INVITATION TO BID

2018/PROC/UNDP-MMR/PN/007

Supply, delivery, installation, testing, commissioning and training to manager/operator of hydro and electro-mechanical equipments for micro hydropower plant including power transmission/distribution works of

Muizawal Micro Hydropower Project (15 kW)

and

Donlui Micro Hydropower Project (30 kW)

UN-HABITAT

Myanmar

United Nations Development Programme

January, 2018

Section 1. Letter of Invitation

Yangon, Myanmar
February 13, 2018

2018/PROC/UNDP-MMR/PN/007
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Dear Mr./Ms.: *[indicate name]*

The United Nations Development Programme (UNDP) hereby invites you to submit a Bid to this Invitation to Bid (ITB) for the above-referenced subject.

This ITB includes the following documents:

Section 1 – This Letter of Invitation
Section 2 – Instructions to Bidders (including Data Sheet)
Section 3 – Technical Specifications (Electromechanical)
Technical Specifications (Hydromechanical)
Section 4 – Bid Submission Form
Section 5 – Documents Establishing the Eligibility and Qualifications of the Bidder
Section 6 – Technical Bid Form
Section 7 – Price Schedule Form
Section 8 – Form for Bid Security
Section 9 – Form for Performance Security
Section 10 – Form for Advanced Payment Guarantee
Section 11 – Contract to be Signed, including General Terms and Conditions
Section 12 – Bill of Quantities
Section 13 - Drawings

Your offer, comprising of a Technical Bid and Price Schedule, together in a sealed envelope or password protected PDF version for email submission, should be submitted in accordance with Section 2.

United Nations Development Programme
No.6 Natmauk Road, Tamwe Township
P.O. Box 650, Yangon 11211, Myanmar
Programme Support Team Leader

The letter should be received by UNDP no later than 12 March 2018, 5:00 pm (Myanmar). The same letter should advise whether your company intends to submit a Bid. If that is not the case, UNDP would appreciate your indicating the reason, for our records.

If you have received this ITB through a direct invitation by UNDP, transferring this invitation to another firm requires notifying UNDP accordingly.

Should you require any clarification, kindly communicate with the contact person identified in the attached Data Sheet as the focal point for queries on this ITB.

UNDP looks forward to receiving your Bid and thanks you in advance for your interest in UNDP procurement opportunities.

Yours sincerely,

Nasantuya Chuluun, Programme Support Team Leader

Section 2: Instruction to Bidders

Definitions

a) *"Bid"* refers to the Bidder's response to the Invitation to Bid, including the Bid Submission Form, Technical Bid and Price Schedule and all other documentation attached thereto as required by the ITB.

b) *"Bidder"* refers to any legal entity that may submit, or has submitted, a Bid for the supply of goods and provision of related services requested by UNDP.

c) *"Contract"* refers to the legal instrument that will be signed by and between the UNDP and the successful Bidder, all the attached documents thereto, including the General Terms and Conditions (GTC) and the Appendices.

d) "*Country"* refers to the country indicated in the Data Sheet.

e) *"Data Sheet"* refers to such part of the Instructions to Bidders used to reflect conditions of the tendering process that are specific for the requirements of the ITB.

f) *"Day"* refers to calendar day.

g) *"Goods"* refer to any tangible product, commodity, article, material, wares, equipment, assets or merchandise that UNDP requires under this ITB.

h) *"Government"* refers to the Government of the country where the goods and related services provided/rendered specified under the Contract will be delivered or undertaken.

i) *"Instructions to Bidders"* refers to the complete set of documents which provides Bidders with all information needed and procedures to be followed in the course of preparing their Bid

j) *"ITB"* refers to the Invitation to Bid consisting of instructions and references prepared by UNDP for purposes of selecting the best supplier or service provider to fulfil the requirement indicated in the Schedule of Requirements and Technical Specifications.

k) *"LOI"* (Section 1 of the ITB) refers to the Letter of Invitation sent by UNDP to Bidders.

l) *"Material Deviation"* refers to any contents or characteristics of the bid that is significantly different from an essential aspect or requirement of the ITB, and (i) substantially alters the scope and quality of the requirements; (ii) limits the rights of UNDP and/or the obligations of the offeror; and (iii) adversely impacts the fairness and principles of the procurement process, such as those that compromise the competitive position of other offerors.

m) *"Schedule of Requirements and Technical Specifications"* refers to the document included in this ITB as Section 3 which lists the goods required by UNDP, their specifications, the related services,

activities, tasks to be performed, and other information pertinent to UNDP's receipt and acceptance of the goods.

n) *"Services"* refers to the entire scope of tasks related or ancillary to the completion or delivery of the goods required by UNDP under the ITB.

o) "*Supplemental Information to the ITB"* refers to a written communication issued by UNDP to prospective Bidders containing clarifications, responses to queries received from prospective Bidders, or changes to be made in the ITB, at any time after the release of the ITB but before the deadline for the submission of Bid.

A. GENERAL

1. UNDP hereby solicits Bids as a response to this Invitation to Bid (ITB). Bidders must strictly adhere to all the requirements of this ITB. No changes, substitutions or other alterations to the rules and provisions stipulated in this ITB may be made or assumed unless it is instructed or approved in writing by UNDP in the form of Supplemental Information to the ITB.

2. Submission of a Bid shall be deemed as an acknowledgement by the Bidder that all obligations stipulated by this ITB will be met and, unless specified otherwise, the Bidder has read, understood and agreed to all the instructions in this ITB.

3. Any Bid submitted will be regarded as an offer by the Bidder and does not constitute or imply the acceptance of any Bid by UNDP. UNDP is under no obligation to award a contract to any Bidder as a result of this ITB.

4. UNDP implements a policy of zero tolerance on proscribed practices, including fraud, corruption, collusion, unethical practices, and obstruction. UNDP is committed to preventing, identifying and addressing all acts of fraud and corrupt practices against UNDP as well as third parties involved in UNDP activities. (See http://www.undp.org/about/transparencydocs/UNDP_Anti_Fraud_Policy_English_FINAL_june_2011.pdf and http://www.undp.org/content/undp/en/home/operations/procurement/procurement_protest/ for full description of the policies)

5. In responding to this ITB, UNDP requires all Bidders to conduct themselves in a professional, objective and impartial manner, and they must at all times hold UNDP's interests paramount. Bidders must strictly avoid conflicts with other assignments or their own interests, and act without consideration for future work. All Bidders found to have a conflict of interest shall be disqualified. Without limitation on the generality of the above, Bidders, and any of their affiliates, shall be considered to have a conflict of interest with one or more parties in this solicitation process, if they:

   5.1 Are, or have been associated in the past, with a firm or any of its affiliates which have been engaged UNDP to provide services for the preparation of the design, Schedule of Requirements and Technical Specifications, cost analysis/estimation, and other documents to be used for the procurement of the goods and related services in this selection process;

5.2 Were involved in the preparation and/or design of the programme/project related to the goods and related services requested under this ITB; or
5.3 Are found to be in conflict for any other reason, as may be established by, or at the discretion of, UNDP.

In the event of any uncertainty in the interpretation of what is potentially a conflict of interest, Bidders must disclose the condition to UNDP and seek UNDP's confirmation on whether or not such conflict exists.

6. Similarly, the following must be disclosed in the Bid:

6.1 Bidders who are owners, part-owners, officers, directors, controlling shareholders, or key personnel who are family of UNDP staff involved in the procurement functions and/or the Government of the country or any Implementing Partner receiving the goods and related services under this ITB; and
6.4 Others that could potentially lead to actual or perceived conflict of interest, collusion or unfair competition practices.

Failure of such disclosure may result in the rejection of the Bid.

7. The eligibility of Bidders that are wholly or partly owned by the Government shall be subject to UNDP's further evaluation and review of various factors such as being registered as an independent entity, the extent of Government ownership/share, receipt of subsidies, mandate, access to information in relation to this ITB, and others that may lead to undue advantage against other Bidders, and the eventual rejection of the Bid.

8. All Bidders must adhere to the UNDP Supplier Code of Conduct, which may be found at this link: http://web.ng.undp.org/procurement/undp-supplier-code-of-conduct.pdf

B. CONTENTS OF BID

9. Sections of Bid

Bidders are required to complete, sign and submit the following documents:

9.1 Bid Submission Cover Letter Form (see ITB Section 4);
9.2 Documents Establishing the Eligibility and Qualifications of the Bidder (see ITB Section 5);
9.3 Technical Bid (see prescribed form in ITB Section 6);
9.4 Price Schedule (see prescribed form in ITB Section 7);
9.5 Bid Security, if applicable (if required and as stated in the DS nos. 9-11, see prescribed Form in ITB Section 8);
9.6 Any attachments and/or appendices to the Bid (including all those specified under the **Data Sheet**)

10. Clarification of Bid

10.1 Bidders may request clarification of any of the ITB documents no later than the number of days indicated in the **Data Sheet** (DS no. 16) prior to the Bid submission date. Any request for clarification must be sent in writing via courier or through electronic means to the UNDP address indicated in the **Data Sheet** (DS no. 17). UNDP will respond in writing, transmitted by electronic means and will transmit copies of the response (including an explanation of the query but without identifying the source of inquiry) to all Bidders who have provided confirmation of their intention to submit a Bid.

10.2 UNDP shall endeavor to provide such responses to clarifications in an expeditious manner, but any delay in such response shall not cause an obligation on the part of UNDP to extend the submission date of the Bid, unless UNDP deems that such an extension is justified and necessary.

11. Amendment of Bid

11.1 At any time prior to the deadline for submission of Bid, UNDP may for any reason, such as in response to a clarification requested by a Bidder, modify the ITB in the form of a Supplemental Information to the ITB. All prospective Bidders will be notified in writing of all changes/amendments and additional instructions through Supplemental Information to the ITB and through the method specified in the **Data Sheet** (DS No. 18).

11.2 In order to afford prospective Bidders reasonable time to consider the amendments in preparing their Bid, UNDP may, at its discretion, extend the deadline for submission of Bid, if the nature of the amendment to the ITB justifies such an extension.

C. PREPARATION OF BID

12. Cost

The Bidder shall bear any and all costs related to the preparation and/or submission of the Bid, regardless of whether its Bid was selected or not. UNDP shall in no case be responsible or liable for those costs, regardless of the conduct or outcome of the procurement process.

13. Language

The Bid, as well as any and all related correspondence exchanged by the Bidder and UNDP, shall be written in the language (s) specified in the **Data Sheet** (DS No. 4). Any printed literature furnished by the Bidder written in a language other than the language indicated in the **Data Sheet**, must be accompanied by a translation in the preferred language indicated in the **Data Sheet**. For purposes of interpretation of the Bid, and in the event of discrepancy or inconsistency in meaning, the version translated into the preferred language shall govern. Upon conclusion of a contract, the language of the contract shall govern the relationship between the contractor and UNDP.

14. Bid Submission Form

The Bidder shall submit the Bid Submission Form using the form provided in Section 4 of this ITB.

15. Technical Bid Format and Content

Unless otherwise stated in the **Data Sheet** (DS no. 28), the Bidder shall structure the Technical Bid as follows:

15.1 Expertise of Firm/Organization – this section should provide details regarding management structure of the organization, organizational capability/resources, and experience of organization/firm, the list of projects/contracts (both completed and on-going, both domestic and international) which are related or similar in nature to the requirements of the ITB, manufacturing capacity of plant if Bidder is a manufacturer, authorization from the manufacturer of the goods if Bidder is not a manufacturer, and proof of financial stability and adequacy of resources to complete the delivery of goods and provision of related services required by the ITB (see ITB Clause 18 and DS No. 26 for further details). The same shall apply to any other entity participating in the ITB as a Joint Venture or Consortium.

