of **2.0 m x 2.5 m** is envisaged at Chaplangchhu diversion works. The gate is to be designed for a head of **6.0m.** The gate will have an upstream skin plate and upstream sealing. The skin plate is to be supported by horizontal girders, vertical stiffeners, end vertical girders, wheels etc. Wheel pins shall be provided with suitable eccentricity (minimum ± 5mm) between centers of wheels and holes in vertical girders to facilitate adjustment in wheel alignment to have proper contact with the roller path. The gate shall be able to transfer the load on either side of the groove through wheel track.

Khorlochhu Hydro Power Ltd.

All equipment, wherever applicable, shall include provisions for safe isolation, locking, and tagging of hazardous energy sources—such as electrical, mechanical, hydraulic, pneumatic, thermal, and stored energy. The systems must be capable of being secured in a fully de-energized and inoperable state during maintenance activities. The vendor shall ensure that all equipment supplied is designed, fabricated, and delivered with complete LOTO provisions, in accordance with applicable standards and best engineering practices

The gate shall be lifted under unbalanced head conditions against upstream water head of 6m. Gate shall be operated by means of a dedicated motorized screw hoist of capacity not less than **15 T** located on the hoist platform at deck level. Suitable lifting attachments shall be provided in the gate body for lifting the gate. Drain holes have been provided in the web of horizontal girder. General arrangement of gate and its hoisting system is shown in Drawing No. **KHPP- HM-CDW-GA-6030**

Following minimum sizes/specifications shall be observed:

Skin plate	:	10 mm structural steel
End Vertical Grider	:	10 mm structural steel
Bottom seal	:	20mm thick wedge type rubber seal (5mm pre-compression)
Side seals	:	14 mm thick stem music note type rubber seal 3mm pre compression)
Seal clamps	:	16 mm thick structural steel
Fasteners	:	16 mm dia. stainless steel
Seal bases	:	12 mm thick M.S (**Machine finished surface)**
Full depth vertical stiffeners	:	12 mm thick
Splice bolts	:	Friction grip/ Fit bolts

Design Consideration and Operation requirements

The gate and embedded parts shall be designed in accordance with the provisions of the latest edition of IS: 4622 in general and in accordance with the provisions specified in these specifications in particular. While designing the skin plate, corrosion allowance of 1.5 mm should be considered. The deflection of the gate members shall be limited to span/ 800.

The gate along with connected equipment shall be designed for design head of 6m with normal allowable stresses as per Clause 2.4.1 of General Technical Specifications.

Earthquake effects shall also be considered and allowed in the design as per stipulations in accordance with IS: 1893. The design shall be checked for additional forces due to horizontal and vertical earthquake acceleration of 0.24g and 0.16g respectively with allowable stresses as per clause 2.4.1(h) of General Technical Specifications.

The gate shall be operated (raised or lowered) under flowing water condition corresponding by motorized screw hoist provided at deck level.

The gate shall satisfy the following requirements:

a) In close position, the gate must be completely watertight.

b) The gate and its accessories shall be so designed that the stresses in different members due to dynamic loads during closing and opening operations and statics loads in the closed position do not exceed the specified permissible stresses.

1.104.2 Embedded Parts

One set of fabricated steel embedded parts for clear opening of gate **2.0m x 2.5m** comprising of bottom sill beam, side guides extending up to the deck, slide track & sealing track, etc. shall be provided. The embedded frames and anchors along with adequate sealing

Khorlochhu Hydro Power Ltd.

arrangement for the gate height have been provided. The main members shall be provided with track path and backing frames suitable for transmitting the load due to the water pressure to civil structure.

The embedded parts shall be provided up to following extents: -

- Tracks from 150mm below sill level up to one gate height above lintel level.
- Side guide from 150mm below sill level up to deck level.

Erection supports shall be suitably braced so that activities like chipping/denting of 1ststage concreting, opening out of bent dowels & 2nd stage concreting operation doesn't in any way affect the alignment.

The following minimum sizes/ specifications shall be observed:

Sill beam	:	ISMB-150
Wheel Track	:	Corrosion resistant steel 100mm x 10 mm **(Machine finished surface)**
Side & bottom seal seat	:	Stainless steel 100mm wide x 10 mm thick (Machine finished surface)
Side guides	:	50mm x 20 mm thick flat within gate groove and 100mm x 20mm above gate opening up to deck level
Groove Liners	:	Min. 10 mm thick
Anchor rods/studs	:	16mm dia. J or U type

1.104.3 Chaplangchhu Intake Motorized Screw Hoist

Chaplangchhu Intake gate shall be operated by motor operated screw hoist. The hoist shall be designed to perform the intended function in accordance with the requirements of IS: 11228 in general. The hoists shall be designed at a rated capacity (Min 15MT) capable to lift or close the gates under all eventualities for which the gate has been designed. The hoist capacity shall be calculated taking into consideration the worst combination of all frictional forces, hydrodynamic loads, dead weights, silt load, seating pressure, etc. during both raising and lowering cycles, plus a reserve capacity of 20% over and above the worst combination of forces.

All the motor screw hoist on addition to its components such as stem, nut, gears, shafts, key, bearings, coupling, gear boxes will also be equipped with gate position indicator and all the required electrical equipment. All the hoist equipment that are permanently or occasionally submerged in water or that might be exposed to splash water or humid weather, shall be adequate to resist without damage the acting water pressure and the corrosive and other effects of submergence and exposure.

All the electrical equipment shall be suitably protected from moisture, corrosion, etc. by providing weatherproof covers and electrical heaters, wherever necessary.

Manual hoisting arrangement with clutch type engaging/disengaging arrangements shall be provided for operation during power failure. Suitable interlocks shall be provided to prevent operation by electrical power when the manual drive is engaged.

1.104.4 Hoist supporting structure for Chaplangchhu Intake Gate

One (1) number hoist supporting structure accommodating the motorized screw of Chaplangchhu intake gate shall be provided. The hoist machinery for the gate shall be mounted on a structural steel hoist platform over structural steel columns at deck level.

Staircase shall be provided to approach the hoist. The hoist bridge shall be fabricated of structural steel members adequately braced and stiffened. These shall be securely attached to the structural steel column. The mounting of hoist platform with the structural steel

Khorlochhu Hydro Power Ltd.

column should have one end fixed and one end free to take care of any thermal expansion/contraction of the platform.

The bridge shall be covered with checkered plates and gratings. The checkered plate shall be minimum 6mm size. The grating shall not have opened more than 50mm x 50mm. At the junction of checkered plate and grating no step shall be formed and it should be flush with each other. The platform shall be securely fenced with double-tiered guardrails and shall be of sufficient width to enable normal maintenance work to be undertaken safely. The hand railing shall be 1.0m high made from pipe (32 NB medium duty) with suitable spaced vertical posts.

Hoist Bridge and its supporting structure including first stage embedment shall be designed for the worst combination of the forces encountered during any of the operations on the gates. Besides dead weight of machinery, guard railing, load due to hoisting of gate, a crowd load of (500 kg per meter sq.) wind load, seismic load etc. shall also be considered for the design of Hoist Bridge. Hoist bridge and its supporting structure shall be designed in accordance with the provision of IS: 800. All structural parts and hoisting equipment shall also have sufficient strength to resist the forces produced by the actual breakdown torque of the motors without exceeding 80% of yield point of materials.

Each screw hoist shall be equipped with a lighting system as follows:

- Two 400 W LED luminaries for proper illumination of the working area of the gate groove,
- Sufficient LED lighting to properly illuminate the Hoist Bridge, access ladders and walkways.

Main Data

- No. of gates : 1 (One)
- Size of gates (clear opening) : 2.0 m (W) x 2.5 m (H)
- Sill elevation : 1574.50 m
- HFL : 1580.50 m
- Design head : 6.0 m
- Hoist : Motorized screw hoist
- Skin plate : Upstream (River side)
- Sealing : Upstream (River side)
- Hoist capacity : Not less than 15T

1.105 Chaplangchhu Desilting Chamber Outlet Gate

1.105.1 Gate

One (1) number 1.8m x 2.1m (opening size) slide type Desilting chamber outlet gate with upstream skin plate and downstream sealing shall be provided in Chaplangchhu diversion complex downstream of desilting chamber to isolate the desilting chamber from HRT side for inspection and maintenance. The gate shall be provided with horizontal girders, vertical stiffeners, guide roller assemblies, bypass valve, dogging devices, slide block, bumpers etc. The gate is to be designed to withstand 4.05 m water head and for lowering under no flow condition and raising under balanced head condition. The gate shall be fitted with side seal elements on the downstream side of gate unit and bottom seal on the upstream which will be connected to the side seal provided on the downstream suitably. Suitable gate lifting sheaves/lugs shall be provided for connecting to the hoist. Full depth stiffeners shall be provided below the lifting sheaves/lugs for complete gate height. The gates shall be operated by means of independent motorized screw hoists of capacity as computed but not less than **15T**.

Khorlochhu Hydro Power Pvt. Ltd.

PTFE/ Fluorocarbon coated side and top rubber seals have been proposed in order to ensure self-lowering of gates against FRL condition and to reduce hoist capacity.

General arrangement of gate & hoist is as per drawing No.**KHPP- HM-CDW-GA-6032**

The following minimum sizes/specifications shall be observed:

Skin plate	:	10 mm structural steel
End Vertical girder	:	10 mm structural steel
Bottom seal	:	20mm thick wedge type rubber seal (5mm pre-compression)-PTFE/fluorocarbon cladded
Side seals	:	14 mm thick stem music note type rubber seal 3mm pre-compression – PTFE/fluorocarbon cladded
Seal clamps	:	16 mm thick structural steel
Fasteners	:	16 mm dia. stainless steel
Seal bases	:	12 mm thick structural steel **(Machine finished surface)**
Full depth vertical stiffeners	:	10 mm thick
Splice bolts	:	Friction grip/ Fit bolts

1.105.2 Embedded parts

One (1) set of fabricated steel embedded parts, for opening of **1.8m x 2.1m**, comprising of sill, side members with side guides extending up to the deck, slide tracks and suitable dogging arrangement, all suitable for slide type gate with downstream sealing. The main members shall be provided with sliding path suitable for transmitting the load developed from the upstream head to the civil structures. The dogging devices are to be provided on top of gate grooves.

Suitable dogging/ holding arrangement to hold the gate in suspended vertical position above the gate groove shall be provided for allowing its inspection, maintenance and repairs as well as normal storage while not in use.

Following minimum sizes/specifications shall be observed:

Sill beam	:	ISMB-150
Wheel Track	:	Corrosion resistant steel 100 mm x 10 m**m (Machine finished surface)**
Side & bottom seal seat	:	Stainless steel 100 mm wide x 10 mm thick **(Machine finished surface)**
Side guides	:	50 mm x 20 mm thick flat within gate groove and 100 mm x 20 mm above gate opening up to deck level
Groove Liners	:	Min. 10 mm thick
Anchor rods/studs	:	16 mm dia. J or U type

Design Consideration and Operation requirements

The gate and embedded parts shall be designed in accordance with the provisions of the latest edition of IS: 5620 in general and in accordance with the provisions specified in these specifications in particular. While designing the skin plate, corrosion allowance of 1.5 mm should be considered. This gate shall be operated under balanced head achieved through bypass valve provided in the gate body. The deflection of the gate members shall be limited to span/ 800.

The gate along with connected equipment shall be designed for water head of 4.05 m with normal allowable stresses as per Clause 2.4.1 of General Technical Specifications.

Khorlochhu Hydro Power Ltd.

The gates shall usually remain in raised position above the groove. Two numbers of side guide rollers shall be provided on each side to restrict lateral movement of gate. The gate shall be lowered under no flow condition and raising under balance head condition.

The gate shall satisfy the following requirements:

a) In closed position, the gates shall be completely watertight.

b) The gates and its accessories shall be so designed that the stresses in different members due to operation of the gate and static loads in the closed position do not exceed the permissible stresses specified.

c) The gate shall be operated at a speed of 0.5m/min± 5%.

d) The following loads shall be considered:

   i) Full hydrostatic water thrust with u/s water head of 4.05 m,

   ii) Dead weight of the gate and hoist,

   iii) Hoisting forces,

   iv) Wind and Earthquake forces.

1.105.3 Chaplangchhu Desilting Chamber Outlet Gate Hoist

This gate shall be operated by motor operated screw hoist. The hoist shall be designed to perform the intended function in accordance with the requirements of IS: 11228 in general. The hoists shall be designed at a rated capacity (Min 15MT) capable to lift or close the gates under all eventualities for which the gate has been designed. The hoist capacity shall be calculated taking into consideration the worst combination of all frictional forces, hydrodynamic loads, dead weights, silt load, seating pressure, etc. during both raising and lowering cycles, plus a reserve capacity of 20% over and above the worst combination of forces.

All the motor screw hoist on addition to its components such as stem, nut, gears, shafts, key, bearings, coupling, gear boxes will also be equipped with gate position indicator and all the required electrical equipment. All the hoist equipment that are permanently or occasionally submerged in water or that might be exposed to splash water or humid weather, shall be adequate to resist without damage the acting water pressure and the corrosive and other effects of submergence and exposure.

All the electrical equipment shall be suitably protected from moisture, corrosion, etc. by providing weatherproof covers and electrical heaters, wherever necessary.

Manual hoisting arrangement with clutch type engaging/disengaging arrangements shall be provided for operation during power failure. Suitable interlocks shall be provided to prevent operation by electrical power when the manual drive is engaged.

1.105.4 Hoist supporting structure for Chaplangchhu Desilting Chamber Outlet Gates

One (1) number hoist supporting structure accommodating the screw hoist of Chaplangchhu Desilting chamber outlet gate shall be provided. The hoist machinery for the gate shall be mounted on a structural steel hoist platform over structural steel columns at gate operation chamber.

Staircase shall be provided to approach the hoist. The hoist bridge shall be fabricated of structural steel members adequately braced and stiffened. These shall be securely attached to the structural steel column. The mounting of hoist platform with the structural steel column should have one end fixed and one end free to take care of any thermal expansion/contraction of the platform.

The bridge shall be covered with checkered plates and gratings. The checkered plate shall be minimum 6mm size. The grating shall not have opened more than 50mm x 50mm. At the junction of checkered plate and grating no step shall be formed and it should be flush

Khorlochhu Hydro Power Ltd.

with each other. The platform shall be securely fenced with double-tiered guardrails and shall be of sufficient width to enable normal maintenance work to be undertaken safely. The hand railing shall be 1.0m high made from pipe (32 NB medium duty) with suitable spaced vertical posts.

Hoist Bridge and its supporting structure including first stage embedment shall be designed for the worst combination of the forces encountered during any of the operations on the gates. Besides dead weight of machinery, guard railing, load due to hoisting of gate, a crowd load of (500 kg per meter sq.) wind load, seismic load etc. shall also be considered for the design of Hoist Bridge. Hoist bridge and its supporting structure shall be designed in accordance with the provision of IS: 800. All structural parts and hoisting equipment shall also have sufficient strength to resist the forces produced by the actual breakdown torque of the motors without exceeding 80% of yield point of materials.

Each motorized screw hoist shall be equipped with a lighting system as follows:

- Two 400 W LED Luminaries for proper illumination of the working area of the gate groove,
- Sufficient LED lighting to properly illuminate the Hoist Bridge, access ladders and walkways,

1.106 Chaplangchhu Silt Flushing Tunnel Gate

1.106.1 Gate

One (1) set of Silt flushing tunnel sliding type gate having a clear opening of **0.6m (wide) x 0.6 m** (high) with sill elevation at about **1568.15m** have been proposed. The gate consists of upstream skin plate and upstream sealing. It is provided with horizontal girders, vertical stiffeners and end vertical plates. The gate is to be designed to withstand and seal against full upstream reservoir head. Silt loads up to one gate height shall be considered. Special care shall be taken for the wear resistance of the gate structure. Bottom seal and gate parts must be designed for high abrasion due to silt movement. **The bidder may propose high strength/abrasion resistant material for gate and liners to take care of wear/abrasion likely to take place due to high flow velocities and silt content in the flow**. The gates are proposed to be operated by means of hydraulic hoists provided at silt flushing gate operation gallery.

The gate shall be provided with bottom seal, side seals and lintel seal on the upstream side of the unit. The gate shall be provided with suitable bearing block assemblies and guide shoe. Suitable lifting lugs and dogging arrangement shall be provided to hold the gates in position for maintenance purpose. The bottom most girders of the gates shall be suitably located and designed to have best hydraulic performance for the operating conditions as envisaged for the gates. The d/s flange of the bottom most girders shall remain clear of water profile under all gate-opening positions.

General arrangement of gates shall be as shown in drawing no **KHPP-HM-CDW-GA-6033.**

Following minimum sizes / specifications shall be observed:

Skin plate	:	20 mm structural steel cladded with stainless steel.
End Vertical girder	:	25 mm structural steel
Bottom seal	:	20mm thick wedge type rubber seal (5mm pre-compression)
Side seals	:	14 mm thick stem music note type rubber seal 3mm pre-compression

Top seals	:	14 mm thick stem double stem type rubber seal 3 mm pre- compression.
Seal clamps	:	16 mm thick structural steel
Fasteners	:	16 mm dia. stainless steel, spacing not more than 5 times the dia. of fasteners.
Seal bases	:	12 mm thick structural steel **(Machine finished surface)**
Steel liners	:	10 mm thick
Splice bolts	:	Friction grip/ Fit bolts

1.106.2 Embedded Parts

One (1) set of fabricated steel embedded parts comprising of sill beam, lintel beam, side seal and lintel seal seats with side guides and dogging device suitable for receiving a slide type gate of clear span 0.6 m (wide) x 0.6 m (high). The main members shall be provided with sliding path suitable for transmitting the load developed on the gate due to upstream head to the civil structure. The sliding track shall be provided up to at least one gate height above gate opening. **The side seal seats, and top seal seats shall be extended at least 0.50 m above the gate opening to cater for partial operations.**

Hoist supporting structures for the gate are required to be provided to facilitate operation of gate from the flushing gate operation gallery.

A working platform for the maintenance of cylinder shall be provided in the operation chamber. For access into the gate groove suitable access is to be provided.

All the embedded parts shall be installed in the first stage concrete itself. As such the design and fabrication shall be done in such a way so as to suit their installation in the first stage concrete.

The following minimum sizes/ specifications shall be observed:

Sill beam	:	ISMB-300 or equivalent built up section
Seal seats	:	Stainless steel 200mm wide x 25mm thick for bottom, 600mm high x 10mm thick for top and 100mm wide x 10mm thick for sides. **(Machine finished surface)**
Track	:	corrosion resistant steel 200mm x 25mm **(Machine finished surface)**
Side guides	:	50 mm x 40 mm thick flat
Anchor rods/studs	:	16 mm dia. J or U type spacing not more than 450 c/c

Design consideration and operation requirements

The gate shall be designed in accordance with the provision of latest edition of IS: 5620 in general & in accordance with provisions specified in these specifications in particular. While designing the skin plate, corrosion allowance of 1.5 mm should be considered. The deflection of the gate members shall be limited to **span/1200**.

The gate and its connected equipment including all embedded parts shall be designed for water head of 7.85 m against the normal allowable stresses. In addition, a silt load of one gate height shall be considered for both the gates against normal allowable stresses.

Earthquake effects shall also be considered and allowed in the design as per stipulations in accordance with IS: 1893.

The gate shall usually remain in closed position & shall be operated by means of hydraulic hoist. The gate shall be designed for operation against 7.85 m water head and shall be capable for regulating the discharge through flushing tunnel during desilting operation and

Khorlochhu Hydro Power Ltd.

shall be used for partial gate opening. The gate is to be designed/ checked under partial operation also against vibrations etc. The hydraulic hoist shall have adequate pushing capacity to ensure gate closure. The pushing capacity of the hoist shall be at least 50% more than resultant of all the forces acting on the gate during lowering operation. The gate lifting capacity shall be computed taking into consideration all frictional forces due to water and silt load, gate weight, down pull forces etc., including a reserve capacity of 50% above the calculated lifting force in accordance with IS: 10210. While calculating pushing force, down pull shall not be considered and for calculation of hoisting force, uplift on the gate shall be neglected.

The operation of the gate shall be from a local control panel with all the facilities. The operation shall also be through a Remote-Control System situated both in the dam control room and Main Station Control Room located in Power House, which shall enable the operation of the service gate as per the flushing requirements. Necessary selector switch for manual / remote mode shall be provided in the local control panel.

The gates shall satisfy the following requirements:

a) The gates shall be required to be operated (open or closed) at a speed of 0.5m/min ± 5%,

b) In closed position, the gates must be completely watertight with full pressure acting from upstream side and sealing must be reliable,

c) The gates and its accessories shall be so designed that the stresses in different members due to dynamic loads during closing and opening operations and static loads in the closed position do not exceed the permissible stresses specified.

1.106.3 Hoists for Chaplangchhu Silt Flushing Tunnel Gate

SFT gate shall be operated by means of an independent double acting hydraulic cylinder connected with the gate through pin. The hydraulic hoist shall include hydraulic actuator complete in all respects including support beams, hydraulic piping and control valves and fixtures, hydraulic power packs, vents, hydraulic oil, height indicator **and hanger stud suitable for weight of gate and cylinder** and all other components required for satisfactory operation of the gates and hoists. **The hoist shall be designed in accordance to IS 10210**. The hoist capacity shall be calculated considering the worst combination of all resisting forces viz. frictional force, dead weight including effects of silt load up to one gate height. The computed hoist capacity but not less than **5 T pulling force & 4 T pushing force shall be adopted** for the gate.

The design of the hoist and controls shall be suitable to maintain the gate at any selected opening position between full open and full closed using a restoring device if **the creep of gate from original position exceeds 100 mm**. Provision shall be made to have a buffer speed of 1/5th of the working speed during last 300mm travel of the gate during lowering operation.

The cylinder design shall provide minimum reserve stroke of 100mm on each end over the computed working stroke. Cylinder stroke length of gate hoist shall be kept in such a way so that maintenance of gate including replacement of bottom seal can be carried out at maintenance platform.

The cylinder walls shall be properly prepared to allow the piston to traverse smoothly and freely and to minimize the oil leakage past the piston. Piston rod shall be of following types:

a) **Stainless steel with hard chrome plating of thickness not less than 50 microns or carbon steel with ceramic coating not less than 250 microns,**

b) The ceramic coating on piston rod shall be designed to rule out corrosion of the piston rod. It shall be homogeneous, scratch resistant, free of cracks & non-conductive.

Khorlochhu Hydro Power Ltd.

The cylinders shall be provided with an **Integrated Measuring System/ Linear Displacement Transducer or similar arrangement for gate position indication**. In case of integrated measuring system or other similar arrangement, the position measuring system shall be based on serrated rod. An incremental encoder shall generate the position output. Position accuracy linearity shall be ± 1mm. The required powers supply of 24V D.C. ± 20% max. 250mA for MIMS shall also be arranged by the supplier.

One **(1)** set of power pack common for Chaplangchhu Silt Flushing gate and De-gravelling gate and associated Control system including motors, pumps, control panel, piping, pressure gauges, flow control valves, pressure switches, direction control valves etc. with controls, limit switches and other miscellaneous fittings, lighting, etc shall be provided.

The hydraulic hoist and power pack are to be sourced from a world-renowned designer cum manufacturer who has in-house facility of piston rod ceramic coatings/ chrome plating.

One manual pump shall be provided with the power pack.

The system shall be provided with operating panels for automatic, remote & manual operating modes. **The hoist shall be designed in accordance with IS: 10210/ DIN: 19704.**

For details of other associated items of power pack like hydraulic power unit, piping, fittings and flanges, flexible connections, fluid reservoir, hydraulic working fluid, design temperature, system cleanliness, flushing and flushing fluid refer to Clause 2.3.1 of particular technical specification.

Main Data

a) Gates

Type of gate	:	Slide type vertical gates
No. of gates	:	One (1)
Width of opening	:	0.6 m
Height of opening	:	0.6 m
Sill Level	:	1568.15 m
WL	:	1576.00 m
Design Head	:	7.85 m
Skin plate	:	Upstream
Sealing		Upstream
Silt load	:	Up to One gate height

b) Hoists:

One (1) number Independent double acting Hydraulic cylinders with Single Power packs.

Operating speed	:	0.5m/min ± 5% Max.
Working pressure	:	20 Mpa at cylinder
Hoist capacity condition.	:	To be computed as per specified operating However, capacity shall be not less than **5 T for pulling** and **4 T pushing** for Cylinder.

1.107 Chaplangchhu De-gravelling Gate and Hoist

1.107.1 Gate

One (1) number **2.0 m x 2.0 m** (opening size) slide type De-gravelling gate with upstream skin plate and upstream sealing shall be provided in Chaplangchhu diversion complex. The

gate shall be provided with horizontal girders, vertical stiffeners, guide shoe assemblies, dogging devices, slide block, bumpers etc. The gate is to be designed to withstand **8.5 m** water head. The gate shall be fitted with side seal elements on the upstream side of gate unit and bottom seal on the upstream which will be connected to the side seal suitably. Suitable gate lifting sheaves/lugs shall be provided for connecting to the hoist. Full depth stiffeners shall be provided below the lifting sheaves/lugs for complete gate height. The gates shall be operated by means of independent double acting Hydraulic Hoist of capacity not less than 10T pulling & 8T pushing force.

General arrangement of gate & hoist is as per drawing no. **KHPP- HM-CDW- GA-6025**

The following minimum sizes/specifications shall be observed:

Skin plate	:	10 mm structural steel
End Vertical girder	:	10 mm structural steel
Bottom seal	:	20mm thick wedge type rubber seal (5mm pre-compression)- PTFE/fluorocarbon cladded
Side seals	:	14 mm thick stem music note type rubber seal 3mm pre-compression
Seal clamps	:	16 mm thick structural steel
Fasteners	:	16 mm dia. stainless steel
Seal bases	:	12 mm thick structural steel **(Machine finished surface)**
Full depth vertical stiffeners	:	10 mm thick
Splice bolts	:	Friction grip/ Fit bolts

1.107.2 Embedded Parts

One (1) set of fabricated steel embedded parts, for opening of **2.0 m x 2.0 m**, comprising of sill, side members with side guides extending up to the deck, slide tracks and suitable dogging arrangement, all suitable for slide type gate with upstream sealing. The main members shall be provided with sliding path suitable for transmitting the load developed from the upstream head to the civil structures. The dogging devices are to be provided on top of gate grooves. Suitable dogging/ holding arrangement to hold the gate in suspended vertical position above the gate groove shall be provided for allowing its inspection, maintenance and repairs as well as normal storage while not in use.

Following minimum sizes/specifications shall be observed:

Sill beam	:	ISMB-150
Slide Track	:	Corrosion resistant steel 100 mm x 10 mm (Machine finished surface)
Side & bottom seal seat	:	Stainless steel 100 mm wide x 10 mm thick (Machine finished surface)
Side guides	:	50 mm x 20 mm thick flat within gate groove and 100 mm x 20 mm above gate opening up to deck level
Groove Liners	:	Min. 10 mm thick
Anchor rods/studs	:	16 mm dia. J or U type

Design Consideration and Operation requirements

The gate and embedded parts shall be designed in accordance with the provisions of the latest edition of IS: 5620 in general and in accordance with the provisions specified in these specifications in particular. While designing the skin plate, corrosion allowance of 1.5 mm should be considered. This gate shall be operated under unbalanced head condition. The deflection of the gate members shall be limited to span/ 800.

Khorlochhu Hydro Power Dept.

The gate along with connected equipment shall be designed for water head of 6.5m with normal allowable stresses as per Clause 2.4.1 of General Technical Specifications.

The gates shall usually remain in raised position above the groove. Two numbers of side guide shoe shall be provided on each side to restrict lateral movement of gate.

The gate shall satisfy the following requirements:

a) In closed position, the gates shall be completely watertight,

b) The gates and its accessories shall be so designed that the stresses in different members due to operation of the gate and static loads in the closed position do not exceed the permissible stresses specified,

c) The gate shall be operated at a speed of 0.5m/min ±5%,

d) The following loads shall be considered:
   i) Full hydrostatic water thrust with u/s water head of 8.5 m,
   ii) Dead weight of the gate and hoist,
   iii) Hoisting forces,
   iv) Wind and Earthquake forces.

1.107.3 Hoists for De-graveling Gate

De-graveling gate shall be operated by means of an independent double acting hydraulic cylinder connected with the gate through pin. The hydraulic hoist shall include hydraulic actuator complete in all respects including support beams, hydraulic piping and control valves and fixtures, hydraulic power packs, vents, hydraulic oil, height indicator and hanger stud suitable for weight of gate and cylinder and all other components required for satisfactory operation of the gates and hoists. **The hoist shall be designed in accordance to IS 10210**. **The hoist capacity shall be calculated considering the worst combination of all resisting forces viz. frictional force, dead weight including effects of silt/gravel load up to one gate height. The computed hoist capacity but not less than 10 T pulling force & 8 T pushing force shall be adopted for the gate.**

The design of the hoist and controls shall be suitable to maintain the gate at any selected opening position between full open and full closed using a restoring device if **the creep of gate from original position exceeds 100mm**. Provision shall be made to have a buffer speed of 1/5th of the working speed during last 300mm travel of the gate during lowering operation.

The cylinder design shall provide minimum reserve stroke of 100mm on each end over the computed working stroke. Cylinder stroke length of gate hoist shall be kept in such a way so that maintenance of gate including replacement of bottom seal can be carried out at maintenance platform.

The cylinder walls shall be properly prepared to allow the piston to traverse smoothly and freely and to minimize the oil leakage past the piston. Piston rod shall be of following types:

a) **Stainless steel with hard chrome plating of thickness not less than 50 microns or carbon steel with ceramic coating not less than 250 microns,**

b) The ceramic coating on piston rod shall be designed to rule out corrosion of the piston rod. It shall be homogeneous, scratch resistant, free of cracks & non-conductive.

The cylinders shall be provided with an **Integrated Measuring System/ Linear Displacement Transducer or similar arrangement for gate position indication**. In case of integrated measuring system or other similar arrangement, the position measuring system shall be based on serrated rod. An incremental encoder shall generate the position output. Position accuracy linearity shall be ±1mm. **The required powers supply of 24V D.C. ± 20% max. 250mA for MIMS shall also be arranged by the supplier.**

Khorlochhu Hydro Power Ltd.

(2) sets of power pack common for service & emergency gates and associated Control system including motors, pumps, control panel, piping, pressure gauges, flow control valves, pressure switches, direction control valves etc. with controls, limit switches and other miscellaneous fittings, lighting, etc.

One **(1)** set of power pack common for Chaplangchhu Silt Flushing gate and De-gravelling gate and associated Control system including motors, pumps, control panel, piping, pressure gauges, flow control valves, pressure switches, direction control valves etc. with controls, limit switches and other miscellaneous fittings, lighting, etc shall be provided.

The hydraulic hoist and pwer pack are to be sourced from a world-renowned designer cum manufacturer who has in-house facility of piston rod ceramic coatings/ chrome plating.

One manual pump shall be provided with the power pack.

The system shall be provided with operating panels for automatic, remote & manual operating modes. **The hoist shall be designed in accordance with IS: 10210/ DIN: 19704**.

For details of other associated items of power pack like hydraulic power unit, piping, fittings and flanges, flexible connections, fluid reservoir, hydraulic working fluid, design temperature, system cleanliness, flushing and flushing fluid refer to Clause 2.3.1 of particular technical specification.

Main Data

a) Gate

Type of gate	:	Slide type vertical gate
No. of gate	:	One (1)
Width of opening	:	2.0 m
Height of opening	:	2.0 m
Sill Level	:	1572.0 m
HFL	:	1580.5 m
Design Head	:	8.5 m
Silt/gravel load	:	Up to One gate height

b) Hoists

One Nos. Independent double acting Hydraulic cylinder with Power pack.

Operating speed	:	0.5m/min ± 5%
Max. Working pressure	:	20 Mpa at cylinder
Hoist capacity	:	To be computed as per specified operating condition. However, capacity shall not be less than **10T** for pulling and **8T** pushing for the Cylinder.

26. Aquatic Life Discharge Piping with Valves

1.108 Aquatic Life Discharge Piping

In order to release water downstream of river during lean season for aquatic life, two sets not less than **15mm** thick **600mm** dia. of stainless-steel pipes are to be provided. Each pipe is provided with two nos. knife-edge gate valves of **600mm** dia. (one service & other emergency) along with transition piece, supports, dismantling joints etc. complete with all other accessories and appurtenance. The approximate length of pipe shall be 110m (both pipes). The arrangement of piping and valves has been shown in the drawing **No-KHPP-HM-DAM-GA-6006**

Khorlochhu Hydro Power Ltd.

The length of pipe is likely to change during detailed design/depending upon site requirements, as such Contractor shall also quote separate rate for unit length of pipe to take care of any increase or decrease in length of pipe.

1.109 Description of the Aquatic Life Discharge Piping

The stainless-steel piping shall conform to ASTM 304 heavy duty seamless steel pipe. On the upstream side of spillway pier, inside the valve chamber, there will be both emergency & service knife-edge gate valves with suitable dismantling joint. The dismantling joint to be supplied by the valve manufacturer shall be of telescopic construction and with suitable sealing system so as to facilitate easy mounting and dismantling of the valves in the limited space in between the u/s and d/s flanges provided on the pipe. The flanged connections shall be machine faced and provided with suitable sealing rings (0- rings) or gaskets to provide leak proof jointing.

The fabrication and erection / installation of pipes shall conform to IS 2825 or section VIII of ASME in that order. All welds shall be fully ultrasonically tested for longitudinal joints and subjected to Dye- Penetrant examination for circumferential / cross-joints at works.

1.110 Design Criteria for Aquatic Life Discharge Piping

i) The piping shall be designed for a head of **24m** (approx.) water column with a factor of safety of two.

ii) The piping shall be designed for head corresponding to FRL.

1.111 Design Criteria for Valves

i) The valve shall be designed for a head of 24m (approx.) water column with a factor of safety of two.

ii) In addition, a silt load equivalent to full valve diameter height shall be considered.

iii) The valve shall be capable of operation under unbalanced head condition between MDDL & FRL.

iv) The operating speed shall be 0.3m/min.

v) The valve shall be capable of operation at partial opening without undue induced vibrations.

vi) The valve shall have a perfect sealing system at stem to prevent ingress of water into the operating chamber during operation.

vii) Valve knife-edge plate and valve seat shall be of stainless steel with precision buffed for tight shut off. Valve body shall be of carbon steel conforming to IS: 2062 Grade-B. Body lining shall also be stainless steel. A silt guard ring of stainless steel shall be provided.

viii) **Test Pressure**: The valves shall be tested for a test pressure of 1.5 times the maximum operating pressure.

ix) All equipment, wherever applicable, shall include provisions for safe isolation, locking, and tagging of hazardous energy sources—such as electrical, mechanical, hydraulic, pneumatic, thermal, and stored energy. The systems must be capable of being secured in a fully de-energized and inoperable state during maintenance activities. The vendor shall ensure that all equipment supplied is designed, fabricated, and delivered with complete LOTO provisions, in accordance with applicable standards and best engineering practices

1.112 Operating Criteria for Valves

The operation of two knife-edge gate valves shall be as under:

i) Emergency/maintenance valve shall normally remain in open position and shall be closed only during inspection/maintenance of service valve.

Khorlochhu Hydro Power Ltd.

ii) The service valve shall always remain in closed position and shall be operated to release water downstream of the river during lean season depending upon site conditions/ operating instructions.

iii) The valves shall be operated by means of electro-mechanical actuators of suitable capacity.

iv) During power failure, the valve shall be capable of manual operation.

The control for valve operation shall be located in valve chamber. Suitable limit switches shall be inbuilt in the device to stop the movement of operation to both extreme travels of the valves. Overload relays shall also be provided in the electrical circuit to check the overloading of the device. The operation and control shall be extended to Dam central control system.

27. Instrumentation and Remote-Control System

1.113 General

PLC based Remote Control System shall be within the scope of Electro-mechanical Package. However, all instruments, field deceives, and local control panels related to the HM works (Clause no. 1.3.1 to 1.3.14 of GTS) shall fall under the scope of this package.

This chapter covers the instrumentation & control (I&C) equipment to be designed, supplied and installed by the Contractor.

Requirement specified within this section shall take precedence over requirements mentioned elsewhere.

Even if not specifically mentioned by this specification but required for the proper and efficient functioning of the equipment, the Contractor shall include supply and installation of such items.

The components shall be of latest state of Art in technology.

1.114 Compatibility of PLC based system for Control and Monitoring from Main Control Room (Powerhouse) (Under the scope of EM)

For control and monitoring of Dam equipment from Powerhouse, the PLC based control system at Dam site shall be designed on open standard on IEC 61850/IEC-60870-5 104 to interface with plant SCADA system of power station. The communication between Dam and Powerhouse shall be made via fibre-optic cable connection. The equipment and installations of the Dam will normally be remote controlled from both Dam Control Room and Main Station Control Room located in Powerhouse.

1.115 Object and Limits of Supply

The Contractor shall supply and install all apparatus, terminal boxes, etc. necessary to make the distribution services complete and ready for operation.

The main items of control & equipment to be supplied and installed under this section comprise the following:

a) Except for the PLC based Remote Control System, all other components including instrumentation, field devices and local control panels complete in all respects supplied and installed shall envisage the following control functions and indications:

i) Individual control and operation of spillway radial gates, intake gates, overall spillway gates, silt flushing tunnel gates, Chaplangchhu silt flushing gate, Chaplangchhu intake gate, Chaplangchhu desilting basin outlet gate and Chaplangchhu de-graveling gate.

ii) Group control for raising and lowering and stop of spillway radial gates

Khorlochhu Hydro Power Ltd.

iii) Individual gate height indications of spillway radial gates, Intake gates, overflow spillway gates & silt flushing tunnel gates.

iv) Auto/manual operation indication.

v) Gate opening/closing flash lamp indication with suitable audible alarm for spillway radial gate, overflow spillway gates and silt flushing gate.

vi) Reservoir water level indication on continuous display mode in digital form with alarm where water level starts exceeding FRL and when water level starts receding. (Levels shall be decided during detail design).

vii) **Two (2)** sets of water level measuring and indication Equipment at dam and Intake area along with necessary alarms.

viii) All equipment, wherever applicable, shall include provisions for safe isolation, locking, and tagging of hazardous energy sources—such as electrical, mechanical, hydraulic, pneumatic, thermal, and stored energy. The systems must be capable of being secured in a fully de-energized and inoperable state during maintenance activities. The vendor shall ensure that all equipment supplied is designed, fabricated, and delivered with complete LOTO provisions, in accordance with applicable standards and best engineering practices

b) Following instruments shall also be provided at their respective locations complete in all respect and is not part of PLC system:

i) **Five (5)** sets of water level measuring system to indicate balance head condition of spillway stop logs.

ii) **Two (2)** sets of Differential pressure measurement and indication equipment across intake trash rack.

iii) **Two (2)** sets of water level measuring system to indicate balance head condition of Intake bulk head gates.

iv) **Two (2)** sets of water level measuring system to indicate balance head condition of desilting chamber gates.

v) **Two (2)** sets of water level measuring system to indicate balance head condition of surge shaft gate.

vi) **Four (4)** sets of water level measuring system to indicate balance head condition of Tailrace Tunnel gates.

vii) **One (1)** set of water level measuring system to indicate balance head condition of TRT outfall gate.

viii) **Two (2)** set of gravel level measuring system for operation of Chaplangchhu De-graveling gate.

ix) **Two (2)** sets of water level measuring and indication Equipment at Chaplangchhu Intake along with necessary alarms.

c) -Distribution board & feeder pillar for all HM equipment

i) Main distribution board/ Switchgear (not in the scope of HM vendor) shall be provided at dam site near Diesel Generating Room for 415/230V AC power supply for Spillway Equipment, Automatic Remote-Control system, Intake equipment, Desilting Chamber Gates and Silt Flushing Gates. Feeder pillars / individual distribution boards (if required) shall be provided in the vicinity of respective local control panels of above equipment and shall be within the scope of HM vendor. Cables between main distribution board and above feeder pillars shall also be part of the HM vendor's scope.

Khorlochhu Hydro Power Ltd.

ii) Feeder pillars (if required) shall be provided for Surge Shaft gates, Tail Race Tunnel gates, TRT outfall gates and Chaplangchhu gates in the vicinity of respective local control panels.

The Works shall be complete with all necessary auxiliaries such as primary elements (position transmitters, limit switches etc.), hardware, software, modules, transducers, cabling etc. as well as frames, built-in and embedded parts including all spare parts and special tools required. All the Equipment shall be standard type of well-known manufacturers.

Additional contacts shall be provided in DCR for communication of status of gates (position indication) for spillway radial gates, Intake gates and silt flushing tunnel gates and measurement of differential pressure across trash racks, reservoir level, and discharge through spillway radial gates to Power House.

1.116 Design Criteria for Spillway Regulation

The specified measuring system shall provide the data (reservoir level, gate position and spillway discharge) to determine the three above-mentioned parameters by the main computer in the DCR (Dam Control Room).

Following parameters shall be indicated on the panel in DCR

1) Reservoir level indication (analog and digital)
2) Radial gates position indicator (% opening) vertical
3) Discharge passing through the radial gates
4) Trash rack chocking
5) Balancing of Intake Bulkhead gates

Design Data:

Rated voltage	:	230AC/110 V, D.C.
Maximum ambient temperature	:	36^0 C
Minimum ambient temperature	:	-7^0C
Degree of protection for Panels	:	IP 66
Degree of protection for transducers	:	IP 67
Special treatment	:	Tropicalized.
Transmitter Output Signal analog	:	4-20 mA (2-wire)

1.117 Equipment for Remote Control System

1.117.1 General

All the necessary transducers and instrumentation, terminals, contacts, cabling etc. for the above at various locations shall be provided and installed by the contractor as a part of HM scope.

The operator shall be able to view the gate positions or gate status with the help of graphic display on the screens of operator stations/Large Screen LED Display.

The PLC based Remote Control System shall have two controllers each backing up the other so that the failure of one of the controllers shall not cause any discontinuity in the control system and shall ensure that no loss of data takes place during change over. The system shall also have a colored ink jet printer (minimum 11 ppm for color printing) and also an event and data logging printer (15 ppm), for printing various logs, instructions and reports. All peripherals shall be provided with necessary desks, paper baskets and noise

Khorlochhu Hydro Power Ltd.

absorption. Interlocking shall be provided between Operator's station and local control panels.

All the input display from field including water level of reservoir shall be displayed at the screen. The system shall monitor the reservoir level and depending upon this level it shall be able to calculate the input discharge into the reservoir. In addition to this the gate opening of spillway radial gates should be displayed in the form of graphic display. The system shall be able to display the output discharge through spillway radial gates so that operation of spillway radial gates can be carried out in auto mode.

1.117.2 Operator Workstations (under the scope of EM)

The operator consoles shall assist the operator for an easy operation and control of gates and shall allow to print out and to show on the displays, all relevant signals, events, alarms, status, status changes, abnormalities and history data on request or immediately in case of alarm.

In the dam control room two operator workstations with desks shall be provided. Each operator desk shall be equipped with one VDU, sealed membrane covered keyboard and pointing device such as mouse, sealed membrane covered function keyboard, integrated telephone set, microphone, writing pad and workplace integrated. Each of the two monitors, attached to the workstations, shall be interfaced to be capable of displaying any of the selected gate control mimic views.

All the Operator workstations shall be implemented in such a way so that each workstation shall be capable of individually controlling the entire control system even in the case of failure of other workstation.

The configuration of each workstation shall be:

i) One VDU each of at least 32", LED flat screen and flicker-free,
ii) Dual Processor CPU with highest CPU clock speeds and Mother Board Front Side Bus speeds available at the time of supply,
iii) Minimum of 4 GB RDRAM,
iv) Two (2) or more – Hard Disk Drives with latest technology each of at least 500 GB capacity,
v) HD-DVD writer,
vi) USB (2.0 or higher, if available at the time of procurement) hub and ports,
vii) Functional key board with all functions and provision of shortcuts for alarms,
viii) Pointing device such as mouse.

The workstations shall be high performance systems with SCSI drives and controllers and latest configuration available at the time of supply. They shall be loaded with latest Windows Operating System and latest 'Professional version' of Microsoft Office Suite. The operator desks, to be supplied by the Contractor, shall be provided with all accessories, telephone desk-type, power socket outlets, provision for public address system installation etc.

1.117.3 Large Screen LED Display (under the scope of EM)

One LED based display of at least 70-inch diagonal Screen, with aspect ratio of 16:9 better and high resolutions of at least 1920 x 1080 pixels with necessary display controller/ accessories along with application software's shall be provided. The display wall shall be connected to the remote control system network through display controller so as to display any combination of the control system views. The concerned operator shall select the views from the available dam area gates control views from the workstation. The display screen shall have a high viewing angle of 1800 and shall have adequate level of brightness for

Khorlochhu Hydro Power Ltd.

display in ambient light conditions of the dam control room. The system shall have automatic colour and brightness control feature. A digital clock with date and time indication shall be provided on top of the display. The display shall be provided with necessary mounting frame.

1.118 Water Level Measuring Systems

The Contractor shall design, supply and install best quality Level sensors at the following points.

Two (2) sets of non-contacting micro wave type water level measuring equipment for dam area with electronic water level transmitter shall be provided. Sensors shall be multiple types to evaluate the water level from a minimum EL. of 1553.0m (i.e. 5.0m below MDDL) to EL.1572.0m (FRL), housed in a weatherproof enclosure, and shall be provided one at the right abutment of the spillway and other at the extreme left end of the intake.

Reservoir levels shall be monitored from the two level transmitters at two different locations to obtain an average position of actual reservoir level. If any of the level sensors provided at any of the points falls defective or giving erratic reading, the other sensor shall govern the signals and Reservoir control and hence both the sensing units shall be compatible. Fault detection shall be displayed in the remote as well as local control panels.

The water level detector shall be of radar type water level measurement sensor and shall consist of necessary accessories.

The sensor shall be very sensitive to transmit the water level considering the fact that these sensors are to work under very heavy silt laden water.

The sensors shall be continuous monitoring type and shall have accuracy of ± 1cm or less.

The Reservoir water level signals shall be available in digital form at all respective control panels of spillway radial gates, intake gates and silt flushing tunnel gates.

1.119 Screen Head Loss Equipment

Two (2) sets of screen head loss equipment shall be supplied to detect head difference at the intake trash rack, and be installed into not less than 8mm thick 300 mm dia. steel pipes embedded at the upstream and downstream side of the trash racks. The pipes shall be provided by the contractor but fixing will be in the scope of civil contractor.

The accuracy of the equipment shall be ±1cm or less.

All necessary instruments, interconnecting wiring, pipe work, housing, cabling, panel etc., shall be provided according to the type of equipment proposed.

Screen head loss shall be measured by pressure difference between the upstream and downstream sides of the intake trash rack. This pressure difference shall be sensed by comparing with reservoir pressure at the upstream side of the trash rack versus pressure just behind the trash rack.

The indicator shall be provided at a remote panel mounted in the Dam Control Room (DCR) and shall indicate from 0 to 2m head loss. At 0.5 m head loss a flashing beacon shall be activated which shall continue to give visual alarm until the necessary remedial action has been taken. At 1.0 m head loss a klaxon shall be activated which can only be muted by an authorized operator inserting and turning a special key in the control panel. It must not be possible to withdraw the key in this position.

Khorlochhu Hydro Power Ltd.

1.120 Water level measuring system to indicate balance head condition across Gates/ Stoplogs

Five (5) sets of water level measuring system for spillway stop logs, **two (2)** sets for Intake bulkhead gates, **two (2)** sets for desilting chamber gates and **two (2)** sets for surge shaft gates to indicate balance head condition shall be supplied

Type of instruments shall be Piezoresistive/Capacitance type Submersible Pressure Sensors.

The instrument shall be installed into not less than 8mm thick 300 mm dia. steel pipes embedded at the upstream and downstream side of the gates. The pipes shall be provided by the contractor but fixing will be in the scope of civil contractor.

The accuracy of the equipment shall be ±1cm or less.

The display unit shall be placed at the deck level at suitable location housed in a weatherproof enclosure.

All necessary instruments, interconnecting wiring, pipe work, housing, cabling, cable trays & panel etc., shall be provided according to the type of equipment proposed.

1.121 Gravel Level Measuring System

The Contractor shall supply and install best quality of two (2) sets of gravel Level sensors at suitable locations to sense the gravel level. The de-graveling gate shall be auto operated using gravel level measuring systems.

The sensor shall be very sensitive to transmit the gravel level considering the fact that these sensors are to work under very heavy silt/gravel laden water.

The sensors shall be continuous monitoring type.

The gravel level signals shall be available in digital form at all respective control panel and at Dam control room.

1.122 Tele-metering and Supervisory Control

The Contractor shall provide the digital transmitters, indications and terminal strips via the bus system.

a) <u>Tele-metering Items</u>

- Digital type gate position indications.
- Digital type water level indication.
- Digital type discharge indication of spillway.

b) <u>Supervisory Items</u>

Dry contacts shall be provided for signal transmission to the DCR for all alarms and indications of gate mentioned above. These shall include, but not limited to, the following:

- A.C. fault
- Common Alarm
- O/L Trip
- Open
- Close
- Stop
- Remote/ Local

1.123 Automatic Reservoir Measuring and Control System (ARMAC) (under the scope of EM)

1.123.1 General

The ARMAC computing and control system shall be situated in the Dam control room (DCR) and shall be provided by EM Contractor.

The control and computing system for the spillway shall be able to calculate the actual spillway discharge depending upon reservoir water level and gate opening. The system is to be mounted in the equipment control cabinet (ECC).

The computing system shall be interconnected with the operator workstations in the DCR, from which the command for the necessary discharge on the spillway shall be provided. All signals shall be sent and received to/from the DCR.

A Programmable controller shall define the required total gate opening. The positioner shall compare the required value with the total actual opening, found by adding up the individual opening values, if the deviation of one or more gates from the required value is large enough, an 'Open' - or 'Close' - instruction shall be given to the respective gate(s). However to prevent hunting of hoist the deviation should be beyond the pre-selected tolerance band.

In a selection circuit the 'open' - instruction shall be transferred to the gate, which at the time of the comparison controls the smallest opening. Similarly, a 'close' - instruction shall be given to the gate controlling the largest opening.

For the gate selection, only those gates shall be considered, of which the manual switches are in the 'Automatic 'position, and where no alarm signal has been received. The 'open'- or 'close' - instruction shall remain with the selected gate, unless any of the following conditions is met:

- The required and actual openings agree and the positioner cancels the instruction, or
- The gate had previously reached its limit position, or
- The max. Permissible deviation (pre-set difference in position between controlled gate and average of all gates available) has been reached previously.
- The selected gate is not in operating condition.
- All equipment, wherever applicable, shall include provisions for safe isolation, locking, and tagging of hazardous energy sources—such as electrical, mechanical, hydraulic, pneumatic, thermal, and stored energy. The systems must be capable of being secured in a fully de-energized and inoperable state during maintenance activities. The vendor shall ensure that all equipment supplied is designed, fabricated, and delivered with complete LOTO provisions, in accordance with applicable standards and best engineering practices

In the event of major changes in required size of opening, the gates shall be moved successively one step each, i.e. after re-setting all gates again agree within the pre-set margin in size of opening. After all available gates have reached their limit positions a corresponding signal shall be given.

At any time individual gates shall be allowed to be switched over from the automatic mode to manual mode of operation, and vice versa, however the operation from the local panel cannot be overruled by the remote /automatic operation stage. Adjustments made manually are to be automatically compensated for with the other gates by the automatic control system.

Manually adjusted gates shall, when returned to automatic mode of operation, be adapted to their normal functioning in the automatic mode. The automatic system shall work independent of the number of available gates with the same characteristic. If all gates have

Khorlochhu Hydro Power Ltd.

been changed over to MANUAL, the master controller shall be reset so as to permit a smooth switching-over to AUTO operation.

The system is to be designed to monitor the duration of the instruction. The monitoring is to prevent, that an instruction is maintained over a period, that is longer than a pre-selected time, e.g. in the event of a malfunction of a gate selected by the controller, if the monitoring system is actuated, the particular gate is to be cancelled from the group of gates available for selection.

Following additional features shall also be incorporated / provided in ARMAC system.

- Cycle time of about 1.5 to 2 seconds for updating the data.
- Continuous monitoring and recording of reservoir level, discharge through gate openings (height) etc.
- Complete surge voltage protection at remote due to isolation of inputs leads from the systems/ grounds.
- Real time clock and calendar.
- Runtime self-check features and system malfunctioning detection.

1.123.2 Discharge Calculation

The discharge rate per gate is to be computed by electronic means. Water level measurement and measurement of the gate position serve as input variables.

The necessary discharge rating curves shall be agreed with the Employer's Representative. The discharge rates shall be added and be displayed digitally as total water discharge rate, which shall also be recorded.

1.123.3 Registration

Registration and recording of all available values shall be in the DCR (Dam Control Room).

15.12 Individual Distribution Panel (wherever applicable)

15.12.1 General Construction

The Individual Distribution Panel (IDP) shall be designed for indoor or outdoor installation, which shall be decided as per the General Arrangement (GA) drawing and placement of equipment. The design shall comply with the construction and performance requirements of IEC 61439-1 and IEC 61439-2. The panel shall comply with the degree of protection requirements of IEC 60529 as follows:
For indoor installations, the minimum enclosure protection shall be IP54. For outdoor installations, the minimum enclosure protection shall be IP65. The enclosure shall be fabricated from cold-rolled sheet steel, minimum 2.0 mm thick for load-bearing members and 1.6 mm for covers and doors. The structure shall be rigid, floor or wall-mounted, with adequate access for operation and maintenance.
Complete wiring of the electrical equipment and the control device with all cables including power source supply from Main distribution board shall be included under the scope of Contractor.

415V / 240V A.C. Distribution Board / Control Panel
Bidder shall include in his scope required number of 415V AC and 240V AC power supply distribution board/control panel for feeding packaged auxiliary load if any. Bidder shall provide incomers from 415V main switchboard to feed the distribution board/control panel. All the incoming and outgoing feeders shall be of MCCB / MCB controlled depending on the fault level.
A.C. distribution boards / control panels shall be provided with thermostatically controlled space heater, cubicle lamp and power plug.

Khorlochhu Hydro Power Ltd.

Cable Termination
Glands shall be of heavy-duty brass castings, machine finished and complete with check nut, washers, neoprene double compression ring etc. The lugs shall be tinned copper/aluminium depending on cable conductor and of solder-less crimping type.

Arc Resistance
The switchgear assembly shall be certified as Arc Resistant. The minimum arcing duration used for testing shall be 500ms as specified in the applicable standard.

Local Push Buttons/ PB Stations
The local P.B. stations shall be metal enclosed, provided with IP-55 protection, made up of die-cast aluminium or 2 mm thick sheet metal.
Start push button shall be recess type, spring return. Stop push button shall be stay-put lockable type with mushroom head.

Earthing
An earthing bus shall be provided at the bottom and extended throughout the length of the switchgear. It shall be bolted / welded to the framework of each unit and each breaker earthing bar.
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.
Positive earthing of the circuit breaker frame shall be maintained both in service and test position.

15.12.2 Miniature Circuit Breakers (MCB)

MCBs shall conform to IEC 60898-1. They shall be suitable for 415 V, 50 Hz AC supply, with breaking capacity of not less than 10 kA. MCBs shall be modular, DIN rail mounted and provided with ON/OFF/TRIP indication. Suitable for protection of outgoing feeders and internal circuits.

15.12.3 Moulded Case Circuit Breakers (MCCB)

MCCBs shall comply with IEC 60947-1 and IEC 60947-2. They shall be manually operated, 3-pole type, AC-based, with adjustable thermal-magnetic trip units. Minimum breaking capacity shall be 35 kA at 415 V. MCCBs shall be of draw-out or plug-in type, with clear ON/OFF/TRIP position indicators.

15.12.4 Timer

Timer devices shall conform to IEC 60947-6-2 and operate on 230 V AC. The timer shall be digital or analog as per design requirement and shall provide programmable ON/OFF delay control for automation purposes.

15.12.5 Indication Lamps

Indication lamps shall conform to IEC 60947-5-1 and operate at 230 V AC. LED-type lamps of red, yellow, and green colors shall be provided for ON, OFF, and TRIP status indications respectively. Lamps shall be panel-mounted and replaceable from the front.

15.12.6 Siren / Buzzer (if applicable)

An audible alarm device operating on 230 V AC shall be provided. The siren/buzzer shall be panel-mounted and rated for industrial duty. Muting and acknowledge feature shall be provided through push button or selector switch.

15.12.7 Nameplates

Each feeder, instrument, and breaker shall be provided with engraved nameplates made of anodized aluminium or trifoliate, fixed using screws or rivets. All labels shall be durable and legible as per IEC 61010-1.

Khorlochhu Hydro Power Ltd.

15.12.8 Safety Instruction

The panel shall be provided with safety instruction labels, including shock hazard, PPE requirements, arc flash warning, and emergency shutdown procedure. Labels shall comply with ISO 3864 and IEC 60417.

15.12.9 Current Transformer (CT)

CTs shall be in accordance with IEC 60044-1 / IEC 61869-2. Required number of single-phase CTs shall be provided for each feeder for metering and protection. CTs shall be of tape-wound resin cast type with accuracy class 1 for metering and 5P20 for protection.

15.12.10 Voltmeter

Voltmeter shall conform to IEC 60051 and shall be analog or digital type with selector switch to monitor R-Y, Y-B, B-R phase voltages. Voltage range shall be 0–500 V AC. Accuracy class shall be 1.5 or better.

15.12.11 Control Circuit Arrangement

Control and protection circuits shall be designed for 230 V AC operation. Control wiring shall be carried out with minimum 1.5 sq.mm PVC insulated copper wires conforming to IS 694. All terminal blocks shall be numbered and color-coded. Control transformers, if used, shall comply with IEC 61558.

15.12.12 Terminals and Wiring

All internal wiring shall be neatly routed through PVC ducts or cable ties. Terminal blocks shall be of reputed make with finger-safe design and proper ferruling. Separate terminals shall be provided for field wiring and internal connections.

Maintenance Requirements

Easy access shall be provided for all components in the switchgear for maintenance. As far as possible the switchgear shall be so designed that no special tools are necessary for installation and maintenance. However, if special tools are required, the Bidder shall include price of one complete set in his bid.
Telescopic trolley or suitable arrangement shall be provided for maintenance of circuit breaker module in a cubicle. The trolley shall be such that the topmost breaker module can be withdrawn on the trolley and can be lowered for maintenance purpose. The telescopic trolley shall be such that all type, size and rating of breaker can be withdrawn / inserted.

Tests

Routine tests shall be carried out on completely assembled equipment as per relevant standards. Functional tests shall be carried out to demonstrate the specified control and interlocks.
Copies of the test certificates for all brought-out items shall be submitted for the PURCHASER'S approval. The contractor shall furnish copies of all valid type test reports as per the relevant standards. Type tests shall be carried out free of cost to prove the design if not tested in the previous five years

1.124 Inspection and Testing

1.124.1 Shop Tests

All equipment shall be checked by the Contractor in order to ascertain their correct functioning and shall be witnessed by the Employer's Representative.

1.124.2 Site Tests

Tests to be performed shall include, but not be limited to, the following:

- Checking sensitivity of transducers, water level transmitters, shaft encoders etc.
- Checking of sensitivity of all Equipment.
- Checking of correct functioning and correct calibration of all Equipment.
- Automatic operation of the gates shall be tested "dry" by simulating various reservoir elevations at the level-sensing equipment.

1.125 Treatment of Surfaces

The provisions of General Technical specifications shall govern.

28. Local Control Systems

It shall consist of complete set of local controls for all equipment near their installation.

All electrical equipment shall be designed for use in a tropical climate. In order to avoid operational errors and accidents, the hoisting equipment of all gates shall be equipped with an electrically operated emergency stop such that all operations of the machine are stopped on pushing of an emergency stop button.

Wherever, PLC based local control panel is provided, a parallel hardwired control shall also be provided for open and close commands for gate to cater emergency in case of PLC failure.

Complete wiring of the hoist/ crane electrical equipment and the control device with all cables shall be included, under the scope of Contractor.

Additional electrical equipment shall comprise the following:

- A cable drum with a junction box for the power supply and electrical control cables in case of moving hoists and gantry cranes,
- A waterproof control box including a dehumidifying unit located on the hoist/ crane as specified.

The control box shall house the following equipment:

- A main selector switch (key operated) for the different modes of operation (local /remote and automatic),
- Controls comprising push buttons and relays (including overload and under voltage relays for motor) for manual/ remote and automatic as the case may be,
- A position indicator showing the exact position of the gate (in case of fixed hoist),
- A position indicator showing the exact position of the gate/ Stoplog (in case of gantry crane),
- Various alarms to indicate the operating faults,
- A transformer for the control instruments with potential separation.

In addition to above, necessary instrument required for control and measurement is to be provided by the supplier.

The following instruments but not be limited to, shall be mounted on or within the control cabinet:

- Incoming supply Moulded Case Circuit Breaker,
- Source voltmeter,
- Source pilot light,
- Load ampere meters,
- Starter for each motor,
- 230V-15A convenience outlets, from own transformer 415/230 V supply,

Khorlochhu Hydro Power

- "Gate fully raised" indicating light,
- "Gate fully lowered" indicating light,
- "Gate stopped at intermediate position" indicating light,
- "Raising" indicating light,
- "Lowering" indicating light,
- "Light test" push button for inspection of all indicating lights,
- Gate position indicator,
- Space heater to prevent moisture condensation with hydrostat,
- Moulded case circuit breakers to protect each motor circuit and other circuits,
- All other necessary transformers, relays, contactors, switches, push buttons and miscellaneous wiring components.

Following additional indications/equipment shall be provided for Gantry crane

- "Gantry crane traveling in left direction" indicating light,
- "Gantry crane traveling in right direction" indicating light,
- "Gantry crane stopped" indicating lights,
- "Trouble conditions" indicating lights,
- "Multi-step speed controller for traveling equipment.

29. Spare Parts

1.126 Mandatory Tools and Tackles

The Contractor shall provide the following tools and tackles including special tools required for maintenance, assembly and disassembly as per list detailed below:

A. **Two (2)** sets comprising of following items /instruments/equipment:

1. Torque wrench (0-150 inch pounds) 3/8 inch square drive with socket (size 6-30mm)
2. Pipe wrench 12, 14, 18 and 24 inches
3. 3/8 inch to 1/2 inch square drive reducer.
4. Screw driver socket 1/2 inch square drive
5. Sockets 1/2 inch square drive (8-24mm)
6. Extensions 1/2 inch square drive
   a) 2 inches
   b) 5 inches
7. Combination wrench one end ring and one end open (6-30mm)
8. Screw drivers
   a) 4 inches
   b) 6 inches
   c) 8 inches
   d) 12 inches
   e) 15 inches
9. Feeler gauge 4 inches long consisting of many strips
10. Nose plier – 150 mm
11. Circlip removing plier 200mm

12. Combination plier 200 mm
13. Cutting Pliers
14. Heavy duty insulated pliers
15. Tweezers (small)
16. Plastic Hammer (15, 25 & 30 mm)
17. Half-moon spanner 3/8 inch * 5/8 inch
18. Allen key set (1.5 - 20 mm)
19. Ball-peen Hammer (2 lb)
20. Hammer (5 lb)
21. Mallet (Wooden Hammer)
22. D.E. spanner set 6mm to 32 mm
23. Ring spanner set 6 mm to 32 mm
24. Box spanner with handle
25. Adjustable spanner 12 inches
26. Adjustable spanner 6 inches
27. Socket spanner set 8 mm to 32 mm
28. Lineman's plier 8 inch
29. Spirit level
30. Soldering iron 15W
31. Wire stripper cum crimpling tool

All items 1 to 31, shall be of reputed make like Taparia/Jhalani.

B. **One (1)** set comprising of following items / instruments / equipment:

1. Digital clamp meter 500V AC/DC, 20Amp AC/DC including Continuity tester and line tester
2. D Sackle 1t capacity
3. D Sackle 2t capacity
4. Chain Pulley block 2t capacity
5. Chain Pulley block 5t capacity
6. Bearing puller

Item 1 shall be of Fluke / MECO / of reputed make and Items 2 to 5 shall be of reputed make and Item 6 shall be of SKF/ FAG/ reputed make.

C. Two (2) Nos. Tool boxes for above A & B shall be of good quality.

1.127 Mandatory Spare Parts

The Contractor shall provide the following mandatory spares for various gates, hoists, cranes and other equipment as detailed below:

1.127.1 Spillway Radial gates and Hydraulic Hoists

Five (5) complete sets of rubber seals including fasteners and clamp plates for radial gates.

Five (5) complete sets of bearing sets of bearing/bush and washers with one set comprising of all bearing/bush and washers installed on one trunnion assembly.

Five (5) sets of Bush and washers for guide roller assembly of radial gates.

Ten (10) sets of Seals for hydraulic hoist cylinder.

Five (5) sets of bearings/bushes for electric motors of hydraulic units.

Ten (10) sets of Clevis ends bearings of hydraulic hoist cylinder.

Ten (10) sets of Gaskets (O-rings) for each hydraulic unit.

Ten (10) sets of fuses, auxiliary contactors, push buttons, indication lamps, switches, relays, limit switches, timer / delays for hydraulic hoist.

Ten (10) sets of filters for radial gate hydraulic hoist.

Five (5) sets of control valves, pressure gauge, pressure switches for radial gate hydraulic unit.

Two (2) sets of filter for gasoline engine operated hydraulic unit.

One (1) set of control valves, pressure gauge, pressure switches, fuses, auxiliary contactors, push buttons, indication lamps etc. for gasoline engine operated hydraulic unit.

One set of bearings/bushes for electric motors of portable oil filter unit.

Four (4) sets of filters/papers for portable oil filter unit.

Two (2) set of fuses, auxiliary contactors, push buttons, indication lamps etc. for portable oil filter & low vacuum dehydration and degasification unit.

1.127.2 Spillway Stop Logs & Gantry Crane

One (1) complete set of rubber seals including fasteners for spillway stop logs.

Two (2) sets of brake shoe for different brakes of gantry crane.

Two (2) sets of guide roller assembly including fasteners

One (1) set of bearings/bushes for gantry crane.

One (1) set of fuses, auxiliary contactors, push buttons, indication lamps, switches and limit switches for gantry crane.

Two (2) sets of bushes/bearings for electric motors for gantry crane.

One (1) set of all types of grease nipples.

1.127.3 Overflow Spillway Service Gates & Motorized Screw Hoist

One (1) set of Rubber seal along with fasteners for Overflow Spillway Service gate.

One set of Complete Wheel Assembly for Overflow spillway service gate.

One (1) set of bearings/bushes for electric motors of screw hoist of service gate.

One (1) set of brake shoes for each type of Hoist brakes for screw hoist of Service gate.

One (1) set each of fuses, auxiliary contactors, push buttons, indication lamps, switches, limit switches and relays of screw hoist of Overflow spillway gate.

One (1) sets of Control valves, pressure gauge, pressure switches for screw hoist of Overflow spillway gate.

1.127.4 Trash Rack Cleaning Machine

One (1) set of Detachable stainless steel / high strength polypropylene sheet combing rake teeth strip with fasteners

One (1) set of control relays

One (1) set of terminal switch

One (1) set of limit switch

One (1) set of push button

One (1) set of brake linings for each type of brakes

One (1) set of motor carbon brushes

Two (2) sets of fuse elements

Two (2) sets of 10% of all nuts, bolts and washers

One (1) set of all types of grease nipples

One (1) set of solenoid, valves, pressure gauge, and pressure switch of each type

Two (2) sets of oil filter

One (1) set of 10% hydraulic oil of each type.

1.127.5 Intake Gate Rope drum Hoists

One (1) set of rubber seal along with fasteners for intake gate.

Two (2) sets of complete wheel assembly for intake gate.

One (1) set of bearings for electric motors of rope drum hoist of Intake gate.

Two (2) sets of brake shoes for rope drum hoist of intake gate.

One (1) set of bearing/bushes for Rope drum Hoist.

One (1) set each of fuses, auxiliary contactors, push buttons, indication lamps, switches, limit switches and relays of rope drum hoist for intake gate.

Two (2) sets each of bush and washers of guide roller assembly of intake gate

1.127.6 Intake Bulk head gate and Gantry Crane

One (1) set of rubber seal along with fasteners for bulkhead gate.

One (1) set of brake shoes for different brakes of gantry crane.

One (1) set of bearings/bushes for gantry crane.

One (1) set each of fuses, auxiliary contactors, push buttons, indication lamps, switches, limit switches and relays for gantry crane.

One (1) set of bush/bearing for electric motors of gantry crane

One (1) set each of bush and washers of guide roller assembly of both type of intake gate.

1.127.7 Downstream Desilting Basin Gate and Rope Drum Hoist

One (1) set of gate rubber seals and fasteners.

Two (2) sets of complete wheel assembly

One (1) set of bearing/bushes for electric motors of rope drum hoist

One (1) set of brake shoes for each type of hoist brake for rope drum hoist

One (1) set of bushes/bearing for Rope drum Hoist

One (1) set of fuses, auxiliary contactors, push button, indication lamps switches, limit switches and relays for rope drum hoist for downstream desilting basin gate.

Two (2) set of bush and washers for guide roller assembly of downstream desilting basin gate

1.127.8 Flushing tunnel Service Gates and Hydraulic Hoists

Two (2) sets of seals and fasteners for flushing tunnel gates

Two (2) sets of hoist cylinder seals

Two (2) sets of hydraulic hoist motor bushes/bearings.

Two (2) sets of Clevis end bearings for hydraulic hoist

Two (2) sets of gaskets (O-rings) for bonnet covers

Two (2) sets of sealing for piston rods gland box

Two (2) sets of fuses, auxiliary contactors, push button indicator lamps, switches relays and limit switches for hydraulic hoist.

Two (2) sets of filters, control valves, pressure gauge, and pressure switch of hydraulic power pack.

1.127.9 Flushing tunnel Emergency Gates and Hydraulic Hoists

Two (2) sets of seals and fasteners for flushing tunnel gates

One (1) set of hoist cylinder seals

Khorlochhu Hydro Power Ltd.

One (1) set of hydraulic hoist motor bushes/bearings.

One (1) sets of Clevis end bearings for hydraulic hoist

One (1) sets of gaskets (O rings) for bonnet covers

Two (2) sets of sealing for piston rods gland box

1.127.10 Surge Shaft Gate and Hoist

Two (2) sets of rubber seals including fasteners for surge shaft gate.

Two (2) sets of bearings/bushes for electric motors of rope drum hoist of surge shaft gate

Two (2) sets of brake shoes for each type of hoist brakes for rope drum hoist

Two (2) sets of bearings/bushes for rope drum hoist

One (1) set of fuses, auxiliary contactors, push button, indicator lamps, switches, relays and limit switches for rope drum hoist for surge shaft gates

1.127.11 Tailrace Tunnel Gates and Hoists

Two (2) sets of rubber seals including fasteners for gates

Two (2) sets of brake shoes for different brakes of gantry crane

One (1) set of bearings/bushes for gantry crane

One (1) set of fuses, auxiliary contactors, push buttons, indication lamps, switches, limit switches and relays for rope drum hoist of gates.

Two (2) sets of bush/bearings for electric motors of gantry crane

Two (2) sets of bush and washers of guide roller assembly for gates.

1.127.12 TRT Outfall Gate and Hoists

Two (2) sets of rubber seals including fasteners for gates

One (1) set of complete wheel assembly for TRT outfall gate

One (1) set of bearings for electric motors of rope drum hoist for gates.

One (1) set of brake shoes for rope drum hoist of gates.

One (1) set of bearing/bushes for rope drum hoist

One (1) set of fuses, auxiliary contactors, push buttons, indication lamps, switches, limit switches and relays of rope drum hoist for gates.

Two (2) sets of bush and washers for guide roller assembly of gates.

1.127.13 Adit Inspection Gates

Two (2) sets of rubber seals assembly along with fasteners etc. for gates.

1.127.14 Pressure Shaft Steel Liners

Six (6) sets of Manhole gaskets

1.127.15 Chaplangchhu Intake Gate and Motorized screw Hoist

One (1) set of rubber seal along with fasteners for Chaplangchhu Intake gate

One (1) set of complete Wheel assembly for Chaplangchhu Intake gate

One (1) set of bearings/bushes for electric motors of screw hoist of Chaplangchhu Intake gate

One (1) set of brake shoes for each type of Hoist brakes for motorized Hoist

One (1) set of Fuses, auxiliary contactors, push-buttons, indication lamps, switches, limit switches and relays for screw hoist for Chaplangchhu Intake gate

One (1) sets of Control valves, pressure gauge, pressure switches for screw hoist of Chaplangchhu Intake gate

Khorlochhu Hydro Power Ltd.

1.127.16 Chaplangchhu Desilting Chamber Gate and Motorized screw Hoist

One (1) set rubber seal along with fasteners for Chaplangchhu Desilting Chamber gate.

One (1) set of bearings/bushes for electric motors of screw hoist of Chaplangchhu Desilting Chamber gate.

One (1) set of brake shoes for each type of Hoist brakes for motorized Hoist

One (1) sets of Control valves, pressure gauge, pressure switches for screw hoist

One (1) set of fuses, auxiliary contactors, push-buttons, indication lamps, switches, limit switches and relays for screw hoist for Chaplangchhu Desilting chamber gate.

1.127.17 Chaplangchhu Silt Flushing Tunnel Gate and Hydraulic Hoist

One (1) set of rubber seal along with fasteners for Silt flushing tunnel gate

One (1) set of Fuses, auxiliary contactors, push-buttons, indication lamps, switches, relays and limit switches, timer /delays for hydraulic hoist

One (1) set of Filters, control valves, pressure gauge and pressure switch of hydraulic power pack

One (1) set of Hydraulic hoist motor bushes/bearings

One (1) set of hydraulic cylinder seals

One (1) set of clevis end bearings for hydraulic hoist

One (1) set of gasket (O-rings) for bonnet covers

One (1) set of sealing for piston rods gland box

1.127.18 Chaplangchhu De-gravelling Gate and Hydraulic Hoist

One (1) set of rubber seal along with fasteners for Silt flushing tunnel gate

One (1) set of Fuses, auxiliary contactors, push-buttons, indication lamps, switches, relays and limit switches, timer /delays for hydraulic hoist

One (1) set of Filters, control valves, pressure gauge and pressure switch of hydraulic power pack

One (1) set of Hydraulic hoist motor bushes/bearings

One (1) set of cylinder seals

One (1) set of clevis end bearings for hydraulic hoist

One (1) set of gasket (O-rings) for bonnet covers

One (1) set of sealing for piston rods gland box

1.127.19 Aquatic Life Discharge Piping with Valves

Two (2) sets of stainless steel knife plate for knife-edge gate valve.

Two (2) sets of gland packing for knife-edge gate valve.

Two (2) sets of Stainless steel stem for knife-edge gate valve.

Two (2) sets of key for knife-edge gate valve.

Two (2) sets of Thrust ring/Thrust bearing (not applicable for valves operated through gear box)

Two (2) sets of Rubber seat ring for knife-edge gate valve.

Two (2) sets of Teflon sheet ring for knife-edge gate valve.

Two (2) sets of fuse for valve control panel.

1.127.20 Instruments and Local Control Panels

Ten (10) nos. each type of contacts

Ten (10) nos. of each set of all fuse elements

There (3) sets of Position transmitter for spillway radial Gates

Two (2) sets of Position transmitter for intake gates

Two (2) sets of Position transmitter for silt flushing gates

Three (3) sets of Digital position indicator for spillway radial gates

Two (2) sets of Digital position indicator for intake gates

Two (2) sets of Digital position indicator for silt flushing gates

Two (2) sets of Differential pressure instrument for trash rack

Two (2) sets of Gravel level sensors and transmitter for Chaplangchhu de-graveling

17.2.22 Individual Distribution Panel

Two (2) nos. MCCB of each type used.

Two (2) nos. MCB of each type used.

Two (2) nos. Current transformer.

Two (2) nos. of each type of voltmeter.

Ten (10) nos. of each type of Indication lamps used including assemblies.

Ten (10) nos. Fuses of each type used.

Two (2) nos. of each type of Control and instrumentation switches.

Two (2) nos. Contactors of each type used.

Two (2) nos. of each type of indicating instruments.

One (1) no. of each type of buzzer /siren .

One (1) no. of each Type of Timer .

1.128 Recommended Spare Parts

If any additional spare parts are recommended by the tenderer, these shall be stated in quantity and description in the Technical Data Sheets for each item.

Orders for recommended spare parts shall be optional to the Employer for a period of three years after the date of Contract award.

1.129 Recommended Special Tools and Tackles

If any additional tools and tackles are recommended by the tenderer, these shall be stated in quantity and description in the technical data sheets for each item.

Orders for recommended tools and tackles shall be optional to the Employer, for a period of three years after the date of Contract award.

30. Data Sheets

Data sheets represent technical questionnaire to be furnished in filled up form with the tender. The data under sub head "**Guaranteed Technical Particulars**" will form an integral part of the contract and will be reviewed for evaluation and is a confirmation of the bidder having agreed to abide by this data during execution. The data under sub head "**Tentative Technical Particulars**" will not form an integral part of the contract but will be only informative in nature and may be used by Employer to see that it meets in general the requirements of specification. This data will not in any way prejudice or overrule the requirements of the specifications and shall be purely tentative to be finalized during detailed design by the successful bidder.

The Tenderer is, therefore, requested to read these Data Sheets with care and to complete them most conscientiously and with every necessary detail.

Khorlochhu Hydro Power Ltd.

SECTION-8

QUALITY ASSURANCE PLAN (QAP)



SECTION-8: QUALITY ASSURANCE PLAN

1.0 Special Instructions: -

1. Bidders/Contractors/Manufacturers/Sub-suppliers are required to submit final QAP for equipment/materials after incorporating all the tests given in this modal QAP and all tests for bought out items, in process/ final inspection as per their latest manufacturing practices and Indian/ International Standards (with latest amendments, if any).
2. Bidders/Contractors/Manufacturers/Sub-suppliers are required to use properly calibrated instruments/equipment during testing/inspection, for which necessary calibration certificates are required to be provided/presented to the Inspecting Officer.
3. Bidders/Contractors/Manufacturers/Sub-suppliers have to make on their own all arrangements for testing facilities at their works/works of sub-vendor for testing of equipment/materials.
4. One set of complete test certificates as per the requirement of QAP shall be made available to the Inspecting Officer at the time of inspection/testing.
5. All the records, as per the requirement of final QAP shall be made available for review by the Inspecting Officer during Inspection.
6. **All Field tests at project site are to be carried out as per the requirements of the contract/ Purchase order.**
7. The terms TC, IR, JIR wherever appearing in the QAP shall represent “Test Certificate”, “Internal Record” and “Joint Inspection Report” respectively.



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

2.0 2nd Stage Embedded Part for all Gates, Sill Beam, Guide etc. (Two sheets)

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
A.	**Raw Material**								
1.	Structural Steel - Steel Plates, Steel Sections like Angles, Channel, Beam etc.	Chemical Properties & Mechanical Properties	Sample	Tech. Spec./Relevant IS/Approved Drawing	TC	3/2	-	1	TC
2.	Stainless Steel	Chemical Properties & Mechanical Properties	Sample	Tech. Spec./Relevant IS/Approved Drawing	TC	3/2	-	1	TC
B.	**Bought Out Items**								
i)	Hardware (Fasteners)	Chemical Properties & Mechanical Properties	Sample	Tech. Spec./Relevant IS/Approved Drawing	TC	3/2	-	1	TC
C.	**In Process**								
1	Welding	Visual / Measurement	100%	Tech. Spec./Relevant IS/Approved Drawing	IR	3/2	-	1	RR
i)	Fillet Welds	D.P. Test	100%	Tech. Spec./Relevant IS/Approved Drawing	TC	3/2	-	1	TC
ii)	Full Strength Welds- (Butt Weld)	Radiography/ U.T	100%	Tech. Spec./Relevant IS/Approved Drawing	TC	3/2	-	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
3	Machining(Roller track, seal track)	Visual / Measurement	100%	Tech. Spec./Relevant IS/Approved Drawing	IR	3/2	-	1	RR
D	**Final Inspection**								
1	Dimensional Checks	Measurement	100%	Tech. Spec./Relevant IS/Approved Drawing	JIR	3/2	1	-	CHP
2	Welding Examination								
i)	Weld Size	Visual / Measurement	at random	Tech. Spec./Relevant IS/Approved Drawing	JIR	3/2	1	-	CHP
ii)	Fillet Weld	D.P Test	10% of Fillet welds length	Tech. Spec./Relevant IS/Approved Drawing	JIR	3/2	1	-	CHP
3	Surface Finish (Machined Surface)	Visual/Comparison with Comparator	100%	Tech. Spec./Relevant IS/Approved Drawing	JIR	3/2	1	-	CHP
4	Shop Assembly (Frames & Guides)	Visual/Measurement	100%	Tech. Spec./Relevant IS/Approved Drawing	JIR	3/2	1	-	CHP
5	Grid Blasting-Surface preparation	Visual	100%	Tech. Spec./Relevant IS/Approved Drawing	TC	3/2	-	1	TC
6	Primer/Paint Coating	Visual & measurement (DFT)	100%	Tech. Spec./Relevant IS/Approved Drawing	TC	3/2	-	1	TC

Note:
a. In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
b. In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

3.0 Radial Gates (Gate Leaf) (Two sheets)

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
A.	**Raw Material:**								
i)	Structural Steel-Skin Plates, Vertical Stiffeners, Horizontal Girder, Arms, Bracings, Rest Beam etc.	Mechanical and Chemical properties	Sample/Lot	Relevant Std./App.Drg./Tech Spec.	TC	3/2	-	1	TC
ii)	Stainless Steel	Mechanical and Chemical properties	Sample/Lot	Relevant Std./App.Drg./Tech Spec.	TC	3/2	-	1	TC
B.	**Brought Out Items:** Guide Roller, Guide Roller Bearing, Bushing, Pin, Fasteners, Rubber Seals, etc.	Material Properties/Dimension Report	100%	Relevant Std./App.Drg./Tech Spec.	TC	3/2	-	1	TC
3	**In Process**								
i)	Edge Preparation	Visual/Measurement	100%	Relevant Std./App.Drg./Tech Spec.	IR	3/2	-	1	RR
ii)	Dimensional checks(Welding Tack Up)	Measurement	100%	Relevant Std./App.Drg./Tech Spec.	IR	3/2	-	1	RR
iii)	Curvature of Skin Plate	Measurement	100%	Relevant Std./App.Drg./Tech Spec.	IR	3/2	-	1	RR
iv)	**Welding**								
1)	Fillet Weld	DPT	100%	Relevant Std./App.Drg./Tech Spec.	TC	3/2	-	1	TC
2)	Butt Weld	X-Ray/UT	100%	Relevant Std./App.Drg./Tech Spec.	TC	3/2	-	1	TC
v)	Guide Roller Assembly	Measurement (fitment & Tolerance)	100%	Relevant Std./App.Drg./Tech Spec.	IR	3/2	-	1	RR

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
C.	**Final Inspection**								
i.	Profile of skin Plate on fixture	Measurement	100%	Relevant Std./App.Drg./Tech Spec.	JIR	3/2	1	-	CHP
ii.	Welding Examination	Visual / Measurement	-do-	-do-	JIR	3/2	1	-	CHP
iii.	NDT-Fillet Welds	D.P. Test	10% of fillet weld	-do-	JIR	3/2	1	-	CHP
iv.	Cladding of Skin Plate	Visual /NDT	100%	-do-	JIR	3/2	1	-	CHP
v.	Dimensional Check	Measurement	-do-	-do-	JIR	3/2	1	-	CHP
vi.	Shop Assembly on Fixture (Dimensional Check, Match Marking)	Assembly of Gate Leaf	-do-	-do-	JIR	3/2	1	-	CHP
vii.	Sand Blasting (surface preparation)	Visual	-do-	-do-	TC	3/2	-	1	TC
viii.	Painting	Visual / Measurement	-do-	-do-	TC	3/2	-	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

4.0 Radial Gates – Trunnion Assembly and Radial Gate Arms (Two sheets)

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
A.	**Raw Material**								
1	Structural Steel - Trunnion Bracket Arms	Mech. & Chem. Properties	Samples	Relevant Std./App.Drg./Tech Spec.	TC	3/2	-	1	TC
2	Cast / forged Steel - Trunnion Hub	Ultrasonic Testing	100%	-do-	TC	3/2	-	1	TC
B.	**Bought Out Items**								
	(Trunnion Bush, Trunnion Pin, Washers, Screws, Nuts and Boils)	Dim. Report & Material Properties	100%	Relevant Std./App.Drg./Tech Spec.	TC	3/2	-	1	TC
C.	**In Process Inspection Fabrication**								
1	Surface defects	Visual	100%	Relevant Std./App.Drg./Tech Spec.	IR	3/2	-	1	RR
2	Fit-up Joints	Visual/Measurement	-do-	-do-	IR	3/2	-	1	RR
3	**Welding**								
a)	Fillet Welds	DP Test	-do-	Relevant Std./App.Drg./Tech Spec.	TC	3/2	-	1	TC
b)	Full strength Welds	Radiography/UT	-do-	Relevant Std./App.Drg./Tech Spec.	TC	3/2	-	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
4	Weld Thickness	Visual / Measurement	100%	Tech Spec. /App.Drg. / Relevant Std.	IR	3/2	-	1	RR
5	Post Weld Stress relieving	Heat Treatment	-do-	-do-	TC	3/2	-	1	TC
6	Machining	Measurement	-do-	-do-	IR	3/2	-	1	RR
D	**Final Inspection**								
1	Dimension Check	Measurement	100%	Tech Spec. /App.Drg. / Relevant Std...	JIR	3/2	1	-	CHP
2	Welding Check	Visual	-do-	-do-	JIR	3/2	1	-	CHP
3	Fillet Welds	D.P. Test	10% of fillet weld length	-do-	JIR	3/2	1	-	CHP
4	Surface finish- Machined Surface	Visual	100%	-do-	JIR	3/2	1	-	CHP
5	Shop Trail Assembly (Fit-up of Trunnion Bush & Pin into Trunnion Hub and Trunnion Hub and Trunnion Bracket)	Fits and Clearance Measurement	-do-	-do-	JIR	3/2	1	-	CHP
6	Grit blasting (surface preparation)	Measurement	-do-	-do-	TC	3/2	-	1	TC
7	Painting	Measurement	-do-	-do-	TC	3/2	-	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

5.0 Fixed Wheel Type Gates (Two sheets)

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
A.	**Raw Material**								
1	Structural Steel-Skin Plates, Vertical Stiffeners, Horizontal Girder, Steel Section like Channel, Beam etc.	Chemical Properties & Mechanical Properties	Sample	Tech. Spec./ Relevant IS/ Approved Drawing	TC	3/2	-	1	TC
2	Stainless Steel	-do-	-do-	-do-	TC	3/2	-	1	TC
3	Forged Steel/Cast Steel	-d0-	100%	-do-	TC	3/2	-	1	TC
4	Plates, Forged / Cast Steel	UT	-do-	-do-	TC	3/2	-	1	TC
B.	**Bought Out Items**								
1	Hardware (Fasteners)	Dimension Report / Material Properties	100%	-do-	TC	3/2	-	1	TC
2	Rubber Seals	-do-	-do-	-do-	TC	3/2	-	1	TC
3	Bushing, Bearing	-do-	-do-	-do-	TC	3/2	-	1	TC
C.	**In Process**								
1)	**Structural Steel, Stainless Steel & Forged Steel**								
i)	Edge Preparation	Visual	100%	-do-	IR	3/2	-	1	RR
ii)	Dimensional Checks in Track Position	-do-	-do-	-do-	IR	3/2	-	1	RR
2)	**Welding**	Visual/Measurement	-do-	-do-	IR	3/2	-	1	RR
i)	Fillet Welds	D.P.Test	100% Fillet welds length	-do-	TC	3/2	-	1	TC
ii)	Full Strength Welds-(Butt Weld)	Radiography/U.T	100%	-do-	TC	3/2	-	1	TC

Note: a. In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
b. In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
3)	**Machining Dimension**								
i)	Seal Bases, Clamp Bar, Rollers, Wheels & Guide Brackets	Visual & Measurement	100%	Tech. Spec./Relevant IS/Approved Drawing	IR	3/2	-	1	RR
ii)	Sub Assembly of Gate Wheels	-do-	-do-	-do-	IR	3/2	-	1	RR
iii)	Dimension (Fits & Tolerances)	-do-	-do-	-do-	IR	3/2	-	1	RR
4)	C.G. Establishment/Gate Units	-do-	-do-	-do-	IR	3/2	-	1	RR
D.	**Final Inspection**								
1	Dimensional Check on assembled Gate Units	Measurement	-do-	-do-	JIR	3/2	1	-	CHP
2	Welding Examination	Visual / Measurement	-do-	-do-	JIR	3/2	1	-	CHP
i)	Fillet Welds	D.P. Test	10% of Fillets welds	-do-	JIR	3/2	1	1	CHP
3	Surface Finish (If applicable) (Machined Surface	Visual/Comparison with Comparator	100%	-do-	JIR	3/2	1	-	CHP
4	Grid blasting & Painting	Visual / Measurement	100%	-do-	TC	3/2		1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

6.0 Slide Type Gates (Three sheets)

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
A.	**Raw Material**								
1	Structural Steel-Skin Plates, Vertical Stiffeners, Horizontal Girder, Steel Section like Channel, Beam etc.	Chemical Properties & Mechanical Properties	Sample	Tech. Spec./ Relevant IS/ Approved Drawing	TC	3/2	-	1	TC
2	Stainless Steel (Seal Seats)	-do-	-do-	-do-	TC	3/2	-	1	TC
3	Forged Sleek/Cast Steel	-do- & UT also	100%	-do-	TC	3/2	-	1	TC
B.	**Bought Out Items**								
1	Hardware (Fasteners)	Dimension Report / Material Properties	100%	-do-	TC	3/2	-	1	TC
2	Rubber Seals	-do-	-do-	-do-	TC	3/2	-	1	TC
3	Bushing, Bearing	-do-	-do-	-do-	TC	3/2	-	1	TC
4	Material for filling – in Valves (As applicable)	-do-	-do-						
C.	**In Process**								
1)	**Structural Steel, Stainless Steel & Forged Steel**								
i)	Edge Preparation	Visual / Measurement	100%	-do-	IR	3/2	-	1	RR
ii)	Dimensional Checks in Track Position	-do-	-do-	-do-	IR	3/2	-	1	RR
2)	**Welding**	Visual/Measurement	-do-	-do-	IR	3/2	-	1	RR
i)	Fillet Welds	D.P.Test	100% Fillet welds length	-do-	TC	3/2	-	1	TC
ii)	Full Strength Welds-(Butt Weld)	Radiography/U.T	100%	-do-	TC	3/2	-	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
3	**Machining Dimension**								
i)	Thrust Pads, Seal Seals, Seal Clamp Bars, and Guide Brackets and Lifting Brackets on Welded Gates Units.	Measurement	100%	Tech. Spec./Relevant IS/Approved Drawing	IR	3/2	-	1	RR
ii)	Sub Assembly of Filling-in-Valve (As applicable)	Dimensional	-do-	-do-	IR	3/2	-	1	RR
iii)	Sub Assembly of sill level Sensing Device(if provided)	Dimensional	-do-	-do-	IR	3/2	-	1	RR
iv)	Dimensional Checks	-do-	-do-	-do-	IR	3/2		1	RR
v)	C.G. Establishment/Gate Units	-do-	-do-	-do-	IR	3/2	-	1	RR

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
D.	**Final Inspection**								
1	Dimensional Check on assembled Gate Units	Measurement	100%	Tech. Spec./ Relevant IS /Approved Drawings	JIR	3/2	1	-	CHP
2	Welding Examination	Visual / Measurement	100%	-do-	JIR	3/2	1	-	CHP
i)	Fillet Welds	D.P. Test	10% of Fillets welds	-do-	JIR	3/2	1	-	CHP
3	Surface Finish (Machined Surface	Visual/Comparison with Comparator	100%	-do-	JIR	3/2	1	-	CHP
4	Functional Test of Filling - in- Valve with Lifting Beam (As applicable)	Visual	100%	-do-	JIR	3/2	1	-	CHP
5	Grid blasting	Surface Finish	100%	-do-	TC	3/2	-	1	TC
6	Painting	Visual & measurement (DFT)	-do-	-do-	TC	3/2	-	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

7.0 Travelling Gantry Crane (Four sheets)

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
A.	**Raw Material**								
1	Structural Steel (Crane Structure, Columns, Rails etc.)	Chemical Properties & Mechanical Properties	Sample	Relevant Std. /Approv. Drawings/ Tech. Spec	TC	3/2	-	1	TC
2	Cast/Forged Steel (Wheels, Shafts, Pins, Gears, Sheaves and Rope Drums)	Chem. & Mech. Properties and UT Test	-do-	-do-	TC	3/2	-	1	TC
B.	**Bought Out Items**								
1	Electric Motors (Main Hoist & Aux. Hoist CT & LT Drive) Routine Test	Electrical	100%	-do-	TC	3/2	-	1	TC
2	Electro-Magnetic Brakes / Thruster Brakes		-do-	-do-	TC	3/2	-	1	TC
2.1	Dimensional Check	Measurement	-do-	-do-	TC	3/2	-	1	TC
2.2	Routine Test (Breaking Torque)	Electrical	-do-	-do-	TC	3/2	-	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
3	Gear Boxes- Routine Test	Test	100%	Relevant Std. /Approv. Drawings/ Tech. Spec.	TC	3/2	-	1	TC
4	Misc. Items: (Wire Rope, Bearings, Plummer Blocks	'Chemical, Mech. Properties & Dim.	100%	-do-	TC	3/2	-	1	TC
C	**In Process- Fabrication**								
1	Welding								
i)	Fillet Weld	DPT	100% of Fillet weld	-do-	TC	3/2	-	1	TC
ii)	Full strength Weld	X-Rays/UT	100%	-do-	TC	3/2	-	1	TC
2	Post Weld Heat Treatment (Fabricated Rope Drum, Gear Box housing)	Heat Treatment	-do-	-do-	TC	3/2	-	1	TC
3	Machining (Rope Drums, Wheels, Shaft, Axle, Sheaves, Brake Drums, Dimensional Checks.	Measurement	-do-	-do	IR	3/2	-	1	RR

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
4	Sub assembly- Wheel Bogies Assembly, Gear Pinions & Shaft, Plumber Bocks Gear Boxes & Motors with Couplings	Alignment, Noise Level, Vibration, Gear Box Leakage	100%	Relevant Std./App.Drg./Tech Spec.	IR	3/2	-	1	TC
D	Final Inspection and Testing with original control panel								
1	BOM Check	Visual	-do-	-do-	JIR	3/2	1	-	CHP
2	Dimensional check on assembled Crane	Measurement	-do-	-do-	JIR	3/2	1	-	CHP
3	Hoist speed-full load	-do-	-do-	-do-	JIR	3/2	1	-	CHP
4	Lowering speed-full load	-do-	-do-	-do-	JIR	3/2	1	-	CHP
5	Over Load Test at 125 % of rated load	-do-	-do-	-do-	JIR	3/2	1	-	CHP

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
6	Brake Test - Hoist up and Lowering	Visual	100%	Relevant Std. /Approv. Drawings/ Tech. Spec.	JIR	3/2	3/2	-	CHP
7	L.T. & C.T speeds	Measurement	-do-	-do-	JIR	3/2	1	-	CHP
8	Control Panel	-do-	-do-	-do-	JIR	3/2	1	-	CHP
8.1	Cubicle Dimensions	Electrical	-do-	-do-	JIR	3/2	1	-	CHP
8.2	IR Test	Electrical	-do-	-do-	JIR	3/2	1	-	CHP
8.3	HV Test	-do-	-do-	-do-	JIR	3/2	1	-	CHP
8.4	Functional test & Interlocking	Visual	-do-	-do-	JIR	3/2	1	-	CHP
9	Grit blasting Surface finish	Measurement	At random	-do-	TC	3/2	-	1	TC
10	Painting	-do-	-do-	-do-	TC	3/2	-	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

8.0 Hydraulic Hoist (Cylinder) (Two sheets)

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
A	**RAW MATERIAL:-** Hydraulic Cylinder, Piston & Allied parts	Chemical & Mechanical Properties	Sample	Tech. Spec./App. Drawings/Relevant IS	TC	3/2	_	1	TC
B	**BOUGHT OUT ITEMS :-** Seal, Spherical bearing, Control Valves etc.	Dim. Report & Material Properties	Sample	-do-	TC	3/2	_	1	TC
C	**IN PROCESS**								
1	Welding :- If applicable								
i)	Butt Weld [Before Stress Relieving]	UT/Radiography	100%	Tech. Spec./App. Drawings/Relevant IS	TC	3/2	_	1	TC
ii)	Fillet Weld [Before Stress Relieving]	DPT	100%	-do-	TC	3/2	_	1	TC
iii)	Post Weld Stress Relieving	Heat treatment	100%	-do-	TC	3/2	_	1	TC
iv)	Welding Test	Radiography/UT/DPT	100%	-do-	TC	3/2	_	1	TC
2	Machining of major items Cylinder, Piston Rod, Piston, End Flanges, etc.	Visual/Measurement	100%	Tech. Spec./App. Drawings/Relevant IS	IR	3/2	_	1	RR
3	Hydrostatic Pressure Test	Visual/Measurement	100%	Tech. Spec./App. Drawings/Relevant IS	TC	3/2	_	1	TC
4	Chrome Plating, Polishing(Piston Rod)	Visual/Measurement	100%	Tech. Spec./App. Drawings/Relevant IS	IR	3/2	_	1	TC
5	Dimensions	Measurement	100%	Tech. Spec./App. Drawings/Relevant IS	TC	3/2	_	1	RR
6	Fitment of Cylinder components :- Fits & Tolerance	Clearance Measurement	100%	Tech. Spec./App. Drawings/Relevant IS	TC	3/2	_	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
D	**Final Inspection**								
1	Dimensional checks	Measurement	100%	Tech.Spec./Approved drawing	JIR	3/2	1	_	CHP
2	Travel of Stem at Test Pressure - Stroke Length(Smooth Operation)	Visual/Measurement	100%	Tech.Spec./Approved drawing	JIR	3/2	1	_	CHP
3	Leakage Test at Working Pressure(Hydrostatic Pressure Test)	Visual/Measurement	100%	Tech.Spec./Approved drawing	JIR	3/2	1	_	CHP
4	Max. Speed & Min. Speed - Functional Tests	Visual/Measurement	100%	Tech.Spec./Approved drawing	JIR	3/2	1	_	CHP
5	Grit Blasting & Painting	Visual/Surface Quality	100%	Tech.Spec./Approved drawing	TC	3/2	-	1	TC
5.1	Dry film thickness	Measurement	Random	Tech.Spec./Approved drawing	TC	3/2	-	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

9.0 Hydraulic Power Pack (Spillway Radial Gate and Flushing Tunnel (Gate) (Two sheets)

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
A	**Hydraulic Equipment & Accessories**								
1	Pump								
a	Make and Type	Visual	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
b	Capacity/Rating	Visual	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
2	Oil Filter & Pressure Filter								
a	Make and Type	Visual	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
b	Capacity/Rating	Visual	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
3	Pressure Gauge, Pressure Switch. Float Switch etc.								
a	Make and Type	Visual	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
b	Capacity/Rating	Visual	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
4	Control Valves	Pressure Test	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
5	Electric Motor								
a	Make, Model & Rating	Visual	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
b	IR Test	Electrical	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
c	HV Test	Electrical	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
d	Full Load RPM	Electrical	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
6	Function of power pack with control cabinet along with piping and pipe fitting for normal and full	Functional	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
7	Oil Tank								
a	Dimensions	Measurement	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
b	Leakage Test/Hydrostatic Test	Visual	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
8	Pipe & Pipe fittings								
a	Dimensions	Measurement	100%	Relevant std./Tech. Spec./Approved Drg	Log Sheet	3/2	_	1	RR
b	Pressure Test	Visual/Measurement	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
B	**Control Panel**								
1	Verification of Material. Rating of Components	Visual	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
2	General layout of components	Visual	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
3	Overall Dimensions	Verification	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
4	IR Test	Measurement	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
5	HV Test	Measurement	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
6	Electric Operational Checks	Visual	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
7	Painting								
a	Visual Check	Visual	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
b	Dry film thickness	Measurement with coat gauge	Random(10 to 20 % of surface area)	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

10.0 Gasoline Driven-Emergency Power Pack Unit- Hydraulic Hoist (Two sheets)

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
A	**Bought Out Items**								
1	**Gasoline Engine**								
i)	Make, Model, Type,	Co-relation of TC	100%	Relevant Std./Tech. Spec./Approved Drgs.	TC	3/2	_	1	TC
ii)	Engine Power(KW/HP)	-do-	-do-	-do-	TC	3/2	-	1	TC
iii)	Max. rpm	-do-	-do-	-do-	TC	3/2	-	1	TC
2	Fuel Consumption	Measurement	100%	Relevant Std./Tech. Spec./Approved Drgs.	JIR	3/2	1	_	CHP
3	Fuel Tank Cap.	Measurement	100%	Relevant Std./Tech. Spec./Approved Drgs.	TC	3/2	_	1	TC
4	Filters	Filtration Std.	100%	Relevant Std./Tech. Spec./Approved Drgs.	TC	3/2	_	1	TC
5	Hydraulic Pump	Flow Rating, Max. Working Pr., Max. Speed	100%	Relevant Std./Tech. Spec./Approved Drgs.	TC	3/2	_	1	TC
6	Flexible Coupling								
i)	Make & Type	Visual	100%	Relevant Std./Tech. Spec./Approved Drgs.	TC	3/2	_	1	TC
ii)	Max. Permissible angular misalignment	Measurement	100%	Relevant Std./Tech. Spec./Approved Drgs.	TC	3/2	_	1	TC
7	Control valve	Flow rating, Max, Operational Pr.	100%	Relevant Std./Tech. Spec./Approved Drgs.	TC	3/2	_	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.

In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.

Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
8	Pr. Switches	Pr. Range, Switching accuracy, Max operating Pr.	100%	Relevant Std./Tech. Spec./Approved Drgs.	TC	3/2	_	1	TC
9	Hydraulic Pipes(Tubes)	Material Properties, Pressure Testing	100%	Relevant Std./Tech. Spec./Approved Drgs.	TC	3/2	_	1	TC
10	Battery - Make, Type & Rating	Co-relation of TC	100%	Relevant Std./Tech. Spec./Approved Drgs.	TC	3/2	_	1	TC
B	**Final Inspection**								
1	Engine :- Type, Make, Model	Visual	100%	Relevant Std./Tech. Spec./Approved Drgs.	JIR	3/2	1	_	CHP
2	Hyd. Pump : Type, Make, Model	Visual	100%	Relevant Std./Tech. Spec./Approved Drgs.	JIR	3/2	1	_	CHP
3	Functional Test	Visual, Series of tests for smooth operation	100%	Relevant Std./Tech. Spec./Approved Drgs.	JIR	3/2	1	_	CHP
4	Installation Dimensions	Measurement	100%	Relevant Std./Tech. Spec./Approved Drgs.	JIR	3/2	1	_	CHP
5	Preservation & Painting	Measurement	Random check	Relevant Std./Tech. Spec./Approved Drgs.	TC		_	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.

In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.

Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

11.0 Lifting Beam (Spillway Stoplogs)

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
A	**Raw Material**								
i)	Structural steel	Chemical Properties & Mechanical Properties	Sample	Relevant std./Tech.Spec. /Approved Drg	TC	3/2	_	1	TC
B	**Bought Out Items**								
i)	Lifting Hook, Lifting Pin, Bushes, side roller, etc.	Chemical Properties & Mechanical Properties	100%	Relevant std./Tech.Spec. /Approved Drg	TC	3/2	_	1	TC
ii)	Lifting Hook-Proof Load Testing	Test	100%	Relevant std./Tech.Spec. /Approved Drg	TC	3/2	_	1	TC
C	**In Process-Welding**								
i)	NDT- Fillet Welds	D.P. Test	100% Fillet welds length	Relevant std./Tech.Spec. /Approved Drg	TC	3/2	_	1	TC
ii)	Full Strength Welds	Radiography/U.T.	100%	Relevant std./Tech.Spec. /Approved Drg	TC	3/2	_	1	TC
D	Final Inspection								
1	Assembly Dimensions	Measurement	100%	Relevant std./Tech.Spec. /Approved Drg	JIR	3/2	1	_	CHP
2	Welding Examination	Visual/Measurement	100%	Relevant std./Tech.Spec. /Approved Drg	JIR	3/2	1	_	CHP
i)	Fillet Weld	DP Test	10% of weld length	Relevant std./Tech.Spec. /Approved Drg	JIR	3/2	1	_	CHP
3	Verticality of Lifting Beam	Visual/Measurement	100%	Relevant std./Tech.Spec. /Approved Drg	JIR	3/2	1	_	CHP
4	Functional Test- Automatic Engaging & dis-engaging of Lifting Hooks on Gate/Dummy	Visual	100%	Relevant std./Tech.Spec. /Approved Drg	JIR	3/2	1	_	CHP
5	Grit Blasting - Surface finish	Visual	100%	Relevant std./Tech.Spec. /Approved Drg	TC	3/2	_	1	TC
6	Primer/Paint Coating	Visual/Measurement	100%	Relevant std./Tech.Spec. /Approved Drg	TC	3/2	_	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

12.0 Trash Rack Panel & Embedded Parts (Two sheets)

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
A	**Raw Material**								
i)	Structural steel - Steel Plates, Steel Sections like Angles, Channel, Beam etc.	Chemical Properties & Mechanical Properties	Sample/Lot	Relevant Std./Tech. Spec./Approved drgs.	TC	3 / 2	_	1	TC
B	**Bought Out Items**								
i)	Hardware(Fasteners)	Dimension Report & Material Properties	Sample/Lot	Relevant Std./Tech. Spec./Approved drgs.	TC	3 / 2	_	1	TC
C	**In Process**								
1	**Structural Steel(Steel Plates)**								
i)	Edge Preparation	Visual	100%	Relevant Std./Tech. Spec./Approved drgs.	IR	3 / 2	_	1	RR
ii)	Dimensional checks	Measurement	100%	Relevant Std./Tech. Spec./Approved drgs.	IR	3 / 2	_	1	RR
2	**Welding**								
i)	NDT- Fillet Welds	D.P.Test	100% Fillet welds length	Relevant Std./Tech. Spec./Approved drgs.	TC	3 / 2	_	1	TC
ii)	Full Strength Welds	Radiography/U.T.	100%	Relevant Std./Tech. Spec./Approved drgs.	TC	3 / 2	_	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
3	**Machining**	Measurement	100%	Relevant std./Tech. Spec./Approved Drg	IR	3/2	_	1	RR
D	**Final Inspection**								
1	Dimensional Check with Template	Measurement	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
2	Welding Examination								
i)	NDT-Fillet Weld	D.P.Test	10% of Fillet welds length	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
3	Grit Blasting - surface finish	Visual	At Random	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
4	Prime/Paint Coating	Visual	At Random	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2-will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

13.0 Hoist Support Frame (Structure)

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
A	**Raw Material**								
1	Structural Steel, Chanel, Angles, Chequered Plates etc.	Chemical Properties & Mechanical Properties	Sample/Lot	Relevant std./Tech. Spec./Approved Drg	Manufacturer's TC	3/2	_	1	TC
2	Hardware- Fasteners, Washers etc.	Visual/Dimensional	Random	Relevant std./Tech. Spec./Approved Drg	Manufacturer's TC	3/2	_	1	TC
B	**In Process**								
1	Welding								
1.1	NDT- Fillet Welds	D.P. Test	100% Fillet welds length	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
1.2	Full strength Welds	Radiography/U.T.	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
2	Dimensional Checks(after machining	Measurement	100%	Relevant std./Tech. Spec./Approved Drg	IR	3/2	_	1	RR
C	**Final Inspection**								
1	Dimensional check	Measurement	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
2	Weld Size	Measurement	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
3	ND- Fillet Welds	D.P. Test	10% Fillet welds length	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
4	Surface Finish- Machined Surfaces	Visual/Comparator	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
5	Surface Preparation & Paintings	Visual	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

14.0 Pressure Shaft/ Penstock Liners (Two sheets)

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
A	**Raw Material**								
1	Steel Plates	Mech. & chem. Prop.	Sample	Tech. Spec./Relevant std./Approved Drg	TC	3/2	_	1	TC
2	NDT of Steel Plates	UT	Sample	Tech. Spec./Relevant std./Approved Drg	TC	3/2	_	1	TC
B	**In Process Inspection**								
1	Surface defects	Visual	100%	Tech. Spec./Relevant std./Approved Drg	Log sheet	3/2		1	TC
1.1	Edge Preparation	Visual/Measurement	100%	Tech. Spec./Relevant std./Approved Drg	Log sheet	3/2		1	TC
1.3	Welding Examination(Shop Welding)								
a	WPS, PQR for each grade of material WPQ for each welder								
a	Fillet weld	DPT	100%	Tech. Spec./Relevant std./Approved Drg	TC	3/2	_	1	TC
b	Circumferential Welds	X-Ray/UT	100%	Tech. Spec./Relevant std./Approved Drg	TC	3/2	_	1	TC
	Longitudinal Welds	X-Ray/UT	100%	Tech. Spec./Relevant std./Approved Drg	TC	3/2	_	1	TC
1.5	Thermal Stress Relieving :- as applicable	TC	100%	Tech. Spec./Relevant std./Approved Drg	TC	3/2	_	1	TC
1.6	Cladding- Interior Surface(if applicable)	TC	100%	Tech. Spec./Relevant std./Approved Drg	TC	3/2	_	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
C	**Final Inspection**								
1	Shop Trail Assembly of Bifurcation	Visual & Dim. Check	100%	Tech. Spec./Relevant std./Approved Drg	JIR	3/2	1	_	CHP
2	Dimensional Check of individual liner	Measurement	100%	Tech. Spec./Relevant std./Approved Drg	JIR	3/2	1	_	CHP
3	Welding Examination	Visual/Measurement	Random	Tech. Spec./Relevant std./Approved Drg	JIR	3/2	1	_	CHP
a	Fillet Weld	DPT	10%	Tech. Spec./Relevant std./Approved Drg	JIR	3/2	1	_	CHP
b	Circumferential Welds	X-Ray/UT	100%	Tech. Spec./Relevant std./Approved Drg	JIR	3/2	1	_	CHP
	Longitudinal Welds	X-Ray/UT	100%	Tech. Spec./Relevant std./Approved Drg	JIR	3/2	1	_	CHP
4	Hydrostatic Pressure Test	Visual	100%	Tech. Spec./Relevant std./Approved Drg	JIR	3/2	1	_	CHP
5	Grit Blasting & Painting	Measurement	Random	Tech. Spec./Relevant std./Approved Drg	TC	3/2	1	_	CHP

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

15.0 Adit Gate (Hinge Type) (Two sheets)

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
A	**Raw Material**								
1	Structural Steel- Steel Plates, Steel Sections like Angles, Channels, Beams etc.	Chem. & Mech. Properties	Sample	Technical spec/Relevant IS/Approved Drg	TC	3/2	_	1	TC
2	Stainless Steel	-do-	Sample	Technical spec/Relevant IS/Approved Drg	TC	3/2	_	1	TC
3	Forged Steel/Cast steel	-do- & UT	Sample	Technical spec/Relevant IS/Approved Drg	TC	3/2	_	1	TC
B	**Bought out items**								
1	Hardware(Fasteners)	Dim. Report & Material Properties	Sample	Technical spec/Relevant IS/Approved Drg	TC	3/2	_	1	TC
2	Rubber Seals	-do-	100%	Technical spec/Relevant IS/Approved Drg	TC	3/2	_	1	TC
3	Bushing/Bearing	-do-	100%	Technical spec/Relevant IS/Approved Drg	TC	3/2	_	1	TC
C	**In Process**								
1	Structural steel, Stainless Steel, Forged Steel								
i)	Fit-Up of Joints	Measurement	100%	Technical spec/Relevant IS/Approved Drg	IR	3/2	_	1	RR
ii)	Dimensional Check	Measurement	100%	Technical spec/Relevant IS/Approved Drg	IR	3/2	_	1	RR
2	Welding	Visual/Measurement	100%	Technical spec/Relevant IS/Approved Drg	IR	3/2	_	1	RR
i)	Fillet	D.P. Test	100% Fillet welds length	Technical spec/Relevant IS/Approved Drg	TC	3/2	_	1	TC
ii)	Full Strength Welds- Butt Weld	Radiography /U.T,	100%	Technical spec/Relevant IS/Approved Drg	TC	3/2	_	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
3	**Machining**								
i)	Machined Surfaces	Visual & Measurement	100%	Technical spec/Relevant IS/Approved Drg	IR	3/2	_	1	RR
D	**Final Inspection**								
1	Dimensional Check on Assembled Gate Unit	Measurement	100%	Technical spec/Relevant IS/Approved Drg	JIR	3/2	1	_	CHP
2	Welding Examination	Visual/Measurement	100%	Technical spec/Relevant IS/Approved Drg	JIR	3/2	1	_	CHP
i)	Fillet Weld	D.P. Test	10% of Fillet Welds	Technical spec/Relevant IS/Approved Drg	JIR	3/2	1	_	CHP
3	Surface Finish(Machined Surface)	Visual/Comparison with Comparator	100%	Technical spec/Relevant IS/Approved Drg	JIR	3/2	1	_	CHP
4	Grit Blasting & Painting	Visual/Measurement	100%	Technical spec/Relevant IS/Approved Drg	TC	3/2	_	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