15.2 Technical Specifications and Implementation Plan – this section should demonstrate the Bidder's response to the Schedule of Requirements and Technical Specifications by identifying the specific components proposed; how each of the requirements shall be met point by point; providing a detailed specification and description of the goods required, plans and drawings where needed; the essential performance characteristics, identifying the works/portions of the work that will be subcontracted; a list of the major subcontractors, and demonstrating how the bid meets or exceeds the requirements, while ensuring appropriateness of the bid to the local conditions and the rest of the project operating environment during the entire life of the goods provided. Details of technical bid must be laid out and supported by an Implementation Timetable, including Transportation and Delivery Schedule where needed, that is within the duration of the contract as specified in the **Data Sheet** (DS noS. 29 and 30).

Bidders must be fully aware that the goods and related services that UNDP require may be transferred, immediately or eventually, by UNDP to the Government partners, or to an entity nominated by the latter, in accordance with UNDP's policies and procedures. All bidders are therefore required to submit the following in their bids:

a) A statement of whether any import or export licences are required in respect of the goods to be purchased or services to be rendered, including any restrictions in the country of origin, use or dual use nature of the goods or services, including any disposition to end users;
b) Confirmation that the Bidder has obtained license of this nature in the past, and have an expectation of obtaining all the necessary licenses, should their bid be rendered the most responsive; and
c) Complete documentation, information and declaration of any goods classified or may be classified as "Dangerous Goods".

15.3 Management Structure and Key Personnel – This section should include the comprehensive curriculum vitae (CVs) of key personnel that will be assigned to support the implementation of the technical bid, clearly defining their roles and responsibilities. CVs should establish competence and demonstrate qualifications in areas relevant to the requirements of this ITB.

In complying with this section, the Bidder assures and confirms to UNDP that the personnel being nominated are available to fulfil the demands of the Contract during its stated full term. If any of the key personnel later becomes unavailable, except for unavoidable reasons such as death or medical incapacity, among other possibilities, UNDP reserves the right to render the Bid non-responsive. Any deliberate substitution of personnel arising from unavoidable reasons, including delay in the implementation of the project of programme through no fault of the Bidder, shall be made only with UNDP's acceptance of the justification for substitution, and UNDP's approval of the qualification of the replacement who shall be either of equal or superior credentials as the one being replaced.

15.4 Where the **Data Sheet** requires the submission of the Bid Security, the Bid Security shall be included along with the Technical Bid. The Bid Security may be forfeited by UNDP, and reject the Bid, in the event of any or any combination of the following conditions:

a) If the Bidder withdraws its offer during the period of the Bid Validity specified in the **Data Sheet** (DS no. 11), or;
b) If the Bid Security amount is found to be less than what is required by UNDP as indicated in the **Data Sheet** (DS no. 9), or;
c) In the case the successful Bidder fails:

i. to sign the Contract after UNDP has awarded it;
ii. to comply with UNDP's variation of requirement, as per ITB Clause 35; or
iii. to furnish Performance Security, insurances, or other documents that UNDP may require as a condition to rendering effective the contract that may be awarded to the Bidder.

16. Price Schedule

The Price Schedule shall be prepared using the attached standard form (Section 7). It shall list all major cost components associated with the goods and related services, and the detailed breakdown of such costs. All goods and services described in the Technical Bid must be priced separately on a one-to-one correspondence. Any output and activities described in the Technical Bid but not priced in the Price Schedule, shall be assumed to be included in the prices of the items or activities, as well as in the final total price of the bid.

17. Currencies

All prices shall be quoted in the currency indicated in the **Data Sheet** (DS no. 15). However, where Bids are quoted in different currencies, for the purposes of comparison of all Bid:

17.1 UNDP will convert the currency quoted in the Bid into the UNDP preferred currency, in accordance with the prevailing UN operational rate of exchange on the last day of submission of Bid; and

17.2 In the event that the Bid found to be the most responsive to the ITB requirement is quoted in another currency different from the preferred currency as per **Data Sheet** (DS no. 15), then UNDP shall reserve the right to award the contract in the currency of UNDP's preference, using the conversion method specified above.

18. Documents Establishing the Eligibility and Qualifications of the Bidder

18.1 The Bidder shall furnish documentary evidence of its status as an eligible and qualified vendor, using the forms provided under Section 5, Bidder Information Forms. In order to award a contract to a Bidder, its qualifications must be documented to UNDP's satisfactions. These include, but are not limited to the following:

a) That, in the case of a Bidder offering to supply goods under the Contract which the Bidder did not manufacture or otherwise produce, the Bidder has been duly authorized by the goods' manufacturer or producer to supply the goods in the country of final destination;
b) That the Bidder has the financial, technical, and production capability necessary to perform the Contract; and
c) That, to the best of the Bidder's knowledge, it is not included in the UN 1267 List or the UN Ineligibility List, nor in any and all of UNDP's list of suspended and removed vendors.

18.2 Bids submitted by two (2) or more Bidders shall all be rejected by UNDP if they are found to have <u>any</u> of the following:

a) they have at least one controlling partner, director or shareholder in common; or
b) any one of them receive or have received any direct or indirect subsidy from the other/s; or
c) they have the same legal representative for purposes of this ITB; or
d) they have a relationship with each other, directly or through common third parties, that puts them in a position to have access to information about, or influence on the Bid of, another Bidder regarding this ITB process;
e) they are subcontractors to each other's bid, or a subcontractor to one bid also submits another Bid under its name as lead Bidder; or
f) an expert proposed to be in the bid of one Bidder participates in more than one Bid received for this ITB process. This condition does not apply to subcontractors being included in more than one Bid.

19. Joint Venture, Consortium or Association

If the Bidder is a group of legal entities that will form or have formed a joint venture, consortium or association at the time of the submission of the Bid, they shall confirm in their Bid that : (i) they have designated one party to act as a lead entity, duly vested with authority to legally bind the members of the joint venture jointly and severally, and this shall be duly evidenced by a duly notarized Agreement among the legal entities, which shall be submitted along with the Bid; and

(ii) if they are awarded the contract, the contract shall be entered into, by and between UNDP and the designated lead entity, who shall be acting for and on behalf of all entities that comprise the joint venture.

After the bid has been submitted to UNDP, the lead entity identified to represent the joint venture shall not be altered without the prior written consent of UNDP. Furthermore, neither the lead entity nor the member entities of the joint venture can:

a) Submit another Bid, either in its own capacity; nor
b) As a lead entity or a member entity for another joint venture submitting another Bid.

The description of the organization of the joint venture/consortium/association must clearly define the expected role of each of the entity in the joint venture in delivering the requirements of the ITB, both in the bid and in the Joint Venture Agreement. All entities that comprise the joint venture shall be subject to the eligibility and qualification assessment by UNDP.

Where a joint venture is presenting its track record and experience in a similar undertaking as those required in the ITB, it should present such information in the following manner:

a) Those that were undertaken together by the joint venture; and
b) Those that were undertaken by the individual entities of the joint venture expected to be involved in the performance of the services defined in the ITB.

Previous contracts completed by individual experts working privately but who are permanently or were temporarily associated with any of the member firms cannot be claimed as the experience of the joint venture or those of its members, but should only be claimed by the individual experts themselves in their presentation of their individual credentials.

If the Bid of a joint venture is determined by UNDP as the most responsive Bid that offers the best value for money, UNDP shall award the contract to the joint venture, in the name of its designated lead entity, who shall sign the contract for and on behalf of all the member entities.

20. Alternative Bid

Unless otherwise specified in the **Data Sheet** (DS nos. 5 and 6), alternative bid shall not be considered. Where the conditions for its acceptance are met, or justifications are clearly established, UNDP reserves the right to award a contract based on an alternative bid.

21. Validity Period

21.1 Bid shall remain valid for the period specified in the **Data Sheet** (DS no. 8), commencing on the submission deadline date also indicated in the **Data Sheet** (DS no. 21). A Bid valid for a shorter period shall be immediately rejected by UNDP and rendered non-responsive.

21.2 In exceptional circumstances, prior to the expiration of the Bid validity period, UNDP may request Bidders to extend the period of validity of their Bid. The request and the responses shall be made in writing, and shall be considered integral to the Bid.

22. Bidder's Conference

When appropriate, a Bidder's conference will be conducted at the date, time and location specified in the **Data Sheet** (DS no. 7). All Bidders are encouraged to attend. Non-attendance, however, shall not result in disqualification of an interested Bidder. Minutes of the Bidder's conference will be either posted on the UNDP website, or disseminated to the individual firms who have registered or expressed interest with the contract, whether or not they attended the conference. No verbal statement made during the conference shall modify the terms and conditions of the ITB unless such statement is specifically written in the Minutes of the Conference, or issued/posted as an amendment in the form of a Supplemental Information to the ITB.

D. SUBMISSION AND OPENING OF BID

23. Submission

23.1 The Technical Bid and the Price Schedule **must** be submitted together and sealed together in one and the same envelope, delivered either personally, by courier, or by electronic method of transmission. If submission will not be done by electronic means, the Technical Bid and Price Schedule must be sealed together in an envelope whose external side must :

a) Bear the name of the Bidder;
b) Be addressed to UNDP as specified in the **Data Sheet** (DS no.20); and
c) Bear a warning not to open before the time and date for Bid opening as specified in the **Data Sheet** (DS no. 24)**.**

If the envelope is not sealed nor labeled as required, the Bidder shall assume the responsibility for the misplacement or premature opening of Bid due to improper sealing and labeling by the Bidder.

23.2 Bidders must submit their Bid in the manner specified in the **Data Sheet** (DS nos. 22 and 23). When the Bid is expected to be in transit for more than 24 hours, the Bidder must ensure that sufficient lead time has been provided in order to comply with UNDP's deadline for submission. UNDP shall indicate for its record that the official date and time of receiving the Bid is the actual date and time when the said Bid has physically arrived at the UNDP premises indicated in the **Data Sheet** (DS no. 20).

23.3 Bidders submitting Bid by mail or by hand shall enclose the original and each copy of the Bid, in separate sealed envelopes, duly marking each of the envelopes as "Original Bid" and the others as "Copy of Bid". The two envelopes, consisting of original and copies, shall then be sealed in an outer envelope. The number of copies required shall be as specified in the **Data Sheet** (DS no. 19)**.** In the event of any discrepancy between the contents of the "Original Bid" and the "Copy of Bid", the contents of the original shall govern. The original version of the Bid shall be signed or initialed by the Bidder or person(s) duly authorized to commit the Bidder on every page. The authorization shall be communicated through a

document evidencing such authorization issued by the highest official of the firm, or a Power of Attorney, accompanying the Bid.

23.4 Bidders must be aware that the mere act of submission of a Bid, in and of itself, implies that the Bidder accepts the General Contract Terms and Conditions of UNDP as attached hereto as Section 11.

24. Deadline for Submission of Bid and Late Bids

Bid must be received by UNDP at the address and no later than the date and time specified in the **Data Sheet** (DS no. 20 and 21).

UNDP shall not consider any Bid that arrives after the deadline for submission of Bid. Any Bid received by UNDP after the deadline for submission of Bid shall be declared late, rejected, and returned unopened to the Bidder.

25. Withdrawal, Substitution, and Modification of Bid

25.1 Bidders are expected to have sole responsibility for taking steps to carefully examine in detail the full consistency of its Bid to the requirements of the ITB, keeping in mind that material deficiencies in providing information requested by UNDP, or lack clarity in the description of goods and related services to be provided, may result in the rejection of the Bid. The Bidder shall assume any responsibility regarding erroneous interpretations or conclusions made by the Bidder in the course of understanding the ITB out of the set of information furnished by UNDP.

25.2 A Bidder may withdraw, substitute or modify its Bid after it has been submitted by sending a written notice in accordance with ITB Clause 23, duly signed by an authorized representative, and shall include a copy of the authorization (or a Power of Attorney). The corresponding substitution or modification of the Bid must accompany the respective written notice. All notices must be received by UNDP prior to the deadline for submission and submitted in accordance with ITB Clause 23 (except that withdrawal notices do not require copies). The respective envelopes shall be clearly marked "WITHDRAWAL," "SUBSTITUTION," or MODIFICATION".