16.0 Fixed Rope Drum Hoist (Three sheets)

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
A	**Raw Material**								
1	Structural steel (Base Frame, Girders, Columns)	Chemical Properties & Mechanical Properties	Sample/Lot	Relevant STD/Tech.Spec./Approved drgs	TC	3/2	_	1	TC
2	Cast Steel/Forged Steel(Rope Drum, Shaft, Pulleys, Gear & Pinions)	Chemical Properties & Mechanical Properties	Sample/Lot	Relevant STD/Tech.Spec./Approved rgs	TC	3/2	_	1	TC
		Ultrasonic Test	100%	Relevant STD/Tech.Spec./Approved rgs	TC	3/2	_	1	TC
B	**Bought out items**								
1	Wire rope, Coupling, Plummer block, Electro Magnetic Brake, EHT Brake	Make, Type Size, Dim. Material Properties	100%	Relevant STD/Tech.Spec./Approve drgs	TC	3/2	_	1	TC
2	Control Panel-components	Make, Type Size Dim. Material Properties	100%	Relevant STD/Tech.Spec./Approve drgs	TC	3/2	_	1	TC
3	Electric Motors, Gear box Assembly	Routine test	100%	Relevant STD/Tech.Spec./Approve drgs	TC	3/2	_	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
C	**In- Process**								
1	Welding								
i)	Fillet welds	DPT	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
ii)	Full strength welds	Radiography/UT	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
2	Post Weld Stress Relieving(If Fabricated Drum)	Heat Treatment	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
3	Machining-rope Drum Dimensions and Surface finish	Measurement	100%	Relevant std./Tech. Spec./Approved Drg	IR	3/2	_	1	RR
4	Sub assembly-Rope Drum and Drive mechanism on base Frame	Alignment Noise Level Vibration	100%	Relevant std./Tech. Spec./Approved Drg	IR	3/2	_	1	RR

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
D	**Final Inspection**								
1	Bought Out Items - BOM, Type, Make, Ratings Dimensional Check	Visual & Measurement	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
2	Rope Drum Assembly on Base Frame	Measurement	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
3	Load Test at SWL	Load Test	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
4	Over Load Test at 125% of SWL	Load Test	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
5	Lifting speed at rated Load	Measurement	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
6	Brake Test	Visual	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
7	Functional Test	Visual	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
8	Grit blasting & Painting	Visual & DFT	At Random	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

17.0 Hydraulic Oil Filter, Low Vacuum Dehydration & Degasification System (Three sheets)

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
1	**Centrifugal Oil Purifier - Bowl Body, Hood & Lock Ring**								
a)	Chemical Reaction	Chemical	Sample	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
b)	Mechanical Strength	Mechanical	Sample	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
2	**Low Vacuum Dehydration & Degasification Unit**								
a)	Make, Type & Rating	Visual	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
3	**Contamination Checking Kit**								
a)	Make, Type & Rating	Visual	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
b)	Calibration	Visual	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
4	**Valves. Pipes, Fitting & Hoses etc.**								
a)	Chemical Composition	Chemical	Sample	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
b)	Mechanical Strength	Mechanical	Sample	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
c)	Dimensional check	Measurement	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
d)	Pressure Test	Test	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
5	**Discharge & Vacuum Pump**								
a)	Type, Make & Capacity	Visual	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
b)	Type Test	Test	Sample	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
c)	Routine Test	Test	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC
6	**Temp. Gauge, Flow Meter, Pr. Gauge, Level switch, Solenoid Valve, Thermostat etc.**								
a)	Type, Make & Calibration	Visual	100%	Relevant std./Tech. Spec./Approved Drg	TC	3/2	_	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection



Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
7	**Motor**								
a)	Type, Make &Rating	Visual	100%	Relevant Std./Tech.Spec./Approved Drgs.	TC	3/2	_	1	TC
b)	Type Test	Test	Sample	Relevant Std./Tech.Spec./Approved Drgs.	TC	3/2	_	1	TC
c)	Routine Test								
8	**Strainer**								
a)	Chemical Composition	Chemical	Sample	Relevant Std./Tech.Spec./Approved Drgs.	TC	3/2	_	1	TC
b)	Mesh Size	Measurement	100%	Relevant Std./Tech.Spec./Approved Drgs.	TC	3/2	_	1	TC
9	**Heating Element**								
a)	Type, Make & Rating	Visual	100%	Relevant Std./Tech.Spec./Approved Drgs.	TC	3/2	_	1	TC
10	**Vacuum & Oil Tank**								
a)	Chemical Composition	Chemical	Sample	Relevant Std./Tech.Spec./Approved Drgs.	TC	3/2	_	1	TC
b)	Mechanical Strength	Mechanical	Sample	Relevant Std./Tech.Spec./Approved Drgs.	TC	3/2	_	1	TC
c)	Capacity	Measurement	100%	Relevant Std./Tech.Spec./Approved Drgs.	IR	3/2	_	1	RR
d)	Leakage test	Test	100%	Relevant Std./Tech.Spec./Approved Drgs.	TC	3/2	_	1	TC
e)	Vacuum Test	Test	100%	Relevant Std./Tech.Spec./Approved Drgs.	TC	3/2	_	1	TC
11	**Purification Test of Hydraulic Oil**								
a)	Moisture Content	Test	100%	Relevant Std./Tech.Spec./Approved Drgs.	JIR	3/2	1	_	CHP
b)	Suspended Particle	Test	100%	Relevant Std./Tech.Spec./Approved Drgs.	JIR	3/2	1	_	CHP

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

17.0 Hydraulic Oil Filter, Low Vacuum Dehydration & Degasification System

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
12	**Low Vacuum Dehydration & Degasifications Unit**								
a)	Dimension Check	Measurement	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
b)	Performance Test of complete system and Individual items	Visual	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
13	**Hydraulic Oil purifier system including Control Panel**								
a)	Dimension Check of assembly	Measurement	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
b)	Verification of Bill of Material	Visual	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
c)	Capacity(Suction & discharge pressure)	Measurement	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
d)	Performance Test of complete system and Individual items	Visual	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP
e)	IR & HV on Control Panel	Elect.	100%	Relevant std./Tech. Spec./Approved Drg	JIR	3/2	1	_	CHP

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

18.0 Trash Rack Cleaning Machine and Grappler (Five sheets)

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
A	**Raw Material**								
1	Structure steal	Chem. & Mech. Properties	100%	Tech. Spec./IS-2062 or equivalent Std.	TC	3/2	_	1	TC
2	Cast steel/Forged steel(Rope drum, L.T. wheels, Axles, Gears, Shafts & Pins, Rollers Hoist Sheaves etc.)	Chem. & Mech. Properties	100%	Tech.Spec./IS-1030/IS-2004	TC	3/2	_	1	TC
3	Stainless steel (Rake teeth, Fasteners etc.)	Chem. & Mech. Properties	100%	Tech.Spec./IS-1570	TC	3/2	_	1	TC
B	**Bought Out Items :**								
i)	Electric Motors								
a)	Make, Model & Rating	Visual	100%	Tech.Specification	TC	3/2	_	1	TC
b)	Routine Test	Electrical	100%	Tech.Spec./IS-325 or equivalent	TC	3/2	_	1	TC
ii)	Brakes for raking hoist Grapple hoist and L-T	Braking torque	100%	Tech. Spec. or Manufacture's Std.	TC	3/2	_	1	TC
iii)	Reduction Gear Box	Gear Ratio, Torque	100%	GTP/Manufacture's Std	TC	3/2	_	1	TC
iv)	Master Controller & Limit switch etc. (Make, Type & Rating)	Visual	100%	GTP/Manufacture's Std	TC	3/2	_	1	TC
v)	Couplings for raking hoist, Grapple hoist and long travel	Type Test	100%	GTP/Manufacture's Std	TC	3/2	_	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
2	**Hydraulic power unit**								
i)	Hydraulic pump: Flow and working pressure	Visual	100%	Tech. Spec/ Manufacture's Std.	TC	3/2	_	1	TC
ii)	Hydraulic Pipe, Tubing Pipe fittings, Control Valves :- Pressure Test	Visual	100%	Tech. Spec/Manufacture's Std.	TC	3/2	_	1	TC
iii)	Hydraulic Actuator(cylinder)	Visual	100%	Tech. Spec/ Manufacture's Std.	TC	3/2	_	1	TC
a)	Working Pressure	Visual	100%	Tech. Spec/ Manufacture's Std.	TC	3/2	_	1	TC
b)	Bore & stroke	Visual	100%	Tech. Spec/ Manufacture's Std.	TC	3/2	_	1	TC
C	**In Process Inspection**								
1	Fabrication								
a)	Dimensional checks	Measurement	100%	Tech. Spec/Manufacture's Std.	IR	3/2	_	1	RR
b)	Welding Examination	Visual	100%	Tech. Spec/ Manufacture's Std.	IR	3/2	_		TC
b.1	Fillet welds	DPT	100%	Tech. Spec/ Manufacture's Std.	IR	3/2	_	1	TC
b.2	Butt welds	X-Ray/UT	100%	Tech. Spec/ Manufacture's Std.	TC	3/2		1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
2	Post Weld stress relieving (Rope Drum)	TC	100%	Tech.Spec./App. Drg	TC	3/2	_	1	TC
3	Machining	Measurement	100%	Tech.Spec./App. Drg	IR	3/2	_	1	RR
4	Surface finish (L.T. wheels, Shafts, Axles, Rope Drum & Pins & Roller, Hoist Sheaves etc.	Visual/Comparison	100%	Tech.Spec./App. Drg	IR	3/2	_	1	RR
5	Shop - Sub Assemblies								
i)	Alignment	Measurement	100%	App. Drg./GTP/Manufacturer's Std	IR	3/2		1	RR
ii)	Fit-Up	Visual & Measurement	100%	App. Drg./GTP/Manufacturer's Std	IR	3/2		1	RR
iii)	Tolerance/Clearance	Visual & Measurement	100%	App. Drg./GTP/Manufacturer's Std	IR	3/2		1	RR

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
D	**Final inspection**								
1	Bought out items(Make, Capacity/Rating, Calibration)	Visual	100%	BOM/GTP/App. Drg.	JIR	3/2	1	_	CHP
2	Assembly Dimensions	Measurement	100%/Random	App. Drg.	JIR	3/2	1	_	CHP
3	**Electrical control panel**								
i)	IR Test	Electrical	100%	App. Drg.	JIR	3/2	1	_	CHP
ii)	H.V. Test	Electrical	100%	App. Drg.	JIR	3/2	1	_	CHP
iii)	Function Test	Visual	100%	App. Drg.	JIR	3/2	1	_	CHP
iv)	Bill of Material	Visual	100%	App. Drg.	JIR	3/2	1	_	CHP
4	Functional Checking of complete unit(TRCM)	Visual	100%	App. Drg.	JIR	3/2	1	_	CHP

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
5	Rake engaging/disengaging and loading	Visual	100%	Tech./Spec./App. Drg	JIR	3/2	1	_	CHP
6	Arrangement operation	Visual	100%	Tech./Spec./App. Drg	JIR	3/2	1	_	CHP
7	Operation of grappling arrangement	Visual	100%	App. Drg./GTP	JIR	3/2	1	_	CHP
8	Operation of swing motion	Visual	100%	App. Drg./GTP	JIR	3/2	1	_	CHP
9	Grappling Crane(If applicable)Interlocking arrangement	Visual/Measurement	Random	Tech. Spec.	JIR	3/2	1	_	CHP

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

19.0 Spillway Stop Logs (Three sheets)

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
A	**Raw material**								
1	Structural Steel - steel Plates, Steel Sections like angles channel, Beams etc.	Chemical Properties & Mechanical Properties	100%	Relevant IS/Approved drawing	Manufacturer's TC	3/2	_	1	TC
2	Stainless Steel	-do-	100%	Relevant IS/Approved drawing	-do-	3/2	_	1	TC
3	Forged Steel/Cast Steel	-do-	100%	Relevant IS/Approved drawing	-do-	3/2	_	1	TC
i)	NDT - Forged/Cast Steel	Ultrasonic Examination	100%	Relevant IS/ASME/Appr. Drgs.	-do-	3/2	_	1	TC
B	**Bought out Items**								
1	Hardware(Fasteners)	Material Properties	100%	Relevant IS/Approved drawing	-do-	3/2	_	1	TC
2	Rubber Seals	Material Properties	100%	Relevant IS/Approved drawing	-do-	3/2	_	1	TC
3	Bushing, Bearing	Material Properties	100%	Relevant IS/Approved drawing	-do-	3/2	_	1	TC
4	Materials for filling - in- valve	Material Properties	100%	Relevant IS/Approved drawing	-do-	3/2	_	1	TC
C	**In Process**								
1	Structural steel(steel Plates, S.S. Plates & forged steel)								
i)	Surface Defects	Visual	100%	Relevant IS/Approved drawing	IR	3/2	_	1	RR
ii)	Edge Preparation	Visual	100%	Relevant IS/Approved drawing	IR	3/2	_	1	RR
iii)	Assembly Welding Track - up	Measurement	100%	Tech. Spec.	IR	3/2	_	1	RR
iv)	Dimensional Checks	Measurement	100%	Approved Drawing	IR	3/2	_	1	RR
2	Welding	Measurement	100%	Approved Drawing	IR	3/2	_	1	RR
i)	NDT - Fillet Welds	D.P.Test	10% Fillet welds length	Approved Drawing	TC	3/2	_	1	TC
ii)	Full Strength Welds	Radiography /U.T.	100%	Approved Drawing	TC	3/2	_	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
3	**Machining**	Measurement	100%	Approved Drawing	IR	3 /2	_	1	RR
i)	Planning of Thrust Bearing Pads, Seal Bases, Clamp Bar Seats on welded gate units	Measurement	100%	Approved Drawing	IR	3 /2	_	1	RR
ii)	Drilling of seal clamp bars, rollers & Guide Brackets on welded gate units	Measurement	100%	Approved Drawing	IR	3 /2	_	1	RR
4	**Shop Assembly**								
i)	Dimensions(Fits & Tolerances)	Measurement	100%	Approved Drawing	IR	3 /2	_	1	RR
ii)	Sub assembly of Filling - in- Valves								
(a)	Dimensional Checks	Measurement	100%	Approved Drawing	IR	3 /2	_	1	RR
iii)	Sub Assembly of Sill Level sensing device								
(a)	Dimensional Checks	Measurement	100%	Approved Drawing	IR	3 /2	_	1	RR
5	**C.G. Establishment/Gate Units**	Measurement	100%	Approved Drawing	IR	3 /2	_	1	RR

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
D	**Final Inspection**								
1	Dimensional Check on Assembled gate Units	Measurement	100%	Approved Drawing	JIR	3/2	1	_	CHP
2	Welding Examination								
(a)	NDT- Fillet Weld	D.P. Test	10% of Fillet welds length	Tech.Spec./Approved Drg.	JIR	3/2	1	_	CHP
3	Surface Finish(Machined Surface)	Visual/Comparison with Comparator	100%	Tech.Spec./Approved Drg.	JIR	3/2	1	_	CHP
4	**Shop Trial Assembly**								
i)	Vertically & C.G. checking of Gate Units	Measurement	100%	Tech.Spec./Approved Drg.	JIR	3/2	1	_	CHP
ii)	Functional Test of Filling - in- valve	Visual	100%	Tech.Spec./Approved Drg.	JIR	3/2	1	_	CHP
5	Grit Blasting - Surface finish	Visual	100%	Tech.Spec./Approved Drg.	TC	3/2		1	TC
6	Primer/paint coating	Visual	100%	Tech.Spec./Approved Drg.	TC	3/2		1	TC
i)	Coating Thickness	Measurement	Random/10-20% of surface area	Tech.Spec./Approved Drg.	TC	3/2		1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

20.0 Instrumentation and Remote Control System (Three sheets)

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
A	**Raw Material**								
1)	Cubicle Panel -Sheet	Chemical Properties & Mechanical Properties	Sample /Lot	Relevant Std./Tech.Spec./Approved Drgs.	TC	3/2	_	1	TC
B	**Bought out items**								
1	**Exhaust Fan, Transmitters, Encoders, Modems, Relays, Control Cables, MCB, Door Limit Switches, Lamp & accessories, Terminals, Power Supply Unit,Data Display Unit,Hooter,Modules etc.**								
i)	Make ,Type Rating	Visual	100%	Relevant Std./Tech.Spec./Approved Drgs.	TC	3/2	_	1	TC
ii)	Function	Test	100%	Relevant Std./Tech.Spec./Approved Drgs.	TC	3/2	_	1	TC
2	Computer & Peripherals								
i)	Make ,Model, Type	Visual	100%	Relevant Std./Tech.Spec./Approved Drgs.	TC	3/2	_	1	TC
ii)	Functional check	Test	100%	Relevant Std./Tech.Spec./Approved Drgs.	TC	3/2	_	1	TC
C	**In Process**								
1	Mechanical & Electrical Assembly Check	Visual	100%	Relevant Std./Tech.Spec./Approved Drgs.	IR	3/2	_	1	RR
2	Cubicle Panel(Assembly)Dim Check	Measurement	100%	Relevant Std./Tech.Spec./Approved Drgs.	IR	3/2	_	1	RR
D	**Final Inspection**								
1	Cubicle Panel(Assembly)Dim Check	Measurement	100%	Relevant Std./Tech.Spec./Approved Drgs.	JIR	3/2	1	_	CHP
2	B.O.M. Check	Visual	100%	Relevant Std./Tech.Spec./Approved Drgs.	JIR	3/2	1	_	CHP
3	IR & HV Test	Electrical	100%	Relevant Std./Tech.Spec./Approved Drgs.	JIR	3/2	1	_	CHP

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
4	**Control Cables**								
i)	IR & HV Test	Electrical	100%	Relevant Std./Tech. Spec./Approved Drgs.	JIR	3/2	1	_	CHP
ii)	Volume Resistivity	Visual/Measurement	100%	Relevant Std./Tech. Spec./Approved Drgs.	JIR	3/2	1	_	CHP
iii)	Capacitance Un-Balance	Visual/Measurement	100%	Relevant Std./Tech. Spec./Approved Drgs.	JIR	3/2	1	_	CHP
5	**Computer and Peripherals**								
i)	Verification of Technical Specification & physical Check	Visual	100%	Relevant Std./Tech. Spec./Approved Drgs.	JIR	3/2	1	_	CHP
ii)	Functional Check	Test	100%	Relevant Std./Tech. Spec./Approved Drgs.	JIR	3/2	1	_	CHP
6	**UPS**								
i)	Make & Rating	Visual	100%	Relevant Std./Tech. Spec./Approved Drgs.	JIR	3/2	1	_	CHP
ii)	Capacity Test	Functional	100%	Relevant Std./Tech. Spec./Approved Drgs.	JIR	3/2	1	_	CHP

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1- will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
iii)	Functional Check(Protection)								
a)	Low Voltage	Test	100%	Relevant Std./Tech. Spec./Approved Drgs.	JIR	3/2	1	_	CHP
b)	High Voltage	Test	100%	Relevant Std./Tech. Spec./Approved Drgs.	JIR	3/2	1	_	CHP
c)	Deep Discharge Protection	Visual	100%	Relevant Std./Tech. Spec./Approved Drgs.	JIR	3/2	1	_	CHP
iv)	Batteries								
a)	Make & Rating	Visual	100%	Relevant Std./Tech. Spec./Approved Drgs.	JIR	3/2	1	_	CHP
b)	Load Backup Test	Test	100%	Relevant Std./Tech. Spec./Approved Drgs.	JIR	3/2	1	_	CHP
v)	UPS with Batteries	Functional	100%	Relevant Std./Tech. Spec./Approved Drgs.	JIR	3/2	1	_	CHP
vi)	Voltage Checkup- Phase to neutral phase to Earth	Measurement	100%	Relevant Std./Tech. Spec./Approved Drgs.	JIR	3/2	1	_	CHP
7	System application software(Logic & Graphics)	Visual	100%	Relevant Std./Tech. Spec./Approved Drgs.	JIR	3/2	1	_	CHP
8	Paint Coating	Visual	100%	Relevant Std./Tech. Spec./Approved Drgs.	TC	3/2	_	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

21.0 Aquatic Life Discharge Pipe Arrangement (Two sheets)

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
A	**Raw Material**								
1	Steel Plates	Mech. & Chem. Prop.	Sample/lot	Tech.Spec./Approved Drg/Relevant std.	TC	3/2	_	1	TC
2	NDT of Steel Plates	UT	100%	Tech.Spec./Approved Drg/Relevant std.	TC	3/2	_	1	TC
B	**In Process Inspection**								
1	Surface defects	Visual	100%	Tech.Spec./Approved Drg/Relevant std.	Log Sheet	3/2	_	1	TC
a)	Edge Preparation	Visual/Measurement	100%	Tech.Spec./Approved Drg/Relevant std.	Log sheet	3/2	_	1	TC
2	Welding Examination(Shop Welding)								
a	Fillet Weld	DPT	100%	Tech.Spec./Approved Drg/Relevant std.	TC	3/2	_	1	TC
b	1.Circumfrencial Welds	X-Ray/UT	100%	Tech.Spec./Approved Drg/Relevant std.	TC	3/2	_	1	TC
	2.Longitudinal Welds	X-Ray/UT	100%	Tech.Spec./Approved Drg/Relevant std.	TC	3/2	_	1	TC
3	Thermal Stress Relieving:- as applicable	Visual	100%	Tech.Spec./Approved Drg/Relevant std.	TC	3/2		1	TC
C	**Bought Out items(Fastener) and seats**	Dimensional report/Material Properties	100%	Tech.Spec./Approved Drg/Relevant std.	TC	3/2		1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
D	**Final Inspection**								
1	Shop Trail assembly	Visual & Dim. Check	100%	Tech.Spec./Approved Drg/Relevant std.	JIR	3/2	1		CHP
2	Dimensional check of individual pipe	Measurement	100%	Tech.Spec./Approved Drg/Relevant std.	JIR	3/2	1		CHP
3	Welding Examination	Visual/Measurement	Random	Tech.Spec./Approved Drg/Relevant std.	JIR	3/2	1		CHP
a	Fillet Weld	DPT	10%	Tech.Spec./Approved Drg/Relevant std.	JIR	3/2	1		CHP
b	Circumferential Welds	X-Ray/UT	100%	Tech.Spec./Approved Drg/Relevant std.	JIR	3/2	1		CHP
	Longitudinal Welds	X-Ray/UT(or as applicable)	100%	Tech.Spec./Approved Drg/Relevant std.	JIR	3/2	1		CHP
c	Hydrostatic Pressure	Test	100%	Tech.Spec./Approved Drg/Relevant std.	JIR	3/2	1		CHP
d	Surface Finish (Machine surface)	Visual/Comparison with comparator	100%	Tech.Spec./Approved Drg/Relevant std.	JIR	3/2	1		CHP
4	Grit Blasting and Painting	Measurement	Random	Tech.Spec./Approved Drg/Relevant std.	TC	3/2		1	CHP
E	**Valves, Flange & Fittings**								
1	Mechanical Strength	Mechanical	Sample	Tech.Spec./Approved Drg/Relevant std.	TC	3/2		1	TC
2	Chemical Composition	Chemical	Sample	Tech.Spec./Approved Drg/Relevant std.	TC	3/2		1	TC
3	Dimensional check of individual pipe	Measurement	100%	Tech.Spec./Approved Drg/Relevant std.	TC	3/2		1	TC
4	Hydrostatic Pressure Test with Flange	Test	100%	Tech.Spec./Approved Drg/Relevant std.	JIR	3/2	1		CHP
5	Painting	Visual	100%	Tech.Spec./Approved Drg/Relevant std.	TC	3/2		1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

NAME OF PROJECT: 4 X 150MW KHORLOCHHU HPP, BHUTAN **CLIENT:** KHORLOCHHU HYDRO POWER LIMITED, BHUTAN
VENDOR:
NIT/P.O REFERENCE:

22.0 Gate Valve

SR. NO.	ITEM/COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECK	REFERENCE DOCUMENTS/ACCEPTANCE NORMS	RECORD FORMAT	INSPECTION AGENCY			REMARKS
						Perform	Witness	Verify	
1	Knife Edge Gate Valve								
a	Make & Rating	Visual	100%	Tech.Spec./App. Drg/IS 780	JIR	2/3	1	_	CHP
b	Material Test	Physical/Chemical	sample	Tech.Spec./App. Drg/IS 780	TC	2/3	_	_	TC
C	Hydrostatic Body Test	Test	sample	Tech.Spec./App. Drg/IS 780	JIR	2/3	1	_	CHP
d	Hydrostatic Seat Test	Test	sample	Tech.Spec./App. Drg/IS 780	JIR	2/3	1	_	CHP
e	Function of Valve with Electro-mechanical Actuator and Manual for normal and full design pressure	Functional	sample	Tech.Spec./App. Drg/IS 780	JIR	3/2	1	_	CHP
f	Flow Direction Test for Stems	Test	sample	Tech.Spec./App. Drg/IS 780	TC	2/3	_	1	TC
g	Primer/ Paint Coating	Visual	100%	Tech.Spec./App. Drg/IS 780	TC	3/2	_	1	TC

Note: In 'Inspection Agency' column, figure 1, 2 or 3 to be filled. 1-will indicate 'Client', 2- will indicate 'Supplier' & 3- will indicate 'Sub-supplier'.
In 'Remarks' column following abbreviations shall be used: - RR- Review of Records. T.C- Test Certificate Submission & CHP- Customer Hold Point.
Test certificates shall be submitted at the time of final inspection

Signature
KHPL (AUTHORISED REPRESENTATIVE)

Signature
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



KHORLOCHHU HYDRO POWER LIMITED

4x150 MW KHORLOCHHU HYDROPOWER PROJECT

TRASHIYANGTSE; BHUTAN

BIDDING DOCUMENT

FOR

CONTRACT PACKAGE: KHM

DESIGN, MANUFACTURING, SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF HYDRO-MECHANICAL WORKS

VOLUME - 5

TENDER DRAWINGS

International Competitive Bidding

These documents are meant for the exclusive purpose of bidding against this NIT and shall not be transferred, reproduced or otherwise used for purposes other than that for which they are specifically issued.

Tender Ref. No. KHPL/C&PD/TENDER:KHM/2025/11534 dt. 07.08.2025

LAYOUT OF BIDDING DOCUMENTS

CONTRACT PACKAGE: KHM

Design, Manufacturing, Supply, Installation, Testing and Commissioning of Hydro-Mechanical Works

Volume - 1: Instructions to Bidders (ITB)

- Section - 1 Abridged Notice Inviting Tender and Notice Inviting Tender (NIT)
- Section - 2 Instructions to Bidders (ITB), Bid Data, Qualification Forms, Information for Bidders (IFB) and Work Schedule

Volume - 2: General Conditions of Contract (GCC) and Particular Conditions of Contract (PCC)

- Section - 3 FIDIC General Conditions of Contract (GCC) for Plant and Design-Build Contract (First Edition 1999)
- Section - 4 Particular Conditions of Contract (PCC)
- Section - 5 Forms and Procedures
  - Form-1: Letter of Tender
  - Form-2: Form of Contract Agreement
  - Form-3: Bank Guarantee Form for Performance Security
  - Form-4: Bank Guarantee Form for Advance Payment
  - Form-5: Form of Taking Over Certificate
  - Form-6: Bank Guarantee Form for Release of Retention Money
  - Form-7: Hindrance Register
  - Form-8: Dispute Adjudication Agreement
  - Form-9: Parent/Holding Company Agreement
  - Form-10: Proforma for Joint Deed of Undertaking

Volume-3: Price Schedules

Volume-4: Employer's Requirements

- Section - 6 General Technical Specifications (GTS)
- Section - 7 Particular Technical Specifications (PTS)
- Section - 8 Quality Assurance Plan (QAP)

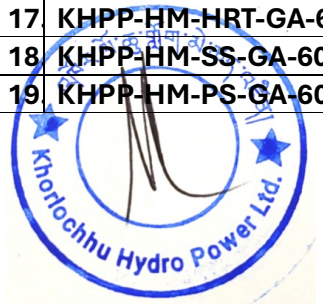
Volume-5: Tender Drawings

Volume-6: Technical Data Sheets



INDEX:

SL. NO.	DRAWING NO.	DESCRIPTION	Remarks
1.	KHPP-HM-GEN-SI-6001	Location Map	
2.	KHPP-HM-GEN-GA-6002	Layout of Project cum Master Plan	
3.	KHPP-HM-DAM-GA-6003	Stop Logs for Sluice Radial Gate - General Arrangement – sh. 01 of 02	(6800mmx17700mm)
4.	KHPP-HM-DAM-GA-6004	Stop Logs for Sluice Radial Gate - General Arrangement – sh. 02 of 02	(6800mmx17700mm)
5.	KHPP-HM-DAM-GA-6005	Gantry Crane for Stop Logs – General Arrangement	
6.	KHPP-HM-DAM-GA-6006	Aquatic Life Discharge Pipe – General Arrangement	
7.	KHPP-HM-DAM-GA-6007	Sluice Radial Gate – General Arrangement – sh. 01 of 02	(6800mmx12900mm)
8.	KHPP-HM-DAM-GA-6008	Sluice Radial Gate – General Arrangement – sh. 02 of 02	(6800mmx12900mm)
9.	KHPP-HM-DAM-GA-6009	Overflow spillway – Emergency & Service Gate – General Arrangement sh. 01 of sh. 02	(4000mmx5000mm)
10.	KHPP-HM-DAM-GA-6010	Overflow spillway – Emergency & Service Gate – General Arrangement sh. 02 of sh. 02	(4000mmx5000mm)
11.	KHPP-HM-INT-GA-6011	Trash Rack & TRCM – General Arrangement sh. 01 of 02	
12.	KHPP-HM-INT-GA-6012	Trash Rack & TRCM – General Arrangement sh. 02 of 02	
13.	KHPP-HM-INT-GA-6013	Intake Bulkhead & Service Gate – General Arrangement sh. 01 of 02	(4250mmx4700mm)
14.	KHPP-HM-INT-GA-6014	Intake Bulkhead & Service Gate – General Arrangement sh. 02 of 02	(4250mmx4700mm)
15.	KHPP-HM-DC-GA-6015	Desilting Chamber Gate – General Arrangement	(4700mm x 4700mm)
16.	KHPP-HM-SFT-GA-6016	Silt Flushing Gate – General Arrangement	(1500mm x 2200mm)
17.	KHPP-HM-HRT-GA-6017	HRT Adit Gate for Adit 2 and Adit 5 – General Arrangement	(2500mm x 2500mm)
18.	KHPP-HM-SS-GA-6018	Surge Shaft Gate – General Arrangement	(2750mm x 5220mm)
19.	KHPP-HM-PS-GA-6019	Pressure shaft Steel Liner – General Arrangement sh. 01 of 02	



20.	**KHPP-HM-PS-GA-6020**	Pressure shaft Steel Liner – General Arrangement sh. 02 of 02	
21.	**KHPP-HM-TRT-GA-6021**	Unit Tail Race Tunnel Gate – General Arrangement	(4000mm x 4500mm)
22.	**KHPP-HM-TRT-GA-6022**	TRT Outfall Gate – General Arrangement	(6500mm x 6500mm)
23.	**KHPP-HM-CDW-GA-6025**	Chaplangchhu Diversion Works Degravelling Tunnel Gate – General Arrangement	(1000mm x 1000mm)
24.	**KHPP-HM-CDW-GA-6027**	Chaplangchhu Diversion Works Trench Weir Sections – sh. 01 of 02	
25.	**KHPP-HM-CDW-GA-6028**	Chaplangchhu Diversion Works Trench Weir Sections – sh. 02 of 02	
26.	**KHPP-HM-CDW-GA-6030**	Chaplangchhu Diversion Works Intake Gate – General Arrangement	(2000mm x 2500mm)
27.	**KHPP-HM-CDW-GA-6032**	Chaplangchhu Diversion Works Desilting Chamber Gate – General Arrangement	(2100mm x 1800mm)
28.	**KHPP-HM-CDW-GA-6033**	Chaplangchhu Diversion Works Silt Flushing Gate – General Arrangement	(1200mm x 1700mm)
29.	**KHPP-HM-CDW-GA-6034**	Chaplangchhu Diversion Works Connecting Tunnel to HRT Steel liner – General Arrangement	

Legends :

GEN – General
DAM – DAM Complex
INT – Intake
DC – Desilting Chamber
SFT – Silt Flushing Gate
HRT – Head Race Tunnel
TRT - Tail Race Tunnel
SS – Surge Shaft
PS – Pressure Shaft
CDW - Chaplangchhu Diversion Works



TITLE: LOCATION MAP

DWG NO KHPP-HM-GEN-SI-6001

CHINA

GASA

PUNAKHA

THIMPHU

PARO

HAA

WANGDUSPHODRANG

DAGANA

TSIRANG

Damphu

SAMTSE

CHUKHA

Phuetsholing

SARPANG

BUMTHANG

Jakar

LHUNTSE

TRASHI YANGTSE

KHOLONGCHHU HEP(600 MW)

TRONGSA

ZHEMGANG

MONGAR

PEMA GATSHAL

TRASHIGANG

NAKOR

CHHENARI

SAMDRUP JONGKHAR

ENTRY POINT

INDIA

GUWAHATI

NOTES :-

1. THIS DRAWING SHOWS THE LOCATION MAP OF KHOLONGCHHU HE PROJECT AREA.

Guwahati to Samdrup Jhonkar/Darnga	110 Km.
Samdrup Jhonkar to Trashigang	180 Km.
Trashigang to Chazam	14 Km.
Chazam to Power House site	10 Km.
Power house site to Duksum	5 Km.
Duksum to Dam Site	17 Km.
Dam Site to Trashiyangtse	8 Km.
Duksum to Trashiyangtse	25 Km.
Paro airport to Dam site	620 Km.
Nearest airport Guwahati (India)	320 Km.
Rangia(Assam) India to Damsite	270 Km.

LEGEND:-

ROAD

INTERNATIONAL BOUNDARY

Khorlochhu Hydro Power Ltd.

FOR TENDER PURPOSE

CLIENT:
KHORLOCHHU HYDRO POWER LIMITED
TRASHIYANGTSE, BHUTAN

CONSULTANT:
Tata Consulting Engineers Ltd. &
Lombardi Engineering Ltd.(JV)

PROJECT:
KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN

TITLE: LOCATION MAP

DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	

DWG No: KHPP-HM-GEN-SI-6001

SCALE: AS SHOWN	ISSUE P1	DATE: 18-JUN-2025

ORIGINAL PRINT SIZE: A1

FILE NAME: KHPP-HM-GEN-SI-6001

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
REVIEWED											

TITLE: LAYOUT OF PROJECT CUM MASTER PLAN

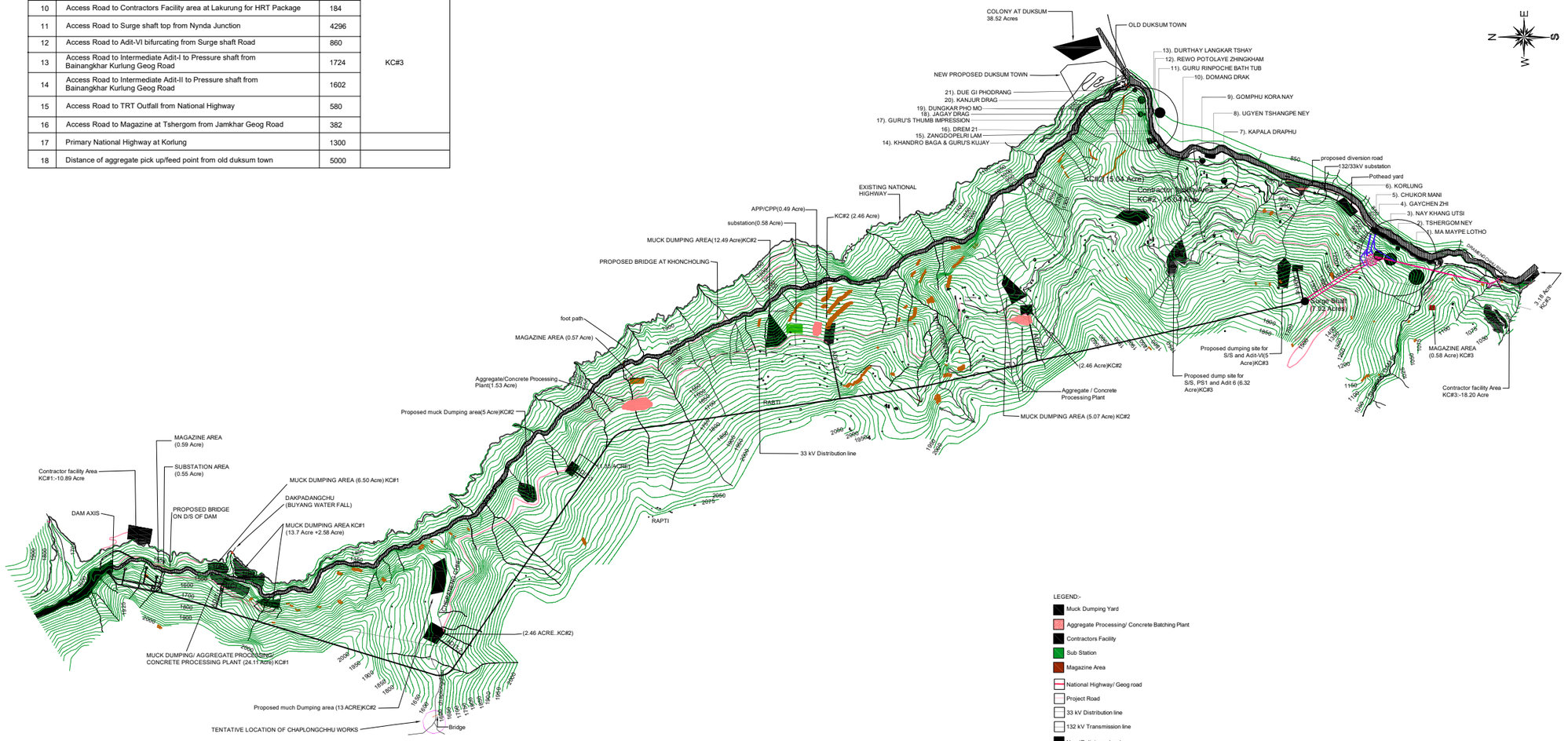
DWG NO KHPP-HM-GEN-GA-6002

Sl.#	Name of Road	Length (m)	To be black toped and maintained by
1	Access Road to Contractors Facility area at Dam	403	KC#1
2	Access Road from NH to Dam Bridge Point	907	
3	Access Road to Adit-I from Dam Bridge Point	1700	
4	Access Road to magazine	200	
5	Access Road from Shali Junction (on NH on left bank) to Junction at Adit-III & Adit-IV on right bank	6840	KC#2
6	Access Road to Adit-V from Tomshang Geog Road	668	
7	Access Road from Tomshang school to Adit-IV	2735	
8	Access Road from Adit-IV to Adit-III	3560	
9	Access Road from Adit-III to Adit-II	4440	
10	Access Road to Contractors Facility area at Lakurung for HRT Package	184	
11	Access Road to Surge shaft top from Nynda Junction	4296	
12	Access Road to Adit-VI bifurcating from Surge shaft Road	860	
13	Access Road to Intermediate Adit-I to Pressure shaft from Bainangkhar Kurlung Geog Road	1724	KC#3
14	Access Road to Intermediate Adit-II to Pressure shaft from Bainangkhar Kurlung Geog Road	1602	
15	Access Road to TRT Outfall from National Highway	580	
16	Access Road to Magazine at Tshergom from Jamkhar Geog Road	382	
17	Primary National Highway at Korlung	1300	
18	Distance of aggregate pick up/feed point from old duksum town	5000	

Sl.#	Name of River Sand quarry	Location
1	Tshangsingma	3-4 km above old Duksum Town along Drangmechhu
2	Dungsekhar	9-10 km from Dam site above Cremation ground. along Kholongchhu
3	Domdee	12 km D/S of Chazam bridge along Drangmechhu
4	Thsergom Chencheri Manidhangri Retshalowoom Tshoshingthang Buna Lungtenzampa Kharpalhaptsa Dhawoon Betshalu	All these sand quarry is located within 15-30 km radius from the project area along Drangmichhu
5	Kurichhu	Approx. 130 km away from Project area at Mongar along kurichhu

NOTE : -

1. Specification Drawing for BID Purpose only
2. The Sacred/Religious sites marked (Sl.No.1 to 21) indicated approximate location of Sacred/religious sites for which the contractor shall take due care of preserve and protect. Mandatory provisions for such diligence have been stipulated in the Bidding document.
3. Location of Choetens/ Lhakhangs are not indicated in the map.



LEGEND:-

- Muck Dumping Yard
- Aggregate Processing/ Concrete Batching Plant
- Contractors Facility
- Sub Station
- Magazine Area
- National Highway/ Geog road
- Project Road
- 33 kV Distribution line
- 132 kV Transmission line
- Ney (Religious place)

Khorlochhu Hydro Power Ltd.

FOR TENDER PURPOSE

CLIENT: KHORLOCHHU HYDRO POWER LIMITED
TRASHIYANGTSE, BHUTAN

CONSULTANT: Tata Consulting Engineers Ltd. & Lombardi Engineering Ltd.(JV)

PROJECT: KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN

TITLE: LAYOUT OF PROJECT CUM MASTER PLAN

DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	
DWG No: KHPP-HM-GEN-GA-6002		
SCALE: AS SHOWN	ISSUE P1	DATE: 18-JUN-2025 ORIGINAL PRINT SIZE: A1

FILE NAME: KHPP-HM-GEN-GA-6002

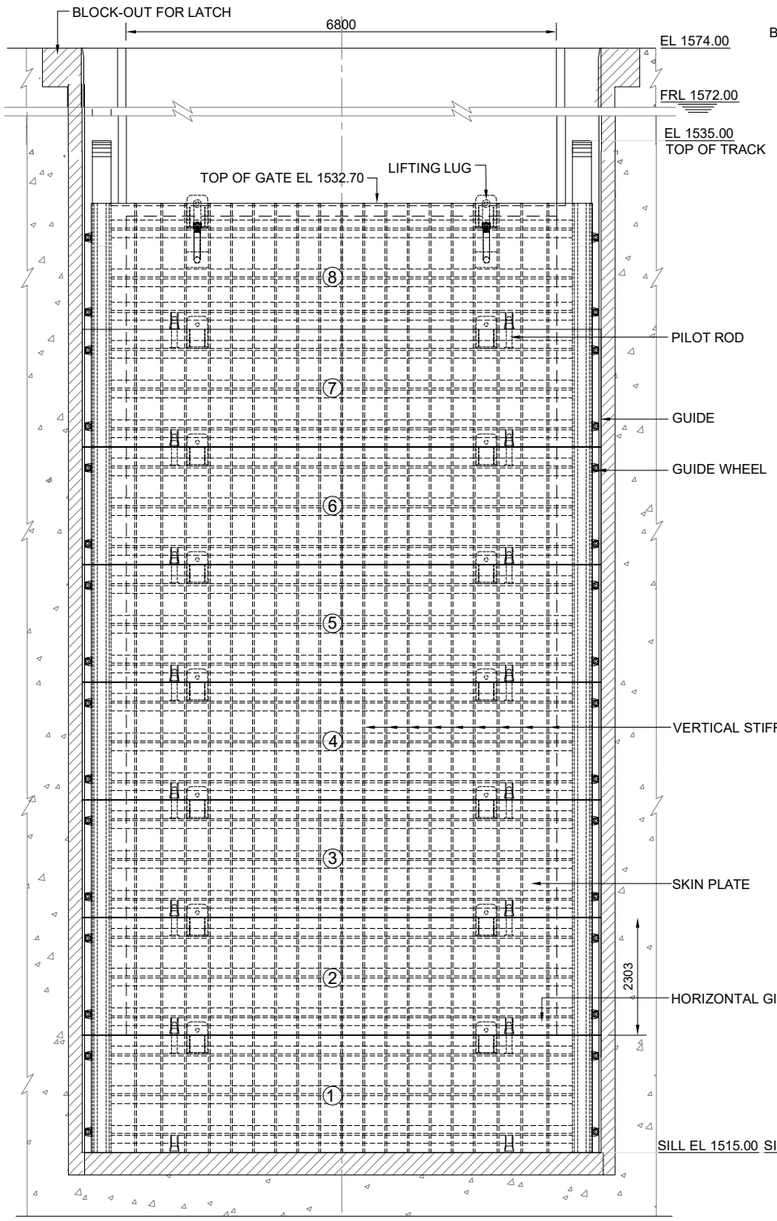
"P" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

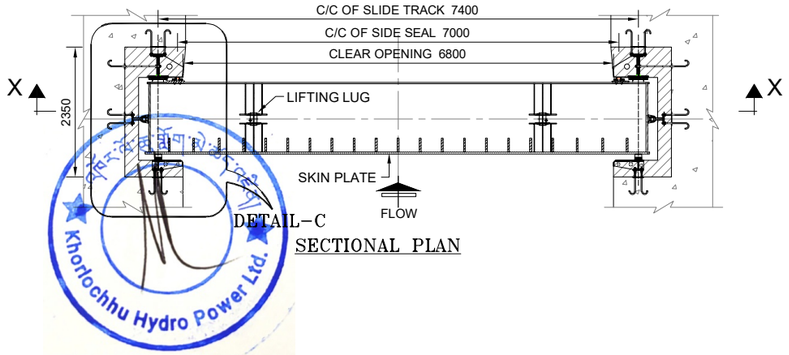
INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
REVIEWED											

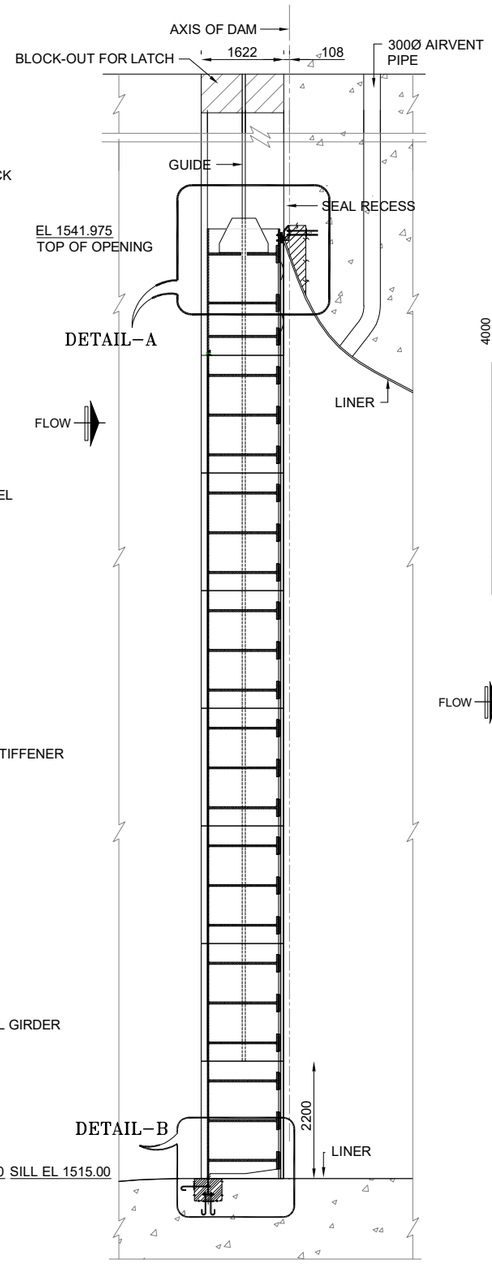
TITLE: STOP LOGS FOR SLUICE RADIAL GATE
6800mm X 17700mm GENERAL ARRANGEMENT
DWG NO KHPP-HM-DAM-GA-6003



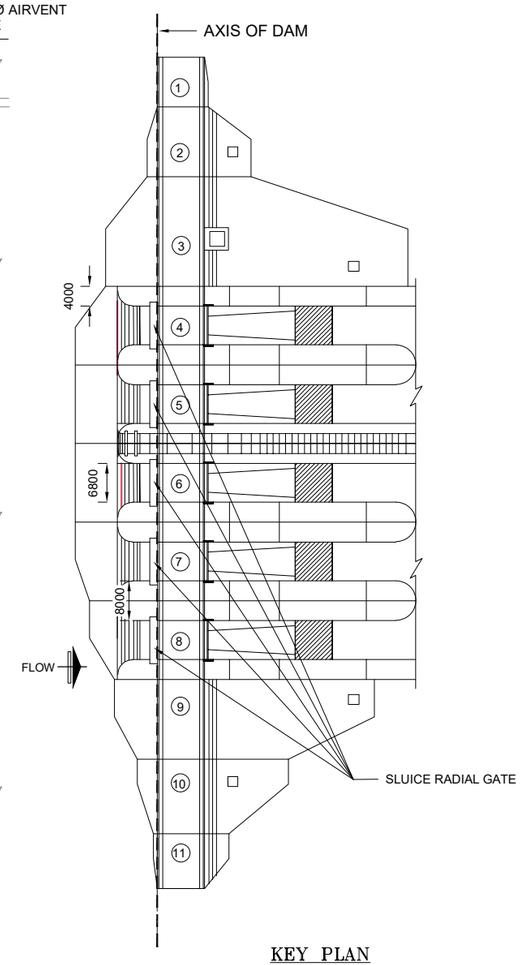
SECTIONAL ELEVATION X – X



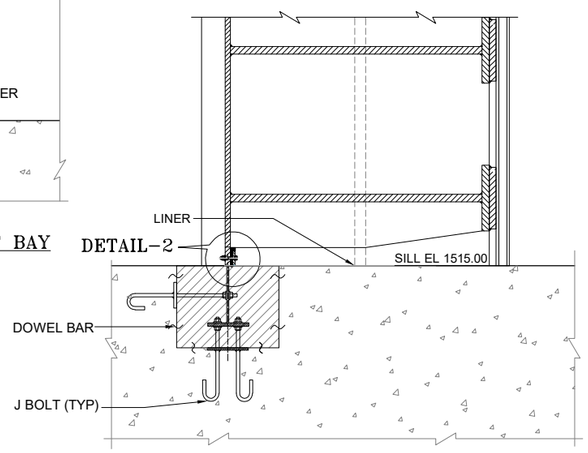
SECTIONAL PLAN



SECTION THROUGH C/L OF BAY



KEY PLAN



DETAIL – B

NOTES:

1. ALL DIMENSIONS ARE IN MM AND LEVELS IN METRES.
2. THIS DRAWING SHALL BE READ IN CONJUCTION OF RELEVANT CIVIL DRAWINGS.

3.	NO OF OPENINGS	5
4.	NO OF STOPLOGS	1 SET (CONTAINING 8 UNITS, SIZE OF TOP UNIT 6.8m X 2.3m WITH FILLING IN VALVE ARRANGEMENT NON-INTER CHANGEABLE & SEVEN (7 NOS INTERCHANGEABLE SIZE 6.8m X 2.2m)
5.	CLEAR SPAN	6.8m
6.	CLEAR HEIGHT	17.7m
7.	SILL LEVEL OF STOPLOG	EL.1515m
8.	FRL	EL.1572m
9.	DESIGN HEAD	57m
10.	ADDITIONAL SILT HEAD	ONE UNIT HEIGHT

11. SUITABLE LATCHING ARRANGEMENT TO BE PROVIDED IN EACH BAY.
12. 5 NOS UNITS TO BE STORED IN 5 NOS BAYS & REMAINING 3 NOS UNITS IN SUITABLE STORAGE RACKS/BAYS AT SUITABLE LOCATION.
13. FACES OF TRACKS, SEAL SEATS & GUIDES SHALL BE IN TRUE VERTICAL PLANES WITHIN THE TOLERANCES SPECIFIED IN IS:5620/9349 (LATEST).
14. CONCRETE IN BLOCK OUTS SHALL BE ONE GRADE HIGHER THAN 1ST STAGE CONCRETE BUT NOT LESS THAN M-25 GRADE CONFORMING TO IS:456 (LATEST).
15. ALL FILLET WELDS SHALL BE 6MM (MIN), UNLESS OTHER WISE SPECIFIED.

DESIGN DATA FOR STOPLOGS

1.	NO OF OPENINGS	5
2.	NO OF STOPLOGS	1 SET
3.	SIZE OF OPENING FROM SILL LEVEL	6.8m X 17.7m
4.	FRL	EL. 1572.0m
5.	SILL LEVEL	EL. 1515.0m
6.	DESIGN HEAD	57.0m
7.	ADDITIONAL SILT LOAD	ONE UNIT HEIGHT
8.	NO OF UNITS	8 UNITS. ONE TOP UNIT OF SIZE: 6.8m X 2.3m WITH FILLING IN VALVE ARRANGEMENT & SEVEN INTERCHANGEABLE UNITS OF SIZE:6.8m x2.2m
9.	TYPE OF SEALING	DOWN STEAM SEALING DOUBLE STEM TYPE TEFLON CLADDED RUBBER SEAL FOR TOP & SIDE FOR BOTTOM - WEDGE TYPE
10.	OPERATION	BALANCED HEAD
11.	HOIST	GANTRY CRANE
12.	LOCATION OF SKIN PLATE	U/S SIDE
13.	GATE LIFTING & LOWERING SPEED	0.5m min.

LEGEND :-

1st. STAGE CONCRETE.

2nd. STAGE CONCRETE.

FOR TENDER PURPOSE

CLIENT:
Khorlochhu
KHORLOCHHU HYDRO POWER LIMITED
TRASHIYANGTSE, BHUTAN

CONSULTANT:
TATA Lombardi
Tata Consulting Engineers Ltd. &
Lombardi Engineering Ltd.(JV)

PROJECT:
KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN

TITLE:
STOP LOGS FOR SLUICE RADIAL GATE SH–01
6800mm X 17700mm GENERAL ARRANGEMENT

DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	

DWG No: KHPP–HM–DAM–GA–6003

SCALE: AS SHOWN | ISSUE P1 | DATE: 18–JUN–2025 | ORIGINAL PRINT SIZE: A1

FILE NAME: KHPP-HM-DAM-GA-6003

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

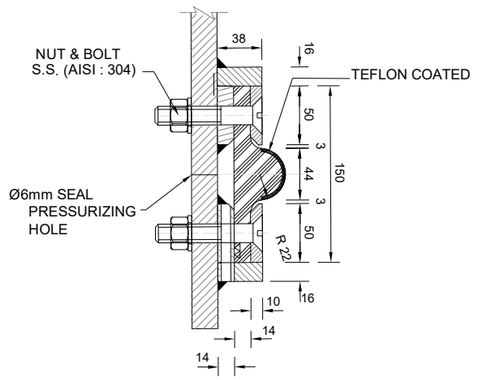
INFORMATION CONTAINED WITHIN "HOLD" IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO "HOLDS".

APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	REVIEWED	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE

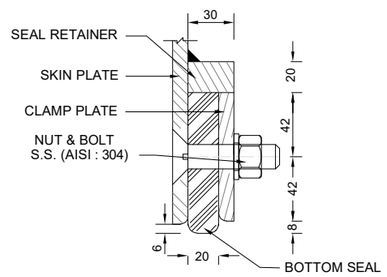
Khorlochhu Hydro Power Ltd.

TITLE: STOP LOGS FOR SLUICE RADIAL GATE SH-02
6800mm X 17700mm GENERAL ARRANGEMENT

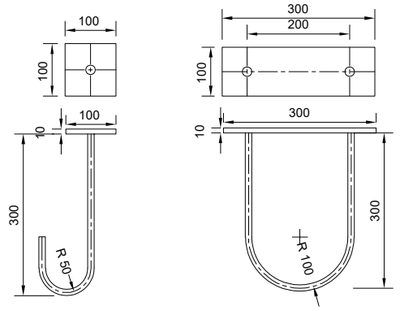
DWG NO KHPP-HM-DAM-GA-6004



DETAIL-3 (TOP SEAL)

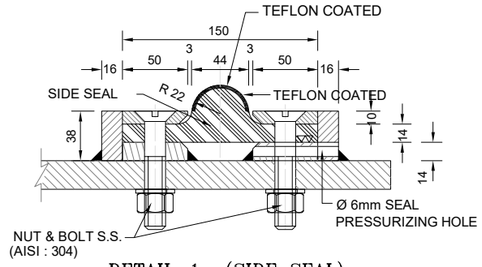


DETAIL-2 (BOTTOM SEAL)

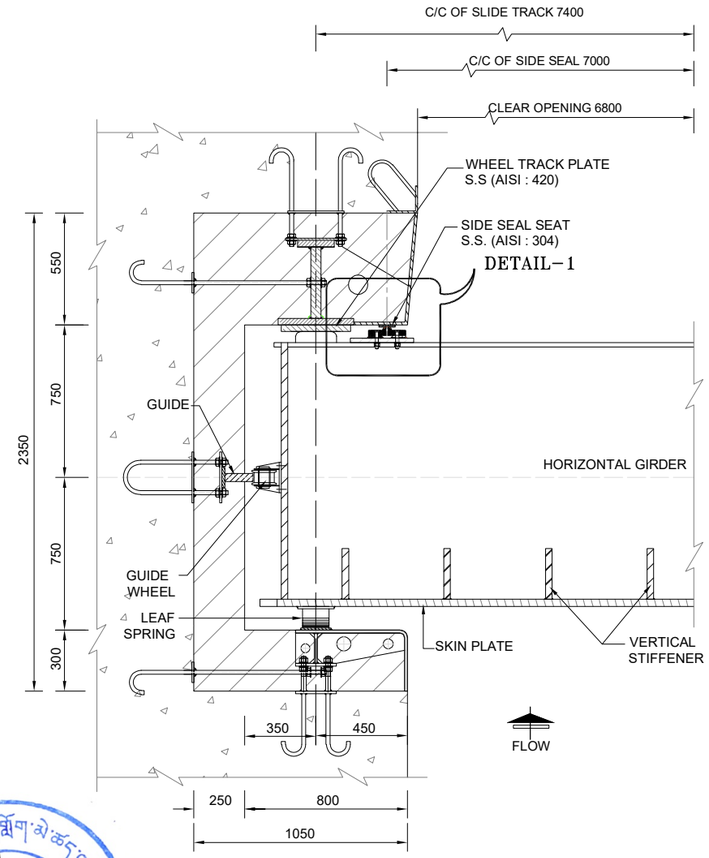


DETAIL OF J-ANCHOR

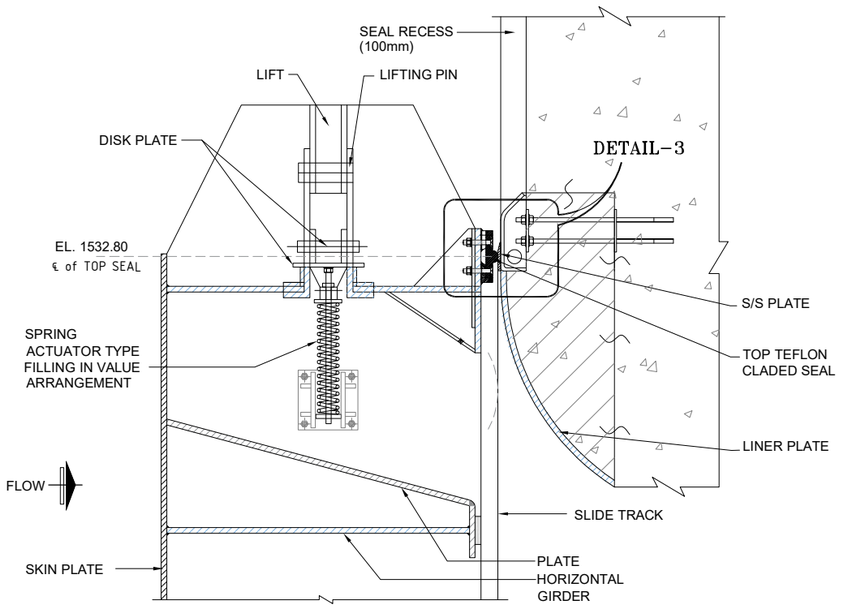
DETAIL OF U-ANCHOR



DETAIL-1 (SIDE SEAL)



DETAIL-C



DETAIL-A

NOTES:

1. ALL DIMENSIONS ARE IN MM AND LEVELS IN METRES.
2. THIS DRAWING SHALL BE READ IN CONJUCTION OF RELEVANT CIVIL DRAWINGS.

3.	NO OF OPENINGS	5
4.	NO OF STOPLOGS	1 SET (CONTAINING 8 UNITS, SIZE OF TOP UNIT 6.8m X 2.3m WITH FILLING IN VALVE ARRANGEMENT NON-INTER CHANGEABLE & SEVEN (7 NOS INTERCHANGEABLE SIZE 6.8m X 2.2m)
5.	CLEAR SPAN	6.8m
6.	CLEAR HEIGHT	17.7m
7.	SILL LEVEL OF STOPLOG	EL.1515m
8.	FRL	EL.1572m
9.	DESIGN HEAD	57m
10.	ADDITIONAL SILT HEAD	ONE UNIT HEIGHT

11. SUITABLE LATCHING ARRANGEMENT TO BE PROVIDED IN EACH BAY.
12. 5 NOS UNITS TO BE STORED IN 5 NOS BAYS & REMAINING 3 NOS UNITS IN SUITABLE STORAGE RACKS/BAYS AT SUITABLE LOCATION.
13. FACES OF TRACKS, SEAL SEATS & GUIDES SHALL BE IN TRUE VERTICAL PLANES WITHIN THE TOLERANCES SPECIFIED IN IS:5620/9349 (LATEST).
14. CONCRETE IN BLOCK OUTS SHALL BE ONE GRADE HIGHER THAN 1ST STAGE CONCRETE BUT NOT LESS THAN M-25 GRADE CONFORMING TO IS:456 (LATEST).
15. ALL FILLET WELDS SHALL BE 6MM (MIN), UNLESS OTHER WISE SPECIFIED.

DESIGN DATA FOR STOPLOGS

1.	NO OF OPENINGS	5
2.	NO OF STOPLOGS	1 SET
3.	SIZE OF OPENING FROM SILL LEVEL	6.8m X 17.7m
4.	FRL	EL. 1572.0m
5.	SILL LEVEL	EL. 1515.0m
6.	DESIGN HEAD	57.0m
7.	ADDITIONAL SILT LOAD	ONE UNIT HEIGHT
8.	NO OF UNITS	8 UNITS. ONE TOP UNIT OF SIZE: 6.8m X 2.3m WITH FILLING IN VALVE ARRANGEMENT & SEVEN INTERCHANGEABLE UNITS OF SIZE:6.8m x2.2m
9.	TYPE OF SEALING	DOWN STEAM SEALING DOUBLE STEM TYPE TEFLON CLADDED RUBBER SEAL FOR TOP & SIDE FOR BOTTOM - WEDGE TYPE
10.	OPERATION	BALANCED HEAD
11.	HOIST	GANTRY CRANE
12.	LOCATION OF SKIN PLATE	U/S SIDE
13.	GATE LIFTING & LOWERING SPEED	0.5m min.

LEGEND :-

1st. STAGE CONCRETE.

2nd. STAGE CONCRETE.

FOR TENDER PURPOSE

CLIENT:
KHORLOCHHU HYDRO POWER LIMITED
TRASHIYANGTSE, BHUTAN

CONSULTANT:
Tata Consulting Engineers Ltd. &
Lombardi Engineering Ltd.(JV)

PROJECT:
KHORLOCHHU HYDRO POWER PROJECT(4X150 MW),
TRASHIYANGTSE, BHUTAN

TITLE:
STOP LOGS FOR SLUICE RADIAL GATE SH-02
6800mm X 17700mm GENERAL ARRANGEMENT

DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	
DWG No: KHPP-HM-DAM-GA-6004		
SCALE: AS SHOWN	ISSUE P1	DATE: 17-JUN-2025

ORIGINAL PRINT SIZE: A1

FILE NAME: KHPP-HM-DAM-GA-6004

"P" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION/FABRICATION WORK IS PERMITTED ON "R" (RELEASED) ISSUES ONLY.

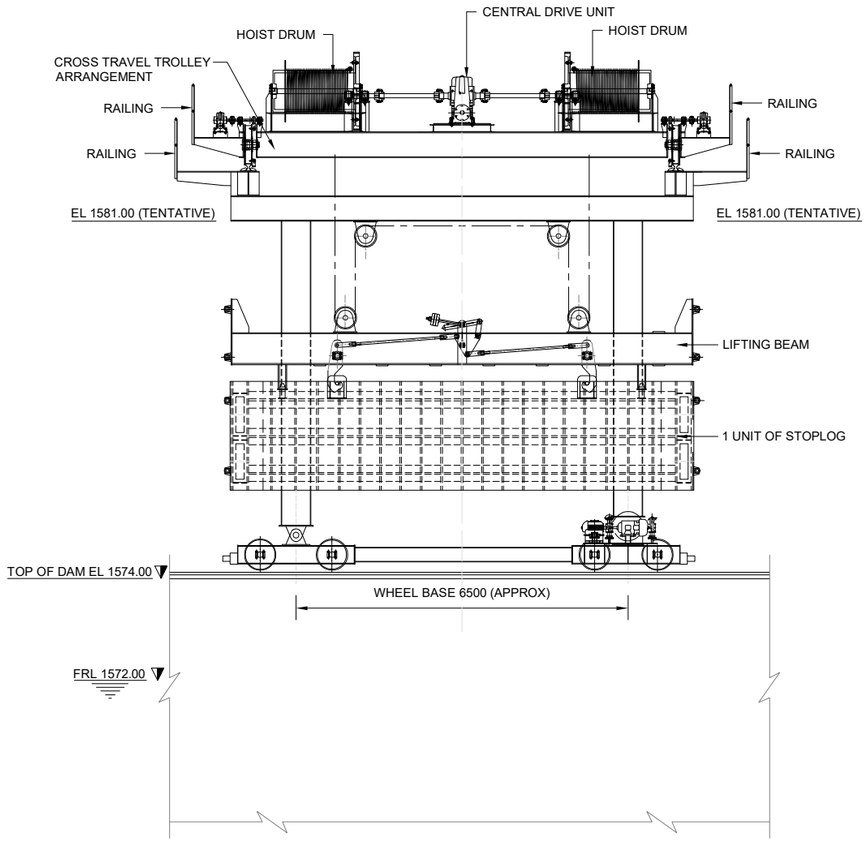
INFORMATION CONTAINED WITHIN "HOLD" IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
REVIEWED											

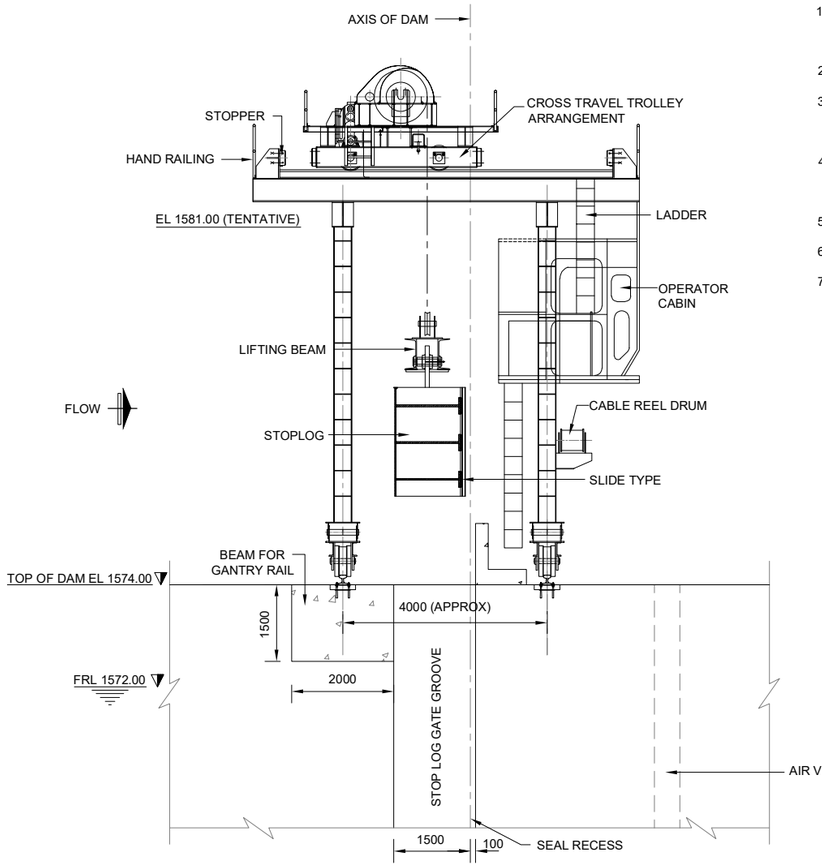
Khorlochhu Hydro Power Ltd.

TITLE: GANTRY CRANE FOR STOPLOGS
GENERAL ARRANGEMENT

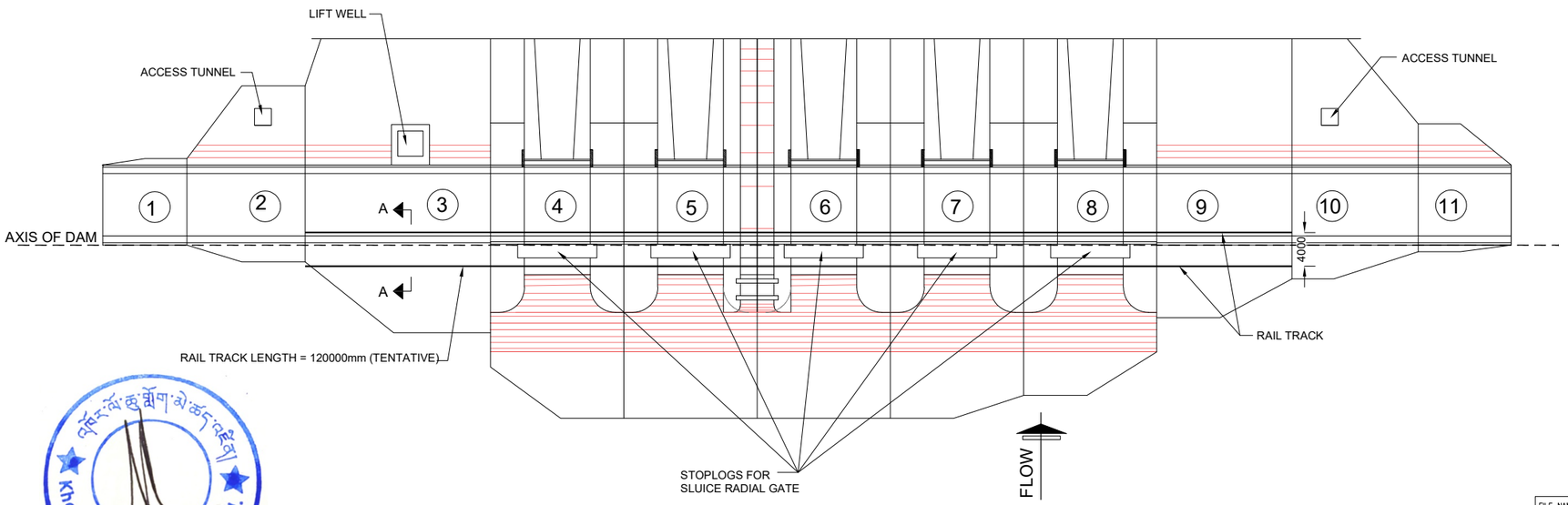
DWG NO KHPP-HM-DAM-GA-6005



ELEVATION



SECTION A-A



KEY PLAN

NOTES :-

1. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS IN METRES UNLESS OTHERWISE SPECIFIED. NO DIMENSIONS SHALL BE MEASURED FROM THE DRAWING
2. NO. OF BAYS - 5 (FIVE)
3. NO. OF STOPLOGS -1 SET CONTAINING 8 UNITS. ONE TOP UNIT OF SIZE 6800mm x 2300mm WITH FILLING VALVE NON INTERCHANGEABLE AND 7 INTERCHANGEABLE UNITS OF SIZE 6800mm X 2200mm.
4. STOPLOGS SHALL BE OPERATED WITH THE HELP OF GANTRY CRANE HAVING AUTOMATIC ENGAGING & DISENGAGING TYPE LIFTING BEAM HOOK OF ADEQUATE CAPACITY.
5. SUITABLE LATCHING ARRANGEMENT SHALL BE PROVIDED AT DECK LEVEL.
6. THIS DRAWING IS BASED ON RELEVANT CIVIL DRAWINGS.
7. GANTRY CRANE CAPACITY MIN. 45T.

LEGEND :-

- 1st. STAGE CONCRETE.
- 2nd. STAGE CONCRETE.

Khorlochhu Hydro Power Ltd.

APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
REVIEWED											

FILE NAME: KHPP-HM-DAM-GA-6005

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

FOR TENDER PURPOSE

CLIENT:
KHORLOCHHU HYDRO POWER LIMITED
TRASHIYANGTSE, BHUTAN

CONSULTANT:
Tata Consulting Engineers Ltd. &
Lombardi Engineering Ltd.(JV)

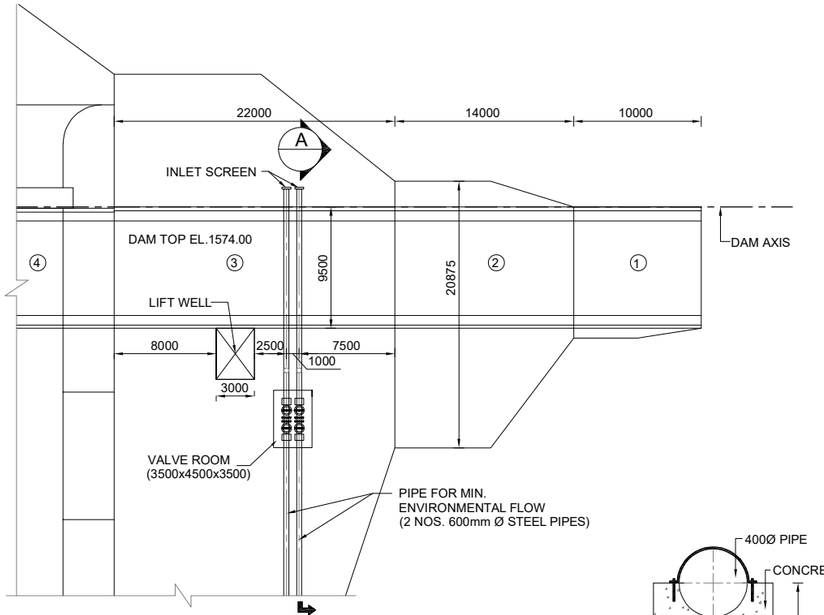
PROJECT:
KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN

TITLE:
GANTRY CRANE FOR STOPLOGS
GENERAL ARRANGEMENT

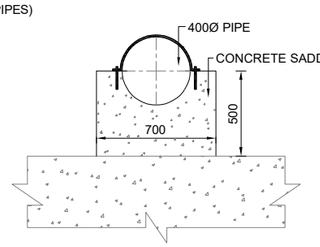
DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	
DWG No: KHPP-HM-DAM-GA-6005		
SCALE: AS SHOWN	ISSUE P1	DATE: 18-JUN-2025
ORIGINAL PRINT SIZE: A1		

TITLE: AQUATIC LIFE DISCHARGE PIPE GENERAL ARRANGEMENT

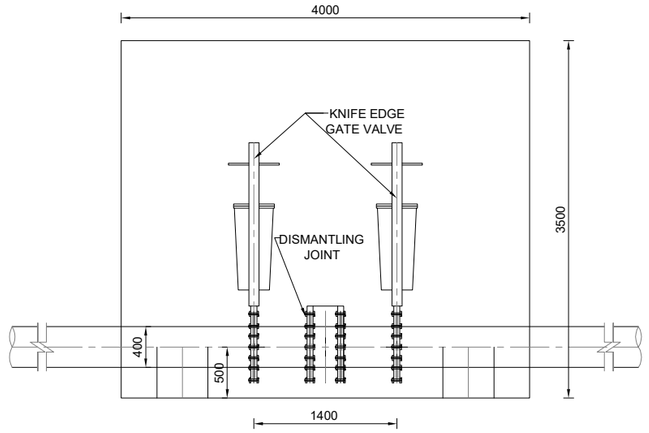
DWG NO KHPP-HM-DAM-GA-6006



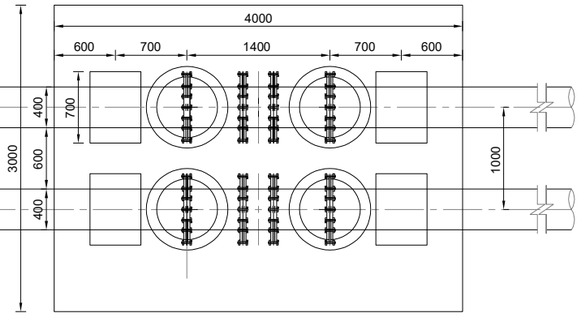
KEY PLAN



SECTION–C

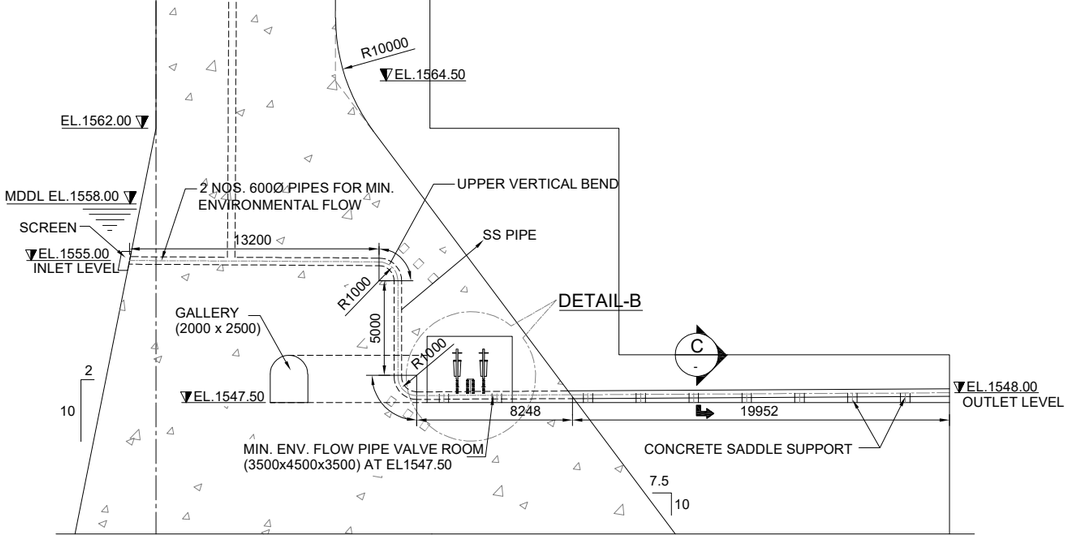


DETAIL–B

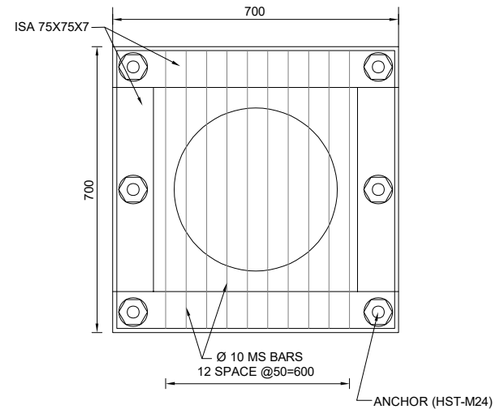


SECTION–D

SCHEMATIC ARRANGEMENT FOR PIPELINE WITH KNIFE-EDGE GATE VALVES



SECTION–A



SCREEN AT INLET OF PIPE (2 Nos)

NOTES:

1. ALL DIMENSION ARE IN MILLIMETERS AND ELEVATION IN METERS
2. THE LOCATION & ALIGNMENT OF MIN. ENVIRONMENTAL FLOW PIPE IS INDICATIVE & MAY BE CHANCE DURING DETAILED DESIGN.
3. ERECTION & PIPING SHALL BE DONE AS PER IS:2825.
4. MATERIAL OF STEEL PIPE & BENDS SHALL CONFIRM IN ACCORDANCE TO IS:3589.
5. MATERIAL OF MECHANICAL TYPE KNIFE EDGE GATE VALVE SHALL BE CONFIRM IN ACCORDANCE TO TECH . SPECIFICATION .
6. MAKE OF MECHANICAL TYPE KNIFE EDGE GATE VALVE SHALL BE OF FOURESS/VASS OR EQUIVALENT.
7. MAKE OF DISMANTLING JOINT SHALL BE FOURESS/VASS OR EQUIVALENT.
8. FLANGE PLATE SHALL CONFIRM IN ACCORDANCE TO IS:6392.
9. COMPRESSED AIR SYSTEM WILL BE ARRANGED AS AND WHEN REQUIRED TO CLEAN THE PIPE ARRANGEMENT.

LEGEND :-

1st. STAGE CONCRETE.

2nd. STAGE CONCRETE.

Khorlochhu Hydro Power Ltd.

APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
REVIEWED											

FILE NAME: KHPP-HM-DAM-GA-6006

"P" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

FOR TENDER PURPOSE

CLIENT:
KHORLOCHHU HYDRO POWER LIMITED
TRASHIYANGTSE, BHUTAN

CONSULTANT:
Tata Consulting Engineers Ltd. &
Lombardi Engineering Ltd.(JV)

PROJECT:
KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN

TITLE:
AQUATIC LIFE DISCHARGE PIPE
GENERAL ARRANGEMENT

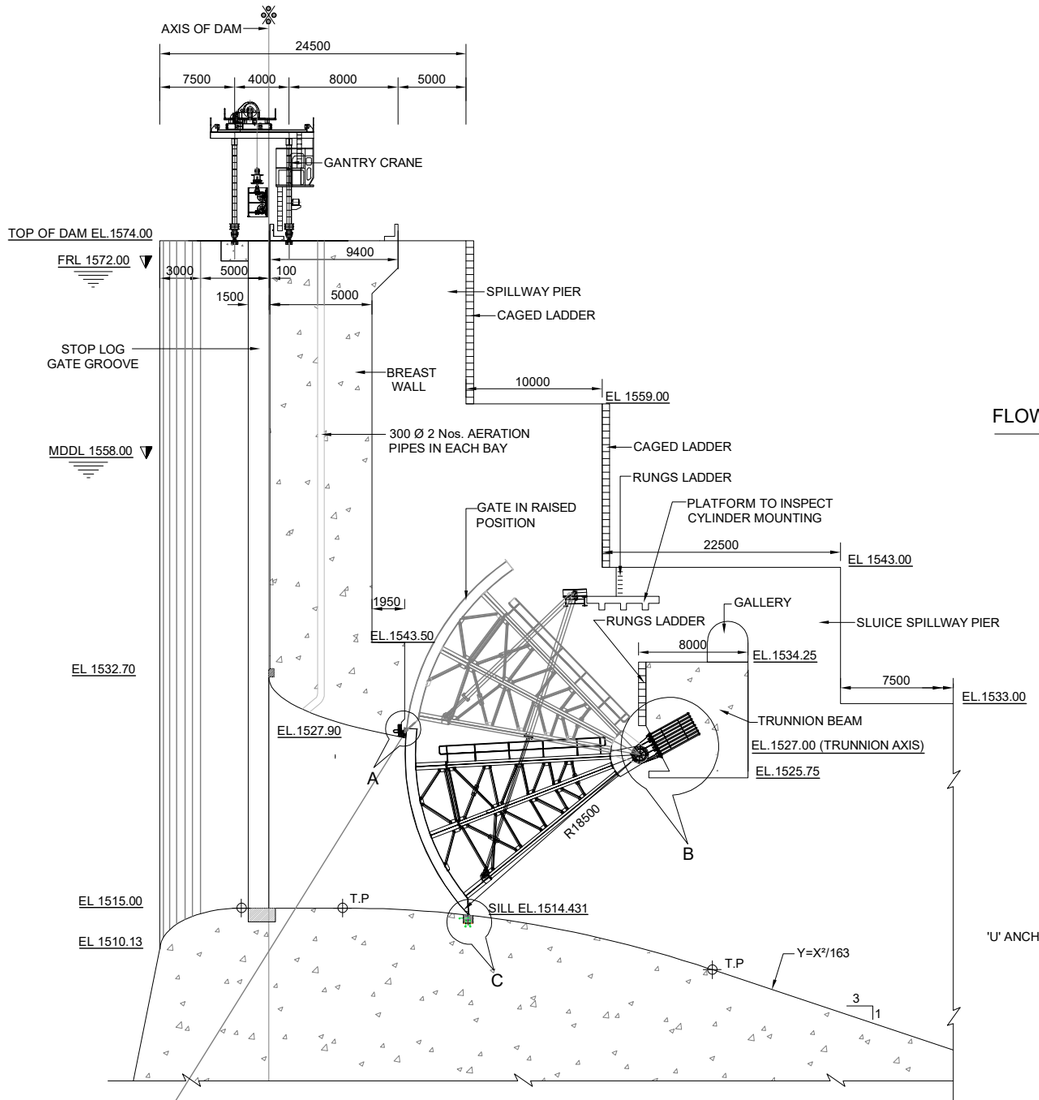
DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	

DWG No: KHPP-HM-DAM-GA-6006

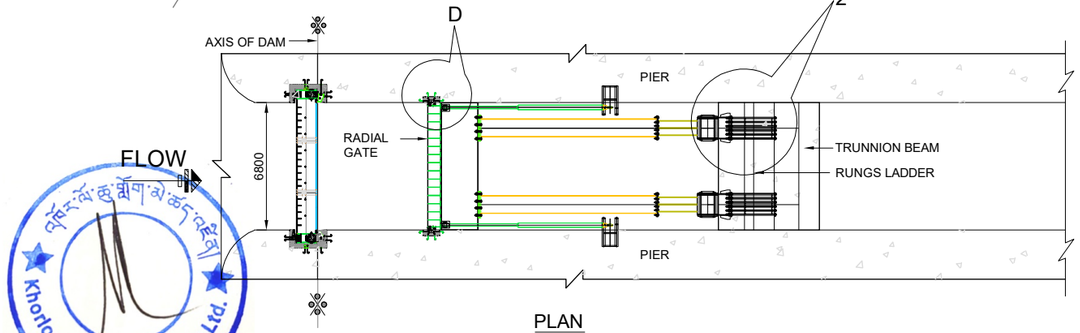
SCALE: AS SHOWN	ISSUE P1	DATE: 18-JUN-2025	ORIGINAL PRINT SIZE: A1

TITLE: SLUICE RADIAL GATE 6800mm X 12900mm GENERAL ARRANGEMENT

DWG No: KHPP-HM-DAM-GA-6007

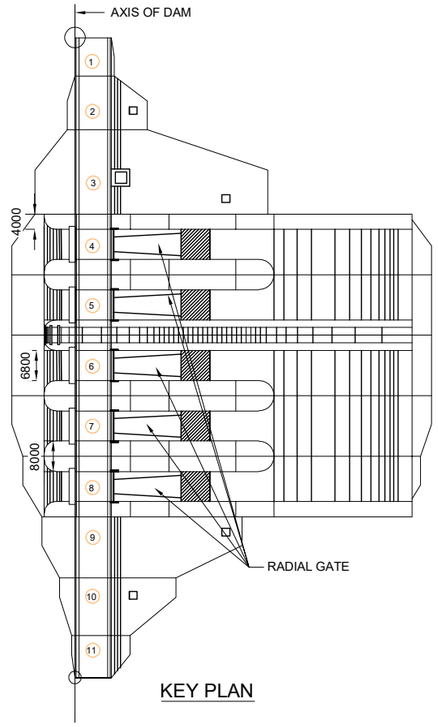


SLUICE SPILLWAY SECTION THROUGH C/L OF BAY

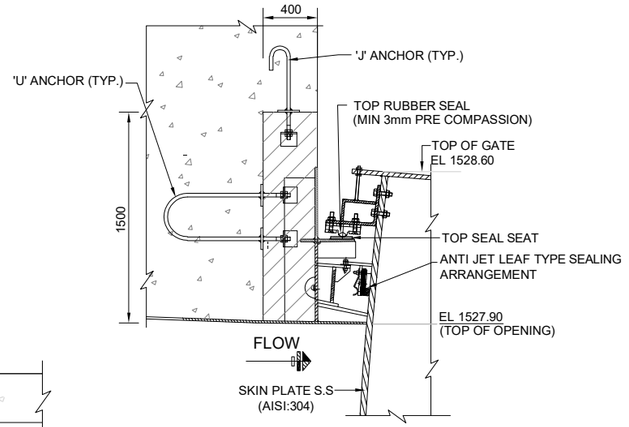


PLAN

FLOW



KEY PLAN



DETAIL - A

LEGEND :-

1st STAGE CONCRETE

2nd STAGE CONCRETE

NOTES :-

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES.
2. IstSTAGE&2ndSTAGE CONCRETE SHALL BE WELL BONDED BY THE EXTENSIONS OF REINFORCEMENT BARS BY PROVISION OF DOWEL BARS.
3. NO. OF BAYS - 5 (FIVE) AND NO. OF RADIAL GATES - 5 (FIVE).
4. FACESOFWALLPLATESANDSEALSEATSSHALLBEINATRUEVERTICAL PLANEWITHATOLERANCEOF0.5mmINANY3.0mHTWITHOUTOFFSETS OR GAPS AT THE JOINTS.
5. FOR DETAILS OF CIVIL STRUCTURES REFER RELEVANT CIVIL DRAWINGS.
6. THE RADIAL GATE SHALL BE DESIGNED FOR A WATER HEAD OF 57.569m.CORRESPONDING TO FRL AT EL.1572.00m.
7. THERADIALGATESHALLBEOPERATEDWITHTHEHELPOFHYDRAULIC HOIST.THERADIALGATESHALLBECAPABLEOFBEINGLOWEREDUNDER FLOWING WATER CONDITION.
8. ALLTHECOMPONENTSOFRADIALGATESHALLBEDESIGNEDASPER IS:4623.
9. SIDEANDTOPSEALSARETEFLONCOATEDEMBEDDEDLABYRINTHSEAL IS ALSO TEFLON COATED TYPE.
10. THEELEVATIONOFBOTTOMMOSTPARTOFRADIALGATEINFULLY RAISED POSITION SHALL BE ABOVE EL 1528.60m (TENTATIVE)
11. SUITABLERECESSSHALLBEPROVIDEDFORSEALSABOVEVENT OPENING OF RADIAL GATE.
12. CONCRETEINBLOCKOUTSSHALLBEONEGRADEHIGHERTHANFIRST STAGE CONCRETE . BUT NOT LEANER THAN M-25 CONFORMING TO IS456.
13. ALLSURFACESBETWEENFIRSTSTAGE&2ndSTAGECONCRETESSHALL BEMADETHOROUGHLYROUGH.SUITABLEDOWELSBARSSHALLBELEFT IN Ist STAGE CONCRETE.
14. SUITABLEARRANGEMENTTOINSPECTTRUNNIONASSEMBLY,TOPSEAL& HYDRAULIC HOIST ASSEMBLY OF RADIAL GATES MAY BE PROVIDED.

TECHNICAL DATA FOR SLUICE RADIAL GATE	
NO OF OPENINGS	5
NO OF GATES	5
CLEAR SPAN	6.8m
CLEAR HT	12.9m
RADIUS OF GATE	±18.50m
℄ OF TRUNNION	EL.1527.00m
SILL EL OF GATE	EL.1514.431m
FRL	EL.1572.00m
TOP OF DAM	EL.1574.00m
DESIGN HEAD	57.569m
ADDITIONAL SILT LOAD	HALF THE GATE HEIGHT
LOCATION OF SKIN PLATE	UPSTREAM
HOIST	HYDRAULIC HOIST
OPERATION CONDITION LOWERING & RAISING	UNDER UNBALANCED HEAD CONDITION WITH LOWERING UNDER GATES OWN WEIGHT.
TYPE OF SEALING	DOUBLE STEM TEFLON CLADDED RUBBER REAL FOR TOP, SIDE & WEDGE TYPE FOR BOTTOM
GATE LIFTING SPEED GATE LOWERING SPEED	0.4m/min 0.4m/min
LIFTING HT APPROX	13.70m.

FOR TENDER PURPOSE

CLIENT: KHORLOCHHU HYDRO POWER LIMITED, TRASHIYANGTSE, BHUTAN

CONSULTANT: Tata Consulting Engineers Ltd. & Lombardi Engineering Ltd.(JV)

PROJECT: KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN SH–01

TITLE: SLUICE RADIAL GATE 6800mm X 12900mm GENERAL ARRANGEMENT

DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	

DWG No: KHPP–HM–DAM–GA–6007

SCALE: AS SHOWN	ISSUE P1	DATE: 18–JUN–2025

ORIGINAL PRINT SIZE: A1

FILE NAME: KHPP–HM–DAM–GA–6007

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

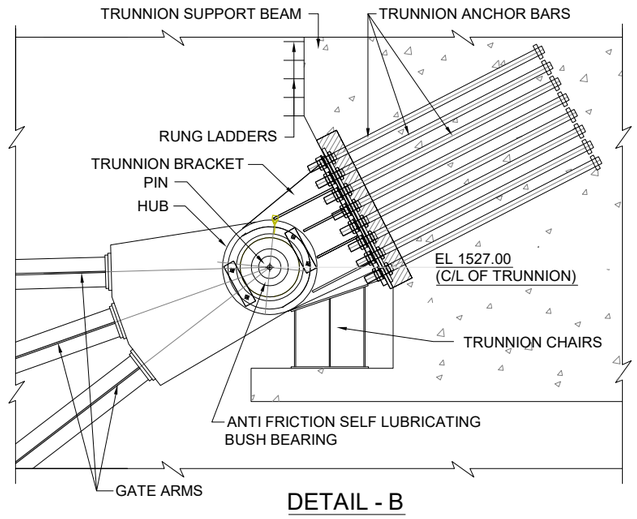
INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
	REVIEWED										

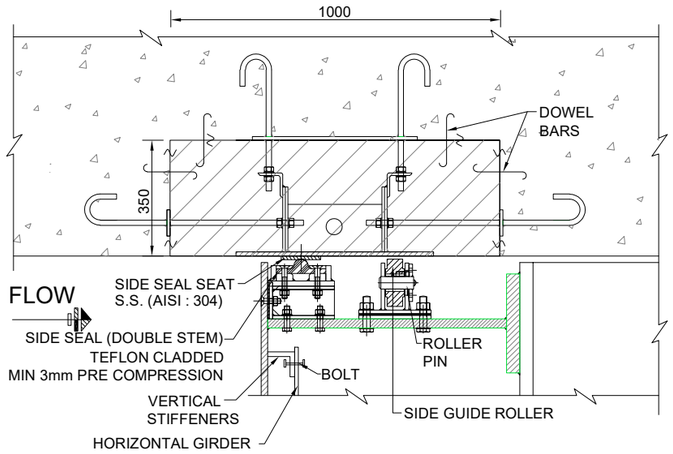
Khorlochhu Hydro Power Ltd.

TITLE: SLUICE RADIAL GATE 6800mm X 12900mm GENERAL ARRANGEMENT

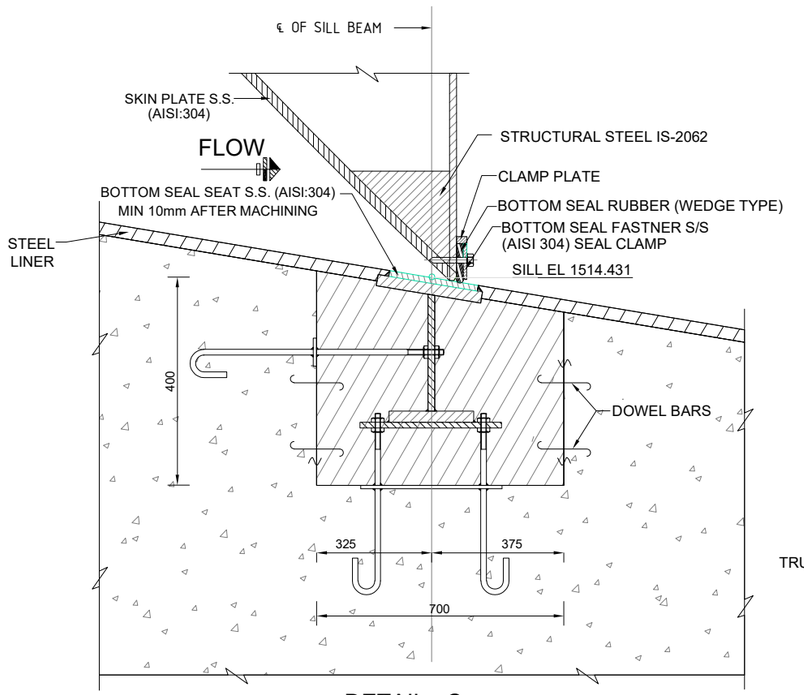
DWG NO: KHPP-HM-DAM-GA-6008



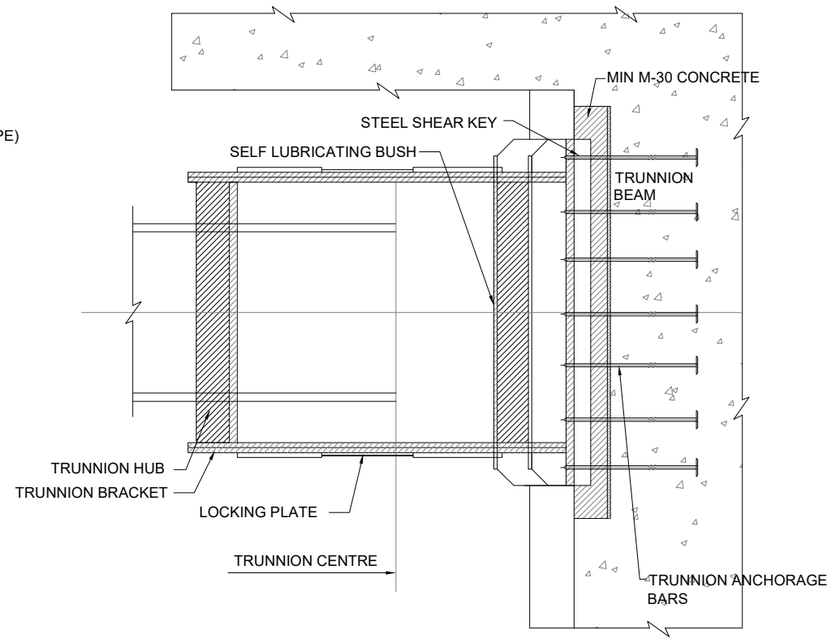
DETAIL - B



DETAIL - D



DETAIL - C



DETAIL - 2

LEGEND :-

1st STAGE CONCRETE

2nd STAGE CONCRETE

NOTES :-

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES.
2. IstSTAGE&2ndSTAGECONCRETESHALLBEWELLBONDEDBYTHE EXTENSIONS OF REINFORCEMENT BARS BY PROVISION OF DOWEL BARS.
3. NO. OF BAYS - 5 (FIVE) AND NO. OF RADIAL GATES - 5 (FIVE) .
4. FACESOFWALLPLATESANDSEALSEATSSHALLBEINATRUEVERTICAL PLANEWITHATOLERANCEOF0.5mmlNANY3.0mHTWITHOUTOFFSETS OR GAPS AT THE JOINTS.
5. FOR DETAILS OF CIVIL STRUCTURES REFER RELEVANT CIVIL DRAWINGS.
6. THERADIALGATESHALLBEDESIGNEDFORAWATERHEADOF 57.569m.CORRESPONDING TO FRL AT EL.1572.00m.
7. THERADIALGATESHALLBEOPERATEDWITHTHEHELPOFHYDRAULIC HOIST.THERADIALGATESHALLBECAPABLEOFBEINGLOWEREDUNDER FLOWING WATER CONDITION.
8. ALLTHECOMPONENTSOFRADIALGATESHALLBEDESIGNEDASPER IS:4623.
9. SIDEANDTOPSEALSARETEFLONCOATEDEMBEDDEDLABYRINTHSEAL IS ALSO TEFLON COATED TYPE.
10. THEELEVATIONOFBOTTOMMOSTPARTOFRADIALGATEINFULLY RAISED POSITION SHALL BE ABOVE EL 1528.60m (TENTATIVE)
11. SUITABLERECESSSHALLBEPROVIDEDFORSEALSABOVEVENT OPENING OF RADIAL GATE.
12. CONCRETEINBLOCKOUTSSHALLBEONEGRADEHIGHERTHANFIRST STAGE CONCRETE . BUT NOT LEANER THAN M-25 CONFORMING TO IS456.
13. ALLSURFACESBETWEENFIRSTSTAGE&2ndSTAGECONCRETESSHALL BEMADETHOROUGHLYROUGH.SUITABLEDOWELSBARSSHALLBELEFT IN Ist STAGE CONCRETE.
14. SUITABLEARRANGEMENTTOINSPECTTRUNNIONASSEMBLY,TOPSEAL& HYDRAULIC HOIST ASSEMBLY OF RADIAL GATES MAY BE PROVIDED.

TECHNICAL DATA FOR SLUICE RADIAL GATE	
NO OF OPENINGS	5
NO OF GATES	5
CLEAR SPAN	6.8m
CLEAR HT	12.9m
RADIUS OF GATE	±18.50m
℄ OF TRUNNION	EL.1527.00m
SILL EL OF GATE	EL.1514.431m
FRL	EL.1572.00m
TOP OF DAM	EL.1574.00m
DESIGN HEAD	57.569m
ADDITIONAL SILT LOAD	HALF THE GATE HEIGHT
LOCATION OF SKIN PLATE	UPSTREAM
HOIST	HYDRAULIC HOIST
OPERATION CONDITION LOWERING & RAISING	UNDER UNBALANCED HEAD CONDITION WITH LOWERING UNDER GATES OWN WEIGHT.
TYPE OF SEALING	DOUBLE STEM TEFLON CLADDED RUBBER REAL FOR TOP, SIDE & WEDGE TYPE FOR BOTTOM
GATE LIFTING SPEED GATE LOWERING SPEED	0.4m/min 0.4m/min
LIFTING HT APPROX	13.70m.

Khorlochhu Hydro Power Ltd.

FOR TENDER PURPOSE

CLIENT:

KHORLOCHHU HYDRO POWER LIMITED
TRASHIYANGTSE, BHUTAN

CONSULTANT:

Tata Consulting Engineers Ltd. &
Lombardi Engineering Ltd.(JV)

PROJECT:

KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN

TITLE: SLUICE RADIAL GATE 6800mm X 12900mm GENERAL ARRANGEMENT SH-02

DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	

DWG No: KHPP-HM-DAM-GA-6008

SCALE: AS SHOWN	ISSUE P1	DATE: 17-JUN-2025

ORIGINAL PRINT SIZE: A1

FILE NAME: KHPP-HM-DAM-GA-6008

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

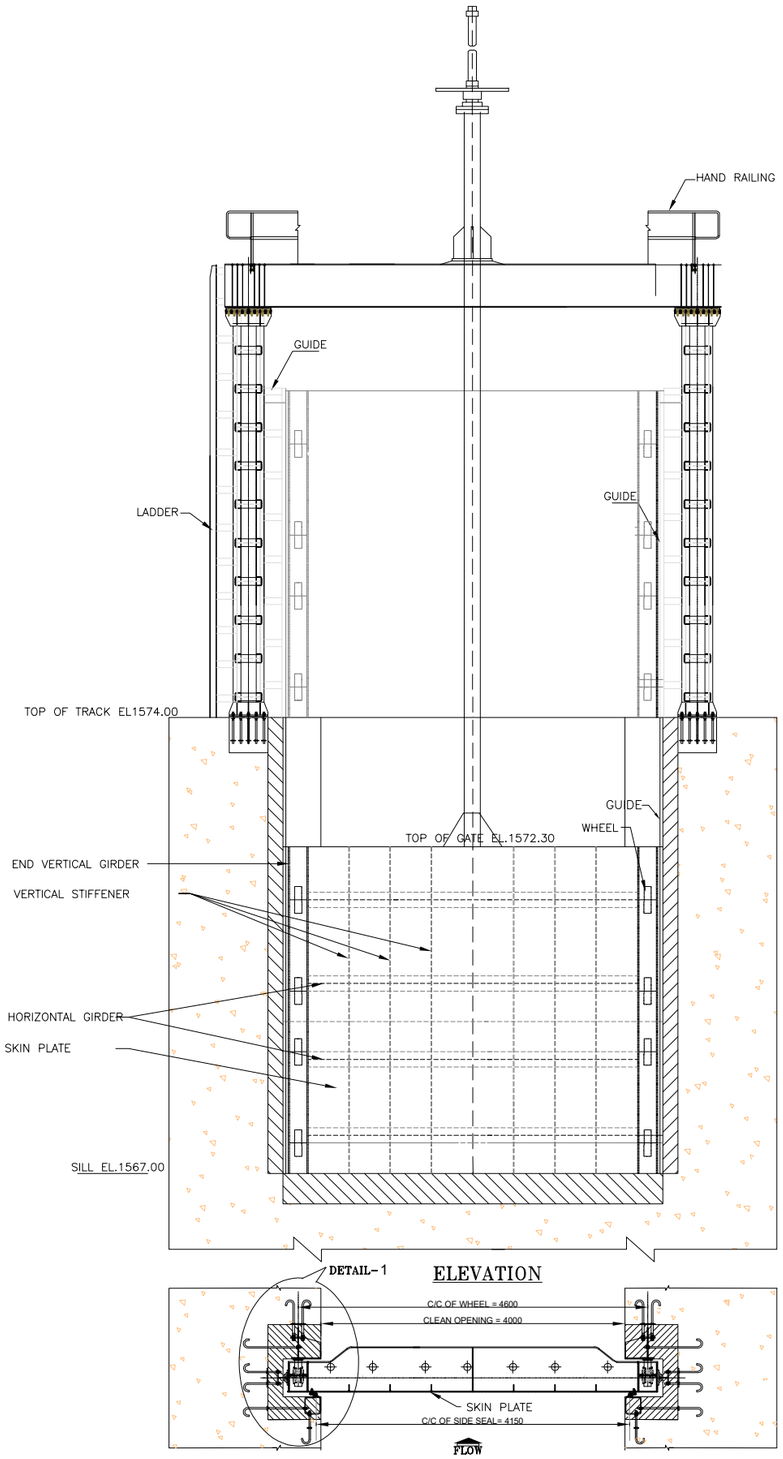
CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	REVIEWED	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE

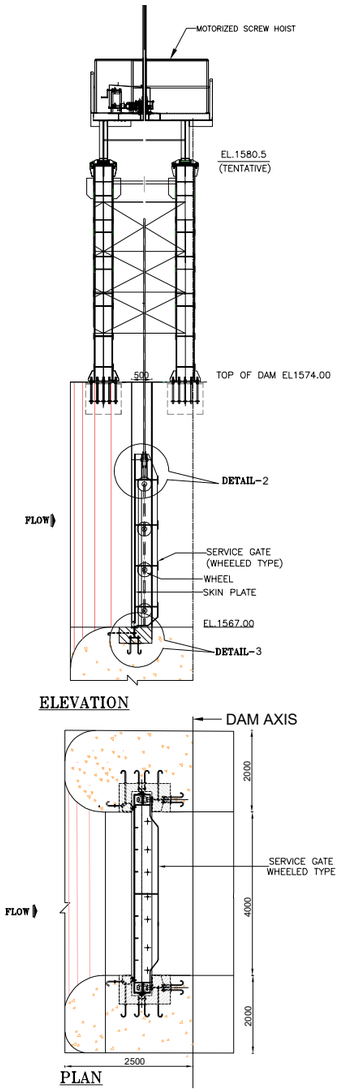
TITLE: OVERFLOW SPILLWAY SERVICE GATE
GATE (4000mm X 5000mm) GENERAL ARRANGEMENT

DWG NO KHPP-HM-DAM-GA-6009



ELEVATION

SERVICE GATE



ELEVATION

PLAN

LEGEND :-

1st. STAGE CONCRETE.

2nd. STAGE CONCRETE.

FOR TENDER PURPOSE

CLIENT: KHORLOCHHU HYDRO POWER LIMITED
TRASHIYANGTSE, BHUTAN

CONSULTANT: Tata Consulting Engineers Ltd. & Lombardi Engineering Ltd.(JV)

PROJECT: KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN

TITLE: OVERFLOW SPILLWAY SERVICE GATE SH-01
GATE (4000mm X 5000mm) GENERAL ARRANGEMENT

DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	

DWG No: KHPP-HM-DAM-GA-6009

SCALE: AS SHOWN	ISSUE P1	DATE: 18-JUN-2025	ORIGINAL PRINT SIZE: A1

FILE NAME: KHPP-HM-DAM-GA-6009

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

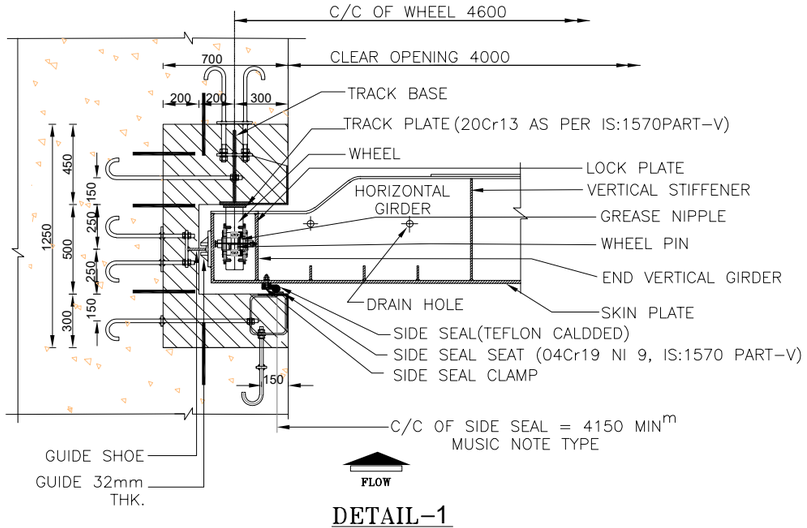
INFORMATION CONTAINED WITHIN "HOLD" IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

APPROV.	CIVL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
REVIEWED											

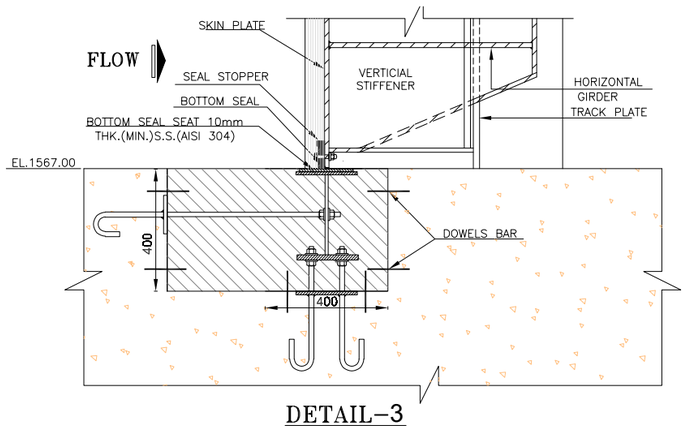
Khorlochhu Hydro Power Ltd.

TITLE: OVERFLOW SPILLWAY SERVICE GATE
GATE (4000mm X 5000mm) GENERAL ARRANGEMENT

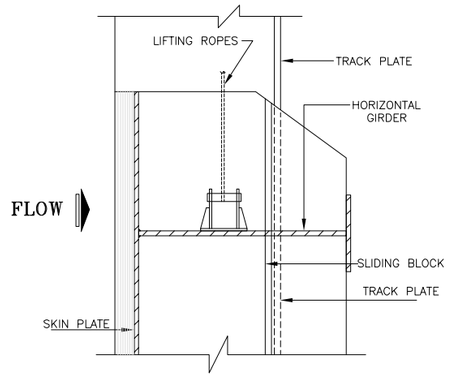
DWG NO KHPP-HM-DAM-GA-6010



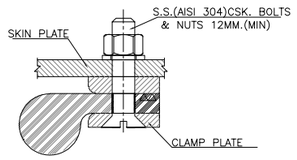
DETAIL-1



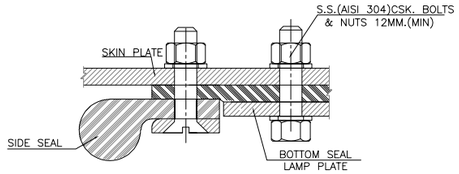
DETAIL-3



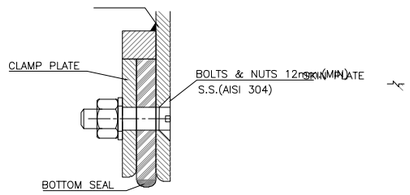
DETAIL-2



SIDE SEAL



DETAIL OF SIDE & BOTTOM SEAL JOINT



BOTTOM SEAL

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES.
2. FOR DETAIL OF CIVIL STRUCTURE & REFER RELEVANT CIVIL DRGS.
3. FACES OF TRACKS & SEAL SEATS HALL BE IN A TRUE VERTICAL PLANE WITH IN A TOLERANCE OF ± 0.5 mm IN ANY 3.0m WITH OUT OFF SETS OR GAPS AT THE JOINTS.
4. ERECTION TOLERANCE FOR EMBEDDED PARTS AND GATES TO BE CONSIDERED AS PER IS 5620.
5. THE 2nd STAGE CONCRETE IN BLOCK OUTS SHALL BE BONDED TO THE Ist STAGE CONCRETE AND NECESSARY DOWELS AT SUITABLE INTERVALS BE LEFT FROM THE Ist STAGE CONCRETE BY THE CIVIL CONTRACTOR.
6. MACHINING OF TRACKS AND SIDE SEAL SEAT SHALL BE CARRIED OUT AFTER WELDING TO THEIR BASES.
7. THE MINIMUM SIZE OF FILLET WELDS SHALL BE 6mm UNLESS OTHERWISE SPECIFIED.
8. SIZE OF GATE :4.0mX5.0m.
9. NO OF GATES : 1
10. DRY TESTING OF THE EMBEDDED PARTS SHOULD BE CARRIED OUT BEFORE COMMISSIONING OF THE GATES.
11. THE GATES SHALL BE SELF CLOSING UNDER FLOWING WATER CONDITION & LIFTING AGAINST UNBALANCED HEAD FOR SERVICE GATE BY MOTORIZED SCREW HOIST.
12. CONCRETE SHOWN AS.