25.3 Bid requested to be withdrawn shall be returned unopened to the Bidders.

25.4 No Bid may be withdrawn, substituted, or modified in the interval between the deadline for submission of Bid and the expiration of the period of Bid validity specified by the Bidder on the Bid Submission Form or any extension thereof.

26. Bid Opening

UNDP will open the Bid in the presence of an ad-hoc committee formed by UNDP of at least two (2) members. If electronic submission is permitted, any specific electronic Bid opening procedures shall be as specified in the **Data Sheet** (DS no. 23).

The Bidders' names, modifications, withdrawals, the condition of the envelope labels/seals, the number of folders/files and all other such other details as UNDP may consider appropriate, will be announced at the opening. No Bid shall be rejected at the opening stage, except for late submission, for which the Bid shall be returned unopened to the Bidder.

27. Confidentiality

Information relating to the examination, evaluation, and comparison of Bid, and the recommendation of contract award, shall not be disclosed to Bidders or any other persons not officially concerned with such process, even after publication of the contract award.

Any effort by a Bidder to influence UNDP in the examination, evaluation and comparison of the Bid or contract award decisions may, at UNDP's decision, result in the rejection of its Bid.

In the event that a Bidder is unsuccessful, the Bidder may seek a meeting with UNDP for a debriefing. The purpose of the debriefing is discussing the strengths and weaknesses of the Bidder's submission, in order to assist the Bidder in improving the bid presented to UNDP. The content of other bid and how they compare to the Bidder's submission shall not be discussed.

E. EVALUATION OF BID

28. Preliminary Examination of Bid

UNDP shall examine the Bid to determine whether they are complete with respect to minimum documentary requirements, whether the documents have been properly signed, whether or not the Bidder is in the UN Security Council 1267/1989 Committee's list of terrorists and terrorist financiers, and in UNDP's list of suspended and removed vendors, and whether the Bid are generally in order, among other indicators that may be used at this stage. UNDP may reject any Bid at this stage.

29. Evaluation of Bid

29.1 UNDP shall examine the Bid to confirm that all terms and conditions under the UNDP General Terms and Conditions and Special Conditions have been accepted by the Bidder without any deviation or reservation.

29.2 The evaluation team shall review and evaluate the Bids on the basis of their responsiveness to the Schedule of Requirements and Technical Specifications and other documentation provided, applying the procedure indicated in the **Data Sheet** (DS No. 25). Absolutely no changes may be made by UNDP in the criteria after all Bids have been received.

29.1 UNDP reserves the right to undertake a post-qualification exercise, aimed at determining, to its satisfaction the validity of the information provided by the Bidder. Such post-qualification

shall be fully documented and, among those that may be listed in the **Data Sheet** (DS No.33), may include, but need not be limited to, all or any combination of the following :

a) Verification of accuracy, correctness and authenticity of the information provided by the bidder on the legal, technical and financial documents submitted;
b) Validation of extent of compliance to the ITB requirements and evaluation criteria based on what has so far been found by the evaluation team;
c) Inquiry and reference checking with Government entities with jurisdiction on the bidder, or any other entity that may have done business with the bidder;
d) Inquiry and reference checking with other previous clients on the quality of performance on on-going or previous contracts completed;
e) Physical inspection of the bidder's plant, factory, branches or other places where business transpires, with or without notice to the bidder;
f) Testing and sampling of completed goods similar to the requirements of UNDP, where available; and
g) Other means that UNDP may deem appropriate, at any stage within the selection process, prior to awarding the contract.

30. Clarification of Bid

To assist in the examination, evaluation and comparison of bids, UNDP may, at its discretion, ask any Bidder to clarify its Bid.

UNDP's request for clarification and the Bidder's response shall be in writing. Notwithstanding the written communication, no change in the prices or substance of the Bid shall be sought, offered, or permitted, except to provide clarification, and confirm the correction of any arithmetic errors discovered by UNDP in the evaluation of the Bid, in accordance with ITB Clause 35.

Any unsolicited clarification submitted by a Bidder in respect to its Bid, which is not a response to a request by UNDP, shall not be considered during the review and evaluation of the Bid.

31. Responsiveness of Bid

UNDP's determination of a Bid's responsiveness will be based on the contents of the Bid itself.

A substantially responsive Bid is one that conforms to all the terms, conditions, and specifications of the ITB without material deviation, reservation, or omission.

If a Bid is not substantially responsive, it shall be rejected by UNDP and may not subsequently be made responsive by the Bidder by correction of the material deviation, reservation, or omission.

32. Nonconformities, Reparable Errors and Omissions

32.3 Provided that a Bid is substantially responsive, UNDP may waive any non-conformities or omissions in the Bid that, in the opinion of UNDP, do not constitute a material deviation.

32.4 Provided that a Bid is substantially responsive, UNDP may request the Bidder to submit the necessary information or documentation, within a reasonable period of time, to rectify nonmaterial nonconformities or omissions in the Bid related to documentation requirements. Such omission shall not be related to any aspect of the price of the Bid. Failure of the Bidder to comply with the request may result in the rejection of its Bid.

32.5 Provided that the Bid is substantially responsive, UNDP shall correct arithmetical errors as follows:

a) if there is a discrepancy between the unit price and the line item total that is obtained by multiplying the unit price by the quantity, the unit price shall prevail and the line item total shall be corrected, unless in the opinion of UNDP there is an obvious misplacement of the decimal point in the unit price, in which case the line item total as quoted shall govern and the unit price shall be corrected;
b) if there is an error in a total corresponding to the addition or subtraction of subtotals, the subtotals shall prevail and the total shall be corrected; and
c) if there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail subject to the above.

32.6 If the Bidder does not accept the correction of errors made by UNDP, its Bid shall be rejected.

F. AWARD OF CONTRACT

33. Right to Accept, Reject, or Render Non-Responsive Any or All Bid

33.1 UNDP reserves the right to accept or reject any Bid, to render any or all of the Bids as non-responsive, and to reject all Bids at any time prior to award of contract, without incurring any liability, or obligation to inform the affected Bidder(s) of the grounds for UNDP's action. Furthermore, UNDP is not obligated to award the contract to the lowest price offer.

33.2 UNDP shall also verify, and immediately reject their respective Bid, if the Bidders are found to appear in the UN's Consolidated List of Individuals and Entities with Association to Terrorist Organizations, in the List of Vendors Suspended or Removed from the UN Secretariat Procurement Division Vendor Roster, the UN Ineligibility List, and other such lists that as may be established or recognized by UNDP policy on Vendor Sanctions. (See http://www.undp.org/content/undp/en/home/operations/procurement/procurement_protest/

34. Award Criteria

Prior to expiration of the period of Bid validity, UNDP shall award the contract to the qualified and eligible Bidder that is found to be responsive to the requirements of the Schedule of Requirements and Technical Specification, and has offered the lowest price (See DS No. 32).

35. Right to Vary Requirements at the Time of Award

At the time of award of Contract, UNDP reserves the right to vary the quantity of the goods and/or related services, by up to a maximum twenty five per cent (25%) of the total offer, without any change in the unit price or other terms and conditions.

36. Contract Signature

Within fifteen (15) days from the date of receipt of the Contract, the successful Bidder shall sign and date the Contract and return it to UNDP.

Failure of the successful Bidder to comply with the requirement of ITB Section F.3 and this provision shall constitute sufficient grounds for the annulment of the award, and forfeiture of the Bid Security if any, and on which event, UNDP may award the Contract to the Bidder with the second highest rated Bid, or call for new Bid.

37. Performance Security

A performance security, if required, shall be provided in the amount and form provided in Section 9 and by the deadline indicated in the **Data Sheet** (DS no. 14), as applicable. Where a Performance Security will be required, the submission of the said document, and the confirmation of its acceptance by UNDP, shall be a condition for the effectivity of the Contract that will be signed by and between the successful Bidder and UNDP.

38. Bank Guarantee for Advanced Payment

Except when the interests of UNDP so require, it is the UNDP's preference to make no advanced payment(s) on contracts (i.e., payments without having received any outputs). In the event that the Bidder requires an advanced payment upon contract signature, and if such request is duly accepted by UNDP, and the said advanced payment exceeds 20% of the total Bid price, or exceed the amount of USD 30,000, UNDP shall require the Bidder to submit a Bank Guarantee in the same amount as the advanced payment. A bank guarantee for advanced payment shall be furnished in the form provided in Section 10.

39. Vendor Protest

UNDP's vendor protest procedure provides an opportunity for appeal to those persons or firms not awarded a purchase order or contract through a competitive procurement process. In the event that a Bidder believes that it was not treated fairly, the following link provides further details regarding UNDP vendor protest procedures: http://www.undp.org/procurement/protest.shtml

Instructions to Bidders

DATA SHEET

The following data for the supply of goods and related services shall complement / supplement the provisions in the Instruction to Bidders. In the case of a conflict between the Instruction to Bidders and the Data Sheet, the provisions in the Data Sheet shall prevail**.**

DS No.	Cross Ref. to Instructions	Data	Specific Instructions / Requirements
1		Project Title:	Muizawal Micro Hydropower Project (15 kW) and Donlui Micro Hydropower Project (30 kW)
2		Title of Goods/Services/Work Required:	Supply, delivery, installation, testing, commissioning and training to manager/operator of hydro and electro-mechanical equipment for micro hydropower plant including power transmission/distribution works
3		Country:	Myanmar
4	C.13	Language of the Bid:	☒ English
5	C.20	Conditions for Submitting Bid for Parts or sub-parts of the Total Requirements	☒ Allowed for the following option: Lot 1. Muizawal Micro Hydropower Project (15 kW) Lot 2. Donlui Micro Hydropower Project (30 kW)
6	C.20	Conditions for Submitting Alternative Bid	☒ Shall not be considered
7	C.22	A pre-Bid conference will be held on:	Time: 11.00 A.M. Date: 28 February 2017 Venue: 6, Natmauk Road, Tamwe Township The UNDP focal point for the arrangement is: Min Min Thein E-mail: procurement.mm@undp.org

8	C.21.1	Period of Bid Validity commencing on the submission date	☒ 120 days
9	B.9.5 C.15.4 b)	Bid Security	☒ Required Amount of Bid Security shall be USD 2,000.
10	B.9.5	Acceptable forms of Bid Security	The form attached to this ITB or a certified cheque.
11	B.9.5 C.15.4 a)	Validity of Bid Security	Bid Security validity period shall be not less than 120 days from the date of submission of bid
12		Advanced Payment upon signing of contract	☒ Allowed Tha advance payment amount shall be not more than 20% of the contract value 10% of the billed amount from each payment shall be deducted to recover the advance payment A Bank Guarantee in the amount of the advanced payment shall be required.
13		Liquidated Damages	☒ Will be imposed under the following conditions: Percentage of contract price per day of delay: 0.1% Max. no. of days of delay: 30 Days Next course of action: Contract Cancellation
14	F.37	Performance Security	☒ Required 5% of the contract value
15	C.17 C.17.2	Preferred Currency of Bid and Method for Currency conversion	☒ United States Dollars (US$) ☐ Euro ☐ Local Currency *Reference date for determining UN Operational Exchange Rate: Framework Agreement issue date*
16	B.10.1	Deadline for submitting requests for clarifications/ questions	10 days before the submission date.