FIRST STAGE

SECOND STAGE

TECHNICAL PARAMETERS	
DESCRIPTION	OVERFLOW SPILLWAY SERVICE GATE
TYPE	WHEEL TYPE
SIZE OF GATE	4.0mX5.0m
SILL EL	EL.1567.0m
NO OF GATES	1
DESIGN HEAD	5.0m
HOIST	MOTORIZED SCREW HOIST
LOCATION OF SKIN PLATE	UPSTREAM
SEALING	UPSTREAM

LEGEND :-

1st. STAGE CONCRETE.

2nd. STAGE CONCRETE.

Khorlochhu Hydro Power Ltd.

APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
REVIEWED											

FILE NAME: KHPP-HM-DAM-GA-6010

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

INFORMATION CONTAINED WITHIN "HOLD" IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

FOR TENDER PURPOSE

CLIENT:
KHORLOCHHU HYDRO POWER LIMITED
TRASHIYANGTSE, BHUTAN

CONSULTANT:
Tata Consulting Engineers Ltd. &
Lombardi Engineering Ltd.(JV)

PROJECT:
KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN

TITLE:
OVERFLOW SPILLWAY SERVICE GATE SH-02
GATE (4000mm X 5000mm) GENERAL ARRANGEMENT

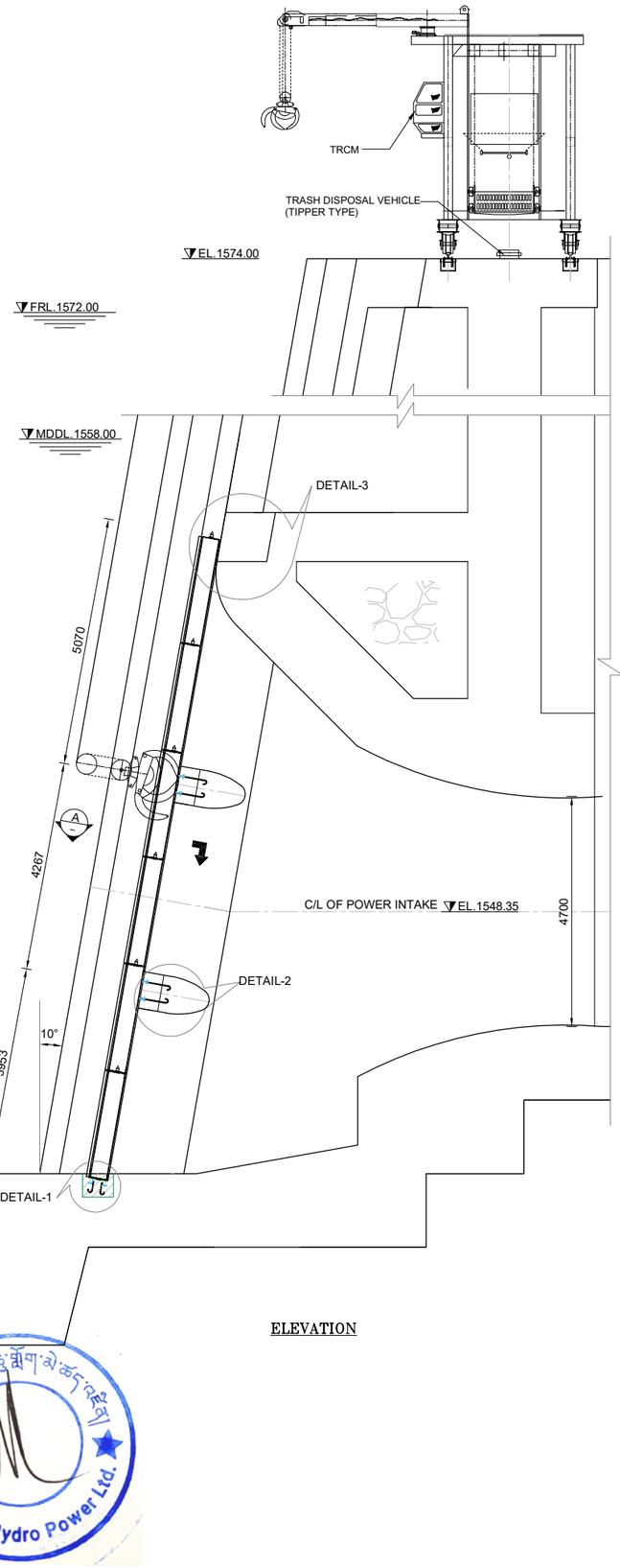
DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	

DWG No: KHPP-HM-DAM-GA-6010

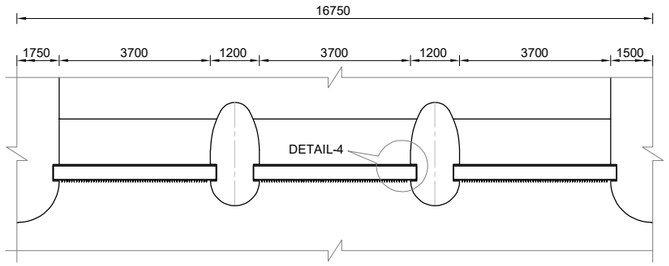
SCALE: AS SHOWN	ISSUE P1	DATE: 17-JUN-2025	ORIGINAL PRINT SIZE: A1

DWG NO KHPP-HM-INT-GA-6011

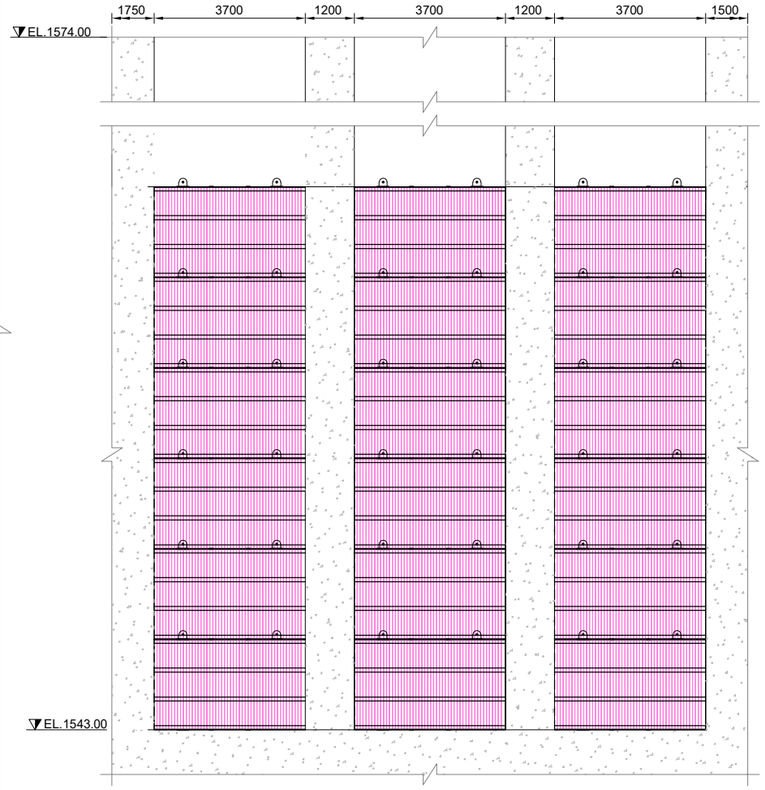
TITLE: TRASH RACK AND TRCM GENERAL ARRANGEMENT



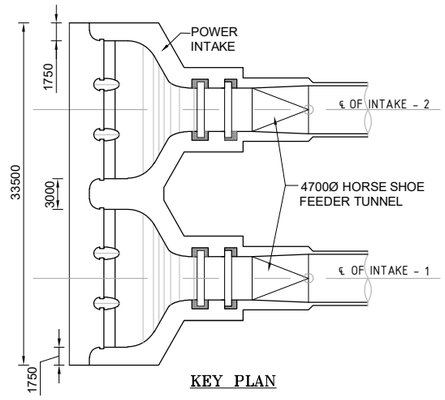
ELEVATION



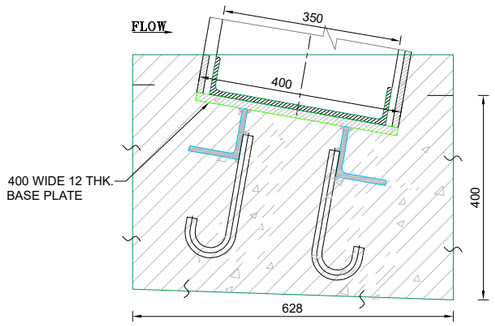
SECTION-A



ELEVATION (INCLINED VIEW)



KEY PLAN



DETAIL-1

NOTES:

1. ALL DIMENSION ARE IN MILLIMETERS AND ELEVATION IN METERS.
2. THE DIMENSION SHALL NOT BE SCALED.
3. GROOVE DETAILS ARE FOR PLANNING PURPOSES ONLY AND THESE SHALL BE FINALIZED AFTER DESIGN BY THE MANUFACTURER OF THE EQUIPMENT.
4. ALL WELDS SHALL BE OF FULL STRENGTH AND OF MIN. 6mm SIZE.
5. ALL STRUCTURAL STEEL SHALL CONFORM TO IS:2062.

Khorlochhu Hydro Power Ltd.

FOR TENDER PURPOSE

CLIENT: Khorlochhu — KHORLOCHHU HYDRO POWER LIMITED, TRASHIYANGTSE, BHUTAN

CONSULTANT: TATA | Lombardi — Tata Consulting Engineers Ltd. & Lombardi Engineering Ltd.(JV)

PROJECT: KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN

TITLE: TRASH RACK AND TRCM SH-01 GENERAL ARRANGEMENT

DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	

DWG No: KHPP-HM-INT-GA-6011

SCALE: AS SHOWN | ISSUE P1 | DATE: 18-JUN-2025 | ORIGINAL PRINT SIZE: A1

FILE NAME: KHPP-HM-INT-GA-6011

"P" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

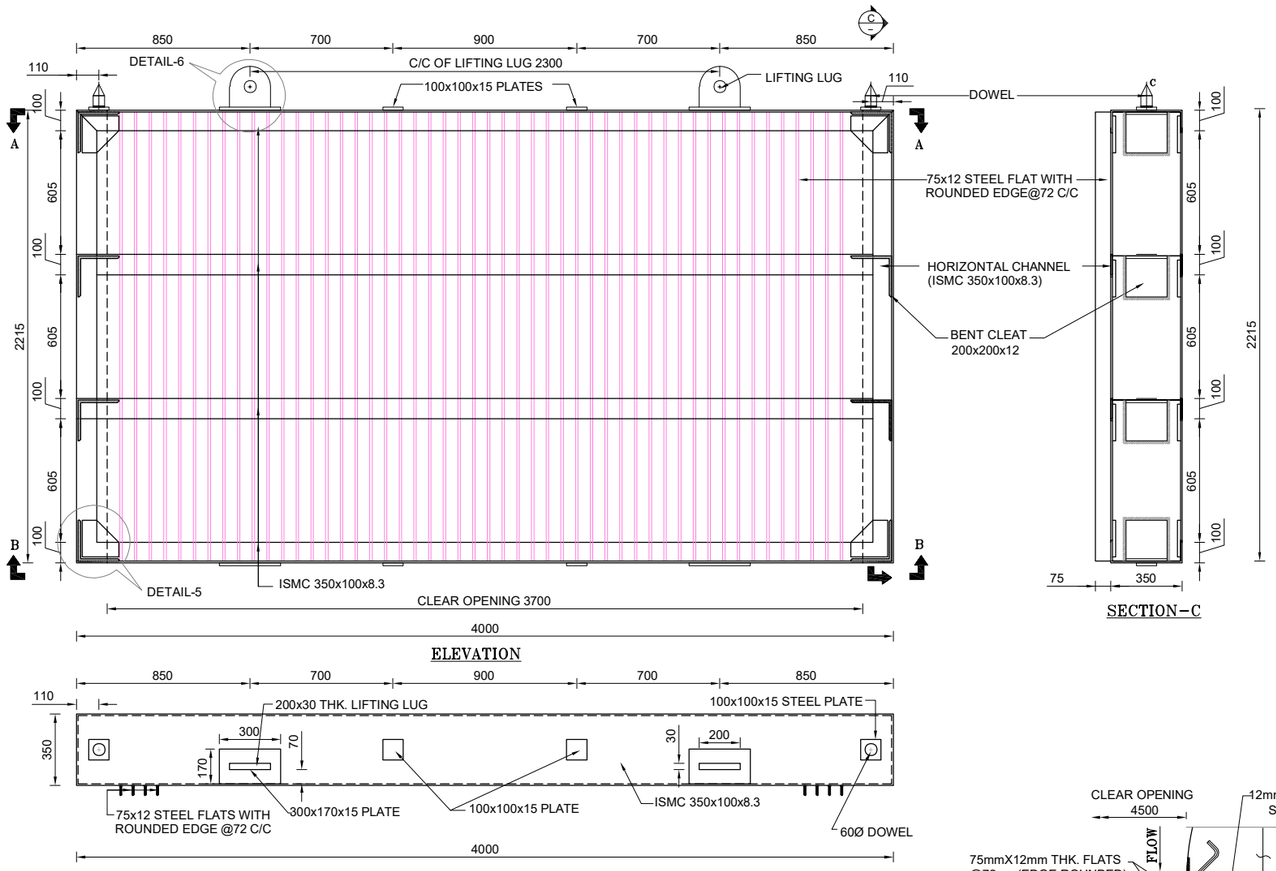
CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

INFORMATION CONTAINED WITHIN "HOLD" IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
REVIEWED											

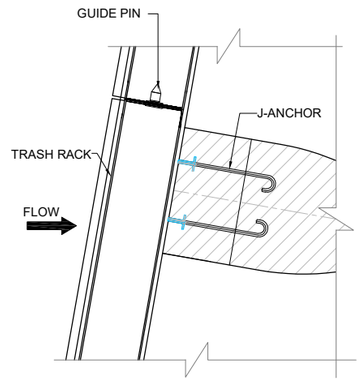
TITLE: TRASH RACK AND TRCM
GENERAL ARRANGEMENT

DWG NO KHPP-HM-INT-GA-6012

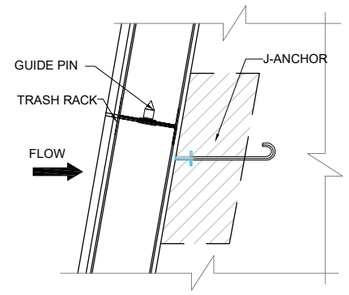


ELEVATION

SECTION-C

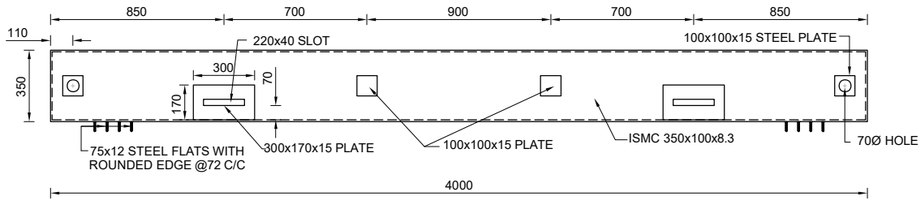


DETAIL-2

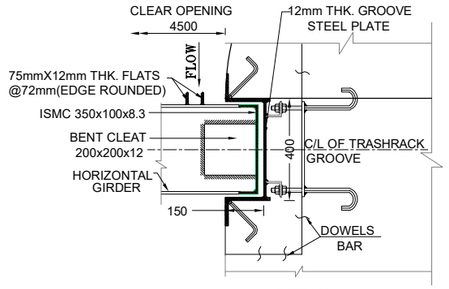


DETAIL-3

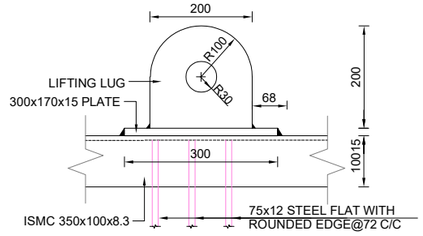
VIEW A-A



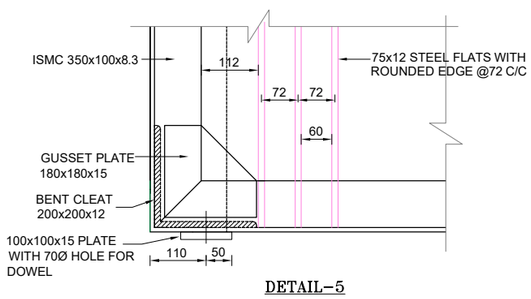
VIEW B-B



DETAIL-4
GROOVE DETAILS OF TRASH RACK
(*FOR INTERMEDIATE PIER)



DETAIL-6



DETAIL-5

NOTES:

1. ALL DIMENSION ARE IN MILLIMETERS AND ELEVATION IN METERS.
2. THE DIMENSION SHALL NOT BE SCALED.
3. GROOVE DETAILS ARE FOR PLANNING PURPOSES ONLY AND THESE SHALL BE FINALIZED AFTER DESIGN BY THE MANUFACTURER OF THE EQUIPMENT.
4. ALL WELDS SHALL BE OF FULL STRENGTH AND OF MIN. 6mm SIZE.
5. ALL STRUCTURAL STEEL SHALL CONFORM TO IS:2062.

Khorlochhu Hydro Power Ltd.

APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
REVIEWED											

FILE NAME: KHPP-HM-INT-GA-6012

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

FOR TENDER PURPOSE

CLIENT:
KHORLOCHHU HYDRO POWER LIMITED
TRASHIYANGTSE, BHUTAN

CONSULTANT:
Tata Consulting Engineers Ltd. &
Lombardi Engineering Ltd.(JV)

PROJECT:
KHORLOCHHU HYDRO POWER PROJECT(4X150 MW),
TRASHIYANGTSE, BHUTAN

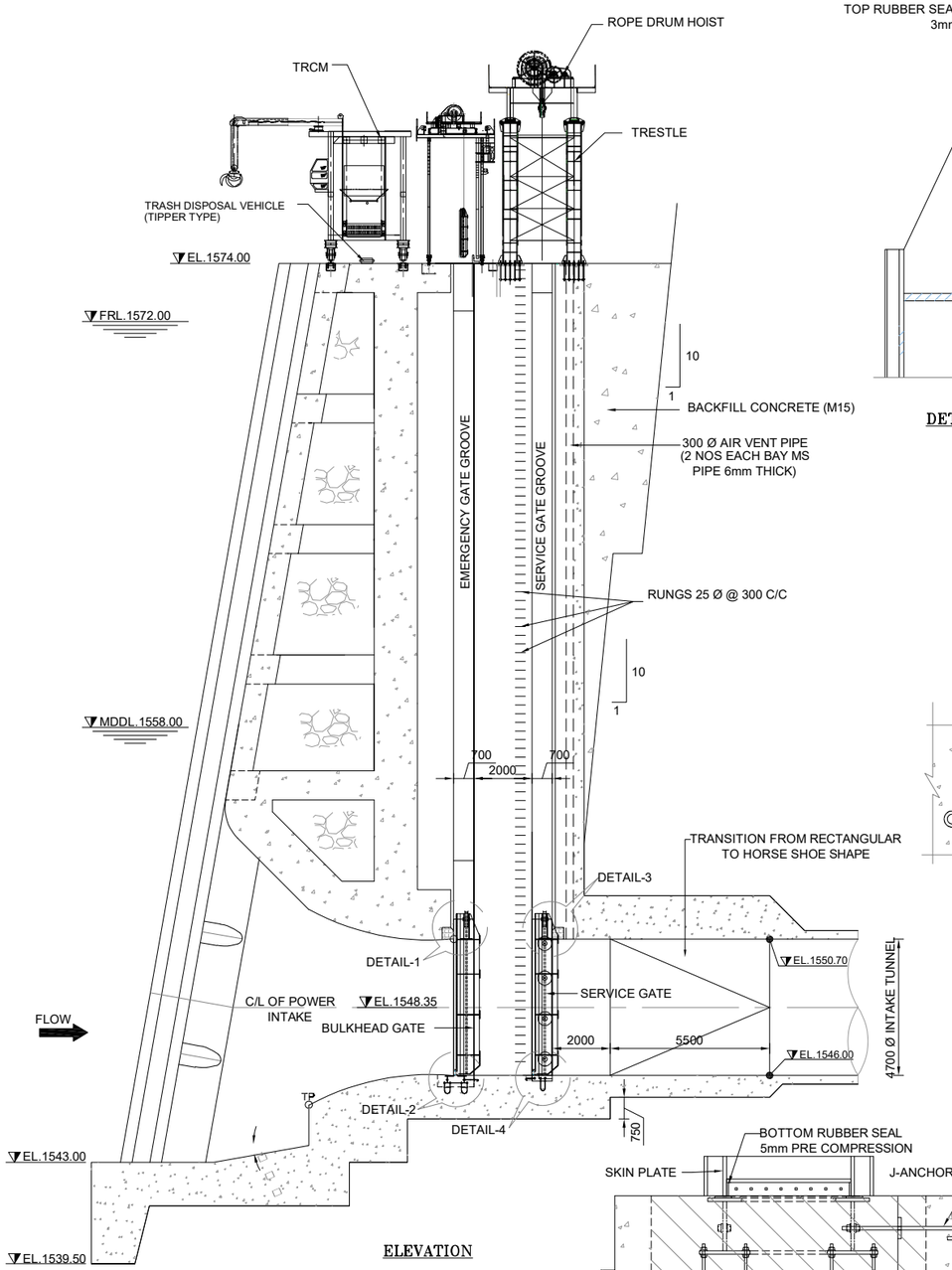
TITLE:
TRASH RACK AND TRCM SH-02
GENERAL ARRANGEMENT

DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	
DWG No: KHPP-HM-INT-GA-6012		
SCALE: AS SHOWN	ISSUE P1	DATE: 17-JUN-2025

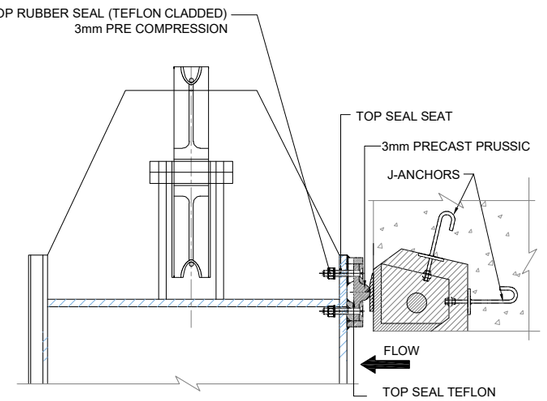
ORIGINAL PRINT SIZE: A1

TITLE: INTAKE BULKHEAD AND SERVICE GATE
4250mm X 4700mm GENERAL ARRANGEMENT

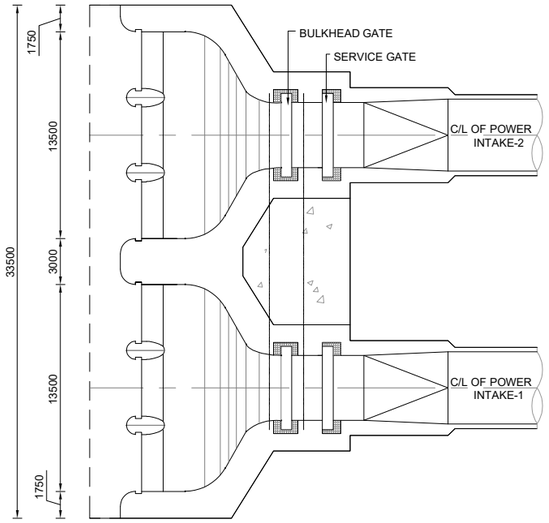
DWG NO KHPP-HM-INT-GA-6013



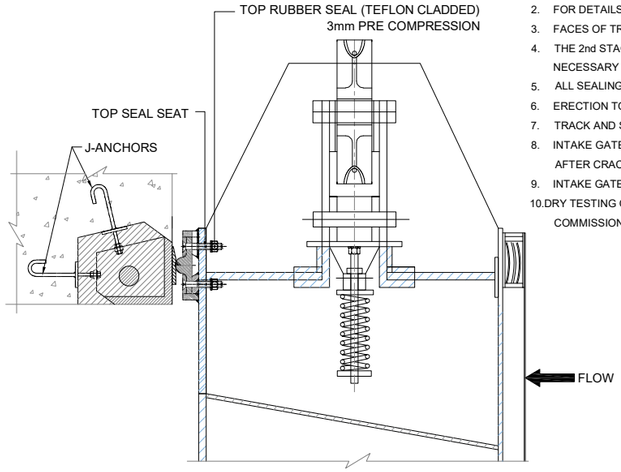
ELEVATION



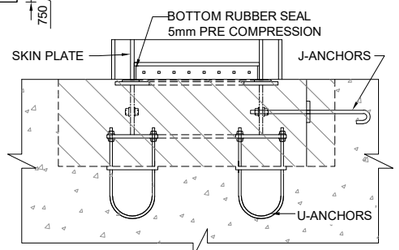
DETAIL-3 (INTAKE SERVICE GATE)



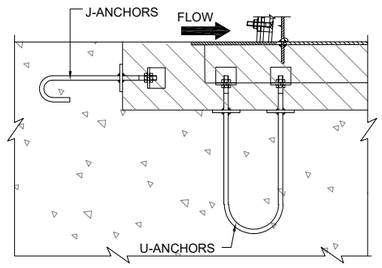
KEY PLAN



DETAIL-1 (INTAKE BULKHEAD GATE) (EMERGENCY)



DETAIL-2 (INTAKE BULKHEAD GATE)



DETAIL-4 (INTAKE SERVICE GATE)

NOTES:

1. ALL DIMENSIONS ARE IN MM AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE SPECIFIED.
2. FOR DETAILS OF CIVIL STRUCTURE REFER RELEVANT CIVIL DRAWINGS.
3. FACES OF TRACKS AND SEAL SEATS SHALL BE IN A TRUE VERTICAL PLANE WITH A TOLERANCE OF 5mm.
4. THE 2nd STAGE CONCRETE BLOCK OUTS SHALL BE BONDED TO THE Ist STAGE CONCRETE AND NECESSARY DOWELS AT SUITABLE INTERVALS BE LEFT FROM THE Ist STAGE CONCRETE .
5. ALL SEALING ARRANGEMENT (BOTTOM, SIDE AND TOP) SHALL BE WATER TIGHT.
6. ERECTION TOLERANCES FOR EMBEDDED PARTS AND GATES TO BE AS PER IS 4622 & IS 9349.
7. TRACK AND SEAL SEATS SHALL BE PROVIDED WITH REQUIRED SURFACE FINISH.
8. INTAKE GATE SHALL BE DESIGNED FOR LOWERING AGAINST FRL AND RAISING UNDER BALANCED HEAD AFTER CRACK OPENING AT FRL.
9. INTAKE GATE SHALL BE PROVIDED WITH TEFLON COATED RUBBER SEALS FOR SIDES AND TOP.
10. DRY TESTING OF THE GATES W.R.T THE EMBEDDED PART SHOULD BE CARRIED OUT BEFORE COMMISSIONING OF INTAKE STRUCTURE.

TECHNICAL PARAMETERS		
DESCRIPTION	INTAKE SERVICE GATE	INTAKE BULKHEAD GATE
TYPE	FIXED WHEEL	SLIDE
SIZE OF OPENING	4250(W)X4700(H)	4250(W)X4700(H)
FRL	EL.1572.00	EL.1572.00
NOS	TWO	ONE
OPERATING MECHANISM	ROPE DRUM HOIST	GANTRY CRANE
LOCATION OF SKIN PLATE	DOWNSTREAM	UPSTREAM
SEALING	UPSTREAM	DOWNSTREAM

LEGEND :-
1st STAGE CONCRETE
2nd STAGE CONCRETE

Khorlochhu Hydro Power Ltd.

FOR TENDER PURPOSE

CLIENT:
Khorlochhu
KHORLOCHHU HYDRO POWER LIMITED
TRASHIYANGTSE, BHUTAN

CONSULTANT:
TATA | Lombardi
Tata Consulting Engineers Ltd. &
Lombardi Engineering Ltd.(JV)

PROJECT:
KHORLOCHHU HYDRO POWER PROJECT(4X150 MW),
TRASHIYANGTSE, BHUTAN

TITLE:
INTAKE BULKHEAD AND SERVICE GATE SH-01
4250mm X 4700mm GENERAL ARRANGEMENT

DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	
DWG No: KHPP-HM-INT-GA-6013		
SCALE: AS SHOWN	ISSUE P1	DATE: 18-JUN-2025
ORIGINAL PRINT SIZE: A1		

FILE NAME: KHPP-HM-INT-GA-6013

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

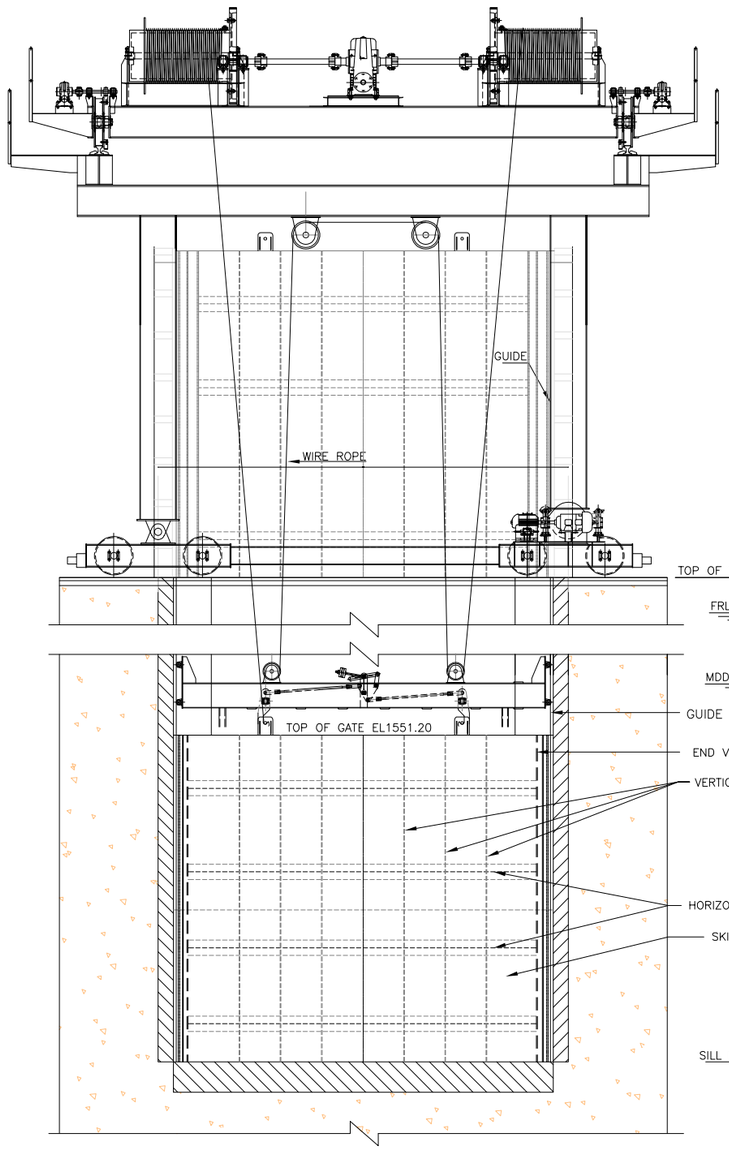
CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

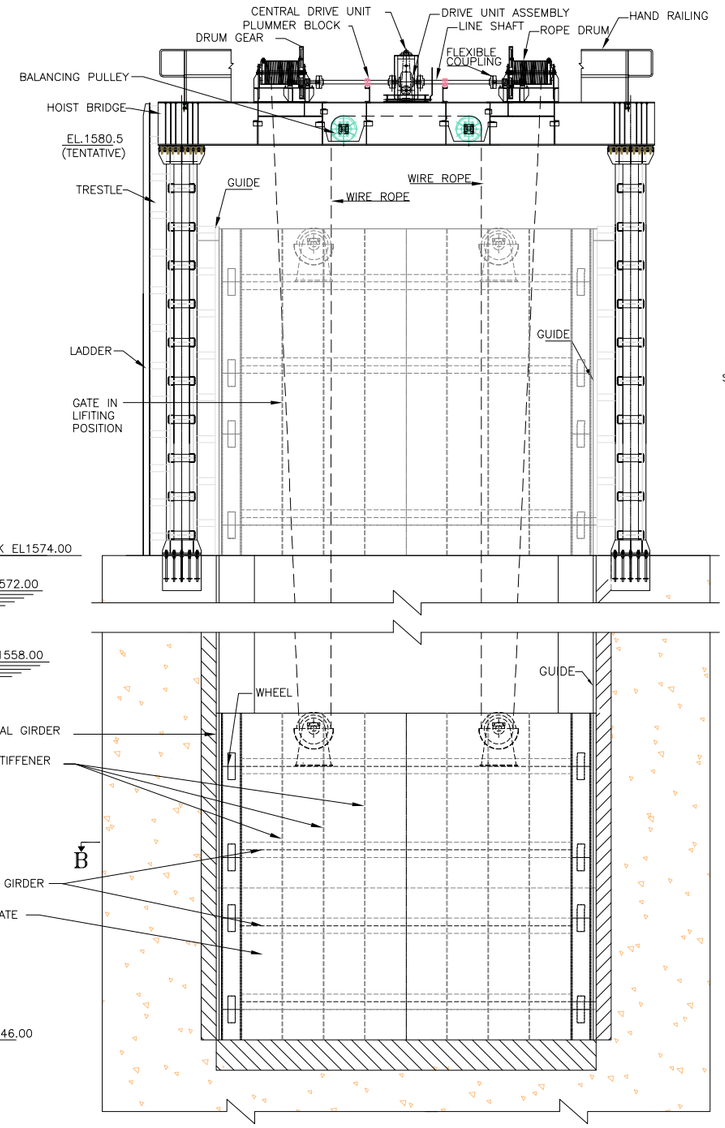
APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
			REVIEWED								

TITLE: INTAKE BULKHEAD AND SERVICE GATE
4250mm X 4700mm GENERAL ARRANGEMENT

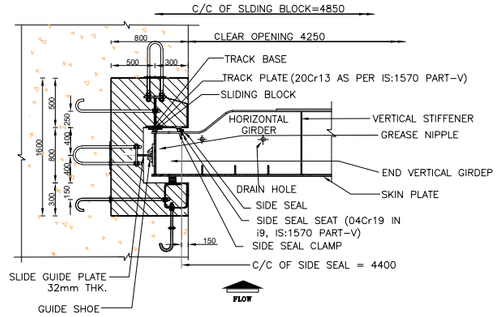
DWG NO KHPP-HM-INT-GA-6014



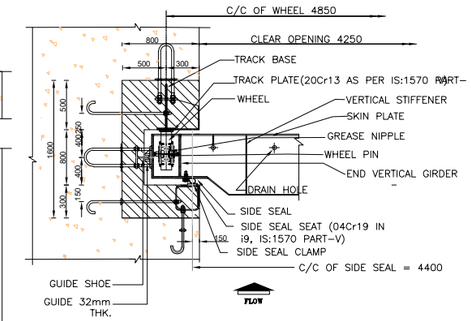
ELEVATION



ELEVATION



DETAIL-C

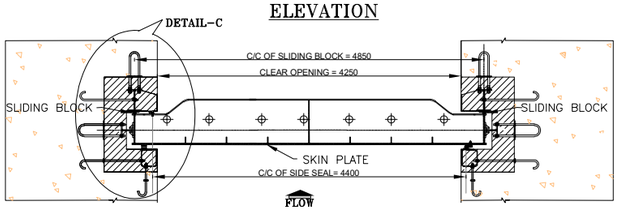


DETAIL-D

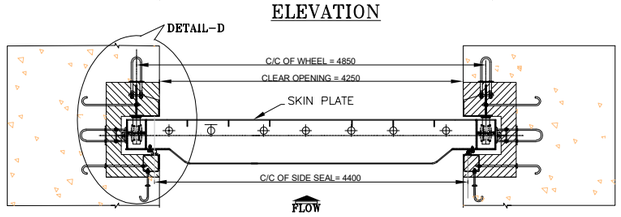
LEGEND :-

1st. STAGE CONCRETE.

2nd. STAGE CONCRETE.



INTAKE BULKHEAD GATE



INTAKE SERVICE GATE

Khorlochhu Hydro Power Ltd.

FOR TENDER PURPOSE

CLIENT: KHORLOCHHU HYDRO POWER LIMITED
TRASHIYANGTSE, BHUTAN

CONSULTANT: Tata Consulting Engineers Ltd. & Lombardi Engineering Ltd.(JV)

PROJECT: KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN

TITLE: INTAKE BULKHEAD AND SERVICE GATE SH-02
4250mm X 4700mm GENERAL ARRANGEMENT

DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	

DWG No: KHPP-HM-INT-GA-6014

SCALE: AS SHOWN | ISSUE P1 | DATE: 17-JUN-2025 | ORIGINAL PRINT SIZE: A1

FILE NAME: KHPP-HM-INT-GA-6014

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

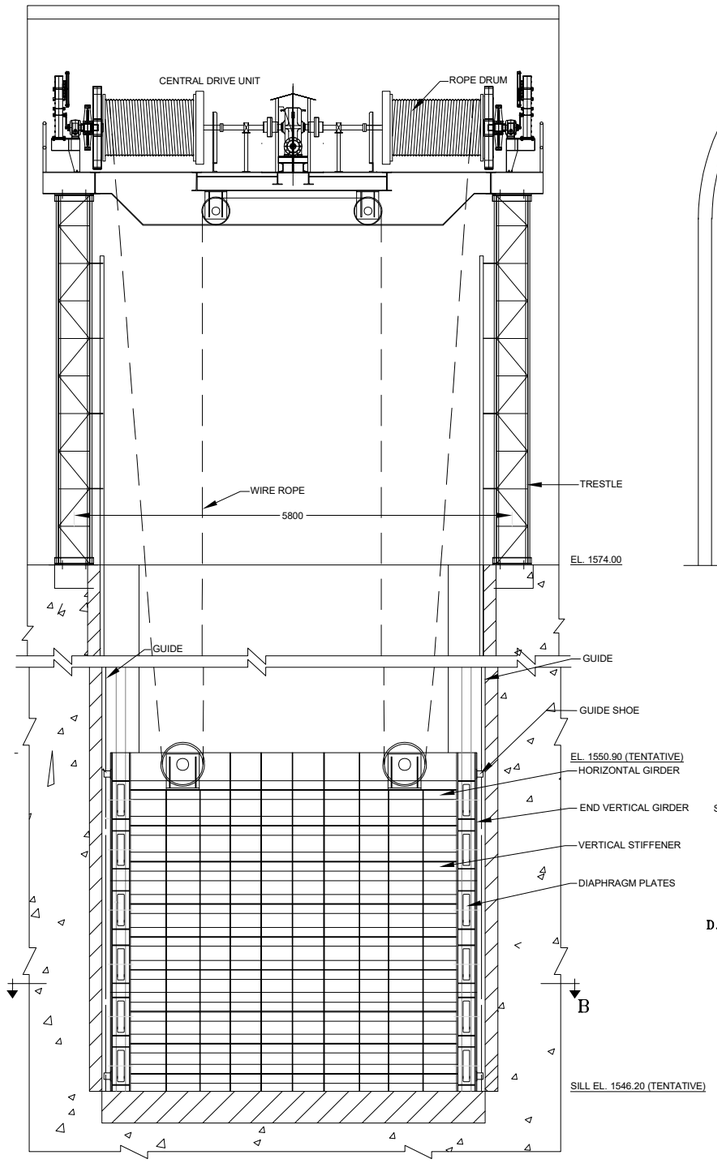
CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

INFORMATION CONTAINED WITHIN 'HOLDS' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

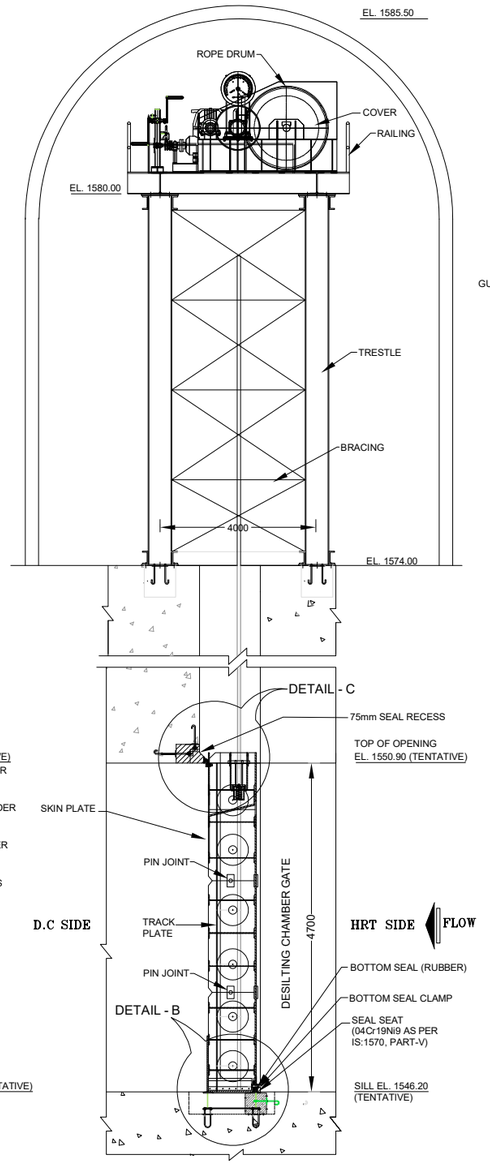
APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
REVIEWED											

TITLE: DESILTING CHAMBER GATE
4700mm X 4700mm GENERAL ARRANGEMENT

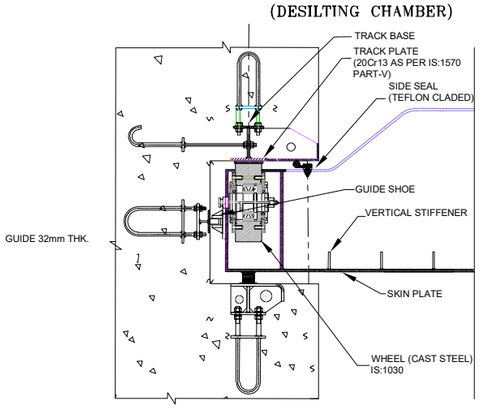
DWG NO KHPP-HM-DC-GA-6015



UPSTREAM ELEVATION AT 'A-A'

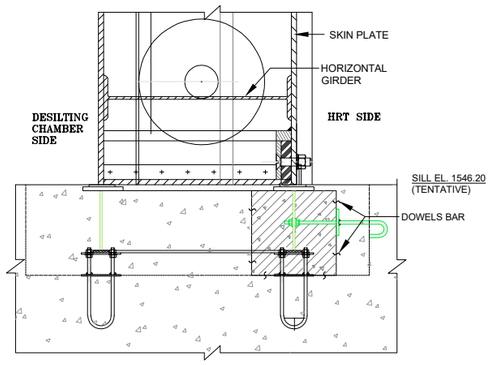


SECTION THRU' C/L OF BAY

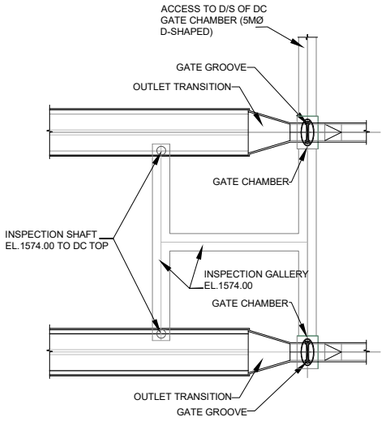


DETAIL - A

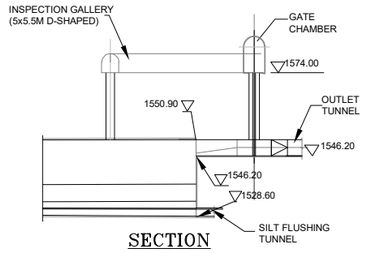
H.R.T. PRESSURE SIDE



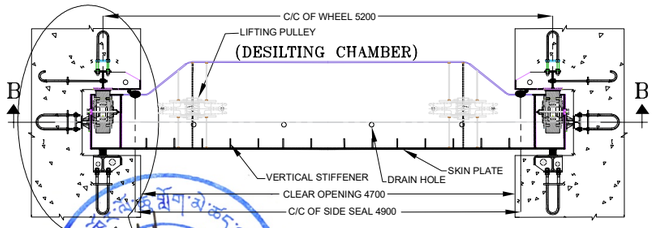
DETAIL – B



KEY PLAN



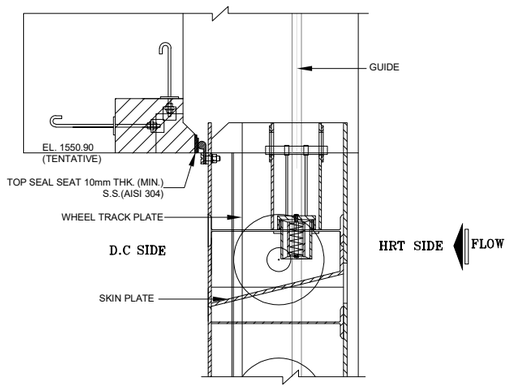
SECTION



DETAIL - A

H.R.T. PRESSURE SIDE

TECHNICAL PARAMETERS	
DESCRIPTION	DESILTING CHAMBER
TYPE	WHEEL TYPE
SIZE OF OPENING & NOS	4700mm X 4700mm
SILL ELEVATION	1546.20
NO OF GATE	2(TWO)
FRL	1572
HOIST	ROPE DRUM
LOCATION OF SKIN PLATE	HRT SIDE
SEALING	DESILTING CHAMBER SIDE



DETAIL – C

NOTES:

1. ALL DIMENSIONS ARE IN mm AND LEVELS ARE IN METRES.
2. FOR DETAIL OF CIVIL STRUCTURES REFER RELEVANT DRAWINGS
3. FACESOFTRACKSANDSEALSEATSSHALLBEINATRUEVERTICAL PLANEWITHINATOLERANCEOF105mmINANY30mWITHOUTOFFSETS OR GAPS AT THE JOINTS.
4. ERECTIONTOLERANCEFOREMBEDDEDPARTSANDGATESTOBE CONSIDERED AS PER IS: 3649
5. THE2NDSTAGECONCRETEBLOCLOUTSSHALLBEBONDEDTOTHE1ST STAGECONCRETEANDNECESSARYDOWELSATSUITABLEINTERVALS BE LEFT FROM THE 1ST STAGE CONCRETE BY THE CIVIL CONTRACTOR.
6. MACHININGOFTRACKSANDSIDESEALSEATSHALLBECARRIEDOUT AFTER WELDING TO THEIR BASES
7. THEMINIMUMSIZEOFFILLETWELDSSHALLBE6mmUNLESS OTHERWISE SPECIFIED
8. A) CLEAR OPINING = 4700 X 4700
   B) NO OF OPENING = TWO
   C) NO OF GATES = TWO
9. GATEISPROPOSEDTOBEMADEOFTHREEUNITESANDTHESEUNITS TO BE ASSEMBLED AT SITE BEFORE INSTALLATION
10. DRYTESTINGOFTHEGATEWRTTHEEMBEDDEDPARTSSHOULDBE CARRIED OUT BEFORE COMMISSIONING OF DESITING CHAMBER
11. THEGATESHALLBELOWEREDUNDERNOFLOWCONDITIONAND RAISEDUNDERBALANCEDHEADCONDITIONBYMEANSOFROPEDRUM HOIST

LEGEND :–

1st. STAGE CONCRETE.

2nd. STAGE CONCRETE.

FOR TENDER PURPOSE

CLIENT:
KHORLOCHHU HYDRO POWER LIMITED
TRASHIYANGTSE, BHUTAN

CONSULTANT:
Tata Consulting Engineers Ltd. &
Lombardi Engineering Ltd.(JV)

PROJECT:
KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN

TITLE:
DESILTING CHAMBER GATE
4700mm X 4700mm GENERAL ARRANGEMENT

DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	
DWG No: KHPP–HM–DC–GA–6015		
SCALE: AS SHOWN	ISSUE P1	DATE: 18–JUN–2025 ORIGINAL PRINT SIZE: A1

FILE NAME: KHPP-HM-DC-GA-6015

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

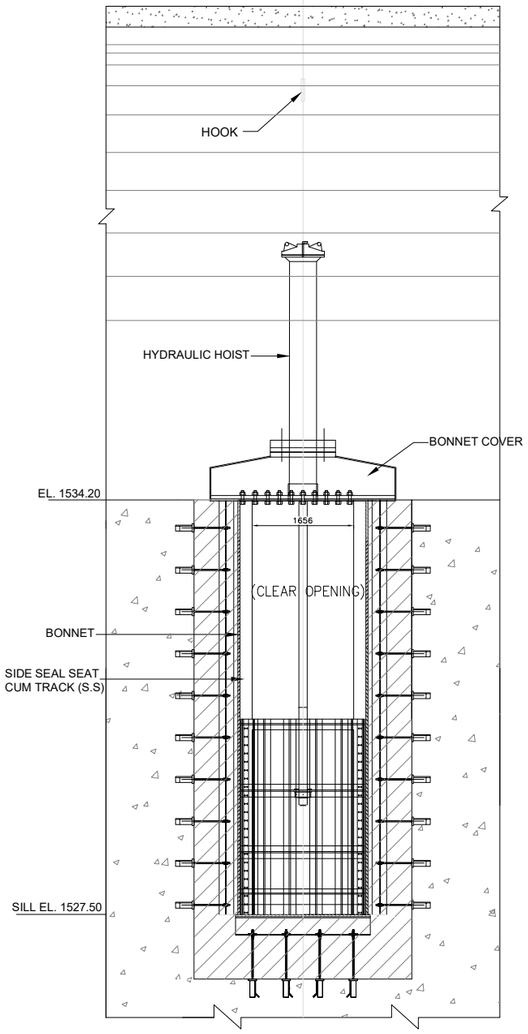
INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
	REVIEWED										

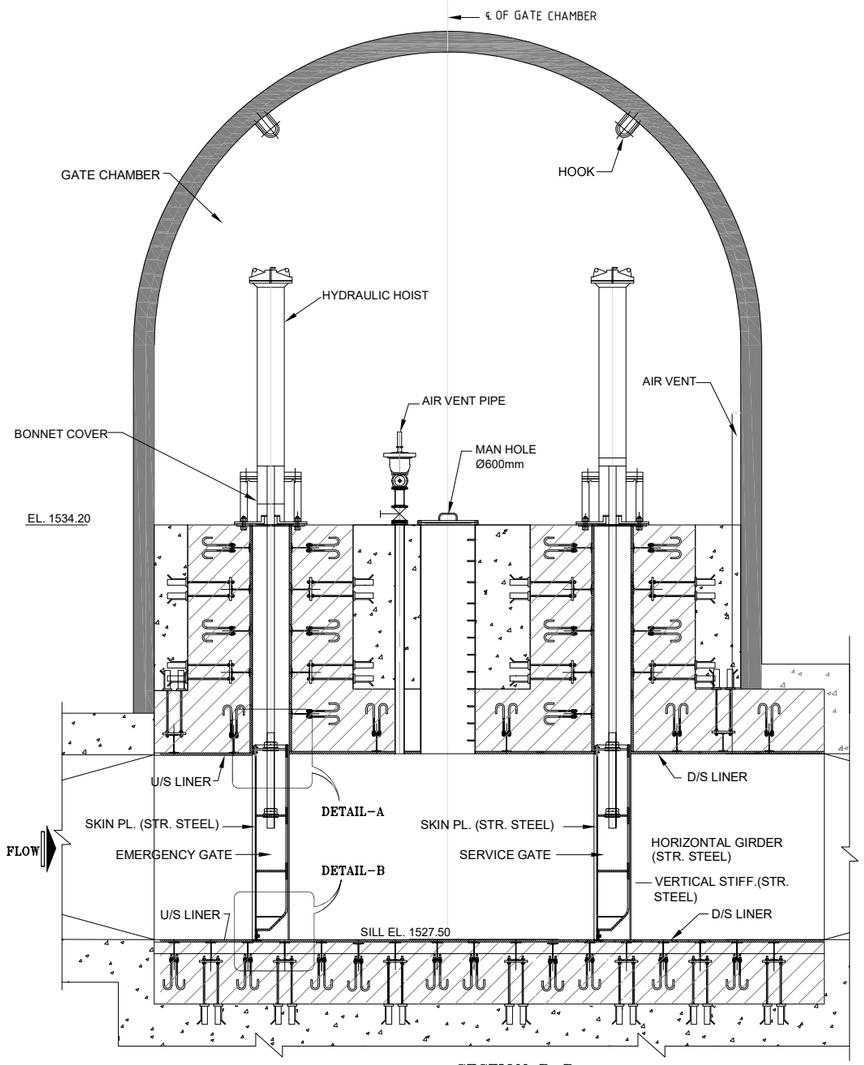
Khorlochhu Hydro Power Ltd.

DWG NO KHPP-HM-SFT-GA-6016

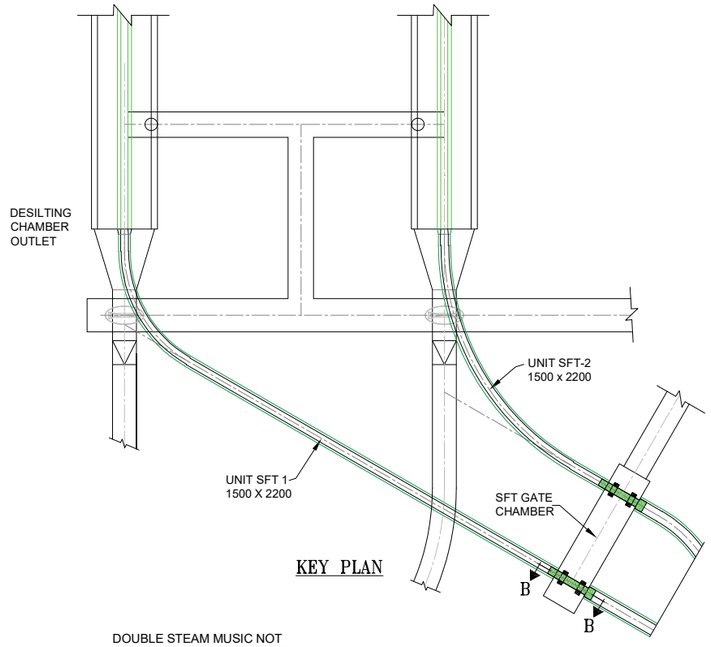
TITLE: SILT FLUSHING TUNNEL GATE
1500mm X 2200mm GENERAL ARRANGEMENT



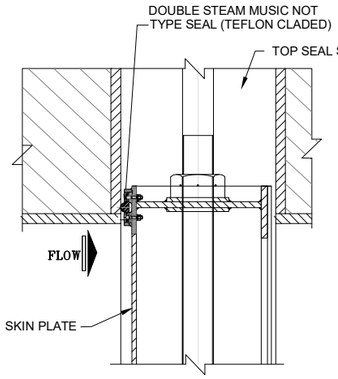
SECTIONAL ELEVATION A-A



SECTION B-B

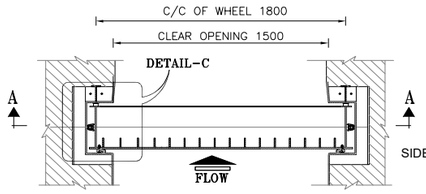


KEY PLAN

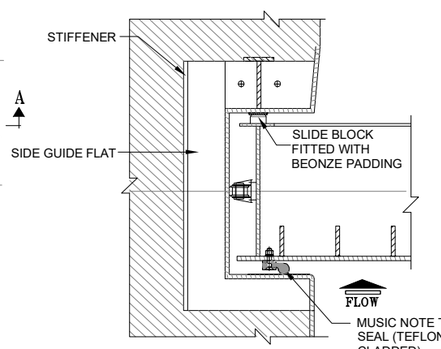


DETAIL - A

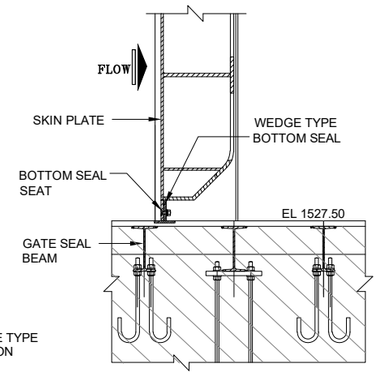
TECHNICAL PARAMETERS		
DESCRIPTION	SERVICE GATE	EMERGENCY GATE
TYPE	SLIDING GATE	SLIDING GATE
SIZE OF OPENING	1500 X 2200	1500 X 2200
SILL ELEVATION	EL 1527.50	EL 1527.50
NO OF GATE	2	2
FRL	EL 1572.00	EL 1572.00
HOIST	HYDRAULIC HOIST	HYDRAULIC HOIST
LOCATION OF SKIN PLATE	UPSTREAM	UPSTREAM
SEALING	UPSTREAM	UPSTREAM



PLAN



DETAIL - C



DETAIL - B

LEGEND :-

1st. STAGE CONCRETE.