17	B.10.1	Contact Details for submitting clarifications/questions[1]	Focal Person in UNDP: Min Min Thein Address: No.6 Natmauk Road, Tamwe Township P.O. Box 650, Yangon 11211, Myanmar E-mail address dedicated for this purpose: procurement.mm@undp.org
18	B.11.1	Manner of Disseminating Supplemental Information to the ITB and responses/clarifications to queries	☒ Direct communication to prospective Bidders by email ☒ Direct communication to prospective Bidders by email or fax, and Posting on the website http://procurement-notices.undp.org/
19	D.23.3	No. of copies of Bid that must be submitted if the bids shall be submitted by courier or hand delivery	Original: 1 Copies: 2
20	D.23.1 b) D.23.2 D.24	Bid submission address	No.6 Natmauk Road, Tamwe Township P.O. Box 650, Yangon 11211, Myanmar.
21	C.21.1 D.24	Deadline of Bid Submission	Date and Time: March 12, 2018 5:00 PM
22	D.23.2	Manner of Submitting Bid	☒ Courier/Hand Delivery ☒ Electronic submission of Bid[2]
23	D.23.2 D.26	Conditions and Procedures for electronic submission and opening, if allowed	☒ Official Address for e-submission: *bids.mm@undp.org* ☒ Format : PDF files only, password protected ☒ Password must not be provided to UNDP until the date and time of Bid Opening as indicated in No. 24 ☒ Max. File Size per transmission: 8 MB ☒ Max. No. of transmission: 5 ☒ Mandatory subject of email: Micro Hydropower Projects (15 kW) and (30 kW) ☒ Virus Scanning Software to be Used prior to transmission. ☒ Time Zone to be Recognized: *Myanmar* ☐ Other conditions: *[pls. specify]*

[1] This contact person and address is officially designated by UNDP. If inquiries are sent to other person/s or address/es, even if they are UNDP staff, UNDP shall have no obligation to respond nor can UNDP confirm that the query was officially received.

[2] If this will be allowed, security features (e.g., encryption, authentication, digital signatures, etc.) are strictly required and must be enforced to ensure confidentiality and integrity of contents.

24	D.23.1 c)	Date, time and venue for opening of Bid	Date and Time: March 13, 2018 10:00 AM Venue : UNDP Office, Myanmar
25		Evaluation method to be used in selecting the most responsive Bid	☒ Non-Discretionary "Pass/Fail" Criteria on the Technical Requirements; and ☒ Lowest price offer of technically qualified/responsive Bid
26	C.15.1	Required Documents that must be Submitted to Establish Qualification of Bidders (In "Certified True Copy" form only)	☒ Company Profile, which should not exceed fifteen (15) pages, including printed brochures and product catalogues relevant to the goods/services being ☒ Tax Registration/Payment Certificate issued by the Internal Revenue Authority evidencing that the Bidder is updated with its tax payment obligations, or Certificate of Tax exemption, if any such privilege is enjoyed by the Bidder ☒ Certificate of Registration of the business, including Articles of Incorporation, or equivalent document if Bidder is not a corporation ☒ Trade name registration papers, if applicable ☒ Local Government permit to locate and operate in the current location of office or factory ☒ Official Letter of Appointment as local representative, if Bidder is submitting a Bid in behalf of an entity located outside the country ☒ Quality Certificate (e.g., ISO, etc.) and/or other similar certificates, accreditations, awards and citations received by the Bidder, if any ☒ Plan and details of manufacturing capacity, if Bidder is a manufacturer of the goods to be supplied ☒ Certification or authorization to act as Agent in behalf of the Manufacturer, or Power of Attorney, if bidder is not a manufacturer ☒ Latest Audited Financial Statement (Income Statement and Balance Sheet) including Auditor's Report for the past *[3 years]* ☒ Statement of Satisfactory Performance from the Top *3* Clients in terms of Contract Value the past *[5 years]* ☒ List of Bank References (Name of Bank, Location, Contact Person and Contact Details) ☐ All information regarding any past and current litigation during the last five (5) years, in which the bidder is involved, indicating the parties concerned,

			the subject of the litigation, the amounts involved, and the final resolution if already concluded.
27		Other documents that may be Submitted to Establish Eligibility	☒ Not Required
28	C.15	Structure of the Technical Bid and List of Documents to be Submitted	*Same as section 26*
29	C.15.2	Latest Expected date for commencement of Contract	*April 15, 2018*
30	C.15.2	Maximum Expected duration of contract	45 days (1.5 Months)
31		UNDP will award the contract to:	☒ One or more Bidders, depending on lowest price per LOT of technically qualified/responsive offer.
32	F.34	Criteria for the Award and Evaluation of Bid	**Award Criteria** ☒ Non-discretionary "Pass" or "Fail" rating on the detailed contents of the Schedule of Requirements and Technical Specifications ☒ Compliance on the following qualification requirements: **Bid Evaluation** **Qualification and credential Criteria** ☒ Experience in similar small hydro turbine installation (manufacture or supply of turbines, A.C Generator, Power transformers, control etc) and grid connected projects completed for 100 KW capacity and more during last 15 years. Bidders to provide details of type of work, name and address of client, value of job and duration including photocopies of contracts and completion certificate. ☒ Successfully completed supply & installation projects of 100 KW aggregate capacity with in last 15 years and at least two projects of minimum capacity of 15 KW. **Please provide the following information for each of the Lots separately:** ☒ Mechanical work experience of fabrication and/ or installation of at least 2 penstocks of min dia 20 cm and 300 m long. (Provide detail of project and its location.)

			Qualification and relevant experience of engineering and technical team to be engaged in the project Under Each Lot ☒ One Electrical Engineer having >5 years of experience engaging for electromechanical project Supervisor -2) (Full CVs signed by the candidates) ☒ One Hydro power engineer and One Supervisor having >5 years of experience engaging for Hydro mechanical project (Full CVs signed by) **Please provide the workplan/ timeline under each Lot separately:** ☒ Methodology & workplan with milestones & timeline for the implementation of project (Supply, delivery, installation, testing & training with a time frame of one month after award of the contract) **(**Detail workplan)
33	E.29	Post qualification Actions	☒ Verification of accuracy, correctness and authenticity of the information provided by the bidder on the legal, technical and financial documents submitted; ☒ Validation of extent of compliance to the ITB requirements and evaluation criteria based on what has so far been found by the evaluation team; ☒ Testing and sampling of completed goods similar to the requirements of UNDP, where available; and ☐ Others *[click here to specify]*
34		Conditions for Determining Contract Effectivity	☒ Others *Meet expected delivery lead time requirements*
35		Other Information Related to the ITB	Bidders are requested to provide full and complete information as requested in the ITB.

Section 3a: TECHNICAL SPECIFICATIONS (ELECTROMECHANICAL)

1. Salient Features of The Project

1 Project Location		**LOT 1**
Country	:	Republic of the Union of Myanmar
State	:	Chin
Township	:	Tedim
Village	:	Muizawl
Nearest Town	:	Tedim / Kalemyo
Geographical Co-ordinates / Elevation		
Intake	:	23° 22' 46.35" N , 93° 32' 50.33" E and El. 1,360m
Fore-bay	:	23° 22' 32.73" N , 93° 33' 36.74" E and El. 1,291m
Power House	:	23° 22' 20.85" N , 93° 33' 43.00" E and El. 1,161m
Load Centre (Muizawl Village)	:	23^0 22' 23" to 23^0 22' 47" N & 93^0 33' 37" to 93^0 33' 52" E
2 General		
Name of Stream	:	Zolui Stream
Catchment Area	:	1.91 km^2
Ownership	:	Muizawl Village Community
Type of Scheme	:	Run-of-Stream
Potential end use application	:	Agro-processing and Rural Carpentry
Beneficiary Household	:	93 HH (82 HH: Village Homes & 11 HH: Public Buildings (Church, School etc.)
Population	:	Total: 567 (Men: 274 & Women: 293)
Average subscribed power/HH	:	161 watts
Distance from Relative Township (Tedim)	:	14 miles (Gravel/Tar Road/Earthen Road)
3 Technical		
Gross Head	:	130.00 m
Net rated Head	:	124.41 m (5.59 m / 4.30% Head loss)
Design Discharge	:	18 LPS (adopted)
Measured Flow	:	38 LPS (September 30, 2017)
Installed Capacity	:	15 kW
Overall efficiency	:	66%

Size and Type of Desander	:	Stone Masonry in c/s, Rectangular, L = 4.0m, W = 1.0m & H = 1.1m of Settling Zone
Headrace Provision	:	2020 m (25m Line Canal and rest of all 5" dia. PVC Pipe)
Size and Type of Fore-bay	:	Stone Masonry in c/s, Rectangular, L = 6.35m, W = 1.0m & Hmax = 1.1m (Inside total including BPT & Outlet Part)
Penstock pipe	:	Circular, MS 125mm dia, L = 320m and 4.5mm thickness
Support Piers	:	Total 88 numbers of Stone Masonry in c/s Mortar
Number of Anchor Blocks	:	Total 14 numbers of PCC (1:2:4) with 40% Plumb
Power House Type and Size (Including Operator's Quarter)	:	Stone Masonry in mud mortar with inside plastering and outside pointing with c/s mortar. CGI Sheet roofing, Outside total size: L = 7.85m, W = 3.90m and Inside of Machine Room: L = 4.0m, W = 3.0m & H(min) = 2.1m
Tailrace	:	L = 10 m, 0.30m x 0.25m (Inside) Rectangular. Stone Masonry in c/s mortar
Turbine	:	Single Jet Pelton Turbine, Horizontal Shaft, 15 kW with Magnetic Jet Deflector, 27.1mm Nozzle dia.,1500 RPM, 75 % Efficiency.290mm PCD, 10 mm thick MS Casing Plate, Cast Steel Rotor Bucket, Spear Valve Needle of Stainless Steel mouth, Rotor Shaft made from EN8 Steel.
Drive system	:	Direct Coupling
Generator	:	30 KVA 230/415 volt 50 Hz, 0.8 pf 1500 rpm 3 phase Synchronous Brushless Type, Self – Excited, Star Connection and Insulation Class: F,
ELC	:	3 Phases Electronic Load Controller (ELC), Thyrister type 15 kW with Metal Box. Equipped with Amp, Volt, Frequency Meters, Over / Under Voltage & Frequency Controller and Turbine Jet Deflector Shut down on off Switch.
Transmission and Distribution Lines	:	Over Head Lines with 7m Steel Poles and Squirrel ACSR three phase / four wires (400 Volt): 605m single phase / two wires (230 Volt): 2545m,

2. ELECTRO-MECHANICAL EQUIPMENT

The powerhouse mechanical equipment of the project mainly consists of the followings:
Turbine
Turbine / Generator Base frame
Adaptor
Turbine Inlet Valve
Drive System
Pressure Gauge
Ballast Water Supply

2.1 Turbine:

Type of Turbine	:	Pelton with Spare Valve, Magnet jet deflector and Bearing Housing attached with Turbine Casing
Shaft Alignment:	:	Horizontal
Number of Jet	:	One
Turbine RPM	:	1500, Turbine Efficiency
Electrical Power	:	15 kW
PCD (Rotor diameter)	:	290mm mm
Nozzle diameter	:	27.1 mm
Turbine Casing	:	10 mm thick MS plate
Rotor bucket	:	Cast steel
Spear valve needle	:	Stainless steel
Rotor shaft	:	EN8 steel

2.2 Turbine / Generator Base frame

Type	:	Mild Steel Channel combined together for Turbine and Generator with Folding System
Size of Channel	:	125 x 65 x 5.3
Anchoring	:	20 mm dia. MS Anchor rods of 1 m Height with minimum 4 Pisces each for Turbine and Generator
Alignment	:	Turbine and Generator Base frame should be accurately aligned
Water Sealing System	:	Around the turbine base should have Groove for 6 mm dia. (e. g. 5.5 mm wide and 3 mm depth one side)

2.3 Adaptor

Between the Turbine and Penstock Pipe, there will be a 4.5 mm thick MS Plate adopter. On this adopter a ½" dia socket should have welded for a Pressure Gauge.

2.4 Drive system

The Drive System shall be Direct Coupling System with Tyre. The centre lines of Turbine & Generator Shafts should be in same straight line. Otherwise incorrect alignment will lead to Loss

of Power, Vibration, Noisy Sound, Reduced life of Bearings and Coupling. In extreme cases, the shafts could also break due to excessive metal fatigue.

2.5 Butterfly Vale

150 mm diameter with gear operated mechanism. The valve should be placed between adaptor and expansion joint. So the one side flange of adopter and expansion joint should have the groove for 150 mm dia Butterfly Valve.