2nd. STAGE CONCRETE.

NOTES:

1. ALL DIMENSIONS ARE IN MM AND LEVELS IN METRES.
2. FOR DETAILS OF CIVIL STRUCTURE REFER RELEVANT CIVIL DRAWINGS.
3. TOLERANCE SHALL BE AS PER RELEVANT IS CODES AND TECH SPECIFICATIONS.
4. NO. OF GATES PER TUNNEL - SERVICE - ONE
   EMERGENCY - ONE
5. NO. OF SILT FLUSHING TUNNELS -2
6. ALL THE GATE EMBEDDED PARTS, BONNETS AND LINERS SHALL BE INSTALLED ACCURATELY IN THE FIRST STAGE CONCRETE
7. ONE POWER PACK IS PROPOSED TO OPERATE SERVICE GATE & EMERGENCY GATE IN SILT FLUSHING TUNNEL
8. SUITABLE HOLES SHALL BE PROVIDED IN THE LINER FOR ENSURING PLACEMENT & COMPACTION OF CONCRETE
9. MINIMUM WELD SIZE SHALL BE 8mm UNLESS OTHERWISE SPECIFIED
10. DRY TESTING OF THE GATE W.R.T THE EMBEDDED PARTS SHOULD BE CARRIED OUT BEFORE COMMISSIONING OF SILT FLUSHING TUNNEL

Khorlochhu Hydro Power Ltd.

APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
REVIEWED											

FILE NAME: KHPP-HM-SFT-GA-6016

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

INFORMATION CONTAINED WITHIN "HOLD" IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

FOR TENDER PURPOSE

CLIENT: KHORLOCHHU HYDRO POWER LIMITED
TRASHIYANGTSE, BHUTAN

CONSULTANT: Tata Consulting Engineers Ltd. & Lombardi Engineering Ltd.(JV)

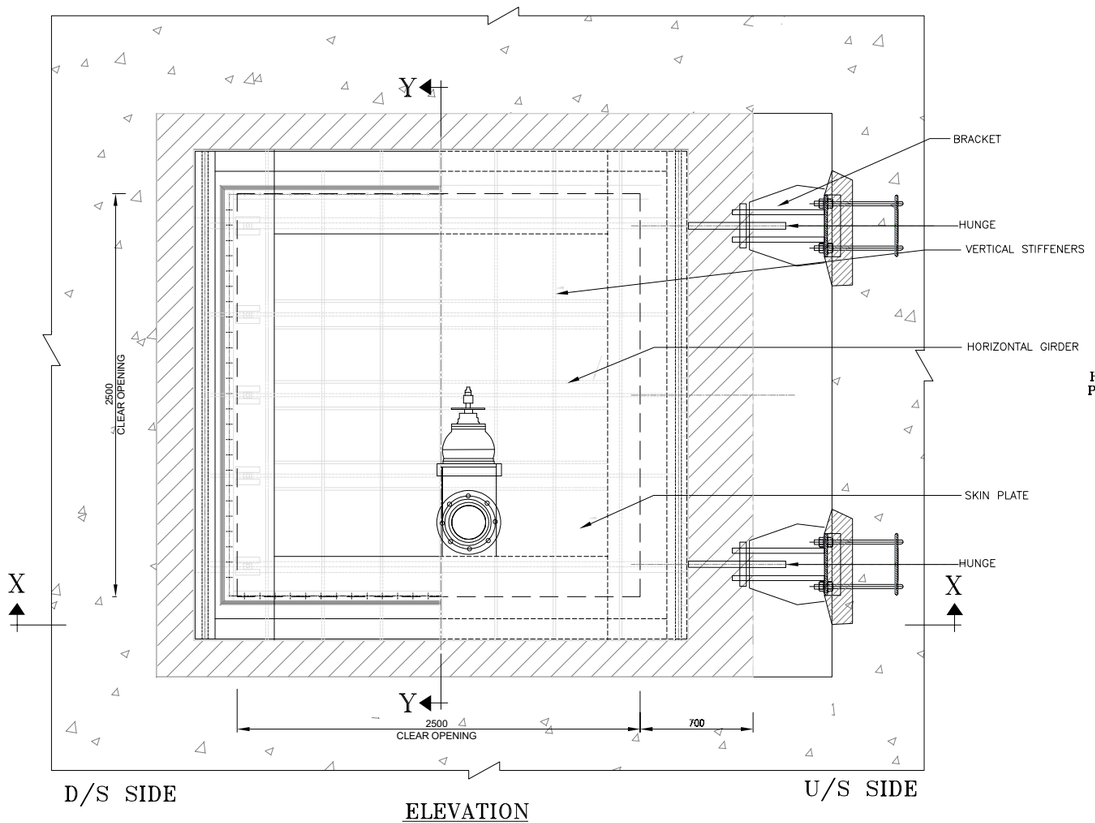
PROJECT: KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN

TITLE: SILT FLUSHING TUNNEL GATE
1500mm X 2200mm GENERAL ARRANGEMENT

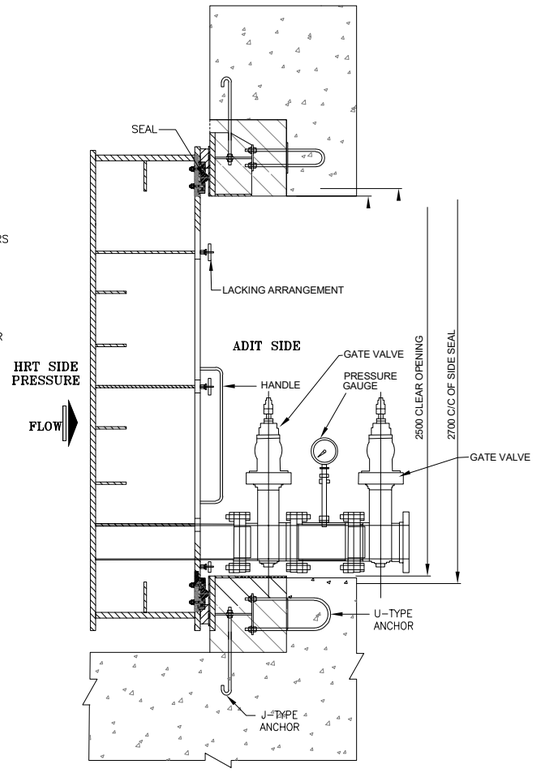
DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	
DWG No: KHPP-HM-SFT-GA-6016		
SCALE: AS SHOWN	ISSUE P1	DATE: 18-JUN-2025	ORIGINAL PRINT SIZE: A1

TITLE: HRT ADIT GATE FOR ADIT-2 AND ADIT-5
2500mm X 2500mm GENERAL ARRANGEMENT

DWG NO KHPP-HM-HRT-GA-6017

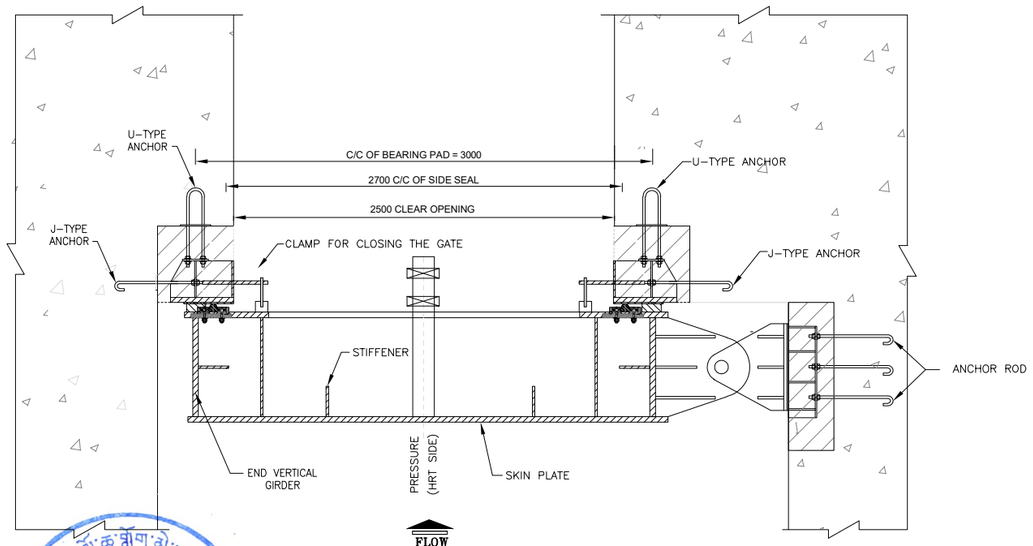


ELEVATION



SECTION Y-Y

TECHNICAL PARAMETERS	
DESCRIPTION	ADIT GATE
TYPE	HINGE TYPE GATE
SIZE OF OPENING & NOS	2.5m X 2.5m
SILL ELEVATION	FOR ADIT - 2 EL. 1506.11 FOR ADIT - 5 EL. 1480.00
NO OF GATE	1+1=2
FRL	EL. 1572.00
SURGE LEVEL	EL.1635.00 (FOR ADIT- 5 GATE)
LOCATION OF SKIN PLATE	HRT SIDE
SEALING	ADIT TUNNEL SIDE



SECTION X-X

1. ALL DIMENSIONS ARE IN MILLIMETERS
2. FOR DETAILS OD CIVIL STRUCTURE REFER RELEVANT DRAWINGS
3. THE SECOND STAFF CONCRETE BLOCKOUTS SHALL BE BOUNDED TO THE FIRST STAGE CONCRETE AND NECESSARY DOWELS AT SUITABLE INTERVALS BE LEFT FROM THE 1ST STAGE
4. THE MINIMUM SIZE OF FILLET WELD SHALL BE 6mm
5. DRAINAGE ARRANGEMENT IS APPLICABLE FOR 1 (ONE) GATE.

LEGEND :-

1st STAGE CONCRETE.

2nd STAGE CONCRETE.

Khorlochhu Hydro Power Ltd.

FOR TENDER PURPOSE

CLIENT:
Khorlochhu
KHORLOCHHU HYDRO POWER LIMITED
TRASHIYANGTSE, BHUTAN

CONSULTANT:
TATA Lombardi
Tata Consulting Engineers Ltd. &
Lombardi Engineering Ltd.(JV)

PROJECT:
KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN

TITLE:
HRT ADIT GATE FOR ADIT-2 AND ADIT-5
2500mm X 2500mm GENERAL ARRANGEMENT

APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.
REVIEWED						

NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE

FILE NAME: KHPP-HM-HRT-GA-6017

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

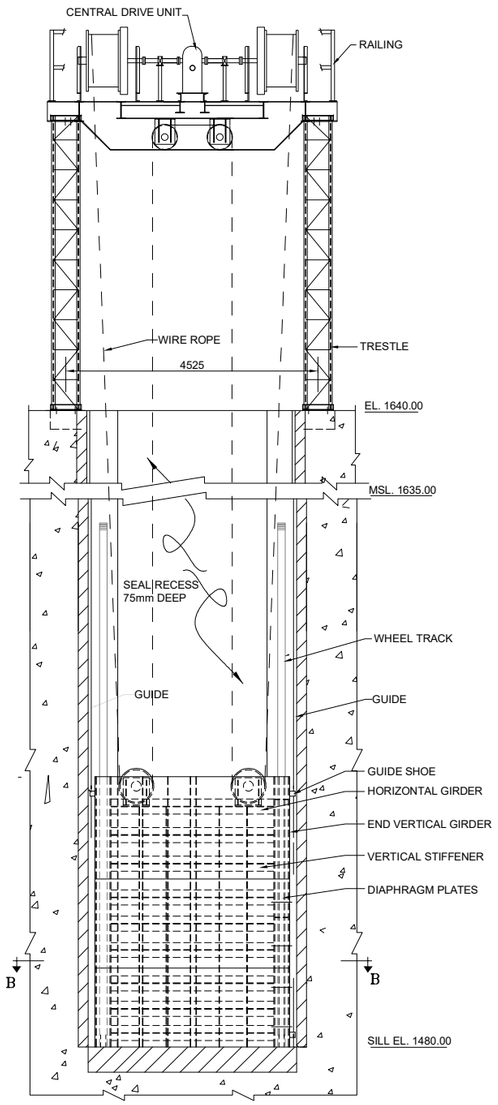
CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

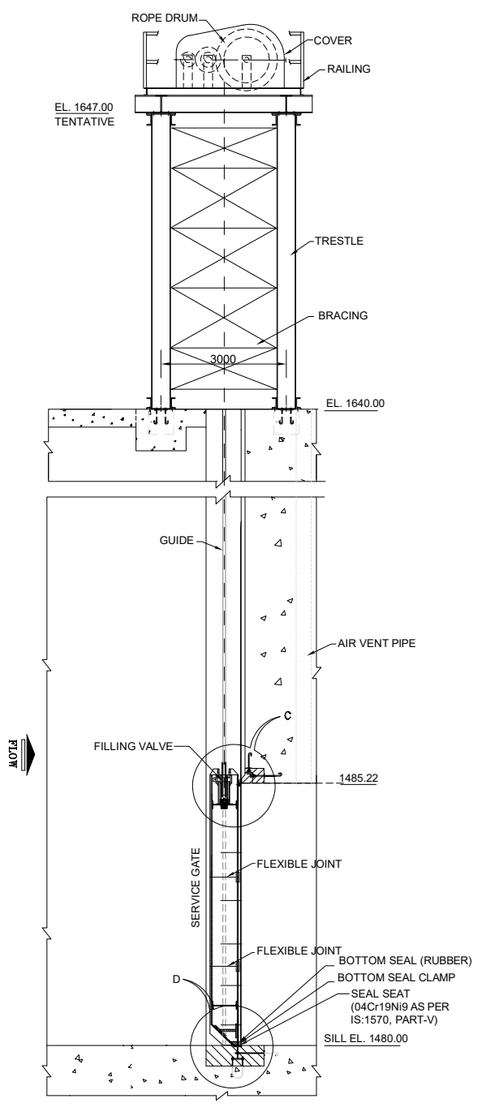
DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	
DWG No: KHPP-HM-HRT-GA-6017		
SCALE: AS SHOWN	ISSUE P1	DATE: 18-JUN-2025	ORIGINAL PRINT SIZE: A1

TITLE: SURGE SHAFT GATE
2750mm X 5220mm GENERAL ARRANGEMENT

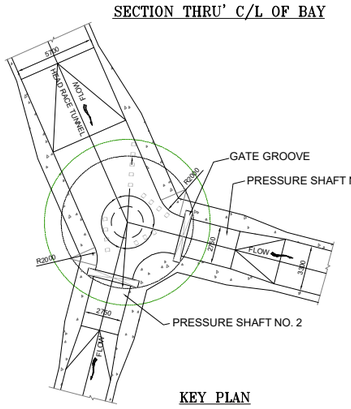
DWG NO KHPP-HM-SS-GA-6018



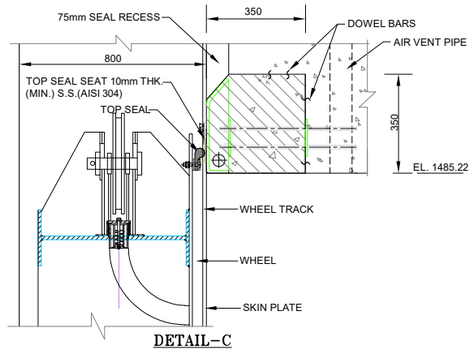
DOWNSTREAM ELEVATION AT 'A-A'



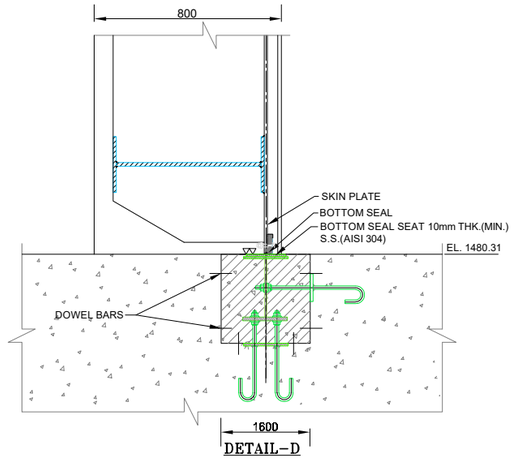
SECTION THRU' C/L OF BAY



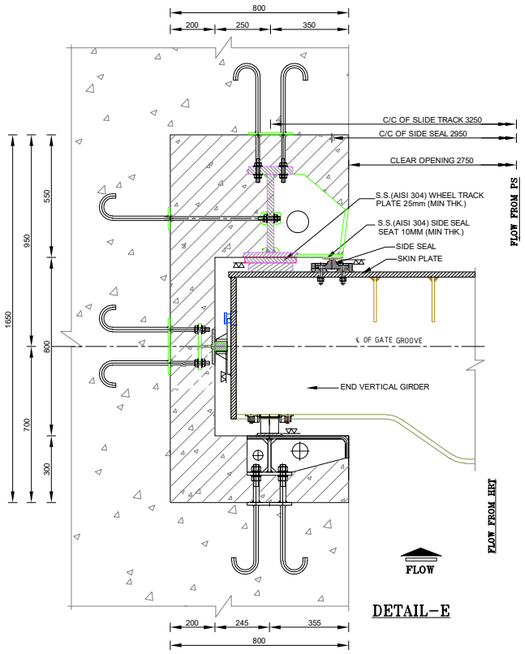
KEY PLAN



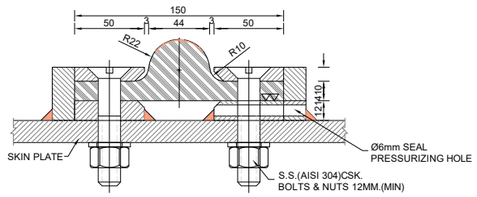
DETAIL-C



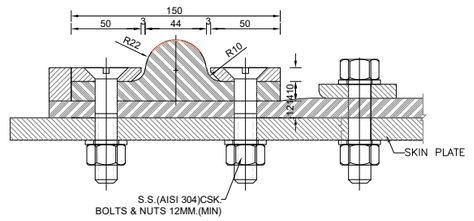
DETAIL-D



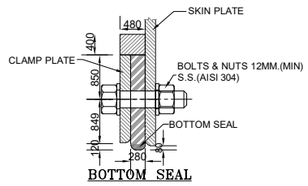
DETAIL-E



SIDE SEAL



DETAIL OF SIDE &
BOTTOM SEAL JOINT



BOTTOM SEAL

NOTES:

1. ALL DIMENSIONS ARE IN mm AND ELEVATION IN m.
2. NO. OF OPENINGS - 2 (TWO) AND NO. OF GATES - 2(TWO)
3. ALL WELDS SHALL BE 6mm FILLET UNLESS OTHERWISE SPECIFIED.
4. ALL SURFACES BETWEEN 1ST. STAGE AND 2ND STAGE CONCRETES SHALL BE LEFT THOROUGHLY ROUGH. SUITABLE DOWEL BARS SHALL BE LEFT IN 1st. STAGE CONCRETE.
5. THE CONCRETE IN BLOCKOUTS SHALL BE ONE GRADE HIGHER THAN 1st. STAGE CONCRETE AND NOT LEANER THAN M-25 GRADE CONFORMING TO IS:456 (LATEST).
6. FACES OF TRACKS, SEAL SEATS AND GUIDES SHALL BE IN TRUE PLANES WITHIN THE TOLERANCES SPECIFIED IN IS:4622 (LATEST).
7. THE GATE SHALL BE DESIGNED FOR A WATER HEAD OF 120.00m CORRESPONDING TO MAX. SURGE LEVEL AT 1635.00m.
8. GATE SHALL BE CAPABLE OF BEING LOWERED UNDER FLOWING WATER AND RAISED UNDER BALANCED CONDITION ACHIEVED BY FILLING VALVE.
9. SUITABLE DOGGING ARRANGEMENT SHALL BE PROVIDED.
10. SUITABLE BALLAST BE ADDED FOR SELF CLOSURE OF THE GATE IF REQUIRED.

LEGEND:

1st. STAGE CONCRETE

2nd. STAGE CONCRETE

FOR TENDER PURPOSE

CLIENT:
KHORLOCHHU HYDRO POWER LIMITED
TRASHIYANGTSE, BHUTAN

CONSULTANT:
Tata Consulting Engineers Ltd. &
Lombardi Engineering Ltd.(JV)

PROJECT:
KHORLOCHHU HYDRO POWER PROJECT(4X150 MW),
TRASHIYANGTSE, BHUTAN

TITLE:
SURGE SHAFT GATE
2750mm X 5220mm GENERAL ARRANGEMENT

DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	

DWG No: KHPP-HM-SS-GA-6018

SCALE: AS SHOWN	ISSUE P1	DATE: 18-JUN-2025	ORIGINAL PRINT SIZE: A1

FILE NAME: KHPP-HM-SS-GA-6018

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
			REVIEWED								

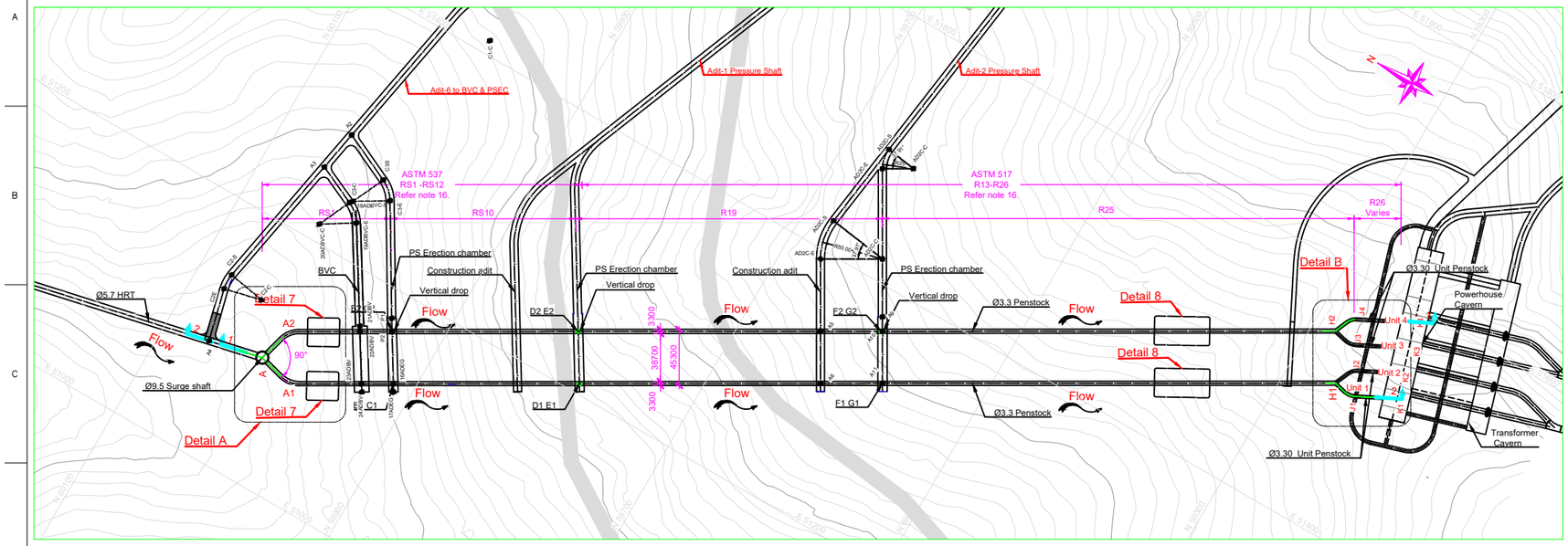
Khorlochhu Hydro Power Ltd.

DWG NO KHPP-HM-PS-GA-6019

: PRESSURE SHAFT STEEL LINER GENERAL ARRANGEMENT

PLAN

(1:2000)



KEY PLAN

(NTS)

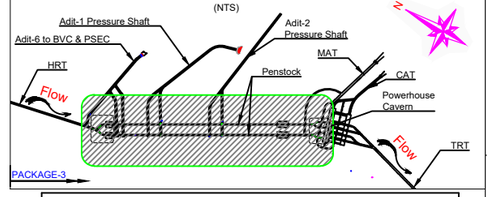


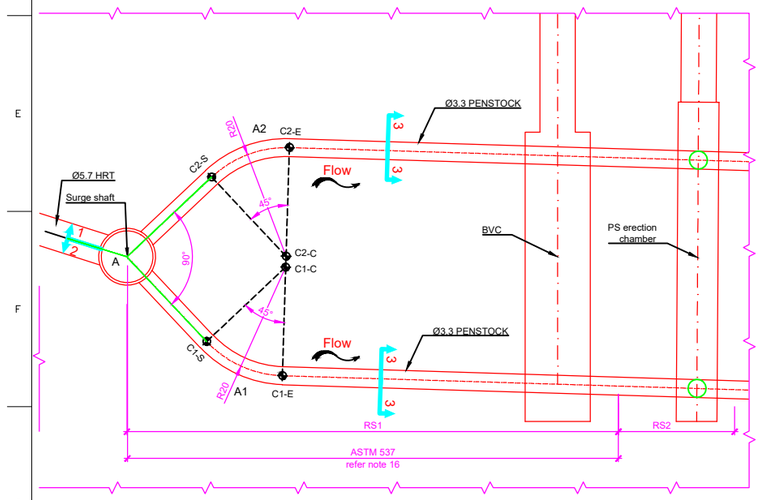
Table 1. Hoizontal Bend Setout Points

CURVE #	JOINT	Point	Easting [m]	Northing [m]	Remarks
CURVE-1	A1	C1-S	51092.292	59998.072	Horizontal Curve Penstock -1
		C1-C	51111.626	59992.954	
		C1-E	51094.335	59982.902	
CURVE-2	A-2	C2-S	51118.473	60013.293	Horizontal Curve Penstock -2
		C2-C	51113.355	59993.959	
		C2-E	51130.645	60004.011	
CURVE-3	J-1	C3-S	51511.934	59249.799	Horizontal Curve Bifurcation Unit-1 / Unit-2
		C3-C	51523.626	59247.100	
		C3-E	51512.934	59241.652	
CURVE-4	J-2	C4-S	51525.960	59255.458	
		C4-C	51521.271	59244.412	
		C4-E	51531.963	59249.860	
CURVE-5	J-3	C5-S	51548.043	59270.038	Horizontal Curve Bifurcation Unit-3 / Unit-4
		C5-C	51559.736	59267.339	
		C5-E	51549.044	59261.891	
CURVE-6	J-4	C6-S	51561.448	59276.915	
		C6-C	51556.759	59265.869	
		C6-E	51567.452	59271.317	

DETAIL-A

(Contour in Plan not shown for clarity)

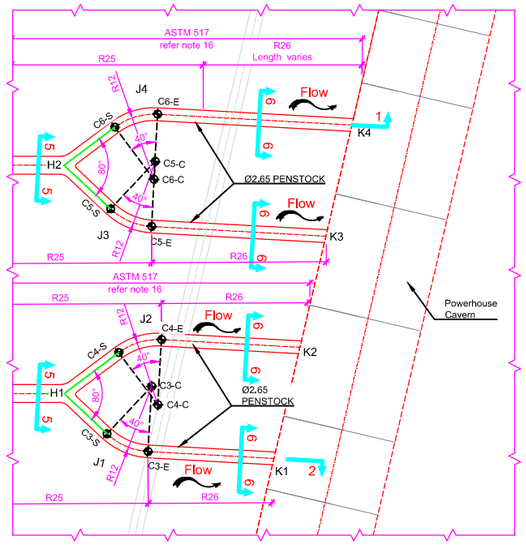
(1:500)



DETAIL-B

(Contour in Plan not shown for clarity)

(1:500)



Notes:

1. All details/dimensions shall be checked and verified at the site before starting fabrication.
2. Steel plates for fabrication of steel liner shall be of boiler quality conforming to ASTM 537 CC & ASTM 517 CR.F or equivalent as approved by E.I.C. and shall be of tested quality.
3. Fabrication and erection piece,'bends of steel penstock shall conform to relevant technical specifications.
4. Welding shall conform to 2825 and IS: 5878 part- VI (as amended from time to time) all welds shall be of full strength.
5. Welding between different types of steel shall be conforming to relevant technical specification.
6. For details of bifurcation and thrust collars refer separate drawings.
7. The erection piece near MIV end shall modified to suit the turbine manufacturers requirement.
8. Surface preparation and painting shall be done as per technical specifications.
9. After edges ay the plates have been prepared for welding, these shall given thorough visual examination for flaws, cracks, lamination, slag, intrusions and other defects if any shall be carried out.
10. All non destructive tests such as radiographic, ultrasonic and hydrostatic testing shall carried out as per technical specifications.
11. Details shown in this drawing are for steel liner only for excavation and support system of the pressure shaft refer separate drawings.
12. Modification required if any, in the length of erection piece shall done with the approval of the E.I.C
13. Manufacturer shall submit the fabrication drawings of steel liner for vetting before starting any execution.
14. The design of the bifurcation pieces shall be carried out by the fabricator and same shall be submitted to project authority/consultant for approval.
15. THE STEEL LINER DETAILS SHOWN IS THIS DRAWING IS INDICATIVE AND FOR TENDER PURPOSE ONLY. THIS DRAWING IS NOT BE USED FOR CONSTRUCTION.
16. THE LINER THICKNESS HAS BEEN CALCULATED BASED ON LIMITED GEOLOGICAL DATA AVAILABLE DURING TENDER STAGE. THE THICKNESS OF THE STEEL LINER MAY EITHER INCREASE/ DECREASE AS MORE GEOLOGICAL INFORMATION GETS AVAILABLE DURING THE CONSTRUCTION PHASE.
17. FOR THICKNESS AND LENGTH OF STEEL LINER REFER SHEET 2.

Legend:

BVC- Butterfly valve chamber
PSEC- Penstock erection chamber

(1:500)
0(m) 10 15 20 30

(1:2000)
0(m) 40 60 80 120

Khorlochhu Hydro Power Ltd.

APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
REVIEWED											

FILE NAME: KHPP-HM-PS-GA-6019

"P" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION/FABRICATION WORK IS PERMITTED ON "R" (RELEASED) ISSUES ONLY.

INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLD(S)TH TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

FOR TENDER PURPOSE ONLY

CLIENT: KHORLOCHHU HYDRO POWER LIMITED
(Joint Venture of DGPC, RGoB & TATA POWER , INDIA)

PROJECT: KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN

TITLE: PRESSURE SHAFT STEEL LINER GENERAL ARRANGEMENT — SH-01

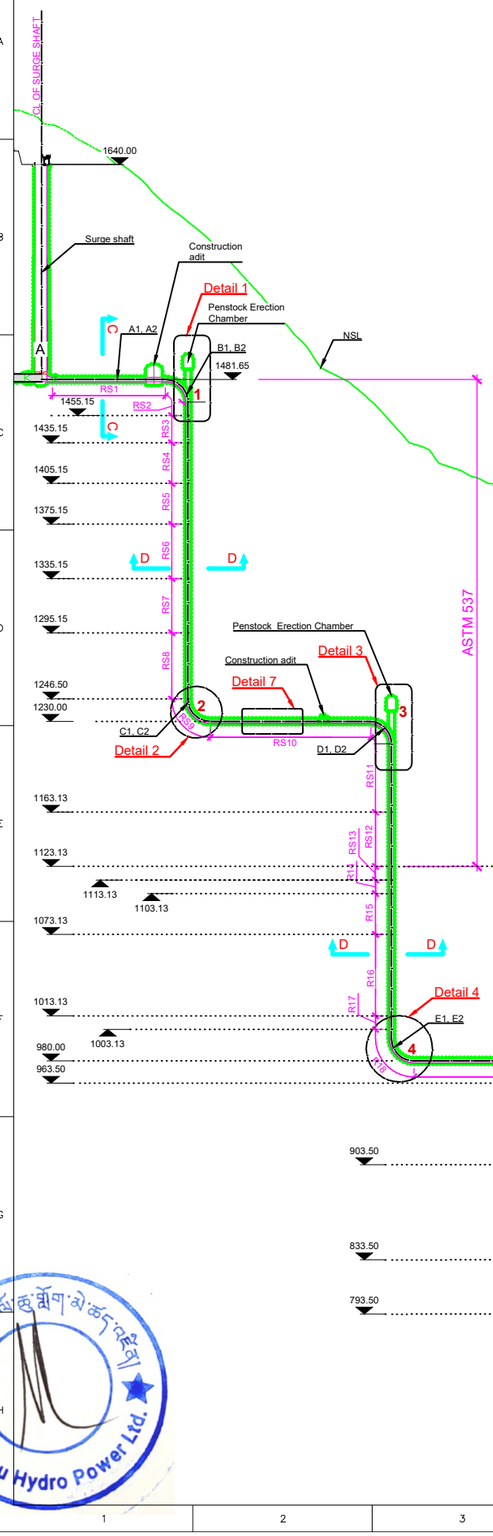
CONSULTANT: TATA CONSULTING ENGINEERS LIMITED MUMBAI
LOMBARDI ENGINEERING LTD. SWITZERLAND

DESIGNED:		REVIEWED:		SCALE: AS SHOWN
DRAWN :		CHECKED:		DATE: 04-04-2025
		APPROVED:		JOB NO: 14124A

DWG No: KHPP-HM-PS-GA-6019 ISSUE P0 SIZE-A1

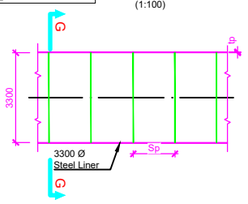
TITLE: PRESSURE SHAFT STEEL LINER GENERAL ARRANGEMENT

DWG NO KHPP-HM-PS-GA-6019



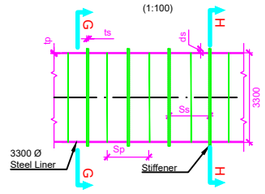
DETAIL-7

(1:100)



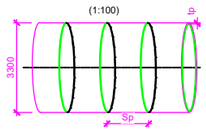
DETAIL-8

(1:100)



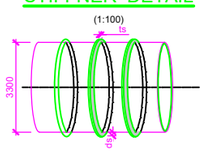
STIFFNER DETAIL

(1:100)



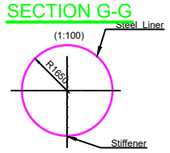
STIFFNER DETAIL

(1:100)



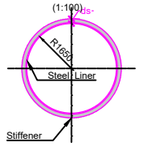
SECTION G-G

(1:100)



SECTION H-H

(1:100)

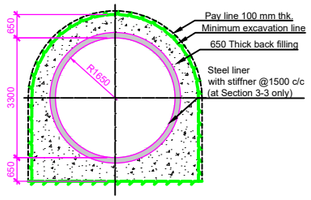


L-SECTION A-A & B-B

(1:2000)

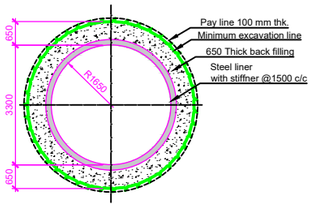
SECTION C-C / SECTION E-E

(MAIN PENSOCK)
(1:75)



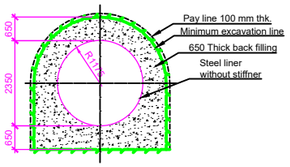
SECTION D-D

(MAIN PENSOCK)
(1:75)



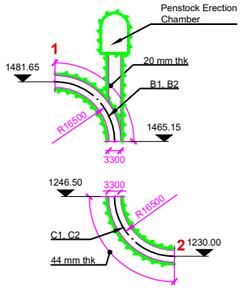
SECTION F-F

(UNIT PENSOCK)
(1:75)



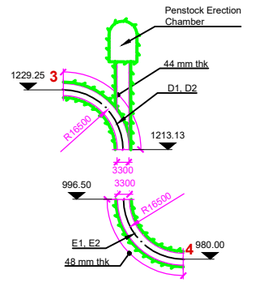
DETAIL-1 & DETAIL-2

(1:750)



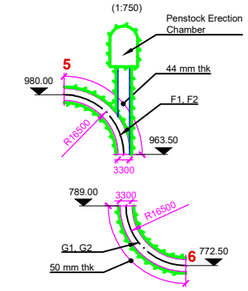
DETAIL-3 & DETAIL-4

(1:750)



DETAIL-5 & DETAIL-6

(1:750)



KEY PLAN

(NTS)

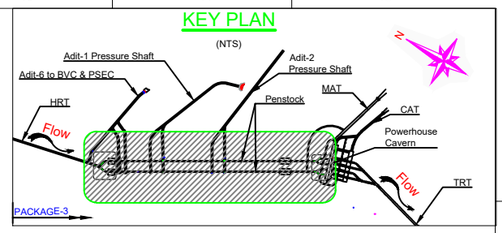


TABLE 2. STEEL LINER ASTM 537 GRADE								STIFFENER (ASTM 537)		
Reach #	RP*	Thick (mm)	Grade	Length (m)	Elevation (m)			ds (mm)	ts (mm)	Ss (mm)
					Start	End				
RS1	0%	18	ASTM 537	83.00	1481.65	1481.65		140	18	1500.00
RS2		20		36.00	1481.65	1455.15		140	18	1500.00
RS3		22		20.00	1455.15	1435.15		140	18	1500.00
RS4		25		30.00	1435.15	1405.15		140		1500.00
RS5		28		30.00	1405.15	1375.15				1500.00
RS6		32		40.00	1375.15	1335.15				1500.00
RS7		36		40.00	1335.15	1295.15				1500.00
RS8		40		49.00	1295.15	1246.50				1500.00
RS9		44		26.00	1246.50	1230.03				1500.00
RS10	10%	40		117.00	1230.03	1230.00				1500.00
RS11		44		76.00	1230.00	1163.13				1500.00
RS12		48		40.00	1163.13	1123.13				1500.00
RS13		44		10.0	1123.13	1113.13				
R14	10%	40	ASTM 517	10.0	1113.13	1103.13				
R15		36		30.00	1103.13	1073.13				
R16		40		60.00	1073.13	1013.13				
R17		44		10.00	1013.13	1003.13				
R18	0%	48		33.00	1003.13	980.00				
R19	15%	44		217	980.00	980.00				
R20	0%	44		26.00	980.00	963.50				
R21	15%	44		60.00	963.50	903.50				
R22		48		70.00	903.50	833.50				
R23		50		40.00	833.50	793.50				
R24	20%	50		30.42	793.50	772.50				
R25		50		353.50	772.50	772.50				
R26	0%	44	ASTM 517	42.00 (Unit-1)	772.50	772.50				
				46.0 (Unit-2)	772.50	772.50				
				52.0 (Unit-3)	772.50	772.50				
				56.0 (Unit-4)	772.50	772.50				

Notes:

1. All details/dimensions shall be checked and verified at the site before starting fabrication.
2. For other notes refer dwg. no. KHPP-PS-CV-ST-30875
3. THE STEEL LINER DETAILS SHOWN IS THIS DRAWING IS INDICATIVE AND FOR TENDER PURPOSE ONLY. THIS DRAWING IS NOT BE USED FOR CONSTRUCTION.
4. THE LINER THICKNESS HAS BEEN CALCULATED BASED ON LIMITED GEOLOGICAL DATA AVAILABLE DURING TENDER STAGE. THE THICKNESS OF THE STEEL LINER MAY EITHER INCREASE/ DECREASE AS MORE GEOLOGICAL INFORMATION GETS AVAILABLE DURING THE CONSTRUCTION PHASE.

Legend:

ts- Stiffner thickness
ds- Stiffner depth
Ss- Stiffener spacing
Rs- Reach with stiffner
R- Reach without stiffener

(1:75)
0(m) 1.50 2.25 3.00 4.50

(1:100)
0(m) 2.00 3.00 4.00 6.00

(1:750)
0(m) 15 23 30 45

(1:2000)
0(m) 40 60 80 120

FILE NAME: KHPP-HM-PS-GA-6019

"P" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION/FABRICATION WORK IS PERMITTED ON "R" (RELEASED) ISSUES ONLY.

INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
REVIEWED											

FOR TENDER PURPOSE ONLY

CLIENT:
KHORLOCHHU HYDRO POWER LIMITED
(Joint Venture of DGPC, RGoB & TATA POWER , INDIA)

PROJECT:
KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN

TITLE:
PRESSURE SHAFT STEEL LINER GENERAL ARRANGEMENT
SH–02

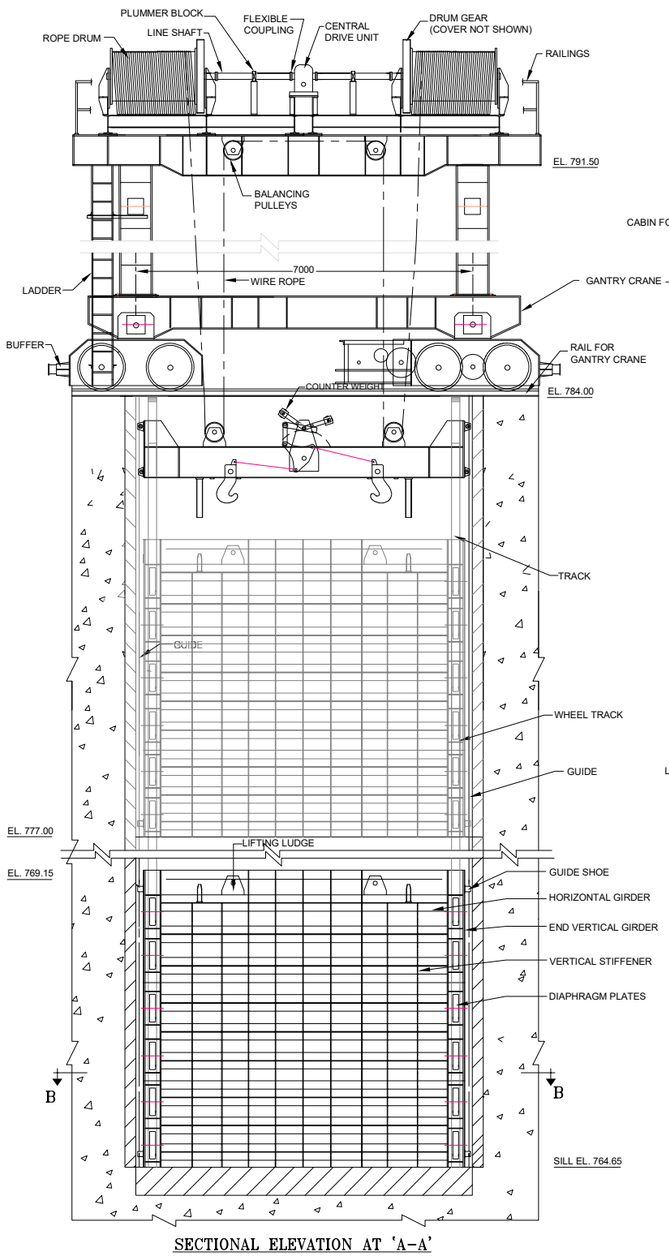
CONSULTANT:
TATA CONSULTING ENGINEERS LIMITED
MUMBAI
LOMBARDI ENGINEERING LTD.
SWITZERLAND

DESIGNED:		REVIEWED:		SCALE: AS SHOWN
DRAWN :		CHECKED:		DATE: 04–04–2025
		APPROVED:		JOB NO: 14124A
DWG No: KHPP–HM–PS–GA–6019			ISSUE P0	SIZE–A1

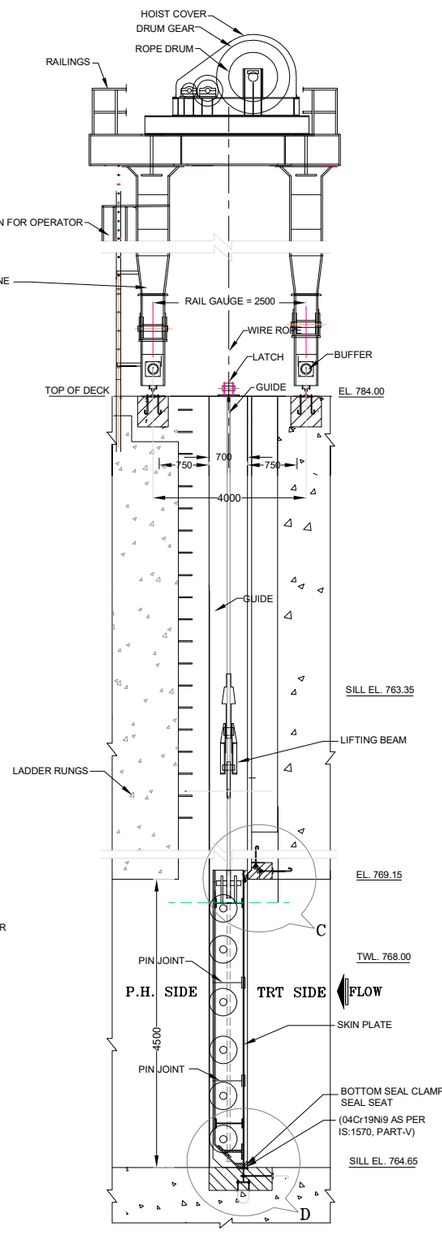
Khorlochhu Hydro Power Ltd.

TITLE: UNIT TAILRACE TUNNEL GATE (4000mm X 4500mm) GENERAL ARRANGEMENT

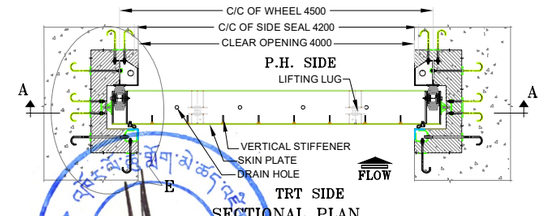
DWG NO KHPP-HM-TRT-GA-6021



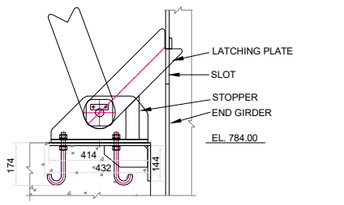
SECTIONAL ELEVATION AT 'A-A'



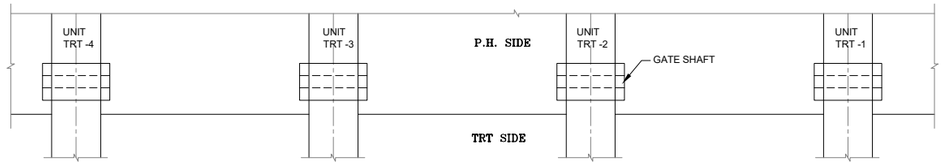
SECTION THRU' C/L OF BAY



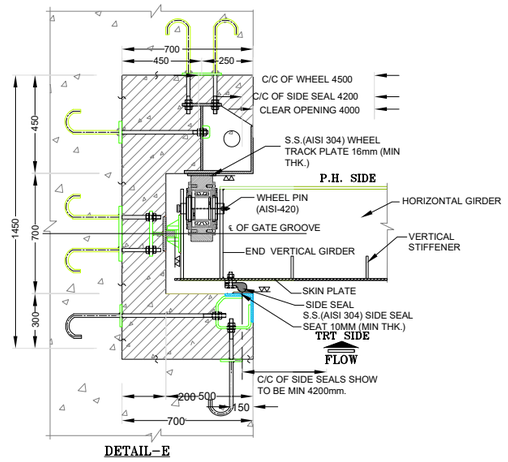
SECTIONAL PLAN



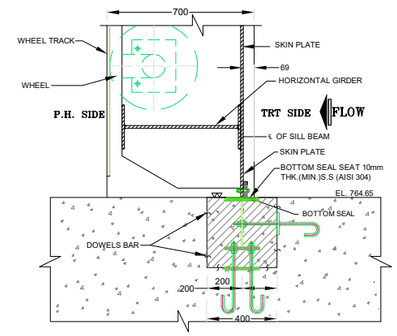
TYPICAL LATCHING ARRANGEMENT



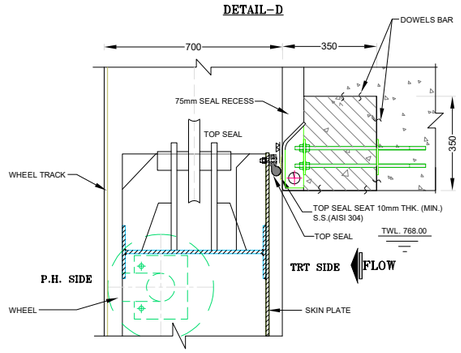
KEY PLAN



DETAIL-E



DETAIL-D



DETAIL-C

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES.
2. NO.OF OPENINGS-4 AND NO. OF GATES-4.
3. THISDRAWINGSHALL BEREADALONGWITHRELEVANTCIVIL DRAWING.
4. ALL WELDS SHALL BE 6mm FILLET UNLESS OTHERWISE SPECIFIED.
5. ALLSURFACESBETWEENIst.STAGEAND2nd.STAGECONCRETE SHALLBELEFTTHOROUGHLYROUGH.SUITABLEDOWELBARSSHALL BE LEFT IN Ist STAGE CONCRETE.
6. THE2ndSTAGECONCRETE INBLOCKOUTSSHALLBEBONDEDTO THEIstSTAGECONCRETE&NECESSARYDOWELSATSUITABLE INTERVALS BE KEPT.
7. THECONCRETE INBLOCK OUTSSHALL BEOFM-25GRADE CONFORMING TO IS:456 (LATEST).
8. FACESOFTRACKS,SEALSEATSANDGUIDESSHALLBEINTRUE PLANES WITHIN THE TOLERANCES SPECIFIED IN IS : 4622(LATEST).
9. GATESHALLBELOWEREDUNDERFLOWINGWATERCONDITIONAND RAISEDUNDERBALANCEHEADCONDITIONACHIEVEDBYCRACK OPENING OF GATE.
10. GATESHALLBEOPERATEDWITHTHEHELPOFGANTRYCRANEAND AUTOMATICENGAGINGANDDISENGAGINGTYPELIFTINGBEAMOF ADEQUATE CAPACITY.
11. TOP OF CRANE TRACK SHALL BE AT EL. 784.00
12. POSITIONOFLATCHSHALLBEFIXEDATSUCHALOCATIONTHATTOP OFGATEREMAINS100mmBELOWFLOORLEVEL&BOTTOMABOVE THAT.
13. TOP OF GROOVE SHALL BE COVERED WITH SUITABLE GRATING.

TECHNICAL PARAMETERS	
DESCRIPTION	TAILRACE TUNNEL GATE
TYPE	FIXED WHEEL TYPE
SIZE OF GATE	4000mm X4500mm
SILL EL	EL.764.65m (TENTATIVE)
NO OF GATES	1
MAXIMUM TAIL WATER LEVEL	EL 768.0m
DESIGN HEAD	3.35m
HOIST OPERATION	GANTRY CRANE CAPACITY (20 T APPROX.)
LOCATION OF SKIN PLATE SEALING	TRT SIDE

LEGEND:

1st. STAGE CONCRETE

2nd. STAGE CONCRETE

FOR TENDER PURPOSE

CLIENT: KHORLOCHHU HYDRO POWER LIMITED, TRASHIYANGTSE, BHUTAN

CONSULTANT: Tata Consulting Engineers Ltd. & Lombardi Engineering Ltd.(JV)

PROJECT: KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN

TITLE: UNIT TAILRACE TUNNEL GATE (4000mm X 4500mm) GENERAL ARRANGEMENT

DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	

DWG No: KHPP-HM-TRT-GA-6021

SCALE: AS SHOWN | ISSUE P1 | DATE: 18-JUN-2025 | ORIGINAL PRINT SIZE: A1

FILE NAME: KHPP-HM-TRT-GA-6021

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

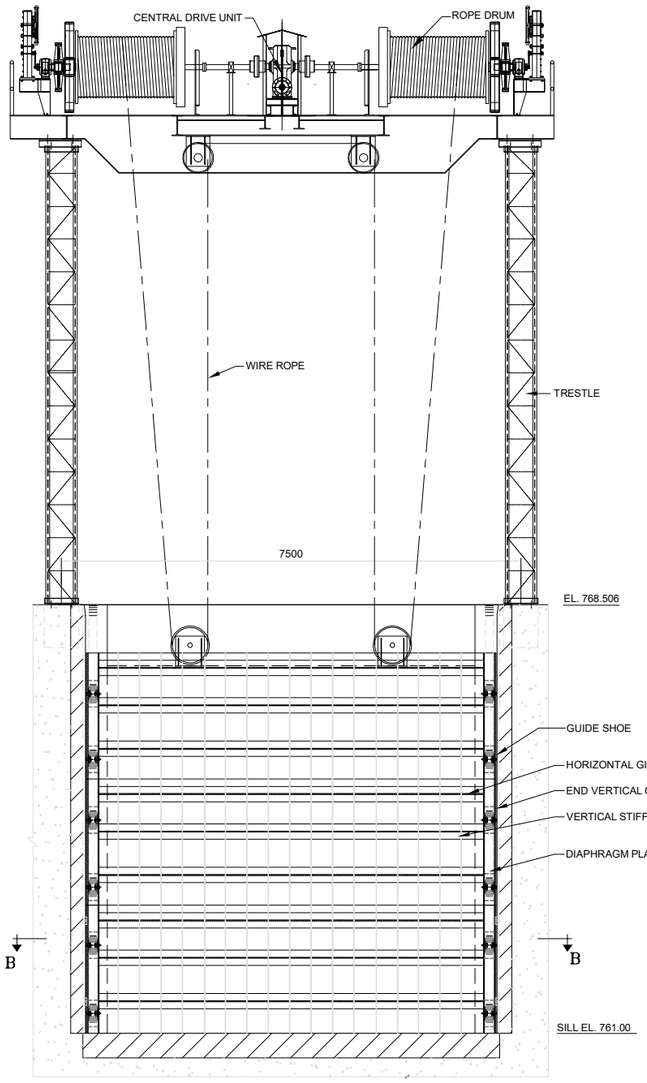
INFORMATION CONTAINED WITHIN 'HOLDS' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
REVIEWED											

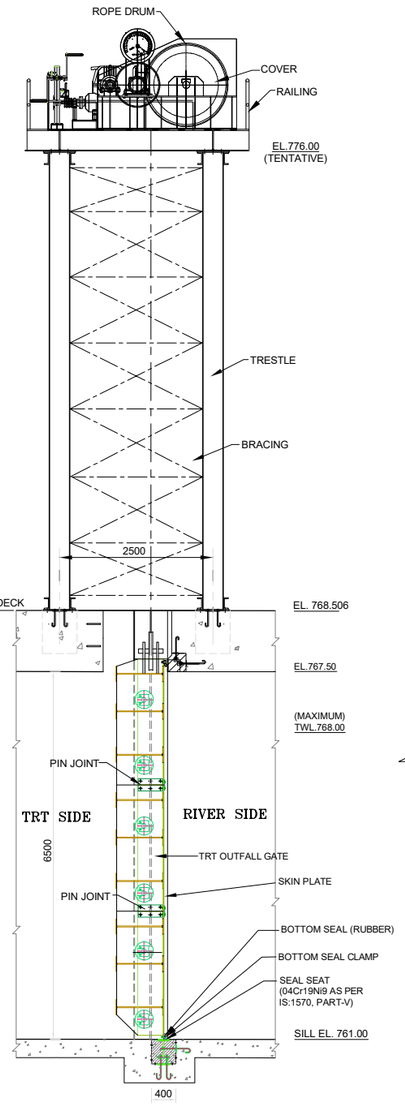
Khorlochhu Hydro Power Ltd.