The Butterfly Valve should be of minimum 25 kg/cm2 bearing capacity for 130 meter static head and additional for surge pressure. If not available this much in market, should be replaced by High Pressure Gate Valve.

2.6 Expansion Joint

14 expansion joints of 125 mm in diameter (same as to penstock pipe) are proposed to install just below the each anchor block to address the effect of expansion and contraction of penstock which occurs due to change in temperatures. Every expansion joint, capable of accommodating 50 mm length has been proposed. The design of expansion joint should be according to design drawing or specified by Engineer and material will be same as used for penstock pipe.

2.7 Pressure Gauge

A Pressure Gauge of up to 20 or 25 kg/cm2 pressure showing capacity shall be placed on turbine adopter to know the water level in penstock/forebay for operator.

2.8 Trash-rack

A coarse trash-rack for intake of 0.60 m x 0.45 m and two fine trash-racks each one for desilting and forebay of sizes 1.0m x 0.75 m for both should have placed as mentioned in drawings. The c/c spacing of 30mm x 5mm bar of coarse trash-rack and fine trash-rack is proposed as 50 mm and 30 mm respectively in 30mm x 30mm x 5mm angle irons for both. The details of trash-rack are given in drawing no MMHP-06.

2.9 Sluice Gate

A 1.20m height and 0.30m x 0.20m opening shall be placed in orifice of intake as shown in drawing no MMHP-06.It should be with rubber around the out-let to water leakage. Minimum 3 x 2 holdfasts should be welded on both side frames to anchor with wall. The handle shall have with bearing to make easy for operation. The sluice gate shall have of no leakage of water and easy for handle. The type and size gate should be as follows:

Type	:	Mild Steel with 100 mm x 50 mm x 5 mm Channel Frame
Clear Height	:	1.2 m
Out-let Size	:	300mm x 200mm
Spindle	:	MS solid (not hollow) minimum 40mm diameter
Opening Plate	:	MS minimum 3mm thick with 30mm x 30mm x 5mm angle frame

2.10 Flush Cone

Two flush cones each one at desilting and fore-bay shall be placed for flushing deposited silt. The base of the cone should have well finished that should not have any leakage of water. The cone should be place near the wall for easy operation. The type and size of Flush Cone should as follows:

Diameter	:	150 mm (ID)
Plate thickness	:	4.5 mm
Clear Height	:	0.80 m

3. ELECTRICAL ITEMS

3.1 Generator

A generator capable of continuously delivering 15 kW power with the following specification is proposed.

Type	:	Brushless, Synchronous
KVA	:	30 KVA
Phase	:	3 Phases,
Rated Volt	:	400 V
Frequency	:	50 HZ
RPM	:	1500 rpm
Power Factor	:	0.80
Efficiency	:	92 %
Insulation class	:	F

The generator size and type are compatible with the electronic regulation system. Secondly, the Generator should be capable of bearing the runaway speed.

3.2 Electronic Load Controller (ELC)

Three phases electronic load controller (ELC), thyrister type 15 kW with metal box. The ELC shall have with three load amp. meters, one generator voltage meter with selector switch, three ballast volts meters, one frequency meter, one kW meter and one energy meter (kWh meter). The protection system should include adequately sized fuses/ MCCBs. The MCCBs shall be placed of 40 amp (generator side) and 32 (load side) each of 10 KA breaking capacity L & T, to protect against overload and short circuits.

3.3 Ballast

A water tank should be installed to consume excess load that generating by generator and not consuming in village. Water supply shall manage from penstock pipes through ½" dia. GI Pipe (Heavy) with one high pressured gate valve to regulate flow. Over flow and washout pipes of larger diameter shall also be placed on the tank. The specification of the ballast tank should be as follows:

Type	:	3mm thick plate welded on 30mm x 30mm x 5mm Angle Frame
Volume	:	L = 0.60m, W = 0.40m & D (without freeboard) = 0.50m (120 Liter)
Capacity	:	18 kW (6 kW each phase)

4. TRANSMISSION & DISTRIBUTION LINES

The generated power is proposed to be transmitted to Muizawl Village through overhead lines and household connection with service wire as follows:

Total T & D Lines	:	3150 m
3 Phase 4 4 wires	:	2545 m (400 V)
1 phase / 2wires	:	605 m (230 V)
Min. Ground Clearance	:	4.6 m

4.1 Electric Poles

Type	:	Mild Steel
Height	:	7 meter
Numbers	:	90
Buried length	:	1.2 meter
Bitumen painting	:	1.5 meter
Top dia. (2.5m	:	Min. 75.3 mm
Bottom dia (3.0m)	:	Min. 88 mm
Thickness	:	4 mm
Weight	:	not less than 51 kg

4.2 Stay Set

Stay -sets are used in the first pole, last pole and poles at bends to stager the pole. The stay rod should be of 16 mm dia. 1.5 m MS with 0.30 m x 0.30 m x 5 mm (thick) plate welded with the rod. 1.5 m length of stay rod toward the plate should be buried in ground with back filling tightly with soil and boulder. The stay wire should be of 16 mm2 high tensile steel which is tighten with pole and stay bow where the bow is bolting with the stay rod. Altogether, 30 stay sets are proposed for the MHP.

4.3 D-Iron Clamp with Nut & Bolts/ Insulator

Similarly, 240 sets of medium shackle insulator with D-iron nuts and bolts are proposed for the T & D lines.

4.4 Lightning Arrestor and Earthing System

Altogether, 9 numbers of 0.5 kV lightning arrestors are proposed for T & D lines to protection. The overhead line earthing should be done on one point at first pole near the powerhouse and two points on the end of three phases at village. These lightning arrestors are proposed to install in within 500m. Each earthing station is proposed separately earthed by using 8 SWG copper conductors. The size of the copper plate is 3 mm x 600 mm x 600 mm, which is proposed for each earthing. Separate earthing shall be done for generator neutral and electromechanical equipments body.

4.5 Service line

6 mm2 concentric aluminium cables have been proposed for the service connection to the households. The internal wiring of each household should be connected through a suitable sized load-limiting switch (MCB). The total length of service wire is proposed 2.79 km @ average 30m per household.

Section 3b: TECHNICAL SPECIFICATIONS FOR (HYDROMECHANICAL)

1. STEEL PENSTOCK PIPE

1.1 Material

Plates for pipe

The Hot Rolled (H.R) plates shall be fabricated in accordance with IS 2062-1999 Grade "B" Mild steel or equivalent Standard.

The required mechanical properties and chemical combination of the H.R. plates shall be as follows

Mechanical Properties:

Specification	Grade	Yield Strength Mpa (min)	Ultimate tensile Strength Mpa (min)	Elongation% Min GL 5.65*Sqrt(so)	Internal Diameter of Bent
IS2062/1999	B	250	410	23	2T

Chemical properties:

Specification	Grade	C % (max)	Mn % (max)	P(%) (max)	S(%) (max)	Si(%) (max)	Carbon Equivalent
IS2062/1999 Or Equivalent	B	0.22	1.5	0.045	0.045	0.40	0.41

These plates shall follow killed deoxidation mode.

1.2 Preference

The H.R. plates confirm to the above mentioned for the requirement mentioned above has to be pre-notified with the engineer and get approval to submit the quotation for the alternative sizes. Such proposal shall come in writing and requires approval for other than the preferred sheet. An unapproved sizes shall be taken as non responsive during evaluation & billing.

1.3 Tolerance

The tolerance in dimension are acceptable as per the IS 1852/1985 or equivalent eg the recommended values of tolerance for the applicable range of sheets are given below and please refer as applicable for the respective order sizes and dimension

The tolerance on length of plate produced in non-continuous mill shall be as follows.

Length mm		Thickness mm	Tolerance on length
Over	Up to and including		
	2200	Up to and including 20 0ver 20	-0, +10mm - 0,+15mm
2200	3000	Up to and including 20 0ver 20	-0 +0.5% - 0, +15mm
3000	6300	Up to and including 20 0ver 20	-0 +0.5% - 0, +0.5%
6300	8000	Up to and including 20 0ver 20	-0 +35mm - 0, +0.5%
8000		Up to and including 20 0ver 20	-0 +35mm - 0, +40mm

The tolerance for length of plates when produced in continuous mill shall be as follows

Length mm	Tolerance
Up to and including 2500	+25mm,-0mm
Over 2500	+1percent of the length subject to a maximum of 70mm,-0mm

Tolerance for plate on width

Length	Width	Thickness	Tolerance on Width
mm	mm	mm	
Up to and including 8000	Up to and including 2000	Up to and including 20 Over 20	+10mm +15mm
Up to and including 8000	Over 2000	Up to and including 20 Over 20	+0.5% of width +20mm
Over 8000	All widths	Up to and including 20 Over 20	+0.2% of length +0.3%of length

Tolerance for plates on Thickness

Thickness	Tolerance in percentage of nominal Thickness
Less than 8mm	+12.5, -5.0
From 8 mm up to & including 12mm	+7.5, -5.0

Over 12 mm	±5.0

The Thickness shall be measured at the following points

a) one at each corner of the plate

b) one in the middle of the width and

c) one in the middle of length at any point

These measurements shall be 25mm away from the edge and at points randomly chosen. The thickness measured at each of these points shall satisfy the tolerances specified above.

1.4 Welding and Painting

Descriptions	Materials
Paint	1 coat zinc rich primer and 3 coat coal tar epoxy. Total DFT not less than 250 micron
Welding Electrodes	E 7018 or equivalent

1.5 Delivery Condition of Materials

The Steel sheets has to be free from surface defects, well and cleanly rolled as per the specifications and dimensions and material should be free from flows ,laminations, rough, jagged, impacted surfaces and free from all other harmful defects. The sheets should be free from rust, oil and other chemical on the surface requiring severe efforts to remove them.

1.6 Tests

The contractor shall perform following tests in presence of the authorized inspector appointed by the Engineer. The tests and test procedures shall be approved by the Engineer. No part of the work shall be considered acceptable until has successfully complied with these to satisfaction of the Engineer. Test records, data, calculation sheets and photographs, if any, shall be submitted to the Engineer in two copies within two weeks after test had been conducted.

1.6.1 Mild Steel Plates

The steel plates for penstock pipe shall be subjected to following mill tests in accordance to ASTM code or equivalent national/international code of practice for each thickness and each quality.

1.6.2 Tensile test

One tensile test has to made from each 50 ton batch and relevant proof has to be furnished with the assurance certificate of the quality meeting the physical properties of the plate. The tensile test piece shall be made in accordance to the IS 1608 and all tests for tensile strength, yield strength and Elasticity constants has to be clearly remarked in the test sheet to comply with the standards.

1.6.3 Bend test

One cross wise bend test shall be carried out for each 50ton production batch and the test pieces are prepared from the same sheets and tests should be conducted in accordance to IS 1599.

1.6.4 Other Tests

Other tests like Impact test, Shear test, Crack ability test, malleability test shall be carried out and the subsequent test result to should be supplied before dispatch of the sheets in accordance with the code IS 10842,1757 or equivalent.

1.7 Welding

All welding shall be done either manually by the shielded metallic arc process or automatically by the shielded arc or submerged arc method. The Contractor shall submit a welding procedure for the approval of the Employer. After the welding procedure has been approved, the Contractor shall record it on a special drawing which shall thereupon become one of the drawings of the Contract. Weld sizes and types shall be shown on all Contractor's drawings where welding is required.

Radiographic inspection shall be carried out by the contractor when required by the standards, these specifications of the design criteria employed. All important welds which, in the opinion of the Employer, may be subject to the full stress induced in the adjacent plate, or which in the opinion of the Employer or Inspector, do not appear to confirm to the welding standards, shall be radio-graphed when required by the Employer.

Suitable meters shall be provided to show the welding current and the arc voltage at all times during the welding operations. Unless otherwise, specifically stated, welded parts requiring machine finished shall be completely welded before being finished. Plates to be joined by welding shall be accurately cut to size and rolled by pressure to the proper curvature which shall be continuous from the edge. Flattening in the curvature along the edges with correction by blows will not be allowed. The dimensions and shape of the edge to be joined shall be such as to allow thorough fusion and complete penetration and the edges of plates shall be properly formed to accommodate the various welding conditions. The surfaces of the plates for a distance of 25 millimeters from the edge to be welded shall be thoroughly cleaned of all rust, grease and scale, to bright metal.

(i) Qualification of Welding Procedure

The technique of welding employed, the appearance and quality of the welds made and the methods used in correcting defective work, shall confirm to the standard in accordance with the Clause 25 of this General Specification.

(ii) Qualification of Welders and Welding Operators

All welders and welding operators assigned to the work shall have passed a qualification test, within the preceding six months, for welders and welding operators, in accordance with the Clause 25 of this General Specification. The Contractor shall furnish the Employer with certified

copies of reports of the results of physical tests of specimens welded in the qualification tests. If, in the opinion of the Employer, the work of any welder at any time appears questionable, he shall be required to pass the appropriate requalification test. All costs of qualification tests shall be borne by the Contractor.

(iii) Welding Electrodes

The weld electrodes shall confirm to standard in accordance with the Clause 25 of this General Specification. Stainless type weld metal, where used in the water passages for protection against pitting, shall be of chromium nickel steel. The type, chemical composition and number of welding rods for this purpose shall meet with the approval of the Employer.

(iv) Test after Welding

All the welded portion shall be tested by X-ray test or dye-penetration test or ultrasonic test for defects when and where required as per decision of the Employer.
All the weld joints of pipe sections, bends and fabrication shall be subjected to NDT mentioned as under;
Radiographic Examination (RT) : 100% of longitudinal weld joints and all T-joints. 50% of the girth welds joints.
Magnetic particle testing (MPT) :100% of total weld joints for both longitudinal as well as girth welding.
Ultrasonic Testing (UT) : 100% for the pipe section having thickness equal or greater than 13mm. (both longitudinal and girth weld joints)
Dye Penetration Test (DPT) : As and when required.
Objectionable defects in welds discovered during the above tests, shall be repaired and 100% RT again.

1.8 Painting

All painting shall be inspected by the Engineer. The Contractor shall be responsible to arrange tools and equipment for following test during the painting inspection by the Engineer. The Contractor shall submit the joint inspection report to the Employer.

- DFT inspection
  The thickness of dry films (DFT) shall be measured by Elcometer during and after painting work and whenever requested by the Engineer.

- Adhesion inspection
  The peeling test for dried films on the pipe shells shall be carried out at any time during painting work.

- Pinhole inspection
  The dried films on the pipe shells shall be checked by holiday detector for pinhole at any time during and after painting work.

1.9 Measurement and Payment

The measurement of the sheet shall be in mm and length of each sheet shall be marked and checked for the dimension accuracy. The weight calculation shall be done based on actual sheet with density of steel as 7850kg/m³. The Tonnage shall be calculation in 2 decimal places and billing shall be done accordingly unless otherwise accepted in writing.

SALIENT FEATURE OF THE PROJECT

4 Project Location		**LOT 2**
Country	:	Republic of the Union of Myanmar
State	:	Chin
Township	:	Tedim
Village	:	Suangzang
Nearest Town	:	Tedim / Kalemyo
Geographical Co-ordinates / Elevation		
Intake	:	23° 15' 29.81" N , 93° 33' 35.61" E and El. 1,340m
Fore-bay	:	23° 15' 25.15" N , 93° 33' 43.97" E and El. 1,310m
Power House	:	23° 15' 22.48" N , 93° 33' 54.83" E and El. 1,240m
Load Centre (Muizawl Village)	:	23^0 15' 08.54" to 23^0 15' 26.90" N & 93^0 33' 20.00" to 93^0 33' 43.11" E
5 General		
Name of Project	:	Donlui Micro Hydropower Project
Name of Stream	:	Donlui Stream
Catchment Area	:	3.17 km^2
Ownership	:	Suangzang Village Community
Type of Scheme	:	Run-of-Stream
Potential end use application	:	Agro-processing and Rural Carpentry
Beneficiary Household	:	200 HH
Population	:	Total: 1,218 (Men: 607 & Women: 611)
Average subscribed power/HH	:	150 watts
6 Technical		
Gross Head	:	69.30 m
Net rated Head	:	67.69 m (1.61 m / 2.32% Head loss)
Design Discharge	:	75 LPS
Measured Flow	:	270 LPS (November 01, 2017)
Installed Capacity	:	30 kW
Overall efficiency	:	60%
Size and Type of Desilting Basin	:	Stone Masonry in c/s, Rectangular, L = 8.5m, W = 2.0m & H = 1.5m of Settling Zone

Headrace Provision	:	293 m (22m Line Canal, 12.8m Desilting & 258.2m 8" Ø PVC Pipe)
Size and Type of Fore-bay	:	Stone Masonry in c/s, Rectangular, L = 10.50m, W = 2.0m & Hmax = 1.5m (Inside area excluding penstock inlet area)
Penstock pipe	:	Circular, MS 250mm Ø, L = 184m and 4mm thickness
Support Piers	:	Total 48 numbers of Stone Masonry in c/s Mortar
Number of Anchor Blocks	:	Total 7 numbers of PCC (M15) with 40% Plumb
Power House Type and Size (Including Operator's Quarter)	:	Stone Masonry in 1:6 c/s mortar with inside plastering and outside pointing with 1:4 c/s mortar. CGI Sheet roofing, Outside total size: L = 8.85m, W = 4.90m and Inside of Machine Room: L = 5.0m, W = 4.0m & H(min) = 2.4m
Tailrace	:	L = 28 m, 0.50m x 0.50m (Inside) Rectangular. Stone Masonry in c/s mortar
Turbine	:	Double Jet Pelton Turbine with Magnetic Jet Deflector, Horizontal Shaft, 300mm PCD, 75% Efficiency, 38 kW Turbine Shaft Power 1,058 RPM Runner Rated Speed, 1,958 RPM Runway Speed, 121 mm Bucket Width, 18 Numbers of Bucket
Drive system	:	Belt Drive System with 1.42 : 1 (Turbine/Generator) Pulley Ratio Turbine Pulley Ø: 312 mm Generator Pulley Ø: 220 mm
Generator	:	60 KVA 230/415 volt 50 Hz, 0.8 pf 1500 rpm 3 phase Synchronous Brushless Type, Self – Excited, Star, 90% Effici Connection and Insulation Class: F,
ELC	:	3 Phases Electronic Load Controller (ELC), Thyrister type 30 kW with Metal Box. Equipped with Amp, Volt, Frequency Meters, Over / Under Voltage & Frequency Controller and Turbine Jet Deflector Shut down on off Switch.
Transmission and Distribution Lines	:	Over Head Lines with 90 nos 7m Steel Poles, 4.68 km Squirrel, 1.32 km Weasel and 2.68 km Rabbit ACSR, 1,200 m, 400 V (3 Phase/4 wires) and 1,560 m, 230 V (1 phase/2 wires

TECHNICAL SPECIFICATION FOR ELECTRO-MECHANICAL EQUIPMENT

(WATER TO WIRE) AND TRANSMISSION LINE WORKS

1. MECHANICAL EQUIPMENT

The trash rack, penstock pipe, turbine and power transmission systems are the major mechanical components of an MHP. The selection of mechanical components of appropriate type, size and material has significant effects on the power generation and durability of the scheme. Replacing poorly performing mechanical components is very costly so they should be selected carefully. This section gives some basic guidelines on their selection.

Trashrack

1) Trashracks are placed at an intake to prevent logs, boulders and other large waterborne objects from enter the waterways and at the forebay to prevent leaves, twigs and branches from entering the penstock. The following factors should be considered in designing and sizing a trashrack:

1. The trashrack should be fabricated from MS bars or plates. The coarse trashrack for an intake should be robust enough to withstand impacts from logs and boulders during the monsoon seasons.
2. The bars of the trashrack should be placed vertically (not horizontally) to facilitate raking.
3. The trashrack sizes, Spacing and Bars should have as follows:

Forebay: The bar spacing should have half the nozzle diameter of the pelton turbine.

4. The velocity through the fine trashrack should be 0.6–1.0 m/s. For the coarse trashrack, the velocity is governed by the type of intake structure (e.g., concrete, stone masonry, etc.) and not the spacing between the bars, which does not cause significant flow obstruction.
5. Each section of the trashrack should be limited to 60 kg for transportability. If the total weight exceeds 60 kg, the trash rack should be fabricated in two or more sections.

Trashracks specification

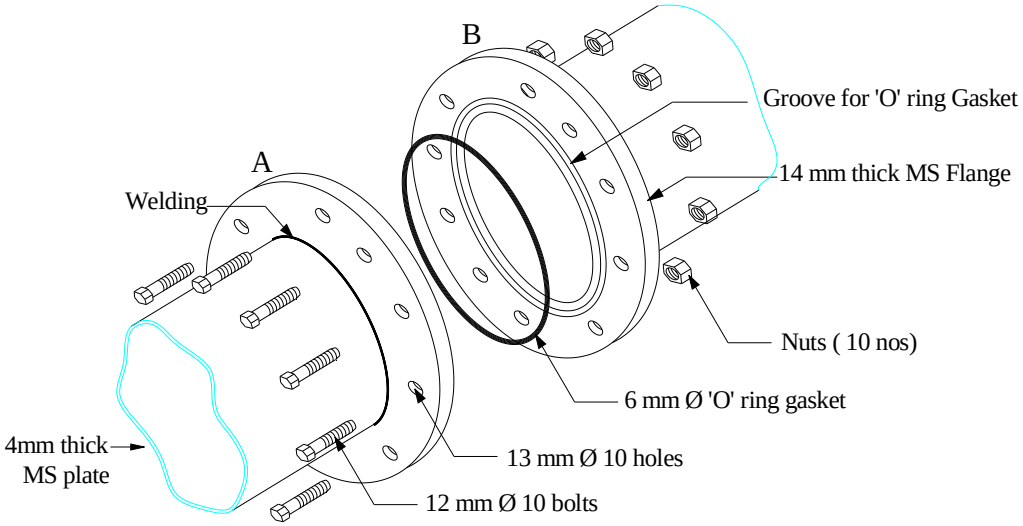
S.No.	Description	Type	Size in m (L x H)	Sizes of Angle for Frame mm	Vertical Bars Width & thickness in mm	c/c Spacing of Bars	Nos	Total Weight in kg
1	Intake	Coarse	0.90 x 0.90	50 x 50 x 5	40 x 5	50	1	40.98
2	Desilting	Fine	1.00 x 1.00	50 x 50 x 5	40 x 5	30	2	139.21
3	Forebay	Fine	1.00 x 1.30	50 x 50 x 5	40 x 5	30	1	87.66

Penstock Pipe

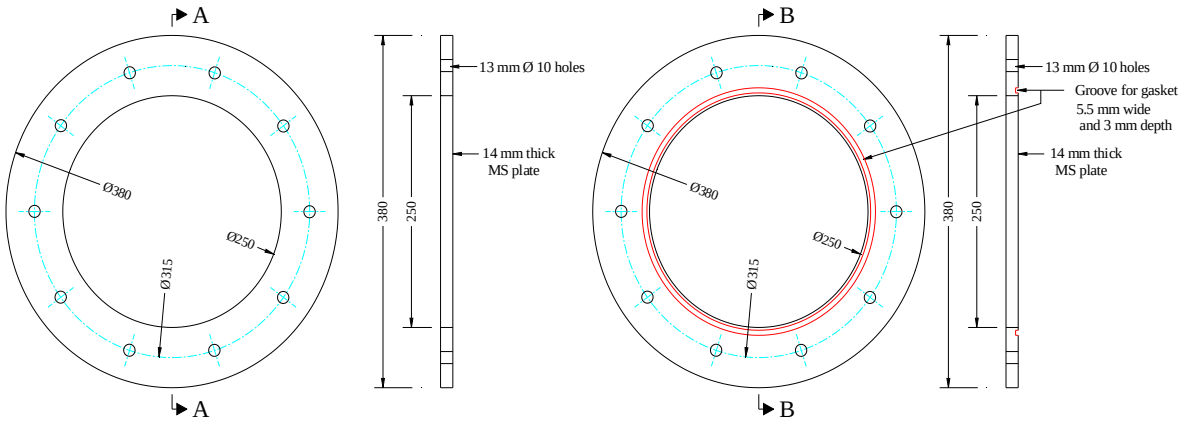
A penstock pipe that carry water to hydraulic turbines or water wheels. Total of 184 m (Slope Length up to Manifold) long penstock has been proposed of Mild Steel. Its production detail should be as follows:

Product Detail

Type	Mild Steel, Surface with minimum 30 cm Ground Clearance	
Size	ID	250mm
	Wall Thickness	4 mm for total 184 m of length
	Length / Piece	2.5m
Bend Pipes	15^0 (Forebay), 02^0, 12^0, 02^0, 04^0, 27^0 (Powerhouse)	
Average Slope	22^0 (Angle between Horizontal line to Forebay to Powerhouse Straight line)	
Hydraulic Pressure tested	Minimum 15 kg/cm^2	
Joint System	Flange Joint with 100mm x 12mm Ø x 10 nos Bolts in each on 13 mm Ø Hole	
Flange Thickness	14 mm	
Width of Flange	65 mm	
Sealing	6 mm Ø 'O' Ring Gasket on 5.5 mm wide & 3 mm depth Groove	
Steel material	Q235 → Grade D,SS400,S235JR,S235JO,S235J2 Q345 → SS500,ST52	
Standard	EN10219,EN10210,ASTMA500,GB/T3094-2000,GB/T6728-2002,GB/T 178-2005,JIS G 3466	
Usage	Used For Structure, Gas, Oil etc.	
Ends	Plain	
Welded Line Type	Longitudinal	
Section Shape	Round	



PENSTOCK JOINT



FRONT VIEW - A SECTION - AA FRONT VIEW - B SECTION - BB

Expansion Joints

2) The exposed sections of penstock pipes are subject to temperature changes (heating and cooling causes the pipes to expand and contract, thereby creating stress as the penstock pipes are rigidly fixed at both ends by the anchor blocks. Expansion joints are essential for accommodating such pipe movement. One joint should be located downstream of the forebay as well as downstream of every anchor block along exposed sections. Joints are not needed for buried sections as temperature differences are not significant.

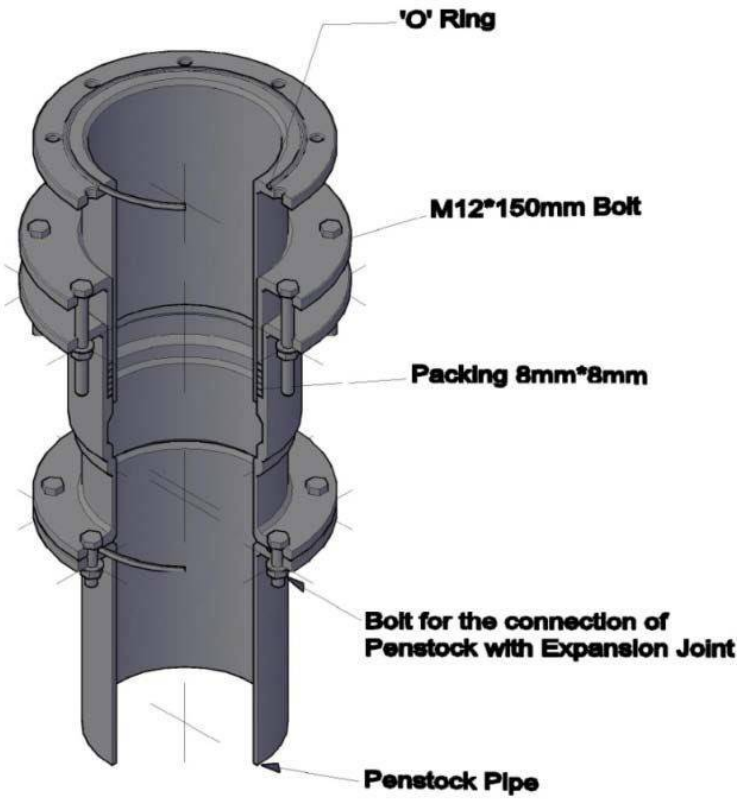
3) Total 7 Expansion Joints have been proposed downstream of each anchor block. Quality of Following are the Specification of Expansion Joint:

4)

5) Specification

6)	Number	:	7
7)	Type	:	Mild Steel
8)	Inside Ø	:	250 mm (Same as the Penstock)
9)	Accommodating Length	:	100 mm
10)	Pressure to be tested	:	Minimum 15 kg/cm^2

11)



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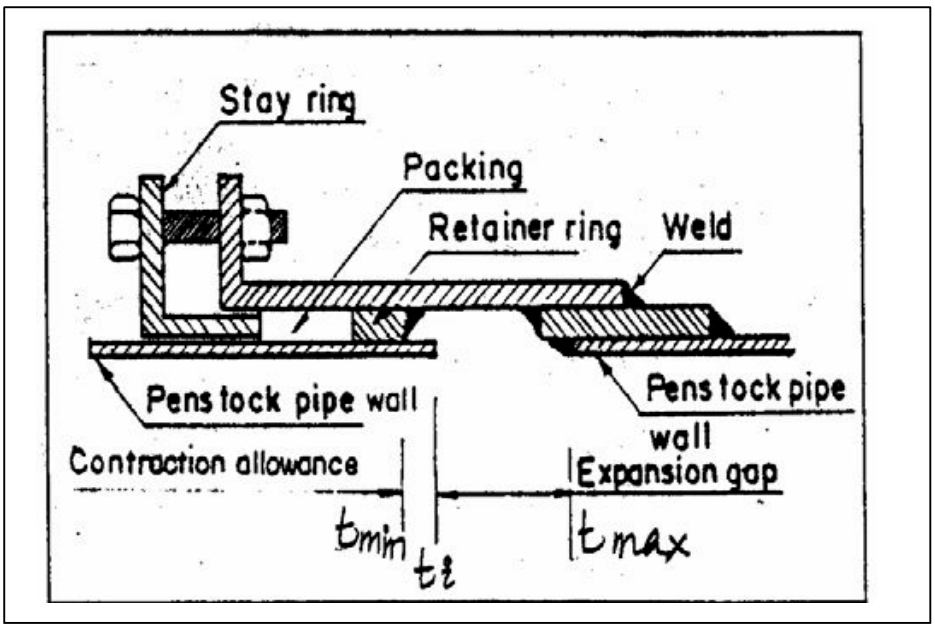


13)

Sectional view of expansion joint

For flange-connected penstocks, if the distance between the last anchor block and the ma- chine foundation is less than 10 m, there is no need for an expansion joint because the changes in pipe size can be accommodated by the gaskets between the flanges. However, a joint can be installed if installing it facilitates the installation of the turbine. Alternatively, a mechanical coupling can be used between the anchor block and turbine to facilitate turbine maintenance. The expansion joint or mechanical coupling between the last anchor block and the machine foundation should be placed outside the powerhouse.

Valves

Valves are used to stop or regulate the flow of water in penstock pipes and nozzles. Because they are costly and may fail, the fewest possible number should be installed. The following factors should be considered while locating and selecting valves:

1. Emptying the flow in the penstock without letting in air causes negative pressure inside and a pipe may even collapse. Such a condition can occur if a gate is placed at the entrance of the penstock and it is closed suddenly or if the trashrack becomes blocked very quickly, thereby obstructing flow into the pipe. To introduce air during such conditions, an air vent should be installed within 1 m length from the start of the penstock pipe.

2. A stop valve should be placed at the turbine inlet or manifold. A gear-operated butterfly valve is recommended.

3. Spear valves should be used to regulate flow to a pelton turbine, but they should not be as stop valves. Instead, a separate stop valve should be installed.

4. Valves made from bronze or brass are preferred but cast iron may be used as an alternative.

Turbines

The turbine shall have Double Jets Pelton turbine. The construction and bearings should be rated to withstand runway speed. The specification of the turbine should be as follows:

- Turbine Type : Pelton with Magnetic Jet Deflector
- Number of Jet : 2
- Spare Valve : 2
- PCD : 300 mm
- Efficiency : Minimum 75%
- Nozzle Diameter : 45.7 mm
- Bucket Width : 121 mm
- Number of Bucket : 18
- Runner Rated Speed : 1058 RPM
- Runway Speed : 1958 RPM
- Turbine Shaft Power : 38 kW
- Housing : 10 mm thick MS Plate
- Rotor Bucket : Cast Steel
- Spear Valve Needle : Stainless Steel mouth
- Rotor Shaft : EN8 Steel

Double Jets Pelton Turbine with Magnetic Jet Deflector

Sluice Gate

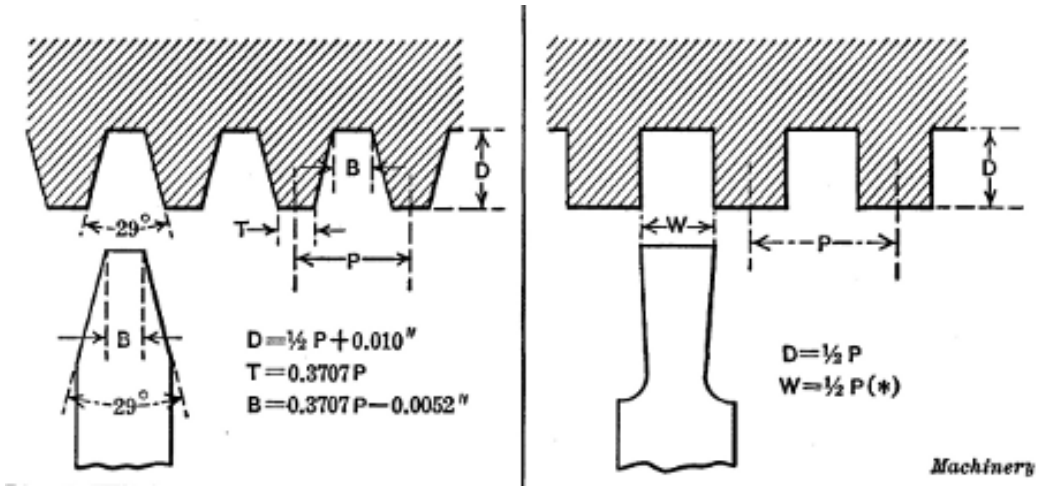
The gate hoist shall be of the screw spindle hoist type, manually operated by means of a crank handle. The screwed spindle shall be made of corrosion resistant steel and shall be provided with machine cut square thread of necessary length.

The hoist nut shall be fabricated from bronze and shall be provided with a ball bearing, mounted in an enclosed bearing house.

The hoist mechanism shall be designed for operation of the gate with full differential water pressure and no leakage. The product detail of sluice gates shall have as follows:

Product Detail

S.No.	Description	Frame size m (Inside)		Channel Size mm	Outlet Area m^2 (Opening)		Vertical Plate thickness	Hoist Type	Total Weight kg
		Breadth	Height		Breadth	Height			
1	Intake	0.40	1.50	100 x 50 x 5	0.40	0.25	5 mm	Screw	61
2	Desilting	0.40	1.50		0.40	0.40			65
3	Forebay	0.40	1.50		0.40	0.40			65



(a) American screw thread and (ACME thread)

(b) Square thread

Essential Features of a Gate

There are three essential features of a gate which can be categorized as below:-

(i) Closing member

(ii) Groove

(iii) Hoisting arrangement,

(iv) Seal

Screw Hoists:

Screw hoists operate on the principle of a screw. They can be hand operated or motorized. The hand operated screw hoists are limited to the operation of small gates such as canal gates of slide or fixed wheel types. They are generally subjected to very small heads and are loaded lightly. It comprises a vertical threaded stem connected to the gate leaf and prevented from rotating, a stem nut and a mechanism that permits nut rotation of the desired direction. The nut may be operated by a hand wheel, or indirectly by means of bevel or worm gear systems. The nut also has a strut function and is usually supported on roller bearings. It has to be designed to support the gate weight, stem weight and all applicable forces such as frictional forces. In general, nuts are made of aluminum bronze, which presents good mechanical strength and a low friction coefficient. This mechanism is normally installed within a frame and mounted on a cast-iron pedestal screwed to the operating deck.

The stem is subjected to tensile stresses during lifting and to compressive stresses during lowering (in case of slide gates), and should be designed as a column. The stems can be made of Carbon Steel, Mild Steel or Forged Steel. SAE 4140 alloy steel or AISI 416 stainless steel are also adopted. They are provided with square or ACME threads, with lead equal to the pitch.

2. ELECTRICAL EQUIPMENT

Generator

A Generator rated to continuously deliver 30 kW power at the given site condition with the following specification is proposed.

Type	: 3-phase, synchronous, A.C. horizontal shaft
Rated Power	: 60kVA
Rated Voltage	: 230/415 Volt
Rated Current	: 114 A.
Rated Frequency	: 50 Hz
Rated Power Factor	: 0.80 (lagging)
Rated Speed	: 1500 rpm
No. of poles	: 6
Rated Efficiency	: 90%
Stator and Rotor insulation class	: F
Stator connection	: star with neutral earthed
Direction of Rotation	: same as that of the turbine
Short Circuit Ratio	: not less than 1.1
Excitation system	: brushless

The generator size and type is compatible with the electronic load regulation system. The construction and bearings should be rated to withstand runaway speed of the turbine. The bearings should further take into account the static load exerted on it due to the drive system.

Governing System

Electronic Load Controller (ELC) 30 kW is proposed to regulate speed/ frequency of generated electricity from the plant. ELC with ballast unit is proposed to control the load system so that the Generator is always operating at its designed load capacity

3. Control and Protection System

Immersion heaters each of 9 kW: 3 numbers and 4kW: 3 numbers are proposed to install at separate water tank with continuous inlet and outlet flow of water. The instrumentation proposed is 3 load amp meters, 1 generator voltage meter with selector switch, 3 ballast volts meters, 1 frequency meter, 1 kW meter and 1 energy meter (kWh meter). The protection system should include adequately sized fuses/ MCCBs (100 A on generator side, 75 A on load side each of 10 KA breaking capacity L & T to protect against overload as well as short circuits without any damage) are proposed.

Energy Meter

Three phases four wire energy meter is purposed in this Scheme which records (shows) both single phase & three phases of all electrical parameter such as Voltage, Current, Frequency, Power Factor- leading & lagging, Power- Active (kW) & Reactive (kVA) and Energy (kWhr). The details Technical Specification of Energy Meter are given below:

Details Technical Specification of Energy Meter:

S. No.	Description	Three Phase
1	Type	3 ph-4 wire, Wye
2	Auxiliary Voltage	140-300V AC
3	Auxiliary Power Burden	15VA maximum
4	Frequency	50Hz
5	Operating Voltage	140-480V
6	Operating Current	1-5A
7	Staring Current	0.05% of Ib
8	Accuracy class	0.5
9	Meter constant	Programmable/factory set
10	VA Burden/phase (CT & VT Circuit)	<1.5VA
11	Communication Port	Optical port for Local with RS 232 Optional
12	Baud rate	Programmable
13	Load Profile Channel	Minimum four(KW Exp. kW Imp, kVArExp Imp<
14	Surge Protection	In built
15	Internal Battery Life	At least 10 Years without Power Supply
16	Applicable Standard	IEC or ANSI

Overhead line protection

The overhead low-tension lines are to be protected from high voltage surge of atmospheric lightning. The lighting arrestors are to be installed at sending end (just near the powerhouse) and at within each 500 m along transmission distribution line. There are 5 earthings (3 at power house and 3 at village) for the protection from lighting. The proposed size of the lighting arrestor is 0.5 kV for the overhead lines.

System protection

It is prosed to provide thermal as well as instantaneous magnet trip feature in each feeder MCCB in the powerhouse and consumer end. Care should be taken in the placement and sizing of MCCBs so that fault isolation is easy and there is no nuisance trapping.

Earthling system

All exposed metal parts of the generating equipment's are proposed to provide earthing properly. The generator neutral terminal is also proposed to be connected to the separate earth point.

600mm x 600mm x 3mm thick cupper plate and 8 SWG wire is proposed to be embedded. Metal roofing, penstock, turbine casing, generator body, main switch body and ballast tank shall be terminated to that terminal bus in continues loop. Generator neutral shall be connected to the earth terminal in the control panel.

Consumer Protection

It is proposed to furnish all consumer connections through MCBs of capacity 0.5 Ampos for each 100 watts rating. These systems are proposed to be installed in ready-made plastic boxes. Adequate wiring and terminal connection should be provided for neat and efficient services cable connection.

Powerhouse cabling

Armoured cupper 35 mm2 power 4 core cables is proposed to connect generator, panel and dummy load bank inside the power house. Similarly, 50 mm2 4 core un-armoured aluminum cable is proposed for connection between the main switch and the first pole connection. Cable rating is

proposed in such a way that at least 150 percent of the required maximum current should be carried by them. At least 3 light points with incandescent lamps and one power point with necessary switches and fuses are proposed for the powerhouse use.

Electronic Load controller (ELC)

These specifications cover the requirements of Load controller used for the MHP interconnection with Local Grid and National Grid.

- Manufacture of the ELC shall be holder the valid ISO 9001 certificate including Design or shall have well recognition in national or international level.
- ELC shall be capable to operate in all parts of Nepal regarding geographical as well as climatic conditions without affecting operation.
- ELC shall have microprocessor/microcontroller/PLC/Analog or Digital Electronic Circuit based design.
- In isolated mode it shall operate in constant frequency controlled mode or shall achieve frequency regulation of +/- 2.5 % of 50 Hz.
- The full load rejection frequency stabilization of ELC shall be less than 0.5 sec.
- Error response time shall be less than 0.05 Sec.
- In Local Grid connected mode it shall control the active power injected to Local Grid in proportion to the active power generation of each MHP station. For this, ELC shall be incorporated with frequency/speed droop characteristics.
- All the plant operating parallel in Mini Grid mode should have same speed droop characteristics so that they share the load in proportion to their respective kW generation. For this the variation of frequency must within 2.5% of standard frequency.
- Adequate provisions for adjusting speed droop (0-10%) shall be provided with ELC to operate in Local Grid mode.
- While in National grid connected mode, the frequency of whole system is governed by that of the large system so there is no any role of ELC. Hence automatic mechanism for disconnection of ELC after synchronization shall be incorporated within ELC.
- It is necessary to incorporate some mechanism within ELC when the plant is disconnected from National Grid it should operate in isolated mode without exceeding standard frequency variation.

- If case 2.4.10 could not be achieve an external relay i.e. ELC off relay shall be used to deactivate the ELC during National Grid connected mode of operation.
- ELC may have auto Grid tracking mechanism for synchronism.
- ELC may have suitable data transfer port for PLC/ SCADA interface.
- ELC may have multichannel design and switching pattern for stability and low harmonics.
- Neutral Current of Generator on full ballast load (no user load) should not to exceed 10% of total current.
- The ballast shall be 230 V, water cooled, size more than 20% larger than kW capacity of Plant.
- **Testing of ELC**

Following tests shall be done after installation of ELC at site

- ✓ Frequency regulation from no load to full load condition in isolated mode
- ✓ Frequency regulation during Local Grid connected mode
- ✓ Operation during National Grid connected mode
- ✓ Frequency stability
- ✓ Frequency Droop characteristic
- ✓ Harmonics Monitoring

Table 2.2: Technical Parameters of Electronic Load Controller

S.N.	Parameters	Description	Remarks
1	Type	Multichannel, Programmable, Analog/Digital, Microcontroller/Microprocessor based	
2	Input Sensing Voltage (Generator)	230 V AC ±10% (L-N))	
3	Input Voltage for frequency Sensing (Grid)	230 V AC ±10% (L-N))	
4	Input Frequency	50 Hz	
5	Input Power	230V AC +/- 10%, 50 Hz	
6	Frequency Regulation	< +/- 2.5% of 50Hz	
7	Response time	Less than 50 milli seconds	
8	Frequency stability time	< 0.5 Sec	

9	Stability Adjustment	Adjustable to get steady state stability and good transient response.	
10	Droop adjustment	0-10% frequency Droop	For Local Grid Mode
11	Auxiliary input	Digital Inputs for Sync Enable, Grid Mode, Circuit Breaker Feedback and Parallel/ Isolation Mode	Optional
12	Operating Temperature	- 20° C to+70° C	
13	Storage Temperature	- 40° C to 80° C	
14	Protection on Devise	Suitable R-C Snubber to be provided for the device used to protect this from surge.	
15	Total Harmonic Distortion %	Low	
16	Frequency Control for synchronization	Auto Grid Tracking Mechanism	Optional
17	Ballast size	>120 % of plant capacity, 230 V	
18	Generator Neutral current at full Ballast Load	<10 % of total full load current	
19	Output for external interface	4-20 mA output and Rs485 or equivalent	Optional

Ballast

A water tank should be installed to consume excess load that generating by generator and not consuming in village. Water supply shall manage from penstock pipes through ½" dia. GI Pipe (Heavy) with one high pressured gate valve to regulate flow. Over flow and washout pipes of larger diameter shall also be placed on the tank. The specification of the ballast tank should be as follows:

Type : 3mm thick plate welded on 50mm x 50mm x 5mm Angle Frame
Volume : L = 0.75m, W = 0.50m & D (without freeboard) = 0.60m (225 Liter)
Capacity : 39 kW (6 kW each phase)

4. TRANSMISSION & DISTRIBUTION LINES

The generated power is proposed to be transmitted to Suangzang Village through overhead lines and household connection with service wire as follows:

Total T & D Lines	:	2,760 m
3 Phase 4 4 wires	:	1200 m (400 V)
1 phase / 2wires	:	1560 m (230 V)
Min. Ground Clearance	:	4.6 m

Electric Poles

Type	:	Mild Steel
Height	:	7 mete
Numbers	:	90
Buried length	:	1.2 meter
Bitumen painting	:	1.5 meter
Top dia. (2.5m	:	Min. 75.3 mm
Bottom dia (3.0m)	:	Min. 88 mm
Thickness	:	4 mm
Weight	:	not less than 51 kg

Stay Set

Stay -sets are used in the first pole, last pole and poles at bends to stager the pole. The stay rod should be of 16 mm dia. 1.5 m MS with 0.30 m x 0.30 m x 5 mm (thick) plate welded with the rod. 1.5 m length of stay rod toward the plate should be buried in ground with back filling tightly with soil and boulder. The stay wire should be of 16 mm2 high tensile steel which is tighten with pole and stay bow where the bow is bolting with the stay rod. Altogether, 30 stay sets are proposed for the MHP.

D-Iron Clamp with Nut & Bolts/ Insulator

Similarly, 240 sets of medium shackle insulator with D-iron nuts and bolts are proposed for the T & D lines.

Lightning Arrestor and Earthing System

Altogether, 9 numbers of 0.5 kV lightning arrestors are proposed for T & D lines to protection. The overhead line earthing should be done on one point at first pole near the powerhouse and two points on the end of three phases at village. These lightning arrestors are proposed to install in within 500m. Each earthing station is proposed separately earthed by using 8 SWG copper conductors. The size of the copper plate is 3 mm x 600 mm x 600 mm, which is proposed for each earthing. Separate earthing shall be done for generator neutral and electromechanical equipments body.

Service line

6 mm2 concentric aluminum cables have been proposed for the service connection to the households. The internal wiring of each household should be connected through a suitable sized load-limiting switch (MCB). The total length of service wire is proposed 2.79 km @ average 30m per household.