TITLE: TRT OUTFALL GATE (6500mm X 6500mm) GENERAL ARRANGEMENT

DWG NO KHPP-HM-TRT-GA-6022

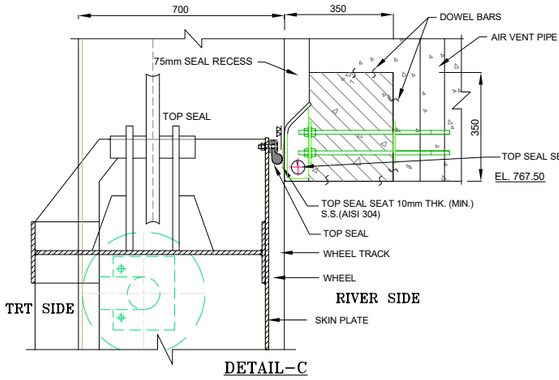


SECTION A–A

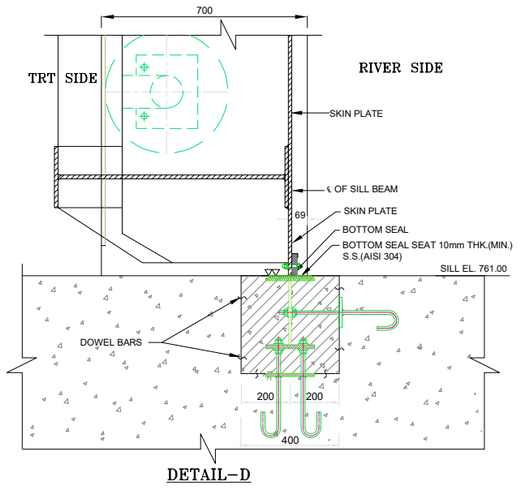


SECTION A–A

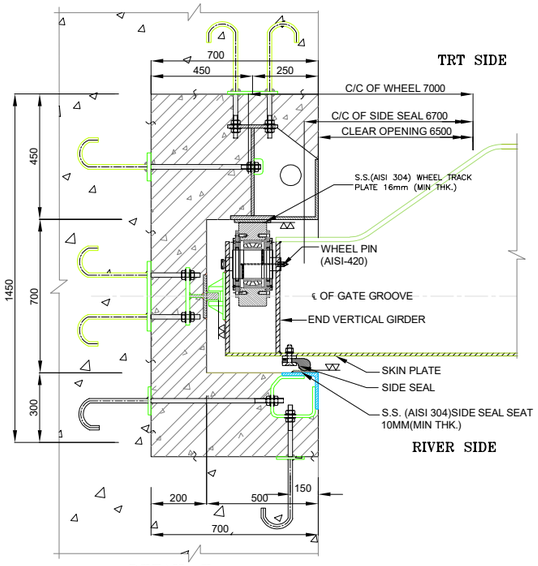
SECTION B–B



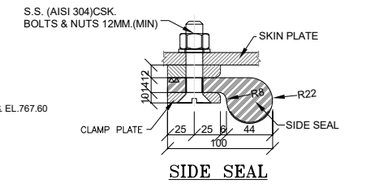
DETAIL–C



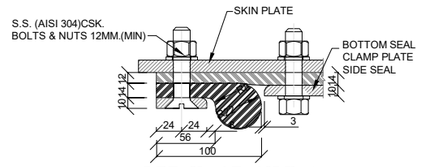
DETAIL–D



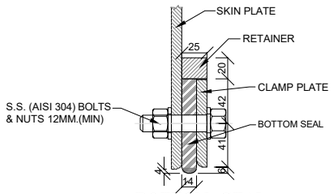
DETAIL–E



SIDE SEAL



DETAIL OF SIDE & BOTTOM SEAL JOINT



BOTTOM SEAL

NOTES:

1. ALL DIMENSIONS ARE IN mm AND ELEVATION IN m.
2. NO. OF OPENINGS - 1(ONE) AND NO. OF GATE - 1 (ONE)
3. THIS DRAWING SHALL BE READ ALONG WITH RELEVANT CIVIL DRAWINGS
4. FOR REINFORCEMENT DETAILS REFER RELEVANT CIVIL DRAWING.
5. ALL WELDS SHALL BE 6mm FILLET UNLESS OTHERWISE SPECIFIED.
6. ALL SURFACES BETWEEN 1ST. STAGE AND 2ND. STAGE CONCRETES SHALL BE LEFT THOROUGHLY ROUGH. SUITABLE DOWEL BARS SHALL BE LEFT IN 1st. STAGE CONCRETE.
7. THE CONCRETE IN BLOCKOUTS SHALL BE OF M-25 GRADE CONFORMING TO IS:456 (LATEST).
8. FACES OF TRACKS, SEAL SEATS AND GUIDES SHALL BE IN TRUE PLANES WITHIN THE TOLERANCES SPECIFIED IN IS:4622 (LATEST).
9. THE GATE SHALL BE DESIGNED FOR A WATER HEAD OF 7.0 m CORRESPONDING TO TWL. 768 m.
10. SUITABLE DOGGING ARRANGEMENT SHALL BE PROVIDED.
11. SUITABLE BALAST BE ADDED FOR SELF CLOSURE OF THE GATE IF REQUIRED.

LEGEND:

1st. STAGE CONCRETE

2nd. STAGE CONCRETE

Khorlochhu Hydro Power Ltd.

APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
			REVIEWED								

FILE NAME: KHPP-HM-TRT-GA-6022

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

FOR TENDER PURPOSE

CLIENT: KHORLOCHHU HYDRO POWER LIMITED, TRASHIYANGTSE, BHUTAN

CONSULTANT: Tata Consulting Engineers Ltd. & Lombardi Engineering Ltd.(JV)

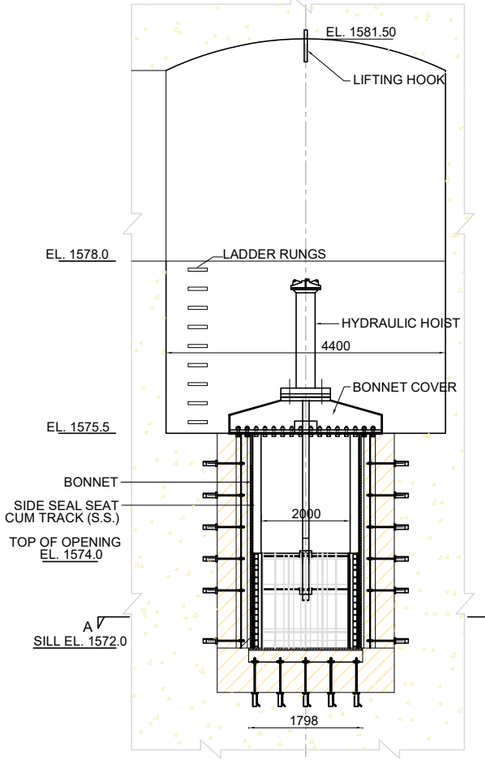
PROJECT: KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN

TITLE: TRT OUTFALL GATE (6500mm X 6500mm) GENERAL ARRANGEMENT

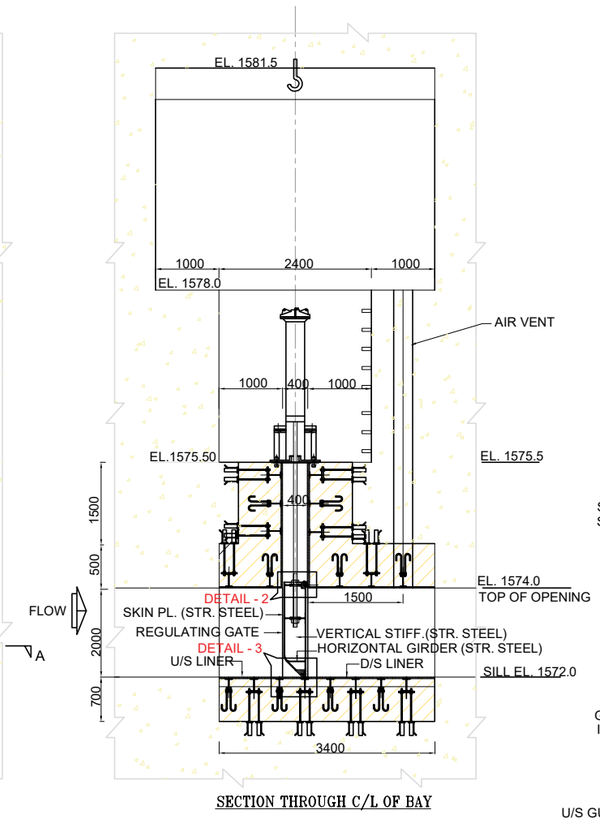
DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	

DWG No: KHPP-HM-TRT-GA-6022

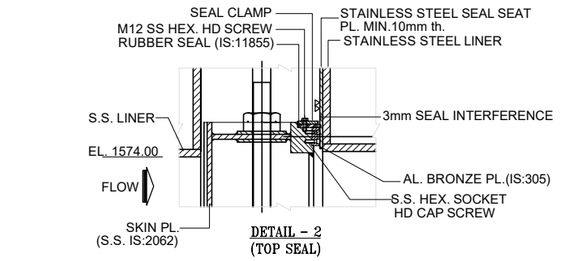
SCALE: AS SHOWN	ISSUE P1	DATE: 18-JUN-2025	ORIGINAL PRINT SIZE: A1



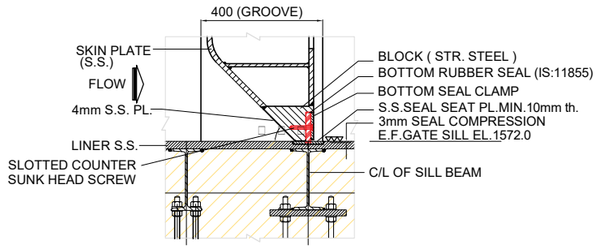
U/S ELEVATION



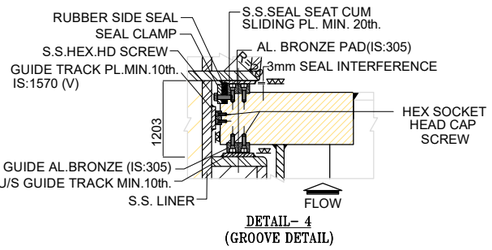
SECTION THROUGH C/L OF BAY



DETAIL - 2
(TOP SEAL)



DETAIL-3
(BOTTOM SEAL)



DETAIL- 4
(GROOVE DETAIL)

NOTES:-

1. ALL DIMENSIONS ARE IN mm AND LEVELS IN METRES.
2. GATE REQUIRED = 1 (ONE) SERVICE .
3. THE 2nd.STAGE CONCRETE IN BLOCK-OUTS SHOULD BE BONDED TO THE 1st. STAGE CONCRETE BY EXTENDING REINFORCEMENT BARS INTO IT AND BY PROVISION OF DOWEL BARS AT SUITABLE INTERVALS.
4. ALL FILLET WELDS SHOULD BE 6mm CONTINUOUS UNLESS OHTHERWISE SPECIFIED.
5. FOR DETAILS OF CIVIL STRUCTURE REFER RELEVANT CIVIL DRAWINGS.
6. THE GATE SHALL BE DESIGNED FOR UNBALANCED WATER HEAD CORRESPONDING TO HFL OF 1580.50M. THE GATE SHALL BE OPERATED UNDER UNBALANCED CONDITIONS
7. ARRANGEMENT OF GATE AND EMBEDDED PARTS IS ONLY INDICATIVE. THIS DRAWING SHOULD NOT BE REFERRED FOR FABRICATION PURPOSES.
8. ADEQUATE GROUT HOLES AND GROUT PINS SHOULD BE PROVIDED IN THE LINERS AS WELL AS STIFFENERS FOR SOUND CONCRETING. GROUT HOLES SHOULD BE TAPPED AT WEAKER LOCATIONS AFTER SOUNDING.
9. CONCRETE SHOULD BE BACKFILLED BEHIND LINERS IN LIFTS NOT EXCEEDING 1 METRE.
10. LAYOUT AND SIZE OF GATE CHAMBER IS INDICATIVE ONLY AND SUBJECT TO CHANGE ACCORDING TO RESULTS OF MODEL STUDIES.
11. FOR WELDING DISSIMILAR METAL USE WELD CONSUMABLES OF APPROPRIATE GRADE.
12. GATE SHALL BE OPERATED BY HYDRAULIC HOIST OF ADEQUATE CAPACITY.

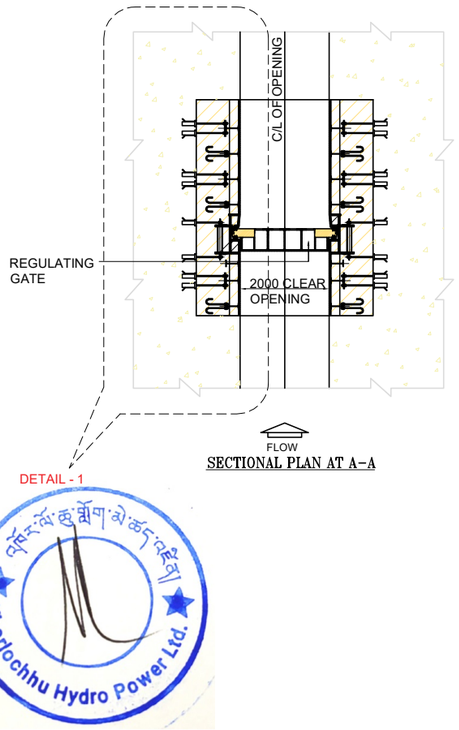
MACHINING INDEX

SURFACE ROUGHNESS IN MICRON	
▽	12.5 - 25
▽▽	1.6 - 6.3
▽▽▽	0.4 - 0.8

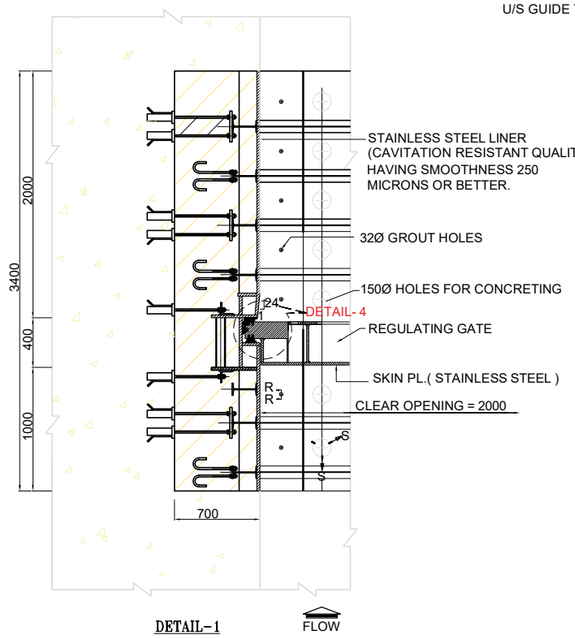
CONCRETING INDEX

1st. STAGE CONCRETE

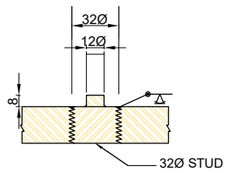
2nd. STAGE CONCRETE



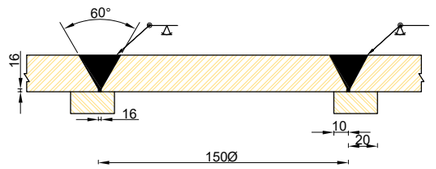
SECTIONAL PLAN AT A-A



DETAIL-1



SECTION R-R



SECTION S-S

DETAIL - 1

Khorlochhu Hydro Power Ltd.

FOR TENDER PURPOSE

CLIENT: KHORLOCHHU HYDRO POWER LIMITED
TRASHIYANGTSE, BHUTAN

CONSULTANT: Tata Consulting Engineers Ltd. & Lombardi Engineering Ltd.(JV)

PROJECT: KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN

TITLE: CHAPLANGCHHU DEGRAVELLING TUNNEL GATE (2000mm X 2000mm) GENERAL ARRANGEMENT

DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	

DWG No: KHPP-HM-CDW-GA-6025

SCALE: AS SHOWN	ISSUE P1	DATE: 17-JUN-2025	ORIGINAL PRINT SIZE: A1

FILE NAME: KHPP-HM-CDW-GA-6025

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

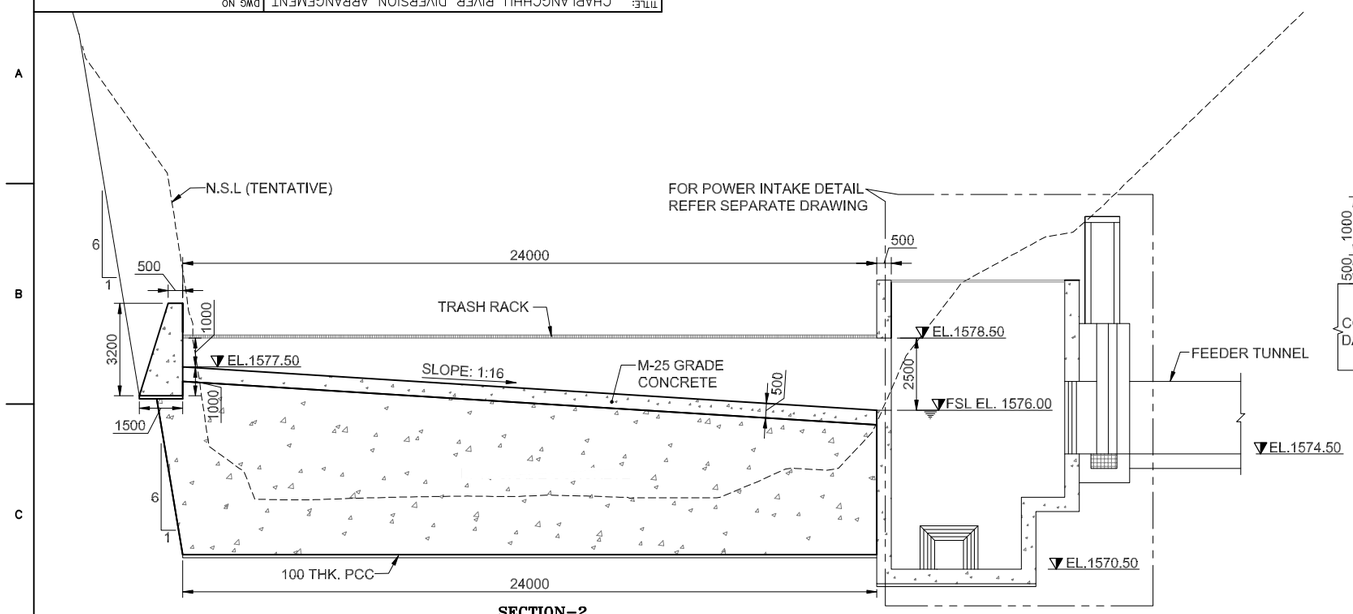
CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

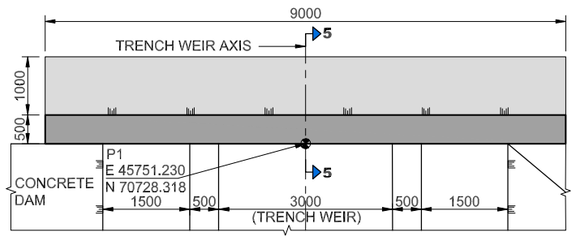
APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	REVIEWED	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE

TITLE: CHAPLANGCHHU RIVER DIVERSION ARRANGEMENT
TRENCH WEIR SECTIONS

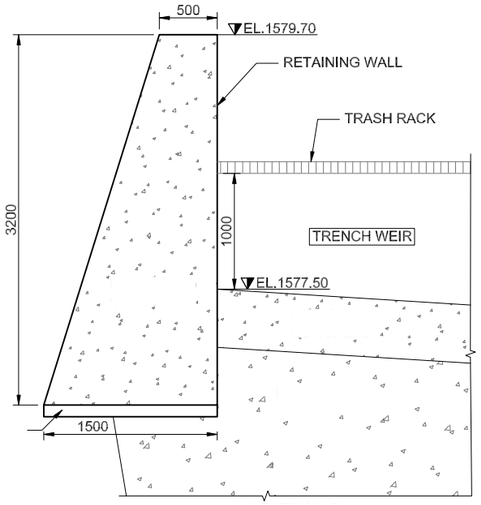
DWG NO KHPP-HM-CDW-CA-6027



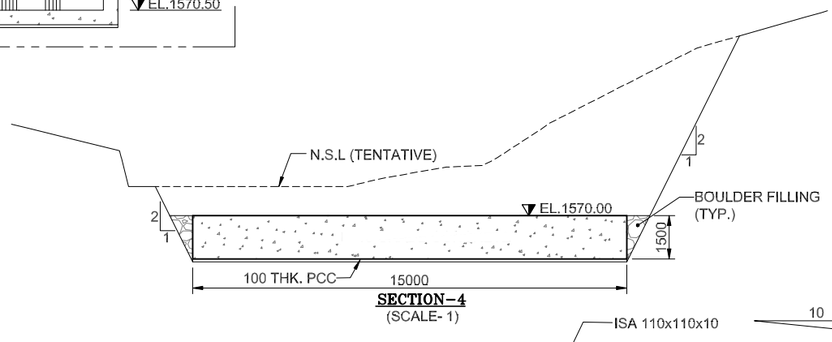
SECTION–2



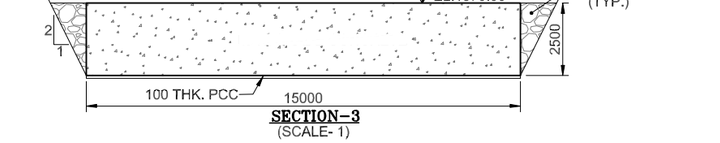
DETAIL–B
(LEFT SIDE RETAINING WALL)
(SCALE- 2)



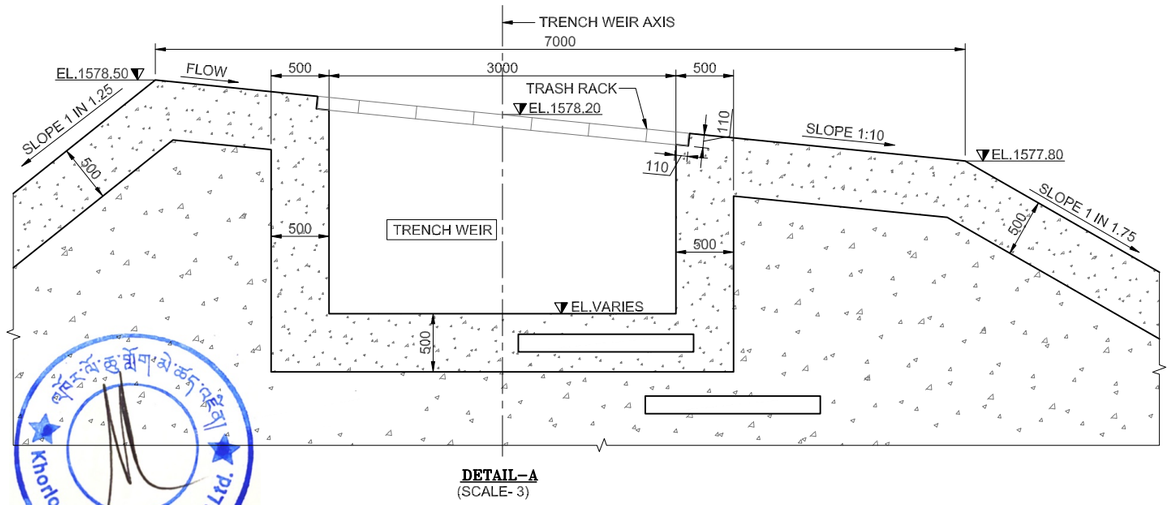
SECTION–5
(SCALE- 3)



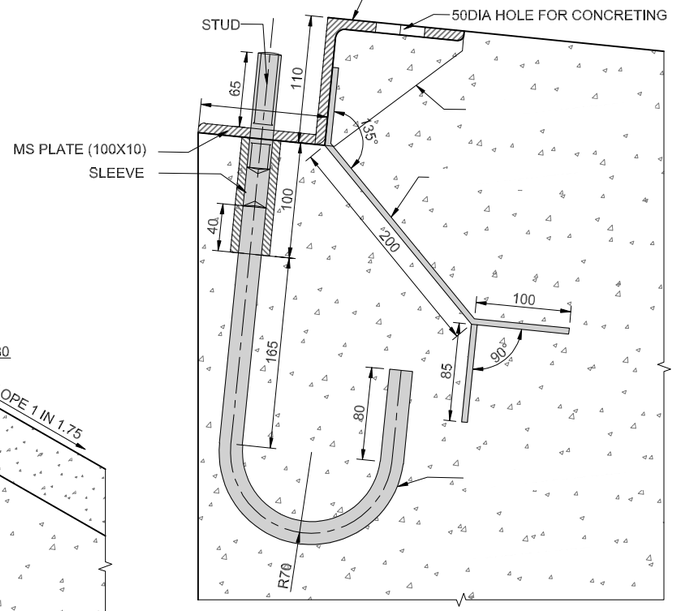
SECTION–4
(SCALE- 1)



SECTION–3
(SCALE- 1)



DETAIL–A
(SCALE- 3)



(TYPICAL DETAIL OF TRASH RACK SEAT EMBEDMENT)
(SCALE- 4)

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRE AND ELEVATIONS ARE IN METRE, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING, ONLY WRITTEN DIMENSION SHALL BE FOLLOWED.
3. THIS DRAWING SHOWS THE LAYOUT PLAN AND SECTIONS OF TRENCH WEIR.
4. THE LAYOUT SHALL BE ACTUALLY LAID ON THE GROUND AND VERIFIED BEFORE STARTING WITH EXECUTION OF WORKS.
5. FOR OTHER NOTES REFFER DRAWING NO. KHPP-HM-CDW-GA-6027.
6. THIS DRAWING SHOULD BE READ INJUNCTION WITH DRAWING NO. KHPP-HM-CDW-GA-6027.

SCALE:– 1
0 2.0 4.0 6.0 8.0 10.0m

SCALE:– 2
0 1.0 2.0 3.0 4.0 5.0m

SCALE:– 3
0 0.5 1.0 1.5 2.0 2.5m

SCALE:– 4
0.0 0.05 0.10 0.15 0.20 0.25m

Khorlochhu Hydro Power Ltd.

FOR TENDER PURPOSE

CLIENT:
KHORLOCHHU HYDRO POWER LIMITED
TRASHIYANGTSE, BHUTAN

CONSULTANT:
Tata Consulting Engineers Ltd. &
Lombardi Engineering Ltd.(JV)

PROJECT:
KHORLOCHHU HYDRO POWER PROJECT(4X150 MW),
TRASHIYANGTSE, BHUTAN

TITLE:
CHAPLANGCHHU RIVER DIVERSION ARRANGEMENT
TRENCH WEIR SECTIONS

DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	
DWG No: KHPP–HM–CDW–GA–6027		
SCALE: AS SHOWN	ISSUE P1	DATE: 18–JUN–2025

ORIGINAL PRINT SIZE: A1

FILE NAME: KHPP–HM–CDW–GA–6027

"P" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

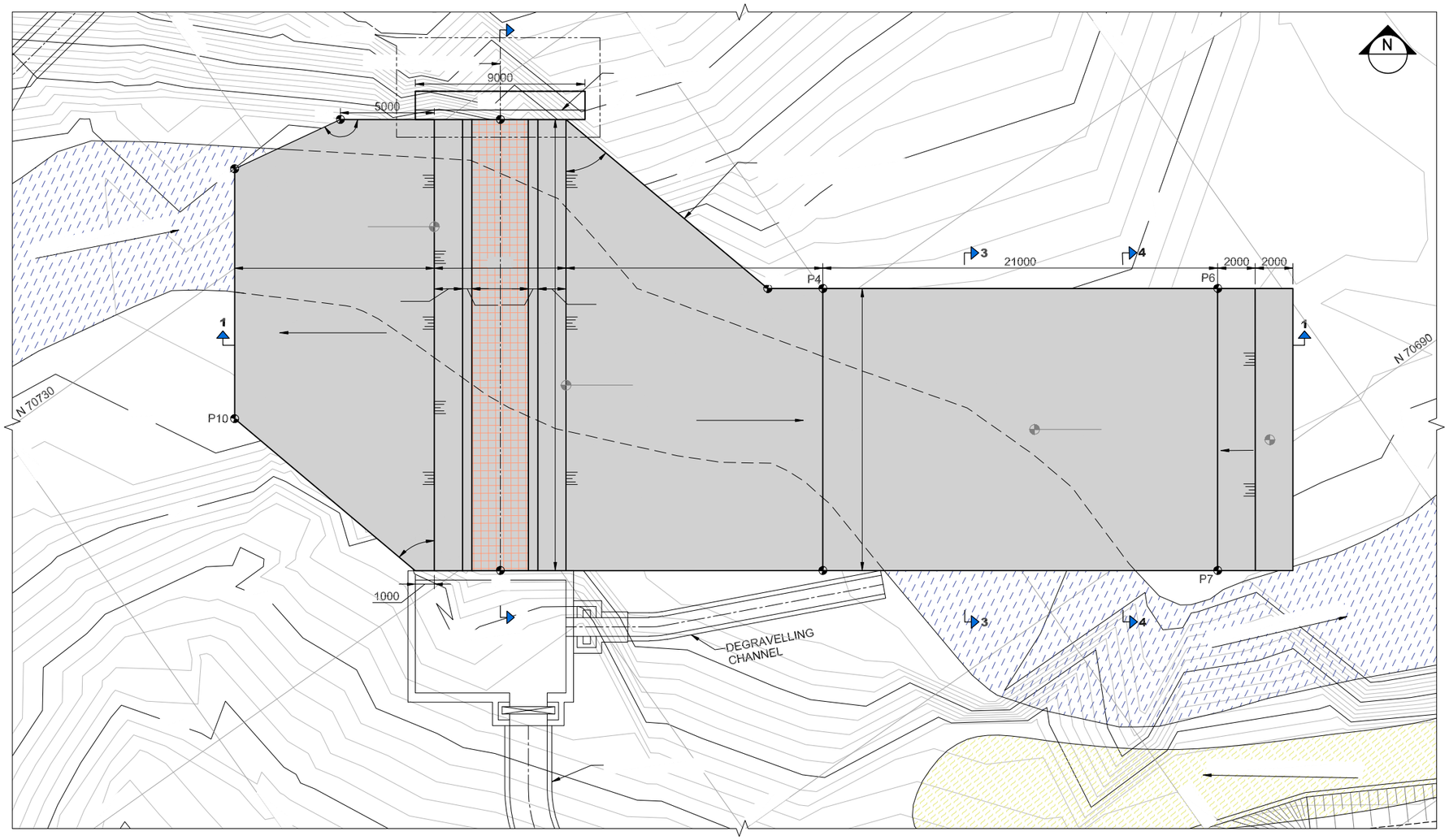
CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

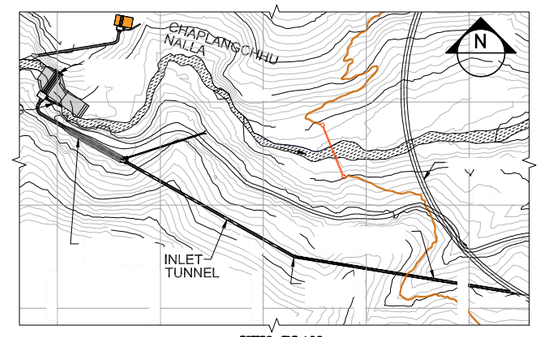
APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
REVIEWED											

TITLE: CHAPLANGCHHU RIVER DIVERSION ARRANGEMENT
TRENCH WEIR LAYOUT PLAN & SECTIONS

DWG NO KHPP-HM-CDW-GA-6028



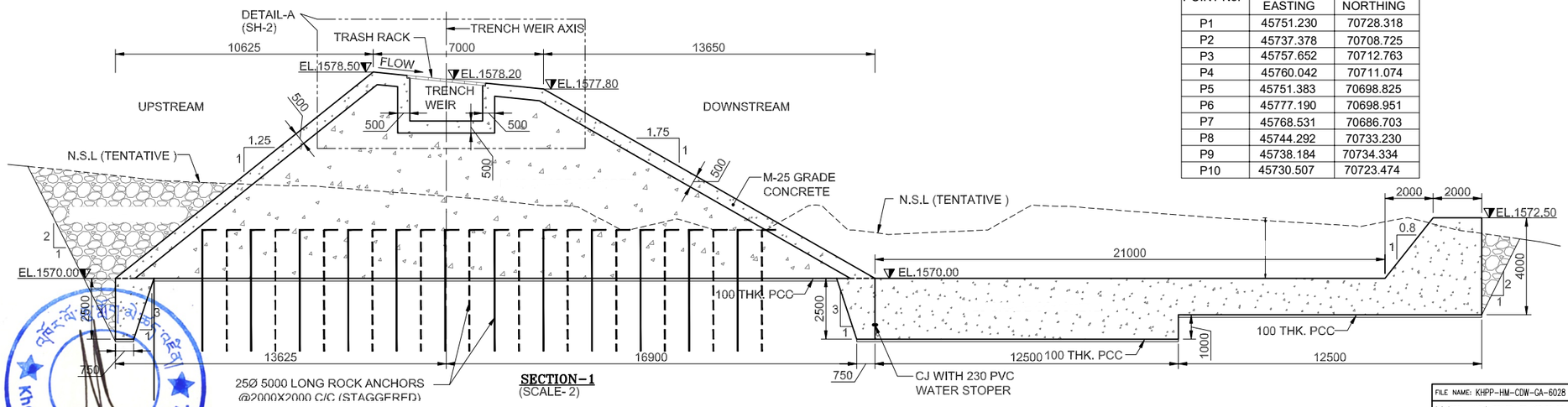
LAYOUT PLAN
(SCALE- 1)



KEY PLAN
(NOT TO SCALE)

REFERENCE POINT

POINT No.	CO-ORDINATES	
	EASTING	NORTHING
P1	45751.230	70728.318
P2	45737.378	70708.725
P3	45757.652	70712.763
P4	45760.042	70711.074
P5	45751.383	70698.825
P6	45777.190	70698.951
P7	45768.531	70686.703
P8	45744.292	70733.230
P9	45738.184	70734.334
P10	45730.507	70723.474



SECTION-1
(SCALE- 2)

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRE AND ELEVATIONS ARE IN METRES, UNLESS OTHERWISE SPECIFIED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING, ONLY WRITTEN DIMENSION SHALL BE FOLLOWED.
3. THIS DRAWING SHOWS THE LAYOUT PLAN AND SECTION OF TRENCH WEIR.
4. THE LAYOUT SHALL BE ACTUALLY LAID ON THE GROUND AND VERIFIED BEFORE STARTING WITH EXECUTION OF WORKS.
5. THE COORDINATES AND ELEVATION OF VARIOUS COMPONENTS IN THE DRAWING ARE BASED ON THE TOPOGRAPHICAL SURVEY FURNISHED BY KHOLONGCHHU HYDRO ENERGY LIMITED VIDEKHEL LETTER NO. 01/KHEL/cons.Contract/Dy.EE/2018/181DATE 28.08.2018 & E-MAIL DATED 05.08.2019
6. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH DRAWING NO. KHPP-HM-CDW-GA-6028
7. FORDETAILSOFPOWERINTAKEANDFEEDERTUNNEL REFER SEPARATE DRAWINGS.
8. BASEDUPONTHEGEOLOGICALCONDITIONOFTHESITE, THESLOPESPROVIDEDINTHEDRAWINGMAYREQUIRED TO BE CHANGED, BUT ANY SUCH CHANGES SHALL BE DONE IN CONSULTATION WITH ENGINEER-IN CHARGE.
9. FOR REINFORCEMENT DETAILS REFER SEPARATE DRAWING.
10. ALL CONCRETE WORKS SHALL CONFORM TO IS:456 [LATEST VERSIONS].
11. CONCRETE SHALL BE THOROUGHLY VIBRATED, COMPACTED AND WORKED AROUND THE REINFORCEMENT INTO THE CORNERS OF FORM WORK.
12. THE GRADE OF CONCRETE M-15 AND M-20 SHALL MEET THE REQUIREMENT OF TECHNICAL SPECIFICATIONS.
13. MAXIMUM SIZE OF AGGREGATE SHALL NOT EXCEED 20mm.
14. LIFT OF CONCRETE SHALL BE RESTRICTED TO 1.2m.
15. DIMENSION OF THE SHALL GROOVES SHOWN FOR GATES AND TRASH RACK GROOVE ARE TENTATIVE ONLY. FOR ACTUAL DIMENSIONS REFER RELEVANT HYDRO MECHANICAL DRAWINGS.

SCALE:-1
0 2.5 5.0 7.5 10.0 12.5m

SCALE:-2
0 2.0 4.0 6.0 8.0 10.0m

FOR TENDER PURPOSE

CLIENT:
KHORLOCHHU HYDRO POWER LIMITED
TRASHIYANGTSE, BHUTAN

CONSULTANT:
Tata Consulting Engineers Ltd. & Lombardi Engineering Ltd.(JV)

PROJECT:
KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN

TITLE:
CHAPLANGCHHU RIVER DIVERSION ARRANGEMENT
TRENCH WEIR LAYOUT PLAN & SECTIONS

DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	
DWG No: KHPP-HM-CDW-GA-6028		
SCALE: AS SHOWN	ISSUE P1	DATE: 17-JUN-2025 ORIGINAL PRINT SIZE: A1

FILE NAME: KHPP-HM-CDW-GA-6028

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

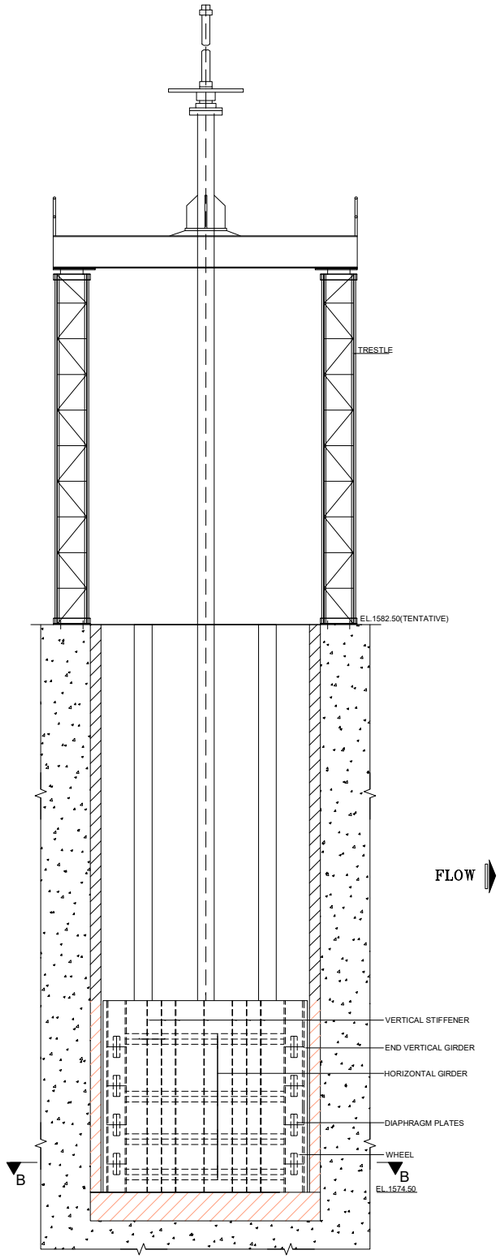
INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

APPROV.	REVIEWED: CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE

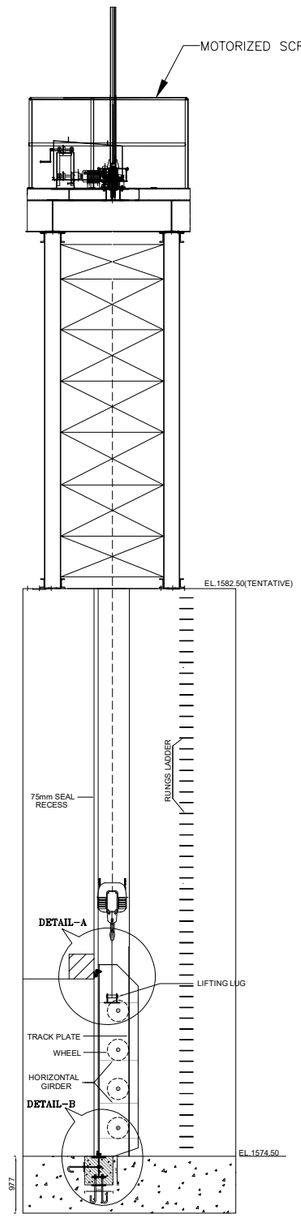
Khorlochhu Hydro Power Ltd.

TITLE: CHAPLANGCHHU DIVERSION WORK INTAKE GATE (2000mm X 2500mm) GENERAL ARRANGEMENT

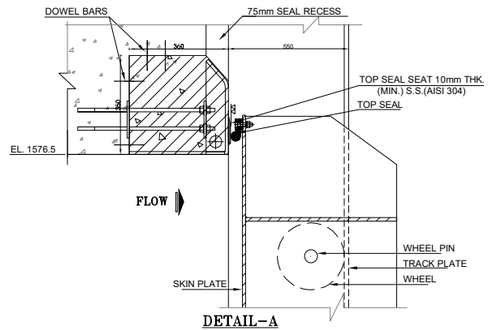
DWG NO KHPP-HM-CDW-CA-6030



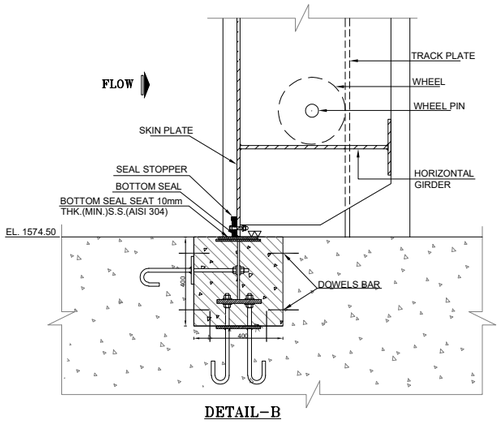
UPSTREAM ELEVATION AT "A-A"



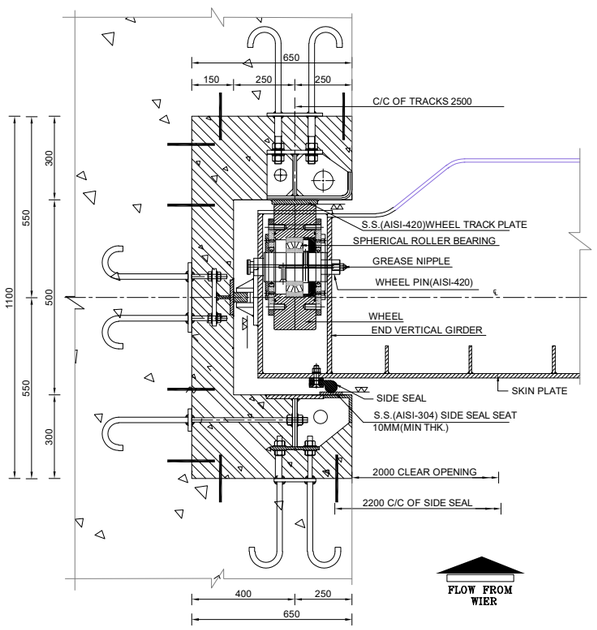
SECTION THROUGH C/L OF BAY



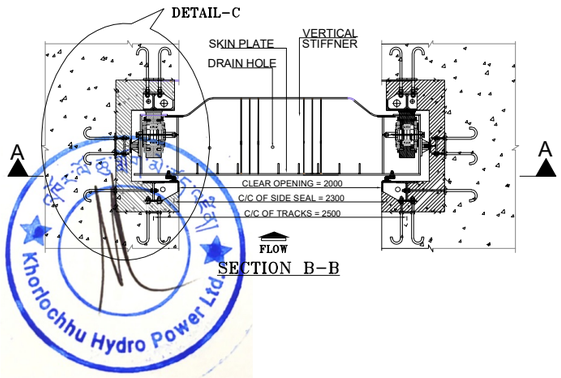
DETAIL-A



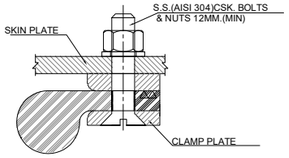
DETAIL-B



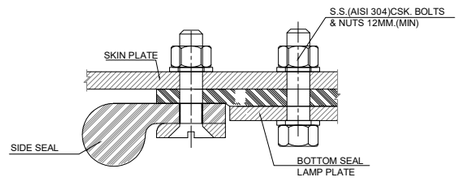
DETAIL-C



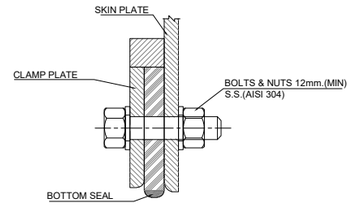
SECTION B-B



SIDE SEAL



DETAIL OF SIDE & BOTTOM SEAL JOINT



BOTTOM SEAL

NOTES:

1. ALL DIMENSIONS ARE IN mm AND ELEVATION IN m.
2. NO. OF OPENINGS - 1(ONE) AND NO. OF GATES - 1 (ONE)
3. THIS DRAWING SHALL BE READ ALONG WITH RELEVANT CIVIL DRAWINGS
4. ALL WELDS SHALL BE 6mm FILLET UNLESS OTHERWISE SPECIFIED.
5. ALL SURFACES BETWEEN 1ST. STAGE AND 2ND. STAGE CONCRETES SHALL BE LEFT THOROUGHLY ROUGH. SUITABLE DOWEL BARS SHALL BE LEFT IN 1st. STAGE CONCRETE.
6. THE CONCRETE IN BLOCKOUTS SHALL BE OF M-25/30 GRADE CONFORMING TO IS:456
7. FACES OF TRACKS, SEAL SEATS AND GUIDES SHALL BE IN TRUE PLANES WITHIN THE TOLERANCES SPECIFIED IN IS:4622 (LATEST). TO IS:456 (LATEST).
8. THE GATE SHALL BE DESIGNED FOR A WATER HEAD OF 6.0m
9. GATE SHALL BE CAPABLE OF BEING LOWERED UNDER FLOWING WATER AND RAISED UNDER UNBALANCED CONDITION. THE GATE SHALL BE OPERATED BY ELECTRIC WIRE ROPE HOIST OF ADEQUATE CAPACITY.
10. SUITABLE DOGGING ARRANGEMENT SHALL BE PROVIDED.
11. SUITABLE BALAST BE ADDED FOR SELF CLOSURE OF THE GATE.

LEGEND:

1st. STAGE CONCRETE

2nd. STAGE CONCRETE

FOR TENDER PURPOSE

CLIENT:
KHORLOCHHU HYDRO POWER LIMITED
TRASHIYANGTSE, BHUTAN

CONSULTANT:
Tata Consulting Engineers Ltd. &
Lombardi Engineering Ltd.(JV)

PROJECT:
KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN

TITLE:
CHAPLANGCHHU DIVERSION WORK INTAKE
GATE (2000mm X 2500mm) GENERAL ARRANGEMENT

DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	

DWG No: KHPP-HM-CDW-GA-6030

SCALE: AS SHOWN | ISSUE P1 | DATE: 18-JUN-2025 | ORIGINAL PRINT SIZE: A1

FILE NAME: KHPP-HM-CDW-GA-6030

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

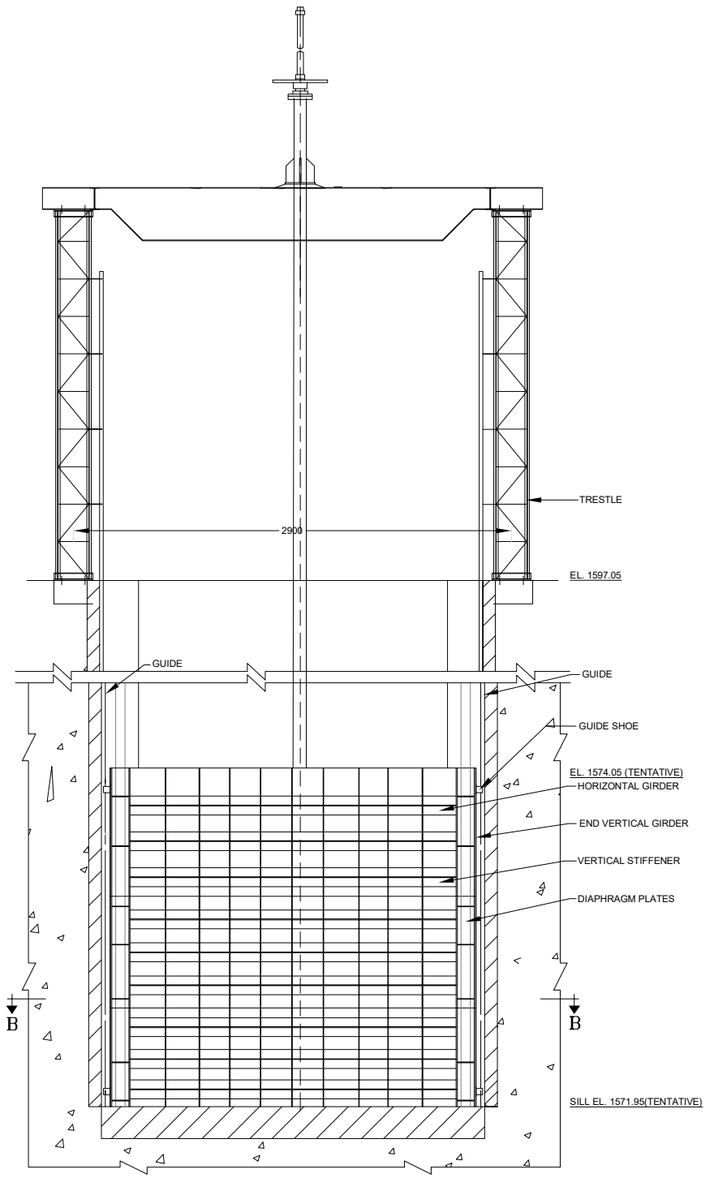
APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.
REVIEWED						

NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE

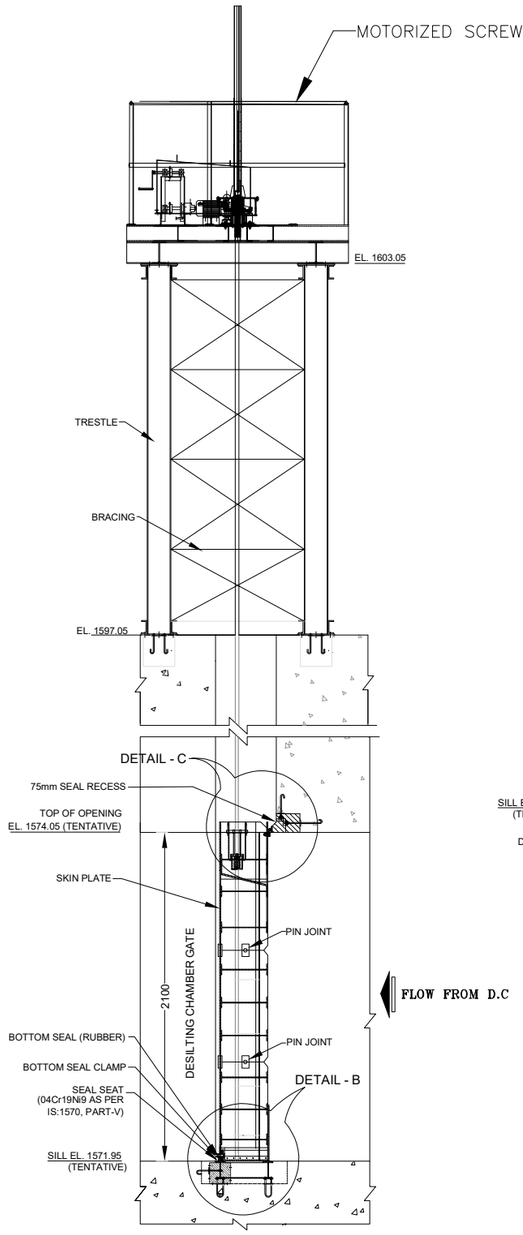
Khorlochhu Hydro Power Ltd

TITLE: CHAPLANGCHHU DIVERSION WORKS DESILTING CHAMBER
OUTLET GATE 1800mm X 2100mm GENERAL ARRANGEMENT

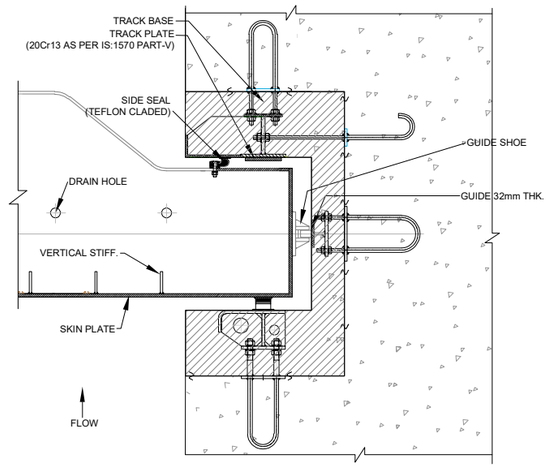
DWG NO KHPP-HM-CDW-GA-6032



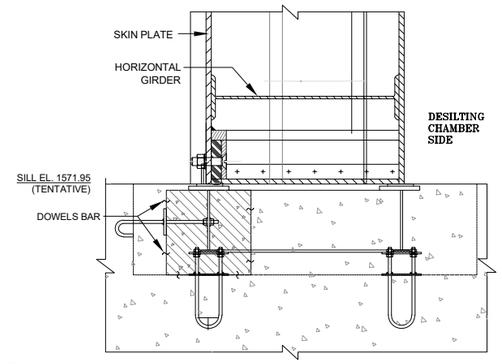
UPSTREAM ELEVATION AT 'A-A'



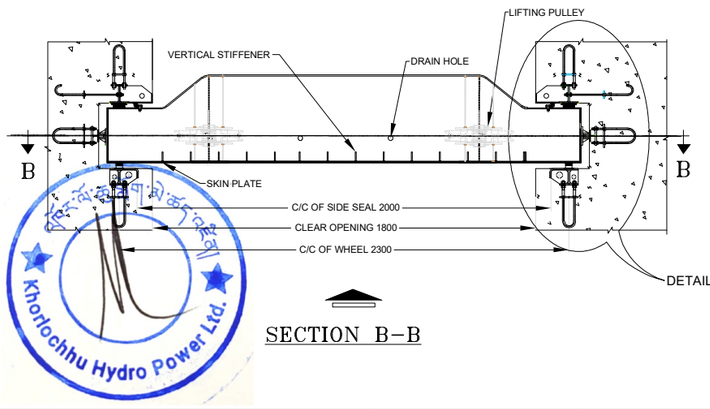
SECTION THRU' C/L OF BAY



DETAIL – A

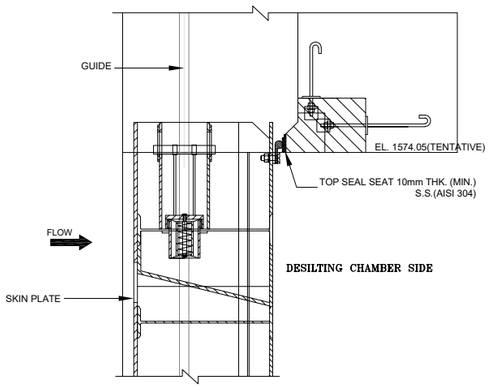


DETAIL – B



SECTION B–B

TECHNICAL PARAMETERS	
DESCRIPTION	DESILTING CHAMBER
TYPE	SLIDE TYPE
SIZE OF OPENING & NOS	1800mm X 2100mm
SILL ELEVATION	1571.95 m
NO OF GATE	1 (ONE)
HOIST	ROPE DRUM
LOCATION OF SKIN PLATE	UPSTREAM
SEALING	DOWNSTREAM



DETAIL – C

1. ALL DIMENSIONS ARE IN mm AND LEVELS ARE IN METRES.
2. FOR DETAIL OF CIVIL STRUCTURES REFER RELEVANT DRAWINGS
3. FACES OF TRACKS AND SEAL SEATS SHALL BE IN A TRUE VERTICAL PLANE WITHIN A TOLERANCE OF 105mm IN ANY 30m WITHOUT OFFSETS OR GAPS AT THE JOINTS.
4. ERECTION TOLERANCE FOR EMBEDDED PARTS AND GATES TO BE CONSIDERED AS PER IS: 3649
5. THE 2ND STAGE CONCRETE BLOCKOUTS SHALL BE BONDED TO THE 1ST STAGE CONCRETE AND NECESSARY DOWELS AT SUITABLE INTERVALS BE LEFT FROM THE 1ST STAGE CONCRETE BY THE CIVIL CONTRACTOR.
6. MACHINING OF TRACKS AND SIDE SEAL SEAT SHALL BE CARRIED OUT AFTER WELDING TO THEIR BASES
7. THE MINIMUM SIZE OF FILLET WELDS SHALL BE 6mm UNLESS OTHERWISE SPECIFIED
8. A) CLEAR OPINING = 1800 X 2100
   B) NO OF OPENING = ONE
   C) NO OF GATES = ONE
9. GATE IS PROPOSED TO BE MADE OF THREE UNITS AND THESE UNITS TO BE ASSEMBLED AT SITE BEFORE INSTALLATION
10. DRY TESTING OF THE GATE WITH EMBEDDED PARTS SHOULD BE CARRIED OUT BEFORE COMMISSIONING OF DESITING CHAMBER
11. THE GATE SHALL BE LOWERED UNDER NO FLOW CONDITION AND RAISED UNDER BALANCED HEAD CONDITION BY MEANS OF ROPE DRUM HOIST

LEGEND :–

1st. STAGE CONCRETE.

2nd. STAGE CONCRETE.

FOR TENDER PURPOSE

CLIENT:
KHORLOCHHU HYDRO POWER LIMITED
TRASHIYANGTSE, BHUTAN

CONSULTANT:
Tata Consulting Engineers Ltd. &
Lombardi Engineering Ltd.(JV)

PROJECT:
KHORLOCHHU HYDRO POWER PROJECT(4X150 MW),
TRASHIYANGTSE, BHUTAN

TITLE:
CHAPLANGCHHU DIVERSION WORKS DESILTING CHAMBER
OUTLET GATE 1800mm X 2100mm GENERAL ARRANGEMENT

DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	
DWG No: KHPP–HM–CDW–GA–6032		
SCALE: AS SHOWN	ISSUE P1	DATE: 18–JUN–2025

ORIGINAL PRINT SIZE: A1

FILE NAME: KHPP–HM–CDW–GA–6032

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

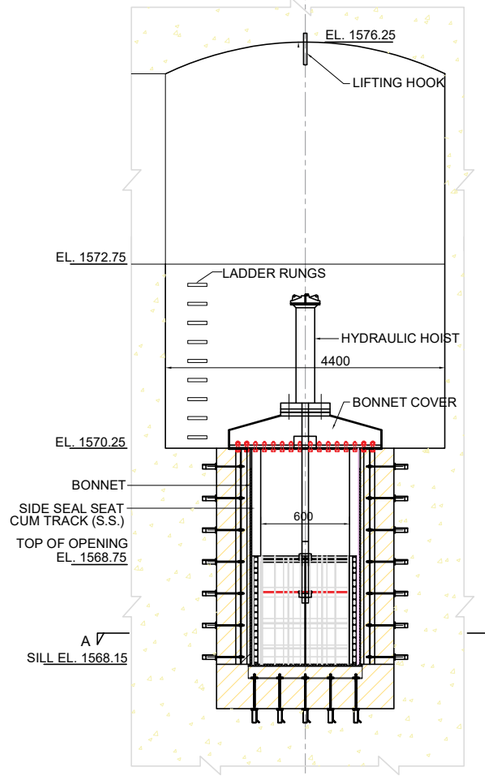
INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
REVIEWED											

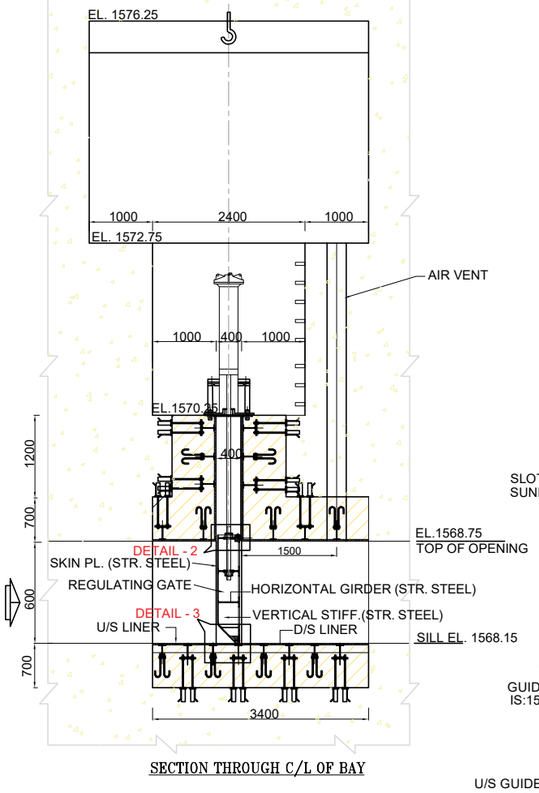
Khorlochhu Hydro Power Ltd.

TITLE: CHAPLANGCHHU SILT FLUSHING TUNNEL GATE (600mm X 600mm) GENERAL ARRANGEMENT

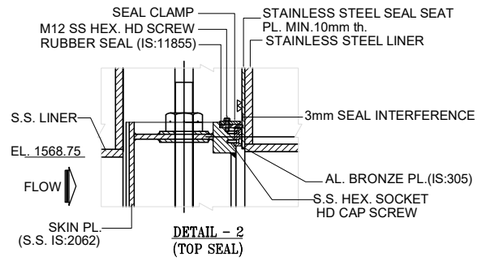
DWG NO KHPP-HM-CDW-GA-6033



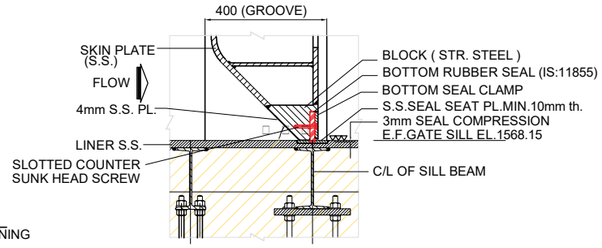
U/S ELEVATION



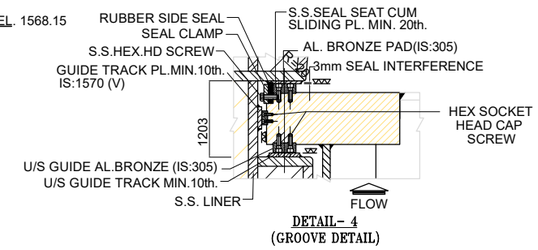
SECTION THROUGH C/L OF BAY



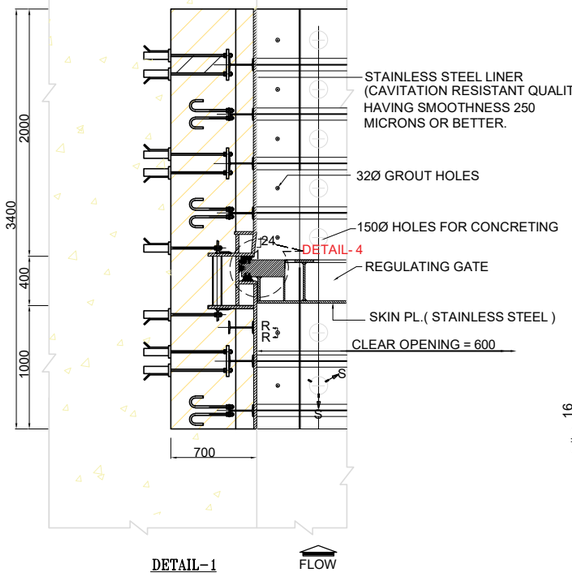
DETAIL – 2
(TOP SEAL)



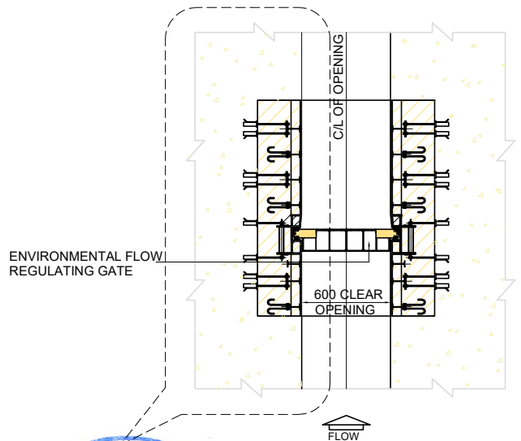
DETAIL–3
(BOTTOM SEAL)



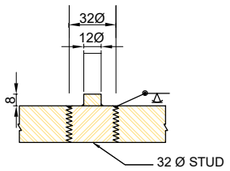
DETAIL– 4
(GROOVE DETAIL)



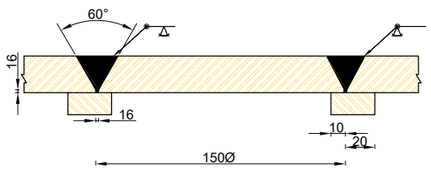
DETAIL–1



SECTIONAL PLAN AT A–A



SECTION R–R



SECTION S–S

NOTES:-

1. ALL DIMENSIONS ARE IN mm AND LEVELS IN METRES.
2. GATE REQUIRED = 1 (ONE) SERVICE .
3. THE 2nd.STAGE CONCRETE IN BLOCK-OUTS SHOULD BE BONDED TO THE 1st. STAGE CONCRETE BY EXTENDING REINFORCEMENT BARS INTO IT AND BY PROVISION OF DOWEL BARS AT SUITABLE INTERVALS.
4. ALL FILLET WELDS SHOULD BE 6mm CONTINUOUS UNLESS OHTHERWISE SPECIFIED.
5. FOR DETAILS OF CIVIL STRUCTURE REFER RELEVANT CIVIL DRAWINGS.
6. THE GATE SHALL BE DESIGNED FOR UNBALANCED WATER HEAD CORRESPONDING TO FSL OF 1576.00M. THE GATE SHALL BE OPERATED UNDER UNBALANCED CONDITIONS
7. ARRANGEMENT OF GATE AND EMBEDDED PARTS IS ONLY INDICATIVE. THIS DRAWING SHOULD NOT BE REFERRED FOR FABRICATION PURPOSES.
8. ADEQUATE GROUT HOLES AND GROUT PINS SHOULD BE PROVIDED IN THE LINERS AS WELL AS STIFFENERS FOR SOUND CONCRETING. GROUT HOLES SHOULD BE TAPPED AT WEAKER LOCATIONS AFTER SOUNDING.
9. CONCRETE SHOULD BE BACKFILLED BEHIND LINERS IN LIFTS NOT EXCEEDING 1 METRE.
10. LAYOUT AND SIZE OF GATE CHAMBER IS INDICATIVE ONLY AND SUBJECT TO CHANGE ACCORDING TO RESULTS OF MODEL STUDIES.
11. FOR WELDING DISSIMILAR METAL USE WELD CONSUMABLES OF APPROPRIATE GRADE.
12. GATE SHALL BE OPERATED BY HYDRAULIC HOIST OF ADEQUATE CAPACITY.

MACHINING INDEX

SURFACE ROUGHNESS IN MICRON	
▽	12.5 - 25
▽▽	1.6 - 6.3
▽▽▽	0.4 - 0.8

CONCRETING INDEX

1st. STAGE CONCRETE

2nd. STAGE CONCRETE

Khorlochhu Hydro Power Ltd.

FOR TENDER PURPOSE

CLIENT: Khorlochhu — KHORLOCHHU HYDRO POWER LIMITED, TRASHIYANGTSE, BHUTAN

CONSULTANT: TATA | Lombardi
Tata Consulting Engineers Ltd. & Lombardi Engineering Ltd.(JV)

PROJECT: KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN

TITLE: CHAPLANGCHHU SILT FLUSHING TUNNEL GATE (600mm X 600mm) GENERAL ARRANGEMENT

DESIGNED: JC / RKR	CHECKED: LGC	RECOMMENDED:
DRAWN : ZMT	APPROVED: PLN	

DWG No: KHPP-HM-CDW-GA-6033

SCALE: AS SHOWN | ISSUE P1 | DATE: 17-JUN-2025 | ORIGINAL PRINT SIZE: A1

FILE NAME: KHPP-HM-CDW-GA-6033

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

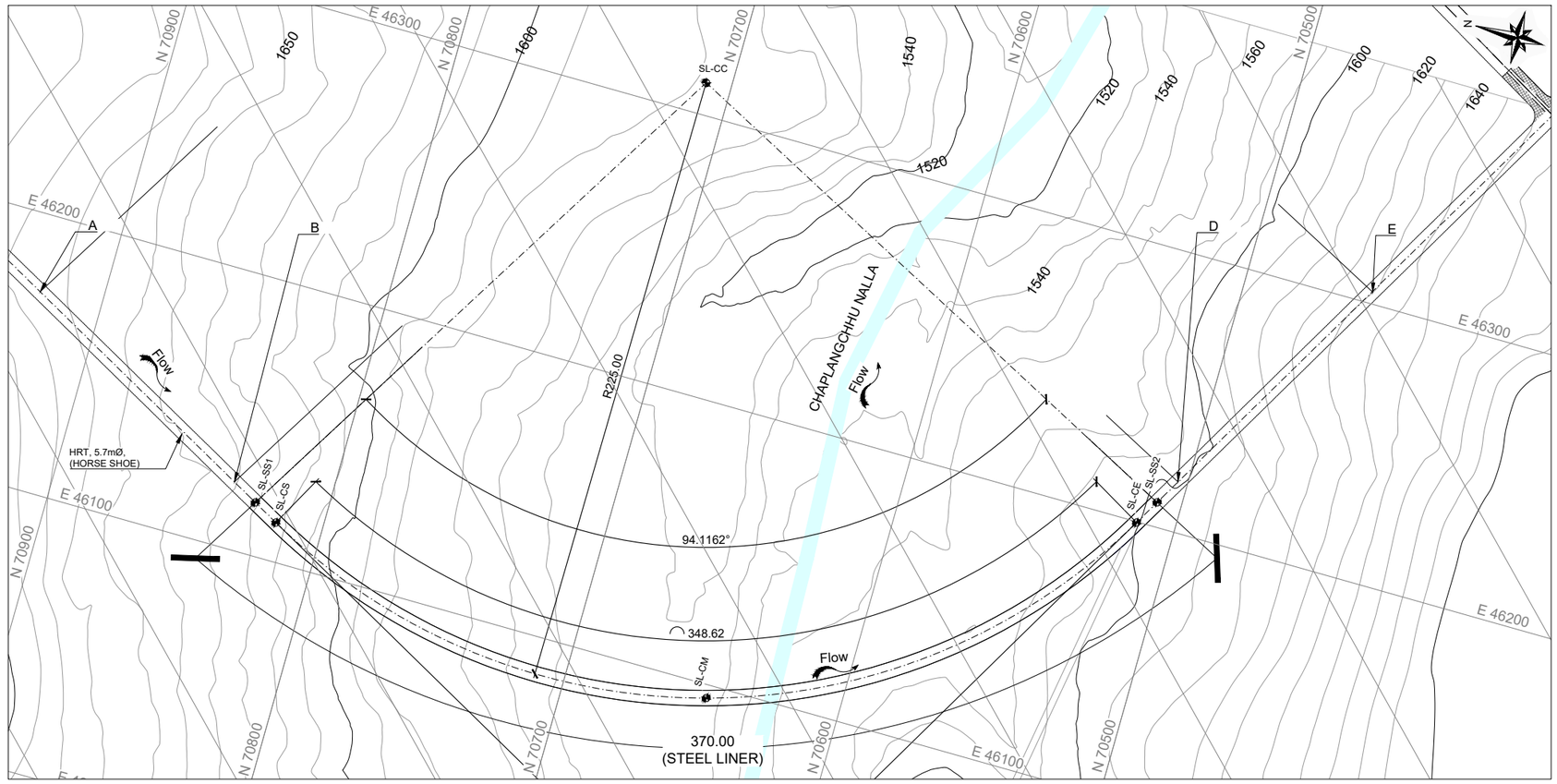
APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
			REVIEWED								

TITLE: CHAPLANGCHHU DIVERSION WORKS CONNECTING TUNNEL TO HRT STEEL LINER-GENERAL ARRANGEMENT

DWG NO KHPP-HM-CDW-GA-6034

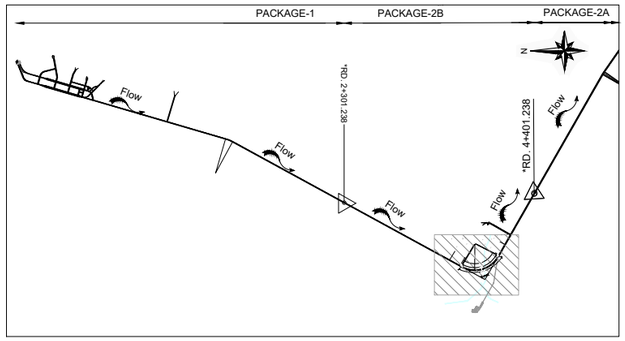
BEND-2 LAYOUT - PLAN

(1:1,000)



KEY PLAN

(N.T.S, ROTATED)



NOTES:

1. This drawing shows the layout plan of head race tunnel and its adits only
2. All dimensions, elevations & *rd's are in metres unless other wise specified.
3. No dimension shall be measured from the drawing only written dimensions shall be followed.
4. The length of HRT is tentative. any change at site must be immediately communicated to the designer.
5. The layout of various components shall be verified at the site before taking up the construction and discrepancy, if any, shall be communicated to project authority & consultant.
6. The drawing of layout plan of head race tunnel has been prepared based on the topographical survey received from the project authority.
7. All invert levels of HRT given in the drawing are finished levels (after concreting).
8. All invert levels and length of adit portals shall be verified at the site before taking up the construction and discrepancy, if any, shall be communicated.
9. This drawing shall be read in conjection will all the 8 sheet related the gad.

References:

- KHPP-CV-GEN-GA-30000.3 GENERAL LAYOUT PLAN OF PACKAGE-2

Coordinates		
Point	East [m]	North [m]
SL-SS1	46119.154	70826.247
SL-CS	46114.132	70817.031
SL-CM	46095.141	70648.113
SL-CE	46199.730	70514.115
SL-SS2	46208.834	70508.894
SL-CC	46311.662	70709.297

Legend:

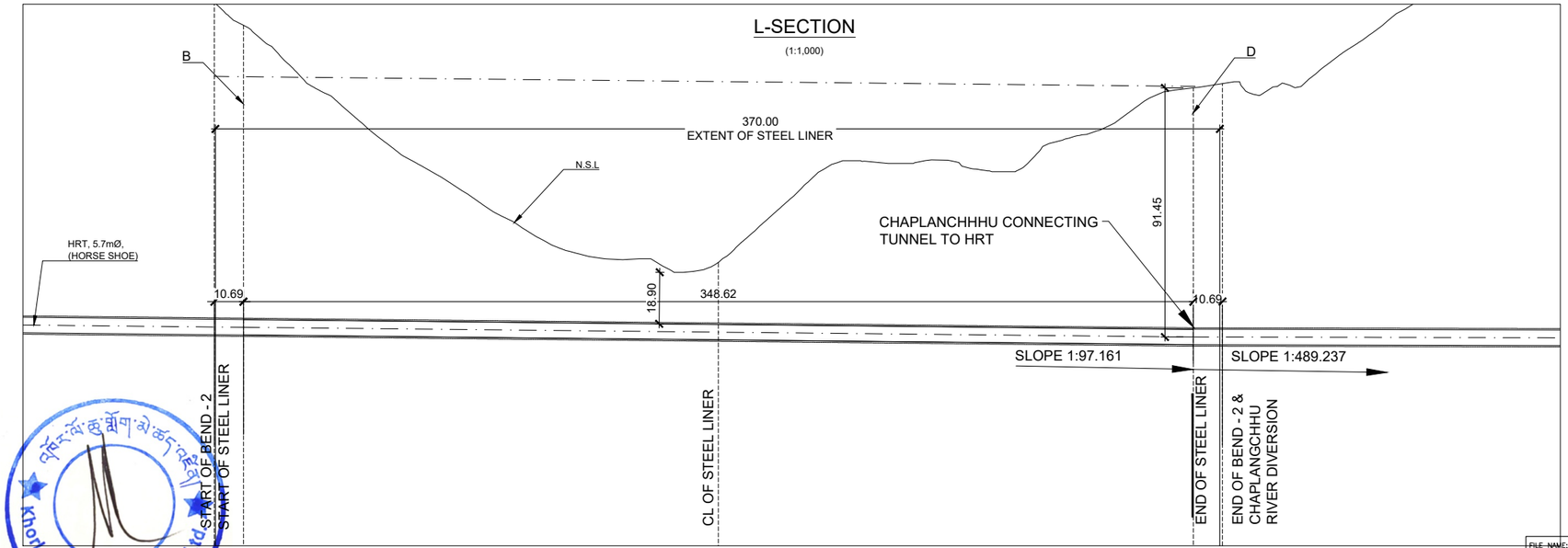
PROJECT ROAD
PACKAGE-1
CONCRETE PLUG
STEEL LINER (PACKAGE-2B)
CONCRETE LINING (PACKAGE-2B)
CONCRETE PLUG WITH GATE

HORZ.	HORIZONTAL
HRT /SFT	HEADRACE TUNNEL / SILT FLUSHING TUNNEL
DC / DT / FT	DESILTING CHAMBER / DIVERSION TUNNEL / FEEDER TUNNEL
Cx	x - BEND NUMBER
Cx - C / E / S	C - CENTER / E- End / S-START OF CURVE
ADx- C / E / S	ADx CURVE ON ADIT x - CENTER / E- End / S-START OF CURVE
*RD	UPDATED "RD" (BASED ON NEW TRANSITION DETAILS)
RDT	AS PER TENDER DOCUMENT

SCALE
(1:1000)
0(m) 100 150 200 300

L-SECTION

(1:1,000)



FOR TENDER PURPOSE ONLY

CLIENT:
KHORLOCHHU HYDRO POWER LIMITED
(Joint Venture of DGPC, RGoB & TATA POWER , INDIA)

PROJECT:
KHORLOCHHU HYDRO POWER PROJECT(4X150 MW), TRASHIYANGTSE, BHUTAN

TITLE:
CHAPLANGCHHU DIVERSION WORKS CONNECTING TUNNEL TO HRT STEEL LINER-GENERAL ARRANGEMENT

CONSULTANT:
TATA CONSULTING ENGINEERS LIMITED MUMBAI
LOMBARDI ENGINEERING LTD. SWITZERLAND

DESIGNED:		REVIEWED:		SCALE: AS SHOWN
DRAWN :		CHECKED:		DATE: 04-04-2025
		APPROVED:		JOB NO: 14124A
DWG No: KHPP-HM-CDW-GA-6034			ISSUE P0	SIZE-A1

FILE NAME: KHPP-HM-CDW-GA-6034

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION/FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION/ FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR HOLDS'IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION/FABRICATION WORK RELATED TO 'HOLDS'.

APPROV.	CIVIL	MECH.	INST.	ELEC.	STRL.	ARCH.	REVIEWED	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE

Khorlochhu Hydro Power Ltd.

KHORLOCHHU HYDRO POWER LIMITED

4x150 MW KHORLOCHHU HYDROPOWER PROJECT

TRASHIYANGTSE; BHUTAN

BIDDING DOCUMENT

FOR

CONTRACT PACKAGE: KHM

DESIGN, MANUFACTURING, SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF HYDRO-MECHANICAL WORKS

VOLUME - 6

TECHNICAL DATA SHEETS

International Competitive Bidding

These documents are meant for the exclusive purpose of bidding against this NIT and shall not be transferred, reproduced or otherwise used for purposes other than that for which they are specifically issued.

Tender Ref. No. KHPL/C&PD/TENDER:KHM/2025/11534 dt. 07.08.2025

LAYOUT OF BIDDING DOCUMENTS

CONTRACT PACKAGE: KHM

Design, Manufacturing, Supply, Installation, Testing and Commissioning of Hydro-Mechanical Works

Volume - 1: Instructions to Bidders (ITB)

- Section - 1 Abridged Notice Inviting Tender and Notice Inviting Tender (NIT)
- Section - 2 Instructions to Bidders (ITB), Bid Data, Qualification Forms, Information for Bidders (IFB) and Work Schedule

Volume - 2: General Conditions of Contract (GCC) and Particular Conditions of Contract (PCC)

- Section - 3 FIDIC General Conditions of Contract (GCC) for Plant and Design-Build Contract (First Edition 1999)
- Section - 4 Particular Conditions of Contract (PCC)
- Section - 5 Forms and Procedures
  - Form-1: Letter of Tender
  - Form-2: Form of Contract Agreement
  - Form-3: Bank Guarantee Form for Performance Security
  - Form-4: Bank Guarantee Form for Advance Payment
  - Form-5: Form of Taking Over Certificate
  - Form-6: Bank Guarantee Form for Release of Retention Money
  - Form-7: Hindrance Register
  - Form-8: Dispute Adjudication Agreement
  - Form-9: Parent/Holding Company Agreement
  - Form-10: Proforma for Joint Deed of Undertaking

Volume-3: Price Schedules

Volume-4: Employer's Requirements

- Section - 6 General Technical Specifications (GTS)
- Section - 7 Particular Technical Specifications (PTS)
- Section - 8 Quality Assurance Plan (QAP)

Volume-5: Tender Drawings

Volume-6: Technical Data Sheets



VOLUME 6

TECHNICAL DATA SHEETS

Table of Contents

1 General 1
2 Data Sheet-1: Technical Particular 2
3 Data Sheet-2: Schedule Of Deviations From Specification 29
4 Data Sheet-3: Proposed Site Organization 30
5 Data Sheet-4: Proposed Work Methodology 31
6 Data Sheet-5: Personnel Capabilities 32
6.1 Data Sheet-5a: Personnel Candidate Data 33
7 Data Sheet-6: Schedule Of Design, Manufacturing, Supply, Erection, Testing & Commissioning Work Program 34
8 Data Sheet-7: Mobilization Schedule/Contractor's Concept Design 35
9 Data Sheet-8: Quality Assurance Plan And Procedures 36
10 Data Sheet-9: Equipment Details 37
10.1 Data Sheet–9a:Equipment Data 38
10.2 Data Sheet–9b: Fabrication/Manufacturing & Testing Facilities 38
10.3 Data Sheet-9c: Deployment Schedule For Equipment 39
11 Data Sheet-10: Schedule Of Transportation Weights & Dimensions 41
12 Data Sheet-11: Information Regarding The Items To Be Manufactured/Supplied By Sub-Supplier And List Of Such Sub-Supplier 42
13 Data Sheet-12: List Of Contracts In Hand And Bids Submitted For Similar Works, ... 43
14 Data Sheet-13: Space Requirement For Fabrication Workshop, Storage, Colonies, Offices And Job Facilities 44
15 Data Sheet-14: Construction Power Load Requirement 45
16 Data Sheet-15: Confirmation Of The Site Visit By The Bidder 46
17 Data Sheet-16: Break Down Of Prices 47
18 Data Sheet-17: Additional/Supplemental Information 49

Khorlochhu Hydro Power Ltd.

1 General

1.1 The empty spaces provided in the attached forms of Technical Particulars shall be filled by the Bidders. Data shall be given as applicable either introducing numeric values or clear Yes/No answers or by repetition of the choice as offered in the question. Questions not applicable shall be answered "N.A."

1.2 The technical particulars which are to be guaranteed by the bidders shall be filled in as per the Data sheet format. The guaranteed particulars are those which are directly related to the performance of the equipment as sought in the technical specification.

1.3 For some specific technical data, Bidders are required to submit the supporting documents in fulfilling of requirement from the past client as specified. Failure to produce such documents shall result in disqualification of the Bid.

1.4 Where due to the question an extended answer is to be given, such an answer should be separately stated in the Tender, with the corresponding data line to be marked “Refer....."

1.5 Proposed deviations from the General or Particular Technical Specifications must be briefly indicated at the proper place as foreseen in the Data Sheets. They may be compiled and described in more detail either exclusively or additionally in only one separate schedule stating both the original requirements and the Tenderer’s proposition. Deviations elsewhere stated in the Tender will not be considered and accepted.

1.6 Where repeated technical data are required for a series of equipment, the relevant pages of the technical data sheets may be used and the page number amended by suffix A, B, C, etc.

1.7 In principle, the Tenderer shall submit all technical data, and all other information called for together with his Tender. Fundamental design data, losses, efficiencies, main dimensions, weights and other important parameters have to be given highest priority.

1.8 Missing technical data which are not given with the Tender have to be submitted before award of the Contract.

1.9 The technical data as finally agreed upon and entered into the Contract Documents constitute the minimum achieved target. The full scope of technical data shall be resubmitted at the proper time during contract implementation, duly filled in or corrected with the technical data as per agreed final design.

1.10 This implies that the Contractor may propose at his discretion other data in compliance with his final choice of equipment, provided such data are not inferior compared with the contractual ones and any improvement shall be provided free of extra cost.

1.11 The Tenderer may propose a variety of manufacturers or sub vendors for the individual equipment, provided all such companies are listed in the Data Sheets or are tabled elsewhere. Upon award of contract, the Employer/Employer's Representative may accept any or all proposed companies, then binding for execution.

1.12 The statement "or equivalent” implies that the first choice remains with the companies explicitly mentioned and the Employer/Employer's Representative reserves the right to accept or reject without justification any future new proposal.

1.13 In case of discrepancies between data as required by Technical Specifications and those stated in the Data Sheets, the Technical Specifications take precedence.



2 Data Sheet-1: Technical Particular

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
2.1 Spillway Radial Gates, Hydraulic Hoists & Support Structure					
A	**To be Manufactured by:**				
B	**GENERAL**				
B.1	**Spillway Radial Gate**				
i)	Maximum permitted total leakage under any water level	l/min/meter			
ii)	Brief description of dogging arrangement				
iii)	Trunnion bearing a) Type b) Make				
iv)	Arrangement for preventing leakage from top seal at partial gate openings (to be described/ supported with sketches)				
B.2	**Hydraulic Cylinder**				
i)	Manufacturer				
ii)	Stroke (Working)			mm	
iii)	Reserve stroke available beyond working stroke a) Piston head end b) Stem head end	 mm mm			
iv)	Hoist cylinder bearings a) Piston head end i) Type ii) Make b) Stem head end i) Type ii) Make				
B.3	**Hoist Power Pack (Complete power pack shall be procured from reputed manufacturer preferably from hydraulic cylinder supplier. It shall not be assembled by procuring individual components)**				
i)	Manufacturer				
ii)	Type of Oil pump				
B.3.1	**Motors (with anti-condensation strip heaters**				
i)	Manufacturer				
B.4	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
C.1	**Painting**				
	Make/Manufacture				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
2.2 Spillway Stoplogs, Lifting Beam and Gantry Crane					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Stoplog**				
	Maximum permitted total leakage under any water level	l/min/meter			
B.2	**Gantry Crane**				
	Manufacturer				
B.2.1	**Motors (Hoist, LT, CT)**				
	Manufacturer				
B.2.2	**Cable reeling drum**				
i)	Manufacturer				
ii)	Type				
B.3	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Lifting Beam**				
	Hooks Material/Specification				
C.2	**Painting**				
	Material/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
2.3 Overflow Spillway Service Gate (Fixed wheel type)					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Service Gate**				
i)	Maximum permitted total leakage under any water level	L/min/meter			
ii)	Make of wheel bearings				
B.2	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Painting**				
	a) Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
2.4 Motorized Screw Hoist for Overflow Spillway Service					
A	**To be Manufactured by:**	……			

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
B	**GENERAL**				
B.1	**Screw Hoist**				
i)	Manufacturer				
ii)	Type of Position Indicator				
iii)	Height of hoist platform above the top of pier level			mm	
B.2	**Actuators**				
	Manufacturer				
B.2	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Motorized Screw Hoist**				
	Pedestal/Housing • Material Specification				
	Lifting Screw • Material Specification				
	Gear • Material Specification				
C.2	**Painting**				
	• Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
2.5 Intake Trash Racks					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
C	**MATERIALS**				
C.1	**Painting**				
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
2.6 Trash Racks Cleaning Machine (TRCM)					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**TRCM**				
	Manufacturer				
B.2	**Details of prime mover operated self-unloading trash disposal vehicle (Tripper Type)**				
i)	Type/Make				
ii)	Capacity of Trash Disposal vehicle				
B.3	**Motors with anti-condensation strip heaters**				
	Manufacturer				
B.4	Brief description about how operational requirements are covered & GA drawing describing all major components especially: a) Rake Machine b) Rake Head c) Boom & Grapple Arrangement d) Lateral Comb for Combing				
	Improvement in specifications/ configuration, if any				
B.5	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
C	**DIMENSIONS**				
C.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
C.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
2.7 Intake Service Gate (Fixed wheel type)					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Intake Service Gate**				
i)	Maximum permitted total leakage under any water level	L/min/meter			
ii)	Make of wheel bearings				
B.2	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Painting**				
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
2.8 Rope Drum Hoist for Intake Gates					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Rope Drum Hoist**				
i)	Manufacturer				
ii)	Type of Position Indicator				
iii)	Height of hoist platform above the top of pier level			mm	
B.2	**Motors with anti-condensation strip heaters**				
	Manufacturer				
B.3	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Rope Drum Hoist**				
	Rope drum • Material Specification				
	Gear • Material Specification				
C.2	**Painting**				
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
2.9 Intake Bulkhead Gate (Slide type)					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Intake Emergency Gate**				

Khorlochhu Hydro Power Ltd.

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
	Maximum permitted total leakage under any water level	L/min/meter			
B.2	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Painting**				
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
2.10 Gantry Crane for Intake Bulkhead Gate					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Gantry Crane**				
	Manufacturer				
B.1.1	**Motors (Hoist, LT)**				
	Manufacturer				
B.1.2	Cable reeling drum				
	Manufacturer				
	Type				
B.2	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Painting**				
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
2.11 Downstream Desilting Chamber Gate (Fixed wheel type)					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Desilting chamber outlet gate**				
	Maximum permitted total leakage under any water level	L/min/meter			
	Make of wheel bearings				
B.2	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Painting**				
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
2.12 Rope Drum Hoist for Downstream Desilting Chamber Gate					
A	**To be Manufactured by:**	……..			

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
B	**GENERAL**				
B.1	**Rope Drum Hoist**				
	Manufacturer				
	Type of Position Indicator				
	Height of hoist platform above the top of pier level			mm	
B.2	**Motors with anti-condensation strip heaters**				
	Manufacturer				
B.3	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Rope Drum Hoist**				
	Rope drum • Material Specification				
	Gear • Material Specification				
C.2	**Painting**				
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
	Height			mm	
2.13 Silt Flushing Tunnel Service & Emergency Gates (Slide type)					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Gate**				
	Maximum permitted total leakage under any water level	L/min/meter			

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
B.2	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Painting**				
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
2.14 Hydraulic Hoists and Supporting Structure for SFT Gates					
A	**To be Manufactured by:**				
B	**GENERAL**				
B.1	**Hydraulic Cylinder**				
	Manufacturer				
	Stroke (Working)	mm			
	Reserve stroke available beyond working stroke a) Piston head end b) Stem head end	 mm mm			
	Hoist cylinder bearings a) Stem head end b) Type c) Make				
B.2	**Hoist Power Pack (Complete power pack shall be procured from reputed manufacturer preferably from hydraulic cylinder supplier. It shall not be assembled by procuring individual components)**				
	Manufacturer				
	Type of Oil pump				
B.2.1	**Motors (with anti-condensation strip heaters)**				
	Manufacturer/Make				

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
B.3	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Hydraulic Hoist and Support Structure**				
	Cylinder Tube • Material Specification				
	Piston • Material Specification				
	Piston Rod • Material Specification				
	Hoist Cylinder Pins Stem End • Material Specification				
C.2	**Painting**				
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
2.15 Surge Shaft Gates (Slide type)					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Surge Shaft Gate**				
	Maximum permitted total leakage under any water level	L/min/meter			
B.2	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Painting**				

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
2.16 Rope Drum Hoist for Surge Shaft Gates					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Rope Drum Hoist**				
i)	Manufacturer				
ii)	Type of Position Indicator				
iii)	Height of hoist platform above the top of pier level			mm	
B.2	**Motors with anti-condensation strip heaters**				
	Manufacturer				
B.3	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Rope Drum Hoist**				
	Rope drum • Material Specification				
	Gear • Material Specification				
C.2	**Painting**				
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
2.17 Tail Race Gates (Wheel type)					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Tailrace Gate**				
i)	Maximum permitted total leakage under any water level	L/min/meter			
ii)	Make of wheel bearing				
B.2	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Painting**				
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
2.18 Gantry Crane, Lifting Beam for Tail Race Gates					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Gantry Crane**				

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
	Manufacturer				
B.1.1	Motors (Hoist, LT)				
	Manufacturer				
B.1.2	**Cable reeling drum**				
i)	Manufacturer				
ii)	Type				
B.2	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Lifting Beam**				
	Hooks • Material Specification				
	Painting				
	Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
2.19 TRT Outfall Gate (Fixed wheel type)					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Intake Gate**				
i)	Maximum permitted total leakage under any water level	L/min/meter			
ii)	Make of wheel bearing				
B.2	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Painting**				

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
2.20 Rope Drum Hoist for TRT Outfall Gates					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Rope Drum Hoist**				
i)	Manufacturer				
ii)	Type of Position Indicator				
iii)	Height of hoist platform above the top of pier level			mm	
B.2	**Motors with anti-condensation strip heaters**				
	Manufacturer				
B.3	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Rope Drum Hoist**				
	Rope drum Material type/Specification				
	Gear Material Specification				
C.2	**Painting**				
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
2.21 Adit Gates					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Adit Gate**				
	Maximum permitted total leakage under any water level	L/min/meter			
B.2	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Painting**				
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			Mm	
2.22 Pressure Shaft Liner					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
B.1	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Pressure shaft liner**				
	Material Specification				
C.2	**Painting**				
	Interior Painting Make/Manufacturer				
	Exterior Painting Make/Manufacturer				
2.23 Head Race Tunnel Liner					
A	**To be Manufactured by:**	……..			
B.1	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Pressure shaft liner**				
	Material Specification				
C.2	**Painting**				
	Interior Painting Make/Manufacturer				
	Exterior Painting Make/Manufacturer				
2.24 Instrumentation					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Water Level Sensors**				
	Type				
	Range of sensors	m			
	Accuracy	cm/mm			
B.2	**Water Level Recorder**				
	Type				
B.3	**Head Loss Measuring Instrument**				
	Type				
	Range of instrument	m			
	Accuracy	cm			
	Alarm system				
B.4	Detailed write-up of configuration and line diagram of Control System				

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
B.5	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**DIMENSIONS**				
C.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			Kn	
iii)	Length			Mm	
iv)	Width			Mm	
v)	Height			Mm	
C.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			Mm	
iv)	Width			Mm	
v)	Height			Mm	
2.25 Knife Edge Gate Valve					
1.	**To be Manufactured by:**	……..			
2.	**GENERAL**				
2.1	**Knife Edge Gate Valve**				
	Make				
2.2	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
2.26 Chaplangchhu Intake Gate (Fixed wheel type)					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Intake Gate**				
	Maximum permitted total leakage under any water level	L/min/meter			
	Make of wheel bearing				
B.2	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Painting**				
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
ii)	Weight			kN	
iii)	Length			Mm	
iv)	Width			Mm	
v)	Height			Mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			Mm	
iv)	Width			Mm	
v)	Height			Mm	
2.27 Motorized screw Hoist for Chaplangchhu Intake Gate					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Motorized Screw Hoist**				
	Manufacturer				
	Type of Position Indicator				
	Height of hoist platform above the top of pier level			Mm	
B.2	**Motors with anti-condensation strip heaters**				
	Manufacturer				
B.3	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Motorized Screw Hoist**				
	Pedestal/Housing • Material type Specification				
	Lifting Screw • Material type Specification				
	Gear • Material Specification				
C.2	**Painting**				
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			KN	
iii)	Length			Mm	
iv)	Width			Mm	

Khorlochhu Hydro Power Ltd.

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
v)	Height			Mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			KN	
iii)	Length			Mm	
iv)	Width			Mm	
v)	Height			Mm	
2.28 Chaplangchhu Desilting Chamber Outlet Gate (Slide type)					
A	**To be Manufactured by:**	……...			
B	**GENERAL**				
B.1	**Desilting Basin Gate**				
	Maximum permitted total leakage under any water level	L/min/meter			
B.2	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Painting**				
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			Mm	
iv)	Width			Mm	
v)	Height			Mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			Mm	
iv)	Width			Mm	
v)	Height			Mm	
2.29 Motorized Screw Hoist for Chaplangchhu Desilting Chamber Outlet Gate					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Motorized Screw Hoist**				
	Manufacturer				
	Type of Position Indicator				

Khorlochhu Hydro Power Ltd.

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
	Height of hoist platform above the top of pier level			Mm	
B.2	**Motors with anti-condensation strip heaters**				
	Manufacturer				
B.3	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Motorized Screw Hoist**				
	Pedestal/Housing • Material type Specification				
	Lifting Screw • Material type Specification				
	Gear • Material Specification				
C.2	**Painting**				
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			Mm	
iv)	Width			Mm	
v)	Height			Mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			Mm	
iv)	Width			Mm	
v)	Height			Mm	
2.30 Chaplangchhu SFT Gate (Slide type)					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Chaplangchhu SFT Gate**				
	Maximum permitted total leakage under any water level	L/min/meter			
B.2	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
C.1	**Painting**				
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			Mm	
iv)	Width			Mm	
v)	Height			Mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			Mm	
iv)	Width			Mm	
v)	Height			Mm	
2.31 Hydraulic Hoists and Support Structure for Chaplangchhu SFT Gate					
A	**To be Manufactured by:**				
B	**GENERAL**				
B.1	**Hydraulic Cylinder**				
	Manufacturer				
	Stroke (Working)	mm			
	Reserve stroke available beyond working stroke a) Piston head end b) Stem head end	 mm mm			
	Hoist cylinder bearings Steam head end a) Type b) Make				
B.2	**Hoist Power Pack (Complete power pack shall be procured from reputed manufacturer preferably from hydraulic cylinder supplier. It shall not be assembled by procuring individual components)**				
	Manufacturer				
	Type of Oil pump				
B.2.1	**Motors (with anti-condensation strip heaters**				
	Manufacturer				
B.3	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
C.1	**Hydraulic Hoist & Support Structure**				
	Cylinder Tube • Material Specification				
	Piston • Material Specification				
	Piston Rod • Material Specification				
	Hoist Cylinder Pins • Material Specification				
C.2	**Painting**				
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			Mm	
iv)	Width			Mm	
v)	Height			Mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			Mm	
iv)	Width			Mm	
v)	Height			Mm	
2.32 Chaplangchhu De-gravelling Gate (Slide type)					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Chaplangchhu De-gravelling Gate**				
	Maximum permitted total leakage under any water level	L/min/meter			
B.2	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Painting**				
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
ii)	Weight			kN	
iii)	Length			Mm	
iv)	Width			Mm	
v)	Height			Mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			Mm	
iv)	Width			Mm	
v)	Height			Mm	
2.33 Hydraulic Hoists and Support Structure for Chaplangchhu De-gravelling Gate					
A	**To be Manufactured by:**				
B	**GENERAL**				
B.1	**Hydraulic Cylinder**				
	Manufacturer				
	Stroke (Working)	mm			
	Reserve stroke available beyond working stroke a) Piston head end b) Stem head end	 mm mm			
	Hoist cylinder bearings Steam head end a) Type b) Make				
B.2	**Hoist Power Pack (Complete power pack shall be procured from reputed manufacturer preferably from hydraulic cylinder supplier. It shall not be assembled by procuring individual components)**				
	Manufacturer				
	Type of Oil pump				
B.2.1	**Motors (with anti-condensation strip heaters**				
	Manufacturer				
B.3	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Hydraulic Hoist & Support Structure**				
	Cylinder Tube • Material Specification				
	Piston • Material Specification				

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
	Piston Rod • Material Specification				
	Hoist Cylinder Pins Stem End Material Specification				
C.2	**Painting**				
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			Mm	
iv)	Width			Mm	
v)	Height			Mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			Mm	
iv)	Width			Mm	
v)	Height			Mm	
2.34 Intake Trash Racks					
A	**To be Manufactured by:**	……..			
B	**GENERAL**				
B.1	**Error/discrepancies/deficiencies, if any in technical specifications and drawings**				
C	**MATERIALS**				
C.1	**Painting**				
	Make/Manufacturer				
D	**DIMENSIONS**				
D.1	**Heaviest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	
D.2	**Longest Part to be transported**				
i)	Name of part				
ii)	Weight			kN	

Khorlochhu Hydro Power Ltd.

ITEM	DESCRIPTION	Guaranteed Technical Particulars		Tentative Technical Particulars	
		UNIT	DATA	UNIT	DATA
iii)	Length			mm	
iv)	Width			mm	
v)	Height			mm	

3 Data Sheet-2: Schedule of Deviations from Specification

Name of Bidder:

All technical exception and deviations to the tender specifications shall be clearly set out by the bidder in the format given hereunder.

SL. No.	Chapter, Clause & Page Number of specification	Exception & deviations from the tender specification proposed by the bidder	Justification for deviation

Certified that the above listed deviations and exceptions are exhaustive and the contract shall be executed as per the tender specification, excepting for the above deviations and exceptions in the event of placing an order on us.

Date: **Signature & Seal of Bidder:**

Place: **Name:**

Designation:

4 Data Sheet-3: Proposed Site Organization

Name of Bidder:

A. Preliminary Site Organization Chart *

B. Narrative Description of Site Organization Chart

C. Description of Quality Assurance at Site/Factory

D. Description of Relationship between Head Office and Site Management

*** Note:** The details of foreign nationals (number and designation) to be deployed at site should also be specified.

Date: **Signature & Seal of Bidder:**

Place: **Name:**

Designation:



5 Data Sheet-4: Proposed Work Methodology

Name of Bidder:

Method Statement

i) Method statement for basic engineering of the plant including preparation of design manuals.

ii) Method statement for detailed design of all Plant and Machinery and system(s).

iii) Method statement for manufacturing Plant and Machinery, shop assembly including shop testing.

iv) Method statement commensurate with equipment planning, project personnel, detail construction programme and milestones.

v) Method statement for packing and transportation of all Plant and Machinery manufactured in India/ abroad from manufacturer's works to Project Site.

vi) Method statement for site installation, land acquisition, storage areas, camps etc.

vii) Method statement for detailed planning, scheduling and Procedure for coordination with other contractors and suppliers, as well as with the Employer in such a way to avoid delays or other difficulties during the erection and testing of Plant and equipment.

The information submitted should be such as to allow an assessment of the general adequacy of the Bidder's proposal. Required number and classification of manpower, equipment and materials to be used for each particular activity should be described.

Date: **Signature & Seal of Bidder:**

Place: **Name:**

Designation:

6 Data Sheet-5: Personnel Capabilities

Name of Bidder:

*For specific positions essential to contract implementation, Bidders should provide the names of at least two candidates proposed to meet the specified requirements. The data on their experience should be supplied in separate sheets using **Data Sheet 5A** for each candidate.*

1.	**Title of position**	
	Name of prime candidate	
	Name of alternate candidate	
2.	**Title of position**	
	Name of prime candidate	
	Name of alternate candidate	
3.	**Title of position**	
	Name of prime candidate	
	Name of alternate candidate	
Remark: *The Categories of Personnel includes Design, Production, Quality Assurance, Site Supervisory, Testing and Commissioning, Managerial and Servicing etc.*		

Note:

1. Names proposed above will be posted against the work. Any change in name at later stage will require the approval of the Employer.
2. Project Manager designated for the Work shall have a minimum of twenty (20) years of total work experience and a minimum of fifteen (15) years in similar work.
3. Managers/Engineers designated for design, fabrication, testing/erection/commissioning and Quality Assurance & Control shall have a minimum of fifteen (15) years of total work experience and a minimum of ten (10) years in similar work.

Date: **Signature & Seal of Bidder:**

Place: **Name:**

Designation:

6.1 Data Sheet-5A: Personnel Candidate Data

Name of Bidder:		
Position		**Candidate** **( ) Prime ( ) Alternative**
Candidate information	**Name of candidate**	**Year of birth**
	Professional qualifications	
Present employment	**Name of employer**	
	Address of employer	
	Telephone	**Contact (manager/personnel officer)**
	Fax	**E-mail**
	Present job title of candidate	**Years with present employer**

Summarize professional experience to meet the specified requirements, in reverse chronological order. Indicate particular technical and managerial experience relevant to the Project.

From: month/yr.	**To: month/yr.**	**Company**	**Project (country)/Position/Relevant technical and management experience**

Date: **Signature & Seal of Bidder:**

Place: **Name:**

Designation:



7 Data Sheet-6: Schedule of Design, Manufacturing, Supply, Erection, Testing & Commissioning Work Program

Name of Bidder :

Submit a construction programme for Design, Manufacturing, Supply, Erection, Testing & Commissioning of various equipment & systems related to KEM-1 works in bar chart form by using a latest project management software Primavera indicating activities starting with date of issuance of Letter of Acceptance and completing within scheduled time as specified in Appendix to Tender.

The Construction Programme shall show various activities and their period including interdependent milestones specified in Appendix to Tender. This program should be based on the civil activities as per attached Construction Schedules of Civil contract packages (KC-1, KC-2 and KC-3).

Date: **Signature & Seal of Bidder:**

Place: **Name:**

Designation:

8 Data Sheet-7: Mobilization Schedule/Contractor's Concept Design

Name of Bidder:

The Bidder shall demonstrate when he proposes to mobilize plant equipment, materials, labour and other resources to deliver the Works in accordance with the requirements of the Specification. The schedule shall be logically linked to the Method statement and the Construction Schedule/ Program and to the Technical Proposals for Personnel and Equipment**.**

Date: **Signature & Seal of Bidder:**

Place: **Name:**

Designation:

9 Data Sheet-8: Quality Assurance Plan and Procedures

Name of Bidder :

Bidders should provide the necessary information on Quality Assurance Plan containing the overall Quality Management System and Procedures to be followed during various phases of execution of the Contract.

Date: **Signature & Seal of Bidder:**

Place: **Name:**

Designation:

10 Data Sheet-9: Equipment Details

Name of Bidder:

The Bidder should provide list of all major equipment for manufacturing and erection and should indicate availability of all Equipment, which he would propose to use for the Contract, in separate sheets in a form as shown below:

List of Proposed Equipment

No.	Name of Equipment	Capacity or production rate	Nos. of unit	Year of manufacture	Current ownership *1	Current location (country)	Estimated purchase price (Nu./Rs. per unit)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

*1: Classify as I for owned or II to be leased and III to be purchased new. The proposed old Equipment should not be older than 50% of scheduled life of Equipment.

Separate Data Sheet-9A and 9B should be prepared for major items of equipment listed in this Data Sheet-3.Separate Data Sheet-9C should be prepared for deployment schedule of all the above Equipment.

NB:

- If Contractor proposes any special methodology of manufacturing and Erection, a note to its effect to be attached and technical details and justification also to be furnished.
- The equipment planning should be commensurate with construction methodology, availability of construction material and overall construction programme.
- Contractor shall plan suitable units of the Equipment as per requirements of the working fronts.

Date: **Signature & Seal of Bidder:**

Place: **Name:**

Designation:

10.1 Data Sheet–9A:Equipment Data

Name of Bidder:		
Name of equipment		
Equipment information	1. Name of manufacturer	2. Model and power rating
	3. Capacity or production rate	4. Year of manufacture
Current status	5. Current location	
	6. Details of current commitments	
Source	7. Indicate source of the equipment ( ) Owned ( ) Leased	( ) To be purchased

Omit the following information for equipment owned or to be purchased by the Bidder.

Present Owner	8. Name of owner	
	9. Address of owner	
	Telephone Fax	Contact name and title
Agreements Details of lease/manufacture agreements specific to the Project:		

Date: **Signature & Seal of Bidder:**

Place: **Name:**

Designation:

10.2 Data Sheet–9B: Fabrication/Manufacturing & Testing Facilities

Name of Bidder:

(i) Fabrication Facilities (Area & Levelled Steel Beds)

(ii) Machining Facility for;

a) Seal Bases on Welded/Assembled Gate Leaf

b) Embedded Parts

(iii) Drilling/Boring Facility for Main Roller End Supports on Assembled Gates

(iv) Facilities for Shop Assembly and Tests

(v) Stress Relieving Facilities

(vi) N.D.T Facilities

(vii) Any other Laboratory Facilities

Date: **Signature & Seal of Bidder:**

Place: **Name:**

Designation:

10.3 Data Sheet-9C: Deployment Schedule for Equipment

Name of Bidder:

DEPLOYMENT SCHEDULE

S. No.	Name of Equipment	Capacity or production rate	Nos. of unit	Year of manufacture	Monthwise Deployment (reckoned from Commencement date)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

NB:

- Tools and plant to be deployed for fabrication, erection/commissioning and material handling shall not be less than those listed above.

Actual deployment at site shall not be limited to above and additional tools and plants, if any required to meet the work schedule shall be mobilized by contractor, without any extra cost to the Employer

Date: **Signature & Seal of Bidder:**

Place: **Name:**

Designation:

11 Data Sheet-10: Schedule of Transportation Weights & Dimensions

Name of Bidder:				
SL. No	**Item/ Description**	**Qty**	**Dimensions (LxBxH) in mm**	**Weight (Tonnes)(Kg)**

Date:

Place:

Signature & Seal of Bidder:

Name:

Designation:

12 Data Sheet-11: Information regarding the Items to be Manufactured/Supplied by Sub-supplier and List of Such Sub-Supplier

The bidder shall indicate here the name of manufacturer/supplier from whom he proposes to purchase the standard items for accomplishment of works

Name of Bidder:			
SL. No	**Items**	**Name of manufacturer/Supplier**	**Place of Manifacturer/Supply**

Date:

Place:

Signature & Seal of Bidder:

Name:

Designation:

13 Data Sheet-12: List of Contracts in Hand and Bids Submitted for similar works,

Name of Bidder:								
SL No	**Project Name**	**Name of Client, full address & Country**	**Nature of equipment installation**	**Detail of equipment and Quantity**	**Date of Award**	**Present Status**	**Expected Completion date**	**Value of the Contract**
1	**2**	**3**	**4(a)**	**4(b)**	**5**	**6**	**7**	**8**
A	**List of completed Contracts**							
i.								
ii.								
B	**List of ongoing contracts**							
i.								
ii.								
C	**List of bids submitted**							
i.								
ii.								

Date: **Signature & Seal of Bidder:**

Place: **Name:**

Designation:



14 Data Sheet-13: Space Requirement for Fabrication Workshop, Storage, Colonies, Offices and Job Facilities

Name of Bidder:				
SL. No.	**Description**	**Space Requirement (Square feet)**	**Expected Time Schedule**	**Remark, if any**
1.	Space for storage for equipment a) Outdoor b) Indoor			
2.	Space for Colonies, Offices			
3.	Fabrication Workshop			
	Total requirement of space			

Date: **Signature & Seal of Bidder:**

Place: **Name:**

Designation:

15 Data Sheet-14: Construction Power Load Requirement

Name of Bidder:

The construction power for the projects at various work fronts like Dam site, ADIT portal, Surge Shaft and Power House etc. shall be arranged and provided by the Employer at 33 kV bus. The Contractor shall make arrangements beyond the facilities provided by the Employer as above for drawing construction power to their various sites, colonies, offices and associated areas of the Contractor within areas of Kholongchhu Hydro Electric Project sites at no cost to Employer.

The bidder shall submit the construction power requirements in kW at each sites in the format given below:

PROFORMA FOR POWER LOAD REQUIREMENT

SL. No.	Location/Purpose	Load requirement (KW)	Expected Time Schedule	Remark
	Total			

The electrical energy consumed by the Contractor shall be measured by a suitable meter installed at the point of supply, which shall be sealed in the presence of the Contractor or his authorized representative and read every month for determining the consumption of electricity, the cost of which shall be paid by the Contractor. Each supply point shall be treated as separate connection.

Arrangements further distribution of power to the Contractor's sites, plant, equipment and machinery, workshop, colonies and offices from the point of supply shall be made by the Contractor at his own cost. The electrical installation plan shall be submitted for approval of the Employer.

Date: **Signature & Seal of Bidder:**

Place: **Name:**

Designation:

16 Data Sheet-15: Confirmation of the Site Visit by the Bidder

Name of Bidder:

We…… ……(Name of Bidder) whose registered office is at…… …… declare herewith that our representatives have visited the site of the works on……day of ……20…. ……., and that we have fully informed ourselves of all conditions, local and otherwise, which may affect the preparation of this bid and the performance of works.

Give names and positions of the representative(s) who took part in the site visit(s):

Name:…….. Signature:……..
Position:…….. Date:……..
Representative of…….
……

Name:…….. Signature:……..
Position:…….. Date:……..
Representative of…….
……

Name:…….. Signature:……..
Position:…….. Date:……..
Representative of…….
……

Date: **Signature & Seal of Bidder:**

Place: **Name:**

Designation:

17 Data Sheet-16: Break Down of Prices

(To be submitted later, if required by the Employer)

Name of Bidder:

Note: *Bidders are not required to complete this Data Sheet at the time of preparation of Bids. Only the Bidders, who are requested by the Employer will submit the analysis of unit rates as per the format below in accordance with the Instructions to Bidders. (Clause 27.1).*

Bidder shall provide the breakdown of such Unit Prices as the Employer may determine, in accordance with the form shown hereunder. This cost breakdown shall include the breakdown of cost, overhead and profit. This form shall become part of the Contract and no claims may be made against the Employer for excess or deficiency therein whether actual or relative to other items.

Item No._____ (in the Schedule)

Work:_____

Unit Price:
Local component : _____

Particular Description (by item):	Unit	Quantity	Foreign Currency Rate	Foreign Currency Amount	Local Currency Rate	Local Currency Amount
1. Material costs						

Subtotal 1			----------		----------	
2. Manpower costs (by grade, except supervisory and managerial staff)						

Subtotal 2			----------		----------	
3. Plant and equipment costs (by type)						

Subtotal 3			----------		----------	
4. Costs of supervisory and managerial staff						

Subtotal 4			----------		----------	
5. Other direct						

Subtotal 5			----------		----------	
6. Indirect costs, if any						

	Subtotal 6	----------	----------
7.	Overhead and profit		

	Subtotal 7	----------	----------
	Total 1+2+3+4+5+6+7	==========	==========

Signature: _____

Title and position: _____

18 Data Sheet-17: Additional/Supplemental Information

Name of Bidder:

Add any further information that the Bidder considers to be relevant to the evaluation. If the Bidder wishes to attach other documents, list them below.

Bidders should not enclose testimonials, certificates, and publicity material with their applications; they will not be taken into account in the evaluation of qualifications and will be discarded.

SL. No.	Description of work	Stipulation in Specification (Clause/Section no. need to be mentioned)	Additional Information

Date: **Signature & Seal of Bidder:**

Place: **Name:**

Designation: