Government of Samoa

TENDER DOCUMENT

Issued on

July 13, 2021

For

PROCUREMENT OF

Engineering Supply and Construction, of Tiapapata Small Hydro Power Station

WORKS Tender No:

SAM EPC TIAP – 25/2021

MARKET PARTICIPANTS

Foreign: *YES*

Local: *YES*

Funded by:

Principal: *Electric Power Corporation for and on behalf of the Electric Power Corporation*

Contact Entity: *Electric Power Corporation*

Standard Bidding Document

Table of Contents

PART 1 – Bidding Procedures

Section I - Instructions to Bidders

Table of Clauses

Section I - Instructions to Bidders

A. General

1. Scope of Bidding

1.1 The procuring entity, as specified in the **BDS,** issues this Bidding Document for the procurement of the works as specified in **Section V – Works' Requirements**.

1.2 The name and identification number of this Open Competitive Bidding procurement are **specified in the BDS**. The name, identification, and number of lots of are also **provided in the BDS**.

1.4 Throughout this bidding document:

(a) "**Contact Entity**" is the procuring entity's assigned agency or person for conducting the bidding and contract administration processes;

(b) **"day"** means calendar day**;**

(c) "**Government**" means the Government of the Independent State of Samoa;

(d) the term **"in writing"** means communicated in written form **(e.g. by mail, e-mail, fax, telex)** with proof of receipt**;**

(e) "**procuring entity**" means the Government or delegate or proxy for the Government and the Executor of the Contract;

(f) if the context so requires, **"singular"** means **"plural"** and vice versa.

2. Source of Funds

2.1 The procuring entity has received public funds toward the cost of the project **named in the BDS** for the execution of this procurement.

2.2 Payment shall be in accordance with the Government's Treasury Instructions and Payment Policy.

3. Fraud and Corruption

3.1 The procuring entity shall require that the contractor, its contractors and their agents (whether declared or not), personnel, subcontractors, sub-consultants, and service providers under Government-financed contracts, observe the highest standard of ethics during the procurement and execution of such contracts.

3.2 Accordingly, the Government shall clarify the terms where it becomes necessary, but for the purposes of this provision the following are considered unacceptable practices;

(a) "corrupt practice" means the offering, giving, receiving, or soliciting, directly or indirectly, anything of value to influence improperly the actions of another party; [1]

(b) “fraudulent practice” means any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation; [2]

(c) “collusive practice” means an arrangement between two or more parties[3] designed to achieve an improper purpose, including influencing improperly the actions of another party;

(d) “coercive practice” means impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party; [4] and/or

(e) “obstructive practice” means:

(aa) deliberately destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede a Government investigation into allegations of a corrupt, fraudulent, coercive, or collusive practice; and/or threatening, harassing, or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation; or

(bb) acts intended to materially impede the exercise of the Government’s inspection and audit rights.

3.3 A person who commits an offence relating to corrupt activities in Samoa shall

(a) be liable for conviction under the provisions of the laws of the Independent State of Samoa relating to corrupt activities in Samoa;

(b) have their bid rejected if it is determined that the bidder is not in compliance with the laws of the Independent State of Samoa relating to corrupt activities in Samoa;

(c) risk other sanctions in accordance with the Procurement Suspensions and Debarments Procedure.

3.4 The procuring entity will:

(i) reject a bid if it determines that the bidder recommended for

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1 *“Another party” refers to a public official acting in relation to the procurement process or contract execution]. In this context, “public official” includes the Government’s staff and employees of other organizations taking or reviewing procurement decisions.*

2 *“Party” refers to a public official; the terms “benefit” and “obligation” relate to the procurement process or contract execution; and the “act or omission” is intended to influence the procurement process or contract execution.*

3 *“Parties” refers to participants in the procurement process (including public officials) attempting to establish bid prices at artificial, non competitive levels.*

4 *“Party” refers to a participant in the procurement process or contract execution.*

award has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices in competing for the contract in question;

(ii) cancel the portion of the funding appropriation allocated to a contract if it determines at any time that representatives of the procuring entity or of a beneficiary of the appropriation were engaged in corrupt, fraudulent, collusive, or coercive practices during the selection process or the execution of that contract, without the procuring entity having taken timely and appropriate action satisfactory to the procuring entity to remedy the situation or address such practices when they occur;

(iii) sanction a bidder, including declaring ineligible, either indefinitely or for a stated period of time, to be awarded a Government financed contract if it at any time determines that the bidder has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices in competing for, or in executing, a Government financed contract; and

(iv) have the right to require that, in contracts financed by a Government appropriation, a provision be included requiring bidders to submit audited financial statements and the same to be certified by an independent auditor, and also to permit the Government to inspect their accounts and records and other documents relating to the submission of proposals and contract performance and to have them audited by auditors appointed by the Government.

3.5 Furthermore, bidders shall be aware of the provision stated in GCC 56.1 of this bidding document with regard to termination for fraudulent and corrupt behaviour.

4. Eligible Bidders

4.1 A bidder may be a natural person, private entity, or government-owned entity or a joint venture (JV), under an existing agreement, or with the intent to constitute a legally-enforceable JV (supported by a letter of intent). All partners shall be jointly and severally liable for the execution of the Contract in accordance with the terms and conditions of Contract. The JV shall nominate a Representative who shall have the authority to conduct all business for and on behalf of any and all the members of the JV during the bidding process and, in the event the JV is awarded the Contract, during contract execution. Unless **specified in the BDS**, there is no limit on the number of members in a JV.

4.2 A bidder shall be deemed to have the nationality of a country if the bidder is a citizen or is constituted, or incorporated, and operates in conformity with the provisions of the laws of that country. This criterion shall also apply to the determination of the nationality of proposed subcontractors or contractors for any part of the Contract including related services.

4.3 An eligible bidder (regardless of its country of registration and including any director, officer, manager or supervisor of the bidder) shall not within a period of 3 years preceding the date of issuance of the invitation to bid have been:

(a) convicted of any criminal offence, whether in Samoa or elsewhere:

(i) relating to his or her professional conduct;

(ii) relating to the making of false statements or misrepresentations as to his or her qualifications to enter into a procurement contract;

(iii) involving dishonesty; or

(iv) under anti-corruption legislation; or

(v) suspended or disbarred by administrative or judicial proceedings from participating in procurements, whether in Samoa or elsewhere; or

(b) convicted of an offence involving dishonesty, obstruction of justice or a lack of honesty or business integrity; or

(c) convicted for an offence involving corruption; or

(d) convicted for engaging in anti-competitive practices, whether or not involving collusion; or

(e) deliberately neglectful or failed without good cause to perform a contract in accordance with its terms, if so serious in nature as to justify suspension or debarment.

4.4 The bidding process is open to all eligible bidders.

4.5 A bidder shall not have a conflict of interest. All bidders found to have conflict of interest shall be disqualified. bidders may be considered to have a conflict of interest with one or more parties in the bidding process if:

(a) they are or have been associated in the past, with a firm or any of its affiliates (including third parties, controlling partner in common or a leading partner of a joint venture, or a common representative) which have been engaged by the procuring entity to provide consulting services for the preparation of the design, specifications, and other documents to be used for the procurement of the goods to be purchased under this bidding document; or

(b) they are associated, or have been associated in the past, with a firm or any of its affiliates (including third parties, controlling partner in common or a leading partner of a joint venture, or a common representative) that have been hired (or is proposed to be hired) by the procuring entity as Project Manager for the Contract.

4.6 Bidders shall not submit more than one bid in this bidding process, except for alternative bids permitted under ITB Clause 13. This does not limit the participation of Subcontractors in more than one bid.

4.7 A firm that has been sanctioned by the Government in accordance with ITB 3 shall be ineligible to be awarded a contract, or benefit from a Government-financed contract, financially or otherwise, during such period of time as the Government shall determine. The list of debarred firms shall be made available as **specified in the BDS.**

4.8 In accordance with the Instructions, the bidder and any named Subcontractors shall certify in the Bid Submission Form that they are in good standing with the Government and have paid all taxes, duties, fees and other impositions as may be levied in Samoa prior to the award of contract. Evidence of such certification may be required from the successful bidder prior to award of contract.

4.9 Foreign Government-owned enterprises and public bodies in Samoa shall be eligible only if they can establish that they:

(a) are legally and financially autonomous;

(b) operate under commercial law; and

(c) are not a dependent agency of the procuring entity or other department or agency of the Government.

4.10 Failure to directly obtain the bidding documents from the procuring entity will result in ineligibility of that bidder from participating in the procurement process.

4.11 Bidders shall provide such evidence of their continued eligibility satisfactory to the procuring entity as the procuring entity shall reasonably request.

4.12 In case a pre-qualification process is conducted prior to the tendering process, this tendering is open only to pre-qualified Bidders **as confirmed in the BDS**.

4.13 Bidders shall be excluded if:

(a) as a matter of law, the Government prohibits commercial relations with that country, provided that the Government is satisfied that such exclusion does not preclude effective competition for the supply of services as required; or

(b) by an act of compliance with a decision of the United Nations Security Council taken under Chapter VII of the Charter of the United Nations, the Government prohibits importation or contracting of general services from that country or payments to a person or entity in that country.

5. Eligible Materials, Equipment and Services

5.1 The materials, equipment and services to be supplied under the Contract and financed by the Government may have their origin in any country not that excluded in the list **specified in the BDS** and expenditures under the contract are limited to such materials, equipment and services. At the procuring entity's request, the bidders may be required to provide evidence of the origin of materials, equipment and services.

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

B. Contents of Bidding Document

6. Sections of Bidding Document

6.1 The Bidding Documents consist of Parts 1, 2, and 3, which include all the Sections indicated below, and should be read together with any Addenda issued in accordance with ITB 8.

PART 1 Bidding Procedures

Section I - Instructions to Bidders ("ITB")

Section II - Bid Data Sheet ("BDS")

Section III - Evaluation and Qualification Criteria

Section IV - Bidding Forms

Section IVA - Eligible Countries

PART 2 Requirements

Section V - Works Requirements

PART 3 Conditions of Contract and Contract Forms

Section VI - General Conditions of Contract ("GCC")

Section VII – Special Conditions of Contract ("SCC")

Section VIII - Contract Forms

6.2 "Bidding documents" means the SBD developed and prescribed by the Ministry of Finance for use in public procurement proceedings and all amendments made to the document for the purposes of a procuring entity and documents attached or incorporated by reference, that individually or collectively

(a) invite bids;

(b) establish the objects of a bid;

(c) specify the conditions of a proposed procurement contract; and

(d) establish the applicable bidding procedures.

6.3 The procuring entity is not responsible for the completeness of the Bidding Documents and their Addenda if they were not obtained directly from the procuring entity and by the process stated by the procuring entity in the Invitation to Bidders.

6.4 The bidder is expected to examine all instructions, forms, terms, and specifications in the bidding document. Failure to furnish all information or documentation required by the bidding document may result in the rejection of the bid.

7. Clarification of Bidding document, Site Visit, Pre-Bidding Meeting

7.1 A prospective bidder requiring any clarification of the bidding document shall contact the procuring entity in writing at the procuring entity's address **indicated in the BDS** within 14 working days before closing date and time for submission of Bids *or* raise his/her inquiries during the pre-bid meeting. The procuring entity shall respond in writing to any request for clarification, provided that such request is received prior to the deadline for submission of bids, no later than the number of days **stated in the BDS** prior to the deadline for submission of bids, within a period **given in the BDS**. The procuring entity shall forward copies of its response to all bidders who have acquired the bidding document, including a description of the inquiry but without identifying its source.

7.2 Should the procuring entity deem it necessary to amend the bidding document as a result of a request for clarification, the Bidding Document may be amended in accordance with the procedure under ITB 8.

7.3 The bidder may, at the bidder's own expenses, risk and responsibility, visit and examine the Site of works and its surroundings and obtain for itself, on its own risk and responsibility, all information that may be necessary for preparing the bid and entering into a contract for the works.

7.4 The procuring entity will arrange for the bidder and any of its personnel or agents to gain access to the relevant site(s), provided that the bidder gives the procuring entity adequate notice of a proposed visit of at least fourteen (14) days. Alternatively, the procuring entity may organise a site visit, if **specified in the BDS**, or visits concurrently with a pre-bid meeting, if one is required. Failure of a bidder to attend a site visit will not be a cause for its disqualification.

7.5 No site visits shall be arranged or scheduled after the deadline for the submission of the bids and prior to the award of contract.

7.6 The bidder and any of its personnel or agents will be granted permission by the procuring entity to enter upon its premises and lands for the purpose of such visit, but only upon the express condition that the bidder, its personnel, and agents will release and indemnify the procuring entity and its personnel and agents from and against all liability in respect thereof, and will be responsible for death or personal injury, loss of or damage to property, and any other loss, damage, costs, and expenses incurred as a result of the inspection.

7.7 The bidder's designated representative may be invited to attend a pre-bid meeting, if provided for in the BDS. The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.

7.8 The bidder is requested, as far as possible, to submit any questions in writing, to reach the procuring entity not later than the number of days **as indicated in the BDS** before the pre-bid meeting.

7.9 Minutes of the pre-bid meeting includes the text of the questions raised, without identifying the source, and the responses given, together with any responses prepared after the meeting, will be transmitted promptly to all bidders who have acquired the bidding document. Any modification to the bidding documents that may become necessary as a result of the pre-bid meeting shall be made by the procuring entity exclusively through the issue of an addendum pursuant to ITB 8 and not through the minutes of the pre-bid meeting.

7.10 Non-attendance at the pre-bid meeting will not be a cause for disqualification of a bidder.

8. Amendment of Bidding Document

8.1 At any time prior to the deadline for submission of bids, the procuring entity may amend the bidding documents by issuing an addendum.

8.2 Any addendum issued shall form part of the bidding documents and shall be communicated in writing to all who have obtained the bidding documents from the procuring entity.

8.3 To give prospective bidders reasonable time in which to take an addendum into account in preparing their bids, the procuring entity may, at its discretion, extend the deadline for the submission of bids, pursuant to ITB 22.2 of this bidding document.

C. Preparation of Bids

9. Cost of Bidding

9.1 The bidder shall bear all costs associated with the preparation and submission of its bid, and the procuring entity shall not be liable for those costs, regardless of the conduct or outcome of the bid process.

10. Language of Bid

10.1 The bid as well as all correspondence and documents relating to the same, shall be written in the English language. Supporting documents and other printed materials that are part of the bid may be in another language provided they are accompanied by an accurate translation of the relevant passages of the bid in the English language, in which case and for the purposes of interpreting the Bidding, the translated version shall take precedent.

11. Documents Comprising the Bid

11.1 The bid shall comprise the following:

(a) the Letter of Bid;

(b) the completed Schedules in accordance with ITB 12 and 14;

(c) Bid Security or Bid Securing Declaration, in accordance with ITB 19;

(d) alternative bids if permissible in accordance with ITB 13;

(e) written confirmation authorising the signatory of the bid to commit the bidder, in accordance with ITB 20.2;

(f) documentary evidence in accordance with ITB 17 establishing the bidder's qualifications to bid and perform the Contract if awarded;

(g) Technical Proposal in accordance with ITB 16;

(h) in the case of a bid submitted by a joint venture (JV), the JV agreement, or letter of intent to enter into a JV including a draft agreement, indicating at least the parts of the works to be executed by the respective partners; and

(i) any other document **required in the BDS**.

11.2 In addition to the requirements under ITB 11.1, bids submitted by a JV shall include a copy of the Joint Venture Agreement entered into by all partners. Alternatively, a Letter of Intent to execute a Joint Venture Agreement in the event of a successful bid shall be signed by all partners and submitted with the bid, together with a copy of the proposed agreement.

12. Letter of Bid and Schedules

12.1 The Letter of Bid, Schedules and all documents listed under ITB 11 shall be prepared using the relevant forms in Section IV - Bidding Forms, if so provided. The forms must be completed without any alterations to the text, and no substitutes shall be accepted. All blank spaces shall be filled in with the information requested if information requested is applicable.

13. Alternative Bids

13.1 Unless otherwise **indicated in the BDS**, alternative bids shall not be considered.

13.2 When alternative times for completion are explicitly invited, a statement to that effect will be **included in the BDS**, as will the method of for the estimated different times for completion.

13.3 When **specified in the BDS**, bidders are permitted to submit alternative technical solutions for specified parts of the works. Such parts will be identified in the BDS and described in Section V - Work’s Requirements. The method for their evaluation will be stipulated in Section - III - Evaluation and Qualification Criteria.

14. Bid Prices and Discounts

14.1 The prices and discounts quoted by the bidder in the Letter of Bid and in the Schedules shall conform to the requirements specified in this ITB 14.

14.2 The bidder shall submit a bid for the whole of the works described in ITB 1.1 by submitting prices for all items of the works, as identified in **Section IV - Bidding Forms – Priced Activity Schedules or Bills of Quantities**. In the case of admeasurement (measure and value) contracts, the bidder shall fill in rates and prices for all items of the works described in the Bill of Quantities. Items against which no rate or price is entered by the bidder will not be paid for by the procuring entity when executed and shall be deemed covered by the rates for other items and prices in the Bill of Quantities.

14.3 The price to be quoted in the Letter of Bid shall be the total price of the bid including VAGST, and excluding any discounts offered and withholding tax.

14.4 Any unconditional discounts and the methodology for their application shall be quoted in the Letter of Bid in accordance with ITB 12.1.

14.5 If so indicated in ITB 1.2, bids may be invited for individual contracts or for any combination of contracts (packages). Unless otherwise **indicated in the BDS**, prices quoted shall correspond to 100 % of the items specified for each lot and to 100% of the quantities specified for each item of a lot. Bidders wishing to offer any price reduction for the award of more than one (1) Contract shall specify in their bid the price reductions applicable to each package, or alternatively, to individual Contracts within the package. Price reductions or discounts shall be submitted in accordance with ITB 14.4, provided the bids for all contracts are submitted and opened at the same time.

14.6 Unless otherwise **provided in the BDS** and the GCC, the prices quoted by the bidder shall be fixed. If the prices quoted by the bidder are subject to adjustment during the performance of the Contract in accordance with the provisions of the GCC, the bidder shall furnish the indices and weightings for the price adjustment formulae in the Schedule of Adjustment Data in Section IV -Bidding Forms and the procuring entity may require the bidder to justify its proposed indices and weightings. These adjustments shall not be considered in the evaluation of bids.

14.7 All duties, taxes, and other levies payable by the contractor under the Contract, or for any other cause, as of the date twenty-eight (28) days prior to the deadline for submission of bids, shall be included in the rates and prices and the total bid price submitted by the bidder. Despite that applicable taxes, duties or other levies are not included such are payable by the contractor and reflected in the Contract as confirmed by the relevant authority prior signing of Contract.

15. Currencies of Bid and Payment

15.1 The currency(ies) of the bid and the currency(ies) of payments shall be the same. The bidder shall quote in Samoan Tala (SAT$), the portion of the bid price that corresponds to expenditures incurred in Samoa, unless otherwise **specified in the BDS**.

15.2 The bidder may express the bid price for expenditure outside of Samoa in any freely convertible currency. If the bidder wishes to be paid in a combination of amounts in different currencies, it may quote its price accordingly but shall use no more than three freely convertible international currencies in addition to Samoan Tala (SAT$).

16. Documents Comprising the Technical Proposal

16.1 The bidder shall furnish a Technical Proposal including a statement of the works methods or works program, equipment, personnel, schedule and any other information as stipulated in **Section IV - Bidding Forms** in sufficient detail to demonstrate the adequacy of the bidders’ proposal to meet the work requirements and the completion time.

17. Documents Establishing the Qualifications of the bidder

17.1 The bidder shall furnish evidence confirming their eligibility under ITB 4. The documentary evidence of the bidder's qualifications to perform the contract if its bid is accepted shall establish to the procuring entity's satisfaction:

(a) that it has the financial and technical capability necessary to perform the contract, meets the qualification criteria **specified in the BDS,** and has a successful performance history. If a pre-qualification process has been undertaken for the contract(s) for which these bidding documents have been issued, the bidder shall, as part of its bid, update any information submitted with its application for pre-qualification. For the purposes of establishing a bidder's qualifications, and unless otherwise **stated in the BDS**, the experience and/or resources of any Subcontractor will not contribute to the bidder's qualifications and only those of a Joint Venture partner will be considered.

(b) that the bidder meets each of the qualification criterion specified in Section III, Evaluation and Qualification Criteria.

18. Period of Validity of Bids

18.1 Bids shall remain valid for the period **specified in the BDS** after the bid submission deadline date prescribed by the procuring entity. A bid valid for a shorter period shall be rejected by the procuring entity as non-responsive.

18.2 In exceptional circumstances, prior to the expiration of the bid validity period, the procuring entity may request bidders to extend the period of validity of their bids. The request and the responses shall be made in writing. If a Bid Security is requested in accordance with ITB 19, it shall also be extended for a corresponding period. A bidder may refuse the request without forfeiting its bid security. A bidder granting the request shall not be required or permitted to modify its bid.

19. Bid Security/Bid Securing Declaration

19.1 The bidder shall furnish as part of its bid, a Bid Security or a Bid-Securing Declaration if required, as **specified in the BDS**.

19.2 The Bid Security or Bid Securing Declaration shall be in the amount **specified in the BDS** and denominated in Samoan Tala (SAT$) or the currency of the bid, and shall:

(a) at the bidder's option, be in the form of either a letter of credit, bank cheque or an unconditional bank guarantee from a banking institution, or a bond issued by a surety;

(b) be issued by a reputable institution selected by the bidder. If the institution issuing the bond is located outside Samoa, it shall have a correspondent financial institution located in Samoa to make it enforceable;

(c) be substantially in accordance with one of the forms of Bid Security in **Section IV- Bidding Forms**;

(d) be payable promptly upon written demand by the procuring entity in case the conditions listed in ITB 19.5 are invoked;

(e) be submitted in its original form as copies will not be accepted; and

(f) remain valid for a period of twenty eight (28) days beyond the validity period of the bids as extended if applicable, in accordance with ITB 18.2.

19.3 If a Bid Security or a Bid-Securing Declaration is required in accordance with ITB 19.1, any bid not accompanied by a substantially responsive Bid Security or Bid Securing Declaration in accordance with ITB 19.1 shall be rejected by the procuring entity as being non-responsive.

19.4 The Bid Security of unsuccessful bidders shall be returned as promptly as possible upon the successful bidder's furnishing of the Performance Security pursuant to ITB 44.

19.5 The Bid Security may be forfeited:

(a) if a bidder withdraws or modifies its bid during the period of bid validity in accordance with ITB 19.1, and as provided for in ITB 19.2 if applicable; or

(b) if a bidder does not accept a correction of errors (arithmetic) in accordance with ITB Clause 30.2; or

(c) if the successful bidder fails to:

(i) sign the Contract in accordance with ITB Clause 43; and

(ii) furnish a Performance Security in accordance with ITB Clause 44.

19.6 In the case where a bid securing declaration is forfeited, the bidder will be disqualified for one year from participation in any Government procurement regardless of the source of funding.

19.7 The Bid Security or Bid- Securing Declaration of a JV must be in the name of a legally constituted JV that submits the bid or otherwise in the names of all future partners as named in the letter of intent mentioned in Section IV -

Bidding Forms - Bidder Information Form.

19.8 If a Bid security is not required in the BDS, and if a bidder withdraws its bid during the period of bid validity specified by the bidder in accordance with ITB 18.1 and ITB 18.2 where applicable, if the bidder fails to sign the Contract, that bid will be disqualified for one year from participation in any Government procurement regardless of the source of funding.

19.9 If a Bid Securing Declaration is required, it must be in the form in Section IV - Bidding Forms, and the same shall remain valid for a period of twenty eight (28) days or beyond the validity period of the bids as extended if applicable, in accordance with ITB 18.2.

20. Format and Signing of Bid

20.1 The bidder shall prepare one original of the documents comprising the bid as described in ITB and clearly mark it "ORIGINAL". If alternative bids are permitted in accordance with ITB 13, the documents shall be clearly marked "ALTERNATIVE". In addition, the bidder shall submit the required amount of copies of that bid, **in accordance with the BDS** and clearly mark them "COPY". In the event of any discrepancy between the Original and the Copies, the Original prevails.

20.2 The Original and all Copies of the bid shall be typed or written in indelible ink and shall be signed by the bidder or a person duly authorised to sign on behalf of the bidder.

20.3 The written confirmation of authorisation to sign on behalf of the bidder shall be:

(a) a notarised Power of Attorney authorising and assigning the authority of the signatory to sign the bid in all its parts; and

(b) in the case of a bid submitted by an existing JV joint venture ("JV"), a notarised undertaking signed by all parties:

(i) stating that all parties shall be jointly and severally liable, if so required in accordance with ITB 4.1, and

(ii) nominating a representative who shall have the authority to conduct all business for and on behalf of any and all the parties of the JV during the bidding process and in the event the JV is awarded the Contract, during contract execution.

20.4 The name and position held by each person signing the authorisation must be typed or printed below the signature.

20.5 Any interlineation, erasures, or overwriting shall be valid only if they are signed or initialled by the authorised person signing the bid.

D. Submission and Opening of Bids

21. Sealing and Marking of Bids

21.1 Bidders may submit their Bids electronically, or by hand. Bidders may submit bids electronically, if permitted in BDS, via the Ministry of Finance's (MOF) Tender Link Portal. Bidders submitting bids by hand delivery, shall enclose the original and each copy of the bid, including alternative bids, if permitted in accordance with ITB 13, in three (3) separate envelopes, sealed and duly marked as "Original", "Copy" and "ALTERNATIVE", respectively. All three (3) envelopes shall then be enclosed in one (1) single envelope. Bids submitted via the MOF Tender Link Portal are to follow the Portal's submission procedures, as directed in the BDS. The rest of the procedure shall be in accordance with ITB 21.2 and 21.3.

21.2 The inner and outer envelopes shall:

(a) bear the name and address of the bidder;

(b) be addressed to the procuring entity in accordance with ITB 22.1;

(c) bear the specific identification of this bidding process indicated in ITB 1.2 and any additional identification marks as **specified in the BDS**; and

(d) bear a warning to the effect that the envelope must not be opened before the time and date for bid opening in accordance with ITB 25.1 of this bidding document.

21.3 If all envelopes are not sealed and marked as required, the procuring entity will assume no responsibility for the misplacement or premature opening of any bid. The procuring entity also assumes no responsibility for delay in courier or any other form of delivery.

22. Deadline for Submission of Bids

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

22.2 The procuring entity may at its discretion, extend the deadline for the submission of bids by amending the bidding document in accordance with ITB 8, in which case all rights and obligations of the procuring entity and bidders previously subject to the deadline shall thereafter be subject to the deadline as extended.

23. Late Bids

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

24. Withdrawal,

24.1 A bidder may withdraw, substitute, or modify its bid after it has been

Substitution and Modification of Bids

submitted by sending a written notice, duly signed by the bidder or an authorised representative of the bidder, and shall include a copy of the authorisation (the power of attorney) in accordance with ITB 20.2, (except that withdrawal notices do not require copies). The corresponding substitution or modification of the bid must accompany the respective written notice. All notices must be:

(a) prepared and submitted in accordance with ITB 20 and ITB 21 (except that withdrawal notices do not require copies), and in addition, the respective envelopes shall be clearly marked "**WITHDRAWAL**", "**SUBSTITUTION**", or "**MODIFICATION**", respectively; and

(b) received by the procuring entity prior to the deadline prescribed for submission of bids in accordance with ITB 22.

24.2 Bids requested to be withdrawn in accordance with ITB 24.1 shall be returned unopened to the bidders.

24.3 No bid may be withdrawn, substituted, or modified in the interval between the deadline for submission of bids and the expiration of the period of bid validity.

25. Bid Opening

25.1 The procuring entity shall conduct the bid opening at the address, date and time **specified in the BDS** in the presence of bidders (or designated representatives of the bidders) who choose to attend, representatives of the procuring entity and Tenders Board. Any specific opening procedures required under electronic Bidding are permitted in accordance with the BDS, and shall be as specified in the BDS.

25.2 First, envelopes marked "WITHDRAWAL" shall be opened and read out and the envelope with the corresponding bid shall not be opened, but returned to the bidder. If the withdrawal envelope does not contain a copy of the "power of attorney" confirming the signature as a person duly authorised to sign on behalf of the bidder, the corresponding bid previously submitted will be opened. No bid withdrawal shall be permitted unless the corresponding withdrawal notice contains a valid authorisation to request the withdrawal and is read out at bid opening.

25.3 Next, envelopes marked "SUBSTITUTION" shall be opened and read out and exchanged with the corresponding bid being substituted, and the substituted bid previously submitted shall not be opened, but returned to the bidder. No bid substitution shall be permitted unless the corresponding substitution notice contains a valid authorisation by means of a copy of the power of attorney to request the substitution and is read out at bid opening.

25.4 Next, envelopes marked “Modification” shall be opened and read out with the corresponding bid. No bid modification shall be permitted unless the corresponding modification notice contains a valid authorisation to request the modification and is read out at bid opening. Only envelopes that are opened and read out at bid opening shall be considered further.

25.5 All other envelopes shall be opened and read out identifying the following:

(a) the name of the bidder and whether there is a modification; and

(b) the bid prices, including any discounts and alternative offers; and

(c) the presence of a Bid Security or Bid-Securing Declaration if required; and

(d) any other details as the procuring entity may consider appropriate. Only discounts and alternative offers read out at bid opening shall be considered for evaluation. No bid shall be rejected at bid opening except for late bids, in accordance with ITB 23.1.

25.6 The procuring entity shall prepare a record of the bid opening that shall include as a minimum:

(a) the name of the bidder and whether there is a withdrawal, substitution, or modification;

(b) the bid price, per lot if applicable, including any discounts, and alternative offers if they were permitted;

(c) the presence or absence of a Bid Security or Bid-Securing Declaration, if one was required.

(d) The bidders’ representatives who are present shall be requested to sign the attendance record sheet. The omission of a bidder’s signature (or signature of bidder’s authorised representative) does not invalidate the contents and effect of the record sheet.

25.7 A copy of the record shall be distributed to all bidders who submitted bids on time.

E. Evaluation and Comparison of Bids

26. Confidentiality

26.1 Information relating to the examination, evaluation, comparison, and post-qualification of the bids and recommendation of contract award, shall not be disclosed to the bidders or any other persons not officially concerned with the bid until the Contract award has been formally communicated to the successful bidders.

26.2 Any effort by a bidder to influence the procuring entity in the examination, evaluation, comparison, and post-qualification of the bids or Contract award decisions may result in the rejection of its bid and may be subject to the provisions of the Government's antifraud and corruption policy.

26.3 Despite ITB 26.2, from the time of bid opening to the time of Contract award, if any bidder wishes to contact the procuring entity on any matter related to the bidding process, it should do so in writing.

27. Clarification of Bids

27.1 To assist in the examination, evaluation, and comparison and post-qualification of the bidders, the procuring entity may, at its discretion, request in writing from any bidder for a clarification of its bid. Any clarification submitted by a bidder that is not in response to a request by the procuring entity or if a bidder does not provide clarification as requested by the procuring entity, the bid shall not be considered and rejected. The procuring entity's request for clarification and the response shall be in writing. No change in the prices or substance of the bid shall be sought, offered, or permitted, except to confirm the correction of arithmetic errors discovered by the Bid Evaluation Committee in the evaluation of the bids in accordance with ITB 30. Any variation of price as a result of tax issues must be referred back to the Tenders Board for approval.

27.2 If a bidder does not provide clarifications of its bid by the date and time set as out in the procuring entity's request for clarification, its bid may be rejected.

28. Definitions of Deviations, Reservations and Omissions

28.1 During the evaluation of bids, the following definitions apply:

(a) "Deviation" is a departure from the requirements specified in the bidding document;

(b) "Reservation" is the setting of limiting conditions or withholding from complete acceptance of the requirements specified in the bidding document; and

(c) "Omission" is the failure to submit part or all of the information or documentation required in the bidding documents.

29. Determination of Responsiveness

29.1 The Bid Evaluation Committee's determination of a bidder's responsiveness is to be based on the contents of the bid itself.

29.2 A substantially

responsive bid is one that meets the requirements of the bidding document without material deviation, reservation, or omission.

29.3 A material deviation, reservation, or omission is one that:

(a) affects in any substantial way the scope, quality, or performance of the works specified in the Contract; or

(b) is inconsistent with the bidding document, and substantially limits the procuring entity's rights or the bidder's obligations under the Contract; or

(c) if rectified would unfairly affect the competitive position of the other bidders who have submitted substantially responsive bids.

29.4 If a bid is not substantially responsive to the requirements of the bidding documents, it shall be rejected by the Bid Evaluation Committee and may not subsequently be made responsive by correction of the material deviation, reservation, or omission.

30. Non conformities, Errors, and Omissions

30.1 Provided that a bid is substantially responsive, the Bid Evaluation Committee may waive any non-conformities, errors or omissions in the bid that do not constitute a material deviation.

30.2 Provided that a bid is substantially responsive, the Bid Evaluation Committee may request that the bidder submit the necessary information or documentation, requested by the procuring entity, within a period of time specified in their request, to rectify minor or non-material non-conformities, errors or omissions in the bid related to its documentation requirements. The procuring entity's request should only be for the purpose of seeking clarification and not result in disqualification of a bid. Requesting information or documentation on such non-conformities, errors or omissions 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.

31. Correction of Arithmetical Errors

31.1 Provided that the bid is substantially responsive, the Bid Evaluation Committee shall correct arithmetical errors on the following basis:

(a) if there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail and the total price shall be corrected, unless in the opinion of the procuring entity 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 (a) and (b) above.

31.2 The amount stated in the bid shall be adjusted by the Bid Evaluation Committee in accordance with the above procedure for the correction of errors and shall be considered as binding upon the bidder. If the bidder does not accept the correction of errors, its bid may be rejected.

32. Conversion to Single Currency

32.1 For evaluation and comparison purposes, the Bid Evaluation Committee shall convert all bid prices expressed in the submitted bids into the amount **specified in the BDS**, using the selling exchange rates established by the source and on the date **specified in the BDS**.

33. Domestic Preference

33.1 Domestic preference shall not be a factor in bid evaluation, unless otherwise **specified in the BDS**.

33.2 If applicable, the percentage of domestic preference which will be applied is **specified in the BDS and bidders must:**

(a) be registered within Samoa;

(b) have majority ownership by Samoan nationals;

(c) not subcontract more than ten percent (10%) of the Contract Price, excluding provisional sums, to foreign contractors or non-resident companies (not including those registered in Samoa).

34. Subcontractors

34.1 Unless otherwise **stated in the BDS**, the procuring entity does not intend to execute any specific elements of the works by Subcontractors selected in advance by the procuring entity.

34.2 The subcontractor's qualifications shall not be used by the bidder to qualify for the works unless their specialised parts of the works were previously designated by the procuring entity **in the BDS** as can be met by subcontractors referred to hereafter as 'Specialised Subcontractors', in which case, the qualifications of the Specialised Subcontractors proposed by the bidder may be added to the qualifications

34.3 Bidders may propose subcontracting up to the percentage of total value of contracts or the volume of works as **specified in the BDS**. Subcontractors proposed by the bidder shall be fully qualified for their parts of the works.

35. Evaluation of Bids

35.1 The Bid Evaluation Committee shall examine each eligible bid to determine, its responsiveness.

35.2 To evaluate a bid, the Bid Evaluation Committee shall consider the following:

(a) the Bid Price, excluding Provisional Sums and the provision, if any, for contingencies in the Summary Bill of Quantities for admeasurement (measure and value) contracts or Schedule of Prices for lump sum contracts, but including Day-work items where priced competitively;

(b) price adjustment for correction of arithmetic errors in accordance with ITB 31.1;

(c) price adjustment due to discounts offered in accordance with ITB 14.3;

(d) converting the amount resulting from applying (a) to (c) above if relevant, to a single currency in accordance with ITB 32;

(e) adjustment for non-conformities in accordance with ITB 30.2; and

(f) the application of all the evaluation factors indicated in Section III - Evaluation and Qualification Criteria.

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

35.4 If the bidding document allows bidders to quote separate prices for different contracts, and to award multiple contracts to a single bidder, the methodology to determine the lowest evaluated price of the contract combinations, including any discounts offered in the Letter of Bidding, is specified in Section III - Evaluation and Qualification Criteria.

36. Comparison of Bids

36.1 The Bid Evaluation Committee shall compare all substantially responsive bids to determine the lowest evaluated bid in accordance with ITB 35.

37. Abnormally Low Bid

37.1 An Abnormally Low Bid is one where the bid price, in combination with other elements of the bid, appears so low that it raises material concerns as to the capability of the bidder in regards to the bidder's ability to perform the contract for the offered bid price.

37.2 In the event of identification of a potentially Abnormally Low Bid, the procuring entity shall seek written clarifications from the bidder, including detailed price analyses of its bid price in relation to the subject matter of the contract, scope, proposed methodology, schedule, allocation of risks and responsibilities and any other requirements of the bidding document.

37.3 After evaluation of the price analyses, in the event that the procuring entity determines that the bidder has failed to demonstrate its capability to perform the bid for the offered bid price, the Bid Evaluation Committee shall reject the Bid.

38. Unbalanced or front loaded bids

38.1 If the bid that is evaluated as the lowest bid price or most advantageous is, in the Bid Evaluation Committee's opinion, seriously unbalanced or front loaded, the procuring entity may require the bidder to provide written clarifications. Clarifications may include detailed price analyses to demonstrate the consistency of the bid prices with the scope of works, proposed methodology, schedule and any other requirements of the bidding document.

38.2 After the evaluation of the information and detailed price analyses presented by the bidder, the Bid Evaluation Committee may as appropriate:

(a) accept the bid; or

(b) require that the total amount of the performance security be increased at the expense of the bidder to a level not exceeding 20 % of the contract Price; or

(c) reject the bid.

39. Qualification

39.1 The Bid Evaluation Committee shall determine to its satisfaction whether

of the Bidder — the bidder that is selected as having submitted the lowest evaluated and substantially responsive bid meets the qualifying criteria specified in **Section III - Evaluation and Qualification Criteria**.

39.2 The determination shall be based upon an examination of the documentary evidence of the bidder's qualifications submitted by the bidder pursuant to ITB 17.1.

39.3 An affirmative determination of qualification shall be a prerequisite for award of the Contract to the bidder. A negative determination shall result in disqualification of the Bidding, in which event the Bid Evaluation Committee shall proceed to the next lowest evaluated bid to make a similar determination of that bidder's qualifications to perform satisfactorily.

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

40.1 The procuring entity reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids at any time prior to awarding the contract, without thereby incurring any liability to the bidders:

a) at any time prior to the acceptance of the successful bid; or

b) after the successful bid is accepted if:

(i) the bidder presenting the successful bid is suspended or debarred;

(ii) the procurement is cancelled;

(iii) the bidder presenting the successful bid is excluded on the grounds of corruption, unfair competition or conflict of interest;

(iv) the procurement, the bid or the bidder contravenes or is otherwise not compliant with the provisions of the laws of the Independent State of Samoa.

40.2 In case of annulment of any bids submitted and specifically, bid securities, the respective bidders are immediately notified and given ample time to uplift the bids and bid securities from the procuring entity.

F. Award of Contract

41. Award Criteria

41.1 The procuring entity shall award the Contract to the bidder whose offer has been determined to be substantially responsive to the bidding documents, provided further that the bidder is determined by the evaluation panel to be qualified to perform the Contract to the satisfaction of the procuring entity. The bidder awarded the Contract may also be considered by the procuring entity as the bidder with the lowest evaluated bid.

41.2 At the time the Contract is awarded, the procuring entity reserves the right to increase or decrease the quantity of the works originally required, provided that this does not exceed the percentages **specified n the BDS**, and without any change in the unit prices or other terms and conditions of the bid and bidding document.

42. Notification of Award

42.1 Prior to the expiration of the bid validity period, the procuring entity shall notify the successful bidder in writing, that its bid has been accepted. At the same time, the procuring entity must also notify all other bidders of the results of the bidding, and shall publish in website of the Ministry of Finance, the results identifying the bid and lot numbers and the following information:

(i) name of each bidder who submitted a bid; and

(ii) name of the winning bidder, and the Price it offered, as well as the duration and summary scope of the contract awarded.

42.2 The date of the notification under ITB Sub-Clause 42.1 establishes the commencement of the standstill period **specified in the BDS**. During this time bidders may request, in writing, a debriefing seeking explanations on the ground on which their bids were not selected, or invoke the ‘right to complain’ in accordance with ITB 45. The request for debriefing may only seek explanations for the grounds on which their bid was not selected.

42.3 The procuring entity shall promptly respond in writing to any unsuccessful bidder who requests a debriefing. If the request is made within the standstill period the contract award will be suspended until the debriefing has taken place.

42.4 Until a formal Contract is prepared and executed, the notification of award shall not constitute a binding Contract.

42.5 Within twenty-eight (28) days of receipt of notification of award, the successful bidder, if international, shall take to successful completion the necessary actions, in liaison with the relevant authorities, to obtain proper registration, licences and membership as required in order to carry out economic or business activities in Samoa.

43. Signing of Contract

43.1 After notification, the procuring entity shall send the successful bidder the Contract Agreement with the Conditions of Contract for any comments before the same is reviewed and cleared by AGO.

43.2 The successful bidder shall return the signed contract within 28 days from the date of the Letter of Acceptance and shall sign, date, and return to the procuring entity the signed Contract Agreement and performance security pursuant to ITB 44.

43.3 On receipt of the signed Contract Agreement and performance security, if required, the procuring entity will immediately notify in writing all unsuccessful bidders, of the final results of the bidding process. This notice will discharge their bid securities pursuant to ITB 19.4.

43.4 Once both the bidder and procuring entity have agreed to the Contract Agreement as cleared by AGO, the same shall be finalised and signed.

43.5 Following signature of the Contract Agreement, the procuring entity shall publish, in the manner prescribed by the Office, the results, identifying the name of the contractor, the contract price and the contract number.

44. Performance Security

44.1 Within twenty eight (28) days of the receipt of notification of award from the procuring entity the successful bidder, shall furnish the Performance Security, using for that purpose the Performance Security Form included in Section VIII - Contract Forms from an institution acceptable to the procuring entity. The procuring entity shall promptly notify the winning bidder to each unsuccessful bidder and discharge the Bid Securities of the unsuccessful bidders pursuant to ITB 19.4.

44.2 If the performance security furnished by the successful bidder is in the form of a bond, it shall be issued by a bonding or insurance company that has been determined by the successful bidder to be acceptable to the procuring entity. A foreign institution providing a bond must have a correspondent financial institution located in the Samoa.

44.3 Failure of the successful bidder to submit the above-mentioned Performance Security, comply with local requirements or sign the Contract shall constitute sufficient grounds for the annulment of the award and forfeiture of the Performance Security. In that event the procuring entity may award the Contract to the next lowest evaluated bidder, whose offer is substantially responsive and is determined by the procuring entity to be qualified to perform the Contract satisfactorily.

45. Adjudicator

45.1 The procuring entity proposes the person **named in the BDS** to be appointed as Adjudicator under the Contract, at the hourly fee **specified in the BDS**, plus reimbursable expenses. If the bidder disagrees with this proposal, the bidder should so state in their bid. If, in the Letter of Acceptance, the procuring entity does not agree on the appointment of the Adjudicator, the procuring entity will request the Appointing Authority designated in the Special Conditions of Contract (SCC) pursuant to Clause 23.1 of the General Conditions of Contract (GCC), to appoint the Adjudicator.

46. Right to complain

46.1 The bidder has a right to complain in accordance with the Procurement Independent Complaints and Review Procedure (Part K.9 of the Treasury Instructions).

46.2 An actual bidder in procurement proceedings who claims to have suffered, or to be likely to suffer harm due to a breach of a duty imposed on a procuring entity by or under the Instructions, may complain to a procuring entity.

46.3 Such complaint must be made in writing working days after the date of notification of award of contract. Any complaint received after the 10-day period shall not be considered.

46.4 The bidder should submit its complaint in accordance with the procedures to the address **specified in the BDS**.

46.5 If a complainant is dissatisfied with the decision of a procuring entity, the complainant has the right to have the complaint and decision of the procuring entity reviewed by an independent adjudicator. To do so, the complainant must submit an Application for Review in writing, to the Secretariat of the Tenders Board.

46.6 A complaint or an application for review must be made in accordance with (Part K.9 of the Treasury Instructions).

46.7 A complaint referred to the independent adjudicator shall not be entertained and is dismissed unless the independent adjudicator is satisfied:

(a) that the complainant is an actual bidder who was part of the relevant procurement proceedings in question;

(b) that the complainant shows that he/she/it/they had suffered or is likely to suffer harm; and

(c) that the harm was due to a breach of a duty imposed on the procuring entity; and

(d) that the duty imposed on the relevant procuring entity is provided for under Part K of the Treasury Instructions.

Section II - Bid Data Sheet (BDS)

The following BDS shall be used for the works to be performed and shall complement, supplement, or amend the provisions in the ITB. Whenever there is a conflict, the provisions herein shall prevail over those in the ITB.

ITB Clause Reference	**A. General**
ITB 1.1	The procuring entity is: The Tender No. is: ***SAM EPC TIAP – 25/2021*** The number and identification of **lots** comprising this tender process is: **NOT APPLICABLE**
ITB 1.2	The name of the bid is: **Engineering Supply and Construction of Tiapapata Small Hydro Power Plant**
ITB 2.1	The name of the Project is: As per 1.2 above
ITB 4.1	Maximum number of members in the JV shall be: Three
ITB 4.7	The list of debarred firms is the same as those that are excluded by, or are not members of, the World Bank or ADB.
ITB 4.12	A pre-qualification shall not apply.
ITB 5.1	Ineligible countries are: Andora, Democratic People's Republic of Korea, Liechtenstein, Monaco (World Bank and ADB non members) and Iraq (UN Security Council) and any other country excluded from the process by the World Bank or ADB. The country of registration must be a member of the World Bank or Asian Development Bank and not under sanction of the UN Security Council.

B. Bidding Documents

ITB 7.1	For **clarification purposes** only, the Principal's address is: Attention: ***General Manager*** Contact Entity Name: **Electric Power Corporation** Address: **Level 5, TATTE Building,** City: **Apia** Country: ***SAMOA***

	Email: ***toimoanai@epc.ws*** Telephone: +**685 65500** Requests for clarification should be received by the Principal no later than: ***4pm (local time) on 23rd August 2021 change date***
ITB 7.1	Requests for clarification should be received by the procuring entity no later than: 14 days before the deadline for submission of bids stated at ITB 22.1.
ITB 7.4	A site visit [will/] be organised as part of the pre-bid meeting. [The site visit will take place at the following date, time and place: Date:22nd July 2021 Time: 10am Place: Tiapapata]
ITB 7.7	A Pre-Tender meeting will take place, it will be at the following date, time and place: Time: ***10am*** Date: 21st July 2021 Place: ***EPC Office, Level 5 Tui Atua Tupua Tamasese Efi Building, Apia, Samoa*** A zoom invitation will also be provided and sent over via email.
ITB 7.8	Any questions must be submitted 3 days before the date of the pre-bid meeting.

C. Preparation of Bids

ITB 11.1	Tenderers who wish to obtain editable copies of the tender templates referenced below should email a request to: General Manager, EPC, Apia Samoa, Attention Project Engineer: Siu Fanolua, fanoluas@epc.ws The Tenderer's attention is drawn to the following information and Schedules that must be submitted with (as essential parts of) the Tender. Section III Evaluation and Qualification Criteria: Evaluation Criteria 1.1 to 1.6: These evaluation criteria must be fully addressed in the Tenderer's Technical Proposal or Financial Proposal as appropriate. Section III Evaluation and Qualification Criteria: Qualification Criteria 2.1 to 2.6: Please refer to Section II (b) – Tender Preparation Checklist ("TPCL") – this identifies which of the Eligibility and Qualification Criteria applies to this Tender, according to the expected Contract value and the Principal's assessment of risk and other factors contributing to the quality and success of Contract outcomes.

	The Documentation Required at Tables 2.1 to 2.4 and Tables 2.5 to 2.6, directly relate to the Schedules to be completed for the Contract, templates for which can be found in Section IV - Tender Forms of this Tender Document. Priced Bill of Quantities: To be competed in full using the template provided in Section IV - Tender Forms). Letter of Tender: to be submitted on the Tenderer's letterhead using the template in Section IV -Tender Forms and accompanied with a written authorization to sign for and on behalf of the Tenderer as defined in ITT 20.2. The Letter of Tender shall contain tender submission undertakings and legal affirmations as to the Tenderer having the following verifiable characteristics: (a)the legal capacity to enter into contract as an individual, firm or joint venture - i (b)freedom from insolvency or bankruptcy proceedings during the immediate past (c)freedom from punitive civil law sanctions imposed by the Independent State of (d)freedom of the firm or its principals from currently or in the past year, criminal (e)current accreditation, certification or registration as a works contractor in activi (f)its willingness, upon being offered contract award, to immediately engage in pro (g)for foreign firms or joint ventures, affirmations cited in ITT 11.1(b) paragraphs (
ITB 11.1(i)	The Tenderer shall submit with its tender the following **<u>additional documents</u>** from Samoa or its country of domicile: (a) For all engineers submitted as part of the bidder's team: current and valid IPES registration or a statement that the proposed engineer will complete registration upon confirmation of award; (b) Draft Construction Program in Gantt Chart format MUST observe Public Holiday(s) (if any); and (c) Manufacturer's authorization for the equipment.
ITB 13.1	Alternative bids **shall** be permitted.
ITB 13.3	Alternative times for completion are not permitted.
ITB 13.3	Alternative technical solutions **shall** be permitted for the following parts of the works - ***Location, design, and size of headpond and configuration of generating equipment*** If alternative technical solutions are permitted, the evaluation method will be as specified in Section III, Evaluation and Qualification Criteria.
ITB 14.6	The prices quoted by the bidder shall not be adjustable during the bidder's

	performance of the Contract.
ITB 15.1	The bidder is required to quote in Samoan Tala (SAT$) the portion of the bid price that corresponds to expenditures incurred in that currency.
ITB 17.1(a)	The bidder shall submit, with its bid, the following documentary evidence to prove that it has the financial and technical and capability to perform the contract. *[List hereunder the requirements: _______________________________]* The Subcontractor(s) experience and/or resources will not contribute to the bidder's qualifications.
ITB 18.1	The bid validity period shall be 120 dayscalendar days after the bid submission date.
ITB 19.1 and 19.8	Bid shall include a Bid Security (issued by bank or surety) included in **Section IV - Bidding Forms**
ITB 19.2	The amount of the Bid Security shall be: **SAT$100,000.00 including VAGST and all applicable taxes.** Failure to provide a Tender Security, the tenderers bid shall be rejected by the Principal as non-responsive.
ITB 20.1	In addition to the Original of the bid, the number of Copies is: 4 Hard Copies and one (1) complete copy on CD-R or flash drive.

D. Submission and Opening of Bids

ITB 21.1	Bids may be submitted electronically via the Ministry of Finance's Tender Link portal (**https://portal.tenderlink.com/mof_samoa/**). The opening of Bids submitted electronically shall follow the procedures as outlined in Annex 1 to this Section II. Bid Data Sheet. Bidders who submit electronically do not need to submit hard copies. If a Bidder submits both electronic submission and the hard copy submission, for the avoidance of doubt, Bids submitted electronically shall take precedence over the hard copies and shall be considered the ORIGINAL copy.
ITB 21.2(c)	The inner and outer envelopes shall bear the following additional identification marks: **Tiapapata Small Hydro Power Plant** **EPC Ref: SAM EPC TIAP – 25/2021**
ITB 22.1	For bid submission purposes, bids must be submitted a the following address:

	Attention: The Secretary, Tenders Board Ministry of Finance Address: Central Bank of Samoa Building, Beach Road Floor/Room number: Level 4 City: Apia Country: SAMOA The deadline for tender submission is: Date: 30 August 2021 Time: 10:00 am (local time)
ITB 25.1	The bid opening shall take place at: **Ministry of Finance,** **Central Bank of Samoa Building** Floor/Room number: **Level 4** City: **Apia** Country: **SAMOA** Date: **30th August 2021** Time: **Tender opening commences from 11.00am** (*local time*) **For Bids submitted electronically in accordance with ITB Clause 24.1(b), the Bid opening procedures shall be as described in Annex 1 to this Section II. Bid Data Sheet.**

E. Evaluation and Comparison of Bids

ITB 32.1	Bid prices expressed in different currencies shall be converted in: **Samoan Tala (SAT$)** The source of exchange rate shall be: **The Central Bank of Samoa,** which can be found at http://www.cbs.gov.ws/statistics/exrates/index.html. The date for the exchange rate shall be: 7 days prior to the date of deadline for tender submission.
ITB 34.1	At this time the procuring entity does not intend to execute certain specific parts of the works by Subcontractors selected in advance.
ITB 34.2	The parts of the works for which the procuring entity permits bidders to propose Specialised Subcontractors are designated as follows: a. Electrical and Mechanical Design b. Manufacture and Installation of generators and all associated equipment and SCADA.

	For the above-designated parts of the works that may require Specialised Subcontractors, the relevant qualifications of the proposed Specialised Subcontractors will be added to the qualifications of the bidder for the purpose of evaluation.
ITB 34.2	Contractor's proposed subcontracting: Maximum percentage of subcontracting permitted is: 30% of the total contract amount or 30% of the volume of work. Bidders planning to subcontract more than 10% of total volume of work shall specify, in the Letter of Bid, the activity (ies) or parts of the works to be subcontracted along with complete details of the subcontractors and their qualification and experience.
41.2	An increase or decrease in the quantity of the works originally required must not exceed: Not Applicable
ITB 42.2	The number of days for standstill shall be 15 days.
ITB 45	The Adjudicator proposed by the Principal is***:*** **one appointed by the Institution of Professional Engineers Samoa ("IPES") at the hourly rate of SAT$250.00** The following reimbursable expenses are recognized: **NOT APPLICABLE** The designated Appointing Authority for a new Adjudicator is **IPES** established under the *Professional Engineers (Registrations) Act 1998*.
ITB 46.4	Any complaint should be sent to the following address: For the attention of: Attention: ***General Manager*** Contact Entity Name: **Electric Power Corporation** Address: **Level 5, TATTE Building,** City: **Apia** Country: ***SAMOA*** Email***: toimoanai@epc.ws*** Telephone: +**685 65500**

Annex 1 to Section II. Bid Data Sheet
Procedure for Electronic Submission of Bids

1. The Bid shall be electronically submitted via the Government of Samoa's e-Tendering Portal only. The Bidder shall use this, and only this, link to submit its electronic Bid.

2 The Portal shall automatically expire on the submission deadline, specified in the relevant Invitation to Bid. No extension shall be provided after the expiry date of the tender.

3 At the submission deadline, and not before, Tender Link will forward to the Portal's Administrator access to the tender box electronic keys to open bids.

4. To ensure the integrity and compliance with Section II (Instructions to Bidders), the Opening of the Tender Boxes can only be actioned by the Ministry of Finance's designated Administrator. For security purposes, all openings are dated and time stamped, ensuring compliance of their opening with Clauses 21 and 25 of this Invitation to Bid.

Section II (b) - Tender Preparation Checklist ("TPCL")

- This checklist specifies the documents to be completed and submitted for this Tender. All documents marked **YES** in the *"Submission Required?"* column **MUST** be submitted.
- Documents should be collated and submitted in the same order as the checklist to assist in the presence of all required documents and facilitating tender evaluation.
- The person **authorised to sign the Tender** shall place their initial in the *"Tenderer to confirm inclusion in Tender"* column once they have checked and ensured the inclusion of each item.

  This checklist MUST be completed, signed by the person authorised to sign the Tender and, submitted with the Tender (in front of the Letter of Tender). **Failure to provide any of the required documents may result in the Tender being disqualified**.

- It is recommended that Tenderers use this checklist while compiling their Tender and for a final review before signature and dispatch.
- Tenderers should carefully check all documents submitted with the Letter of Tender for spelling mistakes and arithmetical errors in the Tendering Forms and Bills of Quantities/ Schedules of Prices, and make corrections as applicable.
- *Items in the table below in italics are provided for the guidance of Tenderers where particular attention must be paid to the contents of the Tender.*

Abbreviations:

EQC	Evaluation Qualifications Criteria (SECTION III)	TD	Tender Document
ITT	Instructions to Tenderer (SECTION I)	TDS	Tender Data Sheet (SECTION II (a))
LOT	Letter of Tender (SECTION IV)	TF	Tender Forms (SECTION IV)

No	TD Section	Clause Ref	Description	Submission Required? YES or NO?	Tenderer to confirm included in Tender:
LETTER OF TENDER					
1	IV	-	Letter of Tender: fully completed with options selected where indicated and signed by an **authorised signatory** in accordance with ITT and TDS 20.2	YES	

No	TD Section	Clause Ref	Description	Submission Required? YES or NO?	Tenderer to confirm included in Tender:
<u>Note to Tenderers</u>. The Letter of Tender must be accompanied by a signed declaration by the Tenderer or Tenderer's representative(s) declaring that all statements in the letter are TRUE. A false declaration is an offence and is punishable upon conviction under the laws of the Independent State of Samoa.					
2	IV/ TF		Documents required **to be attached** to the Letter of Tender are set out in **Section IV - Tendering Forms** (items 3 to 10 following)	YES	
*<u>Note to Tenderers.</u> Only **original documents** or **certified true copies** of original documents must be attached.*					
TENDER SIGNATORY AUTHORISATION – QUALIFICATION / ELIGIBILITY					
3	II	20.2	Notarised Power of Attorney authorising a person to sign on behalf of the Tenderer or Notarised Undertaking signed by all parties of a JV authorising a representative to conduct business and sign on behalf of JV	YES	
TENDERER INFORMATION FORMS – QUALIFICATION/ ELIGIBILTY 2.1					
4	IV/ TF		**Tender Information Sheet – COMPLETED FORM ELI-1.1**: **and for a joint venture** – **COMPLETED FORM ELI-1.2** <u>FOR EACH ADDITIONAL PARTY TO THE JOINT VENTURE</u> pursuant **to Section IV – Tendering Forms**	YES	
5	IV/ TF		**Documents required to be attached to the Form ELI-1.1** as stipulated in paragraph 7 of the form as applicable	YES	
6	IV/TF		**Documents required to be attached to the Form ELI-1.2** as stipulated in paragraph 7 of the form as applicable <u>FOR EACH ADDITIONAL PARTY TO THE JOINT VENTURE</u>	YES	
7	IV/ TF		Business license or permit valid for at least the next six (6) months or for the period of tender or proposed Works (whichever is the longest)	YES	
8	IV/ TF		Certificate of Incorporation or Deed of partnership or Joint Venture (if applicable)	YES	

No	TD Section	Clause Ref	Description	Submission Required? YES or NO?	Tenderer to confirm included in Tender:
9	IV/ TF		Evidence of payment of income tax for the immediate past year.	YES	
10	IV/ TF		Two (2) written business references from relevant and credible sources.	YES	
TENDER SECURITY					
11	ITT/TDS	19.1	Tender Security – Irrevocable Bank Guarantee	YES	
12	ITT/TDS	19.2	Tender Securing Declaration to be signed by the Tenderer	NO	
BILLS OF QUANTITIES or SCHEDULES OF PRICES					
13	TF	-	Schedule of Payment Currencies (for foreign currency tenders only)	YES	
14	TF		Tables of Adjustment Data (only if price adjustment provided for in ITT and TDS 14.6)	NO	
15	TF	-	Fully priced Bills of Quantity ("BOQ"): refer to **Section IV – Tender Forms**	YES	
16	TF		Priced Activity Schedule ("PAS") (for Lump Sum Contracts only): refer to **Section IV – Tender Forms**.	NO	
<u>*Notice to Tenderers*</u>*. Ensure that the Tender Price quoted in the Letter of Tender (in words and numerals)* ***is the same as in the Fully Bill of Quantities ("BOQ") inclusive of applicable taxes. Despite that, taxes that are not included, such are payable as confirmed by the relevant authority.***					
TECHNICAL PROPOSAL					
<u>*Notice to Tenderers.*</u> *Attention is drawn to the Evaluation Criteria to be used for the evaluation of Technical Proposals: (i) as provided in EQC Clauses 1.1 to 1.6 and, (ii) as provided for each Technical Proposal Form provided in* ***Section IV - Tender Forms*** *(as summarised below – these must be carefully addressed)*					
TECHNICAL PROPOSAL FORMS					
Personnel and Equipment					
17	EQC	2.5	Proposed Key Personnel of appropriate qualification and experience according to positions in Section III – Evaluation and	YES	

No	TD Section	Clause Ref	Description	Submission Required? YES or NO?	Tenderer to confirm included in Tender:
			Qualification Criteria at Table 2.5 - Personnel: **COMPLETED FORM PER-1.**		
18	EQC	2.5	Resume of Proposed Personnel: **COMPLETED FORM PER-2** for each person nominated.	YES	
19	EQC	2.6	Demonstrated capability to provide the equipment listed in Section III – Evaluation and Qualification Criteria at Table 2.6 in good working order: **COMPLETED FORM-EQ-1**.	YES	
Organisation, Methods and Schedules – Technical Evaluation Criteria Forms – Evaluation Criteria 1 to 5					
20	TF		**Site Organisation**: Provide the information to the level of detail required in **Section IV - Tender Forms**, Technical Proposal Forms	YES	
21	TF		**Method Statement**: Provide the information to the level of detail required in **Section IV Tender Forms**, Technical Proposal Forms.	YES	
22	TF		**Mobilisation Schedule**: Provide the information to the level of detail required in **Section IV - Tender Forms**, Technical Proposal Forms	YES	
23	TF		**Construction Schedule**: Provide the information to the level of detail required in **Section IV - Tender Forms**, Technical Proposal Forms	YES	
24	TF		**Other:** Provide the information to the level of detail required in **Section IV - Tender Forms**; Technical Proposal Forms.	YES	
QUALIFICATION CRITERIA					
2.1 Eligibility					
Please refer to items 3 to 10 above					
2.2 Historical Contract Non-Performance					
25	EQC	2.2.1	**History of Non-Performing Contracts**: **COMPLETED FORM CON-2.** This may include past poor performance.	YES	

No	TD Section	Clause Ref	Description	Submission Required? YES or NO?	Tenderer to confirm included in Tender:
26	EQC	2.2.2	**<u>Pending Litigation</u>**: **COMPLETED FORM CON-2.**	YES	
2.3 Financial Situation					
27	EQC	2.3.1	**<u>Historical Financial Performance</u>**: **COMPLETED FORM FIN3.1** PLUS: submission of audited balance sheets or other financial statements acceptable to the Principal for the last three (3) years.	YES	
28	EQC	2.3.2	**<u>Average Annual Turnover</u>**: **COMPLETED FORM FIN 3.2**. This factor determines the turnover in profit.	YES	
29	EQC	2.3.3	**<u>Financial Resources</u>**: **COMPLETED FORM FIN-3.3.** This factor determines how liquid a company is, and ensures proper check on existing capital (determining ability to carry out the Works)	YES	
2.4 Experience					
30	EQC	2.4.1	**<u>General Experience:</u>** **COMPLETED FORM-EXP-4.1**.	YES	
31	EQC	2.4.2 (a)	**<u>Specific Experience</u>**: **COMPLETED FORM –EXP-4.2 (a).** This factor proves that similar specific experience have been carried out previously	YES	
32	EQC	2.4.3 (b)	**<u>Specific Key Activities Experience</u>**: **COMPLETED FORM EXP-4.2 (b).** This factor proves that similar specific experience in key activities have been carried out previously.	YES	
Tender Packaging & Dispatch					
	I/ITT	11	Verify that all items 11.1 (a) to (i) are correct in terms of required content and responses	YES	
	I/ITT	12	All Forms and Schedules present and prepared according to Section IV – Tender Forms without alterations to	YES	

No	TD Section	Clause Ref	Description	Submission Required? YES or NO?	Tenderer to confirm included in Tender:
			the original text and no substitute forms. All blank spaces filled in with requested information or if not relevant, mark “Not Applicable”.		
	I/ITT	13	Alternative tenders: packed in envelopes separate to Tender and clearly marked “ALTERNATIVE”	YES	
	I/ITT	20.1	One original of documents marked “ORIGINAL”, required number of copies as per TDS marked “COPY”, and alternatives marked “ALTERNATIVE”	YES	
	I/ITT	20.2	Original and all copies typed in indelible ink and signed by the authorised signatory. Typewritten authorisation attached with names/ positions of signatories clearly printed below the signatures	YES	
	I/ITT	20.3	All amendments, erasures, or overwriting signed and initialed by authorised person signing tender	YES	
	I/ITT	21.1-21.3	All documents packaged up according to **ITT 21**, clearly and correctly labeled for both Principal and Tenderer addresses	YES	
	I/ITT	22.1	Arrangements by the Tenderer to ensure the Principal receives the Tender before the Tender submission deadline	YES	

I confirm that I have checked and have provided all the required documents of this Tender.

NAME: ____________________________________

Signature: __________________________________ Date: ___________________________

No	TD Section	Clause Ref	Description	Required YES or NO
			<u>Notice to Tenderers:</u> The following is provided for the information of the successful tenderer on actions that must be	

No	TD Section	Clause Ref	Description	Required YES or NO
			completed prior to the execution of the Contract. Any foreign firms (either as a lead, associate or joint venture party) should take particular note of item B.	
Pre-requisites to Contract Award				
A	1/ITT	41.1	If offered contract award, the Tenderer must ensure to provide a Performance Security within twenty eight (28) days from the date the Tenderer receives notice of award from the Principal.	YES
B	1/ITT	41.2	If offered contract award, the Tenderer (if a foreign firm) must within twenty-eight (28) days to from the date the Tenderer receives notice of award from the Principal, secure all local approvals namely:	YES
			(a) Business License and associated tax registrations: via the Ministry of Customs and Revenue;	YES
B			(b) Company registration: via the Ministry of Commerce, Labor and Industry;	YES
			(c) Membership of all engineers with Institution of Professional Engineers Samoa (IPES); and	YES
			(d) As applicable, Principal's processes for registration, certification or accreditation	YES

Section III - Evaluation and Qualification Criteria

This Section contains all the criteria that the Principal shall use to evaluate and qualify the Tenderers if the tender process was not preceded by a pre-qualification exercise and post-qualification is applied. In accordance with **ITT 34** and **ITT 36**, no other methods, criteria and factors shall be used. The Tenderer shall provide all the information requested in the forms included in Section IV - Tender Forms.

Table of Criteria

1. Evaluation

In addition to the criteria listed in **ITT 34.2 (a) – (e)** the following criteria shall apply:

1.1 Adequacy of Technical Proposal

The evaluation of the Tenderer's Technical Proposal will include an assessment of the adequacy of the Tenderer's technical proposals for and its capacity to mobilize key equipment and personnel for the Contract consistent with its proposal regarding work methods, scheduling, and material sourcing in sufficient detail and fully in accordance with the requirements stipulated in **Section VI - Principal's Requirements**.

The written Proposal must concisely and completely demonstrate the Tenderer's capacity and abilities to do a good quality job within the required timeframe (refer to "**Technical Proposal/ Technical Proposal Forms" - Section IV**) and in accordance with the requirements stated in **Section VI (Principal's Requirements)** and specifications in the Contract.

The Tenderer's Technical Proposal evaluation will be based on the stengths and weaknesses of the bidder's response to the Employers specified requirements for each of the following components:

(i) Equipment;
(ii) Team Composition, Site Organisation and Manpower;
(iii) Method Statement;
(iv) Mobilization Schedule;
(v) Work Plan/Construction Schedule; and
(vi) Manufacturer's Authorisation.

The Tenderer's Technical Proposal must clearly indicate that the Tenderer has performed adequate planning to accomplish the entire works as defined in the Technical Requirements. It should include a complete plan to accomplish each requirement, including subcontracting. It should demonstrate that appropriate personnel and equipment will be positioned efficiently to carry out the requirements and that the proper level of effort is directed toward each requirement.

In addition to being assessed for adequate responsiveness to the Principal's Requirements and internal consistency between evaluated components, the Technical Proposal shall be used to prepare the Contract with respect to staffing, equipment, work methods and scheduling in a manner consistent with the proposal and fully in accordance with the requirements stated in **Section VI - Principal's Requirements**.

1.2 Quantifiable Nonconformities, Errors and Omissions

Pursuant to **ITT 30.3**, the cost of all quantifiable minor non-conformities or omissions shall be evaluated as follows:

- The Principal will make its own assessment of the cost of any limitations, minor non-conformities and omissions for the purposes of ensuring the fair comparison of Tender.

1.3 Technical Alternatives

Technical Alternatives if permitted under **ITT 13.4**, will be evaluated as follows:

- The Tenderer's proposal for technical alternatives shall fully identify all obvious and implied changes to drawings, technical specifications, bill of quantities, work methods, equipment, personnel, completion time, cost and amended General & Special Conditions of Contract. Quality and value-based justification for the proposed Alternatives must be very clearly and concisely stated.

Please note that:

(i) The Principal's design as presented in this Tender document must be priced with sufficient other information to enable complete comparative evaluation of the alternative proposal where applicable; and

(ii) Only technical alternatives of the lowest evaluated technically conforming Tenderer shall be considered.

1.4 Understanding and Compliance with requirements

The Tenderer's Technical Proposal should include in sufficient detail, a demonstration of their clear understanding of all areas of design, construction, operations and maintenance of a small-hydropower scheme. The Tenderer should provide evidence of sufficient planning to show that work will be accomplished as required and on schedule, utilizing all available resources. It will demonstrate a firm understanding of the requirements and goals set forth in the scope of work.

The Tenderers completed Technical Schedules shall include sufficient detail to confirm compliance with the technical specifications and to provide specified details as to the technical particulars of the Tenderer's offer.

The Tenderers Technical Proposal shall clearly demonstrate that future resilience of the Facilities has been taken into account during their design and that appropriate and compliant design criteria have been adopted.

1.5 Time Schedule

Time to complete the plant and services from the Start date specified in the General Conditions of Contract ("GCC") for determining time for completion of pre-commissioning activities (i.e. 18 months). No credit will be given for earlier completion.

1.6 Excavation in Rock

For rock excavation, bidders must quote a fixed lump price for all rock excavation. It is bidders' responsibility to assess amount of rock excavation during bid in order for them to submit in their bid a lump sum price for all rock excavation, in intake, trenching for pipe from intake to headpond, headpond, trenching for penstock pipe from headpond to power station and at power station.

1.7 Functional Guarantees of the facilities

For the purposes of evaluation, adjustments as detailed below will be made to the bid price:

- For each kW (or part thereof) that the guaranteed power station output is above or below the specified minimum acceptable level: capitalized over a 20 year period using an energy value of $0.40c/kWh, a 10% cost of capital and the Contractors guaranteed Availability Factor.
- For the purposes of this evaluation it will be assumed that the Plant will operate at the Rated Flow for 75% of the time.

1.8 Work, services, facilities, etc., to be provided by the Principal

Where bids include the undertaking of work or the provision of services or facilities by the Principal in excess of the provisions allowed for in the Tender document, the Principal shall assess the costs of such additional work, services and/ or facilities during the duration of the contract. Such costs shall be added to the bid price for evaluation.

1.9 Specific additional criteria

The following additional criteria will be used in the evaluation:

1.10.1 Environmental Management Requirements

The Tenderers will be evaluated on their response to all the environmental design and management requirements as specified in:

i. Section VI – Principal's Requirements, and
ii. Part 3 – Conditions of Contract and Contract Forms.

In addition the Tenderer is required to provide a short statement that confirms the following three points:

I. That all the Environmental Management Requirements have been costed into the bid price.
II. The Tenderer is to provide prior experience of working with a Construction Environmental Management Plan (CEMP).
III. The Tenderer is required to provide the name, details of qualifications and experience of the person on the Tenderer's team who will be responsible for the environmental compliance requirements of the CEMP.

The statement is to be attached to the Bid as part of the Method Statement. During bid evaluation these strengths will be evaluated in the selection of the contractor. Should the Tenderer not provide these details, the bid will be judged to be non-compliant and the bid rejected

2. Qualification

Factor	2.1 Eligibility					
	Criteria					Documentation Required
		Tenderer				
		Single Entity	Joint Venture, Consortium or Association			
Sub-Factor	Requirement		All partners combined	Each partner	At least one partner	
2.1.1 Nationality	Nationality in accordance with ITT 4.2.	Must meet requirement	Existing JV must meet requirement	Must meet requirement	N / A	Form ELI –1.1 and 1.2, with attachments
2.1.2 Conflict of Interest	No- conflicts of interests as described in ITT 4.3.	Must meet requirement	Existing JV must meet requirement	Must meet requirement	N / A	Letter of Tender
2.1.3 Government Ineligibility	Not having been declared ineligible by the Government as described in ITT 4.4.	Must meet requirement	Existing JV must meet requirement	Must meet requirement	N / A	Letter of Tender
2.1.4 Government Owned Entity	Compliance with conditions of ITT 4.5.	Must meet requirement	Must meet requirement	Must meet requirement	N / A	Form ELI –1.1 and 1.2, with attachments

<table>
<tr><td>Factor</td><td colspan="7">2.1 Eligibility</td></tr>
<tr><td rowspan="4">Sub-Factor</td><td colspan="6">Criteria</td><td rowspan="4">Documentation Required</td></tr>
<tr><td rowspan="3">Requirement</td><td colspan="5">Tenderer</td></tr>
<tr><td rowspan="2">Single Entity</td><td colspan="4">Joint Venture, Consortium or Association</td></tr>
<tr><td colspan="2">All partners combined</td><td>Each partner</td><td>At least one partner</td></tr>
<tr><td colspan="2">2.1.5 Ineligibility based on a United Nations resolution or Borrower’s country law</td><td>Not having been excluded as a result of the Borrower’s country laws or official regulations, or by an act of compliance with UN Security Council resolution, in accordance with ITT 4.8.</td><td>Must meet requirement</td><td>Existing JV must meet requirement</td><td>Must meet requirement</td><td>N/A</td><td>Letter of Tender</td></tr>
</table>

<table>
<tr><td>Factor</td><td colspan="6">2.2 Historical Contract Non-Performance</td></tr>
<tr><td rowspan="4">Sub-Factor</td><td colspan="5">Criteria</td><td rowspan="4">Documentation Required</td></tr>
<tr><td rowspan="3">Requirement</td><td colspan="4">Tenderer</td></tr>
<tr><td rowspan="2">Single Entity</td><td colspan="3">Joint Venture, Consortium or Association</td></tr>
<tr><td>All partners combined</td><td>Each partner</td><td>At least one partner</td></tr>
<tr><td>2.2.1 History of non-performing contracts</td><td>Non-performance of a contract did not occur within the last three (3) years prior to the deadline for application submission, based on all information on fully settled disputes or litigation. A fully settled dispute or litigation is one that has been resolved in accordance with the Dispute Resolution Mechanism under the respective contract, and where all appeal instances available to the tenderer have been exhausted.</td><td>Must meet requirement by itself or as partner to past or existing JV</td><td>N / A</td><td>Must meet requirement by itself or as partner to past or existing JV</td><td>N / A</td><td>Form CON - 2</td></tr>
<tr><td>2.2.2 Pending Litigation</td><td>All pending litigation shall in total not represent more than fifty percent (50%) of the Tenderer’s net worth and shall be treated as resolved against the Tenderer.</td><td>Must meet requirement by itself or as partner to past or existing JV</td><td>N/A</td><td>Must meet requirement by itself or as partner to past or existing JV</td><td>N/A</td><td>Form CON – 2</td></tr>
</table>

<table>
<tr><td>Factor</td><td colspan="3">2.3 Financial Situation</td></tr>
<tr><td rowspan="2">Sub-Factor</td><td colspan="2">Criteria</td><td rowspan="2">Documentation Required</td></tr>
<tr><td>Requirement</td><td>Tenderer</td></tr>
</table>

		Single Entity	Joint Venture, Consortium or Association			
			All partners combined	**Each partner**	**At least one partner**	
2.3.1 Historical Financial Performance	Submission of audited balance sheets or if not required by the law of the Tenderer's country, other financial statements acceptable to the Principal, for the last **three (3) years** to demonstrate the current soundness of the Tenderer's financial position and its prospective long-term profitability. As a minimum, a Tenderer's net worth calculated as the difference between total assets & total liabilities **should be positive**	Must meet requirement	N/A	Must meet requirement	N/A	Form FIN – 3.1 with attachments
2.3.2. Average Annual Turnover	Minimum average annual turnover of **SAT$1,000,000.00** calculated as total certified payments received for contracts in progress or completed, within the last three (3) years.	Must meet requirement	Must meet requirement	Must meet twenty-five percent (25% of the requirement	Must meet forty percent (40%) of the requirement and must be the lead partner.	Form FIN –3.2

Factor	**2.3 Financial Situation**					
Sub-Factor	**Criteria**					**Documentation Required**
	Requirement	**Tenderer**				
		Single Entity	**Joint Venture, Consortium or Association**			
			All partners combined	**Each partner**	**At least one partner**	
2.3.3. Financial Resources	The Tenderer must demonstrate access to, or availability of, financial resources such as liquid assets, unencumbered real assets, lines of credit, and other financial means, other than any contractual advance payments to meet: (i) the following cash-flow requirement for this Contract: **SAT$1,000,000.00 – 7,000,000.00. (***20% of bidder's Total Bid Price. Example, if bidders bid is US$6 million or $15.3 million Tala equivalent, then cash flow requirement is $3.06 million Tala in terms of line of credit or cash in bank.)* plus (ii) the overall cash flow requirements for concurrent commitments as determined in FORM-CCC (**Section IV - Tender Forms**) and this contract. These may also include submission of audited bank statements.	Must meet requirement	Must meet requirement	Must meet thirty percent (30%) of the requirement	Must meet sixty percent (60%) of the requirement and must be the lead partner.	Form FIN –3.3

Factor	2.4 Experience					
Sub-Factor	Criteria					Documentation Required
	Requirement	Tenderer				
		Single Entity	Joint Venture, Consortium or Association			
			All partners combined	Each partner	At least one partner	
2.4.1 General Experience	Experience under contracts in the role of civil contractor, subcontractor, or contractor for ***at least the last five (5) years prior to the applications*** submission deadline, and **with activity in at least nine (9) months in each year**.	Must meet requirement	N/A	Must meet requirement	N/A	Form EXP-4.1
2.4.2 Specific Experience	(a) Participation as contractor, management contractor, or subcontractor, in at least ***two (2) contracts within the last five (5) years, each with a value of at least USD2,000,000.00*** that have been successfully and substantially completed and that are similar to the proposed Works. The similarity shall be based on the physical size, complexity, methods/ technology or other characteristics as described in **Section VI - Principal's Requirements**. Additionally, projects of similar nature include following facilities and components: design and	Must meet requirement	Must meet requirement. Either one partner must meet requirement or Any two partners must each demonstrate one (1) successfully or substantially completed contract of similar size and nature	N/A	N/A	Form EXP 4.2(a)

Factor	2.4 Experience					
Sub-Factor	Criteria					Documentation Required
	Requirement	Tenderer				
		Single Entity	Joint Venture, Consortium or Association			
			All partners combined	Each partner	At least one partner	
	construction of pressured pipelines 250 mm and over, with thrust blocks; steel frame structured buildings; reinforced concrete retaining walls; civil works, roads, water tanks; electrical switchgear installation with PLC controls; hydro plants, and pump stations.					

<table>
<tr><th>Factor</th><th colspan="6">2.4 Experience</th></tr>
<tr><td rowspan="4">Sub-Factor</td><td colspan="5">Criteria</td><td rowspan="4">Documentation Required</td></tr>
<tr><td rowspan="3">Requirement</td><td colspan="4">Tenderer</td></tr>
<tr><td rowspan="2">Single Entity</td><td colspan="3">Joint Venture, Consortium or Association</td></tr>
<tr><td>All partners combined</td><td>Each partner</td><td>At least one partner</td></tr>
<tr><td>2.4.2 Specific Experience in Key Activities</td><td>(b) For the above or other contracts executed during the period stipulated in 2.4.2(a) above, a minimum experience in the following key activities:
1. design and build hydro plant;
2. install hydro plant;
3. mobilization and demobilization of equipment;
4. excavation of rock along pipeline/ penstock route from intake to headpond and from headpond to powerhouse and trailrace to river;
5. install new pipeline;
Install new penstock;
Construction of powerhouse, compound and trailrace;
6. etc, construction, refurbishment, installation, commission.</td><td>Must meet requirement</td><td>Must meet requirements</td><td>N / A</td><td>N/A</td><td>Form EXP 4.2(b)</td></tr>
</table>

2.5 Personnel

The Tenderer must demonstrate that it will have the personnel for the **key positions** that meet the following requirements:

The Registered Engineer shall be a fully qualified civil engineer and corporate member of the Institute of Professional Engineers Samoa ("IPES") or be in possession of an alternative professional qualification recognised by IPES as qualifying for membership of IPES and who will register as a member of IPES within one (1) calendar month of the Commencement Date of the Contract.

No.	Position	Total Work Similar General Experience (years)	In Similar Specific Works Experience (Years)
1	**Project Manager**	10	5
2	**Project Engineer**	5	2
3	**Design Hydro Civil Engineer**	10	5
4	**Electrical engineer**	10	5
5	**Hydro mechanical engineer**	10	5
6	**Control engineer**	10	5
7	**Health and Safety Person**	5	4
8	**Construction supervisor**	10	5

The Tenderer shall provide details of the proposed personnel and their experience records in the relevant Forms included in **Section IV - Tender Forms**.

2.6 Equipment

The Tenderer must demonstrate that it will have access to the key equipment listed hereafter:

No.	Equipment Type and Characteristics	Minimum Number required	Name of equipment	What is the function/purpose of equipment?	Year of the equipment	Technical and other details about the equipment
1	Excavators	5	Crawler, whelled excavators,	construction	5 yrs	
2	Loaders	3	Loader	Same	Same	
3	Tip trucks	4	Truck	Same	Same	
4	Flat trucks	1	"	Same	Same	
5	Welding machine	1	Welding	Same	Same	
6	Road Compactor	1	Compactor	Same	Same	
7	Concrete mixer	1	Mixer	Same	Same	
8	Rock breakers	4	Breaker	same	Same	

The Tenderer must confirm working condition of equipment by way of a formal letter to the Principal, and the evaluation panel may undertake a site visit to confirm the same.

The Tenderer shall provide further details of its proposed items of equipment using the relevant Form in **Section IV – Tender Forms**.

Section IV - Tender Forms

Table of Forms

Letter of Tender

The Tenderer must prepare the Letter of Tender on stationery with its letterhead clearly showing the Tenderer's complete name and address.

The Tenderer shall fill in the Form in accordance with the instructions indicated. No alterations to its formal shall be permitted and no substitutions shall be accepted. Note: All italicised text is for use in preparing these forms and shall be deleted from the final fully edited versions.

Date: _______________

Request to Tender No.: _______________

Alternative No:____________

To: **[*insert complete name of Principal*]**

We, the undersigned, declare that:

(a) we have examined and have no reservations to the Tender Documents, including Addenda issued in accordance with Instructions to Tenderers ("ITT") 8;
+

(b) We offer to execute in conformity with the Tender Documents the following Works: ***[insert full name of Tender]*;**

(c) The total price of our Tender, excluding any discounts offered in item (d) below is: $ ________________ [***Insert Tender Price in words in Samoan Tala; including up to three (3) convertible currencies]***

(d) The discounts offered and the methodology for our application are: _____________;[***specify in detail each discount offered and the methodology of application of the discounts. Note: if not offered, state "NOT APPLICABLE")*;**

(e) Our Tender shall be valid for a period of **one hundred and twenty (120) days** from the date fixed for the tender submission deadline in accordance with the Tender Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

(f) If price adjustment provisions apply, the Table(s) of Adjustment Data shall be considered part of this Tender;

(g) If our Tender is accepted, we commit to obtain a **Performance Security** in accordance with **ITT 19.1** Tender Document;

(h) Our firm, including any subcontractors or suppliers for any part of the Contract, have nationalities from eligible countries in accordance with **ITT 4.1** and **Section V – Eligible Countries** of this Tender Document;

(i) We, including any subcontractors or suppliers for any part of the Contract, do not have any conflict of interest in accordance with **ITT 4.3** and are free from insolvency and bankruptcy and confirmation of such from relevant authority is attached to this Letter;

(j) We are not participating, as a Tenderer or as a subcontractor, in more than one Tender in this Tender process in accordance with **ITT 4.3**, other than alternative offers submitted in accordance with **ITT 13;**

(k) Our firm, its affiliates or subsidiaries, including any Subcontractors or Suppliers for any part of the contract, has not been declared ineligible by the Government (**ITT 3.1(d)** and **ITT 4.4**) or by an act of compliance with a decision of the United Nations Security Council (**ITT 4.8/ Section V**) or by reason of sanctions imposed by the Government or the Principal (**ITT 4.4**);

(l) Our firm and any associated firm or joint venture party have not been subject to insolvency or bankruptcy proceedings in the past twelve (12) months and confirmation of such from relevant authority is attached to this Letter;

(m) Our firm, and its principals, currently and in the past year, have not committed criminal offenses involving fraud, corruption or other misconduct signifying unsuitability for participation in any way in the procurement and contracting process and confirmation of such from relevant authority is attached to this Letter;

(n) We are not a ***Government owned entity / We are a Government owned entity*** but meet the requirements of ITT 4.5[5] ***[If no a government owned entity please specify status or if a government owned entity please specify];***

(o) Our firm, or any foreign domiciled associate firm or joint venture party is willing, upon being offered Contract award, to immediately engage in processes to acquire applicable local licenses as stated in **ITT 41.2** for Performance Security and Local Compliance Requirements;[6]

(p) We have paid, or will pay the following commissions, gratuities, or fees with respect to the Tender process or execution of the Contract: [7]

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

(q) We understand that this Tender, together with your written acceptance thereof included in your notification of award, shall not constitute a binding contract between us, until a formal contract is prepared and executed;

(r) We understand that you are not bound to accept the lowest evaluated Tender or any other Tender that you may receive; and

(s) If awarded the Contract:

(i) the authorized person named below has the legal capacity to enter into a Contract and accordingly shall act as the Contractor's Representative; and

(ii) we/the authorised person named below, undertake to complete all required Works within a period of ***[insert]*** months.

Name: ....

In the capacity of: ....

---

[5] *Use one of the two options as appropriate.*
6 Strike out entire clause if no foreign firms are a part ot tender

[7] *If none has been paid or is to be paid, indicate "none".*

Signed: ....

Duly authorised to sign the Tender for and on behalf of: ....

Date: ....

Documents required to be attached to the Letter of Tender

The original copy of the Tender shall include either the original or a certified copy of the following documents. If certified copies are provided the original document must be provided for inspection if so requested by the Principal. All other copies of the Tender shall include photocopies of the documents.

1. **Written notarized authorisation** to sign the Tender in the form prescribed in **Section II - Instructions to Tenderers ("ITT")**/Tender Data Sheet ("TDS") 20.2.

2. **Tenderer Information Form ELI 1.1** and **Party to JV Information Sheet ELI 1.2**, with the appropriate attachment as specified.

3. **From Samoa or country of domicile** according to normal place for conduct of business, **the following documents:**
   (a) current business license in the appropriate category compatible with the tendered Works and valid for at least the next six (6) months or length or tender process or required Works (whichever is the longest);
   (b) current Certificate of Incorporation, or Deed of partnership or joint venture;
   (c) evidence of payment of immediate past year business income tax;
   (d) two (2) written business references from relevant and credible sources issued within the past six (6) months providing assurances of quality outcomes, business integrity, reliability and financial soundness; and
   (e) ***additional particular requirements as may enumerate in the TDS 11.1 (i)*.**

Schedules

Financial Proposal

Bill of Quantities

PREAMBLE

General

1. The Price Schedules are divided into separate Schedules as follows:

   Schedule No. 1: Plant and Materials (including Mandatory Spare Parts) Supplied from Abroad

   Schedule No. 2: Plant and Materials (including Mandatory Spare Parts) Supplied from within the Employer's Country

   Schedule No. 3: Design Services

   Schedule No. 4: Construction, Installation and Other Services

   Schedule No. 5: Grand Summary

   Schedule No. 6: Recommended Spare Parts

2. The Schedules do not generally give a full description of the plant to be supplied and the services to be performed under each item. Tenderers shall be deemed to have read the Principal's Requirements and other sections of the Tender Document and reviewed the Drawings to ascertain the full scope of the requirements included in each item prior to filling in the rates and prices. The entered rates and prices shall be deemed to cover the full scope as aforesaid, including overheads and profit.

3. If Tenderers are unclear or uncertain as to the scope of any item, they shall seek clarification in accordance with ITT 7 prior to submitting their bid.

Pricing

4. Prices shall be filled in indelible ink, and any alterations necessary due to errors, etc., shall be initialed by the Tenderer.

   As specified in the Tender Data Sheet and Special Conditions of Contract, prices shall be fixed and firm for the duration of the Contract.

5. Bid prices shall be quoted in the manner indicated and in the currencies specified in the Instructions to Tenderers in the Tender Document.

   For each item, Tenderers shall complete each appropriate column in the respective Schedules, giving the price breakdown as indicated in the Schedules.

   Prices given in the Schedules against each item shall be for the scope covered by that item as detailed in Section VI (Principal's Requirements) or elsewhere in the Tender Document.

6. Payments will be made to the Contractor in the currency or currencies indicated under each respective item.

7. When requested by the Principal for the purposes of making payments or partial payments, valuing variations or evaluating claims, or for such other purposes as the Principal may reasonably require, the Contractor shall provide the Principal with a breakdown of any composite or lump sum items included in the Schedules.

Schedules of Rates and Prices

Schedule No. 1 – Plant, Materials, and Mandatory Spare Parts Supplied from Abroad

Item	Description	Country of Origin	Qty.	Unit Price[1]		Total Price[1]	VAGST Taxes and Duties
				Foreign Currency	CIP	Foreign Currency	Local Currency
1	2	3	4	5	6	7 = 4 x 6	8
P1	**TIAPAPATA**						
P1.1	**Hydromechanical Works**						
P1.1.1	Provide hydromechanical equipment		1 lot				
P1.1.2	Provide pipeline and penstock & fittings		1 lot				
P1.2	**Mechanical and Electrical Works**						
P1.2.1	Provide intake and headpond level transmitters and stilling wells.		1 lot				
P1.2.2	Provide tail water level switch		1 lot				
P1.2.3	Provide Communications system between intake, headpond, powerhouse and to EPC nearest fiber connection in Alaoa SHP		1 lot				
P1.2.4	Provide Turbine Inlet Valve and bypass Valve		1 lot				
P1.2.5	Provide Turbine.		1 lot				
P1.2.6	Provide PLC type governor system.		1 lot				
P1.2.7	Provide Generator		1 lot				
P1.2.8	Provide Excitation system		1 lot				
P1.2.9	Provide generator		1 lot				

	step up transformer						
P1.2.10	Provide 415V indoor switchgear		1 lot				
P1.2.11	Provide 22kV indoor switchgear		1 lot				
P1.2.12	Provide 22kV transmission line and connection into existing 22kv system		1 lot				
P1.2.13	Provide control and instrumentation system		1 lot				
P1.2.14	Provide RTU and SCADA interface		1 lot				
P1.2.15	Provide Communications system		1 lot				
P1.2.16	Provide protective relaying system		1 lot				
P1.2.17	Provide 24V DC system		1 lot				
P1.2.18	Provide powerhouse lighting and general power system		1 lot				
P1.2.19	Provide ventilation system		1 lot				
P1.2.20	Provide drainage system		1 lot				
P1.2.21	Provide spare parts		1 lot				
TOTAL from Column 7 to be carried forward to Schedule No. 5. Grand Summary							

Name of Bidder ______________________________

Signature of Bidder ______________________________

[1] **All pricing shall be given in United States Dollars ($USD) or three (3) convertible currencies (Refer to ITT 15.1).**

Schedule No. 2 – Plant, Materials, and Mandatory Spare Parts Supplied from Within the Employer's Country

Item	Description	Qty	EXW Unit Price[1]	Total EXW Price[1]	Sales Tax	Total Price
1	**2**	**3**	**4**	**5 = 1 x 2**	**6**	**7 = 5 + 6**
P2.1	**Intake, Pipe and Penstock Bedding & Backfill Materials**					
P2.1.1	Screened bedding & backfill materials	1 lot	1 lot			
P2.1.2	Base course materials	1 lot	1 lot			
P2.1.3	Concrete	1 lot	1 lot			
P2.2	**Headpond**					
P2.2.1	Screened bedding, sub-base, base-course and fill materials		1 lot			
P2.2.2	Concrete		1 lot			
P2.2.3	Security fence materials		1 lot			
P2.3	**Access Roads**					
P2.3.1	Base-course materials		1 lot			
P2.3.2	Concrete and culvert pipes		1 lot			
P2.4	**Powerhouse and Tailrace**					
P2.4.1	Concrete and all blockwork and rebar		1 lot			
P2.4.2	Fill base course materials		1 lot			
P2.4.3	Security fence materials		1 lot			

TOTAL from Column 5 to be carried forward to Schedule No. 5. Grand Summary						

Name of Bidder ______________________

Signature of Bidder ______________________

[1] **Specify currency in accordance with ITT 15.**

Schedule No. 3 - Design Services

Item	Description	Qty.	Unit Price[1]		Total Price[1]	
			Local Currency Portion	Foreign Currency Portion	Local Currency Portion	Foreign Currency Portion
1	2	3	4	5	6 = 3 x 4	7 = 3 x 5
D1	**TIAPAPATA**					
D1.1	Detailed Basic Design of the Project including the access roads, topographical and geotechnical testing of pipeline penstock, powerhouse survey, weir stability assessment, turbine stability analysis and all other civil, hydro-mechanical and electro-mechanical works.		**1 lot**			
D1.2	Detailed Engineering Design and Preparation of Construction Drawings for weir, pipeline, intake, screens, and all other necessary works.		**1 lot**			
D1.3	Detailed Engineering Design and Preparation of Construction Drawings for headpond, penstock inlet, velocity valve, and all other necessary works.		**1 lot**			
D1.4	Detailed Engineering Design and Preparation of Construction Drawings for pipeline and penstock (all above and below ground works, connection to intake and powerhouse, including structures and all other necessary works).		**1 lot**			
D1.5	Detailed Engineering Design and Preparation of Construction Drawings for powerhouse building and tailrace.		**1 lot**			
D1.6	Detailed Engineering Design and Preparation of Manufacturing and Construction Drawings for all mechanical and electrical works.		**1 lot**			

TOTAL for Columns 6 and 7 to be carried forward to Schedule No. 5. Grand Summary						

Name of Bidder ____________________

Signature of Bidder ____________________

[1] **All pricing shall be given in United States Dollars ($USD) or three (3) convertible currencies (Refer to ITT 15.1).**

Schedule No. 4 –Construction, Installation, Testing, Commissioning, and Other Services

Item	Description	Qty.	Unit Price[1]		Total Price[1]	
			Local Currency Portion	Foreign Currency Portion	Local Currency Portion	Foreign Currency Portion
1	2	3	4	5	6 = 3 x 4	7 = 3 x 5
G1	**GENERAL**					
G1.1	Construction, maintenance and subsequent set up and removal of Contractor's Facilities including Staff's and labor's offices, workshop, motor pool, warehouse, stores toilets, and laboratory. Mobilization and demobilization of Equipment, medical facilities and other facilities; Construction Power (including backup supply, fuel and Maintenance), potable water, wastewater disposal, telecommunications and all other utilities required by the Contractor during construction of the works.	1 lot				
G1.2	Construction and maintenance (during the construction period) of access roads, bridges, river crossings, drainage crossings, retaining structures and maintenance of public and village roads used for access purposes.	1 lot				
G1.3	Prepare/submit CEMP & Environmental monitoring and reporting.	1 lot				
G1.4	Social safeguards monitoring and reporting.	1 lot				
G1.5	Monthly progress reporting	1 lot				
G1.6	O&M Capacity Training and Knowledge Transfer Programme.	1 lot				
G1.7	Provision of all as built drawings and documentation	1 lot				
G1.8	Provision of operating and maintenance manuals; hard and e copies	1 lot				
G1.9	Provision of technical support (1 year) in addition to Defects Liability Period Requirements.	1 lot				
C.2	**TIAPAPATA POWERSTATION**					

C.2.1	**Civil Works**					
C2.1.1	Construction of Tiapapata weir, pipeline intake structure ancillaries and all other necessary works.	1 lot				
C2.1.2	Construction of Tiapapata headpond, inlet, overflow, penstock intake structure, ancillaries and all other necessary works.	1 lot				
C2.1.3	Excavation of rock along pipeline / penstock route from intake to headpond and from headpond to powerhouse and tailrace to river, intake, headpond, and powerhouse. (Note: contractor to provide firm lump fix price)	1 lot				
C2.1.4	Installation of new pipeline from intake to headpond (including all above and below ground works, appurtenances, connection to intake and powerhouse, relocation of other services including structures and all other necessary works).	1 lot				
C2.1.5	Installation of new penstock from headpond to powerhouse (including all above and below ground works, appurtenances, connection to intake and powerhouse, relocation of other services including structures and all other necessary works).	1 lot				
C2.1.6	Construction of Tiapapata powerhouse, compound and tailrace.	1 lot				
C2.2	**Mechanical and Electrical Works**					
C2.2.1	Installation of generating unit mechanical and electrical equipment and cabling	1 lot				
C2.2.2	Installation of balance of station mechanical and electrical equipment.	1 lot				
C2.2.3	Supply and install underground 12 pair fiber optic comm. cable from intake to headpond and to power station.	1 lot				
C2.2.4	Testing and Commissioning	1 lot				
	Factory Acceptance Testing – for EPC					

C2.2.5	Project Engineer and 1 technical staff to attend FAT for elec.-mech. Equipment (Note: if in 2 different factories, then 1 person to attend each of testing. Include air travel, transport, hotel, food, internet, on transit and at factory plus US$70 per person per day for other incidentals)	1 lot				
C.3	**Alaoa Power Station**					
C3.1	**Civil Works**					
C3.1.1	Excavate and removal from site (so it is not washed back to extra storage) of fill materials and debris from existing additional storage reservoir down to original level.	1 lot				
C3.1.2	Rehabilitation of pipeline from existing additional storage reservoir to Alaoa headpond.	1 lot				
C3.1.3	Minor concrete repair work	1 lot				
C.4	**Access Roads to Construction Sites**					
C4.1	**Alaoa hydro headpond to power plant**					
C4.1.1	Construct 4m wide compacted gravel formed for drainage access road from Alaoa headpond to power house site	1 lot				
C4.1.2	Construct a ford across middle branch river crossing	1 lot				
C4.2	**Along penstock pipes**					
C4.2.1	Build 3m wide compacted gravel access road and drainage from powerhouse to headpond	1 lot				
C4.2.2	Build 3m wide compacted gravel road and drainage from headpond to intake on river west branch	1 lot				
C4.2.3	Stabilize earth alongside high side of access roads so no slippage. Include planting of suitable plants.	1 lot				
C4.3	**From Cross Island road to intake site**					
C4.3.1	Improve existing access road from Cross	1 lot				

	Island Road to intake site					
TOTAL for Columns 6 and 7 to be carried forward to Schedule No. 5. Grand Summary						

Name of Bidder ____________________

Signature of Bidder ____________________

[1] **All pricing shall be given in United States Dollars ($USD) or three (3) convertible currencies (Refer to ITT 15.1).**

Schedule No. 5 - Grand Summary

Schedule No.	Title	Total [1]	
		Foreign	Local
1	**Plant, Materials, and Mandatory Spare Parts Supplied from Abroad**		
2	**Plant, Materials, and Mandatory Spare Parts Supplied from Within the Employer's Country**		
3	**Design Services**		
4	**Construction, Installation, Testing, Commissioning, and Other Services**		
	GRAND TOTAL to be carried forward to Letter of Bid		

Name of Bidder ______________________

Signature of Bidder ______________________

[1] **All pricing shall be given in United States Dollars ($USD) or three (3) convertible currencies (Refer to ITT 15.1).**

Schedule No. 6 - Recommended Spare Parts

Item	Description	Qty	Unit Price[1]		Total Price[1]	
			EXW Local Parts Local Currency	CIP Imported Parts Foreign Currency	Local Currency Portion	Foreign Currency Portion
1	2	3	4	5	6 = 3 x 4	7 = 3 x 5
				TOTAL		

Name of Bidder ____________________

Signature of Bidder ____________________

[1] **All pricing shall be given in United States Dollars ($USD) or three (3) convertible currencies (Refer to ITT 15.1).**

Form of Tender Security (Bank Guarantee)

___________________________ *[Bank's Name, and Address of Issuing Branch or Office]*

Beneficiary: [*INSERT] [Name and Address of* Principal*]*

Date: ___________________________

TENDER GUARANTEE No.: ___________________________

We have been informed that ___________________________ ***[name of the Tenderer]*** ("Tenderer") has submitted to you its Tender dated ___________***[enter date/month/year]*** ("Tender") for the execution of ________________ ***[name of contract]*** under Request for Tenders No. ___________ ("the RFT").

Furthermore, we understand that, according to your conditions, Tenders must be supported by a Tender Bank Guarantee as security.

[Issuing Bank to delete whichever is not applicable] We confirm that [we are a financial institution legally authorized to provide this guarantee in the Purchaser's country] [OR] [we are a financial institution located outside the Purchaser's country but have a correspondent financial institution located in the Purchaser's country that will ensure the enforceability of this guarantee. The name of our correspondent bank and contact information is as follows: [provide name, address, phone number, and email address]].

At the request of the Tenderer, we ____________________ ***[name of Bank]*** irrevocably undertake to pay you any sum or sums not exceeding in total an amount of _________ ***[enter amount in figures and currency, enter amount in words]*** upon receipt by us of your first demand in writing accompanied by a written statement stating that the Tenderer is in breach of its obligation(s) under the Tender conditions, because the Tenderer:

(a) has withdrawn its Tender during the period of tender validity specified by the Tenderer in the Form of Tender; or

(b) having been notified of the acceptance of its Tender by the Principal during the period of tender validity:
   (i) fails or refuses to execute the Contract Form, if required, or
   (ii) fails or refuses to furnish the Performance Security, in accordance with the ITT.

This guarantee will expire:

(a) if the Tenderer is the successful Tenderer, upon our receipt of copies of the contract signed by the Tenderer and the performance security issued to you upon the instruction of the Tenderer; and

(b) if the Tenderer is not the successful Tenderer, upon the earlier of:
   (i) our receipt of a copy of your notification to the Tenderer of the name of the successful Tenderer; or
   (ii) twenty-eight (28) days after the expiration of the Tenderer's tender.

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

This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 458.

____

[Signature(s)]

Technical Proposal
Technical Proposal Forms

Personnel
The Tenderer shall provide the names of suitably qualified personnel to meet the specified key position requirements stated in Section III, Table 2.5 using Tender Form PER-1 that follows.

The data on their experience should be supplied, using Form PER-2 that also follows, ***for each candidate.*** *The Principal reserves the right to check submitted personnel experience. Additionally, Tenderers are advised that changes to proposed personnel for key positions in Form PER-1 prior to commencement of the Contract will not be permitted.*

Bidders should provide the names of suitably qualified personnel to meet the requirements specified in Section 3 (Evaluation and Qualification Criteria). The data on their experience should be supplied using the Form below for each candidate.

Equipment
The Tenderer shall provide adequate information to clearly demonstrate that it has the capability to ***meet the requirements for key equipment listed in Section III, Table 2.6****. A separate form shall be prepared, using Tender Forms EQ-1 that follows, for each item of equipment listed or for alternative equipment proposed by the Tenderer. For all items of equipment, the Tenderer should demonstrate ownership or reasonable access to all items of plant and equipment from reputable rental or leasing companies.*

A summary list of key equipment should be produced. A satisfactory rating will require clear demarcation of equipment per work team identified in the Site Organisation plan in order to meet the proposed functions, tasks and output of that work team as per the proposed Construction Schedule.

Site Organisation

The Tenderer shall provide adequate information to ***demonstrate a clear, complete and effective organizational structure (with organizational chart)*** *with related staffing plan and summary of staffing resources that demonstrates quantitatively the planned levels of staff throughout the Contract Period.*

(Note: Evaluation of the Tenderer's Site Organization will include an assessment of the Tenderer's capacity to mobilize key personnel consistent with its proposal regarding work methods, scheduling, and material sourcing in sufficient detail and fully in accordance with the requirements stipulated in Section VI (Principal's Requirements))

Method Statement

The Tenderer's Method Statement should describe the activities and methods that will be used to estimate production rates for carrying out the Works within the Time for Completion proposed. The Method Statement should be consistent with other sections of the Technical Proposal including:

- *(a) team composition and proposed organisational structure;*
- *(b) equipment to be provided;*
- *(c) the proposed mobilisation schedule; and*
- *(d) the proposed construction schedules.*

The Method Statement shall provide a ***clear description of the Tenderer's understanding of the Principal's Requirements (Section VI),*** *a proposed strategic approach to achieve the Principal's objective of implementing the Works to the required standards in both a cost effective and time efficient manner. The statement should further demonstrate a sound technical methodology for carrying out the Works.*

The Method Statement must be realistic, establish realistic milestones, seek to maximise results with proposed resources and ensure a prompt and effective launch of contract activities.
Inter alia the Method Statement shall include, in sufficient detail, the following elements:

- *Surveying and setting out;*
- *Proposed sectioning (if any);*
- *A Quality Management Plan and Quality Assurance/Quality Control Procedures;*
- *Document Management Systems;*
- *Reporting Procedures;*
- *Community Liaison;*
- *Environmental Management in accordance with the PEAR;*
- *A Health, Safety and Traffic Management Plan;*
- *Approach to materials sourcing, testing and storage; and*
- *Any other elements or issues the Tenderer considers relevant.*

(Note: Evaluation of the Tenderer's technical proposal will include an assessment of the Tenderer's experience with preparing Construction Environmental Management Plans (CEMP's). The method statement should include the Bidder's proposed form of CEMP).

Mobilisation Schedule

The Tenderer shall provide adequate information to demonstrate a clear, complete and effective plan for mobilising the necessary personnel and equipment resources. The Mobilisation Schedule should be consistent with the other sections of the proposal including:

(i) team composition and proposed organizational structure;
(ii) equipment to be provided; and
(iii) the proposed construction schedules.

Provide a bar chart, GANTT chart or PERT/CPM diagram clearly showing all proposed mobilization activities with start and finish dates.

Construction Schedule

The Tenderer shall provide a work plan for the main Works activities to be undertaken clearly showing their content and duration, phasing and interrelations, milestones (including interim approvals by the Supervisor) and delivery dates of specific tasks/activities or sections of the Works taking into account seasonal weather conditions and existing baseline site conditions. The proposed work plan should be consistent with the Method Statement, illustrating and understanding of the Principal's Requirements and ability to translate these into a feasible work plan. A list of milestones and milestone dates in completing the Works should be included.

Satisfactory rating requires a logical and proper sequencing of activities. Provide a detailed bar chart, GANTT chart or PERT/CPM diagram clearly showing all required construction activities with start and finish dates. A critical path should be clearly demonstrated for multiple but related activities and/or sections. The schedule must show the completion of all construction works no later than the Intended Completion Date given in the GCC/PCC 1.1 (x).

(Note: Evaluation of the Bidder's Site Organization will include an assessment of the Bidder's capacity to mobilize key personnel for the Contractor consistent with its proposal regarding work methods, scheduling, and material sourcing in sufficient detail and fully in accordance with the requirements stipulated in Section 6 (Employers Requirements))

Proposed Subcontractors for Major Items of Plant and Services

The following Subcontractors and/or manufacturers are proposed for carrying out the item of the facilities indicated. [*Tenderers are free to propose more than one for each item]*

Major Items of Plant and Services	Proposed Subcontractors/Manufacturers	Nationality

Manufacturer's Authorisation

[*The Tenderer shall require the Manufacturer to fill in this Form in accordance with the instructions indicated. This letter of authorization should be signed by a person with the proper authority to sign documents that are binding on the Manufacturer. The Tenderer shall include it in its bid, if so indicated in the TDS.]*

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

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

To: [***insert complete name of Principal***]

WHEREAS

We [***insert complete name of Manufacturer or Manufacturer's authorized agent***], who are official manufacturers or agent authorized by the manufacturer of [***insert type of goods manufactured***], having factories at [insert full address of Manufacturer's factories], do hereby authorize [***insert complete name of Tenderer***] to submit a bid the purpose of which is to provide the following goods, manufactured by us [***insert name and or brief description of the goods***], and to subsequently negotiate and sign the Contract.

We hereby extend our full guarantee and warranty with respect to the goods offered by the above firm.

Signed: [***insert signature(s) of authorized representative(s) of the Manufacturer***]

Name: [**insert complete name(s) of authorized representative(s) of the Manufacturer**]

Title: [***insert title***]

Duly authorized to sign this Authorization on behalf of: [***insert complete name of Tenderer***]

Dated on ____________ day of __________________, _______ [***insert date of signing***]

Technical Schedules

Tenderers shall demonstrate their understanding of the Principal's requirements by providing proposed Plant details in the following schedules:-

One set of schedules shall be completed for each Part of the Facilities.

Guarantees

The continuous power output of the Tiapapata small hydropower plant at the 22kV connection to the EPC distribution system with the headpond at the Contractors nominated level of RL ______m, the turbine operating at the rated flow of 0.52m^3/s and the generator at unity power factor is guaranteed to be no less than.	____________ kW
The plant Availability Factor is guaranteed to be no less than	_____________ %

Other specified guarantees for individual equipment items shall be provided as required the following schedules.

Turbine and Inlet Valve Data

The Contractor shall provide the following governing system information and data for each different turbine as part of their Tender offer:

(i) Turbine Manufacturer

Name and address ____

____

____

Country of manufacture ____

(ii) Drawings and Data to be Submitted

- Drawings showing overall dimensions and general arrangement of equipment.

(iii) Guarantees

Guaranteed average efficiency over the range 10% to 100% of Rated Flow.	_____________ %
Guaranteed efficiency at Rated Flow	_____________ %

Cavitation, abrasion and corrosion guarantee	___ Provide details
Runner cracking guarantee	___ Provide details

(iv) Dimensions and Other Data

Turbine type	________________
Rated Speed	____________ Rpm
Runaway Speed at Rated Head	____________ Rpm
Runner	
Material and type of construction	________________
Diameter	_____________mm
Number of Buckets	________________
Shaft	
Material	________________
Diameter	_____________mm
Turbine Bearing	
Type	________________
Maximum possible temperature with continuous operation of the bearing	______________ C
Bearing lubrication	________________
Inlet Valve	
Material	________________
Internal diameter	_____________mm
Servomotor Type	________________
Pressure rating	_____________ Bar
Needle Valves	
Number	________________
Material	________________
Nozzle diameter	_____________mm
Servomotor Type	________________
Deflectors .	
Number	________________
Type	________________
Material	________________
Servomotor Type	________________
Turbine Case	
Material	________________
Protective Coating types	________________

(v) Operating Characteristics

Machine acceleration time for Bidders proposed turbine generator Tm	____________ Sec
Water acceleration time for Bidders proposed configuration Tw	____________ Sec
Ratio of Tm/Tw for Bidders proposed configuration	_______________
Opening time adjustment range of inlet valve	____________ Sec
Closing time adjustment range of inlet valve	____________ Sec
Opening time adjustment range of spear valves/guide vanes	____________ Sec
Closing time adjustment range of spear valves/guide vanes	____________ Sec
Opening time adjustment range of deflector/relief valves	____________ Sec
Closing time adjustment range of deflector/relief valves	____________ Sec
Efficiency Curve	_________Provide

(vi) Component manufacturers

Manufacturer and model of hydraulic servo motors	_______________
Manufacturer and model of electric servo motors	_______________
Manufacturer of hydraulic servo motors	_______________
Manufacturer and model of spear valve/guide vane/deflector position transmitters	_______________
Manufacturer and model of speed monitoring system	_______________

Alternator Bearings, Turbine Bearings and Cooling System

The Contractor shall provide the following alternator bearings, turbine bearings and cooling system information and data for each different as part of their Tender offer.

Alternator Bearings - Sliding self-lubricate Bearing Type
Turbine Bearings - Rolling Bearing Type
Cooling System - Air Radiator Cooling System and water cooled

Governing System Data

The Contractor shall provide the following governing system information and data for each different governor as part of their Tender offer:

(i) Governing System Manufacturer

Name and address ____

____

Country of manufacture ____

(ii) Drawings and Data to be Submitted

- Drawings showing overall dimensions and general arrangement of equipment.
- Descriptive literature of the governors, including schematic and block diagrams.

(iii) Dimensions and Other Data (If hydraulic operated servomotors are offered)

Governor Operating Oil Pressure		
Nominal	_____________	bar
Minimum	_____________	bar
Maximum	_____________	bar
Rating of actuator (pipe size)	_____________	mm
Capacity of governor main oil-pumps, each at	_____________	l/s
delivery pressure of	_____________	bar
Motor rating of governor main oil-pumps, each	_____________	kW
Speed	_____________	rpm
Capacity of accumulator	____________	litre
Accumulator pressure vessel design Standard	________________	
Overall dimensions of governor hydraulic unit	___x___x ___	mm
Net weight of complete governing system	_____________	kgf
Net weight of sump tank	_____________	kgf
Net weight of complete governing system	_____________	kgf

(iv) Operating Characteristics

Range of permanent speed droop	______________	%
Range of speed change	______________	%
Opening time adjustment range of spear valves	_____________	sec
Closing time adjustment range of spear valves	_____________	sec
Opening time adjustment range of deflector	_____________	sec
Closing time adjustment range of deflector	_____________	sec

(v) Component manufacturers

Manufacturer and model of electro-proportional valves	________________
Manufacturer and model of oil pumps	________________
Manufacturer of hydraulic servo motors	________________
Manufacturer and model of spear valve/deflector position transmitters	________________

Manufacturer and model of speed monitoring system ________________

Generator Data

The Contractor shall provide the data listed on the following data sheets for each different generator as part of their tender design:

(i) Generator Manufacturer

Name and address ____
____
____

Country of manufacture ____

(ii) Drawings and Data to be Submitted

- Drawings showing overall dimensions and general arrangement of the generator.
- Drawings and description of bearing lubrication system.
- Descriptive literature of the generator.
- Generator Efficiency Curve
- Generator Capability Curve

(iii) Guarantees

Guaranteed Minimum Average Efficiency ______________ %
Guaranteed Efficiency at Rated Output ______________ %

(iv) Dimensions and Other Data

Rated Output (kVA @ 0.8 lagging power factor ____________ kVA
Rated Voltage _____________ kV
Rated Frequency ___________ 50Hz
Rated Power Factor _____________ 0.8
Rated Speed _____________rpm
Design Runaway Speed _____________rpm
Direction of rotation viewed from turbine ________________
Flywheel effect of generator rotating part (GD^2) ____________T/m^2
Stator
Dimension for shipment ________________
Weight for shipment ________________

Outside dimension of stator frame	________________
Rotor	
Pole Length	________________
Type of pole damper windings	________________
Maximum diameter	________________
Weight for shipment	________________
Bearings	
Type of thrust bearing	________________
Type of guide bearing	________________
Estimated hydraulic thrust load	________________
Maximum possible temperature with	________________
continuous operation of the bearing	________________
Bearing lubrication type	________________
Bearing cooling type	________________
Material of Insulation	
Stator conductors in core	________________
Stator end windings	________________
Stator core plates	________________
Field windings	________________
Neutral Grounding	
Grounding transformer ratio	________________
Grounding transformer rating	____________ kVa
Grounding resistor rating	______________ Ω
Separate Flywheel (If required)	
Diameter	______________ m
Weight	______________kg
Flywheel effect (GD2)	____________T/m^2

(v) Operating Characteristics

Short circuit ratio	________________
Deviation factor of open circuit wave form	________________
Inherent voltage regulation	
At 1.0 power factor	______________ %
At 0.9 power factor	______________ %
Direct axis transient reactance, saturated (Xd')	________________
Direct axis subtransient reactance, unsaturated (Xd")	________________
Negative sequence reactance (X_2)	________________
Zero sequence reactance (XQ)	________________
Direct axis synchronous (Xd)	________________
Max voltage rise when shedding continuous rated load at rated power factor under actual service conditions with speed control and voltage control plant in operation	______________ %

KVAr capability of generator for rated temperature rise
Leading power factor ___________ kVAr
Lagging power factor ___________ kVAr

(vi) Component Manufacturers

Manufacturer and model of bearings ________________
Manufacturer and type of lube oil system ________________
Manufacturer and model of vibration monitors ________________
Manufacturer and type of CTs and VTs ________________
Manufacturer and model of grounding transformer/resistor ________________

(vii) Spare Parts Included (List)

____
____
____

Excitation Systems

The Contractor shall provide the data listed on the following data sheets for each different excitation system as part of their tender design:

(i) Excitation System Manufacturer

Name and address ____
____
____

Country of manufacture ____

(ii) Drawings and Data to be Submitted

- Drawings and description of excitation system.

(iii) Dimensions and Other Data

Exciter rated voltage ________________
Exciter ceiling voltage ________________
Response ratio ________________

Class, ratio and rating required for voltage transformer for AVR ______________

Class, ratio and rating required for current transformer for AVR ______________

(iv) Spare Parts Included (List)

____
____
____

415V Switchgear

The Contractor shall provide the data listed on the following data sheets for each different 22kV Switchgear system as part of their tender design:

(i) 415V Switchgear Manufacturer

Name and address ____
____
____

Country of manufacture ______________________________________

(ii) Drawings and Data to be Submitted

- Drawings and description of 415V Switchgear.

(iii) Dimensions and Other Data

General		
Maximum rated voltage	____________	kV
Frequency	____________	Hz
Rated normal current	____________	A
Number of phases	______________	
Number of breaks per phase	______________	
Interrupting medium	______________	
Short time withstand current		
1 second	_________	rms kA
3 seconds	_________	rms kA
Breaking capacity		
symmetrical	_________	rms kA
asymmetrical	_________	rms kA

Opening time	
without current	____________ ms
at 100% of rated breaking current	____________ ms
Maximum arc duration of any duty cycle	____________ ms
Current at which maximum arc duration occurs (critical current)	____________ ms
Make time	____________ ms
Trip coil voltage	________24 V DC
Close coil voltage	________24 V DC
Circuit breaker trip Free	_________Yes/No
Rated voltage of spring winding motor for closing	_____________ V
Current Transformers	
Type of construction	_______________
Number of current transformers	_______________
Ratio (for each CT)	_______________
Secondary current	_____________ A
Rating	____________VA
Accuracy class (for each CT)	_______________

Voltage Transformers	
Type of construction	_______________
Number of current transformers	_______________
Ratio (for each VT)	_______________
Rating	____________VA
Accuracy class (for each VT)	_______________

Weights and Dimensions	
Overall width	___________ Mm
Overall height	____________mm
Overall front to rear dimension	____________mm
Space required for withdrawal of moving portion	____________mm
Space if required for access at rear	____________mm
Weight of complete panel comprising fixed and moving portions	_____________kg
Weight of circuit breaker complete with all fittings as in service	_____________kg

(iv) Spare Parts Included (List)

____

____

____

Station Transformers

The Contractor shall provide the data listed on the following data sheets for each different generator step-up transformer as part of their tender design:

(i) Transformer Manufacturer

Name and address ____
____
____

Country of manufacture ____

(ii) Drawings and Data to be Submitted

- Drawings and description of transformers.

(iii) Guarantees

No-Load Losses at transformer ratio and rated ONAN kVA	____________ kW
Load Losses at rated voltage	____________ kW

(iv) Dimensions and Other Data

Electrical Characteristics

ONAN Rated continuous current HV windings	____________ A
ONAN Rated power of HV winding	____________ kVA
ONAN Rated power of L.V winding	____________ kVA
Winding connection	____________ Dyn11
Principal ratio of transformation	____________
Tapping range on HV	____________
Tapping steps	____________ %
Number of tap positions	____________
Lightning impulse withstand voltage of HV winding	____________ kVp
1 minute power frequency withstand voltage of HV winding	____________ kV rms
1 minute power frequency withstand voltage of LV winding	____________ kV rms
Estimated maximum inrush current on HV winding (0% tap)	____________ A

Positive phase sequence impedance voltage on rated kVA base between main and secondary windings at:-		
i.	Transformer ratio	_____________ %
ii	Highest ratio	At tap________ %
iii	Lowest ratio	At tap________ %
Regulation at rated kVA between main and secondary windings at:-		
i.	Unity power factor	___ %
ii	. 0.95 power factor lagging	___ %
Rated 3 second short circuit fault level:-		
i.	HV winding	__________ MVA
ii.	LV winding	__________ MVA
Mechanical Characteristics		
Oil strength required for initial filling		_________kV rms
Minimum allowable oil strength in service		_________kV rms
Maximum moisture content in oil for initial filling		___________ ppm
Maximum moisture content in oil service		___________ ppm
Details of Construction		
Type of winding:-		
i	LV	_______________
ii.	HV	_______________
Dimensions, Masses, Volumes		
Total oil quantity at 20C		____________litre
Dimensions of transformer in service		
i.	Length overall (incl. Radiators)	____________mm
ii.	Width overall	____________mm
iii.	Height overall	____________mm
Masses		
i.	Mass of transformer with oil	_____________kg
ii.	Mass of transformer without oil	_____________kg
iii	Untanking mass of core and windings	_____________kg

(v) Spare Parts Included (List)

____

____

____

Control and Automation Systems

The Contractor shall provide the data listed on the following data sheets for each different control and automation system as part of their tender design:

(i) Control System Manufacturer

Name and address ____
____
____

Country of manufacture ____

(ii) Drawings and Data to be Submitted

- Control system architecture drawing
- Technical literature on PLC and HMI systems offered.
- Technical literature on panel system offered
- Concept arrangement drawing for Unit and Station PLC panels
- IO list for each PLC

(iii) Guarantees

Control system Average System Availability guarantee	_____________ %

(iv) Control System Data

PLC Panel Details	
Panel Manufacturer	_______________
Place of Manufacture	_______________
IP Rating of completed panel	_______________
Panel length	____________mm
Panel width	____________mm
Panel height	____________mm
RTU Details	
RTU Manufacturer	_______________
RTU Model	_______________
PLC Details	
PLC Manufacturer	_______________
PLC Model	_______________
Protocol for communications with Employers SCADA	_______________
Remote IO communications protocol	_______________
Max number of digital inputs	_______________
Max number of digital outputs	_______________
Max number of analogue inputs	_______________

Max number of analogue outputs	________________
Max number of RTD inputs	________________
Processor	
Model	________________
Programming methods supported	________________
On line programming supported	__________Yes/No
Digital Input Module	
Nominal input voltage	___________ V DC
Number of DI points per module	________________
Number of DI points per common	________________
Rated impulse withstand voltage between input and ground	_____________ kV
Digital Output Module	
Nominal output voltage	___________ V DC
Clean contact type DO	__________Yes/No
Number of DO points per module	________________
Number of DO points per common	________________
Rated impulse withstand voltage between output and ground	_____________ kV
Analogue Input Module	
Nominal input type	_________ 4-20mA
Number of AI points per module	________________
Number of AI points per common	________________
Rated impulse withstand voltage between input and ground	_____________ kV
Resolution	_____________ Bit
Accuracy	__________ % FSD
Analogue Output Module	
Nominal input type	__ 0-10V/4-20mA
Number of AO points per module	________________
Number of AO points per common	________________
Rated impulse withstand voltage between input and ground	_____________ kV
Resolution	_____________ Bit
Accuracy	__________ % FSD
Voltage Mode Output Loading	______________ Ω
Current Mode Output Loading	______________ Ω
RTD Input Module	
Nominal input type	__________ PT100
Number of RTD points per module	________________
Rated impulse withstand voltage between input and ground	_____________ kV
Resolution	_____________ Bit
Accuracy	__________ % FSD
Power Supply	
Input voltage range	___________ V DC

Redundant	__________Yes/No
Network Switches	
Manufacturer	_________________
Model	_________________
Power supply voltage range	___________ V DC
Number of RJ45 ports	_________________
Number of Fibre optic ports	_________________
Fibre optic port type	Single/multimode
Managed switch	__________Yes/No
HMI Computers	
Manufacturer	_________________
Model	_________________
Power supply voltage range	___________ V DC
Operating System	_______Windows 7
Hard drive capacity	_________________
Solid state hard drive	__________Yes/No
Processor type and speed	_________________
RAM	_________________
Display size	____________ Inch
Display resolution	_________________
Touchscreen display	__________Yes/No
HMI Software	
Manufacturer	_________________
Software Name	_________________
Number of licenses offered	_________________
Software Modules included (list all)	_________________
Maximum number of tags	_________________
Requires hardware lock?	__________Yes/No
PLC Programming Computer	
Manufacturer	_________________
Model	_________________
PLC Programming Software	
Manufacturer	_________________
Software Name	_________________
Number of licenses offered	_________________
Instruments	
Level Transmitter type	_________________
Level Transmitter manufacturer	_________________
Surge Protection type	_________________

(v) Spare Parts Included (List)

____

____

____

Protective Relaying Systems

The Contractor shall provide the data listed on the following data sheets for each different protective relaying system as part of their tender design:

(i) Protective Relaying System Manufacturer

Name and address ____
____
____

Country of manufacture ____

(ii) Drawings and Data to be Submitted

- Technical literature on protective relays offered.
- Technical literature on panel system offered

(iii) Protective Relaying System Data

Relay Panel Details (If relays not incorporated within PLC panels or 400V Switchgear)	
Panel Manufacturer	________________
Place of Manufacture	________________
IP Rating of completed panel	________________
Panel length	_____________mm
Panel width	_____________mm
Panel height	_____________mm
Generator and Transformer "All in One" Protection Relay Details	
Relay Manufacturer	________________
Relay Model	________________
Country of manufacture	________________
Communications protocols supported	________________
Protective functions included (Use ANSI Codes)	________________
Number of programmable digital inputs	________________
Number of trip outputs	________________
Number of programmable digital outputs	________________
Number of single phase CT inputs	________________
Number of single phase VT inputs	________________
Power supply voltage range	___________ V DC

Feeder Protection Relay Details

Relay Manufacturer	________________
Relay Model	________________
Country of manufacture	________________
Communications protocols supported	________________
Protective functions included (Use ANSI Codes)	________________
Number of programmable digital inputs	________________
Number of trip outputs	________________
Number of programmable digital outputs	________________
Number of single phase CT inputs	________________
Number of single phase VT inputs	________________
Power supply voltage range	___________ V DC

Trip Relay Details

Relay Manufacturer	________________
Relay Model	________________
Country of manufacture	________________

Relay Programming Computer

Manufacturer	________________
Model	________________

Relay Programming Software

Manufacturer	________________
Software Name	________________
Number of licenses offered	________________

(iv) Spare Parts Included (List)

____

____

____

24V DC Systems

The Contractor shall provide the data listed on the following data sheets for each different 24V DC system as part of their tender design:

(i) 24V DC System Manufacturer

Name and address ____

____

____

Country of manufacture ____

(ii) Drawings and Data to be Submitted

- Technical literature on dc system offered.

(iii) 24V DC System Data

24V Batteries	
Manufacturer	________________
Type	__________ VRLA
Catalogue number	
Number of cells	________________
Battery bank nominal voltage	___________ V DC
Battery bank capacity	_____________ Ah
Expected battery life	___________ Years
Discharge rates for the following times with an initial electrolyte temperature of 25°C	
i. Eight hour	______________ A
ii Four hour	______________ A
iii. One hour	______________ A
Dimensions of Battery and Rack Assembly	_________ WxHxD
Design continuous demand of connected loads	______________ A
Battery Chargers	
Manufacturer	________________
Type or catalogue number	________________
DC Output (rated).	
i. Current	________________
ii . Voltage	________________
AC Input (rated).	
i. Current	________________
ii . Voltage	________________
Temperature compensation to prevent battery thermal runaway	__________Yes/No
Voltage regulation	______________ %
Ripple	___________V rms
Dimensions of battery charger	_________ WxHxD
DC Distribution Panel	
Manufacturer	________________
Type or catalogue number	________________
Number of feeder MCBs	________________
Dimensions of DC distribution panel	_________ WxHxD

(iv) Spare Parts Included (List)

____

Local Service AC Systems

The Contractor shall provide the data listed on the following data sheets for each different local service AC system as part of their tender design:

(i) Local Service AC System Manufacturer

Name and address ______________________________
____
____

Country of manufacture ______________________________

(ii) Drawings and Data to be Submitted

- Technical literature on local service switchboard.
- Technical literature on light fittings proposed.

(iii) Local Service AC System Data

Local Service Switchboard	
Manufacturer	____________
Type	____________
Rated Current	____________ A
1 second short circuit withstand	____________ kA
Rating of incoming switch	____________
Number of outgoing feeders	____________
Light fittings (complete for each type)	
Manufacturer	____________
Type	____________
Power outlets (complete for each type)	
Manufacturer	____________
Type	____________

(iv) Spare Parts Included (List)

____
____
____

Cabling

The Contractor shall provide the data listed on the following data sheets for each different cable type as part of their tender design:

(i) Cable Manufacturer

Name and address ____
____
____

Country of manufacture ____

(ii) Drawings and Data to be Submitted

- Technical literature on each cable type offered.
- Type test certificates on each cable type offered.

(iii) Cable Data

22kV Cable	
Manufacturer	____________
Country of manufacture	____________
Rated voltage	____________ V
Conductor material	____________
Insulation material	____________
Sheath material	____________
Cross sectional area and stranding	____________
Screen type and 3s current rating	____________ kA
Design Standards	____________
400V Cable	
Manufacturer	____________
Country of manufacture	____________
Rated voltage	____________ V
Conductor material	____________
Insulation material	____________
Sheath material	____________
Cross sectional area and stranding	____________
Design Standards	____________
Control Cable	
Manufacturer	____________
Country of manufacture	____________
Rated voltage	____________ V
Conductor material	____________

Insulation material ________________
Sheath material ________________
Cross sectional area and stranding ________________
Design Standards ________________

Instrument Cable

Manufacturer ________________
Country of manufacture ________________
Rated voltage ______________ V
Conductor material ________________
Screen type ________________
Insulation material ________________
Sheath material ________________
Cross sectional area and stranding ________________
Design Standards ________________

Fiber Optic Cable

Manufacturer ________________
Country of manufacture ________________
Inner/Outer core diameter
Sheath material ________________
Fiber Loss
Design Standards ________________

Cable Tray and Ladder

Manufacturer ________________
Country of manufacture ________________
Material ________________

Pipelines and Penstocks

The Contractor shall provide the data listed on the following data sheets for each different pipeline/penstock type as part of their tender design:

(i) Pipe/Penstock Manufacturer

Name and address ____
____
____

Country of manufacture ____

(ii) Drawings and Data to be Submitted

- Technical literature.

(iii) Pipe/Penstock Data

Pipe material	________________
Jointing method	________________
Protective coating details	________________
Bedding material type	________________
Pipe diameters (ref chainages)	________________
Pressure ratings (ref chainages)	________________

Screens
The Contractor shall provide the data listed on the following data sheets for each different screen type as part of their tender design:

(i) Intake Weir Screen Manufacturer

Name and address ____

____

____

Country of manufacture ____

(ii) Screen Data

Screen material	________________
Screen mounting/fixing method	
Cleaning method (eg self cleaning)	________________
Protective coating details	________________
Screen spacing	
Screen flow performance	________________

(iii) Penstock Intake Screen Manufacturer

Name and address ____

____

____

Country of manufacture ____

(iv) Screen Data

Screen material ________________
Screen mounting/fixing method
Cleaning method (eg self cleaning) ________________
Protective coating details ________________
Screen spacing
Screen flow performance ________________

(v) Drawings and data to be submitted for each screen

- Typical drawing
- Technical literature.

Headpond

The Contractor shall provide the data listed on the following data sheets for the headpond structure as part of their tender design:

(i) Geometrical Properties

- Location (latitude/longitude)
  ____
- Elevation (Formation)
  ____
- Embankment Crest Level
  ____
- Top Water Level
  ____
- Operational Storage Volume
  ____
- Dead storage volume
  ____
- Internal Batter Angle
  ____
- External Batter Angle
  ____

(ii) Structure materials

- Sump

- Type

  ____

- Internal waterproof Liner
  - Type

    ____

  - Manufacturer

    ____

- External Batter protection
  - Type

    ____

  - Manufacturer

    ____

Excavation in rock

The Contractor shall provide the data listed on the following data sheets for their estimate in Schedule 4 and allowance for excavation in rock as part of their tender design:

(i) Headpond Pipeline

Volume ______ m^3

(ii) Penstock

Volume ______ m^3

(iii) **TOTAL**

Volume ______ m^3

Silt Removal at Alaoa Headpond

The Contractor shall provide the data listed on the following data sheets for their estimate in Schedule 4 and allowance for silt removal as part of their tender design:

(i) Headpond Pipeline

Volume ______ m^3

(ii) Headpond Structure

Volume ______ m^3

(iii) **TOTAL**

Volume ______ m^3

(iv) Programme Duration

Shutdown ______ working days

(v) Construction method

Isolation

____

____

Debris Removal

____

____

Debris Disposal

____

____

Forms for Personnel

Form PER-1: Proposed Personnel

The Tenderers should provide the names of suitably qualified personnel to meet the specified requirements each of the positions listed in Section III (Evaluation and Qualification Criteria). The data on their experience should be supplied using the Form below for each candidate.

The Registered Engineer shall be a fully qualified corporate member of the Institute of Professional Engineers Samoa ("IPES") or be in possession of an alternative professional qualification recognized by IPES for membership of IPES and who will register as a member of IPES within one (1) calendar month of the Commencement Date.

1.	**Title of position***
	Name
2.	**Title of position***
	Name
3.	**Title of position***
	Name
4.	**Title of position***
	Name
5.	**Title of position***
	Name
6.	**Title of position***
	Name

Form PER – 2: Resume of Proposed Personnel

The Tenderer shall provide all the information requested below. Fields with asterick (*) shall be used for evaluation.

Position*		
Personnel information	Name*	Date of birth
	Professional qualifications	
Present employment	Name of employer	
	Address of employer	
	Telephone	Contact (manager / personnel officer)
	Fax	E-mail
	Job title	Years with present employer

Summarize professional experience in reverse chronological order (i.e. from most recent to most previous). Indicate particular technical and managerial experience relevant to the project.

From*	To*	Company / Project / Position / Relevant technical and management experience

Forms for Equipment

The Tenderer shall provide adequate information to demonstrate clearly that it has the capability to meet the requirements for the key equipment listed in Section III (Evaluation and Qualification Criteria). A separate Form shall be prepared for each item of equipment listed, or for alternative equipment proposed by the Tenderer. The Tenderer shall provide all the information requested below, to the extent possible. Fields with asterick (*) shall be used for evaluation.

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

The following information shall be provided only for equipment not owned by the Tenderer.

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

Bidders Tenderers shall demonstrate their understanding of the Employers Principal's requirements by providing proposed Plant details in the following schedules:-

One set of schedules shall be completed for each Part of the Facilities.

Guarantees

The continuous power output of the Tiapapata small hydropower plant at the 22kV connection to the EPC distribution system with the headpond at the Contractors nominated level of RL ______m, the turbine operating at the rated flow of 0.52m^3/s and the generator at unity power factor is guaranteed to be no less than.	____________ kW
The plant Availability Factor is guaranteed to be no less than	_____________ %

Other specified guarantees for individual equipment items shall be provided as required the following schedules.

Turbine and Inlet Valve Data

The Contractor shall provide the following governing system information and data for each different turbine as part of their Tender offer:

(vi) Turbine Manufacturer

Name and address ____
____
____

Country of manufacture ____

(vii) Drawings and Data to be Submitted

- Drawings showing overall dimensions and general arrangement of equipment.

(viii) Guarantees

Guaranteed average efficiency over the range 10% to 100% of Rated Flow.	______________ %
Guaranteed efficiency at Rated Flow	______________ %
Cavitation, abrasion and corrosion guarantee	___ Provide details
Runner cracking guarantee	___ Provide details

(ix) Dimensions and Other Data

Turbine type	________________
Rated Speed	____________ Rpm
Runaway Speed at Rated Head	____________ Rpm
Runner	
Material and type of construction	________________
Diameter	_____________mm
Number of Buckets	________________
Shaft	
Material	________________
Diameter	_____________mm
Turbine Bearing	
Type	________________

Maximum possible temperature with continuous operation of the bearing	_____________ C
Bearing lubrication	_______________
Inlet Valve	
Material	_______________
Internal diameter	____________mm
Servomotor Type	_______________
Pressure rating	____________ Bar
Needle Valves	
Number	_______________
Material	_______________
Nozzle diameter	____________mm
Servomotor Type	_______________
Deflectors .	
Number	_______________
Type	_______________
Material	_______________
Servomotor Type	_______________
Turbine Case	
Material	_______________
Protective Coating types	_______________

(x) Operating Characteristics

Machine acceleration time for Bidders proposed turbine generator Tm	____________ Sec
Water acceleration time for Bidders proposed configuration Tw	____________ Sec
Ratio of Tm/Tw for Bidders proposed configuration	_______________
Opening time adjustment range of inlet valve	____________ Sec
Closing time adjustment range of inlet valve	____________ Sec
Opening time adjustment range of spear valves/guide vanes	____________ Sec
Closing time adjustment range of spear valves/guide vanes	____________ Sec
Opening time adjustment range of deflector/relief valves	____________ Sec
Closing time adjustment range of deflector/relief valves	____________ Sec
Efficiency Curve	_________Provide

(xi) Component manufacturers

Manufacturer and model of hydraulic servo motors	________________
Manufacturer and model of electric servo motors	________________
Manufacturer of hydraulic servo motors	________________
Manufacturer and model of spear valve/guide vane/deflector position transmitters	________________
Manufacturer and model of speed monitoring system	________________

..

Governing System Data

The Contractor shall provide the following governing system information and data for each different governor as part of their Tender offer:

(xii) Governing System Manufacturer

Name and address ______________________________
____
____

Country of manufacture ______________________________

(xiii) Drawings and Data to be Submitted

- Drawings showing overall dimensions and general arrangement of equipment.
- Descriptive literature of the governors, including schematic and block diagrams.

(xiv) Dimensions and Other Data (If hydraulic operated servomotors are offered)

Governor Operating Oil Pressure	
Nominal	____________ bar
Minimum	____________ bar
Maximum	____________ bar
Rating of actuator (pipe size)	____________mm
Capacity of governor main oil-pumps, each at	____________ l/s
delivery pressure of	____________ bar
Motor rating of governor main oil-pumps, each	____________ kW
Speed	____________rpm
Capacity of accumulator	___________ litre
Accumulator pressure vessel design Standard	_______________
Overall dimensions of governor hydraulic unit	___x___x ___mm
Net weight of complete governing system	____________ kgf
Net weight of sump tank	____________ kgf
Net weight of complete governing system	____________ kgf

(xv) Operating Characteristics

Range of permanent speed droop	_____________ %

Range of speed change	______________	%
Opening time adjustment range of spear valves	_____________	sec
Closing time adjustment range of spear valves	_____________	sec
Opening time adjustment range of deflector	_____________	sec
Closing time adjustment range of deflector	_____________	sec

(xvi) Component manufacturers

Manufacturer and model of electro-proportional valves	________________
Manufacturer and model of oil pumps	________________
Manufacturer of hydraulic servo motors	________________
Manufacturer and model of spear valve/deflector position transmitters	________________
Manufacturer and model of speed monitoring system	________________

Generator Data

The Contractor shall provide the data listed on the following data sheets for each different generator as part of their tender design:

(xvii) Generator Manufacturer

Name and address ____
____
____

Country of manufacture ____

(xviii) Drawings and Data to be Submitted

- Drawings showing overall dimensions and general arrangement of the generator.
- Drawings and description of bearing lubrication system.
- Descriptive literature of the generator.
- Generator Efficiency Curve
- Generator Capability Curve

(xix) Guarantees

Guaranteed Minimum Average Efficiency	_____________ %
Guaranteed Efficiency at Rated Output	_____________ %

(xx) Dimensions and Other Data

Rated Output (kVA @ 0.8 lagging power factor	___________ kVA
Rated Voltage	____________ kV
Rated Frequency	__________ 50Hz
Rated Power Factor	____________ 0.8
Rated Speed	____________ rpm
Design Runaway Speed	____________ rpm
Direction of rotation viewed from turbine	_______________
Flywheel effect of generator rotating part (GD^2)	___________ T/m^2
Stator	
Dimension for shipment	_______________
Weight for shipment	_______________
Outside dimension of stator frame	_______________
Rotor	

Pole Length	________________
Type of pole damper windings	________________
Maximum diameter	________________
Weight for shipment	________________
Bearings	
Type of thrust bearing	________________
Type of guide bearing	________________
Estimated hydraulic thrust load	________________
Maximum possible temperature with	________________
continuous operation of the bearing	________________
Bearing lubrication type	________________
Bearing cooling type	________________
Material of Insulation	
Stator conductors in core	________________
Stator end windings	________________
Stator core plates	________________
Field windings	________________
Neutral Grounding	
Grounding transformer ratio	________________
Grounding transformer rating	____________ kVa
Grounding resistor rating	______________ Ω
Separate Flywheel (If required)	
Diameter	______________ m
Weight	______________kg
Flywheel effect (GD2)	____________T/m^2

(xxi) Operating Characteristics

Short circuit ratio	________________
Deviation factor of open circuit wave form	________________
Inherent voltage regulation	
At 1.0 power factor	______________ %
At 0.9 power factor	______________ %
Direct axis transient reactance, saturated (Xd')	________________
Direct axis subtransient reactance, unsaturated (Xd")	________________
Negative sequence reactance (X_2)	________________
Zero sequence reactance (XQ)	________________
Direct axis synchronous (Xd)	________________
Max voltage rise when shedding continuous rated load at rated power factor under actual service conditions with speed control and voltage control plant in operation	______________ %
KVAr capability of generator for rated temperature rise	___________ kVAr

Leading power factor ___________ kVAr
Lagging power factor

(xxii) Component Manufacturers

Manufacturer and model of bearings ________________
Manufacturer and type of lube oil system ________________
Manufacturer and model of vibration monitors ________________
Manufacturer and type of CTs and VTs ________________
Manufacturer and model of grounding transformer/resistor ________________

(xxiii) Spare Parts Included (List)

____
____
____

Excitation Systems

The Contractor shall provide the data listed on the following data sheets for each different excitation system as part of their tender design:

(xxiv) Excitation System Manufacturer

Name and address ____
____
____

Country of manufacture ____

(xxv) Drawings and Data to be Submitted

- Drawings and description of excitation system.

(xxvi) Dimensions and Other Data

Exciter rated voltage	____________
Exciter ceiling voltage	____________
Response ratio	____________
Class, ratio and rating required for voltage transformer for AVR	____________
Class, ratio and rating required for current transformer for AVR	____________

(xxvii) Spare Parts Included (List)

____
____
____

415V Switchgear

The Contractor shall provide the data listed on the following data sheets for each different 22kV Switchgear system as part of their tender design:

(xxviii) 415V Switchgear Manufacturer

Name and address ____
____
____

Country of manufacture ____

(xxix) Drawings and Data to be Submitted

- Drawings and description of 415V Switchgear.

(xxx) Dimensions and Other Data

General	
Maximum rated voltage	____________ kV
Frequency	____________ Hz
Rated normal current	_____________ A
Number of phases	_______________
Number of breaks per phase	_______________
Interrupting medium	_______________
Short time withstand current	
1 second	_________ rms kA
3 seconds	_________ rms kA
Breaking capacity	
symmetrical	_________ rms kA
asymmetrical	_________ rms kA
Opening time	
without current	____________ ms
at 100% of rated breaking current	____________ ms
Maximum arc duration of any duty cycle	____________ ms
Current at which maximum arc duration occurs (critical current)	____________ ms
Make time	____________ ms
Trip coil voltage	________24 V DC
Close coil voltage	________24 V DC
Circuit breaker trip Free	_________Yes/No

Rated voltage of spring winding motor for closing	______________ V
Current Transformers	
Type of construction	________________
Number of current transformers	________________
Ratio (for each CT)	________________
Secondary current	______________ A
Rating	_____________ VA
Accuracy class (for each CT)	________________
Voltage Transformers	
Type of construction	________________
Number of current transformers	________________
Ratio (for each VT)	________________
Rating	_____________ VA
Accuracy class (for each VT)	________________
Weights and Dimensions	
Overall width	____________ Mm
Overall height	_____________ mm
Overall front to rear dimension	_____________ mm
Space required for withdrawal of moving portion	_____________ mm
Space if required for access at rear	_____________ mm
Weight of complete panel comprising fixed and moving portions	______________ kg
Weight of circuit breaker complete with all fittings as in service	______________ kg

(xxxi) Spare Parts Included (List)

____

____

____

Station Transformers

The Contractor shall provide the data listed on the following data sheets for each different generator step-up transformer as part of their tender design:

(xxxii) Transformer Manufacturer

Name and address ____
____
____

Country of manufacture ____

(xxxiii) Drawings and Data to be Submitted

- Drawings and description of transformers.

(xxxiv) Guarantees

No-Load Losses at transformer ratio and rated ONAN kVA	____________ kW
Load Losses at rated voltage	____________ kW

(xxxv) Dimensions and Other Data

Electrical Characteristics

ONAN Rated continuous current HV windings	____________ A
ONAN Rated power of HV winding	____________ kVA
ONAN Rated power of L.V winding	____________ kVA
Winding connection	_________ Dyn11
Principal ratio of transformation	____________
Tapping range on HV	____________
Tapping steps	____________ %
Number of tap positions	____________
Lightning impulse withstand voltage of HV winding	____________ kVp
1 minute power frequency withstand voltage of HV winding	_________ kV rms
1 minute power frequency withstand voltage of LV winding	_________ kV rms
Estimated maximum inrush current on HV	____________ A

winding (0% tap)		
Positive phase sequence impedance voltage on rated kVA base between main and secondary windings at:-		
i.	Transformer ratio	_____________ %
ii	Highest ratio	At tap________ %
iii	Lowest ratio	At tap________ %
Regulation at rated kVA between main and secondary windings at:-		
i.	Unity power factor	___ %
ii	. 0.95 power factor lagging	___ %
Rated 3 second short circuit fault level:-		
i.	HV winding	__________ MVA
ii.	LV winding	__________ MVA

Mechanical Characteristics

Oil strength required for initial filling	_________kV rms
Minimum allowable oil strength in service	_________kV rms
Maximum moisture content in oil for initial filling	___________ ppm
Maximum moisture content in oil service	___________ ppm

Details of Construction

Type of winding:-		
i	LV	_______________
ii.	HV	_______________

Dimensions, Masses, Volumes

Total oil quantity at 20C	____________litre

Dimensions of transformer in service

i.	Length overall (incl. Radiators)	____________mm
ii.	Width overall	____________mm
iii.	Height overall	____________mm

Masses

i.	Mass of transformer with oil	_____________kg
ii.	Mass of transformer without oil	_____________kg
iii	Untanking mass of core and windings	_____________kg

(xxxvi) Spare Parts Included (List)

____
____
____

Control and Automation Systems

The Contractor shall provide the data listed on the following data sheets for each different control and automation system as part of their tender design:

(xxxvii) Control System Manufacturer

Name and address ____
____
____

Country of manufacture ____

(xxxviii) Drawings and Data to be Submitted

- Control system architecture drawing
- Technical literature on PLC and HMI systems offered.
- Technical literature on panel system offered
- Concept arrangement drawing for Unit and Station PLC panels
- IO list for each PLC

(xxxix) Guarantees

Control system Average System Availability guarantee	______________ %

(xl) Control System Data

PLC Panel Details	
Panel Manufacturer	________________
Place of Manufacture	________________
IP Rating of completed panel	________________
Panel length	_____________mm
Panel width	_____________mm
Panel height	_____________mm
RTU Details	
RTU Manufacturer	________________
RTU Model	________________
PLC Details	
PLC Manufacturer	________________
PLC Model	________________

Protocol for communications with Employers SCADA	________________
Remote IO communications protocol	________________
Max number of digital inputs	________________
Max number of digital outputs	________________
Max number of analogue inputs	________________
Max number of analogue outputs	________________
Max number of RTD inputs	________________
Processor	
Model	________________
Programming methods supported	________________
On line programming supported	__________Yes/No
Digital Input Module	
Nominal input voltage	___________ V DC
Number of DI points per module	________________
Number of DI points per common	________________
Rated impulse withstand voltage between input and ground	_____________ kV
Digital Output Module	
Nominal output voltage	___________ V DC
Clean contact type DO	__________Yes/No
Number of DO points per module	________________
Number of DO points per common	________________
Rated impulse withstand voltage between output and ground	_____________ kV
Analogue Input Module	
Nominal input type	_________ 4-20mA
Number of AI points per module	________________
Number of AI points per common	________________
Rated impulse withstand voltage between input and ground	_____________ kV
Resolution	_____________ Bit
Accuracy	__________ % FSD
Analogue Output Module	
Nominal input type	__ 0-10V/4-20mA
Number of AO points per module	________________
Number of AO points per common	________________
Rated impulse withstand voltage between input and ground	_____________ kV
Resolution	_____________ Bit
Accuracy	__________ % FSD
Voltage Mode Output Loading	______________ Ω
Current Mode Output Loading	______________ Ω
RTD Input Module	
Nominal input type	__________ PT100
Number of RTD points per module	________________

Rated impulse withstand voltage between input and ground	____________ kV
Resolution	____________ Bit
Accuracy	_________ % FSD
Power Supply	
Input voltage range	__________ V DC
Redundant	_________Yes/No
Network Switches	
Manufacturer	_______________
Model	_______________
Power supply voltage range	__________ V DC
Number of RJ45 ports	_______________
Number of Fibre optic ports	_______________
Fibre optic port type	Single/multimode
Managed switch	_________Yes/No
HMI Computers	
Manufacturer	_______________
Model	_______________
Power supply voltage range	__________ V DC
Operating System	______Windows 7
Hard drive capacity	_______________
Solid state hard drive	_________Yes/No
Processor type and speed	_______________
RAM	_______________
Display size	___________ Inch
Display resolution	_______________
Touchscreen display	_________Yes/No
HMI Software	
Manufacturer	_______________
Software Name	_______________
Number of licenses offered	_______________
Software Modules included (list all)	_______________
Maximum number of tags	_______________
Requires hardware lock?	_________Yes/No
PLC Programming Computer	
Manufacturer	_______________
Model	_______________
PLC Programming Software	
Manufacturer	_______________
Software Name	_______________
Number of licenses offered	_______________
Instruments	
Level Transmitter type	_______________
Level Transmitter manufacturer	_______________
Surge Protection type	_______________

(xli) Spare Parts Included (List)

____

____

____

Protective Relaying Systems

The Contractor shall provide the data listed on the following data sheets for each different protective relaying system as part of their tender design:

(xlii) Protective Relaying System Manufacturer

Name and address ____

____

____

Country of manufacture ____

(xliii) Drawings and Data to be Submitted

- Technical literature on protective relays offered.
- Technical literature on panel system offered

(xliv) Protective Relaying System Data

Relay Panel Details (If relays not incorporated within PLC panels or 400V Switchgear)

Panel Manufacturer	________________
Place of Manufacture	________________
IP Rating of completed panel	________________
Panel length	_____________mm
Panel width	_____________mm
Panel height	_____________mm

Generator and Transformer "All in One" Protection Relay Details

Relay Manufacturer	________________
Relay Model	________________
Country of manufacture	________________
Communications protocols supported	________________
Protective functions included (Use ANSI Codes)	________________
Number of programmable digital inputs	________________
Number of trip outputs	________________
Number of programmable digital outputs	________________
Number of single phase CT inputs	________________
Number of single phase VT inputs	________________

Power supply voltage range	___________ V DC
Feeder Protection Relay Details	
Relay Manufacturer	________________
Relay Model	________________
Country of manufacture	________________
Communications protocols supported	________________
Protective functions included (Use ANSI Codes)	________________
Number of programmable digital inputs	________________
Number of trip outputs	________________
Number of programmable digital outputs	________________
Number of single phase CT inputs	________________
Number of single phase VT inputs	________________
Power supply voltage range	___________ V DC
Trip Relay Details	
Relay Manufacturer	________________
Relay Model	________________
Country of manufacture	________________
Relay Programming Computer	
Manufacturer	________________
Model	________________
Relay Programming Software	
Manufacturer	________________
Software Name	________________
Number of licenses offered	________________

(xlv) Spare Parts Included (List)

____
____
____

24V DC Systems

The Contractor shall provide the data listed on the following data sheets for each different 24V DC system as part of their tender design:

(xlvi) 24V DC System Manufacturer

Name and address ____
____
____

Country of manufacture ____

(xlvii) Drawings and Data to be Submitted

- Technical literature on dc system offered.

(xlviii) 24V DC System Data

24V Batteries	
Manufacturer	________________
Type	__________ VRLA
Catalogue number	
Number of cells	________________
Battery bank nominal voltage	___________ V DC
Battery bank capacity	_____________ Ah
Expected battery life	___________ Years
Discharge rates for the following times with an initial electrolyte temperature of 25°C	
i. Eight hour	______________ A
ii . Four hour	______________ A
iii. One hour	______________ A
Dimensions of Battery and Rack Assembly	_________ WxHxD
Design continuous demand of connected loads	______________ A
Battery Chargers	
Manufacturer	________________
Type or catalogue number	________________
DC Output (rated).	
i. Current	________________
ii . Voltage	________________
AC Input (rated).	
i. Current	________________

ii . Voltage ________________

Temperature compensation to prevent battery thermal runaway __________Yes/No

Voltage regulation ______________ %

Ripple ___________V rms

Dimensions of battery charger _________ WxHxD

DC Distribution Panel

Manufacturer ________________

Type or catalogue number ________________

Number of feeder MCBs ________________

Dimensions of DC distribution panel _________ WxHxD

(xlix) Spare Parts Included (List)

____

____

____

Local Service AC Systems

The Contractor shall provide the data listed on the following data sheets for each different local service AC system as part of their tender design:

(I) Local Service AC System Manufacturer

Name and address ____
____
____

Country of manufacture ____

(Ii) Drawings and Data to be Submitted

- Technical literature on local service switchboard.
- Technical literature on light fittings proposed.

(Iii) Local Service AC System Data

Local Service Switchboard	
Manufacturer	________________
Type	________________
Rated Current	______________ A
1 second short circuit withstand	_____________ kA
Rating of incoming switch	________________
Number of outgoing feeders	________________
Light fittings (complete for each type)	
Manufacturer	________________
Type	________________
Power outlets (complete for each type)	
Manufacturer	________________
Type	________________

(Iiii) Spare Parts Included (List)

____
____
____

Cabling

The Contractor shall provide the data listed on the following data sheets for each different cable type as part of their tender design:

(liv) Cable Manufacturer

Name and address ____
____
____

Country of manufacture ____

(lv) Drawings and Data to be Submitted

- Technical literature on each cable type offered.
- Type test certificates on each cable type offered.

(lvi) Cable Data

22kV Cable		
Manufacturer	______________	
Country of manufacture	______________	
Rated voltage	____________	V
Conductor material	______________	
Insulation material	______________	
Sheath material	______________	
Cross sectional area and stranding	______________	
Screen type and 3s current rating	___________	kA
Design Standards	______________	
400V Cable		
Manufacturer	______________	
Country of manufacture	______________	
Rated voltage	____________	V
Conductor material	______________	
Insulation material	______________	
Sheath material	______________	
Cross sectional area and stranding	______________	
Design Standards	______________	
Control Cable		
Manufacturer	______________	
Country of manufacture	______________	

Rated voltage	______________ V
Conductor material	________________
Insulation material	________________
Sheath material	________________
Cross sectional area and stranding	________________
Design Standards	________________
Instrument Cable	
Manufacturer	________________
Country of manufacture	________________
Rated voltage	______________ V
Conductor material	________________
Screen type	________________
Insulation material	________________
Sheath material	________________
Cross sectional area and stranding	________________
Design Standards	________________
Fiber Optic Cable	
Manufacturer	________________
Country of manufacture	________________
Inner/Outer core diameter	
Sheath material	________________
Fiber Loss	
Design Standards	________________
Cable Tray and Ladder	
Manufacturer	________________
Country of manufacture	________________
Material	________________

Pipelines and Penstocks

The Contractor shall provide the data listed on the following data sheets for each different pipeline/penstock type as part of their tender design:

(lvii) Pipe/Penstock Manufacturer

Name and address ____

____

____

Country of manufacture ____

(lviii) Drawings and Data to be Submitted

- Technical literature.

(lix) Pipe/Penstock Data

Pipe material	______________
Jointing method	______________
Protective coating details	______________
Bedding material type	______________
Pipe diameters (ref chainages)	______________
Pressure ratings (ref chainages)	______________

Screens

The Contractor shall provide the data listed on the following data sheets for each different screen type as part of their tender design:

(lx) Intake Weir Screen Manufacturer

Name and address ____
____
____

Country of manufacture ____

(lxi) Screen Data

Screen material	________
Screen mounting/fixing method	
Cleaning method (eg self cleaning)	________
Protective coating details	________
Screen spacing	
Screen flow performance	________

(lxii) Penstock Intake Screen Manufacturer

Name and address ____
____
____

Country of manufacture ____

(lxiii) Screen Data

Screen material	________
Screen mounting/fixing method	
Cleaning method (eg self cleaning)	________
Protective coating details	________
Screen spacing	
Screen flow performance	________

(lxiv) Drawings and data to be submitted for each screen

- Typical drawing
- Technical literature.

Headpond

The Contractor shall provide the data listed on the following data sheets for the headpond structure as part of their tender design:

(lxv) Geometrical Properties

- Location (latitude/longitude)
- Elevation (Formation)
- Embankment Crest Level
- Top Water Level
- Operational Storage Volume
- Dead storage volume
- Internal Batter Angle
- External Batter Angle

(lxvi) Structure materials

- Sump
  - Type
- Internal waterproof Liner
  - Type
  - Manufacturer
- External Batter protection
  - Type
  - Manufacturer

Excavation in rock

The Contractor shall provide the data listed on the following data sheets for their estimate in Schedule 4 and allowance for excavation in rock as part of their tender design:

(lxvii) Headpond Pipeline

Volume ______ m^3

(lxviii) Penstock

Volume ______ m^3

(lxix) **TOTAL**

Volume ______ $\mathbf{m^3}$

Silt Removal at Alaoa Headpond

The Contractor shall provide the data listed on the following data sheets for their estimate in Schedule 4 and allowance for silt removal as part of their tender design:

(lxx) Headpond Pipeline

Volume ______ m^3

(lxxi) Headpond Structure

Volume ______ m^3

(lxxii) **TOTAL**

Volume ______ $\mathbf{m^3}$

(lxxiii) Programme Duration

Shutdown ______ working days

(lxxiv) Construction method

Isolation

____

____

Debris Removal

____

____

Debris Disposal

____

____

Tenderer's Qualification

To establish its qualifications to perform the contract in accordance with Section III (Evaluation and Qualification Criteria) the Tenderer shall provide the information requested in the corresponding Information Sheets included hereunder.

Form ELI 1.1
Tenderer Information Sheet

Date: ______________________
Tendering No.: ________________
Invitation for Tender No.: ________
Page ________ of _______ pages

1. Tenderer's Legal Name
2. In case of JV, legal name of each party:
3. Tenderer's actual or intended Country of Registration:
4. Tenderer's Year of Registration:
5. Tenderer's Legal Address in Country of Registration:
6. Tenderer's Authorised Representative Information Name: Address: Telephone/Fax numbers: Email Address:
7. Attached are copies of original documents (or original certified copies) of *(insert tick "✓" in box, as applicable)* ☐ Articles of Incorporation or Registration of firm named in 1, above, in accordance with ITT Sub-Clauses 4.1 and 4.2 ☐ In case of JV, letter of intent to form JV including a draft agreement, or JV agreement, in accordance with ITT Sub-Clauses 4.1 ☐ In case of government owned entity from the Principal's country, documents establishing legal and financial autonomy and compliance with the principles of commercial law, in accordance with ITT Sub-Clause 4.5.

Form ELI 1.2
Party to JV Information Sheet

Date: ______________________
Tender No.: ___________________
Invitation for Tender No.:_________
Page ________ of_ ______ pages

1. Tenderer's Legal Name:
2. JV's Party legal name:
3. JV's Party Country of Registration:
4. JV's Party Year of Registration:
5. JV's Party Legal Address in Country of Registration:
6. JV's Party Authorised Representative Information Name: Address: Telephone/Fax numbers: Email Address:
7. Attached are copies of original documents (or original certified copies) of *(insert ✓ in box, as applicable)* ☐ Articles of Incorporation or Registration of firm named in 1, above, in accordance with ITT Sub-Clauses 4.1 and 4.2. ☐ In case of government owned entity from the Principal's country, documents establishing legal and financial autonomy and compliance with the principles of commercial law, in accordance with ITT Sub-Clause 4.5.

Form CON – 2
Historical Contract Non-Performance

Tenderer's Legal Name: ________________________ Date: ______________________
JV Partner Legal Name: ________________________ Tender No.: ___________________
Page _______ of _______ pages

Add rows as required for each contract issue

NON-PERFORMING CONTRACTS IN ACCORDANCE WITH SECTION III EVALUATION AND QUALIFICATION CRITERIA ***(Insert tick "✓" as applicable in highlighted boxes)***			
	Contract non-performance DID NOT OCCUR during the stipulated period, in accordance with Sub-Factor 2.2.1 of Section III (Evaluation and Qualification Criteria)		
	Contract non-performance DID OCCUR during the stipulated period, in accordance with Sub-Factor 2.2.1 of Section III (Evaluation and Qualification Criteria) **as indicated below:**		
Year	Outcome as Percent of Total Assets	Contract Identification	Total Contract Amount (current value, SAT$ equivalent)
______	______	Contract Identification: Name of Employer: Address of Employer: Matter in dispute:	___________
PENDING LITIGATION, IN ACCORDANCE WITH SECTION III (EVALUATION AND QUALIFICATION CRITERIA) ***(Insert tick "✓" as applicable in highlighted boxes)***			
	There is no pending litigation in accordance with Sub-Factor 2.2.2 of Section III (Evaluation and Qualification Criteria)		
	There is Pending litigation in accordance with Sub-Factor 2.2.2 of Section III (Evaluation and Qualification Criteria), **as indicated below**		
Year	Outcome as Percent of Total Assets	Contract Identification	Total Contract Amount (current value, SAT$ equivalent)

______	______	Contract Identification: Name of Employer: Address of Employer: Matter in dispute:	___________

Form CCC

Current Contract Commitments/Works in Progress

Tenderers and each partner to a JV should provide information on their current commitments on all contracts that have been awarded, or for which a letter of intent or acceptance has been received, or for contracts approaching completion, but for which an unqualified, full completion certificate has yet to be issued. Tender must also disclose any other financial obligations that materially affect the implementation of subject contract if such contract were to be awarded to the Tenderer.

Name of contract	**Employer, contact address/tel/fax**	**Value of outstanding work (current SAT$ equivalent)**	**No of months remaining to substantial completion**	**Average monthly cash flow requirement (SAT$/month)**
		A	**B**	**A/B**
1.				
2.				
3.				
4.				
5.				
etc.				
TOTAL CURRENT CASH FLOW REQUIREMENT				**$ XXXXXXXXX**

The number of months remaining until substantial completion of current contract commitments are to be calculated from twenty-eight (28) days prior to the Tender submission deadline.

Value of outstanding work to be calculated from twenty-eight (28) days prior to the Tender submission deadline (SAT$ equivalent based on the foreign exchange rate as of the same date i.e. twenty-eight (28) days before Tender submission deadline).

Financial Situation

Form FIN-3.1 Historical Financial Performance

Tenderer’s Legal Name: ______________________ Date: ____________________

JV Partner Legal Name: ______________________ Tender No.: _________________

Page _______ of _______ pages

To be completed by the Tenderer and, if JV, by each partner

Financial information in SAT$ equivalent	Historic information for previous ______ (__) years (SAT$ equivalent in 000s)						
	Year 1	Year 2	Year 3	Year 4	Year 5	Avg.	Avg. Ratio
Information from Balance Sheet							
Total Assets (TA)							
Total Liabilities (TL)							
Net Worth (NW)							
Current Assets (CA)							
Current Liabilities (CL)							
Information from Income Statement							
Total Revenue (TR)							
Profits Before Taxes (PBT)							

Attached are copies of financial statements (balance sheets, including all related notes, and income statements) for the years required above complying with the following conditions:

- Must reflect the financial situation of the Tenderer or partner to a JV, and not sister or parent companies
- Historic financial statements must be audited by a certified accountant
- Historic financial statements must be complete, including all notes to the financial statements
- Historic financial statements must correspond to accounting periods already completed and audited (no statements for partial periods shall be requested or accepted**)**

Form FIN – 3.2

Average Annual Turnover

Tenderer's Legal Name: ___________________________ Date: _____________________

JV Partner Legal Name: ____________________________ Tender No.: ______________

Page _______ of _______ pages

Annual turnover data (construction only)		
Year	**Amount and Currency**	**SAT$ equivalent**
	____________________________________	______________________
	____________________________________	______________________
	____________________________________	______________________
	____________________________________	______________________
	____________________________________	______________________
*Average Annual Construction Turnover	____________________________________	______________________

**Average annual turnover calculated as total certified payments received for work in progress or completed over the number of years specified in Section III (Evaluation and Qualification Criteria), Sub-Factor 2.3.2, divided by that same number of years.*

Form FIN – 3.3

Financial Resources

Specify proposed sources of financing, such as liquid assets, unencumbered real assets, lines of credit, and other financial means, net of current commitments, available to meet the total construction cash flow requirement of the subject contract or contracts as indicated in **Section III - Evaluation and Qualification Criteria** plus the Total Current Cash Flow Requirement from Current Contract Commitments as calculated below.

Calculation of Financing Requirement for this Contract:

Cash Flow Requirement	Amount (SAT$ equivalent)
1. Construction Cash Flow requirement for subject contract (from Section III, Sub Section 2.3.3)	$ *enter amount*
2. Total Current Cash Flow Requirement from Current Contract Commitments (from Tender Form CCC)	$ *enter amount*
TOTAL FINANCIAL RESOURCES REQUIRED FOR THIS CONTRACT	**$** *enter amount*

Calculation of Total Financial Resources Available:

Source of financing	Amount (SAT$ equivalent)
1.	S *enter amount*
2.	$ *enter amount*
3.	$ *enter amount*
4.	S *enter amount*
TOTAL FINANCIAL RESOURCES	$ *enter amount*

Experience

Form EXP-4.1

General Experience

Tenderer's Legal Name: ______________________________ Date: ______________________

JV Partner Legal Name: _____________________________ Tender No.: _________________

Page _______ of _______ pages

Starting Month / Year	Ending Month / Year	Years*	Contract Identification	Role of Tenderer
______	______		Contract name: Brief Description of the Works performed by the Tenderer: Name of Employer: Address:	_________
______	______		Contract name: Brief Description of the Works performed by the Tenderer: Name of Employer: Address:	_________
______	______		Contract name: Brief Description of the Works performed by the Tenderer: Name of Employer: Address:	_________
______	______		Contract name: Brief Description of the Works performed by the Tenderer: Name of Employer: Address:	_________
______	______		Contract name: Brief Description of the Works performed by the Tenderer: Name of Employer: Address:	_________
______	______		Contract name: Brief Description of the Works performed by the Tenderer: Name of Employer: Address:	_________

*****List calendar year for years with contracts with at least nine (9) months activity per year starting with the earliest year*

Form EXP – 4.2(a) **Specific Experience**

Tenderer's Legal Name: ___________________________ Date: _____________________

JV Partner Legal Name: _________________________ Tender No.: __________________

Page _______ of _______ pages

Similar Contract Number: ___ *[insert specific number] of [insert total number of contracts required].*	**Information**		
Contract Identification	_______________________________________		
Award date Completion date	_______________________________________ _______________________________________		
Role in Contract	☐ Contractor	☐ Management Contractor	☐ Subcontractor
Total contract amount	____________________________		SAT$________
If partner in a JV or subcontractor, specify participation of total contract amount	__________%	_____________	SAT$_______
Employer's Name:	_______________________________________		
Address: Telephone/fax number: E-mail:	_______________________________________ _______________________________________ _______________________________________		
Description of the similarity in accordance with Sub-Factor 2.4.2a) of Section III (Evaluation and Qualification Criteria):			
Amount	_________________________________		
Physical size	_________________________________		
Complexity	_________________________________		
Methods/Technology	_________________________________		
Physical Production Rate	_________________________________		

Form EXP – 4.2(a) Specific Experience [CONTD]

Tenderer's Legal Name: ___________________________ Date: _____________________

JV Partner Legal Name: ________________________ Tender No.: __________________

Page _______ of _______ pages

Similar Contract Number: ___ *[insert specific number] of [insert total number of contracts required]*.	**Information**		
Contract Identification	_______________________________________		
Award date Completion date	_______________________________________ _______________________________________		
Role in Contract	☐ Contractor	☐ Management Contractor	☐ Subcontractor
Total contract amount	____________________________		SAT$________
If partner in a JV or subcontractor, specify participation of total contract amount	__________%	_____________	SAT$_______
Employer's Name:	_______________________________________		
Address: Telephone/fax number: E-mail:	_______________________________________ _______________________________________ _______________________________________		
Description of the similarity in accordance with Sub-Factor 2.4.2a) of Section III (Evaluation and Qualification Criteria):			
Amount	________________________________		
Physical size	________________________________		
Complexity	________________________________		
Methods/Technology	________________________________		
Physical Production Rate	________________________________		

Form EXP - 2(b)

Specific Experience in Key Activities

Tenderer’s Legal Name: ___________________________ Date: _____________________

JV Partner Legal Name: _________________________ Tendering No.: __________________

Subcontractor’s Legal Name: ______________ Page _______ of _______ pages

Similar Contract Number: *[insert specific number]* of *[insert total number of contracts required]*.	**Information**		
Contract Identification	_______________________________________		
Award date Completion date	_______________________________________ _______________________________________		
Role in Contract	☐ Contractor	☐ Management Contractor	☐ Subcontractor
Total contract amount	_________________________		SAT$________
If partner in a JV or subcontractor, specify participation of total contract amount	__________%	_____________	SAT$________
Employer’s Name:	_______________________________________		
Address: Telephone/fax number: E-mail:	_______________________________________ _______________________________________ _______________________________________ _______________________________________		
Description of the key activities in accordance with Sub-Factor 2.4.2 (b) of Section III (Evaluation and Qualification Criteria):			

Form EXP – 4.2 (b)(cont.)

Specific Experience in Key Activities

Tenderer's Legal Name: ____________________________ Date: ______________________

JV Partner Legal Name: _________________________ Tendering No.: ___________________

Subcontractor's Legal Name: ______________ Page _______ of _______ pages

Similar Contract Number: ***[insert specific number]*** **of** ***[insert total number of contracts required]*.**	**Information**		
Contract Identification	____		
Award date Completion date	____ ____		
Role in Contract	☐ Contractor	☐ Management Contractor	☐ Subcontractor
Total contract amount	__________________________		SAT$________
If partner in a JV or subcontractor, specify participation of total contract amount	__________%	_____________	SAT$________
Employer's Name:	____		
Address: Telephone/fax number: E-mail:	____ ____ ____ ____		
Description of the key activities in accordance with Sub-Factor 2.4.2 (b) of Section III (Evaluation and Qualification Criteria):			

Section V - Eligible Countries

Eligibility for the Provision of Goods, Works and Services under a Government of Samoa - Financed Procurement

All countries other than those currently designated as **INELIGIBLE** are eligible to tender to provide the goods, works and services which are the subject of this tender.

Presently **INELIGIBLE** countries are:

- Andora, Democratic People’s Republic of Korea, Liechtenstein, Monaco (not members of the World Bank or Asian Development Bank), and
- Iraq (UN Security Council).

For projects funded solely by a specific donor, please refer to donor concerned for their list of ineligible countries.

PART 2

Principal's Requirements

CONTENTS

SECTION VI – PRINCIPAL'S REQUIREMENTS

1 Scope of Supply of Facilities and Services

1.1 Project Description

The aim of the project is to design, construct, install all equipment, testing and commission to bring into service new Tiapapata small hydropower plant (SHP) and refurbish of the existing storage reservoir of the Alaoa small hydropower plant "The Facilities" on Samoa's main island of Upolu.

The Facilities are owned and operated by the Electric Power Corporation (EPC) a wholly government owned corporation.

The Facilities are:-
- 1 x 710kW Tiapapata SHP.
- Headpond of the existing Alaoa SHP

The Tiapapata facilities comprise of an intake weir, low pressure conveyance pipeline, headpond, penstock and impulse type turbine, electrical switchgear, control and SCADA equipment housed in a powerhouse, step up transformer, fiber optic cable connection, 22kV transmission lines connecting the hydropower Facilities to the EPC electricity transmission system.

The Alaoa facilities comprise the additional storage reservoir (Alaoa headpond), and conveyance pipework connecting the Alaoa intake and headpond.

The Facilities are located on the western branch of the Vaisiago River near to the capital city Apia.

The key features of each Facility are shown on drawing 310103216-01-001-C001: Site Plan (located in Section 6 Part 4 - Supplementary Information) and described below.

1.1.1 **Tiapapata Small Hydropower Plant**

1.1.1.1 Facility Description

The new Tiapapata small hydropower plant shall have a generation capacity of at least 710kWe from a single impulse turbine.

The key parameters are:-

Rated Flow (turbined)	0.52 m^3/s
Weir compensation flow (maximum)	0.10 m^3/s
Design intake level	RL486.5m
Design headpond water level	RL435.0m
Turbine Centreline	RL267.0m
Minimum Net Head	159.6m
Minimum headpond operational storage capacity	3,800m3
Employers minimum acceptable turbine efficiency at Rated Flow	90%
Employers minimum acceptable generator efficiency at Rated Output	96%
Employers Minimum Acceptable Station Power at transformer 22kV terminals.	710kWe

Note that whilst minimum values are stated, the Contractor is encouraged to offer designs that improve on these without requiring any change to the intake or powerhouse locations and design levels.

Salient Features:

The new Tiapapata facility shall comprise, but not limited to, the following hydropower structures:

- Weir structure and intake screen
- Headpond pipeline
- Headpond inlet
- Headpond structure
- Headpond overflow
- Penstock intake and intake screen
- Access road
- River crossing ford
- Penstock
- Powerhouse
- Electro – Mechanical equipment
- Tailrace
- Transformer switchyard
- Fiber optic communication system
- Transmission line

1.1.2 Alaoa Small Hydropower Plant

1.1.2.1 Facility Description

Alaoa small hydropower plant is an existing facility, currently in use by the Employer.

The scope of works to be completed by the Contractor shall include, but not limited to, maintenance de-silting and minor repair works of the following structures:

- Headpond pipeline
- Headpond inlet
- Headpond structure

1.2 Turnkey Contractors Scope of Work

1.2.1 General Description of Contractor's Scope of Work

The principal elements of the Contractor's general scope of work are:

- Topographical survey of the project area.
- Geotechnical investigations.
- Design and planning of the Facilities.
- Provision of basic designs suitable for the Employer to use in the application to PUMA for the development consent.
- Provision of detail designs suitable for the construction and operation of the hydropower plant.
- Provision of Plant, materials and equipment.
- Obtaining building permits including all necessary endorsements and inspections.
- Preparation, implementation and monitoring of the Construction Environmental Management Plan (CEMP).
- Implement CEMP mitigation measures
- Environmental and social safeguard monitoring and reporting.
- Provision of construction and installation services.
- Mobilisation and demobilisation at the project site.
- Debris and vegetation removal
- Provision of temporary works.
- Construction of permanent works.
- All elements of testing and commissioning
- Undertake Guarantee Tests
- Handover of the Facilities to the Employer on achievement of the requirements for Operational Acceptance
- Provision of operating and maintenance manuals and as built drawings
- Provision of operator and technician training
- Remedy defects notified during the Defect Liability Period
- Warrant equipment and works

1.2.2 Key Performance Criteria

- Net power output of the scheme.
- Water to wire efficiency of overall scheme.
- Operating range of the turbine.
- Operating and Maintenance requirements.
- Flood, landslide and cyclone resilience.
- Plant life expectancy
- Plant reliability.
- Zero harm accidents.
- Zero breaches of the CEMP mitigation measures.
- Safety of and public relation with communities along hydro facilities work site.

1.2.3 Available Documents

As a supplement to this Employers' Requirements, the following reports and documents are available on request from the Project Manager:

- Alaoa Multipurpose Dam Project, Factual Geological /Geotechnical Report, Entura, 9 August 2018.

- Initial Environmental Examination for Fuluasou and Tiapapata Small Hydropower Projects, EPC Samoa, Final Draft, 22 May 2015.
- Tiapapata Hydropower Station Feasibility Study, EGIS, 2011
- Lidar survey data for the project area.
- Survey of elevations of SWA water intake, new hydro likely intake site, headpond and power station.

Whilst survey data is available, it is the responsibility of the Contractor to confirm the content and accuracy of all information provided by the Principal.

1.2.4 **Design and Construction of the Facilities**

1.2.4.1 General

As indicated above the Project includes all facets of the design, supply, construction and commissioning of the new hydropower facility at the Tiapapata site. The principal elements of the Contractor’s hydropower plant scope of work are:

- Construction of a weir structure including screens, sluicing arrangements and method of releasing compensation flow downstream.
- Construction of an intake structure including method for isolating pipeline to headpond
- Construction of weir and intake upstream and downstream scour protection.
- Construction of a pipeline from intake to headpond including any necessary air and scour valves.
- Construction of a headpond, including clean-out arrangements and method of releasing overflow back to river.
- Construction of a penstock intake structure including screens and method for isolating penstock to powerhouse.
- Supply and install headpond water level measurement system including power supply and communications to the powerhouse.
- Construction of a penstock from headpond to powerhouse including any necessary air and scour valves.
- Construction of a powerhouse building.
- Construction of an open channel tailrace back to river.
- Construction of tailrace discharge upstream and downstream scour protection to river channel.
- Supply and installation of a single impulse turbine generator rated at not less than 710 kWe.
- Supply and installation of a 415V/22kV step-up transformer rated at not less than 890kVA.
- Supply and installation of a 22kV terminal structure, including 22kV isolator and VTs.
- Supply and installation of 415V switchgear.
- Supply and installation of a turbine generator control and protection system.
- Supply and installation of AC and DC ancillary systems.
- Supply and installation of all cabling systems.
- Supply and installation of powerhouse lighting and utility power systems.
- Testing and commissioning the turbine generator and appurtenant facilities.
- Guarantee performance tests.
- Rehabilitation of the intake access road.
- Construction of a powerhouse access road.
- Construction of headpond access road.

The Principal will supply and install an overhead 22kV distribution line, and connections to the existing EPC 22kV system. The overhead line shall incorporate a single mode fibre optic cable for plant communications.

In addition, the contract includes for the following works at the existing Alaoa Hydropower Facility:

- Cleanout of the existing extra storage facilities at the West Intake.
- Remediation of the pipe between the extra storage facilities and existing Alaoa headpond.

Descriptions of the various components are described below, with the total scope of each section described in the full Specification.

1.2.4.2 Hydraulic Configuration and Plant Regulation

The hydropower plant shall be of peaking type, with limited storage provided by the headpond. The turbine shall be regulated by their governing system to maintain a constant power output as set by the Employers' operator. In addition it shall be possible for the operator to select headpond level regulation, whereby the turbine shall be regulated by the governing system to maintain a constant water level at the penstock inlet chamber. In this mode, the level shall be selectable by the operator to any point within the headpond operating range. The following key criteria must be achieved with the Contractors design:-

- The headpond primary water level measurement system shall be based on a level transmitter in the penstock intake chamber (within a stilling well). This transmitter shall measure the headpond water level to an accuracy of ±1.0mm.
- A backup water level measurement system shall be based on a pressure transmitter at the power station inlet. This transmitter shall measure the level to an accuracy of ±100mm.
- When level regulation mode is selected, the turbine governing system shall respond to the primary level transmitter measurement and shall control the level in the intake chamber to a pre-set level with accuracy ±10mm.
- If the turbine governing system is in power output control mode, and the headpond reaches it's minimum operating level, the turbine shall automatically shutdown, or revert to level control mode, as preset by the operator via SCADA.
- If the turbine governing system is in power output control mode, and the headpond reaches it's full service level, the turbine shall, if not already at rated output, automatically revert to level control mode, with level setpoint at the reservoir full service level.
- In the event of the primary level transmitter failing, the governing system shall respond to the backup level transmitter and shall control the level in the intake chamber to an accuracy ±500mm.
- The intake chamber shall be designed to ensure that the penstock intake has a minimum submergence of 1.0m at all times.
- The intake chamber shall be designed with sufficient surface area and volume to achieve the above level control requirements within the rate of change of flow constraints presented by the specified penstock pressure variance limitations.

1.2.4.3 Access Roads

There are established permanent access via 4x4 tracks (single lane, unsealed, with adequate passing places) to the vicinity of the intake and powerhouse.

The scope of work for the Contractor is to design and build 4x4 vehicle access for the following, but not limited to:

- New permanent access to the intake (rehabilitation of the existing track alignment).
- New permanent access to the powerhouse (rehabilitation of the existing track alignment).

- New permanent access to the headpond (following the penstock alignment where possible).

Construction access for the pipeline/ penstock will be along the pipeline easement.

The Contractor is responsible for all temporary construction access and ensuring the access is suitable for their method of construction, plant and equipment deliveries.

The Contractor is also responsible for maintaining all other project roads during construction and handing them back in condition no worse than at the beginning of the Contract. This will be recorded by photographic record at the beginning and end of the Contract, with the Contractor responsible for any repairs required.

Locations of all existing access roads are indicated on the drawings, and the conditions of these will be seen during the pre-bid site visit.

The Contractor is responsible for obtaining all necessary permits and approvals for constructing such access and must also remove the temporary works following Operational Acceptance.

1.2.4.4 Weir and Intake

The scope of work for the Contractor is to design and build a new intake comprising, but not limited to:-

- A low (nominally 1m) high concrete weir incorporating a drop bed screen intake (Coanda type or similar) supplying the pipeline to the headpond. The nominal design capacity of the intake is to be not less than 0.62 m^3/s (120% of the station rated flow).
- The weir structure shall be designed to pass flood flows without damage. Ideally this shall be done by tying in the structure to bedrock, with prevention of passage of water under and/or around the structure through the adjacent bed rock.
- Upstream and downstream scour protection shall be provided to the banks, channel and weir structure.
- A manually operated sluice gate for clearing out debris from behind the weir and draining the weir pond.
- A manually operated environmental flow release valve and flow gauging facility designed to pass up to 0.10 m^3/s with the valve fully opened.
- An intake chamber shall provide sufficient submergence on the pipeline to prevent air entrainment
- A manually operated slide gate for isolating the pipeline.
- Safe pedestrian access arrangements to the weir and intake chamber structures.

Fish passage may need to be provided, pending further environmental safeguarding investigations by the Contractor.

The Contractor shall undertake any geotechnical investigation they deem necessary to confirm their design.

1.2.4.5 Headpond Pipeline

The scope of work for the Contractor is to design and build a new headpond pipeline comprising, but not limited to:-

- The pipeline shall connect the intake to the headpond and shall generally follow the indicative route shown on the Drawings. Where possible the pipeline shall be designed to be underground and with a continuous fall over its length, except where this requires excessive trench cuts (i.e. >2m), thus avoiding the need for air and scour valves.

- The foundation for the pipe may be in rock and/or on steep terrain. An adequate bench shall be provided for the pipeline.
- The pipeline material and diameter shall be determined by the Contractor and shall be selected to convey the design flow to the headpond, without the need for any pressure reducing valve, or other energy dissipation provisions at the headpond.
- Method for air entrainment at the top to allow emptying of the pipeline
- Pipeline drain valves at the bottom of the pipeline to drain the pipeline.
- The pipeline shall be designed to withstand the maximum operating pressures.
- Consideration should be given to the jointing method (welded vs socket/coupler) to prevent.
- disproportionate collapse of the pipeline should loss of the supporting headrace bench occur.
- Pipe support and thrust restraint (where required).

The alignment for the head pond pipeline is required to traverses slopes of approximately 1H:1V (and up to approximately 1H to 1.6V) and it is likely that a bench will need to be created to allow a pipe route to be established. The pipeline will either be fully or partially trenched into the bench to provide some form of protection from landslides. The pipe should be installed in in-situ cut ground and not installed in fill material due to the potential for fill material to become unstable. No side-casting into river’s is permitted.

Ideally, the foundations for the pipeline should be fully founded on rock. The Contractor shall undertake
any geotechnical investigation they deem necessary to confirm their design.

The pipe route may encounter rock outcrops that will need to be excavated using rock breakers or blasted using explosives.

The pipeline will be located within land not owned by the Government of Samoa (GoS). The Employer shall arrange the necessary consents and approvals once the Contractor has determined the final alignment.

1.2.4.6 Tiapapata Headpond

The scope of work for the Contractor is to design and build a headpond structure comprising of, but not limited to and size not less than 5000 cubic meters:-

- **Headpond Inlet**
    - A valve and/or flow control valve to allow the pond pipeline to be closed to develop water pressure for pond maintenance and to enable flow regulation.
    - A stilling well chamber to dissipate the water velocity exiting the head pond pipeline that discharges to a concrete spillway.
    - A concrete spillway with energy dissipaters constructed at the same angle as the pond wall to convey water down the pond batter and discharging to a small plunge pool at the base of the spillway.

- **Headpond Structure**
    - A geomembrane lined pond with engineered soil embankments.
    - Geomembrane material of HDPE shall be provided to the internal lining of the pond, unless approved otherwise by the Employer.
    - Geomembrane material or other slope stabilisation to be provided to the external batter to prevent soil erosion.

- A minimum operating volume of 5,000m3 shall be provided.
- Additional depth allowances (dead storage) of the structure shall be made for the accumulation of fine material and safe operating freeboard to account for the effect of wind/seismic action causing waves within the pond as per the Contractor's design.
- The soil embankments shall have a stable batter angle (3:1 or similar) to suit the Contractors design.
- All rainfall run-off shall be diverted away from the embankment and adequate toe / embankment drainage provided.
- A concrete drain sump shall be provided in the pond base, with concrete mechanical machine access, to allow for de-silting maintenance.
- Ideally, the foundations for the pipeline should be fully founded on rock. The Contractor shall undertake any geotechnical investigation they deem necessary to confirm their design.

- **Headpond Overflow**
  - An overflow weir structure to divert excessive inflows back to the river and prevent overtopping. The water will be conveyed to the middle branch catchment.
  - A manually operated sluice gate for clearing out debris from within the pond and draining the headpond
  - A spillway / pipeline to convey overflow or sluicing flows from the headpond to the river without erosion of the surface.

- **Penstock Inlet**
  - Penstock intake chamber and bar screen arrangement (manual cleaning, with level sensor), including safe pedestrian access arrangements.
  - The intake chamber shall be designed to ensure that the penstock intake has a minimum submergence of 1.0m (or depth to suit Contractors design for preventing air entrainment) at all times.
  - Stilling chamber for headpond water level measurement, including access arrangements.
  - A gravity / self-actuated emergency close valve for isolating the penstock (including manual operation for maintenance). The valve shall automatically close in the event of a penstock rupture and shall be designed to close under gravity.

The headpond shall be located entirely within land owned by the GoS, understood to be the watershed between the western and middle branches of the Vaisigano River.

It is envisaged that a cut/fill operation shall be undertaken by the Contractor to minimise import of materials to site. Un-used cut material shall be appropriately stockpiled / landscaped on site in agreement with the Engineer. No side-casting into river's is permitted.

Potential efficiencies can be explored by the Contractor to varying the shape/depth of the head pond and also potential relocation. The Contractor may move the location of the headpond to suit their design, but it shall not be located outside of the GoS owned lands without the Employers prior approval.

1.2.4.7 Penstock

The scope of work for the Contractor is to design and build a new penstock comprising, but not limited to:-

- Below ground pipeline and penstock. The pipeline and penstock should have a continuous fall over their length, except where this requires excessive trench cuts (i.e. >2m).

- Method for air entrainment at the top to allow emptying and filling penstock.
- Penstock drain valves at the bottom of the alignment to allow for emptying.
- The penstock shall be designed to withstand the maximum operating pressures.
- The penstock material and diameter shall be determined by the Contractor and shall be selected to convey the design flow to the turbine, whilst also maximise the net head returning the best cost benefit for the scheme. The pressure rating of the penstock shall be designed for the maximum transient pressure from the turbine.
- The penstock shall connect the headpond to the powerhouse and shall generally follow the indicative route shown on the Drawings. Where possible the penstock shall be designed to be underground and with a continuous fall over its length avoiding the need for air and scour valves.
- Adequate support and thrust restraint structures shall be provided, as per the Contractors design.

The penstock shall be located entirely within land owned by the GoS, understood to be the watershed between the western and middle branches of the Vaisigano River. The Contractor may move the location of the penstock to suit their design, but it shall not be located outside of the GoS owned lands without the Employers prior approval.

1.2.4.8 Tiapapata Powerhouse

The scope of the work for the Contractor is to build a new powerhouse which will house the M&E equipment and associated balance of plant comprising, but not limited to:-

- Fencing around the powerhouse compound.
- Access and parking around the powerhouse.
- A steel clad or concrete blockwork building with a reinforced concrete foundation. The building shall have a single room that houses all the M&E equipment and associated balance of plant. The powerhouse structure shall be designed and constructed to be cyclone, earthquake and flood resilient.
- The powerhouse structure shall be weathertight and have adequate provision of stormwater drainage (including oil separator).
- Roller-shutter door (or similar as per Contractor’s design) for access to the machine hall.
- A HVAC system to maintain suitable operating climatic conditions for the Contractors proposed plant and equipment.
- Internal lifting equipment, via a lifting beam and manually operated crane.
- An external concrete pad for the transformer, inclusive of bund and weather protection.
- Turbine discharge to the tailrace channel shall permit free discharge.
- Discharge from the turbine shall be via an open channel tailrace to the river, upstream of the Alaoa intake. Energy dissipation may be required prior to discharge to the Vaisigano River and the discharge shall be located and orientated such that the flow does not affect the performance of the existing Alaoa intake.
- Accesses to the powerhouse and turbine discharges to the tailrace may need be temporarily
- Sealed to prevent water ingress. Consideration should be given to waterproofing the powerhouse to the 100-year flood level.
- Passive flood protection, such as a levee embankment and level of the structure above predicted flood water levels to prevent inundation and debris strike.
- New permanent access to the powerhouse shall be from the existing track/ road to the Alaoa intake.

1.2.4.9 Tiapapata Mechanical & Electrical

The scope of work for the Contractor is:-

- Provide a turbine generator rated at not less than 710kW, 890kVA at the generator terminals, comprising horizontal shaft impulse type turbine, synchronous generator, inlet valve, governor and voltage regulation system.
- Provide 415V switchgear.
- Provide a 415V/22kV step-up transformer rated to match the generator output.
- Provide a PLC based control system for turbine generator start/stop, governing and mechanical protective functions and for interfacing Tiapapata with the Employers remote control centre.
- Provide an industrial touch screen computer based HMI screen, interfaced to the PLC and protection system for alarm annunciation, trending, plant operational status display and for start/stop and loading control of the facility.
- Provide an “all in one” electrical protection relay system for providing generator and step-up transformer protections.
- Provide level measuring systems at the intake and headpond with fibre optic communications back to the powerhouse.
- Provide a 24V DC battery system for the powerhouse control and protection systems.
- Provide a 415V local service switchboard, powerhouse lighting and general power systems.
- Provide a VHF radio system for communicating with the Employers control centre.
- Supply and installation of connections to the Employers 22kV system.
- Provide all required interconnecting cabling.
- Undertake all factory and site testing.
- Commission the Tiapapata power scheme.
- Undertake guarantee test/s.
- Provide technical support (over and above defects liability requirements) and backup for a period of one year following completion. Technical support is defined as up to 8 hours per month assistance by email or telephone, plus one trip of one weeks duration for a suitably qualified technician to visit the site on request of the Employer.

2 Specification

2.1 Performance and Design

2.1.1 Guarantees

2.1.1.1 Output Guarantee

Contractor shall guarantee the continuous power output of the small hydropower plant at the 22kV connection to the EPC distribution system with the headpond at the Contractors nominated full supply water level, the turbine operating at rated flow and the generator at unity power factor.

The Employer may reject the Facility if it is unable to meet 95% of the continuous output guarantee in site tests (refer to Section 4, Schedule of Technical Particulars & Guarantees).

2.1.1.2 Intake Screen Performance

The Contractor shall guarantee the performance of the screens at each intake. The screens shall capture not less than 99.5% of the available river flow for flows between 10% and 120% of the turbine rated flow when new, fully clean and clear of debris. Employer may reject the screens of they are unable to meet this guarantee.

2.1.1.3 Plant Availability Factor

The Contractor shall guarantee the Availability Factor of the Plant. The Availability Factor will be calculated in accordance with IEEE762. Any periods of unavailability owing to river flows less than 10% of the turbine rated flow, the inability of the EPC 22kV system to accept power, or other causes beyond the control of the Contractor shall be deleted from the calculation.

The Employer may reject the Plant if it fails to achieve 95% of the guaranteed Availability Factor.

2.1.1.4 Other Guarantees

The Contractor shall provide the following other guarantees:-

1. A turbine runner cavitation, abrasion and corrosion guarantee as specified in Section 6 Part 2.6.4.8.
2. A turbine runner cracking guarantee as specified in Section 6 Part 2.6.4.9.
3. A turbine minimum average efficiency guarantee as specified in Section 6 Part 2.6.4.3.
4. A generator minimum average efficiency guarantee as specified in Section 6 Part 2.6.8.3.
5. A transformer no-load and load loss guarantee as specified in Section 6 Part 2.6.12.3.
6. A control system Average System Availability guarantee as specified in Section 6 Part 2.6.14.3.2.

The Employer may reject the Equipment if it fails to achieve the relevant guarantee.

2.1.2 Statutory Requirements

2.1.2.1 Background to Environmental

The Project has been the subject of an Initial Environmental Examination (IEE), which included an Environmental Management Plan (EMP) for the projects. The full IEE is included in Section 6 Part 4 - Supplementary Information.

The relevant Environmental Impacts and Mitigation Measures are detailed in the following Sections of the IEE:-

- Construction Impacts on Physical Environment.
- Construction Impacts on Biological Environment.
- Construction Impacts on Social-economic Environment.

The Contractor is responsible for the implementation of construction and rehabilitation activities for the sites and for implementing the impact mitigation measures in the construction phase. The Contractor is also responsible for the monitoring and implementation activities as detailed in the IEE. The Contractor shall include staff to be specifically responsible for preparation and implementation of the Construction Environmental Management Plan (CEMP), which describes the Contactor's construction methodology and measures and plans for implementing the CEMP. This includes maintaining a site diary and a grievance registry. The CEMP shall be approved by the Employer prior to the Contractor's mobilization to the site. The Contractor will be required to report on the implementation status of the CEMP to the Employer. The damages due to the violation of the stipulations by the Contractor shall be compensated and/or restored by the Contractor at his or her own expense.

The "Water Resources Management Act 2008" includes legislative and regulation matters related to hydropower development. It stipulates that the Employer has the right to use Samoan waters. However, it requires the Employer to obtain a governmental license to divert the natural flow of a river for hydropower purposes. A copy of this shall be provided to the Contractor prior to commissioning.

2.1.2.2 Health and Safety

Health and safety procedures on the site shall comply with the Samoa Occupational Safety & Health (OSH) Act 2002 and any associated codes together with any additional requirements specified in the Contract. The Health and Safety plan shall be part of the CEMP as detailed in the IEE.

In order to formulate a specific and competent safety plan, the Contractor shall carry out a detailed risk assessment against the scope and nature of the contracted Facility and the particular site conditions. The documentation arising from this process shall contain a comprehensive schedule of all perceived risks and the proposed elimination and mitigation measures necessary to reduce the risk to a minimum. Risk assessment documentation shall form part of the auditable safety records.

The Contractor shall appoint a Site Safety Officer who will be responsible for the management and control of safety on site. All staff and workers will undergo a site safety training programme developed by the Contractor specifically for the Contract. Tool-box talks on particular safety hazards will be conducted by the Site Safety Officer on a regular basis in order to ensure that a proactive safety culture is maintained on the site through the period of the contract.

The Contractor shall provide a safety training induction to all visitors before they are permitted to enter the site.

2.1.2.3 Emergency Response and Callout

Throughout the contract period, the Contractor shall make contingency arrangements for 24 hour per day, 7 days per week availability of emergency response labour, plant and supervision to respond to emergency situations as may affect the Contract Facility, to ensure the safety and protection of them and adjacent property.

The Contractor is to develop a Site Wide Emergency Evacuation Plan. This plan is to apply to and be available for all personnel on site, Contractors own employees, and the employees of the Employer, Project Manager and any other contractors on the Site.

2.1.2.4 Quality Assurance

The Contractor shall establish, maintain and monitor a Quality Assurance Plan (QAP) which meets the requirements of ISO 9000 and ISO 9001. The QAP shall cover all elements of the permanent Facility.

The Contractor shall submit the QAP to the Project Manager prior to work commencing on site.

2.1.3 **Resources**

2.1.3.1 Contractor Supplied Materials

The Contractor shall supply all materials required for the execution of the Contract Facilities and for any temporary works and shall remove surplus materials from the site prior to completion of the Contract.

Materials awaiting incorporation into the Facilities shall be stored off site in secure premises until required for use on Site. On arrival at the Site, locations for storage shall be identified and planned by the Contractor so as to minimise interference with both the Facilities and other uses of the Sites.

2.1.3.2 Employer Supplied Materials

There are no Employer Supplied Materials

2.1.4 **Key Personnel**

The Contractor shall engage the Key Personnel and the Contractor shall promptly appoint suitable people (and any replacements) who shall be notified to the Project Manager in writing. Key Personnel are nominated in the Technical Proposal.

Technical personnel (engineers, technicians, etc) engaged in the works shall be registered under Institution of Professional Engineers of Samoa (IPES). This is a requirement of the Samoan Professional Engineers Registration Act. Refer to IPES website, *www.ipes.ws* for details.

2.1.4.1 Local Resources

As is standard practice in Samoa, the Contractor is expected to utilise local resources (labour, equipment, engineers, surveyors, etc) as much as possible, in so far as the skills and abilities of the local workforce allow.

Failure of the Contractor to correctly manage the local resources, which results in disruption and delays to the Project, is not deemed valid basis for a time extension claim.

2.1.4.2 Immigration / Work Visas

It is the responsibility of the Contractor to be fully acquainted and in compliance with the Samoa Immigration Department rules regulations and procedures applicable to immigration and work visa issues.

Failure to obtain work visas for the various staff required on the project is not reason for claims for either time or cost.

2.1.5 **The Site**

2.1.5.1 Site Definition and Access

The Project Site areas are contained in the areas indicated on the Drawings.

The rights or customs of adjacent property owners and occupiers for access shall not be infringed by the Contractor.

2.1.5.2 Tolerances

The Contractor shall propose tolerances to be used for the Facilities that shall be subject to the Project Manager's approval.

2.1.5.3 Temporary Works

The Contractor shall ensure that all temporary works are properly designed and constructed so that the safety of persons and Plant has been properly taken into account. The Contractor shall be responsible for all costs associated with the design, construction, and performance of the temporary works.

2.1.5.4 Protection of Facilities

All finished Facilities shall be protected from damage which could arise from other construction activities.

Work shall not be carried out in weather conditions that may adversely affect the quality of the Facilities unless proper protection, acceptable to the Project Manager, is provided.

Facilities under construction and materials for such Facilities shall be protected from exposure to weather conditions, which may adversely affect the quality and performance of the Facilities and the materials.

2.1.5.5 Mobilisation and Demobilisation

Contractor shall furnish all the labour, materials, equipment and shall perform all work required for mobilisation to and demobilisation from the Project Site.

Mobilisation shall include, but not be limited to: moving personnel, plant, and equipment to the Site; arranging for necessary Site utilities; establishing camps, shops, offices and administrative facilities; and obtaining all required permits, licenses, and other regulatory authorisations required for the construction of the Project.

A brief outline of the required permits, and the process and costs associated with obtaining them can be found at:-

http://www.doingbusiness.org/data/exploreeconomies/samoa/dealing-with-construction-permits/

The Contractor shall provide the Basic Design Report to the Employer for the Employer to use in the Development Consent application. The Contractor shall also provide any other reasonable information requested by the Employer in support of the application.

The Contractor is responsible for obtaining the Building Permit, including all necessary endorsements and inspections.

Demobilization shall include, but shall not be limited to: removing all plant, equipment, and temporary works from the Site; disconnecting temporary utilities; relocating personnel from the Site; cleaning-up and restoring all areas occupied by the Contractor; closing out permits, licenses, and other regulatory authorizations; and disposal of all waste materials and excess construction materials which are not the property of the Employer.

2.1.5.6 Site Signage

Prior to the commencement of work at the Site, the Contractor, at the direction of the Project Manager, shall supply and erect three site signs for the information of the public at the entrance to each powerstation site, containing the following information, clearly visible and legible to passers-by intended for the information of those affected by the Facilities, for the guidance of those making deliveries and for general public safety:

- Name of Project;
- Name and logo of Employer;
- Name and logo of Project Owners Engineer.
- Name and logo of Contractor;
- Contractor's contact person and after hours contact details; and
- Restrictions on access and appropriate safety warnings.

The Contractor shall maintain such signs throughout the contract period with up to date information and free from disfigurement.

The Contractor shall also supply, erect and maintain appropriate site signage and safety warning signs as are appropriate for the nature of the work being undertaken. No other signage or advertising materials shall be permitted on the Site, except with the specific consent of the Project Manager.

2.1.5.7 Working Hours

Normal working hours are Monday to Saturday 8am to 5pm. However, the Contractor is free to vary working hours provided there is no disruption to the adjacent villages outside normal working hours. Any work on Sundays or at night must be approved beforehand by the Project Manager. It is the Contractors responsibility to understand, and comply with, all local labour rules and laws.

2.1.5.8 Contractor's Compound

The Contractor shall provide a secure enclosure for the parking of movable Contractor's Equipment, storage of Plant and Materials, fuels and other consumables within the boundary of the Site at a location agreed with the Project Manager which will maximise convenience and minimise interference with the execution of the Facilities.

2.1.5.9 Site Office, Messing and Sanitary Facilities

a) The Contractor shall supply, maintain and at the end of the Contract period remove all necessary temporary sheds, offices, meal rooms, sanitary facilities and other temporary buildings required for storage, management of the site and the welfare of personnel employed on the Facilities. Such buildings shall be maintained secure, tidy and fitted out with appropriate furniture and services.

2.1.5.10 Site Security

The Contractor shall have full responsibility for the care of the Site and the Facilities from the time of obtaining possession of the Sites until the time of Operational Acceptance.

The Contractor shall provide and maintain appropriate fencing, gates, lighting, security visits and personnel as are appropriate to the risks of loss and the location of the Site. The Contractor shall regularly monitor such fencing and other security arrangements to ensure its effectiveness throughout the contract period.

2.1.5.11 Protection of Land, Flora and Fauna

The Contractor shall plan and implement its occupation of the Site to the minimum extent necessary to provide access, turning, parking, material storage, and working space for the construction of temporary and permanent Facilities.

The Contractor shall not damage or destroy natural features of the Site except to the extent described on the Drawings as being part of the Facilities or approved by the Project Manager as essential needs for temporary works. Parts of the Site where work is otherwise complete shall have specified landscape treatment or other finishes applied as soon as this can be done without undue risk of damage or interference with other work.

2.1.5.12 Noise, Dust, Vibration and Damage or Nuisance

The Contractor shall minimise the generation of noise, dust, vibration and other potential causes of damage or nuisance, to the extent that is feasible given the nature of construction activities, statutory requirements and any other special protection specified in the Contract, statutory approvals and consents.

2.1.5.13 Dangerous Goods

No dangerous goods, explosives, chemicals, fuels or similar items shall be brought onto the Site unless the Contractor has advised the Superintendent of the intention to do so, and has complied with all statutory requirements for its safe storage and security.

The Contractor shall minimise the use of the Site for the storage of fuels, explosives and other dangerous goods as may be required for the construction of the Facilities and shall not use the site or allow access for any purpose not connected to the Contract.

Dangerous goods are only to be stored in nominated and approved storage areas and must comply with the Samoa regulations governing such goods.

2.1.6 **Design Principles**

2.1.6.1 Functional Requirements

The Facilities shall be designed in an optimal manner such that they can be operated safely, reliably and economically and are fit for purpose. The design of the Facilities shall be such that they can be readily maintained, are secure, and are capable of continuous operation with minimum attention and maintenance.

The Project shall provide for the safe, reliable and efficient operation and dispatch of the turbine generators from the local powerhouse controls and from the Employers NCC.

Permanent access roads shall provide for all necessary transport, year-round, during construction, operation and maintenance of the Facilities.

The water conveyance systems shall provide for the required conveyance capacity safely and reliably under the specified head conditions.

Provisions shall be made for regular inspection and maintenance of all Facilities during the service life of the Project. Easy access and safety shall be provided for these operations.

2.1.6.2 Lifetime Requirements

The design of the civil, and structural features shall provide a 100-year service life, while the major electrical and mechanical items shall be designed for a service life of at least 40 years. Control systems, protection systems, battery systems shall have a service life of no less than 20 years.

The design service life of a structure or equipment is the period for which it is to be used for its intended purpose. Regular maintenance is anticipated but structural reliability and operational integrity shall be maintained.

The Contractor shall inform the Project Manager of specific parts or components of the design that have a shorter technical life than stated above. Such parts or components shall be included in the Facilities only as approved by the Project Manager.

All materials and equipment used in the Project shall be of acceptable quality and proven design, and shall be furnished by a recognised manufacturer or supplier.

2.1.6.3 Standards

All design and construction work, including the materials used and methods applied, shall be in accordance with one or more internationally recognized standards of practice. By definition, such standards comprise organizations such as the AS (Australian Standards), NZS (New Zealand Standards), ASTM (American Society for Testing and Materials), ISO (International Organization for Standardization), DIN (German Code), BS (British Standard), SS (Swedish Standard), EN (European Standard), or equivalent.

Should the Contractor request alternatives to the above standards, other relevant standards may be used subject to Employer's approval. Differences between the standards specified and the proposed alternative standards must be fully described in writing by the Contractor and submitted to the Employer for review and approval.

The latest editions on the Base Date of the standards and codes, including amendments, shall be used by the Contractor, unless expressly stated otherwise.

An English translation shall be submitted if the standards and codes proposed by the Contractor are in a language other than English.

All specific references to standards and codes throughout these Employer's Requirements are governed by this Part.

The Facilities shall be constructed in accordance with the laws of Samoa and associated Acts and Regulations. These include:-

- National Building Code 2017
- Electricity (Safety) Regulations 2010
- Occupational Safety & Health (OSH) Act 2002
- PUMA 2006
- Environment Management Act and Codes of Environmental Practice (COEP)

In order to achieve Regulatory compliance under the Electricity Regulations, the Facilities shall comply with the Electricity Regulations and AS/NZS 3000 "Wiring Rules".

The standards under which the work is to be performed or tested are specified throughout these Employer's Requirements. Where such standards are in conflict with the provisions of these Employer's Requirements, the Employer's Requirements shall govern. In case of conflicting requirements that are not specified definitely in these Employer's Requirements between the standards of above authorities, such disagreements shall be resolved by the Project Manager, and the Project Manager's decision shall be final. It is understood that the latest revision or edition of such standards at the time of Tender shall apply.

In the absence of specific standards being nominated in the specifications, the following Standards shall apply:-

Australian/New Zealand Standards

AS/NZS	1170	Structural Design Actions
AS/NZS	1429.1	Electric cables - Polymeric insulated - For working voltages 1.9/3.3 (3.6) kV up to and including 19/33 (36) kV
AS/NZS	1768	Lightning Protection
AS	1824	Insulation coordination – Definitions, principles and rules
AS	1940	The storage and handling of flammable and combustible liquids
AS	2067	Switchgear Assemblies and Ancillary Equipment for Alternating Voltages above 1kV
AS/NZS	2312	Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings
AS/NZS	2373	Electric cables – Twisted pair for control and protection circuits
AS/NZS	2650	Common specifications for high-voltage switchgear and controlgear standards
AS	2676.2	Guide to the installation, maintenance, testing and replacement of secondary batteries in buildings: Sealed cells
AS/NZS	3000	Wiring Rules
AS/NZS	3008.1.1	Electrical installations – Selection of cables – Cables for alternating voltages up to and including 0.6/1 (1.2) kV.
AS/NZS	3010	Electrical Installations – Generating Sets
AS	3011.2	Electrical installations – Secondary batteries installed in buildings, Part 2: Sealed cells
AS/NZS	3080	Telecommunications installations - Generic cabling for commercial premises
AS/NZS	3155	Approval and test specification - Electric cables - Neutral screened - For working voltages up to and including 0.6/1 kV
AS/NZS	3191	Electric flexible cords
AS/NZS	3439.1	Low voltage switchgear and control gear assemblies
AS/NZS	3439.2	Low-voltage switchgear and controlgear assemblies - Particular requirements for busbar trunking systems (busways)
AS	3607	Conductors-Bare overhead, aluminium and aluminium alloy – steel reinforced
AS/NZS	3835	Earth potential rise - Protection of telecommunications network users, personnel and plant
AS/NZS	3947	Low voltage switchgear and control gear, (all relevant parts)
AS	4024.1	Safety of machinery, (all relevant parts)
AS/NZS	4026	Electric cables - For underground residential distribution systems
AS	4044	Battery chargers for stationary batteries
AS/NZ	4961	Electric cables – Polymeric insulated – For distribution and services

S		applications
AS/NZS	5000	Electric cables – Polymeric insulated – For working voltages up to and including 0.6/1 (1.2) kV.
AS/NZS	60265.1	High-voltage switches - Switches for rated voltages above 1 kV and less than 52 kV
AS	60529	Degrees of protection provided by enclosures (IP Code)
AS	60870	Telecontrol equipment and systems (All parts)
AS/NZS	60898	Electrical accessories - Circuit-breakers for overcurrent protection for household and similar installations - Circuit-breakers for a.c. operation
AS	ENA C(b)1	Guidelines for design and maintenance of overhead distribution and transmission lines.
AS	HB101	Coordination of power and telecommunications - Low Frequency Induction (LFI): Code of practice for the mitigation of hazardous voltages induced into telecommunications lines.

International Electrotechnical Commission (IEC)

IEC	11801	Information technology – Generic cabling for customer premises
IEC	14763	Information technology – Implementation and operation of customer premises cabling
IEC	24702	Information technology – Generic cabling – Industrial premises
IEC	60034	Rotating Electrical Machines – all relevant parts
IEC	60038	IEC Standard Voltages
IEC	60041	Field acceptance tests to determine the hydraulic performance of hydraulic turbines, storage pumps and pump-turbines
IEC	60044	Instrument Transformers
IEC	60051	Direct acting indicating analogue electrical measuring instruments and their accessories
IEC	60060	High Voltage Test Techniques
IEC	60076	Power Transformers
IEC	60085	Thermal Evaluation And Classification of Electrical Insulation.
IEC	60086	Primary Batteries
IEC	60099	Surge Arrestors
IEC	60137	Bushings For Alternating Voltages Above 1,000 V
IEC	60193	Hydraulic turbines, storage pumps and pump-turbines - Model acceptance tests
IEC	60228	Conductors of Insulated Cables
IEC	60255	Electrical relays
IEC	60269	Low-voltage fuses
IEC	60304	Standard colours for insulation for low frequency cables and wires
IEC	60308	International Code for Testing of Speed Governing Systems for Hydraulic Turbines
IEC	60354	Loading Guide For Oil Immersed Transformers
IEC	60364	Electrical installations of buildings
IEC	60502.1	Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV) - Part 1: Cables for rated voltages of 1 kV (Um = 1,2 kV) and 3 kV (Um = 3,6 kV)
IEC	60502.2	Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV) - Part 2: Cables for rated voltages from 6 kV (Um = 7,2 kV) up to 30 kV (Um = 36 kV)

IEC	60551	Determination Of Transformer And Reactor Sound Levels
IEC	60664	Insulation coordination for equipment within low-voltage systems (All Parts)
IEC	60715	Dimensions of low voltage switchgear and control gear
IEC	60793-1	Optical fibres – All Parts
IEC	60794	Optical fiber cables – Part 1-1: Generic specification - General
IEC	60794-1-2	Optical Fibre Cables - Generic Specification - Basic Optical Test Procedures
IEC	60794-4-1	Optical fibre cables - Part 4-1: Aerial optical cables for high-voltage power lines
IEC	60896	Stationary Lead-Acid Batteries
IEC	60898	Electrical accessories - Circuit-breakers for overcurrent protection for household and similar installations
IEC	60909	Short-circuit current calculation in three-phase AC systems
IEC	60934	Circuit breakers for equipment
IEC	61009	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs)
IEC	61660	Short-circuit currents in DC auxiliary installations in power plants and substations
IEC	62063	High-voltage switchgear and controlgear - The use of electronic and associated technologies in auxiliary equipment of switchgear and controlgear
IEC	62271	High Voltage Switchgear and Controlgear (All parts)
IEC	62305	Protection against Lightning

Institute of Electrical and Electronic Engineers (IEEE)

ANSI/IEEE	Std 1050	Guide for Instrumentation and Control Equipment Grounding in Generating Stations
ANSI/IEEE	Std 450	Recommended Practice for Maintenance, Testing and Replacement of Large Lead Storage Batteries for Generating Stations and Substations
ANSI/IEEE	Std 484	Recommended Practice for Installation Design and Installation of Large Lead Storage Batteries for Generating Stations and Substations
ANSI/IEEE	Std 485	Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations
ANSI/IEEE	Std 665	Guide for Generating Station Grounding
ANSI/IEEE	Std 80	Guide for Safety in AC Substation Grounding
ANSI/IEEE	Std 81	Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Ground System
ANSI/IEEE	Std C37.101	Guide for Generator Ground Protection
ANSI/IEEE	810	Standards for Hydraulic Turbine and Generator Integrally Forged Shaft Couplings and Shaft Runout Tolerances
ANSI/ICEA	S-87-640	Standard for Fibre Optic Outside Plant Communications Cable
ANSI/ICEA	S-83-596	Standard for Fiber Optic Premises Distribution Cable

British Standards (BS)

BS	148	Unused Mineral Insulating Oils For Transformers And Switchgear
BS EN ISO	1461	Hot dip galvanized coatings on fabricated iron and steel articles
BS	6231	Specification for PVC-insulated cables for switchgear and controlgear wiring
BS	6651	Protection of structures against lightning.
BS	7354	Code of Practice for Design of high-voltage open-terminals stations, Section 7: Earthing.
BS	7430	Code of Practice for Earthing.

International Standards Organisation (ISO)

ISO	6826	Reciprocating Internal Combustion Engines - Fire Protection
ISO	8528	Reciprocating Internal Combustion Engine Driven Alternating Current Generating Sets – all relevant parts.
ISO	1000	SI units and recommendations for the use of their multiples and of certain other units

ITU

ITU-T Recommendation	G.650	Definition of a single-mode optical fibre cable
ITU-T Recommendation	G.652	Characteristics of a single-mode optical fibre cable
ITU-T Recommendation	G.655	Characteristics of a non-zero dispersion shifted single-mode optical fibre cable

ASTM

ASTM	A27	Specification for Mild to Medium-Strength Carbon-Steel Castings for General Application
ASTM	A36	Specification for Structural Steel
ASTM	A53	Specification for Welded and Seamless Steel Pipe
ASTM	A148	Specification for High-Strength Steel Castings for Structural Purposes
ASTM	A167	Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM	A176	Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
ASTM	A181	Specification for Forged or Rolled Steel Pipe Flanges, Forged Fittings, and Valves and Parts for General Service
ASTM	A213	
ASTM	A269	Specification for Soft Annealed Stainless Steel Tubing
ASTM	A275	Standard Method for Magnetic Particle Examination of Steel Forgings
ASTM	A282	Forged Stainless Steel Fittings, Socket-Welding and Threaded
ASTM	A285	Specification for Low and Intermediate Tensile Strength Carbon Steel Plates for Pressure Vessels (Plates 50 mm and Under in thickness)
ASTM	A312	Specification for Seamless and Welded Austenitic Stainless Steel Pipe
ASTM	A345	Specification for Flat Rolled Electrical Steel
ASTM	A388	Standard Practice for Ultrasonic Examination of Heavy Steel Forgings
ASTM	A403	Specification for Wrought Austenitic Stainless Steel Pipe Fittings

ASTM	A420	Specification for Stainless and Heat-Resisting Chromium and Chromium-Nickel Steel Plate, Sheet, and Strip for Fusion-Welded Unfired Pressure Vessels
ASTM	A516	Specification for Carbon Steel Plates for Pressure Vessels for Moderate and Lower Temperature Service
ASTM	A517	Specification for High Strength Alloy Steel Plates, Quenched and Tempered, for Pressure Vessels
ASTM	A582	Specification for Free-Machining Stainless and Heat- Resisting Steel Bars, Hot-Rolled or Cold-Finished
ASTM	A668	Specification for Steel Forgings, Carbon and Alloy for General Industrial Use
ASTM	A743	Specification for Casting, Iron-Chromium, Iron-Chromium-Nickel, and Nickel Base (Corrosion-Resistant) Alloy Castings for General Application
ASTM	B21	Specification for Naval Brass Rod, Bar, and Shapes
ASTM	B31.1	Power Piping
ASTM	B42	Specification for Seamless Copper Pipe, Standard Sizes
ASTM	B88	Specification for Seamless Copper Water Tube
ASTM	B127	Specification for Nickel-Copper Alloy Plate, Sheet, and Strip
ASTM	B230	Standard Specification for Aluminum 1350-H19 Wire for Electrical Purposes
ASTM	B232	Standard Specification for Concentric-Lay-Stranded Aluminum Conductors, Coated-Steel Reinforced (ACSR)
ASTM	B241	Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM	B498	Standard Specification for Zinc-Coated (Galvanized) Steel Core Wire for Aluminum Conductors, Steel Reinforced (ACSR)
ASTM	B584	Specification for Copper Alloy Sand Castings for General Applications
ASTM	R0027	Standards Related to Nondestructive Testing Developed by ASTM Committees Other Than Committee E-7
ASTM	Vol 03.03	Nondestructive Testing

Other

ASCE	79	"Manuals and Reports on Engineering Practice No. 79," (Steel Penstocks)
ASME		American Society of Mechanical Engineers, "Boiler and Pressure Vessel Code," Division 2.
AWS		American Welding Society, "Structural Welding Code."
ASME	PTC Code 18	Hydraulic Turbines

All other equipment furnished under this section shall conform to the requirements of applicable Standards.

In addition to the Standards listed in the specification, and the Standards listed, above all other aspects of the Facilities shall be designed, manufactured and tested in accordance with the pertinent provisions of the codes and standards of the following listed institutes, associations and other organisations:

Name	Abbreviation
American National Standards Institute	ANSI

American Society of Mechanical Engineers	ASME
American Society for Testing and Materials	ASTM
American Welding Society	AWS
Australian Standards	AS
Australia/New Zealand Standards	AS/NZS
Institute of Electrical and Electronics Engineers	IEEE
International Electrotechnical Commission	IEC
Specifications for Inspection of Steel Castings for Hydraulic Machines	CCH-70-2
Steel Structures Painting Council	SSPC
New Zealand Standards	NZS

2.1.6.4 Design and Planning of the Facilities

2.1.6.4.1 General

The Contractor shall be responsible for the design and planning of the Facilities in accordance with the Contract. The Contractor shall further establish and execute a Quality Assurance Plan to ensure and verify that his work is in accordance with the requirements of the Contract.

The Contractor shall prepare the design of the Facilities which shall consist of the following:

- Tender Design, performed during the bidding process and submitted with the bidders Technical Proposal.
- Basic Design, performed immediately after the Contract is let. The Basic Design Report shall be submitted in draft form within 6 weeks of the Commencement Date.
- Detailed Design, performed before and during the construction of the Project.

The Contractor shall perform all additional field and laboratory investigations needed to fulfil the design and construction requirements given in the Employer's Requirements.

All design shall be performed in accordance with the requirements given in the Employer's Requirements. The Contractor shall design all Facilities and all necessary temporary works.

2.1.6.4.2 Contractor's Technical Proposal

The Contractor shall prepare and submit to the Employer for his review as part of the bidding process a Contractor's Technical Proposal that shall include the following as a minimum:

- A description of how the design requirements will be achieved including a description of design inputs and their sources, proposed design methods, techniques and software as well as a list of all references to be used for design of all Facilities., including:
  - Weir design and construction methodology
  - Sluice gates and associated systems.
  - Intake gates and associated systems.
  - Intake self cleaning screens
  - Headpond design and construction methodology
  - Pipeline design, headloss calculations and construction methodology
  - Penstock design, headloss calculations and construction methodology
  - Turbine Generator design, manufacture and installation.
  - Control and protection design concept and equipment selections.
  - Approach to testing and commissioning
- A description of **all** proposed exceptions to, or deviations from the Employer's Requirements.
- Principal outline drawings (plans, profiles, sections) of the project layout and all structures with main measurement data, water levels, etc. as well as principal drawings, schematic line diagrams etc. for all mechanical and electrical deliveries.

- Summary of all tests and investigations planned to be carried out in connection with the Detailed Design.
- Quality Assurance Plan.
- Any other information specified in Employer's Requirements.

Drawings shall be appended to the Contractor's Technical Proposal.

The Technical Proposal shall include the following Schedules:

Supplier Schedules, with details of the supplier for all key equipment items for the project including:-

- Pipelines/Penstocks
- Liner materials
- Gates
- Screens
- Valves
- Turbine and Generators
- Governing Systems
- Excitation Systems
- Control and Protection Systems
- Electrical/Mechanical Design Services

Equipment Schedules, completed data sheets for all of the major equipment items. Blank data sheets for this purpose are provided for:-

- Pipelines/Penstocks
- Gates
- Screens
- Valves
- Turbines
- Generators
- Governing Systems
- Excitation Systems
- Control and Protection
- DC Station Service
- Step-up Transformer
- E&M Auxiliary Services
- Powerhouse Electrical Systems

2.1.6.4.3 Design Documents and Construction Drawings

Design documents and construction drawings shall be prepared in the English language.

Design documents and all computations shall be initialled and dated by the designer and checker, and shall clearly state the Project name, calculation number and title, calculation description/objective, revision number (where revision 0 is the original submission), key assumptions, references, and a summary of the calculation conclusions/results.

All construction drawings shall be produced using the latest version of AUTOCAD. Each drawing shall be initialled by the designer and drafter as well as their respective checkers. The drawings shall include a revision number (where revision 0 is the original submission), a brief description of revision(s), and all revisions must be clearly identified on the drawing.

The Contractor shall have staff at the Site to prepare and to revise drawings and documents during construction as needed to document "as-built" conditions. Contractor shall provide three (3) copies and one (1) reproducible of final "as-built" plans for the civil works, electrical single-line drawings, and control logic diagrams, prior to issue of the Operational Acceptance Certificate for the whole of the Facilities.

All design documents and construction drawings shall be delivered in digital form to the Employer. In addition, unless otherwise specified, three (3) printed copies of each drawing and document shall be submitted to the Employer.

2.1.6.4.4 Units of Measure

The system of measurement to be used in the Project shall be in SI units. Angles shall be given in the 360-degree system.

The coordinate reference system to be used for all Facilities shall be defined by a quadrant grid system. Each drawing shall contain a scale reflecting the appropriate meter spacing. The grid system shall be defined in accordance with the Samoa national grid system.

2.1.6.4.5 Seismic Design Requirements

All designs of the Facilities shall consider earthquake loadings such that performance of the Facilities is not adversely impacted under the design seismic event. The Plant shall be designed for the following Seismic Events:

- Strength and Stability: Annual probability of exceedance of 1 in 2500 years,
- Operability (including deformation, water tightness and other fit for purpose requirements): Annual probability of exceedance of 1 in 25 years

The design earthquake parameters shall be in accordance with those given in the National Building Code for Samoa. Alternatively, design to AS/NZS 1170 Part 5, Structural Design Actions - Earthquake, shall also be deemed to comply.

2.1.6.4.6 Flood Design Requirements

All designs of the Facilities shall consider floods such that performance of the Facilities is not adversely impacted under the design flood event. The Facilities shall be designed for the following flood events:

- Weir and intake –Annual probability of exceedance of 1:2 years for operability. For strength and stability, 1 in 100 years.
- Pipeline and penstock – The pipeline and penstock shall be designed not to float when in operation under any conditions including flood.
- Powerhouse - Powerhouse to the waterproofed/ tanked to a minimum of 1.0m above powerhouse floor slab level (pending Contractors design requirements). The powerhouse doors can be made waterproof by the installation of a propriety flood gate system

2.1.6.4.7 Basic Design

The Basic Design Report shall be developed from the Contractors Technical Proposal, updated as necessary. The report shall include all information required under Part 2.1.6.4.2

2.1.6.4.8 Detailed Design

The Contractor shall make the necessary Detailed Design for construction of the Project. For each feature of the project, the Contractor shall submit to the Project Manager for his review and approval, Detailed Design documentation to include as a minimum:

- A description of each structure/feature of the Facilities.
- Assumptions, design objectives, methods and philosophies adopted.
- Design criteria, parameters, loads and load cases used.
- Applicable codes, standards, and references used.
- A short description of each method of analyses, computer programs, etc. used.
- Calculations and results of the detailed design analyses for each structure/feature of the Facilities.
- Testing requirements and criteria.
- Detailed design drawings and specifications ready for construction.

2.1.6.4.9 Design Submissions

The Contractor shall present the detailed designs, specifications and drawings for each aspect of the scheme. Each submission shall provide a complete package of information that is complete in itself and allows a full understanding of the design, drawings design criteria and applicable codes and standards that have been used in developing the design.

In general, the initial documentation for each aspect of work should consist of the items listed in the first five items above. Drawings will be rejected if this initial documentation is not available.

All drawings and design must be submitted for review. The Project Manager and his representatives will comment within the time prescribed in the Contract if there is any matter that they require attention or additional information is required to be submitted. If no comment is received from the Employer within the allowed time, the Contractor may proceed with the aspect of the Facilities covered by that particular submission.

2.1.6.4.10 Value Engineering

The Contractor may, at any time, submit to the Project Manager a written proposal which (in the Contractor's opinion) will, if adopted, (i) accelerate completion, (ii) reduce the cost to the Employer of executing, maintaining or operating the Facilities, (iii) improve the efficiency or value to the Employer of the completed Facilities, or (iv) otherwise be of benefit to the Employer.

2.1.6.4.11 Construction Methods

The Contractor shall prepare and submit to the Project Manager for his review and approval a Construction Method Report and Project Implementation Plan in conjunction with and related to the Contractor's Technical Proposal, Basic Design or Detailed Design as appropriate. The report shall include the following as a minimum:

- A description of how the construction requirements will be achieved.
- A description of construction methods to be used for all major works.
- A procurement plan for major equipment.
- Layout drawings for all temporary works.
- Principal items of construction plants to be used.
- Description of Quality Control and Quality Assurance.
- Construction Environmental Management Plan (CEMP).

The Contractor shall not start any major permanent construction work until the Contractor's Construction Method Reports, Project Implementation Plan and Construction Environmental Management Plan have been reviewed and approval by the Project Manager.

2.1.7 Construction Services

2.1.7.1 Scope of this Specification

This Specification covers requirements of the Contract for the services to be provided by the Contractor during the construction period.

2.1.7.2 General Requirements

This Specification provides an outline of the minimum construction standards required for the services facilities for the duration of the Project.

No accommodation facilities shall be erected on the Project sites, the expectation is that the Contractor will accommodate staff at commercial accommodation facilities.

2.1.7.3 Electrical Requirements

The Contractor shall provide all arrangements for temporary power supply for all sites as required for the construction activities.

Where portable diesel electric generators are used for temporary power, they shall be fitted with residential class silencers and shall only be used between the hours of 7AM and 7PM to avoid disturbing local villagers.

2.1.7.4 Potable Water Supply

The Contractor shall provide all arrangements for the supply of potable water as well as disposal and treatment of used water.

2.1.7.5 Toilet Facilities

The Contractor shall provide portable chemical toilets at each work location and arrange for their regular cleaning and emptying at an approved facility.

2.1.7.6 Fire Protection

Fire extinguishers shall be provided within each building.

2.1.7.7 Communications

The Contractor shall be responsible for providing all communications (connections and hardware) to the work sites and site offices.

2.1.7.8 Office Facilities

The Contractor shall provide the office facilities which he requires for the Project.

The office facility shall be sized to allow for project meetings, including staff from the Contractor, Employer, Project Manager and other Contractors employed on the project.

2.1.8 Pre-Commissioning, Commissioning, Guarantee Tests and Tests on Completion

2.1.8.1 General Requirements

During the erection and before Operational Acceptance of the Facilities, tests shall be performed by the Contractor under the direction of the equipment manufacturers' test engineers to determine whether the Employer’s Requirements have been fulfilled.

This Part describes the minimum field tests to which the equipment shall be subjected. In addition to the tests listed below, the Contractor shall perform any other tests required by the Employer to establish conformance of the equipment with the guarantees and Employer’s Requirements. The provisions of this Part augment any similar requirements in other Parts of the Employer’s Requirements. In case of conflict, the detailed requirements of the particular equipment Part shall prevail. The waiver of any test shall not relieve the Contractor of its responsibility to meet fully the requirements of the Employer's Requirements. The Contractor shall coordinate with the Employer, and the equipment manufacturers involved establishing mutually satisfactory dates for field tests.

2.1.8.2 Responsibility

The Contractor shall be responsible for supervision and for test procedures for all field tests on the Facilities and shall furnish the necessary calibrated test instruments and equipment.

Test Equipment. All necessary test equipment shall be provided, including wire and cable for temporary connections. The test equipment shall meet the requirements of the standards specified herein and shall be properly calibrated in a qualified laboratory. The Employer shall be given catalogues and complete specifications of all test equipment and complete certificates of calibration. Test equipment shall remain the property of the Contractor following the tests.

2.1.8.3 Outline and Schedule of Tests and Test Plan

At least 90 days prior to the start of testing for each part of the Facilities, the proposed schedule for performing the specified tests shall be prepared and submitted to the Employer for approval. Not later than 60 days prior to the start of testing, a complete Test Plan outlining the test objectives and requirements, the proposed methods and the field procedures to be followed for the specified tests. This Plan shall be submitted to the Project Manager for review, including:

- Test procedures and scope of tests
- List of equipment required for each test.
- Number of skilled and unskilled personnel required for each test.
- Input required from other Contractors involved in the Project and the Employer
- Schematic and circuit diagrams showing connections to be used for each test.
- Test forms and summary sheets to be used for recording data.
- The minimum/maximum acceptable test values in order to meet specified requirements for the equipment.

After the Project Manager's review, six (6) copies shall be furnished to the Project Manager for distribution to participating parties.

2.1.8.4 Organisation

During the testing period, starting from Pre-Commissioning through to the Guarantee Tests, the Contractor shall establish a start-up organization including all personnel, their responsibilities and the hierarchy of the organisation.

The Contractor shall appoint a Commissioning Manager, who shall be responsible for the Contractor's obligations during compliance checks, initial tests, system demonstrations and performance tests. The Contractor shall be solely responsible for testing of all systems and subsequent performance tests.

2.1.8.5 Factory Tests

- Factory tests shall be performed for main components and systems including turbines, generators, governors, switchgear, control and protection systems. The Contractor shall allow in their bid for 2 representatives of the Employer to witness and inspect works on equipment at Factory Acceptance Tests on the following
- Turbines and Generators
- Control system

The Contractor shall pay for the economy class travel, hotel accommodation (up to equivalent US$200 per night), transport, food and other incidental expenses for the employer's representatives. In addition, the contractor shall provide the Employers representatives with a $50 USD or equivalent per diem for the duration of the trip. It is the Contractors responsibility to schedule manufacturing so that the Employers representatives can witness the Factory Acceptance Tests for the turbine, generator and control system in one trip of not more than one week duration. Should the Contractor fail to coordinate the manufacture to permit all inspections within the one-week period, then the Contractor shall be responsible for all costs associated with any additional trips required.

2.1.8.6 Testing Sequence

A system testing schedule shall be prepared by the Contractor and reviewed by the Project Manager.

As detailed in the General Conditions of Contract there are three phases to the Facilities gaining Operational Acceptance:-

1. Pre-Commissioning. Prior to the Contractor notifying the Project Manager that the Facility is Complete, the Contractor shall have completed all Pre-Commissioning.

2. Commissioning Tests

3. Guarantee Tests.

The Operational Acceptance Certificate will be issued on the successful completion of the Pre-Commissioning tests, Commissioning tests and Guarantee Tests.

Where testing, pre-commissioning and commissioning procedures are discussed in the various more-detailed Sections and Parts comprising the Employer's Requirements, those procedures are to be followed.

2.1.8.7 Completion of the Facilities

The following Sections of the Plant shall be completed with separate Completion and Operational Acceptance for each Part, as individual Parts of the Facilities as permitted under the GCC:-

Part 1 – Tiapapata Power Scheme

Part 2 – Alaoa Additional Storage Rehabilitation

2.1.8.8 Pre-Commissioning

2.1.8.8.1 Compliance Checks

Prior to Pre-Commissioning, plant systems and subsystems shall be checked for compliance with drawings, specifications, and other Contractor's Documents. Procedures for compliance checks shall be included in the testing packages and shall be approved by the Project Manager. The Contractor shall be responsible for the implementation of compliance checks. The procedure shall include sign-off provisions by the Contractor and the Project Manager.

The compliance checks shall include for an "As Built" survey of the weirs and conveyance systems.

Prior to energisation of any component of the Facilities from the EPC Electricity Network, or connection of any equipment to the EPC Electricity Network, the Contractor shall arrange for the Facility to be inspected by the EPC Regulatory Unit and certified that it is compliant with these requirements. All costs shall be borne by the Contractor.

2.1.8.8.2 Pre-Commissioning Tests

Prior to the Contractor notifying the Project Manager that the works are complete and ready for Commissioning, the Contractor shall have completed all Pre-Commissioning of the Facilities; including: -

- Hydrostatic tests.
- Point to point wiring tests.
- Insulation resistance tests.
- Power frequency withstand tests.
- Ductor tests on all high current carrying joints.
- Primary and secondary injection tests for all protection AC circuits.
- Plant control system software FAT and SAT tests.
- Operational tests of all balance of plant equipment.
- Pre-Start Tests.

In addition the following conditions shall have been met:-

- The conveyance system is complete, and all equipment and personnel removed and all screens are in place. All tests required prior to filling with water or pressurisation have been successfully completed by the Contractor.
- The generating plant is complete and tested ready for watering up and livening

The Contractor shall also have completed flushing of the pipelines and penstocks and have removed all construction debris. A photographic record of the final inspection shall be handed to the Project Manager prior to proceeding with watering.

2.1.8.8.3 Pipeline and Penstock Filling and Flushing

The Contractor is responsible for the first filling of the conveyance systems and also for flushing the intakes and pipelines/penstock prior to commencement of the turbine generator pre-commissioning tests. The Contractor is responsible for ensuring that the conveyance system is free of debris that could endanger the Plant. Any concerns must be advised to the Project Manager immediately.

Flushing shall continue until the Project Engineer and Contractor are satisfied that the water is free of excessive foreign matt

2.1.8.8.4 Dry Tests

Dry testing shall be carried out in the presence of the Project Engineer or his nominated representative. The following tests shall be carried out: -

- Each intake gate shall be subjected to a full open and close cycle.
- The turbine inlet valve shall be opened using the Unit PLC, and closed using the Unit PLC and protection system trips.
- The turbine governor system shall be dry tested to confirm correct operation of the spear valve and deflector positioning controls. Open/Close operating durations for the spear

valves and deflectors shall be set in the governor control program and dry measurements of the actual opening and closing times shall be made. Correct operation of the governor shutdown trips from the Unit PLC and protection systems shall be confirmed.
- The Unit PLC start and stop sequences shall be tested as far as possible under "dry" conditions. During these tests the generator circuit breaker shall be racked out. The Contractor shall simulate the turbine speed using a signal generator to facilitate sequence tests.

Each test will only be deemed complete when the entire system under test operates correctly without any alarms, trips or abnormal or unexplained events occurring, this shall include all remote control and monitoring provisions from the Employers SCADA.

2.1.8.8.5 22kV System Energisation.

The 415V/22kV transformers (with the MSB incoming circuit breaker open) shall be energized from the Employers 22kV distribution system and "soak" tested for 24 hours.

2.1.8.8.6 Wet Tests

Wet testing of the Plant shall be carried out in the presence of the Project Manager. The following tests shall be carried out:-

- The Unit PLC start and stop sequences shall be tested in a sequential manner and shall only proceed to the next stage after the preceding tests have been successfully completed.
- The first step shall be to pressurize the penstock up to the turbine inlet valve. This shall be undertaken in stages, of not more than 25m pressure head. At each stage the penstock shall be inspected and the pressure monitored to confirm no leaks exist before filling further.
- Once the penstock is fully pressurized the turbine shall be operated at speed no load and tests undertaken to confirm that the governor is correctly controlling speed. Shutdown tests shall be undertaken to confirm that the governor and inlet valve can safely isolate the turbine in the event of a fault. Following these tests a bearing heat run shall be carried out. The turbine generator shall be operated at speed no load until such time as the bearing temperatures have stabilized. The Contractor shall confirm that the bearing and oil temperatures are within expected limited.
- The generator shall then be excited and voltage regulator tests conducted. Phase sequence and phase angle measurements shall be made to confirm that the generator can be safety synchronized to the EPC system.
- The turbine generator shall be synchronized to the EPC system and systematically loaded and "drop load" tests conducted at 10%, 25%, 50% and 100% of full load. It shall be confirmed that the penstock pressure rise, and turbine overspeed levels are within acceptable limited.
- A 24hr heat run shall be conducted following the drop load tests.

2.1.8.8.7 Guarantee Tests

Following completion of the turbine generator commissioning tests by the Contractor, tests shall be made to demonstrate that the Facilities have achieved the following guaranteed performance:-

- That the intake is able to take no less than 99.5% of the available river flow for flows between 10% and 120% of the design abstraction flow when new, fully clean and clear of debris.
- That the gate leakage rates do not exceed those stated in BS 7775, Table 1.
- That the power output (at rated head and flow) at the connection to the EPC 22kV distribution system meets the guarantees. The power measurement shall be made at the

415V MSB incoming supply, using the specified power meter, and adjusted to account for transformer losses using the transformer factory test results. Losses in the 22kV connection to the EPC distribution system shall be taken as zero. The Contractor shall provide a portable clamp-on flow meter, or other suitable device for measuring the penstock flow. The intake level transmitter shall be used for measurement of head.

- A 168 hour Availability Factor test shall be carried out to demonstrate the reliability of the Plant supplied by the Contractor. If, during this test period, the generating plant cannot be operated at any load selected by the Principal for any reason attributable to the Contract Plant, then the Contractor shall remedy the defect and the test shall be restarted.

2.1.9 Contractors Documents

2.1.9.1 General

The Contractor shall submit Contractor's Documents as specified in these Employer's Requirements and other portions of the Contract. Unless otherwise specified below, the Contractor shall provide each Contractor's Document to the Project Manager within the time period specified.

Project Manager's review period and provision to comment shall be to confirm the Contractor's compliance with the Contract. It is intended that Project Manager shall have at least one review and comment opportunity for each Contractor Document.

Technical Submittals shall be provided as a complete package for each major system or subsystem. For avoidance of doubt the major system/subsystems shall be: -

- Intake and Weir.
- Headpond
- Pipelines/Penstocks.
- Hydromechanical plant and hydraulic system design.
- Mechanical and Electrical plant.
- Powerhouse and Tailrace.

The package shall include all relevant calculations, specifications and drawings. The Project Managers review/approval period for any submission will not commence until all required components of the package have been received.

2.1.9.2 Monthly Progress Report

Within 28 days after the Commencement Date, and at monthly intervals (by the 5th day of each month) thereafter, the Contractor shall provide a Monthly Progress Report. Such report shall include project progress, problems, significant decisions, corrective action required, supplier status, schedule analysis, and other critical project information. Three (3) original copies of each report shall be provided. The following is a suggested outline for the Monthly Report:

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY
   - A. Narrative
   - B. Contract Invoice Summary
   - C. Executive Summary Schedule
2. ENGINEERING STATUS REPORT
   - A. Narrative
   - B. Document List
3. PROCUREMENT STATUS REPORT
   - A. Narrative
   - B. Major Equipment Manufacturing Status
   - C. Procurement Log

4. CONSTRUCTION STATUS REPORT
   A. Narrative
   B. Quality Summary
   C. Sub-Contractor List
   D. Photographs
   E. Progress Curves (Plan vs. actual “S“ curves) for each major feature and for summary of project
5. ENVIRONMENTAL AND SOCIAL SAFEGUARD STATUS REPORT
   A. Narrative
   B. Non compliances

6. SCHEDULE
   A. 90 Day Look Ahead Schedule
   B. Engineering Schedule
   C. Equipment Procurement and Manufacturing Schedule
   D. Construction Schedule

2.1.9.3 Monthly Project Meeting

Approximately 5-10 days after receipt of the monthly invoice, a Project Management Meeting shall be held to review the Monthly Progress Report with the Project Manager.

2.1.9.4 Integrated Project Schedule

Within 28 days after the Commencement Date, Contractor shall submit an Integrated Project Schedule, including engineering, procurement, manufacturing, fabrication, transportation, construction, and testing, commissioning activities. The schedule shall be presented in electronic format as well as hardcopy. Electronic copies shall be Microsoft MS Project format to the Project Manager. The Contractor is free to use any other package such as Primavera as their main scheduling tool for the project. If a package other than MS Project is used the Contractor must provide paper copies in colour, at a scale able to show the detail inherent in the schedule.

The Contractor shall utilize the Critical Path Method (CPM) of planning and scheduling to produce the Integrated Project Schedule.

The Contractor shall develop a detailed construction plan covering the entire scope of the work. Each task shall include relevant information, such as description and duration, work relationships, material or equipment deliveries, access limitations, and other details that affect the sequence and duration of the work. Negative lags and constraining dates shall not be allowed. Duration of individual activities shall not exceed 30 calendar days.

Monthly Progress Reports shall include a schedule update and progress tracking to compare the actual status of the Project with the scheduled baseline progress. Actual status shall be measured and reported using Earned Value techniques approved by the Project Manager.
The Project Manager may require the Contractor to modify any portion of his schedule and work plan, judged impractical, unfeasible, unreasonable, or not in compliance with the Contract.

2.1.9.5 Safety Plan

Within 42 days after the Commencement Date, Contractor shall provide a Safety Plan applicable to this Project.

The Contractor is responsible for the health and safety of all persons on the Site. All necessary precautions shall be made to prevent accidents and personal injuries. The Contractor shall present his planning and organization for the health and safety in advance of the actual construction works.

The Contractor shall make plans for dealing with emergencies at the Site, the Contractor's work areas, and during transportation. The plan shall include first aid, transporting accident victims to hospital, first aid education for employees, dealing with fires, etc. Such plans shall provide for all types of weather and working conditions which will be encountered at the Site and the Contractor's work areas.

In case of an accident connected with the execution of the Facilities, the Contractor shall immediately notify the Project Manager of the accident and shall provide full details of the circumstances and events regarding the accident.

2.1.9.6 Quality Assurance Plan

Within 42 days after the Commencement Date, Contractor shall provide a Quality Assurance Plan applicable to this Project.

The Contractor’s Quality Assurance Plan shall comprise procedures for Quality Control and Quality Assurance. The plans shall include both design requirements and construction materials and workmanship requirements.

The Quality Assurance Plan shall define and document the Contractor’s commitment to and policy for quality. The Contractor shall ensure that the policy and the associated procedures are understood, implemented and maintained at all levels in his organization, including all subcontractors. The Contractor's Quality Assurance Plan shall be based on well-established principles and proven performance.

The Quality Assurance Plan shall be supplemented as work proceeds with specific work and inspection procedures for all major activity. The work and inspection procedures shall include:

- Acceptance criteria, witness points and hold points specified in the construction requirements or in any standard or code adopted by the Contractor.
- Witness points for all the stages in the construction process where subsequent activities will disguise the quality and/or quantity of the previous activity thus making inspection and testing unfeasible, and/or where the subsequent activities will prevent correction of non-conformities.
- The Contractor shall issue relevant work procedures and inspection plans for the Project Manager's review prior to the commencement of each main activity, unless stricter demands are specified in special cases.

The Contractor's Quality Assurance Plan shall be submitted to the Project Manager for review. The Contractor shall monitor and approve his own work using the Quality Assurance Plan. The Project Manager will monitor the Contractor's ability to follow approved plans and procedures throughout the entire project. The Contractor shall provide copies of review reports and test reports to the Project Manager on a monthly basis. The Project Manager may audit the Contractor's records at any time to verify that sufficient reviews, checks, and tests are being performed. The Project Manager reserves the right to:

- Include further stages as witness or hold points if these are considered to have been omitted by the Contractor;
- Change the designation of any stage from a witness point to a hold point should this be deemed necessary.
- Require all materials to be identifiable and traceable, unless otherwise stated.
-

2.1.9.7 Construction Environmental Management Plan

Within 42 days after the Commencement Date, Contractor shall provide a Construction Environmental Management Plan applicable to this Project.

The requirements of the Construction Environmental Management Plan are detailed in the IEE – refer Section 6 Part 4 - Supplementary Information.

The Contractor's Construction Environmental Management Plan shall be submitted to the Project Manager for review. The Contractor shall monitor and approve his own work using the Construction Environmental Management Plan. The Project Manager will monitor the Contractor's ability to follow approved plans and procedures throughout the entire project. The Contractor shall provide copies of review reports and test reports to the Project Manager on a monthly basis. The Project Manager may audit the Contractor's records at any time to verify that sufficient reviews, checks, and tests are being performed

2.1.9.8 Test and Commissioning Plan

Contractor shall provide a plan to perform Pre-commissioning and Commissioning of the Facilities.

2.1.9.9 Guarantee Test Procedures

Contractor shall provide procedures to perform the guarantee tests.

2.1.9.10 Training Program

Contractor shall provide a plan to train the Employer’s O&M personnel in the operation of the Plant.

2.1.9.11 Materials

Current certificates of tests by manufacturers shall be available for inspection by the Project Manager. Such certificates shall relate to the materials delivered to the Site and Contractor’s work areas. Certified true copies of certificates may be submitted if the original certificates cannot be obtained from the manufacturer. A letter from the supplier certifying that the certificates are related to the delivered materials shall be submitted with the certificates.
Parts and/or materials which are to be assembled on the sites and Contractor’s work areas, shall be marked to identify the component parts.

Materials which are specified by means of trade or proprietary names may be substituted by the equivalent materials from a different manufacturer provided that the materials are of the same or better quality and comply with the specified requirements.

All materials and goods shall be stored strictly in accordance with the manufacturer’s instructions so as to insure no deterioration occurs prior to incorporation in the Facilities.

Materials and goods shall be stored to prevent harm to people’s health or the environment.

2.1.9.12 Supplier Information

Contractor shall submit two (2) copies of technical data for major materials and equipment procured, including shop drawings, erection drawings, and supplier manuals.

2.1.9.13 Purchase Orders

Unpriced purchase orders, shall be submitted by the Contractor for all purchased materials and equipment and any subcontracted services. Every 30 days Contractor shall update and submit two (2) copies of the purchase order log.

2.1.9.14 Spare Parts Lists

Contractor shall provide a recommended priced spare parts list no later than 120 days after its placement of orders for materials and equipment.

2.1.9.15 Geotechnical and Topographical Surveys

Contractor shall submit two (2) copies of the results, reports or recommendations of any additional geotechnical surveys or investigations that the Contractor shall perform at the Site for the purposes of design or construction of the Facilities.

2.1.9.16 Notice(s) of Equipment Inspections

Project Manager will review purchase orders and advise Contractor of any tests or inspection hold points specified in the purchase orders that Project Manager desires to witness. Contractor shall provide Project Manager reasonable notice to witness these inspections and tests designated to be witnessed at suppliers' works.

2.1.9.17 Shop Inspection and Test Reports

All shop inspection and test reports for Materials and Equipment shall be submitted to Project Manager for review.

2.1.9.18 Quality Control Reports

The Contractor shall submit two (2) copies of quality control records such as, concrete test reports, structural steel bolting, weld inspections (visual, magnetic particle, X-ray), stress relieving, pump alignment, motor meggering, continuity wiring checks, etc.

2.1.9.19 Manufacturer Field Service Reports

All manufacturers' field representatives shall provide field inspection reports upon completion of each Site visit. Contractor shall submit these reports to Project Manager.

2.1.9.20 As-Built Drawings

Contractor shall provide three (3) copies and one (1) reproducible of final plans for the civil works, P&ID's, electrical single-line drawings, and control logic diagrams, prior to issuance of the Operational Acceptance Certificate.

2.1.9.21 Technical Documentation

2.1.9.21.1 General

The Contractor shall submit to the Project Manager Technical Documentation in accordance with the requirements of the Employers Requirements.

2.1.9.21.2 Specifications

Contractor shall submit to Project Manager for review all specifications issued by the Contractor to suppliers for procurement of major permanent equipment materials or subcontract services, conformed for purchase.

Contractor shall submit detailed technical specifications. The Contractor's specifications shall be used to ensure that construction of the Facilities satisfies the design requirements, achieves acceptable quality goals, and is consistent with good quality industry standard practices. Specifications shall include sections relevant to:

- Site preparation.
- Temporary works.
- Drainage, sewerage treatment and disposal, storm-water management
- Slope stabilisation works, including retaining structures, reinforced ground, scaling, and blasting,
- Spoil disposal
- Excavation and filling.
- Foundation preparation.

- Embankment Construction (compaction and trimming)
- Diversion and control of water during construction.
- Concrete including cement, reinforcing steel, formwork, joint treatments, placement, and all other details required for the Facilities.
- Structural steel and miscellaneous steel works.
- Cladding, roofing and storm-water management
- Glazing, doors and ironmongery,
- River works, including the ford and the excavation of river materials at the tailrace
- Security fencing
- Masonry construction.
- Pipelines/penstocks.
- Supply and Installation of hydro-mechanical equipment.
- Supply and Installation of mechanical equipment.
- Supply and Installation of electrical equipment.
- Any other necessary sections.

Construction specifications shall include:
- Materials to be incorporated in the Facilities.
- Standards and codes.
- Requirements for material placement and installation.

All technical specifications shall, as a minimum, be prepared in the same standard format and organization. The organization and format shall be consistent with international practice for projects of this type and acceptable to the Project Manager.

2.1.9.21.3 Outline Drawings

Outline drawings shall be drawn to scale and denoted with critical or major dimensions. Drawings shall include estimated weights, external forces, anchoring details, overall dimensions and information on oil, compressed air and cooling water requirements for the equipment.

2.1.9.21.4 Detail Drawings

Detail drawings shall consist of general assembly Drawings, subassembly Drawings and details to demonstrate fully that all parts will conform to the provisions and intent of these Employer's Requirements and to the requirements of their installation, operation and maintenance. The Drawings shall show all necessary dimensions and fabrication details, including type and grade of materials, the design of welded and bolted joint connections and tolerances on fits and clearances; all field joints and subassemblies in which the Contractor proposes to ship the equipment; locations and sizes of auxiliary connections for oil, grease, water and air; and, piping and process flow diagrams. Detailed specifications shall be submitted by the Contractor for the design of all major components and for other features or details when requested, including the stress levels calculated by the Contractor. The Project Manager shall have the right to request the Contractor's design calculations, which clearly indicate all assumptions, methods and results. The Contractor shall provide English translations of any non-English text as required to explain the calculations to the Project Manager satisfaction.

2.1.9.21.5 Single-Line Diagrams

Diagrams shall show the power connections, location of instrument and control transformers, and connections to transducers, meters, relays and instruments.

2.1.9.21.6 Schematic/Elementary Diagrams

Diagrams shall demonstrate the operation of the supplied control equipment. They shall include:
- Range, operation and setting for time delay relays and timers.

- Set and reset points for process instruments.
- Protective relay settings.
- Fuse and circuit breaker ratings.
- Control voltage and, if source of control voltage is not supplied by manufacturer, recommended overcurrent protection and conductor size for supplying the circuit.

2.1.9.21.7 Wiring Diagrams

Diagrams shall show the point-to-point interconnections of the control and power equipment. Control devices and terminal blocks shall be shown in their correct relative positions. One side of the terminal blocks shall be clearly identified for external wiring connections and shall be free of any manufacturer's wiring. Control devices and terminal blocks shall be identified in accordance with schematic/elementary diagrams.

2.1.9.21.8 Front-of-Panel Layouts

Equipment and nameplates mounted on the fronts of control cabinets and switchboards shall be shown. Diagrams shall be drawn to scale.

2.1.9.21.9 Nameplate Schedules, Meter Scales, Engravings and Switch Handles

Schedules for all front-of-panel devices and equipment shall be provided. Nameplate schedules shall include dimensions and lettering size. Scale markings for meters and other indicating instruments shall be shown. Escutcheon plate and legend plate engravings and type and colour of switch handles shall be shown.

2.1.9.21.10 Design Calculations

The design calculations shall define the basic design approach, assumptions, criteria used and the calculated stress levels in sufficient detail to demonstrate that the equipment meets the specified requirements and to provide adequate information for trouble-shooting of the equipment.

Detailed calculations for all protection settings shall be provided

2.1.9.21.11 Bills of Material

A list of equipment shall be submitted for each major assembly or sub-assembly and shall include the names of manufacturers of articles and auxiliary equipment to be incorporated in the work, together with description, part number, ratings, performance characteristics and other significant information as necessary to allow the Principal to obtain replacement parts. A separate list of equipment shall be provided for each printed circuit board and sub-assembly incorporated into the work, identifying the individual components mounted on the board. Bills of Material shall be provided listing the spare parts, special tools and maintenance equipment.

2.1.9.21.12 Cable Schedules

Tabulations showing the routing of all cable and wire used for power, control and instrumentation circuits shall be provided. Cable tabulations shall be prepared showing the type, size and number of conductors in each cable. Each cable shall be given a unique cable identifier. The cable tabulations shall list the equipment to which each cable is connected (From/To) and the cable tray in which it is routed.

2.1.9.21.13 Functional Block Diagrams

Block diagrams shall be provided that show the functional configuration of the main components of a system including the communication network and paths interconnecting them. The functional block diagram shall be presented in a manner that conveys the functionality of the system. Interfaces to main structures and equipment components in the Project shall be shown as well as interfaces with Employer's remote facilities.

2.1.9.21.14 Termination Drawings/Schedules

All terminations of power, control and instrumentation cable external to an electrical component, panel or cabinet shall be shown either on termination drawings or on schedules. Information shall include the terminal block designation, cable identifier, cable characteristics (i.e., size, number conductors/pairs/triads, shielding) conductor identification (e.g., number, colour), number of spare conductors and to where the other end of the cable is routed (with references).

2.1.9.21.15 Logic Diagrams

A complete set of logic diagrams describing the software used in microprocessor-based controllers shall be provided. The logic diagrams shall be provided as follows:

- Analogue Control Loops. These diagrams shall be provided in accordance with ISA standard format.
- Sequencing Controls. Controls used for sequencing logic shall be provided in Boolean or ladder-type format.

2.1.9.21.16 Instructions

2.1.9.21.16.1 General

The Contractor shall submit written detailed instructions for shop assembly and testing; handling and storage; installation, operating and maintenance and field commissioning procedures of check-out, start-up, initial operation, testing and test run for each item of equipment. The instructions shall be submitted as early as possible so that final reviewed copies can be made available to the field for use in planning their work well in advance of actual installation and operation. After review, ten (10) complete, durable bound copies of the final instructions shall be furnished.

2.1.9.21.16.2 Shop Assembly and Testing Procedure

A step-by-step procedure shall be submitted outlining the details of the checks to be made before and after shop assembly and testing of the equipment to demonstrate that the requirements of these Employer’s Requirements and other parts of the Contract have been fulfilled. The shop assembly and testing procedure shall be submitted in a tabular form itemizing each test, indicating the results expected in accordance with the design and leaving space for the actual observation during assembly and testing. The test procedures shall include test values to be used, maximum/minimum acceptable test results and reference to accepted industry standards. The limitations, if any, of the shop tests shall be fully explained and shall be approved by the Project Manager.

2.1.9.21.16.3 Handling and Storage Instructions

Detailed instructions, with illustrations, diagrams and weights, for handling, storage and care of equipment at the site shall be submitted. The instructions shall include:

- Identification of parts requiring special outdoor, indoor or temperature or humidity-controlled storage for both long- and short-term storage;
- Space requirements for outdoor, indoor and temperature- or humidity-controlled storage for both long-term and short-term storage;
- The procedures to be observed in unloading, placing, stacking and blocking of equipment;
- Rigging and lifting procedures;
- Maintenance procedures for both long- and short-term storage including maximum recommended storage period for items stored outdoors;
- Periodic rotation of components, where required;
- Application of protective coatings; and
- Cleaning of protective coatings and/or corrosion prior to installation.
-

2.1.9.21.16.4 Installation Instructions

Detailed instructions for the installation of the equipment shall be submitted together with reduced-size copies of applicable Drawings showing the erection sequence. The instructions and Drawings shall include information on handling and slinging the major pieces of equipment including weights, erection tolerances and special precautions to be observed during installation.

2.1.9.21.17 Operating and Maintenance Instructions

Detailed operating and maintenance instructions, which shall include reduced-size copies of all Drawings, applicable parts lists and catalogues covering all equipment furnished and which may be needed or useful in operation, maintenance, repairs, dismantling or assembling and for repair and identification of parts for ordering replacements, shall be submitted. The operating and maintenance instructions shall include a complete set of performance curves clearly showing the operating limits over the full range of operating heads.

Operating and maintenance instruction manuals shall be written to provide a complete and clear text, which can be used directly throughout the service life of the equipment without any addition by the Employer. Terminology and designations used in the instruction manuals shall be exactly the same as used on the Contractor's Drawings.

The sequence of subjects within the instructions, the arrangement of paragraphs and the use of headings shall permit an overview of the entire subject matter as well as permit quick reference to particular subjects.

The operating and maintenance instructions shall clearly state the salient features of the equipment supplied and the operation of the electrical controls. All required liquid levels, flows, pressure settings and settings for all auxiliary protective devices shall be included. A troubleshooting chart, maintenance timetable, lubrication diagrams and disassembly, reassembly and adjustment procedures shall be provided.

2.1.9.21.18 Reports

The Contractor shall furnish six (6) bound copies of all final reports related to the equipment including testing, initial operation, load rejection and load acceptance tests and the index and capacity tests. The reports shall be bound for permanent reference use.

2.1.9.21.19 Photographs

The Contractor shall furnish progress photographs of the shop and field erection work done. Photographs shall be taken at approximately quarterly intervals. Photographs shall be approximately 200 mm by 250 mm in size including a margin on one 250 mm side for binding. Approximately twenty-five (25) views each of the turbines and generators and five (5) views each of the inlet valves, governing systems and excitation systems will be required. Each photograph shall contain upon its face the date, the name of the manufacturer and the title of the view taken.

2.1.9.21.20 Submission of Technical Documents

The following drawings and document listing is intended to summarize the information and data to be submitted by the Contractor to Project Manager. In the case of differences between this list and the specific submittal descriptions of the Employer’s Requirements, the specific descriptions shall govern.

<u>Document</u>	**<u>Submitted for</u>**

A. Basic Design (Updated Tender Design)

Document	**Submitted for**
Weir and Intake	
General arrangement drawings	Approval
Plans and sections with main dimensions	Approval
Hydromechanical plant details	Approval
Headpond	
General arrangement drawings	Approval
Plans and sections with main dimensions	Approval
Hydromechanical plant details	Approval
Pipelines and Penstocks	
Long sections / Hydraulic Profile	Approval
General arrangement drawings	Approval
Typical details	Approval
Powerhouse	
General Arrangement Drawings	Approval
Plant layout drawings	Approval
One line diagram	Approval
Control System Architecture	Approval

B. Detailed Design

General	
Updated Basic Design	Review
Weir and Intake	
Excavation and foundation drawings	Review
General arrangement and section drawings	Review
Layout plans	Review
Reinforcement drawings	Review
Other miscellaneous drawings	Review
Screen design and fabrication	Review
Gates & embedded parts design and fabrication	Review
Headpond	
Excavation and foundation drawings	Review
General arrangement and section drawings	Review
Layout plans	Review
Reinforcement drawings	Review
Other miscellaneous drawings	Review
Screen design and fabrication	Review
Gates & embedded parts design and fabrication	Review
Pipelines and Penstocks	
Dimension drawings (plan and sections)	Review
Reinforcement drawings	Review
Manufacture drawings (shop drawings)	Review
Other miscellaneous drawings (i.e. anchor blocks, etc.)	Review
Powerhouse	
AC and DC Schematic diagrams	Review
Relay diagrams	Review
Wiring diagrams	Review

Document	Submitted for
Cable schedules	Review
Panel layout drawings	Review
Termination drawings/schedules	Review
Lighting and general power layout drawings	Review
P&IDs	Review
Hydraulic schematics	Review
Plant general arrangement drawings	Review
Plant manufacturing and shop drawings	Info/Record
Logic diagrams	Review
IO Schedules	Review

C. Other Documents

Project Control/Management	
Construction method statement	Review
Specifications	Review
Progress report	Review
Drawings list	Review
Project schedule	Review
Safety plan	Review
Quality Assurance Plan	Review
Construction Environmental Management Plan	Approval
QA/QC procedures	Approval
Shop test/inspection reports	Info/Record
Pre-commissioning, commissioning and guarantee test procedures	Approval
As-Built design drawings	Info/Record
Recommended spare parts and maintenance equipment list	Review
Final Design Report	Review
Final Construction Report	Review

D. All other documents specified in the various parts of the Employer's Requirements, not already described above	Review

Notes:

1. Submittals

   a. "Info/Record" refers to documentation that normally will not be reviewed by Project Manager during the design phase but is required for the testing, commissioning and operation phase.
   b. "Review" refers to documents that Project Manager will receive and comment on during the design, construction or testing, commissioning and testing phase, as applicable.
   c. "Approval" refers to documents Project Manager shall approve or give acceptance by no objection.
   d. If documents are required earlier to support Project Manager related activities such as: permitting interface with other Employer contractors' activities, etc., Contractor shall use all reasonable efforts to support these requirements.

2. Design Drawings and Documents

   a. The Basic Design provided with the Tender shall be updated and issued as follows:
      (1) Issue in draft for comments from the Project Manager
      (2) Project Manager's comment period is 14 days

(3) Incorporate comments and issue for final review within 14 days
(4) Project Manager's final review period is 7days
(5) Basic Design issued within 7days.

b. Detailed Design to be issued as follows:
   (1) Issue in draft for comments from the Project Manager
   (2) Project Manager comment period is 14 days
   (3) Incorporate comments and issue comments for Construction
   (4) Project Manager will comment again if necessary and the Contractor will revise the document if required.

c. Design drawings and documents shall be transmitted to Project Manager upon issuance of the drawing or documents as “Issued for Construction“.

2.2 Civil Specific Requirements

2.2.1 Geotechnical Investigations

Geotechnical information is limited due to site constraints and accessibility. However it is anticipated from site observations and walkover that keying in bedrock will be achievable at the intake locations.

The Employer recognizes that the lack of Geotechnical Investigations, particularly along the penstock/ pipeline route, is a risk to the Contractor. For the purposes of the Tender Design the Contractor is to assume minimal rock excavation (i.e. 10% of rock excavation in trench) will be required, except in areas immediately downstream from the intakes. Extra over rock excavation will claimed at the rate agreed in the Contractors price schedules. As part of their submission the Contractor shall also demonstrate the potential time and cost delays associated with encountering rock along the penstock/ pipeline if the penstock/ pipeline is on the critical path for construction of the Facilities.

A nominal allowance of 3000m3 has been estimated for excavation in rock. The Contractors shall include an estimate in their bid submission.

The Contractor is to assume that there will be minimal rock at the powerhouse locations and that foundation designs will assume that any thrusts from the penstock/ pipeline will be taken by the powerhouse foundation slab.

The Contractor shall allow for any additional Geotechnical Investigations it deems necessary such that the design and construction of the Facilities shall be completed in accordance with the Contract.

Should the Geotechnical Investigations show significant excavation of rock will be required for a below ground penstock/ pipeline the Contractor shall investigate alternative means of conveying the water such as an above ground penstock/ pipeline.

For the avoidance of doubt rock is defined as material which is unable to be excavated with a 15 tonne excavator with a 400mm wide bucket and requires to be broken out with a mechanical breaker or with blasting.

2.2.2 Topographic Investigation and Information

The project areas have not been ground surveyed, but a Lidar survey for the project area is available. This information (electronic copies of the survey) can be provided on request.

The Contractor shall verify the adequacy of the survey information. The Contractor shall make its own interpretation of the surveys and carry out any additional investigations it deems necessary such that the design and construction of the Facilities shall be completed in accordance with the Contract.

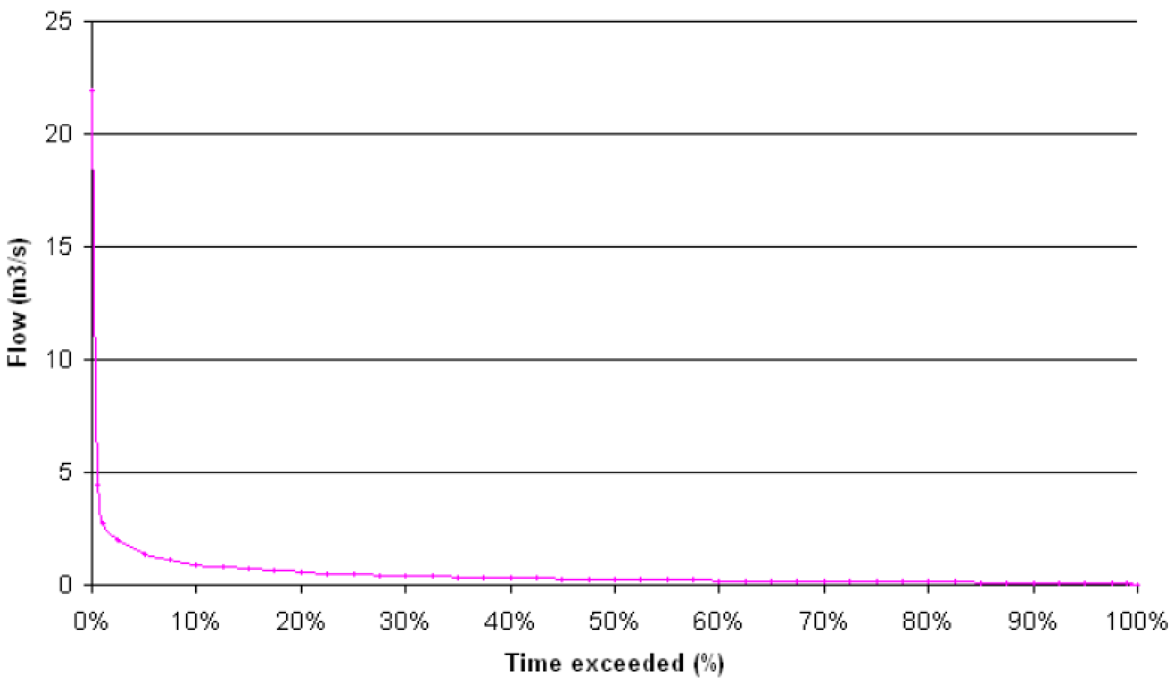
For avoidance of doubt, it is the Contractors responsibility to achieve the guaranteed net head for the Facility and any survey information provided by the Employer is for information purposes only. The Contractor has no right to rely on this information.

All work, including access, spoil, trenches, Plant and Facilities shall be entirely within the easements shown on the Employers survey and site plans. Should the Contractor wish to undertake work outside these areas, or require clarification as to the easement boundaries, they must obtain the Project Managers approval.

2.2.3 **Hydrological Investigations**

A basic hydrological investigation has been undertaken and information is provided in the EGIS report.
A Flow Duration Curve was derived from the 11 years of flow data of the Tiapapata monitoring Station.

Figure 17 - Flow duration curve of Tiapapata hydropower station



FLOOD FLOW CHARACTERISTICS: INSTANT DISCHARGES

Return Period	Dam
1 in 10 years	69
1 in 50 years	118
1 in 100 years	144
1 in 1000 years	246

(excerpts from page 27 of the EGIS report)

The Contractor shall review the hydrology assessment and use the estimated flood flows whilst undertaking design of the intake, powerhouse and tailrace structures. The Contractor is responsible for carrying out any additional investigations they deem necessary such that the design and construction of the Facilities shall be completed in accordance with the Contract.

The Employer requires designs to accommodate a flood return period of 1:100years.

2.2.4 **Access Roads**

2.2.4.1 Function

New permanent vehicle access is required to the intake (rehabilitation of the existing track alignment), the powerhouse (rehabilitation of the existing track alignment to Alaoa Intake and extension to Tiapapata scheme) and to the headpond (new access following the penstock alignment where possible).

The access roads shall provide safe access in all weather conditions for rubber tyre 4x4 vehicles and heavy transporters from existing roads to the intake areas.

All roads shall be designed for the loads from the Contractor's Equipment and the transporters carrying the heavy mechanical and electrical plant.

2.2.4.2 Existing Access Roads

The Contractor and the Project Manager will undertake a condition assessment of the existing public roads to be used prior to commencement of construction to document the existing condition of the road.

In the event of extreme weather conditions or other road users damaging the public highway to an extent that prevents trafficking by the Contractors plant and equipment, the Contractor must inform the Project Manager immediately, prior to repairs being conducted.

2.2.4.3 Contractor's Design

The Contractor shall design, construct and maintain all roads, culvert, bridges, slope support and related works required for access to the Site and that may be necessary for completion of the Facilities.

The Contractors design for the vehicle access roads shall allow for, but not limited to:

- Allow for regular trafficking by 4x4 rubber tyre vehicles.
- All roads shall be designed for the loads from the Contractor's Equipment and the transporter carrying the heavy mechanical and electrical plant.
- Gravel road construction is envisaged.
- Requirements for land acquisition and environmental impacts as stated in the project LARP and IEE.
- A speed limit of 25km/hr should be imposed to ensure safe operation of vehicles.
- A typical road width of 5.0m should be maintained, with passing places and turn-outs provide as required to suit the alignment.
- Proposal of suitable vertical alignment grades and cross-falls for the safe trafficking of vehicles. A normal maximum grade of 10% should be adopted, although shallower gradients may be required to suit the Contractors design. A 5% out-slope cross fall should be adopted for slopes less than 7% and 5% in-slope cross fall for slopes greater than 7%.
- Sufficient drainage in the form of suitable wearing course material, grade and side ditches to ensure the road formation does not become damaged via run-off or submerged during a 1 in 100-year return period rain event. The drainage alignments should minimise the erosion due to flowing water and discharge to soak pits and / or convey surface water to settlement ponds before discharging to rivers. Discharge to down-hill slopes is not preferred due to the potential for destabilising the slope. Cross road culverts or pipes may be required to minimise conveyance or at the location of existing streams/creeks. All culvert and pipe designs shall ensure fish passage.

In case that the access roads are used as construction roads, the Contractor shall repair such access roads, if necessary, and transfer the access roads to the Employer in good condition after taking-over as permanent roads specified in the Contract.

Unsealed access roads in varying states of repair are shown on the drawings.

Where the Contractor believes an existing road needs repair or upgrading to permit construction activities, the Contractor shall repair the road at their own expense. In the situation where the

Contractor damages an existing road, the Contractor shall repair the road back to its original condition.

The proposed alignment of the powerhouse road will require a river crossing

The Contractor shall design and construct a crossing that shall provide, but not be limited to:

- Safe access for vehicles and pedestrians listed above during normal flow conditions.
- A crossing location in an area where the streambed is stable or can be stabilized and sufficiently protected from scour and erosion
- The grade of the approaches to the crossing shall be a maximum of 10 horizontal to 1 vertical (10%).
- The concrete surface finish of the approach and crossing shall be suitably textured to provide adequate grip for vehicle access.
- Depth gauging to allow the depth of flow over the crossing to be determined by a vehicle driver from the river bank.

The Contractor’s design should consider a concrete vehicle ford crossing against a bridged culvert structure to minimise constricting the existing river channel and further blockage by debris resulting in overtopping and damage during flood conditions.

The crossing shall be adequately founded in the existing ground to prevent passage of water under or around the edges of the structure.

The river approach and discharge aprons shall be designed to prevent scour and erosion of the crossing.

2.2.5 **River Diversions**

2.2.5.1 Function

The river diversion works shall temporarily divert the flow of the rivers safely and with minimal effect to the adjoining area and to the environment to enable the construction of the facilities safely and in dry foundation conditions.

The period of time the flow will be diverted, how it will be diverted, and the effects of the diversions will be identified, assessed and discussed with affected parties and stakeholders. Measures to avoid and/or mitigate negative effects will be identified and incorporated into the design, planning and works implementation.

2.2.5.2 Contractor's Design

The Contractor shall design the river diversion works to safely divert the flow of the river to ensure that the Facility shall be constructed and completed in accordance with the Contract. The Contractor shall determine the floods that it needs to divert but such floods shall not be less than those specified in the Employer's Requirements.

The Contractor shall prepare the detailed design of the river diversion works for approval of the Project Manager. Approval by the Project Manager shall not relieve the Contractor of his responsibility for the adequacy of his temporary diversion works.

The Contractor shall design temporary river diversion works as necessary to facilitate construction of the Facilities. In particular, temporary diversion works will be required for the construction of the weir and intake, but may also be required for other components of the sites.

The Contractor shall satisfy himself as to the extent of the temporary diversion works required and shall provide details of suitable diversion methodologies, together with supporting calculations to the Project Manager for checking and approval, not less than 28 days prior to commencing the work. No work shall proceed until the Project Manager has approved the diversion methodology.

Any damage caused to the temporary diversion works because of inadequate design, flooding, etc. shall be repaired and restored at no cost to the Employer.

The diversion works shall be closed and / or removed when the Contractor is ready to flood the permanent works, but not before approval to close / remove the diversion works has been given by the Project Manager. At that stage all works shall be substantially complete, except for minor items not required for the safe working of the site.

2.2.6 Intake Weirs

2.2.6.1 Function

The basic functions of the intake weirs are to:

- Raise the water level in the river and divert sufficient water for generation into the intake structure;
- Provide mounting for the screens;
- Provide the river intake and channel the water to the pipeline/penstock;
- Safely pass floods.

Adequate protection of the section immediately upstream and downstream of the weir will be necessary to prevent scouring of the river bed and banks. Additional protection may be necessary on the section downstream to dissipate energy of the water when discharging over the weir.

Arrangements to allow flushing of the sediment from the area immediately upstream of the weir will be necessary.

2.2.6.2 Contractors Design

The nominal flow captured through the weir shall be a minimum of 0.62 m3/s (120% of the station rated flow) including a 0.1 m3/s compensation flow which shall be released from the weir.

The Contractor shall also make allowances for any system losses through leakage when sizing the intake abstraction flow.

The Intake weir shall:

- Be constructed without adversely affecting the water quality or water supply to the SWA water treatment plant.
- Capture the flow as noted above.
- The weir height is to be determined from the topography and geology of the site and be of such that flood stages are no greater than occur at present within the natural river.
- Should tie into the bed rock such that in flood events and the structure is inundated there is no scouring of the river bank.
- The weir height and width should also consider the screen requirements.
- Provide sufficient submergence on the pipeline/ penstock to prevent air entrainment.
- Pass the full design flood flow without damage to the downstream protection works.
- Be arranged to limit the passage of debris and sediment material into the intake.
- Have a means of isolating the downstream penstock.
- Have a means for returning an environmental flow to the river.

- Provide safe access for screen cleaning (although it is noted that screens should be self-cleansing).

2.2.7 **Headpond**

2.2.7.1 Function

The function of the headpond is to attenuate flow abstracted from the river and store the water to provide adequate water level control (head and flow) for power generation, without air entrainment. Any additional inflow not required for power generation will be safely discharged by an overflow structure and spillway.
Additional function of the headpond will be to provide storage of water for periods of low flow at the intake, where the inflow is less than the required generation flow.

2.2.7.2 Contractors Design

The Contractor shall design and construct a headpond structure (and associated ancillaries) between the headrace pipework and penstock pipe.

The Contractors design shall make adequate provision for, but not limited to

- An operational storage volume of a minimum of 5000m3.
- Provide allowances (dead storage) for the accumulation of fine material and safe operating freeboard to account for the effect of wind/seismic action causing waves within the pond as per the Contractor’s design.
- Provide suitable structure connection to the headrace pipe inlet, penstock inlet and overflow structures to ensure water tightness of the structure for all design loading conditions.
- Ensure that the penstock intake has a minimum submergence of 1.0m (or depth to suit Contractors design for preventing air entrainment) at all times.
- Soil embankment structures shall have a stable batter angle (3:1 or similar) to suit the Contractors design.
- Embankment construction (inclusive of specification for compaction and trimming of fill material) to be submitted for acceptance by the Engineer.
- Suitable erosion protection from rainfall run-off that shall be diverted away from the headpond embankment structure and adequate toe / embankment drainage to prevent scouring and instability
- Suitable waterproof liner that has sufficient UV resistance to provide durability of the required design life.
- Provide mechanical machine access, to allow for de-silting maintenance, without damage or compromise to the waterproof liner.
- Ensure the headrace pipeline inlet flows do not compromise the form or durability of the headpond structure
- Ensure the headrace pipeline inlet flows do not form flow paths / have sufficient entrainment velocity to result in discharge of sediment to the penstock intake that will affect the durability of the turbine.
- Ensure the overflow weir and spillway structures have sufficient flow capacity to convey the intake inflow under turbine rejection / emergency penstock isolation, without compromising the structure of the headpond.
- The overflow weir shall be designed to prevent overtopping of the headpond embankment structure for all design conditions.
- The spillway structure shall be designed to adequately convey the design flow without damage or creating durability issues.

It is envisaged that a cut/fill operation shall be undertaken by the Contractor to minimise import of materials to site. Un-used cut material shall be appropriately stockpiled / landscaped on site in agreement with the Engineer. No side-casting into river's is permitted.

2.2.8 **Powerhouse, Tailrace and Transformer**

2.2.8.1 Function

The powerhouse houses all mechanical and electrical plant and equipment require for the generation of electrical power including the control equipment and ancillary's requirement for the operation and maintenance of the facility.

The tailrace shall safely convey the discharge used in the powerhouse for generation back to the river.

The transformer shall be pad mounted outside of the powerhouse.

2.2.8.2 Contractors Design

2.2.8.2.1 Requirement

The Contractor shall design:

- The powerhouse and the associated structures to house all mechanical and electrical plant required for generation and transmission of electricity.
- The tailrace arrangement to discharge the design discharge to the river.
- The transformer pad.
- The hardstanding area.
- All necessary services that include drainage, lighting and power supply to the area etc.
- Security fencing around the area with gated vehicle access into the hardstanding area.

2.2.8.2.2 Powerhouse

The powerhouse shall include provision for loading and unloading of equipment, materials, tools and other relevant items for the purposes associated with operation, maintenance and overhaul.

The powerhouse shall include:
- Machine bay
- Loading bay.
- Control area
- Batteries and panels area.
- Overhead travelling crane.

The control and panels area shall be an air-conditioned space, separate from the machine bay.

Adequate access, laydown and withdrawal areas shall be provided to allow ready maintenance of the powerhouse equipment without unnecessary dismantling of adjacent plant to gain access.

The powerhouse shall have a minimum of two safe means of access and egress generally located opposite each other.

All access doors to the powerhouse shall be heavy metal construction security doors. Roller doors to the loading bay shall be reinforced to prevent forces entry by vehicles.

Windows for natural lighting shall be fixed glazed to minimise unwanted entry of vermin. The total area of glazing provided shall be at least 10% of the floor area distributed evenly around the room.

Staircase access and platforms shall be provided where necessary to gain access. Where access for operational inspection is required on an infrequent basis only, fixed step ladder access is acceptable, however care is to be taken to ensure that the requirement to use fall arrest devices is avoided. In all cases the creation of confined spaces due to ladder access shall be avoided. Where operational access is required on a frequent basis, or where maintenance access is required, stair access shall be provided.

All floors shall be constructed from reinforced concrete complete with an industrial floor finish suitable for its permanent use.

The Powerhouse shall be provided with forced ventilation. Ventilation shall be incorporated into the Powerhouse to simplify the layout of ducts and pipework for the distribution of supply air and collection of exhaust air throughout the station.

Handrailing shall be provided where required and removable handrailing shall be provided for use around hatches and other openings which may be left open for extended periods.

The Powerhouse will be enclosed by a steel truss roof with weatherproof protected metal roofing and internal linings and metal walls with cladding or concrete blockwork construction. Provisions for stormwater management shall be included in the arrangement. The Contractors design shall prevent condensation from developing on the roof linings and dripping into the powerhouse.

The machine bay shall house a single turbine and generator unit and the associated auxiliary equipment. Permanent station cranage shall be provided that covers the loading bay with sufficient capacity to handle all major plant components. The station crane shall be of a manually operated electric winch driven type.

A loading bay shall be provided in the powerhouse. The loading bay shall be the same width as the machine bay, and with no less than 3m clear space between the turbine generator and loading bay door. It shall be arranged such that vehicles will be able to drive in to load and unload equipment using the station crane.

Cableways shall be adequately sized for the services requirements and shall be fire rated in accordance with the appropriate standards. The cables within the powerhouse shall be laid in cable trenches covered with metal floor plates.

Station drainage shall be collected in a sump pit below the lowest section of the powerhouse. The sump shall be sized and configured to accommodate the drainage and sump pumps, have sufficient volume for requirements associated with pump cycling times, oil spill capture and containment, and have adequate access for operation and maintenance.

The aim of oil containment is to minimise environmental contamination and spread of fire in the event of an oil or fuel spill and to meet requirements of environment regulations.

Oil and other industrial liquid waste shall be separated from rain, water and other drainage water and retained for recovery and deliberate disposal.

Oil containment systems shall be incorporated into the Facilities, designed to catch and contain any oil spilt from oil filled equipment. In addition, provisions shall be made to contain any spillage arising from the storage or handling of oil.

2.2.8.2.3 Tailrace

The tailrace shall be designed to convey design flow from the powerhouse to the river upstream of the Alaoa intake.

The tailrace shall slope towards the river to allow it to drain under gravity.

Stoplogs shall be provided if necessary to prevent backflow of river water into the turbine discharge chamber during turbine maintenance.

The stoplog structure shall be designed to withstand the hydrostatic loads and other loads acting on it when the stoplogs are in place, and the tailrace is dewatered. Training walls shall be designed for differential water levels and for hydrodynamic loads.

The outlet of the tailrace shall be designed and constructed not to cause collapse of scouring erosion of the natural ground and slopes and also to avoid scouring.

The tailrace channel or pipe will be designed to withstand all the structural and hydraulic loads.

The tailrace channel or pipe will be designed to prevent any leakage.

2.2.8.2.4 Transformer Compound

The transformer shall be located in a small compound adjacent to the powerhouse.

The footings for the transformer equipment shall be designed to resist the loadings applied by the installed equipment. Cable ducting shall be provided to distribute cabling from the transformer to the powerhouse and from the transformer to the 22kV overhead distribution line.

The transformer compound shall be covered with a 150 mm layer of crushed aggregate.

The transformer compound shall be drained by a system of drains consisting of pipes, sumps and concrete trenches with gratings connected to the powerhouse drainage system.

The arrangement of the equipment shall have adequate space for access for maintenance and operation; and particularly for electrical and safety clearances.

The arrangement shall permit safe access with all equipment energised, with personnel on foot in all parts of the transformer compound and with vehicles on the road pavement.

The drainage system for the transformer compound shall be designed for a 1 in 100 year return period storm without any sumps surcharging above their gratings. Pipes and surface drains shall have a minimum grade sufficient for self cleaning.

2.2.8.2.5 Hardstand Area

A hardstand area shall be provided adjacent to the powerhouse. The area shall be provided with a security fence and access to the area shall be gated and via the access road for the project.

The area shall have adequate area for:

- Parking facilities for the vehicles that will be used during the operation and maintenance of the facility;

- Sufficient area for the vehicles transporting equipment to load and unload the equipment in addition to the parking facilities;
- Unrestricted access to the powerhouse and switchyard in addition to the parking facilities

2.2.8.2.6 Drainage

- The Contractor shall design a drainage system to collect and remove drainage water from the area.
- The drainage shall discharge to the tailrace or the river.
- Provision of oil-water separation and silt collection shall be incorporated into the drainage system.

2.2.9 Alaoa Additional Storage Rehabilitation

2.2.9.1 Function

The Employer requires debris removal works to be undertaken at the existing headpond for the Alaoa Facility, to rehabilitate the storage capacity of the existing tank, to its original capacity.

The existing headpond is a tank of approximately 5000m2, up to 5m deep and understood to be of concrete construction.

The Contractor will be required to remove all debris (consisting of, but not limited to silt and vegetation) of unknown depth (assume 0.25m) from the tank and if present, from the headrace pipework.

2.2.9.2 Contractors Design

The Contractors design and method shall include for, but not limited to;

- Temporary isolation of the head pond to facilitate de-silting activities.
- Visual survey to confirm extent of debris within the headpond and pipework.
- Confirmation of the volume of debris to be removed and confirmation of programme duration
- All activities required to remove debris (e.g. silt) from the intake inlet chamber, and headrace pipework, inclusive of flushing,
- All activities required to remove debris (e.g. silt) from the head pond.
- Disposal of debris at an approved location (in accordance with the IEE and national
- regulations).
- De-watering activities and silt management during any discharge to adjacent watercourses.
- Minor concrete cover repair (inclusive of cracks up to 5mm width, scaling, pop-outs, deep pitting, damage due to Contractors excavation method)
- De-isolation of the headpond inlet and controlled filling of the structure.

The Contactors method shall not damage or degrade the existing head pond structure, or associated pipework/appurtenances.

The Contractors method shall not allow turbid water or debris to enter the penstock intake chamber or penstock. Removal of silt or debris from these locations will be at the Contractors cost.

The Contractor will be required to liaise with the Employer to sequence the works as such to minimise impact on hydropower generation from the Alaoa Facility. Agreement will be gained from the Employer on a shut-down period, based on the Contractors method and programme of works.

The Contractor shall undertake a visual survey of the concrete surfaces as silt removal works progress for signs of degradation and provide minor concrete repair, as instructed by the Engineer.

Should significant degradation (loss of cover, exposed reinforcement, cracking over 5mm width that results in water loss) of the existing structure/s be witnessed during cleaning operations, the Contractor shall inform the Employer, and await a decision on how to proceed.

2.3 Civil General Requirements

2.3.1 Diversion and Care of Water

2.3.1.1 Scope

The Contractor shall plan, design, construct, maintain and remove facilities for providing and maintaining dry work areas required for the construction of the project. In accordance with the requirements contained in this Part, the Contractor shall:

1. Design, construct, maintain, breach, and remove as necessary all cofferdams and protection dikes;
2. Dewater the construction areas if necessary; care for all surface water and groundwater from any source, as required, so that all the construction work so specified can be performed in areas free from water;
3. Design, furnish, construct, operate, maintain, and remove the necessary facilities as may be required for dewatering the construction areas, for caring for all surface water and groundwater from any source, and for general protection of the Facilities; and
4. Furnish drainage, pumping systems, and temporary bulkheads or barriers as may be necessary for the protection of construction operations from encroachment by water.

2.3.1.2 Submittals

Within 42 days of the Commencement Date, a Care of Water Plan, including a method statement with drawings, shall be submitted for review and acceptance. The care of water plan shall address both the control of groundwater as well as surface water and, as a minimum, shall include the design of all cofferdams, diversion, collection, and retention structures; pumping and conveyance equipment; and operating controls.

2.3.1.3 Care of Water

The Facilities shall be constructed in the dry, and all work areas shall be maintained free of standing or running water from any source, including groundwater, at all times. Upon approval of the Care of Water Plan, all features of the Plan shall be constructed; all required equipment shall be furnished, installed, and maintained; and the approved dewatering system shall be placed into operation. The system shall be operated and maintained during all work. Sufficient standby equipment shall be provided to ensure that unwatering operations are continuous and that backup equipment is available in case of emergencies.

2.3.1.4 Environmental Considerations

Collection, handling, treatment, and disposition of surface and groundwater during the period of construction shall conform to the requirements of applicable laws, regulations and permits. The Contractor is responsible for obtaining and/or complying with any and all permits associated with collection, handling, treatment, and disposition of any surface water or groundwater during the period of construction.

2.3.2 Demolition and Site Clearance

2.3.2.1 Scope

This Specification covers the removal of vegetation and surface obstructions, and the demolition and removal of structures, including their foundations, if any.

2.3.2.2 Applicable Codes and Standards

a) All work, materials and practices shall comply with the requirements of current New Zealand or Australasian standards for that particular class of work. The following standards shall apply specifically:

AS 2601:2001	: Demolition of Structures
NZS 4224:1983	: Code of practice for measurement of civil engineering quantities

b) Compliance with these Codes and with this Specification shall be the minimum requirement necessary for this Contract.

c) The documents listed above and in the clauses that follow refer to their latest issue complete with amendments that are current at the date of the Tender Document and are deemed to form part of this Specification. However, this Specification takes precedence when it is at variance with the cited document.

2.3.2.3 Disposal of Materials

a) Material obtained from clearing and grubbing and from the demolition of structures shall be disposed of by dumping and burying on site at locations indicated by the Project Manager. The Contractor shall control the dumping operation to optimise utilisation of the dump area and shall shape the dump during the progress of the works to prevent erosion or the ponding of stormwater.

b) Where no such place for disposal on the site of the Facilities is indicated by the Project Manager, the Contractor shall make his own arrangements for dumping the material at an approved location outside the site of the Facilities.

c) The Contractor shall endeavour to recover old and damaged pipelines/ penstocks for reuse elsewhere in the Facilities. Should the Contractor wish to sell the pipelines/ penstocks as scrap or to other parties for reuse then these savings shall be passed on to the Employer.

d) Combustible material shall not be burned without the written permission of the Project Manager. Such permission will only be granted where burning is permitted by the local authority and where the resulting air pollution will not cause a nuisance. Plastic material shall not be burnt. It shall be the Contractor’s responsibility to obtain the necessary consents for the burning of waste and to comply with the conditions of the consent. A copy of the consent shall be forwarded to the Project Manager before any burning takes place.

e) Fencing wire shall be neatly wound into rolls and, together with the fence posts and other re-usable materials, neatly stacked on the site of the Facilities.

f) Trees and material from structures shall be removed from the site of the Facilities or unless instructed otherwise by the Project Manager.

2.3.2.4 Area to be Cleared

a) All areas on which earthworks, cuttings, embankments, borrow pits or structures are to be constructed shall be cleared and grubbed.

b) In order to limit dust and erosion, clearing and grubbing shall be carried out at the latest practicable stage of the Contract.

2.3.2.5 Trees

a) When cutting or trimming trees, the Contractor shall take the necessary precautions to prevent injury to persons and animals and damage to property. Where necessary, trees shall be cut from the top downwards.

b) No tree shall be cut down until the Project Manager has given written authorisation for such work to commence.

c) Individual trees indicated and marked by the Project Manager as ‘trees to be preserved’ shall be left standing and uninjured.

2.3.2.6 Clearing

Clearing shall consist of:-

i. the removal of all trees, bushes, roots, other vegetation, rubbish, fences and all other materials that interfere with the construction of the Facilities;

ii. the disposal of all materials resulting from the clearing;

iii. the removal and disposal of pipelines/ penstocks and structures;

iv. the removal of small boulders lying on the surface;

v. where fences have to be taken down and retained on the site of the Facilities, the sorting, coiling and stacking of the material; and

vi. the removal and stacking of other re-usable materials as specified.

2.3.2.7 Grubbing

a) All stumps and roots larger than 50mm in diameter shall be removed to a depth of at least 200mm below the cleared surface.

b) Except in borrow areas, cavities resulting from grubbing shall be backfilled with approved material and compacted to a density at least equal to that of the surrounding ground.

2.3.2.8 Topsoil

If there is good quality topsoil within the limits of the cleared area, the Contractor shall remove and stockpile the topsoil and grass, and shall conserve it for later use in the manner specified.

2.3.2.9 Existing Road Pavements

Existing road pavements or hardstandings that are no longer required, shall be scarified and windrowed free of soils, clay or other contaminating material. The aggregates shall then be recovered and carted to stockpile for subsequent reuse if required or disposed of in an appropriate manner.

2.3.2.10 Reclearing of Vegetation

If vegetation grows on any portion of the cleared areas, such areas shall be cleared again before the construction of earthworks or structures over the area.

2.3.2.11 Demolition of Structures

a) Structures shall be demolished in accordance with AS2601.

b) Structures that cannot be cleared by a bulldozer of mass approximately 20 tonnes and flywheel power 130kW shall only be demolished by contractors suitably qualified and skilled in such work. In such cases, the Contractor shall prepare a method and capability statement to the satisfaction of the Project Manager for the demolition of the structure.

c) Explosives and blasting for clearance of structures shall only be permitted where stated in Section 4 of this Specification.

2.3.2.12 Environmental Considerations

Clearing, grubbing, and permanent disposal of materials removed during clearing and grubbing operation during the period of construction shall conform to the requirements of all applicable laws, regulations and permits. The Contractor shall be responsible for obtaining and/or complying with any and all permits associated with clearing, grubbing, and permanent disposal of materials.

2.3.3 **Crop Compensation**

Prior to clearing the Contractors Local Liaison Officer shall consult with the local landowners to confirm crop compensation values (paid for by others) and shall advise this to the Project Manager.

2.3.4 **Excavation**

2.3.4.1 General

a) Excavations shall be in accordance with Clause 9 of TNZ F/1 and modified by the following requirements.

b) The Contractor shall be responsible for all required temporary works to ensure the safety of workers and the public, including any adjacent buildings and infrastructure.

c) Excavation shall be carried out in a manner to produce neat cut faces to the batters shown on the drawings and to the lines and levels shown on the drawings, including the use of any required slope or excavation support. All excavation shall be done in a manner which ensures the cut surfaces will be adequately drained at all times.

d) Except where otherwise stated in this Specification, the excavation of cuttings shall be halted 400mm above formation level or final subgrade level to provide weather protection and left in place until construction of the formation or final subgrade level. At no time shall the formation or final subgrade level be left exposed to the weather to the detriment of the in-situ materials (including hot dry weather).

e) Dump areas will not be permitted immediately adjacent to engineered fills.

f) Benching shall be undertaken on any slope steeper than 2H:1V. Bench widths shall be of earthworks machinery width and not exceeding 1m high unless otherwise stated in this Specification.

2.3.4.2 Scope

The Contractor shall plan, design, construct, and maintain all permanent and temporary open and underground excavations required for construction of the Facilities. Such work shall include, but not be limited to the excavation and support of all permanent and temporary open excavations required in overburden or rock required for construction of the project.

All excavation work shall be conducted in accordance with this Part and all other pertinent Parts of the Employer's Requirements. The Contractor is solely responsible for conducting all investigations and testing necessary to determine the classifications of excavation, quantities of each classification, and the proper procedures and equipment for performing all excavation activities required for construction of the Facilities.

2.3.4.3 References

a) All work, materials and practices shall comply with the requirements of current New Zealand or Australasian standards for that particular class of work. The following standards shall apply specifically:

NZS 4224:1983	: Code of practice for measurement of civil engineering quantities
NZS 4402:1986	: Methods of testing soils for civil engineering purposes
NZS 4404:2010	: Land Development and subdivision engineering
NZS 4431:1989	: Code of practice for earth fill for residential development
TNZ F/1:1997	: Specification for Earthworks Construction (http://www.nzta.govt.nz/resources/earthworks-const/docs/earthworks-const.pdf)

b) Compliance with these Codes and with this Specification shall be the minimum requirement necessary for this Contract.

c) The documents listed above and in the clauses that follow refer to their latest issue complete with amendments that are current at the date of the Tender Document and are deemed to form part of this Specification. However, this Specification takes precedence when it is at variance with the cited document.

2.3.4.4 Definitions

Stripped Ground : The lowest excavated surface after clearance, removal of topsoil and removal of any other materials deemed unsuitable by the Project Manager.

Engineered Fill : The material placed and compacted in the fill, from ground surface, in a manner and of such material(s) that provides a stable earthfill suitable for the intended purpose.

Landscape Fill : The material placed in the fill, from ground surface after clearance and removal of topsoil (if required), in a manner that provides a stable earthfill for the intended purpose. Material shall exclude vegetation, rubbish, noxious and organic matter.

Hardstanding : A trafficable area constructed from aggregates, including rockfill.

Drainage Blanket : A layer of highly permeable granular or rock fill, including a geotextile above and below the fill.

2.3.4.5 Abbreviations

NZTA : New Zealand Transport Agency, (formerly TNZ)

TNZ	: Transit New Zealand, (now NZTA)
NZSA	: New Zealand Shotcrete Association

2.3.4.6 Quality Control and Assurance

The Contractor's Quality Assurance Plan shall include a method statement regarding the quality assurance intended to be carried out in association with excavation including topographic survey profiles, drilling, blasting, mucking, support and protection, transportation, disposal of excavated material and subsequent stabilization of exposed ground. Quality assurance related to excavation shall also include testing for shotcrete mixes in accordance with NZSA 501: Specification for Shotcrete, and testing of installed rock bolts and other support for temporary and permanent features of the project.

2.3.4.7 Submittals

An excavation plan shall be submitted to the Project Manager for all excavation activities. The plan shall include, as a minimum, conceptual plans and diagrams for handling excavation, fill, and spoil materials, and a description of the proposed excavating and hauling equipment to be used.

Locations, installation procedures and layouts of rock support patterns shall be submitted to the Project Manager for all excavation activities. Layouts shall show spacing type, size, length and any special accessories; and orientation of rock support to cross rock discontinuities in an optimal manner.

A disposal and stockpile plan shall be submitted to the Project Manager for approval prior to the commencement of construction. The plan shall include maximum slopes to be maintained during stockpile and disposal operations and the frequency at which the maintenance of the stockpiles and disposal areas will be undertaken.

Before commencing blasting operations, the Contractor shall prepare and submit a Blasting Plan for review by the Project Manager for conformity with the Employer's Requirements and applicable laws and regulations. Blasting plans for all blasts shall be submitted to the Project Manager a minimum of 24-hours prior to the blast, which shall include a description of the proposed standard blasting pattern including details of the hole pattern, explosives loading and blasting delays. Each plan shall be submitted to an independent blasting consultant hired by the Contractor for approval and to the Project Manager for review.

2.3.4.8 Materials

All materials used to accomplish the work as described herein shall be in accordance with all applicable standards listed within the Employer's Requirements as well as internationally recognized standards.

2.3.4.9 Lines and Grades

Excavation shall be carried out to the lines and grades necessary for the construction of the Facilities. Open cut excavations in soil or rock shall be taken to suitable foundation materials. Permanently exposed excavations shall be finished to the required lines and grades, and final slopes shall be dressed to present a neat and orderly appearance. Excavation slopes and sizes of underground openings may be modified to fit conditions encountered during construction as required for construction of the Facilities in accordance with the Employer's Requirements.

Care shall be exercised in excavation procedures to avoid slides. In case of slides, all slide material shall be removed to a stable slope at or outside the lines and grades, and damaged work shall be repaired in a manner acceptable to the Project Manager. The Contractor shall be responsible for repairing the slides, regardless of whether they occurred in areas where excavation has already been completed or in areas where slopes were steeper than those shown on his excavation drawings.

2.3.4.10 Blasting

Controlled blasting techniques shall be used for the excavation of all materials requiring blasting for removal to minimize overbreak, damage, and fracturing beyond the design lines of the excavation, as well as to prevent damage to existing and newly constructed project features.

No blasting shall be performed within 20-meters of concrete less than five (5) days old and within 20-meters of rock bolts until grout or resin has set.

No blasting shall be performed within 100 meters of holes being grouted or already grouted until the grout has set.

Perform seismographic monitoring of all blasting within 500 meters of existing structures and Facilities under construction. A seismograph shall be placed at the nearest structure or Facilities under construction relative to the blast area (including quarry blasting) to monitor ground motion particle velocity and frequency during each blast. The maximum allowable peak particle velocity at the nearest structure of Facilities under construction shall be as follows:

Frequency (hertz)	**Maximum Peak Particle Velocity (cm/second)**
2.5 to 10	13
11 to 40	0.13 x frequency
>40	5

All blasting activities shall be conducted by blasting experts who hold all necessary licenses or permits required for the use of explosives under the direction of experienced and fully qualified foremen. The Contractor shall hire a qualified independent blasting consultant to review each blasting plan for compliance with all applicable codes, laws regulations, and requirements.

Blasting shall be performed using controlled methods such as pre-splitting, cushion blasting, smooth wall blasting, and line drilling. All blasting operations shall be seismically monitored. Blasting techniques shall be developed and applied, and revised as necessary, to maintain the tolerances necessary for proper construction and operation of the Facilities. Excavation adjacent to the final rock faces shall be carried out in such manner that the final rock face shall be stable and undisturbed. Whenever further blasting may damage the rock upon or against which concrete or fill is to be placed, the use of explosives shall be discontinued and the excavation shall be completed by wedging, barring, channelling, line drilling and broaching, or other suitable methods. All blasting operations shall be in accordance with the approved Blasting Plan.

The purchase, transportation, uses, storage, and safeguarding of all explosives and explosive devices brought on to the Site or otherwise used for the Facilities shall be in accordance with all applicable laws and regulations. The Contractor shall have complete responsibility to obtain all required licenses or permits for the purchase, transport, storage and use of explosives and explosive devices.

2.3.4.10.1 Blasting Submittals

Contractor shall submit a written plan outlining in detail all transportation, storage and handling protocols for explosives at the site including lists of all explosives, specifications for all magazines and the locations and security measures for all storage. The plan shall conform to the requirements of all applicable regulations and referenced standards.

The plan shall include, but not be limited to, details of:

a) The location(s) and construction of any on-site magazines and the type and quantities of explosives to be stored in each magazine and the security measures to implemented at each magazine.
b) Type(s) of vehicles to be used for transporting explosives to and on-site, and the anticipated size and frequency of deliveries explosives from the off-site supplier. Route to be taken when transporting explosives between the on-site magazines and the work areas.
c) Provisions and procedures to transport explosives from the ground surface to the underground blast location.
d) Provisions to inventory and control all explosives arriving on -site, removed from magazines for use and any unused explosives returned to the magazine.

The explosive manufacturer(s) technical specifications and detailed descriptions of the explosive products, their characteristics, limitations and recommended conditions.

Contractor shall implement a written “Blasting and Warning Plan”, describing the audible warning system, signage and procedure which will be used to ensure that all personnel, staff, visitors and all other persons are at a safe distance before blasting takes place. The procedure shall include provisions to “tag out” all workers in the blast area prior to a blast.

Contractor shall submit not less than 30 days prior to starting a new phase of work a proposed Blasting Plan(s) for accomplishing excavation by use of explosives. The Blasting Plan(s) shall include, but not be limited to, the following:

a) Location, depth, area, anticipated excavation lines and relationship to specified dimension lines, adjacent excavations and work.
b) Diameter, spacing, burden, depth, pattern and orientation of blast holes.
c) Type, strength, amount in terms of weight and cartridges of explosives to be used in each hole, on each delay and total of each blast.
d) Distribution of charge in each hole and priming of each hole.
e) Type, sequence and number of delays; delay pattern (including delays in trunklines); wiring, detonation cord, and/or shock tube diagram including any for blast, size and type of hookup/trunk/signal lines and lead lines; and type and capacity of firing source.
f) Stemming of holes and matting or covering of blast area, including surface detonating chords, shock tubes and delays.

Contractor shall submit a record of each blast at least four (4) hours prior to the next scheduled blast. The record shall be prepared in a consistent and concise pre-approved format and include the following:

a) A plan of the hole spacing, depths and orientation of blast holes and the location of the blast point in relation to project and nearby features.
b) Unusual occurrences, including rock falls, unstable ground, ground water problems, work delays, misfires and the location and timing of these occurrences.
c) A complete description of the blast round as blasted including, but not limited to:
    1. Date, time and limits of blast by location.
    2. A comparison of planned versus actual parameters including depths of holes, spacing of holes, number of holes, kilograms of explosive per hole, kilograms of explosive per delay, type of delay, delay periods, total number of delays, method of detonation, type of stemming and length of stemming.
    3. Description and location(s) of blast matting or other noise and fly rock mitigation methods.

4. Diagram of blast pattern holes indicating holes not drilled, drilled but not loaded, changes in spacing, changes in pattern of delays, changes in loading of holes and burden of round.
5. Amount of explosives used by weight and number of cartridges.
6. Total number of delays used and number of holes used for each delay period.
7. An evaluation of the blasting indicating number and percentage of perimeter holes visible after scaling of loose rock, areas of significant overbreak or tights and planned adjustment for the next blast.
8. Peak particle velocity, vibration frequency, and peak overpressure measurements and locations.

2.3.4.10.2 Suspension of Blasting

Blasting operations may be suspended by the Project Manager for any one or more of the following:

a) Safety precautions are inadequate
b) Ground motion vibration levels exceed specified particle velocity/frequency limits as specified herein
c) New or further damage to existing structures or improvements as a result of blasting;
d) Blasting methods which in the opinion of the Project Manager endanger the stability of intact rock outside of the prescribed limits of excavation;
e) Skilled operators and/or the licensed blasting supervisor is not present;
f) Failure to comply with blasting notification requirements; or
g) Fly rock travels beyond the project right-of-way.

Suspension of blasting operations shall not relieve the Contractor of his responsibilities under the terms of the Contract Documents. Do not resume blasting operations until modifications have been made to correct the conditions that resulted in the suspension. The Contractor shall not be entitled to any extension in time, nor to any claim of damage or to excess costs, by reason of any blasting suspension order.

2.3.4.11 Rock Support and Rock Reinforcement

The Contractor shall provide and install all necessary temporary and permanent rock support and rock reinforcement required for excavations in rock for construction of the Facilities. Temporary rock support and rock reinforcement shall be provided as required to provide for the safety of personnel, the construction operations, and adjacent work. Permanent rock support and reinforcement shall be provided as required to maintain the integrity of all excavations in rock throughout the life of the Facilities. Rock support and rock reinforcement may include elements such as rock anchors, rock bolts, plain or fibre reinforced shotcrete, wire mesh, plain or reinforced concrete, and steel members, which may be temporary or permanent if compatible with the permanent lining or adjacent materials. Lagging and blocking shall be concrete or steel. Rock support for underground features shall be designed and installed as to minimize the risk of puncture or damage to waterproofing membranes or lining systems.

All permanent rock support shall be provided with corrosion protection suitable to prevent corrosion of the element or structure for the design life of the Facilities. Rock support for excavated slopes shall consist of galvanised proprietary anchoring systems with threaded anchor bars with nuts, spherical washers and matching bearing plates of not less than 10mm in thickness.

All excavated rock faces and slopes shall be scaled and cleaned of loose and overhanging rock and maintained in a safe condition prior to installation of permanent rock support. Temporary rock support shall be installed immediately after completion of scaling. Excavations in rock shall be inspected as soon as they are exposed to geologically map the joints and other geologic features and to determine the support and reinforcement requirements for the excavation.

2.3.4.12 Open Cut Excavation

2.3.4.12.1 General

Open cut excavation consists of stripping and the removal of overburden and rock, wet and dry, scaling of rock surfaces, and pre-splitting of all rock excavations steeper than 45 degrees.

Upon excavation to final grades, rock surfaces beneath the dam and other structures shall be cleaned such that all cracks and fissures can be located, mapped and treated by dental excavation and concrete.

Open excavations shall be properly drained during construction in accordance with Diversion and Care of Water. Final grades shall be protected against damage from erosion and traffic. Particular care shall be exercised to protect excavated grades and slopes from rutting, squeezing, or other damage by repeated travel of construction equipment. All such damage shall be repaired.

Care shall be exercised in excavation procedures to avoid slides. In case of slides, the Contractor shall remove all slide material to a stable slope at or outside of the design lines, and damaged work shall be repaired.

2.3.4.12.2 Open Cut Excavation in Overburden

Open cut excavation in overburden consists of the removal of all materials that may be removed by earthmoving equipment through breaking, ripping, scraping or hand methods, without continuous and systematic drilling and blasting. Removal of boulders or cemented overburden is classified as overburden excavation even if blasting is used.

If the established slopes of the excavation are undercut, they shall be re-established as required. Rock or boulders encountered in the excavation shall be removed to the design lines and grades or as required. Overburden shall be removed separately from the underlying rock.

2.3.4.12.3 Open Cut Excavation in Rock

Open cut excavation in rock consists of the removal of all materials other than overburden excavation, and any other excavation required for construction of the project which requires continuous and systematic drilling, blasting, barring, or wedging, for removal. Open cut excavation in rock shall also include washing and cleaning of rock surfaces and the pumping, removing and disposing of water used for such activities.

Heavy blasting will not be permitted against final grades. Final grades shall be prepared by drilling, pre-splitting, picking, barring, wedging, light blasting, and similar methods which will leave surfaces in the best practicable condition.

The Contractor shall scale all open cut excavations in rock as required during excavation operations; and install rock support and shotcrete as required by the Contractor’s design or as required by conditions encountered during construction.

2.3.4.13 Foundation Treatment

Upon completion of excavation in overburden or rock to suitable foundation materials as defined by the Contractor during Detailed Design, the excavated surface shall be cleaned and inspected such that any features that may adversely affect the placement of materials on the foundation or adversely affect the performance of the Facilities are identified for treatment.

Overburden and rock foundation materials encountered within the limits of the Facilities that are soft, fractured, blocky or otherwise not suitable to act as a foundation for fills or other structures shall be removed to a depth adequate so that design assumptions are met. Where necessary, rock foundations shall be treated by dental excavation as described in this Part.

2.3.4.14 Dental Excavation

Dental excavation consists of the removal, by hand tools or other methods, and disposal of overburden, rock fragments, soft and disintegrated rock, clay, and weathered material from fissures, joints, seams, faults, cracks, holes, cavities, and caverns within and beyond the lines of excavation. The use of high-velocity air-water jetting may be required to remove stiff and hard material. Dental excavation shall be performed as required for proper construction of the project.

Rock surfaces upon which fills, concrete or other structural features shall be placed shall be cleaned such that all open or soil filled cracks, fissures, joints, cavities, crevices, and solution features in rock or brecciated or decomposed materials from seams, shear zones, or spaces between boulders can be located and mapped. When such features, or other features that may adversely affect the placement of materials or the performance of the Facilities, are uncovered as a result of excavation to final grade or otherwise located, these features shall be inspected and their depth and extent determined by hand methods and/or by drilling exploratory holes. These features shall be thoroughly cleaned by removing all rock fragments, soil, clay, shale, and weathered shale by means of hand excavation, air spades, high velocity air-water jets, high velocity air or other satisfactory means including combinations of the above. Upon completion of the removal and disposal of the above material in these features to their full depth, dental concrete shall be furnished and placed in these features in accordance with ‘Concrete Work’. Dental concrete shall be placed to the final excavated grades.

2.3.4.15 Borrow and Quarry Excavation

Borrow excavation consists of the removal of material from approved borrow areas for obtaining materials to be used in the Facilities. Borrow areas shall be kept graded and drained in accordance with ‘Diversion and Care of Water’. The borrow areas shall be left with stable slopes. The slopes and bottoms of borrow areas shall be dressed to present a neat and orderly appearance.

Borrow excavations conducted within the reservoir area shall be limited so that a minimum thickness of overburden of 1-meter is left undisturbed in the reservoir area to act as a natural impervious blanket to control hydraulic gradients beneath the dam.

Quarries opened for obtaining rock materials shall be sloped to drain, where possible, so that water will not collect or stand unless otherwise permitted. At the conclusion of the Facilities, all rock surfaces, slopes and bottom of cuts shall be scaled and cleaned of all loose and overhanging rock and left in a safe condition. Loose rock from the scaling and cleaning operations shall be disposed of in an approved manner. Slopes in quarries flatter than 1H:1V shall be grassed.

2.3.4.16 Road and Yard Excavation

Road and yard excavation consists of all excavation for permanent roads and yards shown as required and shall be performed in accordance with all other pertinent parts of the Employer’s Requirements. Excavation for permanent roads and yards shall be to design lines, grades, and cross-sections.

2.3.4.17 Excavation for Contractor’s Convenience

Excavation for Contractor’s convenience consists of all excavation for temporary works, including but not limited to temporary haul and access roads; offices, shops, storage facilities, and work areas as well as any other excavation performed only for convenience during construction. Excavation for Contractor’s convenience shall be approved prior to the start of such excavation. Slopes of such excavations shall be stable.

2.3.4.18 Disposal and Stockpiling

Excavated materials not used for construction of the Facilities shall be taken to approved disposal areas. Excavated materials in stockpiles that will be used for construction of the Facilities shall not be contaminated or mixed with unusable materials. Materials placed in disposal areas or stockpiles shall be sloped to drain and shall be maintained and left in such condition that they present a neat and orderly appearance and blend with the surrounding topography. Areas surrounding stockpiles and/or disposal areas shall be maintained such that drainage from these areas remains unimpeded. Materials disposed of within the Site shall be treated to blend in with the surrounding environment.

2.3.5 **Fills**

2.3.5.1 Scope

The Contractor shall plan, design, construct, and maintain all permanent and temporary fills required for construction of the Facilities. Such work shall include, but not be limited to preparation of foundations for placement of fills, and furnishing, placing, compacting, and maintaining materials for fills required for construction of the Facilities.

All fill work shall be conducted in accordance with this Part and all other pertinent parts of the Employer's Requirements. The Contractor is solely responsible for conducting all investigations and testing necessary to determine fill properties, quantities, placement requirements, and placement techniques to achieve the requirements of the design.

2.3.5.2 Quality Control and Assurance

The Contractor's Quality Assurance Plan shall include a method statement regarding the quality assurance intended to be carried out in association with fill placement, including topographic survey profiles, foundation preparation, material sampling, in-place density testing of all constructed fills to confirm that the required compaction has been achieved, and related laboratory testing has been performed. Quality assurance related to fill work shall also include test fills required to determine the engineering properties of various fill materials in accordance with this specification, and refine fill placement techniques. In-place density testing shall be carried out using a Nuclear Density Meter for all fill materials containing coarse aggregates that are maximum 40mm in size. Site testing of fills with maximum aggregate size greater than 40mm shall be tested. Filling and compaction shall be in accordance with Clause 10 of TNZ F/1.

2.3.5.3 Submittals

The Contractor shall submit to the Project Manager gradations of all materials, laboratory and field density testing, and records of inspections and all other tests and test fills required to furnish and place fills for construction of the Facilities, as well as records of any corrective actions taken during fill placement activities.

2.3.5.4 Materials

The Contractor shall construct test fills as required to determine the engineering characteristics and suitability of materials obtained from borrow or excavation on Site as fill materials, as well as to determine the proper placement and compaction conditions and requirements to achieve the design objectives. Results of all test fill construction and testing shall be recorded and provided to the Project Manager.

Demonstration and verification of the suitability of all materials and their placement in the fills shall be the Contractor's sole responsibility.

Materials shall be reasonably well graded except where specified, and shall be free of roots and organic matter. All fills supporting, or influenced by any structure shall comprise of clean well graded gravel with a maximum size of 100mm, and shall be crushed and/or screened (i.e manufactured) material.

Adjacent fill materials of varying gradation shall be compatible with each other. Suitable geotextile filter fabric may be used to separate adjacent fill materials of varying gradations in fills other than fill dams, if necessary, as long as the geotextile filter fabric is designed, supplied and installed in accordance with all applicable standards and regulations. Where the potential for seepage through fill exists, adjacent fill zones shall be designed in accordance with standard filter criteria as specified.

2.3.5.5 Lines and Grades

The fills shall be constructed to the design lines, grades, and cross sections developed by the Contractor and shown on the Construction Drawings. Fills shall be over-built as required to account for settlement during and after construction of the Facilities. Slopes exposed to view, including rockfill slopes, shall be dressed to neatly appearing final surfaces. The thickness of various fill zones within each embankment may be increased or decreased or other such changes may be made as required for conditions encountered during construction or as a result of test fill results.

2.3.5.6 Foundation Preparation

All surfaces on or against which fill material is to be placed shall be treated after excavation to final grades in accordance with 'Excavation'. All foundations upon which fill will be placed shall be unwatered and free of standing or running water in accordance with 'Diversion and Care of Water'. No fill material shall be placed until the foundation has been treated and prepared for receiving fill.

Foundations in overburden, excavated overburden slopes and fill slopes upon which fill material will be placed shall be scarified and compacted prior to fill placement.

2.3.5.7 Placement and Compaction

All fill materials shall be placed in lifts at the proper moisture content and compacted by suitable compaction equipment to achieve the proper density, including fills placed on slopes that may require specialized equipment or compaction procedures.

Fills shall be maintained and protected in a satisfactory condition at all times until final completion and acceptance of the Facilities. As soon as practicable after the construction of the fills has commenced, the surfaces shall be sloped or crowned sufficiently to prevent the ponding of water and this crown or slope shall be maintained during construction.

Any fill material rendered unsuitable after being placed in the fills shall be removed and replaced to the satisfaction of the Project Manager.

Temporary construction slopes within the fill should not be steeper than 2.5H:1V. Materials placed against temporary slopes should be well keyed into the temporary slope.

In order to achieve a good contact against adjacent structures, and achieve good compaction, fill materials adjacent to structures and abutments should be ramped for a minimum distance of 5 meters to a height approximately 600 mm, or two layer of fill, higher than the general level of the fill during construction.

Care shall be exercised when operating compaction equipment adjacent to abutment contact areas to avoid disturbing abutment material. Disturbed material shall be removed, appropriate foundation treatment be made, and replaced with appropriate fill materials.

During severe weather conditions when fill works must be temporarily halted, the top surface of fills to receive additional fill materials shall be protected by placing a loose layer of fill or plastic sheeting over the compacted surface. Prior to resuming fill placement activities, the protective layer of loose fill or plastic sheeting shall be removed and the original surface scarified and compacted. Should the original surface be found to be frozen, disturbed, or otherwise contaminated, such zones shall be removed. Resumption of fill placement activities can occur only after inspection and acceptance by the Project Manager of the repaired surfaces.

2.3.6 **Earthworks (Pipe Trenches)**

2.3.6.1 Scope

This specification covers the excavation, backfilling and reinstatement of trenches for pipes and culverts, but excludes the bedding of pipes and culverts.

2.3.6.2 Applicable Codes and Standards

a) All work, materials and practices shall comply with the requirements of current New Zealand, Australasian or other standards for that particular class of work. The following standards shall apply specifically:

BS 1377.1-9:1990	: Methods of test for soils for civil engineering purposes
NZS 3109:1997	: Concrete construction
NZS 3111:1986	: Methods of test for water and aggregates for concrete
NZS 3116:2002	: Concrete segmental and flagstone paving
NZS 4224:1983	: Code of practice for measurement of civil engineering quantities
NZS 4402.2.1-8:1986	: Methods of testing soils for civil engineering purposes - Soil classification tests
NZTA M07:2009	: Specification for roadmarking paints
SNZ HB 2002:2003	: Code of practice for working in the road
TNZ B/02:2005	: Specification for construction of unbound granular pavement layers
TNZ F/1:1997	: Specification for earthworks construction
TNZ HM/11:2006	: Surfacings – Maintenance Specification
TNZ M/4:2006	: Specification for basecourse aggregate
TNZ M/6:2004	: Specification for sealing chip
TNZ M/10:2010	: Specification for asphaltic concrete
TNZ P/3:1995	: Specification for first coat sealing
TNZ P/9:1975	: Specification for construction of asphaltic concrete paving
TNZ P/12:2000	: Specification for pavement marking

b) Compliance with these Codes and with this Specification shall be the minimum requirement necessary for this Contract.

b) The documents listed above and in the clauses that follow refer to their latest issue complete with amendments that are current at the date of the Tender Document and are deemed to form part of this Specification. However, this Specification takes precedence when it is at variance with the cited document.

2.3.6.3 Definitions

Backfill	: The material used for filling the trench from the top of the bedding to the underside of the finished surface.
Bedding	: The material surrounding the pipe to a level 300mm above the crown of the pipe.
Flexible pipe	: Flexible pipes include pipes and fittings manufactured from ABS, PVC, PE, FRP, GRP, Steel, Ductile Iron and Cast Iron
Rigid pipe	: Rigid pipes include pipes and fittings manufactured from Concrete and Vitrified Clay
Surface	: The concrete, seal, paving or grassing at the top of the trench.

2.3.6.4 Abbreviations

CIV : Clegg impact value

IANZ	:	International Accreditation New Zealand
MDD	:	Maximum dry density
NZTA	:	New Zealand Transport Agency (formerly TNZ)
RCA	:	Road controlling authority
STMS	:	Site traffic management supervisor
TNZ	:	Transit New Zealand (now NZTA)

2.3.6.5 Materials

2.3.6.5.1 Materials for Backfilling in Carriageways

a) On all arterial routes, principal streets and industrial streets, base course shall comply with TNZ Specification M/4 AP20. On lesser streets, base course shall comply with GAP 40 as specified below.

b) Sub base shall comply with GAP 65

c) The aggregate source used for backfilling under carriageways shall have the following properties:
   i. Sand equivalent, based on NZS 4402 of not less than 40;
   ii. Clay Index, based on NZS 4402 of not greater than 3;
   iii. Plasticity Index, based on NZS 4402 of less than 15%; and
   iv. Crushing resistance of the parent aggregate, based on NZS 3111 of not less than 125kN.

d) Rock material shall be free from clay, organic matter and other deleterious materials.

e) The Contractor shall provide test results demonstrating this compliance.

f) Unless the Project Manager approves alternative gradings for locally available materials, GAP 20 shall meet the following grading limits:

GAP 20	Percentage Passing	
Aperture Size (mm)	Lower Limit	Upper Limit
19.0	100	100
13.2	80	95
9.5	64	76
4.75	37	48
2.36	26	36
1.18	18	28
0.6	12	22
0.3	6	14
0.15	2	7
0.075	0	3

g) Unless the Project Manager approves alternative gradings for locally available materials, GAP 40 shall meet the following grading limits:

GAP 40	Percentage Passing	
Aperture Size (mm)	Lower Limit	Upper Limit
37.5	100	100
19.0	61	80
9.5	38	57
4.75	23	43
2.36	10	33
1.18	7	25
0.6	2	19
0.3	0	14
0.15	0	10

0.075	0	7

h) Unless the Project Manager approves alternative gradings for locally available materials, GAP 65 shall meet the following grading limits:

GAP 65	Percentage Passing	
Aperture Size (mm)	Lower Limit	Upper Limit
65.0	100	100
37.5	80	90
19.0	50	70
9.5	30	55
4.75	20	40
2.36	15	30
1.18	10	22
0.6	6	18
0.3	4	14
0.15	2	10
0.075	0	7

i) Unless the Project Manager approves alternative gradings for locally available materials, GAP 100 shall meet the following grading limits:

GAP 100	Percentage Passing	
Aperture Size (mm)	Lower Limit	Upper Limit
100.0	100	100
75.0	80	92
65.0	70	85
40.0	54	75
19.0	39	60
13.2	32	52
9.5	27	46
4.75	20	34
2.36	15	25
1.18	10	18
0.6	6	13
0.3	3	10
0.15	1	7.5
0.075	0	5

j) Unless the Project Manager approves alternative gradings for locally available materials, GAP 150 shall meet the following grading limits:

GAP 150	Percentage Passing	
Aperture Size (mm)	Lower Limit	Upper Limit
150.0	100	100
100.0	79	95
75.0	64	89
65.0	58	85
40.0	41	73
19.0	28	54
9.5	21	40
4.75	15	30
2.36	9	23

1.18	6	18
0.6	4	14
0.3	3	10
0.15	1	8
0.075	0	5

2.3.6.6 Materials for Backfilling Outside Carriageways

a) Unless otherwise instructed by the Project Manager, material for backfilling outside carriageways shall be sound material excavated from the trench.

b) If, in the opinion of the Project Manager, the site material is unsuitable, suitable material shall be imported by the Contractor at rates to be agreed in advance.

c) Under footpaths and vehicle crossings, the material in the upper 100mm shall be GAP 65 sub-base complying with the above.

d) Under berms and outside road reserves, the material in the upper 100mm shall be topsoil selected from the trench excavation.

2.3.6.7 Bedding of Pipes

Bedding of pipes shall be in accordance with the relevant specification for pressure pipelines and in accordance with the manufacturers' specifications.

2.3.6.8 Health and Safety

All trench excavation, backfill and reinstatement shall be carried out in accordance with the New Zealand Department of Labour's Approved Code of Practice for Safety in Excavation and Shafts for Foundations (April 2000).

2.3.6.9 Traffic Management

Prior to any excavation commencing in the road, the site shall be prepared in accordance with a site specific traffic management plan. Safety at roadwork sites shall be maintained at all times to ensure the safe movement of all road users.

2.3.6.10 Underground Services

a) The Contractor shall give at least 48 hours' notice to the owners of all utilities in the vicinity of the trench and shall comply with the requirements of the owners with respect to marking and protecting their underground services.

b) The Contractor shall pothole for existing or suspected services at least 50m ahead of the laid pipe.

c) The Contractor shall physically locate all underground services before commencing with excavation. The Contractor shall expose all existing underground services, public and private as required. If failure to explore ahead necessitates altering work already done, then the cost of altering shall be borne by the Contractor.

d) Where existing services are damaged by trenching work, the Contractor shall immediately advise the Project Manager and shall arrange for the service to be repaired by the appropriate Authority. The Contractor shall be responsible for the cost of repair unless the service or services were unavoidably damaged.

e) The Contractor shall notify the Project Manager in advance of any diversion or removal of utilities, which it may require for its own convenience or because of its proposed method of working, and shall comply with any requirements of the Project Manager with respect to them.

f) The Contractor shall ensure that during the operation of its works, no part of a machine or its load should come the minimum approach distance from overhead power lines unless written permission has been obtained from the controlling electricity authority.

g) The Contractor shall record the positions, levels and particulars of all existing services which are exposed during the construction of the works.

2.3.6.11 Access to Properties

Unless alternative arrangements are made to the satisfaction of the Project Manager, temporary access over the trench shall be provided to all adjacent properties until permanent access has been reinstated.

2.3.6.12 Silt Control

a) The Contractor shall submit a programme and method of construction statement to the Project Manager both on site and at any proposed disposal site in relation to the Contractor's works.

b) The method of construction statement shall include but not be limited to the following:
   i. Extent of works at various stages during the Contract.
   ii. Length of time bare ground is to be exposed.
   iii. Length of trenches open at any one time.
   iv. Method of dealing with run-off and sediment control from the site of the Works.
   v. Method of dealing with run-off and sediment control from any landfills associated with the Facilities.

c) Silt settling areas and detention storage shall be constructed where necessary to pond run-off and precipitate silt, so as to prevent damage to adjoining property, road channels and public stormwater systems.

d) The Contractor shall provide the necessary measures to prevent silt laden water leaving the site of the Facilities.

e) Erosion control shall be maintained in good working order throughout the length of the Contract up to the end of the Defects Liability Period.

f) The Contractor shall remove any such silt retention measures and structures at the end of the Contract and reinstate the land to its original condition or better.

2.3.6.13 Stockpiled Material

During construction, the Contractor shall take all the necessary measures to prevent materials yet to be compacted from becoming waterlogged, to prevent erosion of fill materials, to prevent damage to or fouling of work in progress or completed and to prevent damage to any street, public or private property, road channel or public stormwater system.

2.3.6.14 Excavation

2.3.6.14.1 Classification of Excavation

Excavation shall be classified as per Transit NZ Specification F/1, except for the following:

i. Type R1 Materials. This group of materials shall include all rock-like materials which can only be excavated with a hydraulic excavator of not less than 22 - 24 tonnes weight as defined in the latest issue of the New Zealand Contractors Federation Guide to New Zealand Plant Hire Rates with a bucket of width not greater than one metre and fitted with ripper teeth.

ii. Type R2 Materials. This group of materials shall include all materials which cannot be removed using a hydraulic excavator as defined for Type R1 materials.

iii. Boulders. Boulders shall include loose rocks and other hard, inorganic objects which can be removed by normal trench excavation, but which are larger than 1m in their longest dimension. Boulders and objects smaller than 1m in their longest dimension shall be classified as Type F/1 material.

2.3.6.14.2 Excavation - General

a) Excavation shall not commence until sufficient supplies of all materials are available to ensure speedy and uninterrupted progress of the work.

b) When working within existing road reserves, all surplus excavated material shall be removed from the work site within 48 hours of being excavated. Where excavated material meets required specifications and is to be re-used, it may be stockpiled on site provided it is used within 48 hours. Alternatively, stockpiling arrangements may be approved by the Project Manager and shall be included in the traffic management plan.

c) All excavation shall be carried out to the grades and levels shown on the Contractors Drawings and shall be excavated by open cut unless otherwise approved by the Project Manager.

d) The maximum length of trench open prior to backfilling, or otherwise causing local disruptions to vehicles or people, shall not exceed 20 metres unless the Project Managers written agreement to a longer length has been obtained. The Project Manager may, in particular circumstances, instruct the Contractor to limit his operations to some shorter lengths of open trench.

e) Open sections of trench shall be maintained in a safe condition at all times by the use of steel cover plates, safety fencing or other appropriate measures.

f) All necessary precautions shall be taken to ensure that no spoil (either spilled from trucks or spread from truck wheels) is deposited on carriageways. Should deposition occur, the Contractor shall immediately clean and wash down the affected area.

g) It is the Contractor's responsibility to remove all surplus excavated material from site to an appropriate disposal location. The cost shall be borne by the Contractor unless otherwise stated. No material that is suitable for re-use shall be removed from a site without the permission of the Project Manager.

h) Should any over dig occur, then the void shall be filled with suitable material, as approved by the Project Manager, to the correct formation level. The cost of any over dig shall remain with the Contractor.

2.3.6.14.3 Poor Ground Conditions

a) If in the opinion of the Contractor the formation level is unsuitable, or is damaged or is allowed to deteriorate, he shall inform the Project Manager immediately.

b) Where the bearing capacity of the trench bottom is low, and the Project Manager so directs, extra depth shall be excavated in order to obtain a firm trench bottom. The portion excavated shall be refilled to the level required for the bedding of the pipe with an approved fine non-cohesive material such as sand or crushed fine rock, placed in layers of 150mm thick and compacting by approved means.

c) Where the ground at the bottom of the trench is spongy or boggy in nature, and the Project Manager so directs, clean hard rock ballast, of nominal size 150mm (85%, passing 150mm sieve and less than 20% passing 100mm sieve) shall be placed in layers and compacted by ramming into the boggy ground until an approved firm foundation is obtained at the level required for bedding of the pipe.

2.3.6.14.4 Trench Width (relating to clearance around the pipe as defined by the embedment zone).

a) Trenches shall be excavated within the tolerances specified below. Generally trenches are expected to be excavated with vertical sides within the embedment zone. Sloped trench walls within the embedment zone are only permitted with the approval of the Project Manager. Sloping trench walls for flexible pipe installations are permitted above the embedment zone.

b) Unless otherwise specified by the Project Manager, the trench width limits for flexible pipes shall be:

Pipe OD mm	**Minimum clearance to trench walls from pipe OD mm**	**Minimum Trench Width mm**	**Maximum Trench Width mm**
≤ 150	300	Pipe OD + 600	800

>150 and ≤ 300	300	Pipe OD + 600	900
> 300 and ≤ 450	300	Pipe OD + 600	1200
> 450 and ≤ 600	300	Pipe OD + 600	1500
> 600 and ≤ 900	300	Pipe OD + 600	Refer to section 4
> 900 and ≤ 1500	350	Pipe OD + 700	Refer to section 4

c) Unless otherwise specified by the Project Manager, the trench width limits for rigid pipes shall be:

Pipe OD mm	Minimum clearance to trench walls from pipe OD mm	Minimum Trench Width mm	Maximum Trench Width mm
≤ 600	300	Pipe OD + 600	Refer to section 4
> 600, ≤ 1200	300	Pipe OD + 600	Refer to section 4
> 1200, ≤ 1800	300	Pipe OD + 600	Refer to section 4

d) Over-excavation

i. Where the “maximum trench width” has been exceeded, either as a result of over-excavation or due to collapse of one or both walls of the trench, before or after laying the pipe, the Contractor shall remove all disturbed material from the trench.

ii. The Project Manager may then direct one or more of the following actions to be taken by the Contractor:

- Bedding and laying, as specified, using the same pipe.
- Installation of a heavier class of pipe
- Fill the space between the pipe and the undisturbed ground on both sides of the pipe and to a height of 300mm above the top of the pipe using an approved granular material complying with the relevant AS/NZS or AS Standard.
- Another course of action, as advised by the Project Manager, until the Project Manager can confirm that the Contractor has put corrective measures in place to ensure that the pipe installation is a structurally compliant design.

iii. Localised widening and deepening may be necessary to allow for jointing, e.g. welding of pipes in the trench, and the installation of valves, fittings and associated thrust or anchor pipes. The extent of permitted localised widening or deepening allowed shall be discussed and agreed with the Project Manager.

2.3.6.14.5 Temporary Support

a) Temporary support, shoring or other alternatives shall be provided where unstable ground conditions are encountered and where required by the New Zealand Department of Labour’s Code of Practice for Safety in Excavation and Shafts for Foundations (April 2000). Alternatives may include battering, dewatering, ground stabilisation or sheet piling.

b) Temporary support shall also be provided where the excavation would otherwise endanger the stability of adjacent properties or structures.

c) A suitably qualified person shall design and oversee the installation of all temporary support, shoring or other alternatives. The temporary support shall be placed so that it does not prevent pipes from being bedded and laid to specification. Any damage to the surrounding area that may occur as a result of the work shall be the responsibility of the Contractor.

d) All trench support used in trenches shall be incrementally removed in short sections before backfilling so as not to compromise the safety of personnel working in the trench.

2.3.6.14.6 Excavation Across Sealed Surfaces (Sawcutting)

a) Where an excavation is required to be made through any existing concrete, asphalt or chip seal surface, the edges of the excavation or trench shall be neatly cut with a power saw in straight lines prior to commencing the excavation. Joints shall form a neat simple pattern to include trimming allowances. Generally this will mean parallel or rectangular sawcuts on the sides of the excavated area. The minimum over break length of cut shall be 5m.
Saw cutting shall comply with the relevant national code of practice. In New Zealand this is the national code of practice for Utility Operator’s access to Transport Corridors, November 2011. This includes for reinstating trench over breaks.

b) The cuts shall be at least 30mm deep and shall extend through the full thickness of the surface layer. The cuts shall be made in such a way that subsequent use of excavation equipment does not lift or disturb adjacent surfaces.

c) A minimum trench trimming allowance width of 150mm applies to all trenches in the carriageway, except in concrete carriageways where a minimum trimming allowance width of 300mm is required.

d) Areas adjacent to the excavation shall not be undercut. If slumping of material from the sides of the excavation causes depressed areas adjacent to the excavation, or if the edges of the pavement are lifted during the excavation, additional saw-cutting outside of the original line and outside of the area of damage will be required before the final surface reinstatement. If overbreak occurs, a change in direction of the saw-cut shall not exceed 45º.

e) Over break of the trench shall not exceed 10% per 100 metres of trench and shall not be more than three separate areas within the 100m length. Should two over breaks occur within 5 metres of each other, a straight parallel line shall be formed between the two.

f) Where the line of the trench changes direction by more than 45º, the inside corner of the existing seal shall be cut back 500mm to form a 45º corner.

g) If the edge of a trench is within 1m of a crack, joint, edge of an existing trench, boundary or kerbline, the existing pavement shall be replaced as part of the surface reinstatement, and saw-cut accordingly.

2.3.6.14.7 Excavation in Private Property

a) A precondition survey shall be undertaken by the Contractor and shall be provided to the Project Manager prior to works commencing. This survey shall be agreed with the landowner. The Contractor shall reinstate the property as agreed of the conditions with the landowner.

b) All topsoil and turf from lawns shall be saved and re-used when completing the backfilling. The Contractor shall be careful not to damage gardens or property unnecessarily and shall only use excavating machinery appropriate for the circumstances. Excavated material shall be stockpiled well clear of the tops of trenches and any surplus material shall be removed from site. Topsoil shall be stockpiled separately.

c) Where directed by the Project Manager, tarpaulins shall be placed under stockpiles.

2.3.6.15 Groundwater

Should groundwater appear in trenches, it shall at all times be kept down below the level of joints or bedding by means of side channels and pumping if necessary until backfilling. Adequate precautions shall also be taken at all times to prevent completed sections of pipeline from floating. The cost of all machinery and work in connection with the handling of subsoil water shall be included in the Contractor’s price. All sumps and channels shall be backfilled upon completion in accordance with this Specification. All ground water discharges shall comply with the Silt Control Measures.

2.3.6.16 Surface Water

During the course of any trenching work, the Contractor shall maintain all channels, watercourses and catchpits free of debris and provide for the free flow of surface water. Where such is not practical, the Contractor shall make adequate temporary arrangements for dealing with the surface water and shall be responsible for the operating of such measures and the re-establishment of the permanent water channel on completion of the trenching work.

2.3.6.17 Backfilling

This covers the material zone from above the pipe embedment zone (which includes the overlay zone).

2.3.6.17.1 General

a) No backfilling shall be done until the laying and jointing of the pipe has been approved by the Project Manager. Special care shall be taken not to damage the pipes or joints during backfilling.

b) Where instructed by the Project Manager, the Contractor shall provide groundwater drainage to ensure that the groundwater is kept below 1m from the finished surface level.

c) The degree of compaction required in the embedment zone is specified on the Contractors drawings. This relates to the design selection of the pipe support type. The Contractor is responsible to ensure that material in the embedment zone is not compacted beyond the limits specified and note the following clauses in taking care not to over load the pipe.

d) Compaction of embankment material needs to be completed carefully to ensure that adverse loading is not transferred onto the pipe during compaction.

e) The use of vibratory trench rollers and other heavy compaction equipment should be avoided at least within 500mm from the top of the pipe (flexible or rigid), unless otherwise confirmed that this is acceptable by the Project Manager.

f) The Contractor shall take care during the installation of rigid pipes to ensure that material in the overlay zone is not over compacted. The overlay zone shall extent from the top of the side zone to 150mm above the pipe crown. The fill material in the overlay zone shall be *Selected* or *Ordinary fill* consisting of material from the excavation or elsewhere. It shall not contain stones larger than 150mm, nor more than 20% with a size between 75mm and 150mm. Overlay zone material should be compacted to provide a minimum 85% dry density (R_D) or 50% density (I_D) for installations outside of a highway and 90% dry density (R_D) or 60% density (I_D) for installations within a highway.

g) Over-compaction over the top of a flexible pipe will lead to pipe deflection as the pipe sheds loading into the supporting embedment zone. If compaction occurs close to the pipe crown there will be little if any side support offered by the embedment material and the pipe will deflect, likely beyond the maximum permissible limit. Once deflection has occurred, the pipe will have lost some of its ring bending strength and be less able to shed loading to the supporting embedment zone as backfill continues. For hand held or walk- behind equipment, the minimum depth of un-compacted material over the top of the pipe should be at least 200mm, and for large ‘ride-on’ machines operating within the trench, the minimum depth of material should be increased to 500mm, unless otherwise confirmed by the Project Manager.

h) Where the compactive force and bearing area of the compaction/ construction equipment is known, design in accordance with AS/ NZS 2566.1 may be used to determine the minimum height of cover before that load can be applied.

2.3.6.17.2 Backfilling in Carriageways

a) Backfilling under carriageways means the basecourse layer, the sub-base layer and ordinary backfill above the pipe embedment zone.

b) Compaction of all materials shall be carried out in layers with mechanical compaction equipment appropriate to the size and location of the trench and the type of backfill used.

c) The basecourse layer thickness shall comply with the pavement design or to local / regional engineering standards, whichever is appropriate. It shall be compacted in layers no greater than 200mm thick to achieve a mean value greater or equal to 98% of the maximum dry density (MDD) as per TNZ B/02: 2005 or as otherwise specified by local/ regional engineering standards.

d) The sub-base course layer thickness shall comply with the pavement design or to local / regional engineering standards, whichever is appropriate. It shall be compacted in layers no greater than 200mm thickness, and achieve a mean value greater or equal to 95% of the maximum dry density (MDD) as per TNZ B/02: 2005 or as otherwise specified by local/ regional engineering standards.

e) The subgrade (measured as the top 1m of the construction from the underside of the sub-base course) shall be compacted with *Selected* or *Ordinary* fill in layers no greater than 150mm thick in the lower 600mm or 135mm thick in the top 400mm depth, unless field trials show, to the satisfaction of the Project Manager, that the specified compaction is obtained with thicker layers. *Ordinary* fill placed within 1.5m of the finished surface shall be a material suitable for use as a subgrade as defined by TNZ F/1: 1997.

f) Unless otherwise specified, *selected* fill shall be placed within 0.8m depth from the finished road surface and shall be GAP 65 or a suitably approved excavated material compacted to at least 95% of maximum dry density at optimum moisture content.

g) Subgrade material below 0.8m depth from the finished road surface shall be a suitable selected or ordinary fill, and shall be compacted to at least 90% of the maximum dry density at optimum moisture content.

2.3.6.17.3 Backfilling Outside Carriageways

Unless otherwise instructed by the Project Manager, material excavated from the trench shall be used for backfilling outside carriageways. Backfill shall be compacted in layers not exceeding 200mm thick to 90% of MDD or to the same density as the surrounding ground, whichever is the lesser.

2.3.6.17.4 Backfilling of Over-width Trenches

The Contractor shall keep trench widths to a minimum consistent with the above. However, if for any reason a trench is excavated to a width such that it affects the stability of buildings or any structures (e.g. fences, kerbs, other services or roads), the placing of the whole of the backfill and the standards of compaction shall be to the appropriate specification. If, in the opinion of the Project Manager, any such extra width was unnecessary and will result in more load being placed on the pipe than it can safely carry, the Contractor shall provide at own cost additional bedding, backfill or stronger pipes as appropriate.

2.3.6.18 Trench Subsidence

The Contractor shall be responsible for any trench subsidence or failure of reinstatement works occurring after the work has been completed up to the end of the defects liability period.

2.3.6.19 Testing

2.3.6.19.1 Testing – General

a) All testing shall be the responsibility of the Contractor who shall provide the Project Manager with the results of the tests within 48 hours of testing occurring or as otherwise agreed with the Project Manager to demonstrate that the backfilling has complied with the Specification.

b) The Contractor shall be responsible for carrying out laboratory tests according to NZS 4402:1986, Test 4.1.3 to determine the maximum laboratory dry density at the optimum water content (OWC) of the backfill material to be used. The Solid Density of the aggregate tested shall be determined according to NZS 4407:1991, Test 3.7. The tests shall be undertaken on material that is representative of that used in construction and a grading for the material tested shall be supplied with the results.

c) Prior to commencement of fill compaction the Contractor shall carry out a ‘Trial Compaction – Plateau Test’ in the presence of the Project Manager to provide confirmation that the laboratory compaction results can be achieved onsite. The methodology for this trial shall be submitted to and agreed by the Project Manager prior. This should generally is in accordance TNZ B2 Specification.

d) Compaction testing shall be carried out with a nuclear densometer or approved equivalent that can demonstrate that the required standards have been met. A Clegg hammer (4.5 kg) may be used to monitor compaction densities, providing laboratory correlation tests have been carried out to confirm that the specified density has been achieved in accordance with ASTM D5874-95. The following Clegg impact hammer values (CIVs) may be used as a guideline for estimating maximum dry density (MDD):

CIV	MDD
35	98%
32	95%
25	90%

2.3.6.19.2 Testing of Compaction in Carriageways

a) Testing of compaction shall be carried out in accordance with the above.

b) All materials used for backfilling shall have been sampled and tested by a certified testing laboratory. The Project Manager may instruct the Contractor to provide records of material test certification.

c) Density testing shall be carried out and recorded by a suitably qualified person at the following frequencies:

i. For trenches in berms, testing is required at least one per layer of backfill per 15 m of trench, with a minimum of two tests.

ii. For trenches in carriageways or footpath testing is required at least one per layer of backfill per 5 m of trench with a minimum of two tests.

iii. Where the excavated area greater than 0.5 m2 and less than 5 m2 testing is required one per backfill layer.

iv. Where the excavated area greater than 5 m2 testing is required one per 5 m2.

v. Tests shall be carried out on every lift of each tested backfill layer to be assured of proper compaction of all of the backfill.

2.3.6.19.3 Benkelman Beam Testing in Carriageways

a) The Contractor shall undertake Benkelman Beam tests on the existing carriageway before the works are undertaken to determine a baseline for the stiffness of the existing carriageway.

b) Prior to placing the base course and the final sealing the Contractor shall undertake Benkelman beam tests at 20m intervals. No sealing shall be undertaken until the Contractor supplies the results of the beam testing demonstrating compliance with the Engineering standards.

2.3.6.19.4 Testing of Compaction Outside Carriageways

a) Testing of compaction shall be carried out in accordance with the above.

b) Density testing shall be carried out by a suitable qualified person at the following frequencies:

i. For trench lengths of 100m or more, testing is required at a rate of at least one test per layer of backfill per 50m of trench.

ii. For trench lengths less than 100m, a minimum of two tests per layer will be required.

iii. Where the excavated area is greater than $0.5m^2$ and less than $30m^2$, one test per backfill layer will be required.

2.3.6.20 Reinstatement

2.3.6.20.1 Scope

Reinstatement of trenches includes:-

i. removal of surplus soil, stones and debris;

ii. trimming of the backfill to line and level;

iii. topsoiling and, where applicable, seeding;

iv. initial restoration of sealed and concreted surfaces where required;

v. temporary surfacing; and

vi. permanent reinstatement of existing surfaces.

2.3.6.20.2 Reinstatement – General

a) All materials used for reinstatement shall have been sampled and tested for compliance with this Specification by a certified testing laboratory. The Project Manager may instruct the Contractor to provide records of material test certificates.

b) The Contractor shall reinstate trenches within five working days or as soon as practicable after the backfilling has been completed in accordance with the specification. If, in the opinion of the Project Manager, reinstatement is not following up pipelaying work as soon as practicable, the Project Manager may order a stop to further trench excavation until practicable reinstatement has been achieved. The Contractor shall not be entitled to compensation for any such stoppage.

c) The finished reinstatement shall have a neat appearance with clean long straight lines parallel to the kerb or footpath.

d) Permanent reinstatement materials shall be similar in type, quality, texture, skid resistance and strength to the surrounding materials.

e) The quality of the final reinstatement shall be better than or equal to the standard prior to undertaking the works. The surface level of the trench shall match the surrounding surface level, finished flush or not more than 5mm above the existing surface. No ponding of water will be permitted. Where the transverse or longitudinal shape of the existing pavement is not a straight line the Contractor shall shape the reinstatement work accordingly.

2.3.6.20.3 Temporary Surfacing

In major roads, or where instructed by the Project Manager, backfilling in carriageways shall be topped immediately after completion with a temporary plant mix surfacing. This temporary surfacing, together with overcut material, shall be removed prior to constructing the final surfacing.

2.3.6.20.4 Reinstatement in Carriageways

2.3.6.20.4.1 Concrete Surfaces

a) All concrete shall comply with NZS 3109 and shall have a compressive strength of at least 20MPa at 28 days. The concrete shall contain a rapid hardening additive giving nominal 7 day strength in 24 hours and shall have attained at least 80% of its specified strength before being exposed to traffic.

b) The thickness of the concrete shall match the thickness of the existing concrete.

c) Cut edges shall be treated with cement grout, to which an approved bonding additive (e.g. Cemstick or Febmix) has been added prior to placing concrete.

d) Expansion and/or construction joints shall be formed to match the existing surface.

e) Concrete surfaces shall be broom finished, except where an asphalt overlay is required, in which case the concrete surface shall be roughened to facilitate bonding between the asphalt and the concrete.

f) Where the existing concrete surface contains reinforcing steel, the reinstated concrete shall be similarly reinforced.

g) In all instances D16 starter bars at 300mm centres shall be epoxied into the existing concrete with an embedment length of not less than 150mm.

2.3.6.20.4.2 Asphalt (hot mix surfaces)

a) Asphalt shall comply with TNZ Specification M/10 and shall be placed and compacted in accordance with TNZ P/9.

b) The Contractor shall demonstrate that the mix design meets the specifications and shall submit the proposed design to the Project Manager prior to commencing reinstatement.

c) The Contractor shall remove previously placed metal and/or plant mix to depth of the original paving, compact as necessary, clean free of dust and apply a tack coat to the edges and metal with rapid breaking emulsion. Asphalt Mix 10 at a temperature of 150°C - 160°C shall then be placed and rammed in layers not exceeding 50mm and the final surface finished by rolling.

d) The thickness of the asphalt layer shall be the same as existing layers or 50mm using a Mix 15 sized aggregate or 30mm using a Mix 10 sized aggregate, whichever is the greater.

e) The surface shall be smooth and even, having no ridges or depressions; shall finish flush with, but in no case more than 3mm above, the adjacent surface; and shall not cause water to pond.

f) The Project Manager may from time to time take core samples of the asphalt for testing. Should the tests show that that the depth and materials do not comply with the specification, the Contractor shall remove the sub-standard asphalt and replace it to specification.

g) Where reinstated with asphaltic concrete is specified, the Contractor shall maintain the consistency of the texture and skid resistance between running lanes and AC surfaces shall be texturised with a chip seal layer. The asphalt mix and depth shall be in accordance with the project specification.

2.3.6.20.4.3 Chip Sealed Surfaces

a) Chip sealed surfaces shall match the existing surface. Where this is not specified, the reinstated surface shall comply with TNZ Specification P/3. Chips shall be Grade 4 complying with TNZ Specification M/6.

b) In locations where the existing chip seal surface has been placed over an asphalt layer, the Contractor shall sweep the backfilled surface and apply a rapid breaking emulsion. 20mm of asphalt mix 10 shall then be placed at a temperature of 150°C - 160°C, and finished by rolling and applying chip seal to the same texture as the adjacent surfaces.

2.3.6.20.4.4 Joint Sealing of Carriageway Surfaces

Within one week of final reinstatement taking place, either side of joints in carriageways shall be sealed with hot poured rubber bitumen. The material shall be in accordance with TNZ HM/11 specification. Prior to sealing, the joints shall be water blasted to remove loose dirt and other foreign matter and dried. The sealant shall be applied and levelled with a sealing shoe in a 100mm band across the joint with an overlap of 50mm on either side of the joint.

2.3.6.20.4.5 Kerbs and Channels

a) Where a section of kerb and channel is damaged by a trench crossing, the damaged section shall be replaced to the original line, level and standard.

b) Where an excavation extends under a concrete channel or kerb and the channel has not subsided, cracked or been damaged, it may remain in place. A 200 mm deep concrete foundation shall be placed under the channel for support. The concrete shall have a minimum strength of 20MPa at 28 days.

c) All stone kerbs must be salvaged and re-used to match existing stone kerbs.

2.3.6.20.4.6 Road Marking and Signs

a) Prior to the commencement of the Facilities, the Contractor shall offset or otherwise record the location of the existing road marking and signs and shall include the information with the road opening notice.

b) Road marking and signs shall be replaced with the same type

c) All road markings and signs shall be reinstated.

2.3.6.20.4.7 *Reinstatement near Joint or Edge*

If the edge of the trench in a footpath or road carriageway is within 1m of a joint or existing edge of the pavement, then the existing pavement shall be replaced to that joint or edge as part of the surface reinstatement, and cut accordingly.

2.3.6.20.4.8 *Reinstatement outside Carriageways*

a) On completion of backfilling and compaction, the Contractor shall spread the stockpiled topsoil evenly over the area from which it was removed, relay turf and reinstate all fences and other parts of the property which may have been disturbed or damaged by the works, to the original condition or better. Grassed areas shall be reinstated at least to the original standard. The grassed or planted area shall be maintained until it has been restored to its original condition.

b) Reinstatement of footpaths, drives, paths, fences, walls and any other features shall be reinstated in the same material and to the same standard as that existing at the commencement of the works unless otherwise approved by the Project Manager.

2.3.6.21 Damage to Adjacent Areas

a) On any section where the sealed surface has been damaged beyond the trench line in any way as a result of the Contractor's operations, the surface is to be resealed over an area that ensures that uniformity of skid resistance of both wheel paths of any particular lane, approved by the Project Manager.

b) Details of the proposed surfacing repair method, including the first and second coat chips sizes, shall be submitted to the Project Manager for approval, not less than 5 working days prior to sealing.

c) If the pavement under the sealed surface is disturbed as a result of the Service Owner's operations it shall be repaired by digging out the full pavement depth, re-compacting the subgrade and then relaying a new pavement layer complying with this specification.

2.3.6.22 Cleaning Up and Making Good

As reinstatement work proceeds, the Contractor shall progressively carry out all reinstatement and tidying up work by clearing away all rubbish and surplus material, cleaning and sweeping the area and leaving it in a condition as good as or better than it was when work commenced.

2.3.7 **Concrete Work**

2.3.7.1 Scope

In accordance with the Employer's Requirements, the Contractor shall:

1. Design and detail all concrete work;
2. Prepare and submit shop drawings and all other information required by the Project Manager as specified herein;
3. Furnish all plant, Materials, Contractor's Equipment, and labour required to manufacture, transport, place, finish, protect, repair, and cure concrete;
4. Construct, erect, and dismantle forms;
5. Detail, furnish, and place steel reinforcing bars and welded wire fabric;
6. Furnish and place materials for waterstops; expansion, contraction, control, and construction joints; and beam seats;
7. Design and furnish all labour, plant, and Contractor's equipment to manufacture, cure, transport, and place prestressed or precast concrete components, where approved for use by the Project Manager;
8. Use lift numbers designated by the Contractor in all correspondence, drawings, and reports.

2.3.7.2 Applicable Codes and Standards

a) All work, materials and practices shall comply with the requirements of current legislation, standards and codes for that particular class of work. The following standards shall apply specifically:

AS 1478.1:2000	:	Chemical admixtures for concrete, mortar and grout – admixtures for concrete
AS 3610:1995	:	Formwork for concrete
AS 3799:1998	:	Liquid membrane forming curing compounds for concrete
BS 4486:1980	:	Specification for hot rolled and hot rolled and processed high tensile alloy steel bars for the prestressing of concrete
AS/NZS 1554.1:2011	:	Structural Steel Welding - Welding of Steel Structures
AS/NZS 1554.3:2008	:	Structural Steel Welding - Welding of Reinforcing Steel
AS/NZS 1170 Set	:	Structural Design Actions Set
AS/NZS 2980:2007	:	Qualification of welders for fusion welding of steels
AS/NZS 4671:2001	:	Steel Reinforcing Materials
AS/NZS 4672.1:2007	:	Steel prestressing materials – General requirements
ASTM C309-07	:	Standard Specification for Liquid membrane-forming compounds for curing concrete
NZS 3101:2006	:	Concrete Structures Standard
NZS 3104:2003	:	Specification for Concrete Production
NZS 3106:1986	:	Concrete Structures for the storage of Liquid
NZS 3109:1997	:	Concrete Construction
NZS 3111:1986	:	Methods of Test – water and aggregate
NZS 3112:1986	:	Method of Tests for Concrete
NZS 3114:1987	:	Specification for Concrete Surface Finishes
NZS 3121:1986	:	Specification for Water and Aggregate for Concrete
NZS 3122:2009	:	Specification for Portland and Blended Cements (General and Special Purpose)
NZS 3123:2009	:	Specification for Pozzolan for use with Portland and Blended Cement
NZS 3124:1987	:	Specification for Concrete Construction for Minor Works
NZS 3125:1991	:	Specification for Portland–Limestone filler Cement
NZS 4224: 1983	:	Code of practice for measurement of civil engineering quantities
NZS 4702:1982	:	Metal-arc welding of Grade 275 Reinforcing Bar

b) Compliance with these Codes and with this Specification shall be the minimum requirement necessary for this Contract.

c) The documents listed above and in the clauses that follow refer to the latest issue complete with amendments that are current at the date of the Tender Document and are deemed to form part of this Specification. However, this Specification takes precedence when it is at variance with the cited document.

2.3.7.3 Other Publications

Other publications applicable to this specification are:

i. Building Industry Authority: New Zealand Building Code Handbook and Approved Documents, 1992.

ii. Cement and Concrete Association of New Zealand, TR 3, 1991: Alkali aggregate reaction- minimizing the risk of damage to concrete.

iii. Cement and Concrete Association of New Zealand, TR 11, 2003: Properties of New Zealand Concrete Aggregates

iv. Cement and Concrete Association of New Zealand/ SANZ, New Zealand Guide to Concrete Construction

v. New Zealand Transport Agency TNZ Standards.

vi. New Zealand OSH approved Codes of Practices.

2.3.7.4 Quality Control and Assurance

The Contractor's Quality Assurance Plan shall include a method statement regarding the quality control and assurance intended to be carried out in association with concrete works, including reinforcing steel, joint sealers, waterstops, etc. The method statement shall include the standards and codes that the Contractor proposes to use for his concrete works, the intended sampling frequencies, quality control testing, and methods for transportation, storage, and handling of all materials used, as well as testing of the Contractor's equipment utilized.

The Materials used in the project shall be mill or factory tested, where appropriate. Mill or factory test reports made by the manufacturer or fabricator certifying that the material is in conformance with the applicable standards shall be delivered with the shipments and shall be made available for review by the Project Manager.

Standard release forms shall be utilized for all concrete work to provide check lists for the Project Manager to verify that the work is in conformance with the latest revision of the Contractor's Quality Assurance Plan. The release form shall be completed prior to concrete placement and shall certify that the formwork, reinforcement, embedded items, waterstops, etc. are located correctly and adequately braced to prevent movement during concrete placement and that requirements of the design are met in all respects. The release form shall be signed by the Project Manager prior to concrete placement.

The Contractor's quality assurance procedures shall encompass all aspects of the concrete construction, including, but not necessarily limited to:

- i. concrete mix design;
- ii. evidence of compliance with requirements to prevent alkali-aggregate reaction;
- iii. proposed concrete testing procedures;
- iv. shop drawing submission and review;
- v. pre-pour inspection procedures;
- vi. reinforcing compliance records;
- vii. certificates for pre-stressing and post tensioning strand;
- viii. extension calculations for pre-stress strand;
- ix. post tension calculations of extensions, friction losses and force profiles along the cable length;
- x. concrete batch/delivery docket records;
- xi. curing methodologies for the various parts of the structures; and
- xii. off site precast inspection.

The Contractor shall nominate and advise the Project Manager of a suitably experienced and qualified representative to be responsible for the quality control of all precast and in-situ concrete.

The Contractor shall supply evidence of production quality standards to the Project Manager in advance of construction in accordance with NZS 3109.

2.3.7.5 Submittals

Should it be requested by the Project Manager, the Contractor shall provide the following information for review:

- i. the ready mixed concrete supplier's mix design including evidence from the Contractor that he has provided full information to the supplier to enable him to understand the concrete design requirements and to enable him to design the concrete mix to satisfy the requirements of the Contract;
- ii. curing methodology;

iii. concrete compression test results analysed in accordance with the requirements of NZS 3109;

iv. slump tests analysed in accordance with the requirements of NZS 3109;

v. shop drawings of precast concrete items;

vi. delivery dockets and pre-pour check sheets which shall be available for the Project Manager's inspection on site;

vii. extension calculations for prestressed concrete items; and

viii. extension, friction, and force calculations for post tensioning cables.

2.3.7.6 Material Standards

2.3.7.6.1 Cement

a) Cement shall comply with NZS 3122, and be certified as made in New Zealand unless otherwise approved in writing by the Project Manager, or specified in this Specification. Alternative cement may only be used if specifically approved in writing by the Project Manager.

Alternative cements shall comply with NZS 3123 or NZS 3125.

2.3.7.6.2 Aggregate and Water

Aggregate and water shall comply with the requirements of NZS 3122. The maximum nominal aggregate size used in the concrete mixes shall be 20mm, with the exception of mass concrete or unless otherwise specified in section 4 of this Specification or on the drawings.

2.3.7.6.3 Reinforcement

a) Reinforcing steel bars shall be hot rolled steel bars complying with AS/NZS 4671 unless otherwise approved in writing by the Project Manager.

b) Reinforcing steel shall be Class E in accordance with AS/NZS 4671. Class L and N shall not be used unless expressly noted on the drawings.

c) Grade 500 reinforcing steel shall be manufactured by micro alloy techniques. Reinforcing manufactured by quenching and tempering processes will not be permitted.

d) Reinforcing steel shall be identified along its length with:
   i. The strength grade
   ii. The ductility class
   iii. The steel producer
   iv. The method of manufacture

e) The length of laps shall be in accordance with NZS 3101.

j) Hooks and bends shall be in accordance with NZS 3101 and NZS 3109.

l) Mechanical connection of reinforcement shall not be permitted without prior written approval from the Project Manager. All mechanical connections where permitted shall be installed in accordance with the manufacturer's recommendation, and shall comply with the provisions of NZS 3101.

2.3.7.6.4 Concrete

2.3.7.6.4.1 Concrete Strengths

Concrete strength and durability shall be selected by the Contractor to meet the specific requirements at each location. Concrete strength shall be clearly marked on the Contractors drawings.

2.3.7.6.4.2 Concrete Mix Design Submission

a) Concrete mix design details shall be submitted to the Project Manager at least two weeks before concrete supply commences. Submission of these details in no way reduces the Contractor's obligation to meet the requirements of this Contract. Neither does the submission of details infer in any way that the Project Manager has approved them.

b) The following mix details shall be supplied in writing:

   i. specified strength of concrete and grade;

   ii. minimum target mean strength;

   iii. nominated slump;

   iv. grading curve for the aggregates;

   v. source and type (crushed etc) of aggregate;

   vi. batch weights of cement and aggregate;

   vii. total free water content;

   viii. water/cement ratio by weight;

   ix. fineness modulus of the sands;

   x. any admixtures, name and quantity;

   xi. yield;

   xii. source and type of cement and aggregates including sands; and

   xiii. proposals for extending the workability for time periods longer than the 90 minutes in NZS 3109 cl 7.4.1, if required.

c) Concrete mixes shall be capable of being readily placed and compacted in normal placing situations without segregation. They shall result in homogeneous, dense concrete with low shrinkage characteristics, and capable of achieving the specified surface finish. The Contractor shall show by previous records or trial mixes that these requirements can be met with concrete achieving the specified strength.

d) No change shall be made to the submitted mix details without approval of the Project Manager.

e) All concrete mixes shall be produced strictly in accordance with submissions accepted in writing by the Project Manager.

2.3.7.6.4.3 Concrete Supply

a) Concrete used in the construction shall be either made on the site, supplied ready mixed, or supplied in the form of precast products. Site mixed concrete shall comply with NZS 3104 or NZS 3124 as appropriate.

b) The concrete plant must have a current Certificate of Audit in terms of NZS 3104 or approved equivalent. The concrete supplier shall submit to the Project Manager the current Certificate of Audit and the name and contact details of the assigned plant engineer.

c) Delivery dockets shall be supplied by the producer for each load. Dockets shall contain the following minimum information for each load:-

   i. name of concrete supplier;

   ii. specified grade of concrete (strength);

   iii. cement content;

   iv. maximum aggregate size;

   v. slump;

   vi. date and time of mixing;

   vii. quantity delivered;

   viii. identifying number of truck; and

ix. additives used.

2.3.7.6.4.4 Concrete Additives

a) Unless otherwise specified, no concrete additive shall be included in the concrete mixes without the written approval of the Project Manager. Chemical admixtures, where approved by the Project Manager for use in concrete, shall comply with AS 1478, and shall be used in accordance with NZS 3109.

b) No calcium chloride or chloride containing admixture shall be added to any mix.

c) An approved air entraining agent shall be added to all concrete mixes sufficient to provide an air content of 4.5% ± 1½%.

c) An approved water reducing agent may be included in the mix designs.

2.3.7.7 Storage of Reinforcement

Upon delivery to the site, the reinforcement shall immediately be stacked in racks located in a clean dry area removed from construction traffic.

2.3.7.8 Defective Concrete

a) Acceptance of concrete in the works will be primarily based on the results of slump and compression testing in accordance with the acceptance criteria in table 9.3 of NZS 3109 and tolerances for slump in table 9.1 of NZS 3109.

b) Where concrete is liable for rejection, the location and extent of the concrete so represented shall be assessed and identified. No further concrete shall be placed where it would prejudice the subsequent removal of the concrete in question. If the Contractor disputes the results and elects to have confirmatory testing of hardened cores undertaken, all coring and testing shall be at the Contractor's expense and shall be undertaken by a testing authority approved by the Project Manager.

2.3.7.9 Quality Assurance

It shall be the Contractor's responsibility to ensure that the materials comply in all respects with the Contractors Drawings and Specifications.

2.3.7.10 Inspection and Testing

2.3.7.10.1 Inspection

a) The Project Manager may inspect construction in accordance with NZS 3109, clause 1.3. Before pouring commences, the Project Manager or his representative shall be given 24 hours notice to enable inspection of formwork, reinforcement and construction joints. No concrete shall be placed until the Project Manager is satisfied that all provisions of the specifications and drawings have been complied with.

b) Where necessary, the Project Manager's instructions shall be carried out before concrete placing commences.

c) The Contractor shall submit in writing to the Project Manager for approval a method statement for handling, placing, finishing, curing and protecting fresh concrete giving the precautions that will be taken to prevent the influences of the weather causing premature cracking of the concrete element. The sequence of placing of concrete and method shall not be varied without further approval.

2.3.7.10.1.1 Concrete Assessment

a) The concrete manufacturing process shall follow the sampling, testing and control requirements of NZS 3104.

b) Assessment of special concrete mixes and other concrete for this Contract shall be as specified in Section 4 of this Specification.

2.3.7.11 Durability

a) To provide durable concrete structures, the Contractor shall provide, in place, a dense low permeability concrete with low chloride ion content, sound aggregates free from alkali aggregate reaction, and a concrete which will provide adequate protection to the prestressing and reinforcing steel.

b) The Contractor shall ensure that the handling and placing of all concrete shall be in accordance with section 7 of NZS 3109.

c) The personnel placing concrete shall be experienced in the handling and placing of concrete.

d) Compliance with this specification shall be the minimum requirement necessary to meet the objectives in a) above.

2.3.7.12 Compaction

a) All concrete shall be vibrated in accordance with section 7.6 of NZS 3109. Complete compaction of the concrete will be required to ensure that the concrete in place has the durability necessary for its long term environment. Refer also to the Cement and Concrete Association guide “Placing and Compacting Concrete”.

b) Control of compaction shall at all times be under the control of experienced operators and supervised by staff of at least foreman level.

2.3.7.13 Finishing

The surface finish of unformed concrete shall comply the requirements of NZS 3109 clause 7.7 and with the provisions of NZS 3114.

2.3.7.14 Formwork

2.3.7.14.1 General

a) All formwork shall be designed by the Contractor to meet the requirements of Section 5 of NZS 3109 and AS 3610.

b) Formwork may be re-used provided forms are adequately cleaned to maintain the standard of finish and the tolerances specified.

c) Unless specified otherwise, forms shall be radiused or chamfered at all sharp edges with a dimension of 20mm across the diagonal face. The surface finish of the fillets shall match that of the forms. All fillets shall be well greased to avoid tearing of edges during form stripping.

2.3.7.14.2 Tolerances

Dimensional tolerances shall be in accordance with Table 4 of NZS 3109, except where modified in Section 4 of this Specification.

It is recommended that at key structural positions the tolerance for both fabrication and erection be checked and where necessary revise the default tolerances of NZS 3109 clause 5.3.

2.3.7.14.3 Ties

a) Where ties pass through joints, the ties shall be removed after concreting so that no part remaining in the concrete shall be nearer the surface than 40mm.

b) Ties left in the walls of hydraulic structures shall have a rubber ring waterbar attached. Ties which leave a penetration through the wall are not permitted.

c) Holes left after removal of the tie cones shall be filled with an epoxy mortar or hard pack cement grout such that leakage or damp patches are prevented in the completed hydraulic structure. The Contractor shall obtain the approval of the Project Manager for the mortar or grout prior to filling the holes.

2.3.7.14.4 Surface Finishes

a) Surface finishes shall be finished to the most appropriate standard detailed in NZS 3114 Table 1 (formed finishes) and Table 2 (unformed finishes).

c) Defects such as honeycombing, voids around reinforcement etc shall not be repaired without the knowledge and approval of the Project Manager. The Contractor shall provide a methodology of repair to the Project Manager prior to execution of the work. Superficial defects shall be repaired by grinding and “bagging in” with mortar.

2.3.7.14.5 Stripping

Removal of formwork shall be removed without shock or vibration and in such a manner to permit the concrete to take the imposed stresses gradually. Stripping times shall be in accordance with Clause 5.4 of NZS 3109. Due regard shall be taken of the special characteristics of concrete containing Duracem cement, such as a longer cure time, for example.

2.3.7.15 Falsework

a) The Contractor shall be responsible for the engineering design, erection, maintenance, safety, and staged removal of all falsework, including staging, walkways, forms, ladders etc.

b) All falsework shall be designed and constructed to provide the necessary rigidity and to support the loads. Falsework for the support of a superstructure shall be designed to support the loads that would be imposed if the entire superstructure were placed at one time.

c) Falsework shall be placed on solid footings, safe against undermining, and protected from softening.

d) Where falsework is supported on any portion of the structure which is already constructed, the load imposed by the falsework shall be spread, distributed and braced in such a way as to avoid any possibility of damage to the structure.

2.3.7.16 Construction Joints

a) Concrete placed monolithically shall be of such size, geometry, and sequence that shrinkage cracking is minimised. Where any shrinkage crack exceeds 0.1mm in width and where required by the Project Manager, remedial work shall be carried out. The Contractor shall obtain the approval of the Project Manager for all materials and methods before undertaking the repairs.

b) Construction joints shall be either
   i. as shown on the drawings, or
   ii. “type B” in accordance with NZS 3109, located as shown on the drawings, or where the locations are not defined, at positions of low shear stresses as approved by the Project Manager.

2.3.7.17 Curing

a) Curing shall be carried out in accordance with NZS 3109. This standard shall be the absolute minimum for any structure on this Contract.

b) From immediately after placement, concrete shall be protected from premature drying, excessively hot or cold temperatures and mechanical injuries. The concrete shall be maintained with minimum moisture loss for the period necessary for hydration of cement and hardening of the concrete as defined in clause 7.8 of NZS 3109.

c) For non-hydraulic structures, concrete shall be cured for a minimum of 7 days. Curing compounds may be used on these structures.

d) For hydraulic structures, membrane curing compounds shall not be used. Concrete shall be cured for a minimum of 14 days as follows:

Either	first 7 days	all concrete and its formwork and other surfaces shall be kept continuously wet by ponding where possible, and protected from sun and drying winds
	8 – 14 days	all concrete surfaces shall be protected from sun and drying winds, and shall be kept damp by occasional hosing
or,	where approved in writing by the Project Manager, a curing compound complying with ASTM C309 or AS 3799 may be used.	

2.3.7.18 Reinforcement

2.3.7.18.1 Cover to Reinforcement

a) The minimum cover shall not be less than 50mm on surfaces exposed to liquids or soil unless approved protective coatings are used, or 40mm elsewhere. Concrete cast against ground shall have a 75mm minimum cover.

b) Cover is measured from the concrete surface to the nearest layer of reinforcement.

c) If the concrete surface contains rebates or architectural features which in places reduce the cover, then the cover is measured from the deepest surface rebate to the nearest layer of reinforcement.

2.3.7.18.2 Workmanship and Care of Reinforcement

a) Prior to bending, bars shall be cleaned of all loose rust, mill scale, dirt, oil, paint etc. The use of flame for cleaning and straightening is not permitted.

b) Badly twisted bars shall be rejected and removed from the site. Bars shall not be bent or straightened after placing unless approved in writing by the Project Manager, for each specific case.

c) At the time of concreting, the bars shall be free of any foreign coatings, form oil or dried accumulation of mortar, which reduce the effective bond between concrete and steel.

2.3.7.18.3 Additional Reinforcement Requirements to NZS 3109

a) In all hydraulic structures and in concrete cladding panels, all tie wire shall be galvanised. Ends of tie wire shall be bent back away from the cover concrete.

b) Spacer blocks shall be plastic or 40MPa concrete. Concrete masonry spacers, or spacers made on site shall not be used.

c) Reinforcing shall not be tack welded.

d) Welding of reinforcing is not permitted without the Project Manager’s approval. If approval is given, welding shall be in accordance with NZS 4702.

e) If approved, welding shall be carried out by qualified welders and shall be in accordance with NZS 4702, to achieve at least Class S welds. Welding shall not be carried out under damp conditions or at temperatures of below 10ºC. Welders shall be adequately supervised so as to ensure use of proper electrodes, suitable amperages and sufficient time for each weld to avoid sudden quenching. For 500E strength grade, welded using 'Manual Metal Arc Welding process', without preheating, low hydrogen electrodes are the only electrode that shall be used. Reduction in tie (bar cross section) area or faulty welding will be cause for rejection or repair of welds.

f) For concrete cast against ground, particular care shall be taken to ensure that
   i. no damage occurs to any waterproofing membrane or damp proof course; and
   ii. reinforcement is not displaced by foot traffic to reduce its cover.

2.3.7.19 Embedded Items

2.3.7.19.1 Minor Embedded Items, Holes, Chases, Rebates

a) The Contractor shall provide and adequately support prior to concreting, all sleeves, inserts, anchors, holding down bolts, conduits, pipes and other embedded items. Voids in sleeves, inserts and anchor slots shall be plugged, taped or filled temporarily with readily removable material to prevent entry of concrete into the voids.

b) The Contractor shall accurately form and position all chases, fillets, holes, upstands and nibs as shown on the drawings, prior to concreting.

2.3.7.19.2 Embedded Pipework

a) All pipes and fittings cast into concrete shall be provided with puddle flanges or other approved systems of ensuring water tightness.

b) Pipes passing through post-tensioned concrete shall be connected after completion of the post-tensioning in one of two ways. Either blockouts to accommodate such pipes shall be formed in the appropriate place, or spool pieces shall be cast into the concrete prior to tensioning.

2.3.7.20 Casting New Concrete Against Old

a) Where concrete is to be cast against old concrete (any concrete which is older than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by water blasting or abrasive blasting (exposing aggregate).

b) The joint surface shall be coated with an epoxy based bonding agent unless indicated otherwise by the Project Manager.

2.3.7.21 Sealants and Waterstops

2.3.7.21.1 General

a) All joint sealants shall be mixed and applied strictly in accordance with the manufacturer’s specification and applied by skilled applicators.

b) Concrete surfaces shall be prepared in accordance with the sealant manufacturer’s specification. All surfaces in contact with sealant shall be clean and dry prior to the application of joint sealants. Sealing shall not be carried out while surfaces show any sign of dampness.

c) Joint cross section dimensions are shown on the Contractors drawings. The Contractor shall examine all joint details to confirm that the sealant may be formed in a satisfactory manner to provide a completely watertight joint.

d) All joint surfaces shall be primed prior to the application of joint sealant material. Primers, bond-breaking tape and filler rods shall be as specified by the sealant manufacturer, and shall be applied and allowed to cure before sealant application in accordance with the manufacturer’s specification.

e) Surfaces adjoining the joints shall be masked to prevent contamination by sealant or primer materials. Masking shall be removed on completion of sealant application.

f) The Contractor shall take care to prevent damage due to any action, including mechanical or chemical attack, after the application of sealant material.

g) A detailed record shall be kept of when sealants were placed so that curing times can be monitored. No sealant shall be relied upon to fulfil its purpose until fully cured.

2.3.7.21.2 PVC Waterbars and Waterstops

All waterbars and waterstops shall be joined, spliced and installed in accordance with the manufacturer's specifications. The Contractor shall allow for all necessary additional reinforcing, ties, supports, etc. to ensure that the waterstop is restrained in its correct position during concreting.

2.3.7.21.3 Hydrophilic Waterstops

a) Hydrophilic waterstops shall be butted and glued together in accordance with the manufacturer's instructions to give a water-tight junction.

b) Hydrophilic waterstops shall be installed with a minimum of 100mm cover.

2.3.7.22 Dry Pack Mortar

a) Dry pack mortar shall be a sand cement mortar in the proportions of one part cement to three parts sand by weight.

b) Additives to reduce water content or to enhance adhesion shall not be used without the written approval of the Project Manager.

c) Water and additives shall be added to the sand cement to produce a mortar that has a dry consistency. When squeezed in the hand to a ball, the mortar shall retain its shape, but shall not be so dry that it shows cracking on its outer surface.

d) The water/cement ratio shall not exceed 0.40 by weight.

e) Mortar shall be placed in layers, packed hard with a wooden caulking tool and hammered tight. Adequate rigid formwork shall be used where required to confine the mortar during the packing operation.

2.3.7.23 Waterproofing Form-Tie Holes

2.3.7.23.1 Preparation

Plastic cones, snap-ties and tapered rods shall be removed from the concrete to expose tie holes. Tie holes shall then be cleaned with a wire brush to remove loose debris and other contaminants. Tie holes shall then be flushed with clean water. If necessary, form oil is to be removed.

2.3.7.23.2 Application

a) Tie holes and surrounding areas shall be pre-soaked with clean water to a saturated, surface-dry condition (SSD).

b) The application shall be protected for a minimum of 48 hours from:
   i. rapidly drying out due to heat;
   ii. damage from rain;
   iii. excessive wind;

2.3.8 **Steel Work and Metal Work**

2.3.8.1 Scope

The Contractor shall design, detail, fabricate, furnish, install, and paint or galvanize all steelwork and metalwork.

2.3.8.2 Applicable Codes and Standards

a) All work, materials and practices shall comply with the requirements of current New Zealand or Australasian standards for that particular class of work. The following standards shall apply specifically:

AS 1101.3:2005	:	Graphical Symbols for general engineering – Welding and non-destructive examination
AS 1111.1:2000	:	ISO metric hexagon bolts and screws – Product Grade C - Bolts

AS 1111.2:2000	:	ISO metric hexagon bolts and screws – Product Grade C - Screws
AS 1112.1:2000	:	ISO metric hexagon nuts - Style 1 - Product grades A and B
AS 1112.2:2000	:	ISO metric hexagon nuts - Style 2 - Product grades A and B
AS 1112.3:2000	:	ISO metric hexagon nuts - Product grade C
AS 1112.4:2000	:	ISO metric hexagon nuts - Chamfered thin nuts - Product grades A and B
AS 1214:1983	:	Hot-dip galvanised coatings on threaded fasteners (ISO metric coarse thread fasteners)
AS 1237.1:2002	:	Plain washers for metric bolts, screws and nuts for general purposes - General plan
AS 1237.2:2002	:	Plain washers for metric bolts, screws and nuts for general purposes - Tolerances
AS 1397:2001	:	Steel sheet and strip – hot-dipped, zinc-coated or aluminium / zinc-coated
AS 1674.1:1997	:	Safety in welding and allied processes – fire precautions
AS 1897:1976	:	Electroplated coatings on threaded components (metric coarse series)
AS 3828:1998	:	Guidelines for the erection of building steelwork
AS 4100:1998	:	Steel structures.
AS/NZS 1163:2009	:	Cold-formed structural steel hollow sections
AS/NZS 1252:1996	:	High strength steel bolts with associated nuts and washers for structural engineering
AS/NZS 1554.1:2011	:	Structural steel welding Part 1: welding of steel structures
AS/NZS 1554.2:2003	:	Structural steel welding Part 2: stud welding (steel studs to steel)
AS/NZS 1554.5:2011	:	Structural steel welding Part 5: welding of steel structures subject to high levels of fatigue loading
AS/NZS 2980:2007	:	Qualification of welders for fusion welding of steels
AS/NZS 4680:2006	:	Hot dipped galvanised (zinc) coatings on ferrous articles
AS/NZS 4855:2007	:	Welding Consumables – Covered electrodes for manual metal arc welding of non-alloy and fine grain steels - Classification
AS/NZS ISO 9000.2:1998	:	Quality management and quality assurance standards - Quality management and quality assurance standards - Generic guidelines for the application of ISO 9001, ISO 9002 and ISO 9003
AS/NZS ISO 9001:2008	:	Quality Management Systems - Requirements
ASTM A106/A106M-08	:	Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
BS 466:1984	:	Specification for power driven overhead travelling cranes, semi-goliath and goliath cranes for general use
BS EN 10025:2004	:	Hot rolled products of structural steels
BS EN 10029:2010	:	Specification for tolerances on dimensions, shape, and mass for hot rolled steel plates 3mm thick or above
BS EN 60974	:	Arc welding equipment
BS EN ISO 2560:2009	:	Welding consumables. Covered electrodes for manual metal arc welding of non-alloy and fine grain steels. Classification

HERA: June 1998	:	Design and Construction Bulletin (HERA *DCB No.44*)
HERA	:	Structural Steel Design Guide, Volumes 1 and 2
NZS 3404.1 & 2:1997	:	Steel structures standard and Commentary
NZS 3910:2003	:	Conditions of contract for building and civil engineering construction
NZS 4224:1983	:	Code of practice for measurement of civil engineering quantities
NZS 4781:1973	:	Code of Practice for safety in welding and cutting
WTIA	:	Flame cutting of steels, WTIA Technical Note No. 5
WTIA	:	Health and safety in welding, WTIA Technical Note No.7

b) Compliance with these Codes and with this Specification shall be the minimum requirement necessary for this Contract.

c) The documents listed above and in the clauses that follow refer to their latest issue complete with amendments that are current at the date of the Tender Document and are deemed to form part of this Specification. However, this Specification takes precedence when it is at variance with the cited document.

2.3.8.3 Definitions

Specification	:	The Technical Specification covering the stated discipline
Construction Reviewer	:	A person who, on the basis of qualifications or experience, is competent to undertake the review. See Clause 1.6.3.1 of NZS 3404
Welding Supervisor	:	A person engaged by the Contractor who shall ensure that all welding is carried out in accordance with the plans, specifications, any other documents, and the requirements of AS/NZS 1554.1. His qualifications shall comply with AS/NZS 1554.1 Section 4.12.1.
Welding Inspector	:	A person who has qualifications complying with AS/NZS 1554.1 Section 7. The Welding Inspector shall normally be an independent party contracted directly to the Contractor.
Part turn	:	Method of tensioning bolts. See NZS 3404 15.2.5.2

2.3.8.4 Abbreviations

NZS	:	New Zealand Standard
AS	:	Australian Standard
HERA	:	Heavy Engineering Research Association
BS	:	British Standard
ISO	:	International Standards Organisation
ASTM	:	American Society for Testing and Materials
UB	:	Universal beam
UC	:	Universal column
PFC	:	Parallel Flange Channel
TFC	:	Taper Flange Channel
EA	:	Equal Angle
RHS	:	Rectangular Hollow Section
CHS	:	Circular Hollow Section
HDG	:	Hot Dipped Galvanised
NDT	:	Non Destructive Testing
GP	:	General Purpose (welds)
SP	:	Special Purpose (welds)
WITA	:	Welding Technology Institute of Australia

2.3.8.5 Storage

a) Storage shall comply with the relevant sections of NZS 3404.

b) Steel shall be stored in such a manner that is not damaged. Steel shall be stacked in a clean dry area on the site at least 300mm clear of the ground. Sufficient timber packing shall be provided to prevent distortion.

c) Steel decking shall be stored in accordance with the written requirements of the decking manufacturer. In all instances, decking shall be stored clear of the ground and protected from the weather.

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2.3.8.6 Material Standards

2.3.8.6.1 Structural Steel

Structural steel shall comply with NZS 3404 and the steel Grade shall be as listed below.

i. Universal Beams, Universal Columns, Parallel Flange Channels, Equal Angles, Unequal Angles, Taper Flange Channels, Taper Flange Beams.
Grade 300 or
BHP-300PLUS

ii. Hot-rolled plate, flat, packing or filler plates
Grade 250

iii. Welded Beams and Welded Columns
Grade 300 MOD (BHP New Zealand Steel)

iv. Rectangular Hollow Sections (RHS) and Square Hollow Sections (SHS)
Grade C350

v. Circular Hollow Sections
Grade C350 to AS1163 or
Grade B to ASTM A106, or
API Spec. 5L

2.3.8.6.2 Welding consumables

Welding consumables shall comply with AS/NZS 1554.1 and NZS 3404.

2.3.8.6.3 Bolts, Nuts and Washers

a) Bolts, nuts and washers shall comply with the standards listed in NZS 3404.

b) All bolts, nuts and washers shall be hot-dip galvanised by the manufacturer and comply with AS 1214. Custom galvanising of high strength bolts is not permitted.

2.3.8.6.4 Cold Formed Sections

a) These shall be Steel & Tube HST profiles to finish and grade as follows:
   i. Grade 450 for metal thickness > 1.5mm
   ii. Grade 500 for metal thickness < 1.5mm
   iii. Hot-dip galvanised Z275 finish

b) Cold formed members forming a part of a roof or a wall are to be provided with galvanised sag and brace members in accordance with the manufacturers recommendations.

2.3.8.6.5 Steel Shear Studs

Steel shear studs shall comply with AS 1554.2.

2.3.8.6.6 Steel Decking Systems

a) Steel tray decking systems shall be manufactured from G550 galvanised steel coil, to AS 1397, with a Z200 zinc layer.

b) The Contractor shall be responsible for supply of all end caps, closure strips, edge forms and hanger tabs required to complete the decking.

2.3.8.6.7 Crane Rails

Lengths of individual crane rails shall not be less than 3m.

2.3.8.7 Grating and Grating Treads

Grating shall be per NAAMM MBG 531 for standard grating and per NAAMM MBG 532 for heavy duty grating. Depth of the bearing bars shall be based on the loading and span requirements. Gratings shall have an anti-slip system. Welding should be per NAAMM MBG 533.

Grating stair treads shall be sized for the required design load and span and shall meet the requirements of NAAMM.

2.3.8.8 Handrails

Handrails shall be designed, fabricated and installed per AS1657 "Fixed Platforms, Walkways, Stairways & Ladders – Design, construction and installation". Handrails should consist of hollow steel pipe of nominal size not less than 25 mm and thickness not less than 3mm. Posts, rail and corners maybe joined by either flush-type rail fittings, mitering and welding, or bending with suitable jigs so as to not crush the pipe. Removable sections should be provided where appropriate around access openings. Handrailing shall be attached to walls and floors by suitable connections and face plates.

All pipe handrail systems shall be hot dipped galvanised, and site welding and repair is to be minimised.

2.3.8.9 Fixed Ladders

Comply with the requirements and recommendations of AS1657 "Fixed Platforms, Walkways, Stairways & Ladders – Design, construction and installation". The ladders and the stays shall be thickly galvanised after complete manufacture.

2.3.8.10 Staircases

Comply with the requirements and recommendations of AS1657 "Fixed Platforms, Walkways, Stairways & Ladders – Design, construction and installation". Staircases shall be suitable for the design loads acting on the plan area of the stair. The grating treads should be as described above. Stair and landings shall be guarded on each side with a continuous guard/handrail as appropriate. Staircases should have a maximum angle to the ground of 50º, while above 65º ladders should be boarded between 50º & 65º.

2.3.8.11 Access Covers

Access covers and frames shall be fabricated from standard steel sections and checker plate. They shall be weatherproof (prevent the ingress of water) when closed, and shall in all respects be strong and durable.

The minimum thickness of all materials shall be 3 mm. The covers shall be lockable. The covers and frames shall be galvanised.

2.3.8.12 Chain-Link Fence and Gates

Chain-link fence shall be per the Chain-Link Fence Manufacturer's Institute Product Manual. Fence posts, gates, and accessories shall be of the design that is standard with the manufacturer.

Post tops, extension arms, gate hinges, stretcher bars, top-fitting rails, stretcher-bar bands, bolts and nuts, clips, and fabric bands shall be steel, wrought iron, or malleable iron.

Barbed wire shall be zinc coated after fabrication. Extension arms shall be cast steel galvanised to accommodate the provided number of strands of barbed wire and sloped to 45 degrees.

Gates should be of the swing type, hinged to swing through 90 degrees from closed to open, and shall be complete with latches, stops, keepers, hinges, fabric, braces, and padlocks. Gate frames and fabric shall match the fence. Provisions shall be made for the padlocks to be attached and operated from either side of the installed gate. Gate posts and gate end members shall extend above the top of fabric to support three strands of barbed wire.

With the exception of the chain link fabric, all ferrous metal used in the construction of the fence shall be hot-dipped zinc-coated after fabrication.

2.3.8.13 Guard Rail

Guard rail shall consist of a galvanised steel beam mounted on galvanised steel posts. Bolts, washers, and nuts used in connection with the guard rails shall be galvanised.

2.3.8.14 Fabrication and Erection

2.3.8.14.1 Connections

In general, shop connections shall be welded and field connections shall be bolted. All bolted connections for structural framing shall be made using ASTM A325/A490 high-strength bolts. Welded connections shall be completed in accordance with AWS D1.1.

2.3.8.14.2 Fabrication

Fabrication and assembly shall be performed in the shop to the greatest extent possible. All work shall be performed to the best modern practice in the manufacture and fabrication of materials of the type covered by the Employer's Requirements.

The Contractor shall fabricate all metal work in accordance with the accepted shop drawings and all requirements of AISC "Manual of Steel Construction." All work shall be square, true, straight, and accurate to the required size, with joints closely fitted and properly secured. All shearing, planning and machine flame-cutting shall be done neatly and accurately. All joints that depend on bearing contact for transfer of load shall have the bearing surfaces machined to a common plane. Self-tapping shake-proof screws shall be used on items requiring assembly by screws or as required. Exposed welds shall be continuous for the length of each joint. Exposed welds shall be filed or ground smooth and flush.

2.3.8.14.3 Corrosion Protection, Painting, and Galvanizing

The Contractor shall adequately protect all parts of the Facilities against corrosion under service conditions and during transport, storage, and erection. The surface treatment shall in general be carried out at the manufacturer's facilities. Prior to shipment, the work shall be cleaned and primed or galvanised as required.

Items in contact with concrete, friction connection surfaces, machined surfaces, surfaces to be field welded and galvanised items shall not be primed. One shop coat of red oxide primer should be applied to all nongalvanised steelwork items. Minimum film thickness should be 50 mm. After grinding of rough welds and sharp edges, surfaces to be painted should be blast cleaned to Commercial SSPC SP6.

Heavy deposits of grease shall be removed by solvent prior to blast cleaning. Any rust formed on cleaned surfaces prior to painting shall be removed and the affected surfaces cleaned again. All damaged surfaces and surfaces without shop coat with primer shall be touched up, except as specified otherwise.

Material, including structural shapes, plates, bolts, expansion anchors, nuts, lock nuts, handrails, railings, railing posts, gratings and grating frames shall be hot-dip galvanised. Material shall not be galvanised until all shop operations upon it have been completed, except that nuts may be threaded after galvanizing.

Aluminium surfaces should be treated as follows:

a) Clean all surfaces and degrease with white spirit.
b) Apply etching primer to a total dry film thickness of not less than 2.5 mils.
c) Apply to two finishing coatings with paint of a single pack alkyd finish.
d) The final total dry film thickness should not be less than 12.0 mils. The coats of paint shall have different colours.
e)

2.3.8.15 Erection of Structural Steel

2.3.8.15.1 General

Erection of structural steel shall be in accordance with the applicable provisions of the AISC Specification, unless otherwise indicated.

2.3.8.15.2 Connections

Anchor bolts and other connections between the structural steel and the concrete structure shall be provided and shall be properly located and embedded.

2.3.8.15.3 Field-Welded Connections

Field-welded structural connections shall be completed in accordance with AWS D1.1.

2.3.8.15.4 Correction of Errors

Minor misfits may be corrected by moderate amounts of reaming, chipping, or cutting, and the drawing of elements into line through the use of drift pins. The Contractor shall clean with mechanical brushes and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.

2.3.8.16 Installation of Miscellaneous Metals

Installation of miscellaneous metals shall be in accordance with applicable provisions of the relevant specifications.

Grating shall be installed in accordance with manufacturer's standards. Fasteners shall be mechanical and detailed so that grating can be easily removed. All fasteners and hardware shall be galvanised or of corrosion resistant materials.

All anchors shall be chemical epoxy type and installed in accordance with manufacturer's instructions. Expansion type anchors are not permitted.

Exposed fastening devices shall match finish and be compatible with material through which they pass.
Contractor shall touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with primer. Contractor shall touch-up galvanised surfaces with zinc rich primer where burned by field welding.

2.3.9 Concrete (Block Masonry)

2.3.9.1 Scope

This Specification covers the requirements for the supply and laying of all concrete masonry work including filling with grout.

2.3.9.2 Applicable Codes and Standards

a) All work, materials and practices shall comply with the requirements of current New Zealand or Australasian standards for that particular class of work. The following standards shall apply specifically:

AS/NZS 1170.0:2002	: Structural design actions - general principles
AS/NZS 1170.1:2002	: Structural design actions - permanent, imposed and other actions
AS/NZS 1170.2:2011	: Structural design actions - wind actions
AS/NZS 1170.3:2003	: Structural design actions - snow and ice actions
AS/NZS 1170.5:2004	: Structural design actions - earthquake actions - New Zealand
AS/NZS 2699.1:2000	: Built-in components for masonry construction - wall ties
AS/NZS 2699.2:2000	: Built-in components for masonry construction - connectors and accessories
AS/NZS 4455.1:2008	: Masonry units, pavers, flags and segmental retaining wall units - Masonry units
AS/NZS 4455.3:2008	: Masonry units, pavers, flags and segmental retaining wall units - Segmental retaining wall units
AS/NZS 4671:2001	: Steel reinforcing materials
NZS 3101.1 & 2:2006	: Concrete structures standard
NZS 3103:1991	: Sands for mortars and plasters
NZS 3104:2003	: Specification for concrete production
NZS 3109:1997	: Concrete construction
NZS 3112.1:1986	: Methods of test for concrete - tests relating to fresh concrete
NZS 3604:1999	: Timber framed buildings
NZS 4202:1995	: Standard method of measurement of building works
NZS 4210:2001	: Masonry construction: materials and workmanship
NZS 4224:1983	: Code of practice for measurement of civil engineering quantities
NZS 4229:1999	: Concrete masonry buildings not requiring specific engineering design
NZS 4230:2004	: Design of reinforced concrete masonry structures

b) Compliance with these Codes and with this Specification shall be the minimum requirement necessary for this contract.

c) The documents listed above and in the clauses that follow refer to their latest issue complete with amendments that are current at the date of the Tender Document and are deemed to form part of this Specification. However, this Specification takes precedence when it is at variance with the cited document.

2.3.9.3 Materials

2.3.9.3.1 Quality Assurance

a) It shall be the Contractor’s responsibility to ensure that the materials comply in all respects with the Drawings and Specification.

2.3.9.3.2 Material Standards

2.3.9.3.2.1 Masonry

a) All concrete masonry shall be in accordance with AS/NZS 4455. All to have true and unblemished surfaces and arises and be from a single manufacturer. Excessively damaged or otherwise irregular blocks will not be accepted.

b) Where block types are not shown on the Drawings, the blocks used shall be such as to achieve the joint patterns shown on the drawings, and be capable of being placed to reinforcing steelwork already in place. Knock-in bond beam blocks shall not be used instead of plain end blocks.

c) For intermittently filled construction, where vertical reinforcement is placed prior to laying of blocks, “Standard” blocks shall be used except at vertical reinforcement where “Open End” blocks shall be used. At horizontal reinforcement “Channel Bond Beam” blocks shall be used together with “Open End Channel Bond Beam” blocks at vertical reinforcement.

d) For “all Cells Filled” construction, “Open End Bond Beam” blocks shall be used throughout with “Knock-In Bond Beam Corner” blocks to be used at ends.

e) Blocks shall be cut, as necessary, to fit dimensions or to suit reinforcing. Cutting shall be done by means of a special hydraulic block cutting machine or carborundum saw and exposed edges shall be clean, square and even.

2.3.9.3.2.2 Mortar

All mortar shall have a compressive strength of 12.5MPa and shall generally be in accordance with NZS 4210, Section 2.2. Approved workability additives may be used.

2.3.9.3.2.3 Reinforcement

a) Reinforcement is as per this Specification and shall conform to Clause 2.6 of NZS 4210.

b) In general, reinforcement shall comply with AS/NZS 4671 and shall be deformed steel, except for ties, which are plain round mild steel.

2.3.9.3.2.4 Grout

a) Grout shall have properties specified in NZS 4210 clause 2.3.2 for the particular durability zone.

2.3.9.4 Alternative Materials

Should the Contractor propose to use materials other than those in this Specification, he shall submit to the Project Manager for approval detailed specifications of the materials he proposes to use. The Contractor shall not use any such materials until he has obtained written approval for their use from the Project Manager.

2.3.9.5 Storage of Materials

a) Materials shall be stored on site in accordance with the manufacturer’s specification and shall be adequately protected against mechanical damage and prolonged exposure to ultraviolet radiation.

b) Upon delivery to site, the reinforcement shall immediately be stacked in racks located in a clean dry area removed from construction traffic. Before use, blocks shall be kept dry, free from contact with ground and completely covered from the weather.

2.3.9.6 Defective Materials

Defective materials shall not be used for the construction of the Facilities and shall be removed from Site and replaced with sound materials at the Contractor’s expense.

2.3.9.7 Execution

2.3.9.7.1 Laying & Cleaning Down

a) Blockwork shall be carried out by blocklayers employed by a Contractor specialising in the laying of concrete blocks. All work shall be carried out in a tradesman-like manner. A foreman Blocklayer who is a Registered Mason shall be on site at all times blocks are being laid.

b) The surface on which the first course is laid shall be scabbled to form a good construction joint.

c) To facilitate cleaning out of mortar droppings and other debris, the first course of each lift shall be laid using inverted knock-in bond beam blocks. The surface on which the first course has been laid shall be sprinkled with sand to facilitate easy removal of the mortar.

d) All walls shall have clean out ports at the bottom of each lift, in accordance with NZS 4210 clause 2.7.8.2, and shall be formed by leaving half of full-face shells off. Where clean out ports will not be visible on completion of the work, the block side may be made good with the infill concrete. Where clean out ports will be exposed in the finished work face shells are to be mortared in and pointed to match the surrounding blockwork. The face shells shall be braced prior to grouting, but only after cleaning out and inspection by the Project Manager. Alternatively, retain the block fill with a recessed form, later to be plastered to a finish to match the balance of the masonry.

e) Masonry shall, in general, maintain stretcher bond, except where otherwise specified or shown on the drawings. Laying shall conform to NZS 4210 clause 2.7. Masonry shall be carefully laid out to avoid the use of cut blocks where possible. The Contractor shall advise the Project Manager when the first course has been laid.

f) Build Masonry to vertical reinforcing with open ended type blocks and end closers. Provide bond beam and open ended bond beam type blocks and end closers for horizontal reinforcement. Use special blocks or cut blocks as required.

g) Where Masonry is not course bonded at wall junctions, cut blocks to allow bond beam reinforcing to pass through.

h) Starter positions: Check the location of starter reinforcement before block laying commences, or by a dry trial lay up of the first course. Do not attempt to correct misplacement by cranking bars. Where misplacement exceeds the location tolerance, obtain written directions before proceeding further.

i) Moisture content: Ensure that blocks are air-dry prior to laying. Blocks shall not be laid during weather sufficiently inclement to affect the quality of the finished work. If necessary to reduce excess absorption of water from the mortar, some dampening of the surface is permissible but no surface water may be present at the time of placing mortar.

2.3.9.7.2 Joints

a) Joints, both horizontal and vertical, shall be level and plumb and of uniform thickness throughout, nominally 10mm and perpends on alternate courses shall be in a vertical line.

b) Remove excess mortar and droppings as the laying proceeds and in particular, keep spaces to be filled with concrete clear and clean. Mortar fins protruding more than 10mm from joints shall be removed before pouring core-filling concrete.

2.3.9.7.3 Construction Joints

a) Ensure the structural integration of all masonry with adjacent concrete work by providing well-roughened retarded construction joints at all junctions.

b) All construction joints between grout and concrete and between grout and grout shall be similar to Type B as described in NZS 3109, clause 5.6.3, prepared using an approved retarder, except that the roughness at fine grout surfaces may be ±1.5 mm above and below the average level. Use a "double strength" retarder if necessary to suit the high cement content of the grout.

c) Vertical joints between masonry and concrete shall achieve full structural integration across the joints. Allow to construct concrete work first with prepared vertical construction joints at block junctions the same as for horizontal construction joints. Lay masonry so that all courses have open ends abutting the existing concrete work.

2.3.9.7.4 Control Joints

a) Build control joints into walls where detailed on drawings, or, at no greater spacing that the maximum given in NZS 4210 clause 2.10.

b) Control joints shall be continuous vertical perpends. Reinforcement shall be discontinuous through the joint as detailed in Figure 2 of NZS 4210. Grouting of bond beams at control joint locations to be discontinuous unless specifically noted otherwise.

c) Rake back the vertical joints where accessible, to a depth of 10mm on each face at the block joint. At least four weeks after adjacent masonry has been grouted neatly point interior control joints with mortar to match all normal joints.

d) Joints required to be weatherproof shall be sealedwith an approved sealant on approved bond breaking tape. Prime the masonry before application. Use in complete accordance with the manufacturer's written instructions.

2.3.9.7.5 Pointing and Cleaning Down

a) Walls to be exposed in the finished work shall be neatly and expertly pointed with ruled concave joints of mortar, as previously specified, as the work proceeds.

b) Walls to be covered in the finished work shall have joints compacted by tooling and left flush. Add additional mortar to joints to ensure that they are completely full before tooling.

c) On completion of walls exposed in the finished work, clean down and remove all mortar projections and irregularities. Peach and make good around all pipes, conduits, etc., that penetrate concrete blockwalls. Make good any faults in the pointing.

2.3.9.7.6 Reinforcement

a) Ensure correct location of Masonry starters, paying regard to block layout, etc. Co-operation with other trades will be necessary in the set out of starters.

b) In general, vertical reinforcing will be positioned in advance of laying, but horizontal reinforcing will be positioned when the appropriate course is laid. Lapping bars shall be tied to each other.

c) Reinforcement shall be adequately held in position to achieve the cover specified.

d) Reinforcing details shall conform with Clause 2.6 of NZS 4210.

2.3.9.7.7 Rebates, Reveals, etc

Ensure all blocks around openings, etc. are correctly laid with sills, reveals and rebates as necessary.

2.3.9.7.8 Building In

As the work proceeds, build into masonry all necessary bolts, steelwork and metalwork items and other fittings and fixings as shown on the drawings or otherwise required for the work. The Blocklayer is to ascertain these particulars and make the necessary provisions beforehand.

2.3.9.7.9 Filling

a) Grouting shall be by the high lift grouting method described in NZS 4210. Note that a sequence of compacting, waiting and recompaction is to be followed.

b) All grout shall be vibrated using suitable equipment and shall intimately and completely surround the reinforcement and fill the voids. Finish to a level surface at the top of each pour and ensure good construction joints between pours. Do not grout until spaces to be filled are checked for restriction or debris.

c) Prevent any movement of reinforcement during grouting and setting. Ensure all face shells, supports, forms, etc. are adequately supported to prevent bursting of the wall during filling.

d) No cell filling shall take place above a bondbeam until that bondbeam and all cells below it have been properly filled.

2.3.9.7.10 Tolerances

Construct within the tolerances set out in NZS 4210, clauses 2.6.5 and 2.7.1.4. Lay blocks with jointing of consistent thickness throughout.

2.3.9.7.11 Weather Precautions

When extreme temperatures prevail, make adjustments to construction as listed in NZS 4210, sections 2.18 and 2.19.

2.3.9.7.12 Bracing

a) Provide temporary lateral bracing where necessary to ensure stability and until final supporting construction is in place.

b) The Contractor's attention is drawn to the fact that reinforced walls will not be stable under all conditions until the infill concrete in them has reached its design strength, and that he should therefore allow to strut walls until this strength has been achieved.

2.3.9.7.13 Inspection and Testing

a) Blockwork will be subject to observation by the Project Manager to ensure the standard of blockwork construction satisfies this Specification.

b) The Project Manager requires the Contractor to notify him, at least one full working day in advance, when any cell filling will be done, so that he may have the opportunity of observing prior to its beginning, and of being in attendance. Such notification, observation or attendance shall in no way relieve the Contractor of any of his responsibilities under the contract.

c) Specific testing requirements shall be as specified in Section 4 of this Specification. All costs of testing shall be borne by the Contractor, who is required to maintain on site the necessary equipment for taking and preparing samples for test. All test results shall be supplied to the Project Manager.

2.3.9.7.14 Completion

Protect angles and corners against impact and other damage. On completion, clean down walls and remove all mortar projections and irregularities and all surplus mortar from beneath the overhanging edges of bottom courses. Make good around all penetrations. Make good any damaged corners, arises, or surfaces. Remove from Site any debris pertaining to this trade. Remove all efflorescence at the end of the defects liability period.

2.3.10 **Retaining Systems (Gabions)**

2.3.10.1 Scope

This specification covers the construction of coated rock-filled wire mesh basket gabions in accordance with New Zealand and international standards and industry practice.

2.3.10.2 Applicable Codes and Standards

a) All work, materials and practices shall comply with the requirements of current New Zealand statutes, regulations, codes and standards for that particular class of work. Where a relevant NZ document does not exist, Australian or other recognised international standards may be accepted, subject to the Project Manager’s approval.

b) Compliance with the standards referred to herein shall be the minimum requirement necessary for this contract.

c) The documents listed in this specification refer to their latest issue complete with amendments current at the date for return of tenders and are deemed to form part of this specification. However, this specification takes precedence when it is at variance with a cited document.

AS 2758.4:2000	:	Aggregates and rock for engineering purposes – Aggregate for gabion baskets and wire mattresses
AS 4678:2002	:	Earth-retaining structures
AS/NZS 4534:2006	:	Zinc and zinc/aluminium-alloy coatings on steel wire
AS/NZS 4680:2006	:	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
ASTM A313 – 10e1	:	Standard Specification for Stainless Steel Spring Wire
ASTM A856 - 03	:	Standard Specification for Zinc-5% Aluminum-Mischmetal Alloy-Coated Carbon Steel Wire
ASTM A975 - 97	:	Specification for Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel Wire with Poly Vinyl Chloride (PVC) Coating)
ASTM B750 - 09	:	Standard Specification for GALFAN (Zinc 5%-Aluminum-Mischmetal) Alloy in Ingot Form for Hot-Dip Coatings
NZS 4402:1986	:	Methods of testing soils for civil engineering purposes – Soil Tests
NZS 4407.3.10:1991	:	Methods of sampling and testing road aggregates - Laboratory tests - Test 3.10 - The crushing resistance of coarse aggregate under a specific load

2.3.10.3 Definitions

Diaphragm	Transverse mesh panel which divides the gabion into cells
Galfan	95%-Zinc, 5%-Aluminium-Mischmetal (Zn-5Al-MM) alloy used in the production of hot-dip coatings on steel (see ASTM B750 and ASTM A856)
Galmac	Maccaferri trade name for its version of Galfan
Mischmetal	Alloy of rare-earth metals containing about 50% cerium and 50% lanthanum, neodymium, and similar elements
Selvedge	Reinforced wire edge of a basket, wound so that the gabion will not fray or unravel

2.3.10.4 Materials

2.3.10.4.1 Baskets

2.3.10.4.1.1 Mesh

a) Mesh wire shall have a tensile strength between 372 – 470 MPa and be manufactured with wire coating in accordance with the coating types and standards specified.

b) The mesh shall be hexagonal and formed of double twisted wire. It shall have sufficient deformability to permit minimum mesh elongation equivalent to 10% of the un-stretched length of a mesh test section without reducing the gauge or tensile strength of individual wire strands to less than that for similar wire, one gauge smaller in diameter.

c) The mesh shall be fabricated so as not to unravel. It shall resist pulling apart at any twist or connection forming the mesh when a single wire strand in a section of mesh is cut or broken.

2.3.10.4.1.2 Fabrication

a) Gabions shall be fabricated so that the sides, ends, lid and diaphragms can be assembled at Site into baskets of the size specified and shown in the Drawings. The gabion base, lid, ends, and sides shall be woven into a single unit.

b) All edges shall be selvaged using wire of diameter not less than 25% greater than that of the gabion. Alternatively, stainless steel ring fasteners of diameter ≥ 3.0 mm and tensile strength between 1530 - 1745 MPa (to ASTM A313) may be used in lieu of lacing wire.

c) Where the length of the gabion exceeds 1.5 times its horizontal width, the gabion shall be divided into cells by diaphragms of the same mesh and gauge as the gabion body. Individual cell length shall not exceed the cell width + 100 mm. The gabion shall be furnished with the necessary diaphragms secured in the proper position on the base in such a way that no additional diaphragm tying is required at Site.

2.3.10.4.1.3 Form for Delivery

Gabions shall be delivered to site in collapsed form, folded and in compressed strapped bundles. Lacing wire shall be delivered in coils. Ring fasteners shall be delivered in boxes. Preformed bracing wires shall be delivered in bundles.

2.3.10.4.2 Gabion Fill Material

a) Gabion fill shall be durable dense rock compliant with AS 2758.4 and be weather resistant, non-friable, insoluble and sufficiently hard for its duty.

b) The rock shall be between 1.5 and 3 times the diameter of the dimension of the mesh, in the range 100 – 200 mm. A variation of 5% oversize and/or 5% undersize rock may be permitted, provided it is not placed on the gabion’s exposed surface. On no account shall oversized rock exceed 210 mm or undersized rock be smaller than 90 mm. Rock that can pass through the mesh shall not be used.

c) Rock shall have a minimum crushing resistance of 130 kN when tested in accordance with the NZS 4407:1991 Test 3.10 “The Crushing Resistance Test”.

d) Every effort shall be made to ensure that the stone fill material used in constructing the gabion structure matches the stone fill on which the designs were based.

2.3.10.4.3 Granular Backfill

Granular backfill shall consist of a durable, free draining, and crushed granular material. The backfill shall be graded and conform to the grading specification as determined by NZS 4402-1986.

2.3.10.4.4 Geotextile Filter Fabric

Filter fabric shall be non-woven needle punched geotextile or approved equivalent.

2.3.10.5 Execution

2.3.10.5.1 Excavation

a) Excavation for the gabion baskets shall be kept to the minimum necessary to provide suitable foundations. The base of the finished foundation, ready for the placement of gabion baskets, shall be dished to provide a positive outlet such that water does not pond beneath the baskets.

b) The Project Manager shall verify on-site the suitability of foundations. The Contractor shall give the Project Manager at least one working day’s notice of when the excavation to foundation level will be ready for inspection. Inspection must be conducted prior to installation of the gabion baskets.

c) Installation of gabion baskets shall proceed as quickly as practicable after excavation and inspection so as to minimise the effect upon adjacent areas.

2.3.10.5.2 Lining

Unless shown otherwise on the drawings, geotextile filter fabric shall be placed immediately beneath and behind the gabion walls.

2.3.10.5.3 Gabion Assembly

a) Gabion size, construction and selvaging shall be according to the manufacturer’s specification and as shown on the Drawings. All gabion dimensions shall be within ±5 % of the manufacturer’s stated dimensions.

b) Each gabion unit shall be assembled by tying or fastening all connecting seams using selvage wire of the diameter specified. The binding wire shall be tightly looped around every other mesh opening along the seams in such a way that single and double loops alternate.

c) Ring fasteners, if used, shall be applied at not more than 200 mm intervals on all vertical and horizontal seams. No fewer than 2 fasteners shall be used per 300 mm on any seam. The ring ends shall have a nominal overlap of 25 mm after closure.

2.3.10.5.4 Gabion Placing

a) All work shall be installed in accordance with the manufacturer's recommendations. A line of empty gabions shall be placed into correct position, alignment and angle according to the Drawings. Binding wire or alternative wire fasteners shall be used to secure each unit to the adjoining one along the vertical reinforced edges and the top selvedges.

b) Baskets shall be correctly tensioned. A manufacturer approved corner closure tool shall be used to join adjacent gabions to ensure a tight, neat seam at front and back and minimise additional wire or fasteners.

c) The end from which work is to proceed shall be secured either to completed work or by steel stakes driven into the ground. The stakes must be secure and reach at least to the top of the gabion box.

d) Placement of adjacent gabion units in any one layer shall be front to front and back to back so that pairs of facing lids can be wired down in one process.

e) When more than one layer of gabions is to be assembled, in order to provide a unified structure, the next layer of gabions must be secured to the layer underneath after the lower layer has been securely closed. This securing shall be to the same centres and methods specified for selvedges.

f) To achieve optimum alignment and finish for retaining walls, stretching if the gabion boxes shall be carried out using a pull lift of at least 1 tonne capacity, which is firmly secured to the free end of the assembled gabion boxes. Tension shall only be released when the gabions are fully laced and sufficiently filled with rock to prevent the mesh from slackening.

2.3.10.5.5 Gabion Filling

a) Rock filling shall be performed manually to minimise voids. Care shall be taken to avoid damage to the wire coating. Rocks shall not be dropped from more than 600 mm vertically above the gabion basket. Exposed faces shall be carefully hand placed to give a neat, flat and compact appearance. Fill shall be fully compacted and the completed gabion shall be without deformation.

b) The cells shall be filled in stages to avoid local deformation. No cell shall be filled to a depth exceeding 300 mm higher than an adjoining cell.

c) To prevent distortion of the gabion units during filling and in the completed structure, pre-formed bracing wires shall be inserted into the cells during the filling operation according to the manufacturer's instructions and at least every 300 mm vertical fill of the gabion unit. A minimum of two ties must be used per 300 mm lift. The bracing wires shall be wrapped around two of the mesh wires and extend from front to back.

d) The rock fill shall be levelled off 20 - 30 mm above the top of the mesh to allow for settlement. The top edge of diaphragms must remain exposed.

2.3.10.5.6 Gabion Closing

a) The lids of filled gabion units shall be folded down and pulled where necessary using a crowbar to close any gaps between the edge of the lid and the edges of the basket before lacing down. Excessive deformation of the lid or basket shall be avoided by redistribution of fill if necessary.

b) The closed lids shall be tightly laced along all edges, ends and diaphragms in the same manner used for assembling the gabions. Adjacent lids may be securely attached simultaneously. All end wires shall be turned in.

2.3.10.5.7 Granular Backfill

a) The backfill shall extend behind the gabion walls for at least 300 mm and shall be spread evenly in horizontal layers not exceeding 200 mm loose depth. Unless specified otherwise on the drawings, the granular backfill shall be capped with a layer of geotextile filter fabric and a 200 mm thick layer of clay to prevent the entry of surface runoff.

b) Where more than one lift of gabions is constructed, granular backfill should proceed with the construction of the baskets, such that no more than one basket-height of fill remains at any time.

2.4 Hydromechanical Specific Requirements

2.4.1 Pipelines/Penstocks

2.4.1.1 Function

The pipeline shall steadily and safely convey the design discharge for power generation from the intakes to the headpond.

The penstock shall steadily and safely convey the design discharge for power generation from the headpond to the turbine.

An underground arrangement is preferred however an above ground pipeline and penstock are permissible should the ground conditions dictate this as a more cost effective option.

2.4.1.2 Contractor's Design

The Contractor shall choose the penstock materials to suit the site environment, headloss minimization and pressure ratings.\

The penstocks shall:

- Deliver the net heads at the turbine inlet.
- The Pressure rating at any point on the pipeline/penstock shall be static plus no less than 15%.
- The Contractor shall design and construct the penstock arrangement to suit the proposed construction arrangements.
- Be designed to prevent buckling and to maintain the pipe circularity. Suitable stiffeners, if required, will be designed to enable the pipe section to resist the following minimum stresses on both inside and outside:
    - Circumferential stresses due to internal pressure.
    - Floatation (if below ground)
    - Traffic loads (if below ground)
    - Longitudinal bending stresses due to the weight of pipe and water.
    - Local shell bending stresses.
    - Seismic stresses.
    - Temperature effects.
    - Traffic loading.
    - Combinations of any of the above.
- For steel pipelines/penstocks a 2mm corrosion allowance shall be added for all plate thickness for steel penstocks.
- For surface penstocks it shall be designed to span between concrete pedestals.
- Where there is a bend of the penstock, bends shall be designed to adequately resist design internal pressures. At every bend there shall be a concrete anchor block designed to resist the resultant load.
- Long radius bends through joint defection or using the allowable bend radiuses of continuously welded pipe is permissible without the need for thrust restraint as long as they are within the manufactures recommendations.
- Anchor blocks shall be suitably designed to resist the resultant forces and shall wherever possible be founded on bedrock with dowel bars anchored to resist pullout and shear loads. Dowel bars shall be corrosion protected.
- Where appropriate expansion joints shall be provided at suitable centres between anchor blocks to prevent additional stresses in the pipe due to thermal expansion or contraction movements.
- Where appropriate provision for air inlet shall be provided to prevent negative pressures.

- The pipeline/penstock shall be designed to operate in a full state during normal operation.
- The Contractor shall design and undertake its temporary works and construction methodology to ensure that temporary and variant conditions do not result in greater stress than those for which the pipeline/ penstock was/ is designed.
- The pipeline/ penstock shall have a means to draining it other than through the turbine. Draining and filling of the pipeline/ penstock shall be able to be undertaken over a 24hr period. This shall include suitable means of allowing air in to the top of the pipeline/ penstock when the intake gate is closed and valves at the bottom of the pipe as a means of both draining the pipe and dissipating the head.

2.4.2 Scour Gates

2.4.2.1 Function

The purpose of the scour gates are to provide means of emptying the headpond behind the weir and scouring any debris and sediments from behind the weir. They are closed when the project in generating electricity.

2.4.2.2 Contractor's Design

The scour gates shall:

- Be capable of being safely operated in a 1 in 1 year flood event.
- The size of the gates are to be determined by the Contractor.
- For lift gates - lifting mechanisms shall be manually operated. Operation of the gate shall be from the side of the weir/ intake.
- All gates should be complete with sliding surfaces, guides, seals and accessories.

2.4.3 Intake Gates

2.4.3.1 Function

The purpose of the intake gates are to provide means to prevent water entering the pipeline/penstock. The intake gates are closed when maintaining the pipeline/penstock. They are open when the project is generating electricity.

2.4.3.2 Contractor's Design

The intake gates shall:

- Be capable of operating up to the abstraction for generation.
- The size of the gates are to be determined by the Contractor.
- Gates shall be manually operated from a safe location at the side of the weir/ intake.
- All gates should be complete with sliding surfaces, guides, seals and accessories.

2.4.4 Intake Screens

2.4.4.1 Function

The intake screens shall screen out water borne materials from the river including weeds and sediments. They shall be mounted on the weirs.

2.4.4.2 Contractor's Design

The Contractor shall provide intake screens of the Coanda type screen installed on the weir. The screen bars shall follow the flow and radius of a Coanda weir profile. The clear spacing between bars shall not excess 1mm, unless agreed otherwise by the Project Manager. The nominal flow through the screens shall be selected to provide sufficient water supply to meet the station rated flow and not impede the turbine generation capacity.

All screens shall be self-cleansing and shall require minimal maintenance. Alternative screens to Coanda screens may be accepted as long as the Contractor can demonstrate that their proposals have the same levels of sediment removal efficiency.

The Contractor shall make an assessment of the potential for large water transported materials (i.e. logs and large rocks) and make necessary arrangements for the protection of the screens with boulder bars.

2.5

Hydromechanical General Requirements

2.5.1 Pipework (Pressure Pipelines)

2.5.1.1 Applicable Codes and Standards

a) All work, materials and practices shall comply with the requirements of current New Zealand standards for that particular class of work. The following New Zealand standards shall apply specifically:

ANSI/ASME B36.19M: Stainless Steel Pipe
ANSI/ASME B16.9 : Factory-Made Wrought Buttwelding Fittings
AS 1111.(1-2):2000: ISO metric hexagon bolts and screws
AS 1281:2001 : Cement mortar lining of steel pipes and fittings
AS 1554.1:2004 : Structural steel welding - Welding of steel structures
AS 1579:2001 : Arc- welded steel pipes and fittings for water and wastewater
AS 2239:2003 : Galvanic (sacrificial) anodes for cathodic protection
AS 2638.1:2002 : Gate valves for waterworks purposes – Metal seated
AS 2638.2:2006 : Gate valves for waterworks purposes – Resilient seated
AS 2832.1:2004 : Cathodic protection of metals – pipes and cables
AS 3571.1:2001 : Plastics piping systems - Glass-reinforced thermoplastics (GRP) systems based on unsaturated polyester (UP) resin - Pressure and non-pressure drainage and sewerage (ISO 10467:2004, MOD)
AS 3571.2:2001 : Plastics piping systems - Glass-reinforced thermoplastics (GRP) systems based on unsaturated polyester (UP) resin - Pressure and non-pressure water supply (ISO 10639:2004, MOD)
AS 3680:2008 : Polyethylene sleeving for ductile iron piping
AS 3681:2008 : Application of polyethylene sleeving for ductile iron piping
AS 3690:2009 : Installation of ABS pipe systems
AS 3996:2006 : Access covers and grates
AS 4037:1999 : Pressure equipment – Examination and testing
AS 4041:2006 : Pressure Piping
AS 4087:2011 : Metallic flanges for waterworks purposes
AS 4321:2001 : Fusion-bonded medium-density polyethylene coating and lining for pipes and fittings
AS/NZS 1200:2000 : Pressure Equipment
AS/NZS 1516:1994 : The cement mortar lining of pipelines in situ
AS/NZS 1518:2002 : External extruded high-density-polyethylene coating system for pipes
AS/NZS 2033:2008 : Installation of polyethylene pipe systems
AS/NZS 2280:2004 : Ductile iron pipes and fittings
AS/NZS 2312:2002 : Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings
AS/NZS 2566.1:1998 : Buried flexible pipelines – Structural Design
AS/NZS 2566.2:2002 : Buried flexible pipelines - Installation
AS/NZS 2980:2007 : Qualification of welders for fusion welding of steels
AS/NZS 3518:2004 : Acrilonitrile butadiene styrene (ABS) compounds, pipes and fittings for pressure applications
AS/NZS 3725:2007 : Design for installation of buried concrete pipes
AS/NZS 3750:various : Paints for steel structures
AS/NZS 3862:2002 : External fusion-bonded epoxy coating for steel pipes
AS/NZS 3992:1998 : Pressure equipment - Welding and brazing qualification
AS/NZS 4020:2005 : Testing of products for use in contact with drinking water
AS/NZS 4058:2007 : Precast concrete pipes (pressure and non-pressure)
AS/NZS 4130:2009 : Polyethylene (PE) pipes for pressure applications
AS/NZS 4158:2003 : Thermal-bonded polymeric coatings on valves and fittings for water industry purposes
AS/NZS 4331.1:1995 : Metallic flanges – Part 1: Steel flanges
AS/NZS 4331.2:1995 : Metallic flanges – Part 2: Cast iron flanges
BS/EN 545:2006 : Ductile pipes, fittings, accessories and their joints for water pipelines – requirements and test methods

BS/EN 598:2007 : Ductile pipes, fittings, accessories and their joints for sewerage applications – requirements and test methods
BS/EN 1092-1:2007 : Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Steel flanges
BS/EN 1092.2:1997 : Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Cast iron flanges
ERMA Code
HSNOCOP 22-1:2007 : Code of Practice for Pipework Under Pressure
NZS 3109:1997 : Concrete construction
NZS 3501 : Specification for copper tubes for water, gas, and sanitation
NZS 4104:1994 : Seismic restraint of building contents
NZS 4224:1983 : Code of practice for measurement of civil engineering quantities
NZS 4442:1988 : Welded steel pipes and fittings for water, sewage and medium pressure gas
NZS 5807:1980 : Code of practice for industrial identification by colour, wording or other coding

b) Compliance with these Codes and with this Specification shall be the minimum requirement necessary for this Contract.

c) The documents listed above and in the clauses that follow refer to their latest issue complete with amendments that are current at the date of the Tender Document and are deemed to form part of this Specification. However, this Specification takes precedence when it is at variance with the cited document.

2.5.1.2 Definitions

Expansion joint: A pipe joint that allows relative longitudinal movement between adjacent pipes without the occurrence of fracture or leakage
Flexible joint: A pipe joint that allows relative angular (radial) and longitudinal movements between adjacent pipes without the occurrence of fracture or leakage
Specification: The Technical Specification covering the stated discipline
Rigid joint: A pipe joint that allows no relative movement between adjacent pipes without the occurrence of fracture or leakage
Specifications: The Employer's Requirements as defined in the Conditions of Contract

2.5.1.3 Abbreviations

CI: Cast iron
DI: Ductile iron
GRP: Glass filament reinforced thermosetting plastic
HDPE: High density polyethylene
MDPE: Medium density polyethylene
PE: Polyethylene

2.5.1.4 Materials

2.5.1.4.1 Material Standards

2.5.1.4.1.1 Polyethylene (PE) Pipes

PE pipes shall comply with AS/NZS 4130.

2.5.1.4.1.2 Ductile Iron Pipes

Ductile Iron Pipes shall comply with AS/NZS 2280, cement mortar lined in accordance with AS 1281 or AS/NZS 3862 as applicable and externally painted with a bituminous protective coating in accordance with AS/NZS 3750.4 or equivalent. When laid underground, the pipe shall have a loose polyethylene protective sleeve to AS 3680 and applied in accordance with AS 3681.

2.5.1.4.1.3 GRP Pipes

GRP pipes shall be SN5000 and shall comply with AS 3571.

2.5.1.4.1.4 Steel Pipes

a) Steel pipes shall comply with NZS 4442 and shall be cement mortar lined in accordance with AS 1281 or AS/NZS 1516 as applicable. Unless otherwise specified, steel pipes shall be externally protected with one of the following :

i. for buried pipes, a high density polyethylene sleeve, “black jacket” complying with AS 1518.
ii. for pipe bridges and pipes above ground, a zinc metal spray sealed with vinyl or epoxy coating complying with AS/NZS 2312 or a fusion bonded epoxy coating complying with AS/NZS 3862.

b) Steel pipes shall be fitted with cathodic protection complying with AS 2239 and AS 2832.1.

2.5.1.4.1.5 Fittings, Joints and Couplings

a) Except as set out in (b) below, tees, hydrant tees, crosses, tapers, blank caps, bends and gibaults shall be ductile iron complying with AS/NZS 2280.

b) All fittings shall be protected with a thermal bonded coating complying with AS/NZS 4158, or be externally bitumen coated and internally concrete lined to comply with AS/NZS 2280.

c) Bolts, washers and nuts in joints shall be 316 stainless steel or hot dipped galvanised mild steel with a thermal bonded coating complying with AS/NZS 4158. A nickel or molybdenum based anti-galling lubricant (e.g. molybond) shall be used when installing stainless steel nuts and bolts.

d) Spigot and socket rubber ring joints shall ductile iron to AS/NZS 2280.

e) Flanged joints shall comply with AS 4087. Buried joints shall be protected in accordance with the manufacturer’s recommendations.

f) Welded joints shall either be butt welded or spigot and socket welded as appropriate. The welded joints of steel pipe shall be protected in accordance with the manufacturer’s recommendations.

g) Gibault joints shall be fitted with grade 316 stainless steel bolts or galvanised mild steel bolts, provided that if galvanised bolts are used, the whole Gibault shall be protected by plastic sleeve, taped in place. Buried joints shall be protected in accordance with the manufacturer’s recommendations. Gibaults shall not be used in direct contact with concrete lined steel pipe.

h) MDPE joints shall be welded.

2.5.1.4.1.6 Pressure Classes

Pipes and fittings shall be designed and manufactured for the design pressure including transient allowances.

2.5.1.4.1.7 Bedding Material

Material used for bedding, pipe surround and haunching shall be selected granular, non-cohesive, free draining material selected in accordance with the pipe manufacturers recommendations.

2.5.1.4.2 Storage of Materials

a) Pipes shall be unloaded and handled in accordance with the manufacturer’s recommendations.

b) Pipes shall be stored on level ground.

c) Pipes shall be protected from direct sunlight if stored for more than one month after delivery from the supplier.

d) PE pipes that have scoring or damage to a depth greater than 10% of the wall thickness or have been distorted because of improper handling and/or storage shall not be used in the Facilities.

e) Steel and ductile iron pipes shall be stored in such a way that liners and coatings are not chipped or damaged or become debonded from the pipe.

2.5.1.4.3 Defective Materials

Any pipes or other materials that do not comply with this Specification or that have been damaged during handling and storage shall be removed from site and replaced or repaired by the manufacturer.

2.5.1.5 Execution

2.5.1.5.1 Trench Excavation, Backfilling and Reinstatement

Trench excavation, backfilling and reinstatement shall be in accordance with the Specification.

2.5.1.5.2 Handling and Placing

The plant and rigging equipment used by the Contractor for the handling and placing of pipes shall be of the type recommended by the pipe manufacturer and such that at no time during handling and placing is any pipe overstressed or damaged.

2.5.1.5.3 Bedding, Laying and Jointing

2.5.1.5.3.1 Bedding

All principal and rider mains shall be thoroughly bedded, haunched and surrounded by a granular bedding at least 100mm thick below the soffit of the pipe and at least 300mm thick above the crown of the pipe. The material shall be well rammed and compacted so as to hold the pipe firmly in position and prevent future settlement. Care shall be taken during compaction to avoid displacing or damaging the pipe.

2.5.1.5.3.2 Laying and Installation of Pipes

a) Where socketed pipes are required to be laid on a granular or sand bed, joint spaces shall be formed in the bedding material to ensure that each pipe is uniformly supported throughout the length of its barrel and to enable the joint to be made.

b) No protective cap, disc or other appliance on the end of a pipe or fitting shall be removed permanently until the pipe or fitting which it protects is about to be jointed. Pipes and fittings, including any lining or sheathing, shall be examined for damage and the joint surfaces and components shall be cleaned immediately before laying.

c) Suitable measures shall be taken to prevent soil or other material from entering pipes, and to anchor each pipe to prevent flotation or other movement until the works are complete.

d) Where a metallic detection strip is specified, it shall be laid between 100mm and 300mm above the pipe and shall be continuous and adequately secured to valves and fittings.

e) In all cases, the manufacturer’s recommendations for pipe storage, handling, protection and laying techniques shall be followed.

f) All pipe joints, fittings and anchors shall be left exposed for inspection during the course of the acceptance test unless otherwise agreed by the Project Manager.

g) Pipes shall be installed so they are centred in the trench and on the alignment as shown in the Drawings.

2.5.1.5.3.3 Cutting of Pipes

a) Pipes shall be cut by a method which provides a clean square profile, without splitting or fracturing the pipe wall, and which causes minimal damage to any protective coating. Where necessary, the cut ends of pipes shall be formed to the tapers and chamfers suitable for the type of joint to be used. Any protective coatings shall be made good.

b) Where pipes are to be cut to form non-standard lengths, the Contractor shall comply with the manufacturer's recommendations in respect of end preparation for further jointing.

c) Pipe jointing surfaces and components shall be kept clean and free from extraneous matter until the joints have been made or assembled.

2.5.1.5.3.4 Jointing of PE Pipes

a) PE pipes shall be butt-welded or electrofusion welded in accordance with the manufacturer's specifications.

b) All welding, both butt and electrofusion, shall be carried out by welders who are certified by an accredited PE welding technical institute.

c) The Contractor shall keep weld records of all welds and shall forward them to the Project Manager immediately after welding. The weld records shall clearly demonstrate that the procedure specified by the manufacturer and that the weld parameters have been achieved.

d) All butt-welding of PE pipes shall be undertaken within a welding tent that completely surrounds the pipe and welding equipment. The open ends of the pipes shall be sealed during installation to prevent contamination of the ends prior to welding and to prevent circulation of air within the pipe. Welding of pipes during inclement weather periods shall not be undertaken.

e) All welds shall be stamped with a weld number and the welder's identification number. The stamp shall be made in the bead at the beginning of the cooling process, while the material is still soft.

f) Each welded joint shall have a record, correlated with the weld number.

g) The internal weld bead shall be removed to provide a smooth bore.

h) Flanges on PE pipes shall be stub flanges with loose metal backing rings or full face up to 100 mm pipe diameter. On ABS and PE pipes of 100 mm diameter and larger, stub flanges with metal backing rings shall be used. Backing rings shall be manufactured from 316 or 316L stainless steel.

2.5.1.5.3.5 Jointing of GRP Pipes

GRP pipes shall have spigot and socket joints with rubber rings or shall be jointed with GRP pressure couplings in accordance with the manufacturer's recommendations.

2.5.1.5.3.6 Jointing of Ductile Iron Pipes

Ductile iron pipes shall have spigot and socket joints with rubber rings.

2.5.1.5.3.7 Jointing of Steel Pipes

a) Steel pipes shall have spigot and socket joints with rubber rings or shall be plain ended and butt welded as appropriate.

b) Pipes for welding shall be jointed by an arc welding process capable of consistently producing welds complying with the requirements of NZS 4442.

c) Full details of the welding procedure and of the edge preparation proposed to be used shall be supplied to the Project Manager prior to welding.

d) Any faulty welds shall be cut out and rewelded. On no account shall leaks be sealed by caulking.

e) On completion and acceptance of the welding by the Project Manager, the external corrosion protection shall be repaired.

2.5.1.5.3.8 Jointing of Curved Pipelines

Where steel and ductile iron pipes with flexible joints are required to be laid to curves, the maximum deflection at any joint shall be 2.5 degrees, which is equivalent to a 250mm offset for a 6 metre length pipe.

2.5.1.5.3.9 Thrust Blocks and Anchorage

a) Cast in situ concrete thrust blocks shall be provided at all points where the pressure pipeline changes direction, and where other unbalanced thrust occurs, with the exception of where alternative provision is made and thrust blocks are specifically omitted.

b) Normal maximum concrete encasement shall be 180 degrees. All thrust blocks shall be designed according to the soil bearing capacity and shall be installed so as not to impair access to bolts or fittings.

c) Where concrete is poured against PE pipe or fittings, a protective membrane shall be placed to separate the concrete from the pipe or fitting.

d) All fittings and anchors shall be left exposed for inspection until after the acceptance test unless previously inspected by prior arrangement with the Project Manager.

2.5.1.5.3.10 Pipes Connected to Structures

Where a pipe is built into an underground structure, a flexible joint shall be provided as close as possible to the outside face of the structure. A short length of rocker pipe shall be connected to the flexible joint. The length of the rocker pipe shall not exceed 8 diameters or 3m, whichever is the shorter.

2.5.1.6 Tolerances

a) No deviation will be permitted from the minimum cover shown on the Drawings.

b) The centreline of the pipeline and designated changes in gradient shall be regarded as control points and shall be located with a permissible vertical deviation of ±100mm on the centreline. The same deviation will be permissible laterally, except where the Contractor is required to lay the pipeline at a designated distance from a fence line, kerb line or boundary, in which case the permissible deviation shall be ±20mm.

c) The permissible deviation in alignment between control points from a straight line joining the control points shall be ±100mm or ±20% of the nominal diameter of the pipe, whichever is the larger, and the permissible deviation per pipe length shall be ±20mm.

d) The permissible deviation from the designated level at any point on the pipeline shall be ±50mm or ±10% of the nominal diameter of the pipe, whichever is the larger.

2.5.1.7 Inspection and Testing

2.5.1.7.1.1 Pressure Testing of Pipelines

a) All new pipes shall be subjected to a pressure test after laying and jointing.

b) All necessary apparatus for testing shall be supplied by the Contractor. The section to be tested shall be capped or flanged off at either end, and at branches intended to be tested separately. The blanked off ends and branches shall be securely propped or otherwise prevented from movement, before applying any pressure.

c) Pipelines shall withstand a hydrostatic pressure of 1.5 times the maximum working pressure for 15 minutes measured at the lowest point of the section under test without any drop in pressure.

d) For PE pipes, the test procedure shall be identical to that for all other pipe types, except that, if the test pressure cannot be maintained for 15 minutes, the pressure shall be rapidly lowered to 300kPa on the test gauge by opening a release valve at the extremity of the section under test. When 300kPa is reached, the valve shall be shut, and in order for the pipe to pass the test, the pressure on the test gauge shall rise to 450kPa within 10 minutes.

e) The Contractor shall successfully pre-test the line before requesting an acceptance test.

f) Any faulty pipes, joints or fittings shall be replaced by the Contractor and the line retested.

2.5.1.7.1.2 Joint Inspection and Testing (PE Pipes)

a) All joints installed by open trench methods shall be left uncovered until the Project Manager completes the visual inspection.

b) Each butt welded joint will be visually inspected by the Project Manager to check that:

i. Both fusion beads are of the same size and shape and project evenly above the outside diameter of the pipe.
ii. The bead width is within the parameters shown in the table below.
iii. The fusion bead does not have a highly polished appearance (indicating too high a temperature).
iv. There are no cracks in the beads.
v. There are no obvious inclusions or other faults present.

Bead Width		**Bead Width** (continued)	
Minimum Wall Thickness (mm)	Width of Bead (mm)	Minimum Wall Thickness (mm)	Width of Bead (mm)
3	4-6		
4	4-7	13	10-14
5	5-8	16	11-15
6	6-9	18	12-16
8	7-10	19	12-18
9	8-11	22	13-18
11	9-12	24	14-19

c) Each electrofusion joint will be visually inspected by the Project Manager to check that:

i. The pipes and fitting have been aligned correctly.
ii. The pipe ends have been positioned centrally to the coupling. Measurement marks on the pipes shall be visible to show this.
iii. The pipe ends have been cleaned by scraping. The scrape marks shall extend at least 20mm from the edge of coupling.
iv. There are no cracks or inclusions in the interface between the fitting and the pipe.
v. There is no evidence of under- or over-melt (observe the extent rise of melt in the fusion indicator holes).
vi. There is no evidence of melt leak from the interface between the pipe and coupling.
vii. There is no evidence of the electrofusion wires exposed in the joint.

d) The Contractor shall obtain the approval of the Project Manager for each joint prior to installation or backfilling.

2.5.2 Valves and Gates

2.5.2.1 General

a) Valves and penstocks shall comply with NZS/AS specifications and the relevant provisions of the Standards and the following clauses.

b) Valve extension spindles shall be solid stainless steel 316, fabricated in single lengths. Any lengths stated or shown are approximate only and the Contractor shall be responsible for obtaining the exact length. The maximum length between guides shall be 2m.

c) Operating handwheels shall have the direction of open/close operation cast, stamped, or otherwise permanently marked upon the handwheel rim.

d) All valves shall be supplied with handwheels.

e) Handwheels shall be sized to enable the valve to be operated against the maximum operational differential pressure or a minimum of one bar; whichever is the greater, with an operating effort at the rim (push/pull) not exceeding 250N.

f) Where situated remote from the valve, operating handwheels shall be positioned at a nominal height of 1m above operating floor level. Extension spindles shall be supported by means of guide brackets/floor pedestals.

g) Lever-operated valves shall require a force not exceeding 250N, applied at the lever, to open or close the valve. In the open position the lever shall be parallel to the direction of flow. In the closed position the lever shall be at right angles to the direction of flow.

h) Remote mounted actuators shall each be mounted on a floor pedestal and shall be provided with drive shafts between valve and actuator units complete with all necessary universal joints and shaft support bearing brackets.

i) Provision shall be made for the necessary lubrication of all universal joints/bearing points in an extended valve drive shaft assembly. Lubrication facilities shall be in the form of grease nipples or grease filled protective gaiters as appropriate.

j) Guards shall be designed such that universal joints and other serviceable areas are readily accessible without dismantling the headstock or valve unit. Guards may be split along the longitudinal axis or be of telescopic design. Guards shall be designed to comply with "Guidelines for Guarding Principles" published by NZ Department of Labour.

k) Valves shall normally be designed for clockwise closing.

l) Valves shall be capable of being locked in their operating and isolation position to prevent unauthorised use of the valves. Valves fitted with a handwheel shall incorporate a locking bracket for use with a padlock or padlock and chain. Valves fitted with valve caps shall be provided with a lockable cap. All devices shall be easily removed when unlocked and captive to prevent loss of the device.

2.5.2.2 Gate Valves

a) All gate valves shall be resilient seated constructed to AS/NZS 2638.2.

b) Each valve shall present a virtually full bore opening to the flow when fully open, free from obstruction and from a seat pocket where solids can accumulate and give rise to solids compaction when the valve is being closed.

c) The body/gate seal shall be located outside the fluid flow so as to be protected from erosive/abrasive solids in the flow and shall provide a bubble tight shut-off.

2.5.2.3 Air Release and Vacuum Relief Valves

Combination air release and vacuum relief valves shall be Stainless Steel. All air valves shall be rated to PN10. An isolation valve shall be fitted immediately upstream of the air valve.

2.5.2.4 Flap Gates

All new flap gates shall be rectangular type with neck and plain flap for anchor bolting, manufactured from 316L stainless steel, chloroprene seal.

2.5.2.5 Slide Gates

a) Slide gates shall consist of a sliding door controlled by a mechanically operated spindle moving vertically over an aperture in the frame.

b) Each gate shall have a rising spindle.

c) The gate supplier shall provide a seating detail for each gate.

d) Each gate shall be engineered to ensure it is suitable for the loading and duty required. Seat materials and design will take into consideration the service duty and service life.

e) The design, selection of materials, manufacture, testing/inspection, definitions and provision of information shall comply with the requirements of BS 7775.

f) The gate size and aperture size shall be selected from Tables 9, 10 or 11 of BS 7775. The permitted tolerance on the aperture shall not exceed that stated in BS 7775, Table 12.

g) The permitted gate leakage rate between the door and the frame shall not exceed that stated in BS 7775, Table 13. The joint between the gate frame and the supporting structure shall be sealed drop tight. No leakage shall occur.

h) Provision shall be made for taking up wear. Any wedges or adjusting bolts shall be accessible.

i) The information listed in Annexe ‘A’ of BS 7775 shall be provided.

j) The gate door and mountings shall be designed to withstand a combined load, without permanent deformation, equivalent to:

- The maximum differential operating head, and
- Simultaneously an impact load to the gate that will induce a stress equivalent to 50% of the stress resulting from the maximum operating head.

They shall be designed to:

- prevent cavitation and deposition of particles from the working liquid,
- prevent turbulence and erosion,
- prevent noise generation due to movement.

k) Gates shall be lockable in both open and closed positions.

l) Handwheel diameters shall not exceed 450mm and shall be clearly marked with the open and close operating directions. The required force to operate a hand wheel shall not exceed 0.25kN.

m) Rising spindles shall be protected with graduated transparent plastic covers. Non rising spindles shall have “slot and pointer” type indication within a pillar.

n) Spindles more than 2m long shall be provided with intermediate supports.

o) Gate materials shall be suitable for the duty and the installed environment, designed and sized to minimise turbulence and erosion.

p) Materials shall be selected from Tables 1 to 8 of BS 7775. Materials shall be selected to avoid galvanic corrosion. Insulating sleeves and washers shall be provided where necessary. Stainless steel components shall be to BS 970 grade 316. Any welded components shall be grade 316L.

q) All spindles, pins, screws and couplings shall be stainless steel to BS 970 Grade 316, except for those used to secure gunmetal seals, which shall be non-ferrous. Any welded components shall be grade 316L.

r) Gate spindle nuts shall be manufactured from materials to BS EN 1982:1999 Grade AB2.

s) Gates shall be suitable for manual or automatic operation as specified. They shall be suitable for intermittent operation with periods of idleness of up to six months.

t) The service life shall not be less than 20 years.

u) Details of slide-gates shall be submitted for the Project Manager’s approval a minimum of five (5) days prior to scheduled procurement. Procurement shall only be initiated after written approval of the proposed items is provided by the Project Manager.

2.5.2.5.1 Installation

Gates shall be installed by an experienced person/supplier. The Contractor shall ensure that the pipework, fittings and valves can be assembled as shown on the Contractors Drawings.

2.5.3 **Screens**

2.5.3.1 General

a) This part of the specification covers the supply of materials, manufacture, assembly, inspection and delivery to site of the screens and associated hardware. Screens shall be mounted at the river intakes. The screens shall prevent water borne objects from entering the waterways and turbines.

2.5.3.2 Materials

a) As all screens are normally under water they shall be manufactured of 316 stainless steel material.

2.5.3.3 Welding

a) All welding shall be fusion welding carried out by an electric arc process, whereby the arc and the deposited weld metal are protected from atmospheric conditions.

2.5.3.4 Manufacture

a) All intake screens shall be made up from a series of standard screen panels designed for easy replacement.

b) The diagonals of each panel shall be equal to within ±3mm. When each panel is laid free on horizontal co-planer supports, the upstream surface of each panel shall lie within 3mm of a horizontal plane passing through the end of the panels. All screen bars shall be parallel and spaced within the toleranced dimension shown on the drawing over their entire height.

c) All top horizontal members of each screen panel shall he match drilled together with the mating members of the black assemblies. All horizontal members shall have the slots for the screen bars machined as one batch.

2.5.3.5 Installation

a) Screens shall be installed to the lines and levels shown in the Contractor’s Drawings. In particular bars between adjacent screen panels shall not be out alignment by more than 2mm in any direction. The space between the outer bars of panels and adjacent concrete wall shall note exceed 50mm.

2.5.4 Fixtures and Fittings

2.5.4.1 Fasteners

a) Bolts and screws shall be in accordance with AS 1111. Washers shall be in accordance with AS1237. Nuts shall be in accordance with AS 1112.

b) Extensive use of stainless steel, especially for nuts, bolts and screws shall be adopted for components coming in contact with moisture or in a corrosive environment.

c) All bolts and studs for gland joints, couplings joints and flanges shall be stainless steel grade 316 unless specified otherwise. Associated nuts and washers shall be stainless steel grade 316. Where high strength is required and approval is given, high tensile bolts, nuts and washers may be used.

d) All threads of stainless fasteners shall be coated with an approved nickel based anti-seize compound prior to assembly.

e) All fasteners, including chemical set, anchor bolts, threaded rods, nuts and washers that are embedded into concrete shall be manufactured in stainless steel grade 316. Zinc plated or black bolts and screws shall not be used.

f) On structural components, such as walkways and handrails, fasteners shall be stainless steel grade 316 excepting when structural components are hot-dipped galvanised, hot-dip galvanised fasteners shall be used.

g) The anchor bolts, nuts, and washers shall be sized for the duty required. Chemical set or cast-in fasteners are permitted. Wherever possible, chemical set fasteners shall be used. Chemical anchors, when used, shall be installed in accordance with the manufacturer's directions.

h) Abandoned drill holes shall be thoroughly cleaned and filled with epoxy grout.

i) Where the relocation of masonry anchors necessitates alteration to steelwork base plates, the installer shall determine all additional stiffening or strengthening of the base plate and adjacent steelwork required.

2.5.4.2 Sockets

a) All socketed pipes shall be rubber ring jointed. Rubber rings shall comply with AS 1646.

b) In connecting pipes with rubber rings, the pipes shall be cleaned prior to connecting and care shall be taken to ensure that the rubber ring is maintained in a plane at right angles to the axis of the pipe. Each pipe shall be installed and connected as recommended by the manufacturer and each joint checked with a feeler gauge to ensure that the ring is in place. For pipes with skid type rubber ring joints, only the lubricant specified in writing by the manufacturer shall be applied in making that joint. The installer shall make the joint such that the witness mark, at no point, shall be more than one (1) mm from the end of the socket.

2.5.4.3 Gaskets

a) Flange gaskets shall be in accordance with AS/NZS 4087.

b) Gaskets shall be manufactured from an elastomer (neoprene/fabric) complying with AS 1646 and may contain a reinforcement material. The minimum working pressure for gaskets shall be 1600 kPa at 3.0mm thick.

c) The gasket material shall be suitable for contact with the fluid being conveyed, the operating conditions and environment.

d) Pipes and fittings shall be in their correct position, alignment and grade before the joints are made and no springing of joints shall be permitted.

e) Pipe anchorages shall be provided to absorb static and dynamic thrusts from pipe fittings and valves.

2.5.4.4 Flanges

a) Flanges shall be in accordance with AS/NZS 4087.

b) Raised face flanges shall be mated with raised face flanges. Flat faced flanges shall be mated with flat face flanges.

c) Flanges on all steel, ductile iron, PVC, and GRP pipes shall be fully fixed flanges. Flanges on ABS and PE pipes may be stub flanges with loose metal backing rings or full face up to 100 mm pipe diameter. On ABS and PE pipes of 100 mm diameter and larger, stub flanges with metal backing rings shall be used. Backing rings shall be manufactured from 316 or 316L stainless steel.

2.6 M&E Specific Requirements

2.6.1 **Turbine Parameters**

The turbine shall be designed for a net head of not less than ____ m and a Rated Flow of 0.52m3/s. The Contractor shall finalise the turbine net head as part of their intake, headpond and penstock design optimisation.

The turbine centreline shall be at RL267.0m.

The Employers minimum expected output of the turbine, as measured at the generator terminals is 710kW.

The turbine centreline shall be set at least 1.5m above the water level in the discharge channel..

2.6.1.1 Generator Parameters

The Employers minimum expected generator rating is 890kVA.

The preferred generator speed is 1000 rpm.

2.6.1.1 Station Transformer Parameters

The Employers minimum expected station transformer rating is 900kVA.

The Station Transformer shall be installed on a ground mounted concrete pad adjacent to the powerhouse building.

2.6.1.2 Protection Requirements

The electrical protection system shall be designed to ensure that the generator cannot operate into an islanded or faulted 22kV network. The protection shall incorporate rate of change of frequency and neutral voltage displacement elements.

2.6.1.3 24V DC System Parameters

The 24V DC system shall be sized to supply the Plant 24V DC requirements for a duration not less than 24 hours, with both chargers inoperative.

2.6.1.4 22kV Grid Connection

An over head 22kV line shall be constructed by the Employer between the powerhouse and the existing EPC 22kV transmission network at Alaoa powerhouse

The line will be terminated on a pole structure, provided by the Contractor, adjacent to the station transformer. The termination pole shall include surge arrestors, 22kV isolator and 22kV CTs for the neutral voltage displacement protection and indication purposes.

A short length of 22kV cable shall be provided between the 22kV isolator and the station transformer HV terminals.

2.6.2 **M&E General Requirements**

2.6.3 **Contract Wide Requirements**

2.6.3.1 Design Responsibility

The Contractor shall assume full responsibility for a coordinated and adequate design of all equipment specified and shall ensure that such equipment conforms to the best engineering practice for the operating conditions specified. When requested by the Project Manager, the Contractor shall furnish complete information as to the maximum stresses and other criteria used in the design. All equipment shall be proportioned and arranged to fit with proper clearances into the powerhouses.

2.6.3.2 Units of Measurement

The units of measurement to be used throughout this Contract shall be metric in accordance with ISO 1000:1992 "SI units, etc." On drawings or printed pamphlets where other units have been used, the equivalent metric measures shall also be shown.

2.6.3.3 Site Conditions

2.6.3.3.1 General Conditions

The equipment shall be suitable for operation at, and ratings shall be based on, the following conditions:

- Maximum outdoor ambient temperature for design purposes 40°C
- Minimum average over 24 hours 23°C
- Maximum average over 24 hours 29°C
- Design river water temperature 25°C
- Relative Humidity 80 - 97%
- Average annual rainfall 3500 mm
- Thunder storm days per year (estimate) 50

2.6.3.3.2 Transport Limitations

The contractor shall be free to select the route for delivery of plant to site and shall be responsible for determining any limitations on route selections imposed by weight and/or size limits on roads, bridges, etc.

2.6.3.3.3 Water Conditions and Corrosion

The Contractor shall perform his own analyses and evaluation of the water in determining that suitable materials are used for the equipment.

The Contractor shall design the equipment and provide materials that will give satisfactory service based upon his evaluation of the water characteristics.

Corrosion resisting steel or bronze shall be used for bolts and nuts when either or both are subject to contact with river water and/or frequent adjustment or frequent removal, such as adjusting bolts for packing glands on removable screens or strainers, on adjustable bearings, etc.

2.6.3.4 Labels and Plates

The Contractor shall supply all name plates, caution plates and labels for the safe and efficient operation of the plant.

Each item of plant shall have permanently attached to it in a conspicuous position a nameplate or label of approved size and pattern. Before the manufacture of any nameplates or labels, the Contractor shall submit to the Project Manager a copy of the nameplate and label design standard for approval. All data, name plates and instruction plates on plant and cubicles shall be in the English language. Any other language labels may be provided for construction and commissioning purposes but shall be temporary and removed prior to completion.

2.6.3.5 Standards and Workmanship

All materials shall be new, of a first-class nature. All materials shall comply with the latest relevant authorised standards for testing materials unless otherwise specified or permitted by the Project Manager.

All workmanship shall be of highest class throughout to ensure smooth and vibration free operation under all possible operating conditions, and the design, dimensions and materials of all parts shall be such that the stresses to which they may be subjected shall not render them liable to distortion, undue wear, or damage under the most severe conditions encountered in service.

All parts shall conform to the dimensions shown, and shall be built in accordance with, the approved drawings. All joints, datum surfaces and mating components shall be machined and all castings shall be spot faced for bolts and/or nuts. All machined finishes shall be shown on the approved drawings.
All screws, bolts, studs and nuts and threads for pipe shall conform to the latest standards of the International Organization for Standardization (ISO) covering these components and shall all conform to the standards for metric sizes.

The Contractor shall use exclusively the standard and size system presented in his Tender and accepted and incorporated in this Contract.

2.6.4 **Turbines**

2.6.4.1 General

The hydraulic turbine offered shall be either: -

- a two or three jet, single runner horizontal shaft Pelton type
- a two jet, single runner horizontal shaft Turgo type
- a multi-jet, single runner, vertical shaft Pelton type.

The turbine shall be directly coupled to a 50 Hz asynchronous generator. A flywheel shall be added if required to provide the necessary machine inertia during unit startup and for stable operation. Other turbine types will not be considered.

2.6.4.2 Flows and Heads

The turbines must be capable of operating continuously at any flow between 10% and 100% of Rated Flow.

The Contractor shall optimise the Rated Net Head of the turbine in order to maximise output of the turbine whilst balancing the capital cost of the installation. The Contractor should use the evaluation criteria given in Section 3 Clause 1.2.4 in determining their optimal design.

2.6.4.3 Efficiency

The turbine average efficiency shall be greater than 80% over a flow range of 15% to 100% of Rated Flow. The peak turbine efficiency, at Rated Flow, shall exceed 90%. The Contractor shall provide a guaranteed minimum average turbine efficiency over the flow range 15% to 100% of Rated Flow and a guaranteed turbine efficiency at Rated Flow.

The Contractor shall provide an efficiency curve for each turbine with their offer. The curve shall plot turbine efficiency for the full range of head and flow and shall also show the cut-over points between jet operations.

2.6.4.4 Turbine Regulation

The turbines shall be designed to be regulated to control speed during start-up and synchronizing, to control the power output and headwater level during on-line operation, and to positively contribute to the Samoa electricity system frequency and overall stability. The turbine generators are not required to operate into an islanded load and will only operate when in parallel with other generating facilities.

The maximum pipeline pressure developed during load rejection or in any other circumstance shall be less than 15% of the gross head when measured at the turbine inlet.

Jet deflectors shall be provided to provide rapid cut-off of water to the turbine runner in the event of a turbine generator tripping.

The Contractor shall select the turbine inlet valve and injector nozzles operating times (from fully opened to fully closed) in order to limit the pressure rise to the specified value even in the event of a deflector failure.

Means shall be provided to ensure that, once the closing time is set, faster closure cannot occur under any circumstance.

In addition, the Contractor shall select the maximum rate of load acceptance to ensure that negative pressures in the pipeline cannot occur.

The designs for the needle valve, jet deflectors plates and generator flywheel shall be submitted to the Project Manager to ensure that above limits on pressure rise shall not be exceeded, the generator can tolerate the associated overspeed and duration, and that no water hammer problems will arise. Any modifications to the system required by the Employer to meet these requirements shall be made at the Contractors own cost.

2.6.4.5 Turbine Speed

The Contractor shall select the speed of the machines in accordance with their standard design criteria. The rotation of the machine shall be anti-clockwise when looking at the generator end.

2.6.4.6 Runaway Speed

All rotating parts of the turbine generator, flywheel and bearings shall be capable of withstanding fifteen (15) minutes operation at the runaway speed as determined by the turbine operating under the condition of maximum head and the injector nozzle fully open and the generator disconnected.

2.6.4.7 Overspeed Protection

An electrical overspeed switch shall be provided. In the event of the overspeed being activated, the deflector shall engage and the injector nozzle and inlet valve shall be tripped to the closed position.

2.6.4.8 Cavitation, Abrasion and Corrosion

The Contractor shall guarantee that the erosion of the runner supplied shall not exceed 5 cm^3 and the depth of pitting shall not exceed 2mm over 8000 hours of operation. The erosion damage shall be evaluated in accordance with IEC 60609.

The Contractor shall guarantee that the total corrosion damage to the runner and wicket gates shall be less than 7 cm^3 and the depth of damage shall not exceed 1 mm over 8000 hours of operation. In the event of the Plant failing to meet this requirement, the Contractor shall replace the runner at its cost.

2.6.4.9 Turbine Cracking

A guarantee against the formation of cracks on the turbine shall be given. The testing for cracks and acceptance standards shall be in accordance with the requirements of the appropriate ASTM or other internationally recognised standard. In the event of the Plant failing to meet this requirement, the Contractor shall replace the runner at its cost.

Details of the guarantee shall be given in the tender.

2.6.4.10 Hydraulic Thrust

The turbine shall be designed and manufactured to ensure that the hydraulic thrust is reduced to the minimum practically possible. The resultant thrust shall be taken by a thrust bearing. The size of the thrust load shall be given in the tender.

2.6.4.11 Runner and Buckets

The runner and buckets shall be manufactured from a stainless steel with 13% chromium and 4% nickel. Tenderers are free to offer materials that are superior to 13/4 CrNi. Details of the materials offered shall be included in the technical schedules. The runner shall be manufactured from a single piece forging. The buckets shall be dressed in accordance with the Contractors standard practice in order to minimise hydraulic losses. If deemed necessary by the Contractor, surface painting shall be applied.

The runner and buckets shall be statically and dynamically balanced, independent of the turbine shaft. The runner shall be supported at both ends by bearings and coupled to the generator. It must be possible to remove the runner without disturbing the generator rotor. Please note the requirement of being able to remove the generator as a complete unit for maintenance purposes.

Due to the need to repair minor cavitation pitting or abrasion damage at site, the runner must be capable of being repaired without having to heat the runner above 150°C for stress relieving.

2.6.4.12 Nozzles and Defectors

The turbine shall be fitted with two or more nozzles, or injectors depending on the Contractors design. The design of the nozzle shall ensure that the needle tip and nozzle seat ring are easily removable and replacable. The needle tip and the nozzle seat ring shall be manufactured from high quality stainless steel, and shall be machined to reduce the frictional head loss through the valve to a minimum. The valve opening and closing times shall be characterised so as to ensure that the specified pipeline pressure limitations are not exceeded.

Deflectors shall be provided in order to divert the water flow away from the runner in the event of a sudden load rejection or fault in the turbine generator. If it is necessary to use the deflector to assist with regulating the turbine during synchronization then the deflector shall be cut in type.

It shall be possible to use the deflectors in conjunction with the spear valves to dewater the penstock in a controlled manner.

2.6.4.13 Turbine Housing

The turbine casing shall be manufactured from fabricated steel. The housing shall be designed to eliminate the possibility of water leaving the buckets being deflected onto the runner.

2.6.4.14 Shaft, Couplings, Sealing and Bearings

The arrangement of the turbine shaft, generator and flywheel and the location of bearings and couplings shall be established carefully in order to facilitate the installation, alignment, inspection and dismantling or replacement of the bearings and shaft seal. The plant shall be arranged in order that the generator can be removed as a complete unit for maintenance. A thrust bearing shall be provided to resist the maximum axial thrust imposed by the turbine. The thrust bearing shall be located on the generator side of the turbine or flywheel.

The main shaft shall be made of forged carbon steel and machined all over. The shaft shall be of ample size to operate at any speed up to the maximum runaway speed without detrimental vibrations or distortions, and to operate at maximum output without exceeding acceptable design stresses.

The shaft sealing system shall ensure that there is no possibility of grease and water mixing. The turbine seals and liners shall be easily replaceable. It should be noted that as the water discharged from the turbine will be used for potable water by the local villages, no leakage of grease or other contaminant will be allowed.

The shaft seals shall be designed to prevent back-flooding of the powerhouse in the event of flood events causing the tailrace level to rise up to 2.0m above the turbine centerline.

2.6.4.15 Radial Thrust

The turbine shall be fitted with guide bearings designed to accommodate the radial loads under all operating conditions (including fault conditions). The bearings shall be roller bearings and grease lubricated type. The turbine bearings shall each be fitted with a Pt100 temperature sensor for bearing temperature monitoring by the control system. Journal bearings will not be accepted.

2.6.5 **Turbine Actuation System**

2.6.5.1 General

The turbine and inlet valve actuation system shall be either hydraulic or electric or a combination of both. The actuation system shall ensure that the turbine operates and shuts down safely, and is cost effective and appropriate for the size of plant.

In assessing the most appropriate system, the Contractor shall consider the following:-

- The turbine shall have two methods of isolation from the water circuit, a deflector and the turbine isolation valve. Both devices shall be operated from the control and protection system to shut the turbine down and isolate following a fault.
- At least one of these two isolations shall be able to operate using either gravity, stored pressure or a spring as the energy source.
- The other isolation may use hydraulic or electric actuation.
- The turbine nozzles are not considered as an isolation point and may use hydraulic or electric actuation.
- The maximum rate of closure of the inlet valve and injector nozzle shall be limited under all circumstances in order to prevent unacceptable penstock pressure rise.

The turbine actuation system provided under this contract shall consist of sufficient servomotors/actuators, valves and all instrumentation needed to allow full control over the deflector and needle valve positions from the control system. The actuation system shall also operate the turbine inlet valve.

If hydraulics are used, the Contractor shall provide the first fill of all oils and lubricants for the entire turbine generator set and the associated auxiliary plant. This also includes any filtering required to ensure satisfactory performance. The Contractor is to provide a full specification of the oils and lubricants with the draft manuals.

2.6.5.2 Electric Actuation (if offered)

Electric actuators may be used for the turbine inlet valve and injector actuation only. If electric actuation of the inlet valve is adopted, then the turbine deflector operation must be engaged using either a spring, pressurized reservoir or gravity counterweight.

Electric actuators shall operate from a 24V DC power supply and shall include excess torque protection to prevent damage should a foreign body lodge in the valve or injector. The actuators shall be rated to IP68 standard.

If electric actuators are used for the injectors then they shall be of a type suitable for continuous modulating duty. The actuator shall include a 4-20mA control input, 4-20mA position output and fully open and fully closed limit switches for interfacing with the Employer’s Control System.

The Contractor shall ensure that the actuator response rate is sufficiently fast to permit the turbine speed to be regulated to match the power system frequency during start-up. The actuator shall include the following interfaces to the plant control system:-

- Actuator opening position - (%)
- Actuator Status – opening, closing etc.
- Alarms – Thrust Trip, Manual operation, lost phase, thermostat trip.

If electric actuators are used, the following components shall operate as described below:

- Needle Valve
    - Electrically driven open and closed.
    - Manual operation shall be provided for in the event of actuator failure, and must be geared to ensure safe operation of the valve.
    - Actuator must be static under load (i.e. no motion) in the event of complete power failure

- Inlet valve
    - Electrically driven open and closed.

- Actuator must be static under load in the event of complete power failure

2.6.5.3 Hydraulic System Requirements (If offered)

The oil pressure system (if used) shall be complete with all necessary Plant and instrumentation for safe injector nozzle and deflector operation, including, but not limited to, pumps, accumulator, coolers, heaters, filters, tanks, pressure switches, temperature transmitters and level switches. All piping between the hydraulic oil system and the injector/deflector servomotors shall be provided. All hydraulic oil used shall be vegetable based oil that is readily degradable in water.

The hydraulic oil system (if used) shall be provided with two vertical oil pumps on a sump tank. The pumps shall be driven by independent AC motors. Either pump can be selected as the duty pump, with the other acting as the standby pump. The standby pump will automatically start when the pressure in the system falls below a minimum operating pressure. The pump motor starters and electrical protective devices will be incorporated into a motor control centre to be provided by the Employer.

The turbine oil hydraulic system shall incorporate:-

- A Proportional / servo valve for the injector servomotor actuation. This shall be of reputable manufacture, with a 4-20mA control input for interfacing with the governing system
- A solenoid for operating the deflector. When energised, the deflector shall move to the disengaged position. The solenoid shall be 24V dc operated.
- A solenoid for opening the turbine inlet valve. When energised, the inlet valve shall open. The solenoid shall be 24V dc operated.
- A shutdown solenoid. When de-energised the injector shall close, deflector engage and inlet valve close irrespective of the operation of any other device within the turbine hydraulic oil system. The solenoid shall be 24V dc operated.
- A hand operated emergency shutdown valve. When operated the injector shall close, deflector engage and inlet valve close irrespective of the operation of any other device within the turbine hydraulic oil system. The valve shall be of press to operate, twist to reset type, with auxiliary contact for connection to the plant control system.

If required to prevent excessive cycling of the oil pressure pumps an accumulator may be provided. The accumulator shall be manufactured to an internationally recognised pressure vessel standard, and shall be a bladder type accumulator. The accumulator shall be fitted with high and low pressure, and level alarm switches.

A sump tank shall be provided, which will be sized to hold all of the oil in the system with 10% free space. The tank shall be fitted with an oil level gauge, high and low level alarm switches and be complete with all pipework and valves necessary to bleed air from the system, drawing oil back into the sump tank and to fill the sump tank. A 240V electric heater shall also be provided.

In addition to the control devices listed above, the following interfaces to the plant control system are required from the turbine hydraulic system:

- Hydraulic system oil pressure (AI)
- Oil filter alarm
- Oil filter differential pressure
- Oil temperature high
- Oil sump high level
- Oil sump low level

- Oil sump low trip

2.6.6 Inlet Valve

The turbine unit shall be supplied with an inlet isolating valve. The valve is required to isolate the turbine unit for safety and maintenance purposes. The inlet valve shall meet the following requirements:

- Valve Type: Double flanged resilient seated butterfly valve (waterworks style valve)
- Nominal diameter: not less than the penstock internal diameter.
- Minimum pressure rating: 150% of gross head
- Valves shall be end-of-line rated (full pressure on the upstream side and atmospheric pressure air on the downstream side)
- Actuation Refer Section 2.6.5
- Valve Seat: Field replaceable. Entire wetted area of the valve body shall be rubber lined
- Valve shaft: self-lubricating bearings at both ends of shaft and rigid shaft-to-disc connection
- The valve opening and closing lines shall be as follows:
- Opening (0-100%) 30 seconds
- Closing (100-0%) 30 seconds (nominal, refer Section 2.6.4.4)
- Materials:
  - Body: Cast Iron (with manufacturer coating system to be approved by the engineer)
  - Disc: 316 Stainless steel
  - Shaft: 431 Stainless steel
  - Seat: Natural rubber
- Instrumentation:
  - Valve fully opened
  - Valve cracked (nominally 5% open)
  - Valve fully closed
- The inlet valve shall be able to be actuated open with full differential head across the valve. Alternatively the valve may be supplied with an automated bypass valve that allows balancing of pressures across the inlet valve prior to opening. If provided, the bypass valve shall be an actuated stainless steel ball valve (nominal bore 50mm), complete with open and closed limit switches to the Employer's control system.

2.6.7 Governor

2.6.7.1 Type and Description

Turbine governing function shall be provided by the Unit PLC for regulating the speed and controlling of the associated turbine.

The turbine governing function shall be in accordance with IEC-Recommendation No.60308, International Code for Testing of Speed Governing Systems for Hydraulic Turbines.

The governor function shall:

a) Include proven software routines for governor control functions and I/O interfaces to the turbine actuation system for regulation of the spear valve and deflectors.
b) maintain the speed of the associated turbine generator in a stable manner and return the speed to steady state condition following a system disturbance.
c) combine with the deflector and spear valve to limit surges and overpressures within the penstock safety margins.
d) positively contribute to the overall electricity grid stability.
e) permit operation of the associated turbine generator in parallel with other turbine generators in the system.
f) be capable of adjustment, while the unit is in operation, to optimize performance during commissioning and periodic testing.
g) be compatible with the auto-synchronizer and manual synchronizing.

2.6.7.1.1 Performance Requirements

2.6.7.1.2 Stability

Governing functions shall be capable of controlling with stability the speed of the associated turbine generator unit when operating at rated speed and no-load. The governing system shall also be capable of controlling with stability the power output between zero and maximum power output inclusive when the generator is operating in parallel with other generators in the plant or in the transmission systems. The governing system shall be deemed stable, if the hydraulic system of the turbine and water conduits is inherently stable, when:

- The magnitude of the sustained speed oscillation caused by the governor does not exceed -0.15% to +0.15% of rated speed with the generator operating at rated speed and no-load or when operating at rated speed and isolated sustained load with the speed droop set at 2% or above.

- The magnitude of the sustained power output oscillation caused by the governor does not exceed -0.5% to +0.5% of the rated power output of the turbine with the speed regulation set at 2% or above and with the generator operating under sustained load demand in parallel with other generators, which are themselves capable of operating in parallel with other generators.

2.6.7.1.3 Dynamic Characteristics

After full load rejection, the number of occurrences of a peak speed over 3% of the rated speed shall not exceed 2 times.

2.6.7.1.4 Speed Dead Band

The total magnitude of the sustained speed change within which there is no measurable change in the position of the turbine control servomotor(s) at rated speed of the unit shall not exceed 0.02% of the rated speed at any gate opening. The minimum speed change in percent of rated speed to which the governor will respond (sensitivity) is defined as one-half the measured dead band.

2.6.7.1.5 Permanent Speed Droop

The permanent speed droop shall be capable of adjustment, while the unit is in operation, to values between 0 and 10% when the speed adjustment is set to give rated speed with full wicket gate opening.

2.6.7.1.6 Stability Adjustment

The dynamic performance of the governing system shall be achieved with proportional, integral, and derivative function blocks, each with independent continuously-adjustable gains.

The gains shall be adjustable while the governing system is in operation and shall be automatically adjusted by the governing system depending on its operating mode. Independent adjustable gains shall be provided in the proportional and integral function blocks.

2.6.7.1.7 Range of Speed Adjustment

The governor shall permit fully opening the spear valve when the unit is operating at speeds up to 110% of normal speed with a speed regulation setting at 10% or less. With the unit operating at zero power output, it shall permit operating the unit at speeds down to 90% of normal speed, with zero speed regulation setting. It shall permit synchronizing the generator for parallel operation with other generators at operating speeds between 90% and 110% of normal speed by local or remote adjustment of the speed setting. The rate-of-change of speed settings shall be software adjustable and, as a minimum, shall include a range of variation between 20 and 40-s to reduce the setpoint from maximum to zero, or vice versa.

2.6.7.1.8 Power Controller

The governor shall be equipped with a power controller which shall develop a governor error signal based on a power setpoint, real power feedback, and speed. The power controller shall be initiated by the plant control system. This mode of operation shall only be in effect while the machine's speed remains within an adjustable speed band. If the machine's speed falls out of the speed band, then the governor logic shall change its operating mode to speed control..

2.6.7.2 Speed Sensing System

Speed sensing systems shall consist of a toothed disc mounted on the top of the generator shaft, proximity sensor pick-ups and a transducer for providing an analogue speed measurement to the control system and digital outputs for turbine generator overspeed protection and any key start/stop interlocks required by the Contractors design.

Speed sensing systems shall be able to detect complete stop and creeping of the associated turbine generator. Speed sensing using the generator frequency as measured at the generator line terminals shall also be provided and shall be utilized by the governor system as the primary speed sensing mechanism for frequency tracking, synchronisation and on load operation. The generator frequency sensing shall only be used once the generator has been excited by the AVR. The transition between speed sensing systems shall be bumpless.

Speed sensing systems shall be capable of operating without damage at the maximum turbine runaway speed and shall be designed, mechanically and electrically, for continuous operation.

In the event of a fault in the speed sensing system the associated turbine generator shall be shut-down.

2.6.7.3 Spear Valve/Deflector Position Transmitters

The turbine spear valve position shall be derived by electronic position transducers connected to the control system. The accuracy of measurement shall not exceed 0.2%. All necessary mounting brackets, hardware, and linkage to translate turbine spear valve into a linear 4-20mA signal shall be provided. The signal shall be reverse acting, i.e. 0-100% servomotor position shall be scaled 20-4mA. In case of loss of the feedback signal, the governor shall shut down the associated turbine generator.

Limit switches shall be provided to signal the fully open and fully closed position of each spear valve and deflector to the control system.

2.6.8 **Generators**

2.6.8.1 Type and Description

Generator shall be totally enclosed, three phase, rotary field, horizontal or vertical shaft, salient pole type synchronous machines. Cooling shall be open circuit air through the generator with rotor mounted fans (IC01). The heat shall be ducted from the generator to the powerhouse exterior; the ductwork will be as specified in Section 6 Part 2.6.19. The generator enclosure shall be IP 23 of IEC60034-5.

The rated continuous output of the generator shall be matched to the associated turbine.

The terminal voltage shall be 415V phase to phase.

The maximum continuous output of the generators shall be possible at any voltage between 95 and 105% of rated voltage and at any frequency between 49 and 51 Hz from 0.8 lagging to 0.95 leading power factor. The generators shall be suitable for operation in parallel with the other generators in the existing power system.

2.6.8.2 Speed

The generator speed shall be as required by the turbine manufacturer.

The generator shall be capable of withstanding the maximum runaway speed of the turbine continuously without damage.

2.6.8.3 Efficiency

The generator average efficiency shall be greater than 91% over the range 15% to 100% of Rated Output and at unity power factor. The Contractor shall provide a minimum average generator efficiency over the range 15% to 100% of Rated Output.

The minimum acceptable generator efficiency at rated output, and at unity power factor, is 96%.

The Contractor shall provide an efficiency curve for each generator with their offer. This curve shall show the generator efficiencies at 25%, 50%, 75% and 100% of rated output for unity and 0.8 power factor.

2.6.8.4 Voltage Regulation

The inherent voltage regulation (without AVR) of the generator at 0.9 lagging power factor shall not be greater than ± 30 percent. Guaranteed values at 0.9 lagging and 1.0 power factors shall be given in the Tender.

2.6.8.5 Insulation and Temperature Rise

Insulation of the generator windings shall be classified as Class F. With the turbine at the rated design output as defined in IEC 60085 and the generator at 0.9 lagging power factor, the temperature rise shall not exceed the limit for Class B insulation as defined in IEC 60085.

2.6.8.6 Unbalanced Load

The generator shall be capable of a negative sequence I_2^2t value of 20 for transient operation under system fault conditions and continuous operation of 10% negative phase sequence current.

2.6.8.7 Generator Connections

The generator shall be star connected with three (3) terminals brought out at the neutral side and three (3) terminals at line side of the stator winding. Both the line and neutral terminals shall be insulated for full line voltage.

2.6.8.8 Temperature Detectors and Thermometers

The generator shall be provided with RTD temperature detectors. At least three (3) for the stator winding and one (1) for each bearing. These shall be located where it is anticipated the maximum temperatures will occur. The RTDs shall be 3 wire or 4 wire Pt 100 type and wired to the Generator Terminal Box.

2.6.8.9 Structural Design

a) Stator

The stator frame shall be made of welded steel plate with sufficient reinforced ribs. The stator cores shall be built up with high-permeability and low specific loss silicon steel lamination. Preferably, the stator core shall be adequately keyed or detailed to the stator frame. Any deviation from this shall be specifically noted with the Tender offer. The stator frame shall be provided with lifting lugs suitable for applying slings for lifting the stator or generator assembly by crane or lifting gear.

Within the generator housing, the stator terminals shall be copper, and shall be of the bolt-clamped type for connection to the power cable terminals.

The stator coil conductor shall be electrolytic copper with a conductivity not less than the value for annealed copper specified in the approved standard. The coil insulation shall be properly vacuum and pressure impregnated with high-grade insulating varnish or thermos-setting epoxy resin to eliminate voids.

b) Rotor

The entire rotor shall be designed to safely withstand all mechanical stresses to be imposed by the maximum runaway speed of the turbine continuously. Special case shall be taken to prevent the end turns from deforming or slipping due to the centrifugal stresses on the interconnections. The poles shall be provided with copper damper-bars and a complete damper winding. The rotor leads shall be connected to the brushless exciter mounted on the generator shaft.

c) Shaft

The generator shaft shall be forged carbon or alloy steel properly heat-treated. The shaft shall be of ample size to operate safely at any speed up to the maximum runaway speed of the unit without detrimental vibration or distortion.

The exterior cylindrical surface of the shaft and couplings shall be accurately and smoothly machined all over and polished at bearing surfaces. The end of the shaft shall be arranged for suitable coupling to the turbine.

The entire turbine generator set shaft line shall be designed to ensure that the first critical speed is at least 25% greater than the runaway speed.

d) Bearings

The generator shall be provided with self-aligning roller bearings, journal bearings will not be accepted.

The bearings shall be grease lubricated and shall be fitted with an automatic greasing system sized such that refilling the grease reservoirs is required no more than once per month.

Bearing seals shall be provided to prevent grease leakage, as well as to prevent the entrance of foreign materials into the bearing housing.

The bearings shall be designed to withstand safely and without damage the natural retardation of the turbine-generator unit from the maximum runaway speed to rest.

Each bearing shall be fitted with a Pt100 temperature sensor for bearing temperature monitoring and protection.

Each bearing shall be fitted with a two axis vibration detector with switch output to signal high vibration levels.

e) Generator Housing

A steel plate housing shall be furnished for the generator and shall be sufficiently rigid to prevent objectionable vibrations.

The generator housing shall be arranged to permit easy removal for the purpose of inspection and maintenance.

f) Generator Heaters

The Generator shall be provided with suitable type space haters of adequate capacity to prevent moisture condensation while the generator is shutdown. The space heaters shall be arranged to be energised automatically when the generator is not running. Power supply to the heaters shall be three-phase 415 volt or single-phase 240/250 volt AC.

g) Bedplate

Preferably, the generator components shall be mounted on soleplates to facilitate site alignment. The generator shall be fully assembled at the Contractor's shop.

2.6.8.10 Generator Neutral Earthing

The generator neutral shall be solidly earthed.

2.6.8.11 Terminal Boxes

The main and neutral terminals shall be brought out to terminal boxes on the side of the generator that shall also house the voltage and current transformers. The main and neutral cable connections shall be made at these terminal boxes. All other electrical interfaces to the generator including CT and VT secondary's, instrumentation, protection and controls shall be made at the Generator Terminal Box, mounted on the generator.

The terminal boxes shall be totally enclosed and provided with removable front panels for Plant inspection and termination.

2.6.8.12 Specified Spare Parts

The Contractor shall furnish spare parts for the generators as listed below. A set is defined as the total number of each component required for one generating system. One set of spare parts shall be provided. Where listed components differ between generators supplied, one set shall be provided for each design of generator.

- One set of bearings
- Other items recommended by the Contractor.

2.6.9 **Excitation Systems**

2.6.9.1 Type and Description

The capacity of the excitation system shall be more than 110% of capacity required for the generator. The ceiling voltage of the excitation system shall be not less than 175% of the rated field voltage under the field winding temperature at 75°C. The response ratio of the system shall be to less than 2.0.

The excitation system and voltage regulating shall be able to operate safely at any speed put the frequency corresponding to the maximum momentary speed rise when full load is rejected.

2.6.9.2 Power Supply

The excitation system shall be powered either from a permanent magnet generator (PMG) mounted on the generator shaft, or by means of the AREP principal whereby auxiliary series and shunt windings are installed in the generator.

The existing AC exciter on the generator shaft shall be re-used.

2.6.9.3 Rotating Rectifier

Rotating rectifiers shall be:-

- of three-phase full bridge silicon diode type connected to the AC exciter.
- provided with protection devices to suppress overvoltage and transient voltage in the rectifier circuit. The rectifier diodes and protection devices shall be mounted rigidly on the holder ring so as to withstand centrifugal force of the maximum runaway speed, and shall withstand all site ambient temperatures.
- designed that when one diode is faulted, the generator shall be able to keep running safely until the next scheduled servicing shutdown. A diode failure detector shall be provided to given protection and alarm for the excitation system.

2.6.9.4 Voltage Regulator

The voltage regulator shall consist of an automatic voltage regulator (AVR). The automatic voltage regulator shall be of high speed, quick response static transistor amplifier type and shall include a power system stabiliser. The AVR is to be housed in the generator junction box. The AVR shall preferably be able to be interfaced to an external device by a digital communications link. This link shall be a standard protocol such as Profibus, Modbus or DeviceNet.

The AVR shall operate in one of two modes. When operating isolated from the power system, the AVR shall operate in voltage setpoint mode. The voltage setpoint shall be adjusted from “Raise” and “Lower” inputs from the Employer control system. An adjustable droop shall be present which allows the machines within the scheme to operate in parallel. When operating in parallel with the power system, the AVR shall be able to control the power factor of the output. The power factor setpoint shall be set by the Employer Control System. The AVR shall adjust the relevant parameter linearly over the range. The selection between the two operating modes shall be made by an input driven by the Employer Control System. The outputs must be limited so that machine capability is neither exceeded nor artificially limited.

The automatic voltage regulator shall continuously respond with high speed to correct any change in generator voltage and maintain the generator terminal voltage under steady state conditions within plus or minus 2.5 percent (± 2.5 %) without hunting for any excitation value within the normal operating range.

The AVR shall include a Volt/Hertz limiting function. Provision shall be made to de-energise the field quickly if a fault is identified in the generator.

All adjustments shall provide a wide range of settings to allow the full use of the generator capability.

2.6.9.5 Protection and Alarm for Excitation System

The protection for the excitation system shall be classified into two groups by the nature and extent of faults. If a serious fault is detected the excitation system shall be tripped and the generating unit will be shut down. When a fault is not so serious, the faulted device shall be isolated from the system without interruption of the generator excitation and an alarm shall be raised.

The protection and alarm system for the excitation system shall be designed to be compatible with the protection and alarm system for the generating Plant. The protection and alarms shall be provided for, but not limited to, the followings:-

a. Protection (Trip)

- AVR power source, failure
- Two (2) diodes on one phase of rotating rectifier, fault
- AVR, fault
- Field overvoltage

b. Alarm

- One (1) diode on one phase of rotating rectifier, fault
- Field circuit, ground

2.6.9.6 Specified Spare Parts

The Contractor shall furnish spare parts for the excitation systems as listed below. A set is defined as the total number of each component required for one excitation system. One set of spare parts shall be provided. Where listed components differ between excitation systems supplied, one set shall be provided for each design of excitation.

- One set of all plug-in type electronic components and printed circuits cards.
- Other items recommended by the Contractor.

The power station shall be connected to the EPC 22kV distribution system as shown on Figure 1 below. The following sections detail the technical requirements for each component.

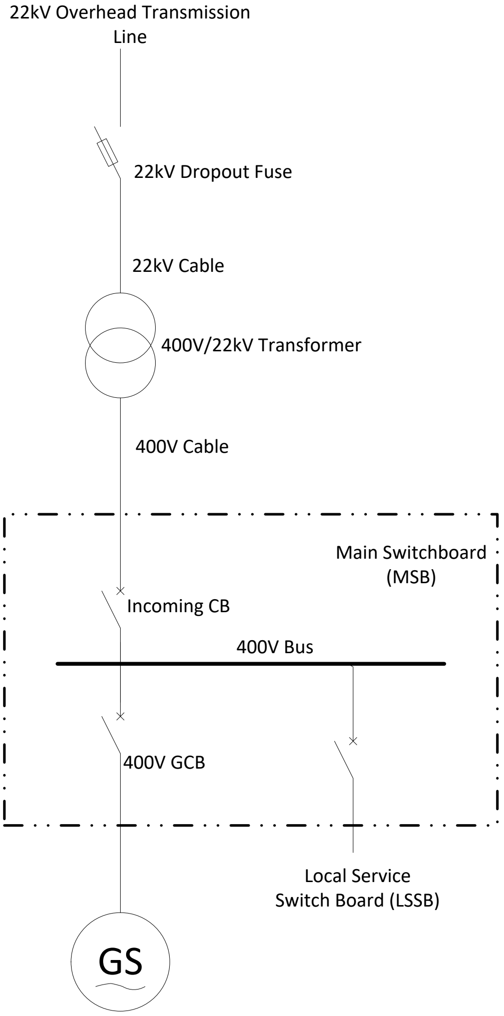

Figure 1 – Single Line Diagram

2.6.11 **22kV Connection and Ancillary Items**

The contractor shall construct the 22kV connection from the power station transformer HV terminals to the designated interface point on the EPC system.

The 22kV connection shall consist of:-

- Pole mounted drop out fuses and surge arrestor at the terminal pole adjacent to the powerhouse.
- Pole mounted 22kV VTs for protection and indication.
- 22kV underground cable from the terminal pole to the station transformer.

The overhead 22kV conductor shall be “Wasp”(7/4.39) All Aluminium Conductor (AAC) to AS/NZS1531.

All insulators shall be polymeric type rated for 33kV and with 95kV/130kV wet/dry power frequency flashover voltage.

Poles shall be softwood utility poles to AS3818.11 “Utility Poles” and shall be treated to grade H5 in accordance with AS1604.1 “Timber – preservative treated”.

2.6.12 **Station Transformers**

2.6.12.1 Type and Description

The station step-up transformer shall be an outdoor, oil-immersed three phase, double-wound type unit based in a single tank.

The transformer shall conform to the requirements of IEC 60076 and be suitable for operation under IEC 60354. The transformers shall each meet continuous rated power with ONAN cooling.

Number of phases	3
Cooling	ONAN
Frequency, Hz	50
Number of windings	2
Primary winding, rated V	22,000
Secondary winding, rated V	415
Primary connection	Wye
Secondary connection	Delta
Winding Vector Group	DYN11
Minimum impedance from high voltage to low-voltage winding, based on rated kVA (%)	5.0%
Primary winding taps for rated kVA on-load taps; low rated voltage	+5.0% to -5% in 2.5% steps
Average sound pressure level, dBA	65
Winding temperature rise, above a 24-hr average 25°C ambient, with a maximum ambient of 40°C	80°C
Power Frequency Withstand Primary/Secondary windings	50kV/2.5kV
Basic Insulation Level Primary Windings	125kV

2.6.12.2 General Design Requirements

Each transformer shall be of the hermetically sealed type with radiators supported from the transformer tank. Designs requiring a conservator tank will not be accepted.

Each transformer shall be mounted on a concrete pad, with bunding sufficient to hold the entire quantity of oil used in the transformer. A system of draining water from the bund, whilst preventing drainage of oil, shall be provided.

2.6.12.3 Losses

The Contractor shall provide guaranteed no-load and load losses for the transformer.

2.6.12.4 Core

The core shall be constructed of the highest quality steel especially suitable for the purpose. The steel shall be in thin laminations, annealed after cutting, and rolled to ensure a smooth surface at the edges. Both sides of each sheet shall be insulated with a durable, heat-resistant, baked enamel or varnish. The cores shall be carefully assembled and rigidly clamped to ensure adequate mechanical strength to support the windings.

2.6.12.5 Windings

Both primary and secondary windings shall be vacuum pressure impregnated. Each coil shall be cast under vacuum to ensure complete and void-free resin impregnation throughout the entire insulation system.

Transformer windings shall be copper.

2.6.12.6 Enclosures

The transformer shall be provided with an oil-tight galvanized steel case. The joints between the case and cover shall be such that the cover and top section of the case are integral. Gasket or shield material, which will not deteriorate under service conditions, shall be provided between the top cover and case. The top cover shall be bolted to the case.

The transformer shall be provided with eyebolts and/or lugs for lifting the essential parts and for lifting the completely assembled transformer filled with oil. Guides shall be provided inside the case for guiding the cores and windings as they are being removed from or lowered into the case.

The transformer case shall be provided with a pressure relief diaphragm or valve of adequate size to protect the case against a primary explosion due to arcing below the surface of the oil. The relief diaphragm shall be designed so as to minimize discharge of oil and to exclude air and water after it opens. It shall be equipped with a visual alarm indicator and with alarm contacts.

The transformer case shall be capable of withstanding without leakage or distortion a full vacuum and an internal gas pressure 25% greater than the maximum operating pressure resulting from the system of oil preservation used. All valves, fittings, and piping affected by this requirement shall be of correct design and construction for full vacuum filling.

The transformer shall be provided with approved valves as required for:

- Draining the case (flanged-gate valve).
- Sampling oil from the extreme bottom of the case.
- Sampling oil from the top of the case.
- Filling the case and radiators.

Oil valves shall be specially designed for use with insulating oil and shall hold hot oil without leaking. An air vent shall be provided on the transformer at the top of the case and piped to a valve within reach from the floor for releasing air when the case is being filled with oil and/or nitrogen gas.

Two transformer tank grounding pads shall be furnished on opposite sides of the tank near the transformer base.

2.6.12.7 Tap Changer

The transformer shall be equipped with an externally, manually-operated no load tap changer rated for the maximum rating of the transformer and suitable for changing connections to the taps in the windings. Taps shall be changed only when the transformer is de-energized. The operating hand wheel shall be mounted on the side of the case at a convenient height for operating from the floor on which the apparatus is mounted and shall include an indicating pointer and dial and means for locking the tap changer in any desired position.

2.6.12.8 Insulating Oil

Insulating oil used for oil impregnation and testing at the Contractor's works shall be PCB free, uninhibited and free of all additives.

Oil used for filling on site will be supplied under this Contract and will be inhibited oil to Class 1A of BS 148.

2.6.12.9 Cooling System

Cooling shall be ONAN.

Where external radiators are required, they shall be of the panel type and shall have the following features:-

- Externally galvanised
- Two lifting lugs per radiator
- Isolating valves to permit uncoupling from the radiator bank without draining the bank. These valves shall withstand full vacuum.
- No crevices where moisture may be trapped and thereby cause corrosion

Radiators shall be tested for leaks by the same methods as used for the transformer tank, and shall withstand full vacuum.

Any radiator shall be able to be removed from a bank without first removing any other items.

2.6.12.10 Bushings & Terminals

The HV and LV winding connections of each transformer shall be brought out through the transformer tank wall by means of outdoor bushings in a cable box.

Cable boxes shall be air insulated and located with the bottom of the box located at a sufficient level above the bottom of the transformer tank to permit power cable access.

Each cable box shall be provided with two earth terminals per phase for the following purposes:-

- The separate earthing of the copper wire screen of each cable.
- The temporary earthing of the cable terminal.
- The temporary earthing of the bushing terminal.

Each cable box shall have a removable gland plate made of non-magnetic metal.
Where proprietary plug and socket arrangements are used for HV terminations, the cable termination kit shall be supplied.

2.6.12.11 Earthing Terminals

Earthing terminals complying with this specification shall be provided. Two shall be located on the transformer tank, one on either side and near to ground level. The earthing terminals shall be sized for connecting 150 mm2 cable clamps

2.6.12.12 Control, Instrumentation & Protection

The following control, instrumentation and protection features shall be provided:-

2.6.12.12.1 Winding Temperature Indicator

The transformer shall be provided with winding temperature indicator consisting of a current transformer, thermal replica device, winding temperature indicator and relay contacts.

Each winding temperature relay shall have two or more independent contacts, which shall be separately adjustable trip/alarm contacts with a range of at least 60°C to 150°C.

The winding temperature indicators shall have a range of at least 20°C to 150°C over a scale length of 110 mm.

2.6.12.12.2 Oil Level Indicators

An oil level indicator shall be supplied for the transformer tank. This indicator shall have contacts for high and low level. The contacts shall be wired to the Unit PLC.

2.6.12.12.3 Pressure Release Device

The transformer shall be fitted with a pressure release device, the device shall be fitted with visual indication and contacts wired to the Unit PLC.

2.6.13 415V Main Switchboard (MSB)

2.6.13.1 General Requirements

Each MSB shall have a voltage rating of 415V, with incoming line circuit breaker, generator circuit breaker and local service switchboard (LSSB) feeder. The MSBs shall be composed of factory assembled metal clad cubicles. The equipment shall be of type tested design and shall be completely factory assembled and tested prior to shipment.

MSBs shall be designed and supplied as per below specification:

- Nominal system voltage (r.m.s. value, phase to phase voltage): Un = 0.415 kV
- Highest value of system operating voltage (r.m.s. phase to phase voltage): Um = 0.46 kV
- Rated insulation voltage: Ui = 1.0kV
- Rated impulse voltage: Uimp = 8.0kV
- Standard Rated Frequency: 50Hz
- System configuration: 3 ph, effective earthed.
- Design fault level 16kA (3s).
- Form of Construction: Form 3b.

The LSSB, Unit Control Panel and Unit Protection panel may be incorporated into the MSB panel suite at the Contractors discretion.

2.6.13.2 Busbars

The switchgear shall have a 3-phase, 4-conductor bus with a continuous current-carrying capacity of at least 630 A with a hottest-spot temperature rise not greater than 65°C above the ambient temperature outside the switchgear.

The neutral bus shall be of the same rating as the phase bus.

Buses and connections shall be fully insulated with flame-retardant sleeve-type or moulded insulating material.

An earth bus shall extend through the entire length of the switchgear. The switchgear frame and all internal equipment bases and mountings shall be connected to the earth bus.

2.6.13.3 Circuit Breakers

Circuit breakers shall comply with IEC 60947-2.

The incoming and generator circuit breakers shall both be either moulded case circuit breakers (MCCBs) or air circuit breakers (ACBs) and shall be specifically designed for generator applications.

The circuit breakers shall be suitable for at least two (2) daily open-close operations over the 40 year design life of the plant.

Circuit breakers shall have a minimum short circuit rating of 16kA (3s).

Circuit breakers shall be of utilisation category B and suitable for isolation to overvoltage category IV as defined by IEC60947.

The operating mechanism shall be of the quick make quick break type, with the speed of operation independent of the operator, and shall be trip free.

The generator circuit breaker shall be withdrawable to permit isolation of the generator during maintenance.

The breakers shall be operated by a toggle, which shall clearly indicate the three fundamental positions
ON, and OFF and TRIPPED. It shall not be possible to close the generator circuit breaker using the front toggle.

The breakers shall provide double insulation from the front face allowing field installable auxiliaries to be fitted without isolating the unit.

Each Circuit Breaker shall be provided with an integral trip unit suitable for interfacing with the plant 24V DC protection system.

Each circuit breaker shall be provided with a spring charged, motor wound, closing mechanism suitable for interfacing with the automatic synchroniser system.

Auxiliary contacts shall be provided for the remote indication of the following conditions “CB Closed”; “CB Open”; “CB Tripped” to the control system.

2.6.13.4 Instrument Transformers

2.6.13.4.1 General

The instrument transformers shall be indoor type designed and rated in accordance with IEC60185 or 60186.

2.6.13.4.2 Voltage Transformers

Voltage transformers shall be manufactured to IEC60186.

The IEC relaying accuracy class at 50-Hz shall be at least 3P for protective circuits and class 1.0 for measuring or metering circuits.

2.6.13.4.3 Current Transformers

Current transformers shall be manufactured to IEC60185 and shall use standard IEC winding ratio’s. Protection and instrumentation current transformers shall use 1 A secondary and metering transformers 5A secondary.

The IEC relaying accuracy class at 50-Hz shall be at least 5P20 for protective circuits and class 0.5 for measuring or metering circuits.

Standard application data shall be furnished in accordance with IEC 60185. Curves and data to be furnished for the transformers shall include, but not be limited to the following:

- Ratio and phase-angle correction curves.
- Short-time thermal and dynamic stability current ratings.
- Excitation current curves showing “knee” point voltage for each type and rating.

Current transformers shall be provided on the circuit breakers as listed herein.

Incoming Circuit Breaker	
• Ratio	Circuit Breaker Rating/5A
• Number of three phase sets required	One
• Accuracy Class	0.5
Generator Circuit Breaker	
• Ratio	Circuit Breaker Ratings/1A
• Number of three phase sets required	Two
• Accuracy Class	5P20 (CT1) 0.5 (CT2)

2.6.13.5 Surge Protection Equipment

Surge protection shall be provided on each incoming circuit breaker. Each set of surge protection equipment shall consist of 3 surge arresters mounted in a separate compartment of the switchgear assembly.

2.6.13.6 Cable Terminators

Cable entry shall be from the top or bottom via removable gland plates. The gland plates shall be made of non-magnetic metal. The gland plates shall completely seal off the bottom of the cable termination panel and shall be bonded to the associated cubicle to provide earth continuity.

Control and instrumentation cable and AC / DC power cables shall be wired between panels and marshalled at a single termination point at the switchboard. The boxes shall be suitable for termination of a single or a number of multicore control and or power low voltage cables.

Each cable box shall be provided with two earth terminals per phase for the following purposes:-

- The separate earthing of the copper wire screen of each cable.
- The temporary earthing of the cable terminal.
- The temporary earthing of the bushing terminal.

2.6.13.7 Control Switches

Control switch for each circuit breaker control shall be 3-position, momentary-contact type, with spring return to the neutral position, and shall have a pistol-grip handle. A pull-to-lock feature shall be provided.

Selector switch for local/remote control shall be 2-position, maintained contact type and shall have a round notched handle.

2.6.13.8 Protective Relaying

All protection required for the units shall be mounted on the Unit Control, and protection panels. Refer Section 2.6.16 Protective Relays.

2.6.13.9 Multifunction Metering Modules

A multifunction metering module shall be provided on the control cubicle for each incoming and generator circuit breaker. The multifunction meter modules shall be a digital instrumentation package consisting of the following:

- Field selectable displays for unit and feeder volts, amperes, kVA, kW, kVAR, demand amperes, demand power factor, frequency, kWh, and kVARh.

- Serial communications port for transmitting data to the PLC control system.

Multifunction meter modules shall be suitable for accurately measuring 3-phase, 50-Hz quantities. The maximum allowable error shall not exceed ±0.25% of full scale at 25°C. The modules shall have electrical isolation between input, output, power supply, and the case ground connection. The module shall have a minimum dielectric test voltage rating of 1500-V AC rms for 1 minute.

2.6.13.10 Revenue Metering

The MSBs shall include revenue meters onto each incoming circuit breaker. This shall include:-

- A four quadrant Class 0.5 revenue meter complying with IEC 62053.
- DNP3 communications to the station control system.
- Sealable terminals for the connection of the meters to CT and VT secondary circuits.

2.6.14 **Control and Instrumentation Systems**

2.6.14.1 Type and Description

A control and instrumentation system shall be provided to control and monitor the generating unit and all the power plant apparatus.

The control system shall be designed to allow the scheme to operate in a fully automatic manner with limited Operator involvement. The powerhouse will normally be monitored and controlled from the Employers National Control Centre (NCC) located at Fuluasou Substation. The power scheme controls and protection systems must be designed to:-

a) Ensure the safety of the Facilities, EPC staff and the general public during normal and abnormal event.
b) Maximise the efficient utilization of water of the controlled scheme.
c) Minimise the lost generation following plant trips and other disturbances.
d) Alert the EPC Operator to any abnormal condition that may exist with the Facilities and of any maintenance that may be required.

The scope of supply, work and services shall be complete in every respect for the purpose it is intended, even if it is not explicitly stated in these technical Employer's Requirements.

The Plant and Facilities will be monitored and controlled locally via the local HMI's and/or remotely at the Employer's NCC.

2.6.14.2 Controlled Equipment

For turbine generator and transformer Unit:

a) Turbine and speed governor.
b) Generator and excitation system.
c) Unit Transformer.
d) 415V Switchgear
e) All unit auxiliary systems and equipment.

General services of the powerstation:

a) Station service AC and DC systems.
b) Powerhouse drainage systems
c) Powerhouse ventilation

2.6.14.3 Control System Operation

2.6.14.3.1 General Requirements

The control system shall provide centralized control and monitoring of the power plant from an HMI located at the powerhouse and/or from the Employers NCC.

The control system shall be configured to provide the following functions:

a) Manual and automatic starting and stopping of the generating unit.
b) Control of MW and MVAr output of the generating units.
c) Monitor and log the status of generating units.
d) Monitor and control the station services, generating unit auxiliaries, intake water levels, and other powerhouse systems hereinafter specified.

Features of the control system shall include:

a) Alarm annunciation and management
b) Data acquisition and control.
c) Human Machine Interface (HMI)
d) Historical data management
e) Integration with the EPC NCC

The control system shall be programmable logic controller ('PLC' – as per IEC 61131) based with PC based HMI workstations, providing a completely integrated state-of-the-art system. The system shall have an "open architecture" which shall permit reconfiguration, expansion, and future upgrade.

The control system at each powerhouse shall include as a minimum the following equipment:

a) One HMI Operator's Station located in the powerhouse.
b) One "Unit" PLC per turbine generator used for control and monitoring of the associated turbine generator.
c) For stations with more than one turbine generator; one "Station" PLC for control and monitoring of the power station, remote Penstock Valve and headpond level. For stations with only one turbine generator, the Unit PLC shall be used for the "Station" control functions.
d) One fault-tolerant, redundant, fibre optic based 100MBPs Ethernet LAN serving all of the equipment listed above.
e) Other hardware and software required to fulfil the requirements of these Employer's Requirements.

2.6.14.3.2 Design and Performance Criteria

The control system shall be designed to minimize the duration of failures by the ability to diagnose and resolve problems quickly and to replace any failed part easily.

The Average System Availability over a one year period shall be 99.8% or better. The Contractor shall provide a guarantee for the Average System Availability with his Tender.

The hardware and software elements of the Control system shall be easy to maintain using the maintenance facilities, hardware and software tools, and recommended spare parts provided by the Contractor.

All tuning parameters and setpoints shall be accessible by the Employer, via password protected engineering screens on the HMI system.

The PLC code shall be provided to the Employer, along with a licensed copy of the programming software installed onto a Notebook computer. The PLC code must be fully open to the Employer with no 'locked' elements.

2.6.14.3.3 Expandability

The Control system shall be capable of being expanded over and above the specified system by adding more stations, PLCs, functions, input-output modules, or metering modules. This expansion shall not degrade the performance of the existing system. Twenty (20) percent spare capacity is to be provided.

For ease and flexibility in expanding the Control system, the Contractor shall conform to the open architecture concept as described herein.

2.6.14.3.4 Product Quality and Advanced Technology

The Employer requires hardware and software products of high quality in design, fabrication, and performance.

The standard hardware equipment (such as printers, etc) and devices of the control system shall be brand-new and shall be as close as possible to being of the latest design technology. In order to meet this requirement, the Contractor shall defer the procurement of all standard hardware as late as possible in the project schedule until just prior to system integration. Similarly, for the standard software, the latest versions available at time of Factory Acceptance Test (FAT) shall be delivered.

The Contractor shall use and provide the latest versions of all the standard software, e.g., the operating system, utilities, language compilers, graphics software, picture editor, networking software, database management system, which are available at the time of system integration, as long as there is full upward compatibility with the control system software. PLC programming must comply with IEC 61131-3.

All software shall be standard. Therefore, any Contractor’s code modification on standard software packages shall not be permitted.

All software shall use the Microsoft Windows 10 Operating System. All software shall be in the English language.

The control system PLC hardware and software must be from a recognised global supplier of such equipment. Spare parts and engineering support for the PLC hardware and software must be available to the Employer from licensed representative companies located either in Samoa, or in countries with regular (at least bi-weekly) direct flights to Apia.

2.6.14.4 Unit Controllers

2.6.14.4.1 General Requirements

a) Unit Controllers (Unit PLC) shall be PLC based, and shall include main and auxiliary memory, HMI with keyboard/pad and optical mouse, interfaces with intelligent devices and Process LAN interface.
b) The Unit PLC shall be a standalone system, designed to operate totally independent from other devices in the Control system. Therefore, all functions shall be available in the Unit PLC at all times, regardless of whether the Process LAN is in service or not.
c) The Unit PLC shall be house in a Unit control panel located in the air conditioned control room.
d) The Unit PLC shall communicate with multifunction meter modules, and protection relays using Modbus or DNP3 communication protocols.
e) The Unit PLC shall communicate with other drops in the system over the Process LAN, using industry-standard communication protocol based on TCP/IP.
f) The Unit PLC functions shall be programmed in an IEC61131-3 compliant language.

2.6.14.4.2 Control Functions

The Unit PLCs shall have the necessary processing power, memory, software, and peripheral facilities to perform the following functions:

- Control of unit start up.
- Control of unit shut down.
- Turbine speed and load governing.
- Monitoring of turbine generator unit pressures, levels, vibrations, flows, temperatures etc and providing protection system “trips”.
- Monitoring of hardwired trips from protective relaying system and providing backup ‘trips’.
- Headpond water level control.
- Individual control of generating Unit MW and MVAr setpoints.
- Control of auxiliary equipment including pumps.
- Control of unit 415V circuit breaker (synchronised closing will be via synchroniser).
- Unit alarms.
- Local Service AC System control and monitoring.
- DC Systems monitoring
- Powerhouse sump pumps control and monitoring
- Powerhouse dewatering pumps control and monitoring.
- Fire alarms monitoring.
- Security Systems monitoring.
- Interfacing with Employers SCADA

Note that the Unit designs shall be based on the premise that the Unit PLC must be in service for the generating unit to operate.

2.6.14.4.3 Control of Headwater Level

When in level control mode the turbine shall be regulated to maintain the water level at the headpond to a predetermined setpoint with an accuracy of ±10mm. The Unit PLC shall include a routine to automatically start and stop the unit in response to high and low extremes in headpond level.

In the event of the headpond water level transmitter signal failing, the PLC shall raise an alarm and automatically fall back to using the penstock pressure transmitter at the powerhouse as backup. Under this backup control the PLC shall be able to control the intake water level to an accuracy of ±500mm.

2.6.14.4.4 Individual Control of MW Generation

The Unit PLC shall have the software for executing MW setpoint controls entered manually by the operator at any of the operator stations or HMIs. The setpoint control software shall be a closed loop, proportional-integral controller of the generator MW output. When in MW control mode, the unit shall be loaded to the lower of the MW setpoint, or the headpond level control algorithm.

2.6.14.4.5 Individual Control of MVAR Generation

The Unit PLCs shall have the software for executing MVAR setpoint manually entered by the operator at any of the operator stations or HMIs. The setpoint control software shall be a closed loop, proportional-integral controller of the generator MVAR output.

The setpoint control algorithm shall respect the maximum and minimum reactive power limits of the generating unit that shall be calculated dynamically in the Unit PLC. Reactive power limits shall be calculated using the generator capability curves. These limits shall be modifiable by the Operator on the HMI.

2.6.14.4.6 Automatic Start Sequence Control

The generating unit automatic start sequence shall be initiated by an operator's request at the HMI or from the headwater level control.

A sequential control algorithm resident in the Unit PLC shall execute the automatic start sequence. The Contractor shall define the exact sequence, pre-start conditions, and timers.

The automatic starting sequence program shall control the turbine-generator unit through a series of steps from one steady state to another, starting with the unit at dead stop and ending with the unit synchronized to the power system and with load.

The Unit PLC shall perform as a minimum the following sequence within a predetermined time schedule:

a) Pre-start conditions and permissives satisfied.
b) Penstock at pressure.
c) Unit Auxiliaries start.
d) Governor start.
e) Unit spinning up.
f) Excitation on at 95% speed.
g) Unit auto synchronizer activated at greater or equal to 95% speed.
h) Unit synchronized on-line.
i) Unit loaded to minimum load.

The Unit PLC shall notify the operator of any discrepancy of unit status with the expected normal operation at all stages of the starting sequence. Failure to complete the sequence will result in the unit being automatically shut down.

The operator shall have the option of interrupting the starting sequence at any steady state. After the operator interrupts the automatic sequence, the Unit PLC control logic shall be designed to return to the last steady state.

2.6.14.4.7 Automatic Stop Sequence Control

The generating unit automatic stop sequence shall be initiated by an operator's request at the HMI or from the headwater level control..

A sequential control algorithm resident in the Unit PLC shall execute the automatic stop sequence. The Contractor shall define the exact sequences, pre-stop conditions, and timers.

The automatic stopping sequence program shall control the turbine-generator unit through a series of steps from one steady state to another, starting with the unit loaded and ending at dead stop.

The Unit PLC shall perform as a minimum the following sequence within a predetermined time schedule:

a) Pre-stop conditions.
b) Load condition reduced to minimum operational load.
c) Unit circuit breaker trips.
d) Excitation off.
e) Spear valve closed.
f) Speed reduction.
g) Zero speed.
h) Inlet valve closed
i) Dead stop condition.

The Unit PLC shall notify the operator of any discrepancy of unit status with the expected normal operation at any stage of the unit stopping sequence. Failure to meet the stop sequence will result in a unit trip being initiated.

The operator shall have the option of interrupting the stopping sequence at any steady state. After the operator interrupts the automatic sequence, the Unit PLC control logic shall be designed to return to the last steady state. A Unit restart shall be possible from any of the steady states.

2.6.14.4.8 Turbine Generator Protective Functions.

The Unit PLC shall monitor the mechanical behaviour of the turbine generator unit and trip the unit in the event of abnormal condition detection.

The PLC shall have outputs wired directly into the turbine generator shutdown circuits for this purpose. In addition, the Unit PLC shall have a watchdog contact that will trip the turbine generator in the event of a PLC failure.

Further details of the protective functions to be provided by the Unit PLC are described in Part 2.6.16 Protective Relaying System.

2.6.14.4.9 Synchronising

The Unit Control Panel shall include an automatic synchroniser configured to operate into the generator circuit breaker. Provision for manual synchronising shall also be provided at the Unit Control Panel.

2.6.14.4.10 Employers SCADA Interface

The Facilities shall be integrated with the Employers National SCADA system. Modifications to configuration at Fuluasou National Control Centre (NCC) are required covering all necessary additions and changes to communication and database parameters, including new screen displays and control dialogs. All software modifications required at NCC shall be undertaken by the Contractor.

An RTU shall be provided in the powerhouse to interface the power plant PLC based control system with the NCC SCADA system. The Employer’s NCC uses ClearSCADA software and SCADAPackeNET RTUs, manufactured by Schneider Electric Ltd. Any Remote Terminal Unit offered by the Contractor must be fully compatible with these existing systems.

One SCADA panel and Remote Terminal Unit is required, to be located inside the powerhouse. This panel shall :-

- Be floor standing, swing door front access panel, containing:
- Media conversion for fibre
- Include a PoE network switch with spare port
- Include a rack type modular Remote Terminal Unit for data processing compatible with existing NCC SCADA
- Include terminal rails for interconnections, power supplies, surge suppression and protection. Power for the Remote Terminal Unit and accessories shall be taken from the powerstation 24V DC system.
- Include an internal panel light and 240V socket outlet.

The following IEDs shall be connected to the RTU using either DNP3 OR Modbus format via TCP/IP transport:-

- All protection relays, including generators, transformer and feeders.

- Metering, including revenue meters
- The Unit PLC

The Unit PLC shall act as data concentrator for transferring data from the turbine generator, intake and headpond to the RTU.

Local and NCC control modes should be safely interlocked and able to be selected from either the local control system HMI panel or the NCC, with NCC SCADA being able to control the generation system when in NCC mode. Audible/visible warnings should be provided for prior alert of the remote operation of the turbine generator.

The Unit PLC to RTU communications shall pass all data required to enable the NCC control screens, and alarms to be able to be configured as an exact replica of the local HMI system.

All IP devices should satisfy EPC's IP scheme, which should be re-confirmed during the design phase but is currently 10.50.100.xxx for powerhouse all SCADA interfaced devices. All EPC subnet masks should be set to 255.255.0.0.

At both the powerhouse and headpond sites provision should be made for the connection of a least one IP telephone (IP 10.20.150.xxx) and one CCTV Ethernet connection (10.30.100.xxx at Powerhouse, 10.30.101.xxx at Dam).

2.6.14.5 PLC Technical Requirements

2.6.14.5.1 General

Each PLC shall be provided with a system of input-output modules (local or remote), instrumentation bus, and power supplies.

The input-output modules and power supplies shall meet the Surge Withstand Capability standards as defined by IEC or ANSI/IEEE.

2.6.14.5.2 Processors

Processors shall support standard IEC 61131-3 languages. As a minimum these are to include the following:

- Ladder Logic.
- Sequential Function chart.
- Function Block Diagram.
- Structured Text.

The processors shall have sufficient internal memory to run the PLC program without the need for external memory cards. Processors shall be supplied with enough surplus memory to allow future modifications to the program.

All processors shall have either non-volatile memory or be supplied with internal batteries to prevent loss of volatile memory.

The processors must have facility for online changes to be made to the program code.

2.6.14.5.3 Digital Input Modules

Digital input modules shall accept normally open or normally closed dry contacts for status and sequence-of-events inputs. All digital inputs shall include optical isolators and filtering to eliminate contact bounce.

The digital input module shall accept bistable and momentary-change inputs. Circuit breaker status and switch positions are bistable inputs. Equipment alarms and protective relay operations are momentary-change inputs.

Protective relay operations, including electrical and mechanical protective devices, shall be processed as Sequence-of-Event (SOE) inputs. SOE inputs are momentary-change inputs that shall be detected within the resolution window specified for SOE recording.

Digital input modules shall use 24V-DC as the signal voltage.

No more than 16 IO points are permitted on any single digital input Module. The maximum number of IO points with common 0V rail shall be 8.

2.6.14.5.4 Analogue Input Modules

The analogue input modules shall accept and process transducer voltage signals in the range of ± 10-V DC or current signals in the range of ±20 mA DC. All inputs shall be optically isolated.

The analogue input processing shall include filtering, scaling, and A/D conversion with a 12-bit 2's complement resolution.

Accuracy shall be at least ±0.05% and linearity ±2 LSB over the full input range and temperature range.

2.6.14.5.5 Resistance Temperature Detector (RTD) Input Modules

The RTD input modules shall have the capability of interfacing with Platinum RTDs.

All RTD inputs shall be wired to RTD input modules on the PLCs. Multiplexing of RTD signals is not permitted.

The RTD input module shall have a resolution of 0.1°C, accuracy of 0.8°C for RTD Type 100-Ohm Platinum.

2.6.14.5.6 Control Output Modules

The control outputs shall be of the “clean contact”, individually isolated type, with each output individually configurable as normally open or normally closed.

Control Output modules shall use 24V-DC as the signal voltage.

No more than 16 IO points are permitted on any single control output module.

2.6.14.5.7 Analogue Output Modules

The analogue output modules shall transmit process control signals in the range of ± 10-V DC or current signals in the range of ±20 mA DC. All outputs shall be optically isolated. Outputs shall revert to 0V DC or 0mA DC in the event of a module failure.

The analogue output processing shall include filtering, scaling, and A/D conversion with a 12-bit 2's complement resolution.

Accuracy shall be at least ±0.05% and linearity ±2 LSB over the full input range and temperature range.

2.6.14.5.8 Communications Media

The communications media for external (outside PLC cabinet) communication links shall be fibre optics.

The communications media for internal (inside PLC cabinet) communication links and short links between adjacent cabinets may be copper but shall be to the Project Manager's approval.

2.6.14.5.9 Physical Requirements

The PLCs shall be housed in a standard electronic equipment cabinet with a window door.

2.6.14.5.10 Power Requirements

The PLCs shall be suitable for operation from 24V-DC. All control and indication wiring to and from the PLC panels shall be 24V-DC and 240V-AC wiring is strictly prohibited.

2.6.14.5.11 Configuration System

The PLCs shall be provided with a Windows-based configuration system, which shall include all the necessary software to configure and program any function in the PLC.

The configuration system shall be installed on the portable maintenance PC.

The configuration system shall allow downloading and uploading of configuration data files.

The configuration system shall program, download, debug and store programmable algorithms.

The Contractor shall ensure that **all** OEM licenses for the configuration system are valid throughout the warranty period. The configuration software must have an international license and there shall be no requirement for hardware 'dongle' type security devices.

The Operating system shall be Microsoft Windows 10.

2.6.14.5.12 Programming Language

The programming package shall be an industry standard package IEC 61131-3 compliant and shall be totally integrated with the PLC software. No special database shall be required for the implementation of control programs. The control programs shall use ladder diagrams; function block diagrams, sequential function charts, structured text, instruction lists, and C++ based routines. Programs shall be fully annotated with tags and comments on a per line basis to fully document the code functionality. The programming package shall support on-line and off-line development, off-line simulation, documentation and reporting capabilities.

2.6.14.6 Human Machine Interface

2.6.14.6.1 General

The Human Machine Interfaces (HMIs) shall consist of an integrated SCADA/HMI PC-based graphic display system to support an interactive dialogue between the operator and the power plant equipment.

The HMI shall be based on an industrial touch screen, panel mounted computer, which shall be mounted on the Station Services PLC panel or, in the case of single unit stations, on the Unit Control Panel.

The HMI computer shall incorporate a solid state hard drive, and shall be designed for operation from a 24V DC power supply.

The HMI package shall include alarming, reporting, event logging and trending capabilities.
The HMI package shall include an interactive display editor.

All displays (formats and design) shall be subject to review by Project Manager.

The Contractor shall be responsible for integrating as a minimum the following displays:

a) Alarm Lists. Display of alarms. The entries in the alarm lists shall be arranged in chronological order.
b) System events summary. A chronological listing of all system events, i.e., alarms and operator-initiated actions.
c) Sequence of events list (one list).
d) Unit generation displays.
e) Station service displays.
f) Control system configuration display.
g) Generator and turbine capability curves with operating point shown.
h) Single line diagrams.
i) Headpond levels.
j) Sequence Monitor. The sequence monitor function shall monitor the sequential operation of the unit by checking the processing time for each step of the normal start and stop sequences. In the event of trouble in any sequential step, the step and equipment/devices shall be indicated on the sequence monitor to be mounted on the operator console.
k) Temperature Monitor. The winding temperatures of the generator, and generator step-up transformer winding temperatures shall be monitored with reference to the load and shall be continuously compared with the design characteristics. When an abnormal temperature trend is detected the related temperature-monitoring image shall be displayed. Display shall include a unit vertical section graphic indicating the location of the temperature sensors of the machine.
l) Daily and monthly reports.
m) Help screens.
n) Additional displays shall be as required by other functions included in this Contract.

2.6.14.6.2 Software Requirements

The operating system for the PC-based stations shall be Microsoft Windows 10 compatible.

The HMI software must have an international license and there shall be no requirement for hardware ‘dongle’ type security devices.

The database shall be designed to support the following input types:

a) Analogue Inputs - Read an analogue value either directly from a PLC or from a register within a protection relay device, and automatically convert the raw count to engineering units.
b) Analogue Alarms - Alarm capabilities for alarm suspension and remote acknowledge.
c) Calculations - Perform arithmetic calculations based on other database inputs.
d) Digital Inputs - Sense logical state of a switch or relay directly from the PLC input module or from a bit in memory of a protection relay.
e) Digital Alarm - Alarm capabilities for alarm suspension and remote acknowledge.
f) Digital Output - Set a logical on/off state in an output relay either directly in the PLC output module or in a bit within the memory of a protection relay.
g) Each database point shall include an instrument tag name, hardware device name, address, specific parameters, signal conditioning requirements and point description. The database shall be shared with the PLC database so as to ensure commonality of tag names throughout all devices.
h) The database shall be stored as a standard Windows file.

i) The database maintenance facilities shall be totally integrated with the graphic display system.
j) The database shall use a high-level data manipulation language such as Structured Query Language (SQL).

2.6.14.6.3 Security Management

The HMI software shall provide a user-based security system. If enabled, the security system shall allow for the creation of users with certain rights and/or privileges. These rights must include the ability to run any combination or all of the applications in the data acquisition system.

The ability to allow or disallow users' access to change values, such as setpoints and machine-setups, on an individual tag basis shall be supported.

2.6.14.6.4 Historical Data Management

Historical Data shall be collected at periodic intervals and stored in historical files, classified by type.
The periodicity of data collection and storage shall be different for each data type and shall be changeable for a specified period at the Operator's option.

The storage of collected real-time data in the historical files shall be in the same format as in the HMI database.

It shall be possible for the user to retrieve sets of data belonging to the same time sample or different time samples through a sort operation or through relational constructs and displays them in tabular form.

It shall be possible to archive historical files on optical disk for storage in a disk library.

2.6.14.7 System Performance and Testing

2.6.14.7.1 General Requirements

The Contractor shall meet the system functional and performance requirements given in these Employer's Requirements. The verification of compliance with the requirements shall be done through a series of tests focused primarily on functionality and system availability.

The testing sequence of the complete system shall consist of the following:
a) Pre-Factory Acceptance Test (PreFAT).
b) Factory Acceptance Test (FAT).
c) Site Acceptance Test (SAT).

All system testing shall be made with the ultimate number of PLC and Operator stations and the ultimate number of points being simulated.

2.6.14.7.2 Acceptance Tests

The Contractors shall prepare a Factory Acceptance Test (FAT) Plan and shall submit it to the Project Manager for review and approval at least four (4) months before the scheduled start of system FAT.

The FAT Plan shall consist of the following:

1. <u>FAT Overview</u>
   This shall describe the test configuration, the hardware and software simulators used, the measurement tools, the complete test schedule, the forms for recording test results, the classification of discrepancies, and the processing of test reports.

2. <u>Test Procedures</u>

This shall describe the test preconditions and assumptions, the detailed steps to be taken for each test and the verification of results of each step.

a) The Test Procedures shall include both hardware and software tests.
b) The Test Procedures shall have a separate section for the acceptance test procedures for the Plant Control System.
c) A Pre-Factory Acceptance Test (Pre-FAT) shall be performed by the Contractor to verify that the system as fully integrated complies with all of the required functional details and that the system satisfies the response and resource utilization requirements.
d) The Pre-FAT shall follow completely the test procedures of the FAT Plan reviewed by the Project Manager.
e) The Project Manager may choose to witness the pre-FAT.
f) The Contractor must correct all discrepancies found in the pre-FAT before the Factory Acceptance Test can be started.
g) Project Manager or representative will witness the FAT upon notification by the Contractor that the system is ready for the FAT.
h) The FAT shall verify that the system as fully integrated complies with all of the required functional details and that the system satisfies the response and resource utilization requirements.
i) All discrepancies found in the FAT shall be corrected prior to shipment of the system.
j) After the system has been installed and checked out completely on site to the satisfaction of the Project Manager, Contractor shall perform the Site Acceptance Test (SAT). As part of the check-out, the SAT shall be preceded by a system generation of the clean software free of any remaining errors found in the FAT.
k) Essentially the SAT procedures shall be a repeat of the FAT test procedures under actual field conditions. Some of the FAT procedures shall be modified by the Contractor to reflect the field conditions.
l) At the end of the SAT the software shall be free of any ‘forces’ or other temporary bypasses.

2.6.14.8 Specified Spare Parts

The Contractor shall furnish spare parts for the control systems as listed below. A set is defined as the total number of each component required for one control system. One set of spare parts shall be provided. Where listed components differ between control systems supplied, one set shall be provided for each design of c.

- One PLC power supply
- One PLC processor.
- One of each type of IO module.
- Other items recommended by the Contractor.

2.6.15 **Communication Systems**

2.6.15.1 Type and Description

The Contractor shall design and install the following communication systems:

- Control system fibre optic LAN at the powerhouse.
- A fibre optic communications cable linking the powerhouse controls to the intake and headpond level transmitters.
- SCADA system DNP3 communications linking intelligent electronic devices (IED’s) at the Powerhouse to the Employers SCADA at the NCC.
- Extension of the Employers VHF 2-way radio network for voice communications between the Powerhouse and NCC.

The Employer presently uses TAIT Communications (TB7100 Base Station/Repeater) for VHF voice communications.

The Employer will provide a single mode fibre optic cable to the power station building for the SCADA communications. The Contractor shall provide a fibre optic termination frame and terminate the single mode fibre cable. All fibre optic cable, transceivers, convertors etc required to interface the power station controls and protection scheme to the Employer provided cable shall be provided by the Contractor. The Contractor shall provide a VOiP telephone at the powerhouse for connection (via the fibre optic cable) to the Employers telephone system.

The Contractor shall undertake a radio survey to confirm acceptable signal strength for connection to the Employers VHF systems. If the survey determines that the powerhouse site has inadequate coverage, then the Contractor shall inform the Employer accordingly and await further instructions. For avoidance of doubt the provision of any repeater sites is outside the scope of Contractors responsibility.

2.6.15.2 Fibre Optic Network Features

2.6.15.2.1 Fibre Patch Panels

Fibre patch panels shall be provided at:-

- Powerhouse
- Headpond
- Intake

Each individual fibre core of all cables shall be terminated into SC type receptacles in the patch panels.
All fibres are to be terminated with type ‘SC’ connectors. Preformed fiber patch cables shall be provided. These shall be colour coded in accordance with the service they are associated with. The coding shall be:-

- Blue for control system LAN.
- Green for SCADA DNP3 network.
- Red for protection signalling.

No patch cords in excess of 15m long are permitted.

All fibres are to be fully tested ‘point-to-point’ i.e. from the source device to the destination device with all interconnecting ‘patch’ cables installed. The attenuation over the entire length of each fibre is to be measured and recorded and each length measured using an OTDR to check for any significant step changes in attenuation. Any loss greater than that expected and commonly recognised as being ‘typical’ is to be thoroughly investigated and the suspect/faulty component replaced and the complete length retested. A record of the measured loss and OTDR profile for each fibre is to be submitted for the Project Managers approval and once approved, included with the ‘as-built’ documentation.

2.6.15.2.2 Power Station Control System LAN

Power station control LAN’s shall be ‘fault-tolerant’, fibre optic based 100 MBPs ‘Ethernet’ network. All network links between steel enclosures shall be fibre optic. Network connections within steel enclosures or between adjacent steel enclosures shall be implemented using either fibre or CAT 6 cabling.

The LAN shall link the following devices on the Plant control system:

- The Unit PLCs, located in the Unit control panels.
- HMI workstations, located in the power station control room.

- One monochromatic printer, located at the power station control room.

Network switches, hubs and routers shall be provided as necessary. These devices shall be located in the same enclosure as the PLC / HMI operator interface or in a wall or desk mounted enclosure for the HMI workstations. All switches, hubs or routers shall be provided with power supplies taken off the powerhouse 24V DC system.

The station control system LAN cabling shall be run in stainless steel conduit over all sections external to steel panels.

2.6.15.2.3 SCADA Network

The Contractor is to design and implement a transport network for a Level 2 DNP3 communication between IED’s and a SCADA master located at the Employers NCC.

The Employers NCC uses ClearSCADA manufactured by Schneider Electric Ltd.

As a minimum the DNP3 network shall link the following IED’s to the SCADA RTU:

- The generator protection relays.
- The revenue meters.
- The Unit PLC

Failure of any single device shall not affect the integrity of the overall DNP3 network.
Network switches, hubs and routers shall be provided as necessary. These devices shall be located in the same enclosure as the IED. All switches, hubs or routers shall be provided with 24V DC power supplies.

2.6.16.1 Type and Description

The protective relaying system shall be utilized for the protection of major equipment including the generator and step-up transformer.

Relaying shall consist of a multifunction, multiprocessor-based digital relay having the protective functions as indicated.

2.6.16.2 General Requirements

Protective relays shall be solid state, multi-function, flush mounted with dust tight covers. Isolating and shorting facilities shall be provided for prevention of opening of current circuit on withdrawal of the relay.

Protective functions shall be configured to be fail safe and the protected Plant shall be tripped in the event of a fault within the protection system, including partial loss of DC supplies.

Protective relays shall be supplied with all necessary auxiliaries such as auxiliary instrument transformers, filters, rectifiers, etc. as required. They shall be provided with testing facilities and operation indicators (flags) with manual reset push buttons.

All protective relays, unless otherwise specified, shall be for operation from instrument transformers having nominal 1 amperes and 110/√3 volts secondary's and from 24-V DC station battery.

All protection required for the generating units and generator transformers shall be mounted on the Unit Control Panels. Devices shall include all protective relays, automatic and manual synchronizing devices, and any machine condition monitoring equipment.

Secondary circuits of the instrument transformers shall be connected to the test block permitting separation from the low voltage equipment fed by them. Shorting terminals shall be provided for all current transformer cores. All voltage relays shall have sufficient thermal capacity for continuous energisation, using external resistors if necessary.

All relays and instruments shall be provided with an identification nameplate. The nameplates shall be of engraved laminated black on white Bakelite or equal material.

Tripping relays (device 86) shall be high speed, manual reset, and multicontacts type. One tripping relay shall provide for each protective relaying system. Tripping relays shall be front-of-panel mounted, complete with targets and a white indicating light used to supervise the status of the tripping coil. The relays shall have manual reset provisions from a pushbutton on the relay as well as electrically via the HMI.

2.6.16.3 Turbine Generator & Generator Transformer Protective Relaying System

2.6.16.3.1 General

The protective relaying system shall be designed to protect the synchronous generator, step up transformer and the turbine. The trips shall be arranged in three operational groupings to allow for different protective actions to be taken depending on the nature of the fault.

Designation	**Function**	**Description**
Trip A (86A)	Turbine Generator Trip Loaded	Trip unit CB and turbine immediately when a serious fault is detected.
Trip B (86B)	Turbine Generator Trip Unloaded	Unload unit, then trip turbine and unit CB.

Designation	Function	Description
Trip C (86C)	Generator Trip	Disconnect the unit when an external system electrical fault is detected. Unit may synchronise back onto the grid when the appropriate Operator command is given via SCADA.

Each turbine generator shall be provided with an 'all in one' generator protection relay supplemented by trips initiated by the Unit PLC and hardwired devices. In general the generator protection relays shall be used for faults of an 'electrical' nature (eg differential protection), with the Unit PLC being used for faults of a 'mechanical' nature (eg bearing temperature). Critical safety trips (eg turbine overspeed) shall be hardwired.

The **minimum** trip initiating functions required are listed in the sections that follow. The Contractor shall add to this list any additional functions that are required to adequately protect the Plant provided against all foreseeable fault events.

2.6.16.3.2 Turbine Loaded Trip A

Trip A initiates an immediate "emergency" shutdown of the turbine generator without unloading. The following table details the minimum protection functions required.

Function Description	ANSI Code
Synch Check. (CB close block only)	25
Under Voltage	27
Over-current	50/51
Overvoltage	59
Inadvertent energisation	50/27
Earth fault protection	50N/51N

The following devices shall also be hardwired into Trip A:-

Function Description	ANSI Code	From Device
Emergency Stop Trip push button	5	Pushbutton on unit control panel
Unit Over speed device	12A	Over speed device
Governor Accumulator Low Pressure Trip	65P	Pressure switch on accumulator
Generator Transformer Pressure Relief	63BT	Transformer Pressure Relied Devices
Unit PLC Watchdog	UPLC	NC contact from Unit PLC

In the event of one of these faults, the initiating device shall energise the Trip A Relay, which shall operate:

- Generator Breaker Trip Circuit.
- Turbine Emergency Shutdown Device.
- Inlet Valve Emergency Shutdown circuit.
- Excitation Trip

After the unit has shutdown, it shall be locked out from restarting until the protection relay, and the trip relay have been reset. This is done either locally on the unit protection panel, or remotely from the Plant Control System.

2.6.16.3.3 Turbine Trip Unloaded - Trip B

Trip B initiates a turbine unload sequence before tripping the turbine and 22 kV circuit breaker. In general it will be used for trips required for a mechanical fault with the generator or turbine. The trip is handled by the Unit PLC, using readings from instruments monitoring the unit.

Function Description	ANSI Code
Control AC/DC power supplies fail	33
Penstock Pressure low trip	63
Bearing Temperature high trip	38T1
Bearing Vibration high	38V1
Stator Winding temperature	49T1
Tailwater high level trip	71
Generator Transformer Winding Temperature	49T5
Generator Transformer Oil Temperature	49T6
Generator Transformer Oil Level	71LT

On the occurrence of this trip the PLC shall lockout the unit and prevent it from starting until reset locally on the protection reset button, or from the station HMI.

2.6.16.3.4 Trip C

Trip C is an external system electrical fault. The objective of this trip is to disconnect the unit from the grid to prevent damage to the generator. The unit shall go to speed no load mode with excitation left on. In this mode, the unit shall be ready to re-synchronise with the grid quickly.

The trip will be ordered by the unit ‘all in one’ protection relay.

Function Description	ANSI Code
Under frequency	81L
Over frequency	81H
Vector Shift	78
Rate of Change of Frequency	81R

2.6.16.4 General Protective Relaying Requirements

2.6.16.4.1 Trip Circuit Supervision

Each trip circuit shall be provided with a trip circuit supervision relay monitoring both the status of the trip circuit DC supplies and the integrity of the trip circuit wiring.

2.6.16.4.2 Time Synchronization

The protection relays at the powerhouse shall be time synchronized to an IRIG-B signal. Event reports generated in the different protection relays are to be time stamped to within 10 µs of each other.

2.6.16.4.3 SCADA Interface

The Protection Relays are to be interfaced with the Employers SCADA system using DNP3.

2.6.16.5 Specified Spare Parts

The Contractor shall furnish spare parts for the protection systems as listed below. A set is defined as the total number of each component required for one protection system. One set of spare parts shall be provided. Where listed components differ between protection systems supplied, one set shall be provided for each design of protection system.

- One generator protection relay.
- Two trip relays.

- Other items recommended by the Contractor.

2.6.17 DC Systems

2.6.17.1 General

The Contractor shall furnish all labour, materials, and equipment required to design, supply, install, field test, and pre-commission battery backed up DC system for the powerhouse control, protection, SCADA, communications and emergency lighting systems.

The system shall normally supply 24 V DC to the powerhouse systems by utilizing the DC output from the battery charger to feed the 24 V DC switchboard. When the 415/240 V AC power supply to the battery charger fails, the battery set shall provide 24 V DC to the 24 V DC switchboard.

24 VDC power supplies shall consist of:

- One Battery bank rated for 100% of station 24VDC load.
- Two Battery chargers each for 100% of station DC load plus the capacity to recharge one battery bank in 8 hours
- One DC distribution board including paralleling diodes.
- DC distribution.
- 24V DC shall be used for all protection and control functions.

The Contractor shall provide all necessary associated equipment, special tools, controls and detailed information for the installation, testing, pre-commissioning and operation of the equipment supplied.

2.6.17.2 Battery Sets

The batteries shall be valve regulated lead acid (VRLA) type complying with IEC 60896-21 and 60896-22.

The batteries shall be designed for a minimum service life of twelve years to 80% remaining capacity. The battery rating shall be increased to allow for an 80% end-of-life capacity (i.e. battery increased by 1.25).

Each battery set shall have the capability of being completely discharged to the 1.8 V per cell rating over a 4-hr period a minimum of 50 times over the 12-year life period.

The plates shall be assembled in plastic jars of heat-resisting and shock-absorbing material which will not warp, bulge, or lose its shape. The jars shall provide a permanent seal at the joint of the jar and cover and shall be easily cleaned. Plastic cell jars shall be clear with no colouring.

Cell covers shall have flame arrester type vent caps.

The cables from the batteries to the DC charger/distribution panels shall be electrically protected by fuses located as close as practical to the battery terminals. DC positive and negative cables shall not run in close proximity until after the fuse protection.

2.6.17.3 Battery Rack

The battery cells shall be located on a battery rack at a convenient height and shall be easily replaceable. The rack shall be of the stepped type with a maximum of 2 steps and made of galvanized steel. It shall permit easy maintenance and cleaning of the battery set and the battery room floor. It shall allow a compact assembly of the cells to assure maximum voltage across the battery. The rack shall be painted with 2 coats of acid resisting paint.

Note: the battery voltage test point on the battery terminals shall not be higher than 1800mm above floor level.

2.6.17.4 Battery Chargers

Battery chargers shall:

- be housed in a heavy gauge sheet metal cabinet. The cabinet shall be free standing, floor or wall mounted. Access shall be from the front through a hinged door
- be regulated, thyristor controlled with fully automatic controls.
- Be designed for use with VRLA batteries.
- be self-ventilated for operation in an ambient temperature not to exceed 40°C or below 0°C
- be capable of float charging the battery set and simultaneously supplying other loads to its full ampere capacity.
- be provided with an adjustable current limiting feature that will limit the output current to the maximum recharge current recommended by the VRLA battery manufacturer.
- Be provided with temperature compensation to prevent over charging or thermal runaway of the batteries. A remote temperature sensor shall be provided for each battery cell.
- have a voltage regulation of ±1.0% from no load to full load with a ±10% supply voltage variation
- operate properly over a ±5% supply voltage frequency variation.
- be capable of picking up a fully discharged battery without tripping.
- be designed for parallel operation with a second battery charger.
- have a two or more winding transformer to isolate the AC supply from the DC output
- have reverse-current protection to prevent draining the battery in the event of rectifier failure or short circuit

The A-weighted sound level shall not exceed 60 dB when measured at a distance of one meter from the charger enclosure. The sound level shall be measured while the charger is operating at rated voltage and frequency and at maximum rated output current.

The chargers shall have surge suppressors and filters to prevent voltage spikes or other distortion from being fed back into the AC power supply or from affecting the DC output. The filters shall limit the voltage transients to not more than 5% of the fundamental. Output ripple content shall be limited to less than 2% rms.

Thermal magnetic circuit breakers of suitable current carrying and interrupting capacity shall be used in the following applications:

a) Alternating Current Input
   All chargers shall have a thermal magnetic circuit breaker.
b) Direct Current Output
   All chargers shall have a 2-pole thermal magnetic circuit breaker.

Each battery charger shall also be equipped with the following:

a) Output DC voltmeter.
b) Output DC ammeter.
c) AC power failure relay, with one normally open and one normally closed contact and a local pilot light.
d) DC low and high voltage alarm relays, each furnished with one normally open and one normally closed contact. A local pilot light shall be furnished for each relay.
e) DC ground detection relay for remote alarm with local pilot light.
f) AC power “ON” pilot light.

Each battery charger nameplate shall contain:

a) Manufacturer's name.
b) Model, type, and serial number.

c) AC voltage and frequency.
d) Number of phases.
e) AC ampere rating.
f) DC voltage rating.
g) DC ampere rating.

2.6.17.5 DC Main Distribution Boards

DC distribution boards shall be designed and constructed in accordance with AS/NZS 3439.1 and AS 2672.2, as applicable. Where compliance is not relevant the board shall be designed for the fault rating expected using industry standard components.

All circuit breakers shall be at least two-pole, breaking both the negative and the positive lines. All MCCBs shall be fitted with panel-front mounted rotary handles.

2.6.18 **Powerhouse Lighting and General Power**

2.6.18.1 General Requirements

The Contractor shall provide powerhouse lighting and general power equipment as specified below:-

- Provision of cables from the Main Switch board (MSB) to the Local Services Switch Board (LSSB).
- Provision of LSSB.
- Interior lighting.
- Exterior floodlighting.
- Emergency evacuation lighting.
- Power outlets.
- Power supplies to turbine generator ancillary equipment.

2.6.18.2 Local Service Switch Board

Provide a Local Service Switch Board for each powerhouse. The LSSB shall comprise:-

- A main incoming switch.
- Busbars rated for the incoming main switch capacity and prospective fault level.
- Outgoing feeder circuit breakers for the turbine generator ancillary services requirements, battery chargers, lighting and general power outlets. 25% spare capacity is to be provided.

The switchboard shall be wall mounted and located in an area where best protected from flood events.

The LSSB may be incorporated into the Main Switch Board.

2.6.18.3 Lighting

Provide luminaires complete with control gear and lamps. All luminaires shall be adequately mounted and supported in accordance with the manufacturer's recommendations and when installed shall operate at a lagging power factor of not less than 0.95.

Sufficient luminaires shall be provided to ensure a minimum illumination level of 300lux, as measured 1000mm above the powerhouse floor.

The placement of the fittings shall in no way affect the operation of other services.

All wiring to light fittings and switches shall be run in suitable surface mounted conduit and the size shall be as indicated in the load schedules.

2.6.18.4 Indoor Luminaires

All indoor luminaires shall be light emitting diode (LED) type with built in driver and control gear. The luminaires in areas with a ceiling height less than 3500mm shall consist of linear type T8 tube fittings. Luminaires in areas with higher ceiling height may either use linear fittings, or industrial high bay fittings.

All fittings shall have fibreglass reinforced polyester or aluminium housing with polycarbonate prismatic clear diffusers and shall have a protection rating of at least IP66 and minimum impact protection rating of IK08.

Lamps shall have a correlated colour temperature of 4000 K.

Fittings and lamps shall have a rated life of not less than 50,000 hours with ambient temperature in the range +20 to +40 °C.

2.6.18.5 Emergency Evacuation Lighting

Two automatic emergency lighting luminaires shall be provided in each powerhouse to allow safe egress from the machine floor areas when the main lighting has failed. The emergency lighting luminaires shall be robust weatherproof battens complete with led lamps. Each luminaire shall consist of a moulded GRP body and moulded polycarbonate diffuser and shall have a protection rating of at least IP65. The emergency evacuation lights shall be powered from the 24V DC system.

2.6.18.6 Auxiliary Emergency Lighting

Provide a battery backed emergency luminaire to provide limited manual lighting in the powerhouse entrance area when the emergency evacuation lighting batteries have fully discharged following an extended power outage. The unit shall be installed to operate independently from the normal emergency lighting system with the charger permanently connected to a power supply and the lighting circuit switched off via a suitable switch. This light shall only run when the manual switch is operated.

2.6.18.7 Outdoor Floodlights

Provide outdoor floodlights to illuminate the powerhouse entrance, transformer and tailrace areas. The outdoor floodlights shall be robust high performance fittings complete with energy efficient LED lamps and electronic control gear. Each luminaire shall consist of a white moulded GRP body with asymmetrical reflector and toughened glass lens in a GRP frame and shall have a protection rating of at least IP65. The floodlights shall be supplied with proprietary mounting stirrups for surface mounting and the final aiming angles shall be determined on site to achieve optimal area lighting.

The outdoor floodlights shall be provided with automatic night-time/movement detection for switching the lights on & off. A manual switch shall be provided within the powerhouse to select the light control “On, Auto, Off”.

2.6.18.8 Lighting Control and Switching

All light switches shall be mounted at a height of 1.30m above floor level and within 0.20m of any doorframe on the handle side.

The light switches shall be robust and have surface mounting enclosures made from high-impact strength polycarbonate (or equivalent) with a protection rating of IP66. They shall be fitted with integral red neon indicators that illuminate when each switch is in the “ON” position.

2.6.18.9 Power Outlets

Provide new power outlets on the machine floor, switchgear area and controls annex. One single phase and one three phase outlet shall be located on the powerhouse wall close to each turbine generator.

Four single phase outlets shall be provided in control rooms and two single phase outlets in the switchgear area. Two single phase and one three phase outlet shall be located in the unloading bay area.

All outlets shall be adequately mounted in accordance with the manufacturer’s recommendations. All wiring to power outlets shall be run in suitable surface mounted steel conduit and the sized to suit the loads.

All single phase 10A socket outlets shall have a flat pin configuration complying with AS/NZS 3112 and the three phase 32A socket outlets shall have a round pin configuration complying with AS/NZS 3123.

All socket outlets shall be protected by the use of suitable RCD units mounted on the distribution boards with each RCD suitably labelled identifying the protected sockets.

2.6.19 **Ventilation Systems**

2.6.19.1 Scope

The Contractor shall provide ductwork and louvres to vent hot air from the generators outside the powerhouse. In addition, louvres shall be fitted at a high level on the powerhouse wall to provide a return air flow.

2.6.19.2 Ductwork

Unless otherwise stated all ductwork shall be constructed from galvanised mild steel. Internal roughness and unspecified obstructions to air flow will not be accepted in ductwork. Where practicable, sharp edges or corners on the outside of ductwork, fittings and supports shall be avoided. Remove all sharp corners including from angle at flange corners. Paint all cut edges, all lock seams, and any place where the galvanising is broken, with zinc rich paint.

Duct penetrations through roofs or external walls shall be weather-proofed with a weather cravat or other purpose made arrangement. Flashings and making good shall be done by this Contractor. The casings of all ventilation equipment shall be rigidly constructed and stiffened where necessary to prevent drumming and vibration. Locking devices shall be used with all fastenings subject to vibration.

Flexible joints shall be heavy-weight, white vinyl covered glass fibre cloth.

2.6.19.3 Louvres

Weather Louvres shall be drainable blade louvres with blades which drain through vertical down pipes to discharge water at the bottom of the louvre. Drainable louvres blades shall be 102mm louvred blades set at 76mm centres and constructed in a 107mm flanged (F) or channel (C) frame to suit the installation profile. Drainable blade weather louvres shall be of extruded aluminium construction and finished in natural anodised, powdercoat and fitted with accessories and dampers. Louvres shall be fitted with insect and bird proof mesh.

2.6.19.1 Air Conditioner

The powerhouse control room shall be fitted with a split system air conditioner to maintain the room temperature at 20C (With adjustment range ±3C). The air conditioner shall be a make and model serviceable within Samoa.

2.6.20 **Drainage Pumps**

The Contractor shall provide two drainage pumps to facilitate removal of flood water from the powerhouse in the event of flood events. The pumps shall be located at a low point within the powerhouse machine floor level, and shall be mounted in a sump if required for the Contractors design.

The combined pump capacity shall be sufficient to clear the powerhouse machine floor level of 1.0m deep water in a period of four hours. The pumps shall each be self-priming, suitable for pumping water containing silts and gravels, and shall discharge into tailrace downstream of the powerhouse.

The pumps are to be controlled from hardwired sump level sensors, with operation monitored by the Plant Control System.

Each sump shall be fitted with the following instruments for control and protection:

- Sump Low Level Switch
- Sump High Level Switch
- Sump High High Level Switch

The pump control equipment shall be mounted in a stainless steel, IP67 rated, control cabinet adjacent to the pumps.

Each pump shall have a three-position switch that shall select the type of control of the pump. The three positions shall be marked AUTO/OFF/RUN for each switch.

In AUTO mode the pumps shall start when the high level in the sump is detected by the high level float switch. The pump shall turn off when the sump low level is detected by the float switch. In OFF mode the motor will not run, and when in RUN mode it shall run regardless of float switch position.

The cabinet shall also have the following indications that shall be flush mounted on the pump control cabinet:

- Pump Running Green
- Pump Faulted Red

2.6.21 General Mechanical Requirements

2.6.21.1 Materials

Materials shall be new and of first-class quality, suitable for the purpose, free from defects and imperfections, and of the classifications and grades listed herein or their equivalents. Materials not listed herein may be used subject to the Project Manager's review of their acceptability, application, and the maximum allowable design stresses established by the Contractor. Material specifications, including grade or class, shall be shown on the appropriate detail Drawings submitted to the Project Manager.

Material	Specification
Carbon Steel Castings	ASTM-A27, "Specification for Mild to Medium-Strength Carbon-Steel Castings for General Application," Grade 65-35, Grade 70-36, and Grade 70-40.
Low-Alloy Steel Castings	ASTM-A148, "Specification for High-Strength Steel Castings for Structural Purposes," Grade 80-50.
Corrosion-Resistant Steel Castings	ASTM-A743/A 743M, "Specification for Casting, Iron-Chromium, Iron-Chromium-Nickel, and Nickel Base (Corrosion-Resistant) Alloy Castings for General Application," Grade CA-15, Grade CF-8 and Grade CA-6NM. ASTM-A487/A487M, "Specification for Steel Castings Suitable for Pressure Service," Grade CA-15, and Grade CA-6NM.
Corrosion-Resistant Steel Plate	ASTM-A167, "Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip." ASTM-A176, "Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip." ASTM-A240, "Specification for Stainless and Heat-Resisting Chromium and Chromium-Nickel Steel Plate, Sheet, and Strip for Fusion-Welded Unfired Pressure Vessels," Type 405 and Type 410.
Corrosion-Resistant Steel Bars	ASTM-A582, "“Specification for Free-Machining Stainless and Heat- Resisting Steel Bars, Hot-Rolled or Cold-Finished,"” Type 303 and Type 416.
Carbon and Alloy Steel Forgings	ASTM-A668, "“Specification for Steel Forgings, Carbon and Alloy for General Industrial Use,"” Class D.
Carbon Steel Forgings (for pipe flanges, fittings, etc.)	ASTM-A181, "“Specification for Forged or Rolled Steel Pipe Flanges, Forged Fittings, and Valves and Parts for General Service,"” Grade I and Grade II.
Carbon Steel Plates (for low-stressed parts)	ASTM-A283, "Specification for Low and Intermediate Tensile Strength Carbon Steel Plates of Structural Quality (Plates 50 mm and Under in Thickness)," Grade A and Grade B. ASTM-A36, "Specification for Structural Steel." AS/NZS 3678:2011 "Structural Steel – Hot-rolled Plates, Floor Plates and Slabs"

Material	Specification
Carbon Steel Plates (for important stress-carrying parts) Intermediate Strength Steel Plates (for important stress-carrying parts)	ASTM-A285, "“Specification for Low and Intermediate Tensile Strength Carbon Steel Plates for Pressure Vessels (Plates 50 mm and Under in thickness),"” Grade B and Grade C. ASTM-A516, "“Specification for Carbon Steel Plates for Pressure Vessels for Moderate and Lower Temperature Service,"” Grade 60 or better, except that all plates thicker than 25 mm (one inch) shall be normalized to produce grain refinement. AS 1548:2008 “Fine Grained, Weldable Steel Plates for Pressure Equipment”
High Strength Steel Plates (for highly stressed parts) Carbon Steel Plates (for important stress-carrying parts)	ASTM-A517, "“Specification for High Strength Alloy Steel Plates, Quenched and Tempered, for Pressure Vessels AS 1548:2008 “Fine Grained, Weldable Steel Plates for Pressure Equipment”
Bronze Castings, Bronze (for bearings, wearing plates, etc.)	ASTM B584, “Specification for Copper Alloy Sand Castings for General Applications”, UNS Alloy Nos. C90300 and C92300.
Bronze (for bolting) High Strength Steel Plates (for highly stressed parts)	ASTM-B21, "“Specification for Naval Brass Rod, Bar, and Shapes,"” Alloy No. 464.ASTM-A517, "Specification for High Strength Alloy Steel Plates, Quenched and Tempered, for Pressure Vessels."
Copper Tubing	ASTM-B88, "“Specification for Seamless Copper Water Tube,"” Type K.
Copper Pipe	ASTM-B42, "Specification for Seamless Copper Pipe, Standard Sizes." ASTM B88/B88M, “Specification for Seamless Copper Water Tube”, Type K.
Steel Pipe	ASTM-A53, "Specification for Welded and Seamless Steel Pipe." ASTM A106, “Specification for Seamless Carbon Steel Pipe for High - Temperature Service”. ASTM A120, “Specification for Pipe, Steel, Black and Hot – Dipped Zinc - Coated (Galvanized) Welded and Seamless, for Ordinary Uses” NZS 4442:1988 “Welded Steel Pipes and Fittings for Water, Sewage and Medium Pressure Gas” AS 1579:2001 “Arc-welded Steel Pipes and Fittings for Water and Wastewater”

Material	Specification
Stainless Steel Pipe	ASTM A312, Type 316L "Specification for Seamless and Welded Austenitic Stainless Steel Pipe. **Type 304 or 304L is not acceptable.** ANSI B36.19M "Stainless Steel Pipe", seamless, Grade TP316N. ASTM 376, TP316 "Seamless Austenitic Steel Pipe for High-Temperature Central-Station Service
Stainless Steel Pipe Fittings	ASTM A282, Type 361L "Forged Stainless Steel Fittings, Socket-Welding and Threaded." **Type 304 or 304L is not acceptable.** ASTM A403, Type 316L "Specification for Wrought Austenitic Stainless Steel Pipe Fittings."
Stainless Steel Tubing	ASTM A269 or ASTM A213, Grade TP316 "Specification for Soft Annealed Stainless Steel Tubing."
Stainless Steel Tube Fittings	Compression type stainless steel flareless tube fittings, suitable for 1200 psi working pressure.
Steel Pipe Flanges and Flanged Fittings	ANSI-B16.5, "“Steel Pipe Flanges and Flanged Fittings." AS/NZS 4087:2011 "Metallic Flanges for Waterworks Purposes" AS/NZS 4331.1:1995 ”Metallic Flanges – Part 1: Steel Flanges"
Brazing Filler Metal	ANSI/AWS A 5.8, "Specification for Brazing Filler Metals". AS/NZS 1167.1:2005 "Welding and Brazing – Filler Metals – Filler Metal for Brazing and Braze Welding"
Welding Electrodes	AWS A 5.1, "Specification for Carbon Steel Covered Arc-Welding Electrodes". AS/NZS 4855:2007 "Welding Consumables – Covered Electrodes for Manual Metal Arc Welding of Non-alloy and Fine Grain Steels – Classification"

2.6.21.2 Test of Materials

2.6.21.2.1 General

All materials or parts used in the equipment shall be new and shall be tested, in conformity with applicable methods prescribed by the relevant Australian, New Zealand or such other equivalent standards.

All steel used in pressure vessel applications, including turbine distributors, shall be factory acceptance tested to the requirements of the applicable pressure vessel design standard.

Materials for all principal parts shall be tested for impact resistance and using the Charpy "V" notch method. Bend tests shall be performed on specimens of all major steel castings and forgings, in accordance with the applicable Standard.

2.6.21.2.2 Test Certificates

Certified material test reports shall be submitted as soon as possible after the tests are made. The test certificates shall identify the component for which the material is to be used and shall contain all information necessary to verify compliance with the design Standard.

2.6.21.3 Safety Factors and Design Stresses

The design, dimensions and materials of all parts shall be such that they will not cause damage or corrosion under the most adverse conditions and not result in deflections or vibrations which will adversely affect the operation of the Plant.

The Contractor shall be responsible for an adequate design based on factors proven safe in practice and shall use lower working stresses wherever it deems this necessary or desirable or where it deems deflection to be the controlling design criterion.

Generous factors of safety shall be used throughout the design, particularly of components (parts) subject to alternating stresses, fatigue, vibration, impact, or shock.

The adopted design stress levels shall be based on an internationally recognised standard or code, applicable to hydro-electric power generating equipment. The Contractor shall provide details of the proposed standard/code for the Project Managers approval. Where the equipment provided is manufactured as part of the suppliers standard range, then the manufacturers standard design methods may be acceptable provided proof of satisfactory long term, in-service , performance is provided.

The selection of materials and design of all components shall include proper consideration to ensure against fatigue damage and excessive material and structural deflections, vibration, dynamic loading, wear, and other factors which may affect the functioning and durability of these components. A 40 year minimum life is required for the components.

The following conditions shall be considered as a minimum for the cyclic loads and the fatigue of the components in the design of the turbine and generator components:

Minimum Service Life:	40 years
Controlled starts and stops:	3 times per day per unit
Full or part load trips	Ten trips per annum
Runaway	One event of 5 minutes duration every two years Two events of 15 minutes duration over the equipment design life.
Daily Operation: Full Load 50% Load	 24 hours per day per unit 8 hours per day per unit
Load changes between 50% and 100% load in generating mode:	12 times per day per unit

2.6.21.4 Tolerances

Machining tolerances for all mating fits shall be suitable for the intended service and shall be in accordance with ISO Standards.

2.6.21.5 Welding

2.6.21.5.1 General

All welding shall be performed by the electric-arc method, by a process that excludes the atmosphere from the molten metal, and, where practicable, by automatic machines. After being deposited, all welds shall be cleaned of slag by shot blasting, unless otherwise approved, and shall be uniform, smooth, showing good fusion with the base metal, and free of voids, crack, and clinkers. Machined surfaces of parts affected by welding shall be machined to final dimensions after welding. Machined surfaces of parts requiring stress relief shall be machined to final dimensions after the parts have been stress relieved. Localized stress relieving will not be permitted for shop welded parts. All principal load carrying welds shall be full penetration type welds. Strength of welded joints shall be based upon the allowable stress of the parent materials.

2.6.21.5.2 Edge Preparation

Members to be joined by welding may be cut to shape and size by mechanical means such as shearing, machining, grinding, or by gas or arc cutting, to suit the conditions. Design of welded joints and selection of weld filler metal shall allow thorough penetration and good fusion of the weld with the base metal. The edges of surfaces to be welded shall be sound metal free of visible defects, such as laminations or defects caused by cutting operations, and free from rust, oil, grease and other foreign matter.

2.6.21.5.3 Welding Qualifications

The qualification of welding procedures, welders, and welding operators for all welding of pressure-containing components, including weld repairs and other high stressed components, shall conform to standards at least equal to Section IX of the ASME “Boiler and Pressure Vessel Code”. Certificates of welders' qualifications shall be furnished when requested. The procedure for qualification testing of the field welders shall be prepared by the Contractor, and the qualification tests shall be witnessed and accepted by the Contractor. Contractor shall replace any welder or welding operator deemed unacceptable by the Project Manager.

2.6.21.5.4 Documentation

The Contractor shall maintain a strict quality control program for the welding work performed in the shop. Weld procedure specifications (WPS) shall be submitted for review prior to starting the fabrication work. All welds shall be identified on the Contractor's Drawings by numbers. All welding work shall be performed by qualified welders and welding operators and shall be properly documented.

2.6.21.6 Non-destructive Testing

2.6.21.6.1 General

The Contractor shall propose the Standards for the non-destructive inspections. Such proposal shall include documentation that clearly demonstrates in the judgment of the Project Manager that the inspection and acceptance criteria are appropriate for the Plant supplied.

2.6.21.6.2 Examination of Welds

All welds on weld-fabricated parts, except minor parts or low stressed parts, shall be given complete non-destructive examination. Weld examination shall be by ultrasonic, dye penetrant and magnetic particle methods, supplemented by radiographic examination where required by the shape and nature of a component.

Supplemental radiographic examination shall include examination of critical high-stressed areas where interpretations of other methods are unclear, or where the integrity of the weld is doubtful. All butt welded joints exposed to significant stress levels shall be given a 100% radiographic or ultrasonic inspection accompanied by a 100% magnetic particle or liquid penetrant inspection.

The Project Manager shall have the right to request random spot-check examination of welds, including radiographic examination, as part of his inspection of the equipment. The Project Manager shall also have the right to review films of previously performed radiographic examinations. The non-destructive examination scope, procedures and acceptance standards of welds shall be clearly indicted on the Drawings.

2.6.21.6.3 Examination of Castings

Major castings incorporated in the equipment or their components that are castings, shall be given complete non-destructive examination by ultrasonic, dye penetrant, and magnetic particle methods supplemented by radiographic examination. Supplemental radiographic examination shall include examination of critical high-stressed areas where interpretation of other methods is unclear or where the integrity of the casting is doubtful. Non-destructive examination of other castings shall be in accordance with accepted good practice to assure sound castings and shall be indicated on the Drawings.

2.6.21.6.4 Examination of Forgings

Forgings for the shafts, needles (if made of forgings), and shaft coupling bolts shall be given complete ultrasonic examination with liberal overlap and other approved non-destructive tests, to determine that they are sound. Non-destructive examination of other forgings shall be in accordance with accepted good practice to assure their soundness and shall be indicated on the Drawings. The structure of forgings shall be homogeneous and free from excessive non-metallic inclusions. An excessive concentration of impurities or separation of alloying elements at critical points in a forging will be cause for its rejection.

2.6.21.7 Castings

All castings shall be dense, sound and true to pattern, of workmanlike finish and of uniform quality and condition, free from blowholes, porosity, hard spots, shrinkage defects, cracks or other injurious defects, and shall be satisfactorily cleaned for their intended purposes. All castings shall be checked for defects before final machining.

Castings shall not be repaired, plugged, or welded without with Project Managers permission. Such permission will be given only when the defects are shallow and do not adversely affect the strength, use, or machineability of castings. Excessive segregation of impurities or alloys at critical points in a casting will be cause for its rejection. The largest fillets compatible with the design shall be incorporated where a change in section occurs.

Surfaces which do not undergo machining and are exposed in the final installation shall be dressed to provide a satisfactory appearance so that they will not require surface smoothing at the Site prior to painting.

2.6.21.8 Forgings

The ingots from which the forgings are made shall be cast in metal moulds. The workmanship shall be first class in every respect and the forgings shall be free from all defects affecting their strength and durability, including seams, pipe flaws, cracks, scales, fins, porosity, hard spots, excessive non-metallic inclusions and segregations.

The largest fillets compatible with the design shall be incorporated wherever a change in section occurs. All finished surfaces of forgings shall be smooth and free from tool marks.
The forging shall be stamped with the heat number in such location as to be readily observed when the forging is assembled in a completed unit.

2.6.21.9 Surface Finish of Equipment Parts and Welds

All surfaces of turbine water passages from the penstock adjacent to the powerhouse to the end of the draft tube liner shall provide a smooth-contoured hydraulic surface. Upstream/downstream inlet valve extensions, turbine casing, draft tube liner plate sections shall neither be offset, bent, buckled, nor depart significantly from the water passage outline.

Finished surfaces shall be indicated on the Contractor's drawings and shall be in accordance with International Industrial Standards or equivalent. Compliance with specified surface will be determined by visual inspection of the work compared to standard roughness specimens, in accordance with the provisions of the above stated standards.

Welds shall in general be treated so that they will display good appearance and a surface suitable for painting. Structural welds shall be ground and blended, to avoid stress raisers. All welds which require radiographic or other non-destructive examination shall be dressed by chipping and grinding as required for good interpretation of radiographic film or interpretation by other weld examination methods.

Welds exposed in water passages shall be ground to provide smooth-contoured hydraulic surfaces. The welded joints of the air receivers and oil pressure tanks shall not be ground to the extent that the tank is weakened structurally. Details of weld dressing and finishing and non-destructive testing (NDT) shall be shown on the Drawings submitted for approval.

2.6.21.10 Hydraulic Packing

Packing for seals shall be a high-grade commercial product acceptable to the Project Manager and where feasible, with polytetrafluorethylene (PTFE) content suitable for the application and for long seal life. Packing grooves that are exposed to water shall be protected from corrosion by the use of corrosion-resistant materials. Contractor shall select materials suitable for the water chemistry and temperatures expected in service. Materials containing asbestos will not be accepted.

2.6.21.11 Piping

2.6.21.11.1 General

The arrangement of piping and locations of valves and joints shall be such that there will be minimum disturbance of the piping and interference with other equipment and systems when the turbine, generator, or other equipment is dismantled or parts are removed for inspection or repairs. Bolted flange connections or unions shall be provided at points where a piping system must be disconnected for dismantling.

2.6.21.12 Water Piping

Water piping shall be of welded 316L stainless steel pipe. Piping connection shall be of welded joints for embedded water piping and welded joints and flanged fittings for exposed water piping. Valves 75 mm and smaller shall be of stainless steel; valves 100 mm and larger shall be cast steel flanged valves with stainless steel trim, epoxy-coated inside.

2.6.21.13 Oil Piping

Pressure piping for servomotors shall be 316L stainless steel, of appropriate strength, with stainless steel compression type fittings and steel bodied valves. Lubricating oil piping shall be seamless drawn copper or red brass with brass or bronze fittings and valves.

2.6.21.14 Instrument Piping

Piping exposed to river water shall be 316L stainless steel tubing with stainless steel compression type fittings and shut-off valves. Shut-off valves shall be provided at pressure gauges and at points where the gauge piping connects to the main equipment, together with suitable blow-off valves and drain connections. Flexible tubing for the dial thermometers shall be armoured.

2.6.21.15 Pipe Supports and Piping Materials

Adequate pipe supports shall be provided for all piping included in the supply. Supports, pipe hangers, wall brackets, pipe clamps, fastening devices and all necessary studs, bolts, nuts, washers, oil-resistant gaskets, packing, etc., required for the piping systems shall be furnished. These items shall be supplied as finished products requiring no field fabrication such as welding, cutting and drilling.

2.6.21.16 Piping Connections

On connections for all equipment, pipes may be threaded or flanged with the flanges faced and drilled in accordance with standards selected by the Contractor. All flanged external connections shall be provided with bolts, nuts and gaskets for connection to piping furnished by others. All governor and inlet valve oil piping, generator oil lubricating piping, etc. shall be furnished as a part of a complete system.

2.6.21.17 Pumps

2.6.21.17.1 General

Pumps shall be installed strictly according to the pump manufacturer's requirements. Every effort shall be made to ensure that the minimum number of pump vendors are used as suppliers, and that pumps with identical duties are interchangeable in every respect.

The pump and motor combination shall be selected so that non-overloading operation is ensured under all flow conditions.

2.6.21.17.2 General Requirements for Pumps

Pumps shall be of a design and capacity capable of maintaining the fluid flow rate at the actual system resistance. The material and construction of the pump shall be suitable for the type, temperature and pressure of the fluid to be handled.

All moving parts of the pump shall be statically and dynamically balanced.

All pumps shall either be fitted with mechanical seals or be of canned construction so there is no liquid path past a moving surface. Mechanical seals shall be used wherever possible. The preferred sealing face combination is carbon on silicon carbide. Seals shall be water flushed wherever practicable.

2.6.21.17.3 Centrifugal Type Pumps for General Use

Pump installations shall consist of pump casing, impeller, suction and discharge connections, driven shaft, couplings and motor as stated. Pumps shall be complete with all necessary water seals. Pump installations shall comprise suction and discharge pipe reducers and expansion pieces directly connected to the pump connections, vibration isolation equipment, and motor terminal box suitable for connection to a flexible conduit system.

Generally, pump base plates shall be constructed from cast iron, however unit constructed close coupled pumps may be mounted on mild steel rails or a fabricated mild steel flat bed plate if full corrosion resistant surface treatment is provided.

Pump flanges shall be tapped and plugged to receive gauge connections.
Volute casings shall be drilled, tapped and plugged at the bottom to enable complete drainage to be carried out.

Spherical roller bearings, or in light load applications deep groove ball bearings, are required on all pumps using rolling element bearings and shall be arranged to operate either within an oil reservoir or with grease lubrication. Parallel roller bearings are not permitted. Bearing lubricators shall be fitted with drain plugs and oil content indication.

Impellers and couplings shall be keyed to the drive shaft, the impeller being retained by a hexagonal nut. Shafts shall be fitted with water deflectors.

Unless specifically indicated elsewhere in this document, motor enclosures shall be totally enclosed fan cooled.

Belt driven pumps shall not be permitted, except in the case of gear pumps.

Unit-constructed close coupled pumps shall be of the back pull-out type, enabling the motor, drive and impeller to be withdrawn from service without disturbing the volute casing connections, piping, etc.
Where pumps are to be coupled to their prime mover on site, the motor and pump shall be carefully levelled on shims and packing to achieve a close order of alignment. Dial gauges shall be used to achieve this end and the maximum permitted eccentricity shall be 0.05 mm.

Care shall be taken that the connecting pipe is so arranged as to ensure that no stresses are transmitted through the connections to the pump casing.

2.6.21.17.4 Performance

The Contractor shall provide pump characteristics, power and efficiency curves certified by an internationally recognised authority to the Project Manager for approval.
All pumps shall operate with no cavitation. In the case of pumps operating at elevated temperatures, the Contractor shall demonstrate to the Project Managers satisfaction, the no cavitation will occur under all normal operation conditions. Detailed NPSH calculations shall be submitted for approval by the Project Manager.

2.6.21.18 Fasteners and Anchor Bolts

2.6.21.18.1 General.

Bolts, studs, nuts and screws shall conform to ISO standard thread forms and dimensions and be of high quality material. All bolts, studs, nuts and screws (including their washers) shall be well protected against corrosion according to the Site of their installation or made of corrosion resistant material. Fastener materials shall be as close together as possible in the galvanic series to minimize electrical potential differences. Fitted bolts shall be a driving fit in reamed holes they occupy, shall have the screwed portion of a diameter such that it will not be damaged in driving and shall be marked in a conspicuous position to ensure correct assembly at Site.

Washers, locking devices and anti-vibration arrangements shall be provided and shall be subject to the approval of the Project Manager. Taper washers shall be fitted where necessary.
Nuts, bolts and screws that might become loose during operation shall be locked in fastened position by means approved by the Project Manager.

All torque values shall be stated on the drawings or torque value listing.

2.6.21.18.2 Corrosion Resisting Bolts and Nuts.

Corrosion resisting steel shall be used for bolts and nuts when either or both are subject to contact with water and/or frequent adjustment or frequent removal, such as adjusting bolts for packing glands on removable screens or strainers, on adjustable bearings, etc.

2.6.21.18.3 Anchor Bolts – General Requirements.

Anchor bolts shall be supplied and installed in accordance with the anchor manufacturer's recommendations, details shown on the plans and with the requirements of these Specifications unless otherwise directed.

Anchoring to concrete of components such as turbine and generators and other heavy equipment including transformers shall be provided with sleeved or hook type anchors installed in the concrete

foundations. Chemical, adhesive bonded anchors shall not be used for heavy load applications. Anchors that are subject to immersion in water or anchors, which penetrate and are welded to stainless steel liners, shall be of stainless steel.
Anchors for lighter static loads shall be of the drilled epoxy adhesive bonded anchors of 316 stainless steel.

After anchor bolts have been embedded, Contractor shall protect threads by applying grease and by having the nuts screwed on until the time of installation of the equipment or metalwork.

Minimum depth of embedment of drilled mechanical anchors shall be as recommended by the manufacturer, but not less than six and one-half bolt diameters.

2.6.21.19 Protection, Cleaning and Painting

2.6.21.20 General

All parts which will ultimately be embedded in concrete shall be cleaned and protected by a cement wash or other approved method before forwarding from the Contractor's shop. Before being installed, they shall be thoroughly de-scaled and cleaned of all rust and adherent matter. Such cleaning must not affect the strength or final operation or function of the Plant.

All machined parts or bearing surfaces shall be cleaned and protected from corrosion by the application of an approved rust preventive lacquer or a peelable plastic film before forwarding from the Contractor's shop. Where the latter is impractical, such parts shall be heavily covered with high melting point grease. After erection, such parts shall be cleaned with solvent and wiped or polished bright.

All parts, other than machined parts that will be exposed after erection, shall be thoroughly cleaned and given two coats of best quality approved primer and one coat of best quality approved finish paint before being forwarded from the Contractor's shop. One further coat of paint of an approved quality and colour shall be applied after erection and touching up on the Site (except such apparatus as panels and instruments which shall be finish painted in the factory). Paint colours shall be submitted to the Project Manager for approval by presentation of RAL ‘Classic’ or equivalent colour samples or colour chips.

Primer shall be applied to surfaces prepared in accordance with the paint Contractor's instructions. The surface shall be wiped clean immediately prior to applying the paint. The primer and finish coats of paint shall be applied using the methods and plant recommended by the manufacturer.

The internal surface of all pipelines shall be cleaned out by approved methods before installation and again prior to commissioning, to ensure freedom from dirt, rust, scale, welding slag, etc. All exposed pipes shall be coloured for identification after erection is completed. The colour for each classified pipeline shall be approved by the Project Manager.

The final colour of the Facilities shall be approved by the Project Manager. The Contractor shall comply with this colour scheme for the Facilities.

All Facilities shall be painted as specified herein. The painting shall include the preparation of the metal surfaces, paint application, protection and drying of the paint coatings, as well as the supplying of all tools, labour and materials necessary for the entire painting work.

Paint shall be the product of reputable manufacturers and its selection shall be approved by the Project Manager. Sufficient paint shall be provided for site painting.

2.6.21.21 Employers Colour Scheme

The Employers Colour Scheme for the powerhouse and appurtenant facilities is as follows:-

Item	Colour	Code	
Building Cladding	Pale Eucalypt	RAL6011	
Building Masonry Walls - Exterior	Pastel Green	RAL6019	
Building Masonry Walls - Interior	Pure White	RAL9010	
Building Roof	Olive Green	RAL 6003	
Steel Frame (Internal)	Moss Green	RAL 6005	
Handrails	Signal Yellow	RAL1003	
Stairway Bearers	Signal Yellow	RAL1003	
Ladders	Signal Yellow	RAL1003	
Powerhouse floor	Signal Grey	RAL7004	
Powerhouse floor "walkway markings"	Signal Yellow	RAL1003	
Control Room Interior Walls and Ceiling	Pure White	RAL9010	
Control Panels	Grey	RAL7032	
11kV Switchgear	Grey	RAL7032	
Distribution Boards	Grey	RAL7032	
Turbine	Light Blue	RAL5012	
Generator	Melon Yellow	RAL1028	
HPU	Cream	RAL6001	
Air Ventilation Louvres	Olive Green	RAL 6003	
Lube Oil	Cream	RAL6001	
Penstock Stub Section	Patina Green	RAL6000	
Transformers	Green Grey	RAL7009	
Crane and rails	Signal Yellow	RAL1003	

Item	Colour	Code	
Generator Cooling Water pumps and piping	Light Blue	RAL5012	

2.6.21.22 Surface Preparation

All oil, paraffin, grease and dirt shall be removed from the surfaces to be painted using solvents. All weld spatters, slags, burrs, loose rusted mill scale and other foreign substances shall be removed by shot or sandblasting to *"white"* metal. The interior surface of the steel pipe shall be mechanically cleaned or sandblasted to a commercial standard.

Special attention shall be given to cleaning of corners and converging angles. If rust forms or the surfaces become contaminated in the interval between cleaning and painting, re-cleaning to the same degree appropriate is required. Effective means shall be provided for removing all free oil and moisture from the air supply lines of blasting plant. All surface preparations shall be subject to the approval of the Project Manager before any paint is applied.

2.6.21.23 Application Procedure

All paint, when applied, shall provide a satisfactory film and a smooth, even surface. Paint shall be thoroughly stirred, stained, and kept at the uniform consistency during application. Paint shall not be applied when the temperature of the metal or of the surrounding air is below 10°C. Surfaces that will be coated shall be performed by brushing or spraying. Each coat shall be allowed to dry or harden thoroughly before the succeeding coat is applied.

2.6.21.24 Surfaces Not to be Painted

Bronze, brass, surfaces of gear teeth, finished ferrous surfaces, surfaces in rolling or sliding contact after field assembly, stainless steel and wire ropes shall not be painted.

All corrosion resisting steel surfaces for bearings and machinery parts shall not be painted.
On completion of cleaning, such surfaces shall be coated with an adhesive plastic film to protect the surfaces from minor mechanical damage and corrosion during shipment and storage at the site. The film shall be stripped off immediately prior to field erection of the Plant.

2.6.21.25 Galvanising

Unless specifically mentioned to the contrary, iron and steel shall be effectively galvanised after all fabrication is completed.

The zinc coating shall be uniform, clean, smooth and as free from spangle as possible. Galvanising shall be applied by the hot dip process for all parts other than steel wires. All steel wires shall be galvanised by an approved method before stranding.

The minimum quantities of zinc coating shall be 350 g/m² for bolts and nuts and 550 g/m² for all other parts except steel wires. The uniformity of zinc coating, tested by dipping the sample into the solution of sulphate of copper, shall be such that no surface of iron or steel shall expose until four times of dipping for bolts and nuts and six times for all other parts.

The preparation for galvanising and the galvanising itself shall not distort or adversely affect the mechanical properties of the materials. After galvanising, holes shall be free from nodules of splatter.
Galvanised parts are subject to the formation of white rust during shipment or storage on the Site, and special treatment shall be made during the galvanising process to prevent the formation of white rust.

2.6.21.26 Paint Schedule

All finished surfaces of ferrous metals including screw threads that will be exposed during transportation or while awaiting installation shall be cleaned and given a heavy uniform coating of gasoline soluble, rust preventive compound.

For painting steel, follow the requirements and recommendations of the combined Australian and New Zealand Standard AS/NZS 2312 "*Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings*". This standard has paint systems suitable for inland conditions in the Pacific islands.

The painting shall be performed as follows:-

Painting Systems Table 1 of 4

Base Material	Material Detail	Exposure	Environmental Conditions	Paint System	Comments
Mild Steel	General	Indoor	Dry	S1 or S3	
			Water Immersed	S2 or P1	
			Diesel Immersed	S5	
			Hydraulic Oil Immersed	S6	Dependent on oil type
		Outdoor	Exposed	S3 or P3	
			Water Immersed	S2	
		Buried	Soil	S11 or P2	Or coating manufacturers recommendations
	Pre-Galvanised	Indoor	General	HDG600P3	
		Outdoor	General	HDG600P3 +	
	Penstock	Inner wall of penstock	Water Immersed	P1	
		Outer wall of embedded pipe	Soil	P2	
		Outer wall of open / outdoor pipe	Exposed	P3	
	Gates	All surfaces	Flowing water	G1	
Concrete	Walls and Ceilings	Indoor	Dry	C1	
			Water Immersed	C3	
		Outdoor	Exposed	C1	
			Oil / Water Immersed	C3	Oil Interceptor, Transformer area
			Water Immersed	C4	
			Buried Soil	--	Coating manufacturers recommendations
	Floors	Indoor	Light Foot Traffic	C2	
			Heavy Foot Traffic	C2	
			Water Immersed	C3	
Plastics and Fibreglass	All	Indoor	General	F1	
		Outdoor	General	F1	
Wood	--	--	--	--	No wood in this project
Aluminium	Window Frames	Indoor and Outdoor	Exposed	S7 or S8	
	Louvres	Indoor and Outdoor	Exposed	S7 or S8	
Electrical panels		Indoor	Dry	S9 or S10	

Painting Systems Table 2 of 4

System	S1	S2	S3	S4	S5	S6	S7	S8
Description	Medium build epoxy with acrylic top coat	High build MIO epoxy	Polyurethane - higher build	High build epoxy - water immersion	Epoxy - diesel immersion	Epoxy - hydraulic oil immersion	Powder coated	Anodised
Substrate	Steel	Steel	Steel	Steel	Steel	Steel	Steel or aluminium	Aluminium
Typical Application	Indoor and Outdoor. Not immersed in water	Water Immersed (a more general version of system G1)	Indoor and Outdoor. Not immersed in water	Indoor and Outdoor. Potable Water	Indoor. Immersed in diesel	Indoor. Immersed in hydraulic oil	Indoor and outdoor. Ventilation louvres and windows.	Indoor and outdoor. Ventilation louvres and windows.
Reference Standard	AS/NZS2312 ACC5	AS/NZS2312 EHB6 with thicker coats	AS/NZS2312 PUR5	AS/NZS2312 EHB8				AS 1231
Surface Preparation	SA 2 ½	SA 2 ½	SA 2 ½	SA 2 ½ (profile 50-75 µm)	SA 2 ½			
Coat 1	Zinc rich primer	Zinc rich primer	Zinc rich primer	Epoxy primer	Epoxy with amine adduct or as recommended by paint manufacturer	Dependent on oil type	As recommended by coating manufacturer	As recommended by coating manufacturer
DFT (µm)	75	100	75	250				
Coat 2	High build epoxy	Epoxy MIO	High build epoxy	High build epoxy	Epoxy with amine adduct		PVDF powder coating	Anodising thickness AA10
DFT (µm)	125	150	200	250	250			10
Coat 3	Acrylic 2-pack	Epoxy MIO	Polyurethane gloss	--	--		--	--
DFT (µm)	50	150	50					
Total DFT (µm)	250	400	325	500	250			10

Painting Systems Table 3 of 4

System	S9	S10	S11	HDG600	HDG600P3	HDG600P3 +	C1	C2
Description	Epoxy powder finish	Polyester powder finish	Ultra high build epoxy	Hot dip galvanising	Epoxy painted hot dip galvanised (interior)	Epoxy painted hot dip galvanised (exterior)	Architectural paint for concrete	
Substrate	Steel	Steel	Steel	Steel	Hot dip galvanised steel	Hot dip galvanised steel	Concrete	Concrete

Typical Application	Indoor. Electrical Panels	Indoor. Electrical Panels	Soil		Interior	Exterior	Internal and external walls and ceilings	Internal concrete floors heavy traffic
Reference Standard			AS/NZS2312 EUH1	AS/NZS4680 HDG600	AS/NZS2312 HDG600P3	AS/NZS2312 HDG600P3 with polyurethane top coat		
Surface Preparation	SA 3	SA 3	SA 2 ½ (profile 75-100 µm)	Hot dip galvanised 600g/m² to AS/NZS4680	Hot dip galvanised 600g/m² to AS/NZS4680	Hot dip galvanised 600g/m² to AS/NZS4680	May need a lime stain inhibitor coating to stop lime staining	
Coat 1	As recommended by paint manufacturer	As recommended by paint manufacturer	Ultra high build epoxy		High build epoxy	High build epoxy	Penetrating epoxy primer	Epoxy enamel (solvent based) with slip resistant additive
DFT (µm)			1000	85	150	150	10	125
Coat 2	Epoxy powder finish	Polyester powder finish	Ultra high build two-pack epoxy	--	--	Polyurethane gloss	High build epoxy	Epoxy enamel (solvent based)
DFT (µm)	50	50	1000			50	200	50
Coat 3	--	--	--	--	--	--	Polyurethane gloss	--
DFT (µm)							50	
Total DFT (µm)	50	50	2000	85	HDG+150	HDG+200	260	175

Painting Systems Table 4 of 4

System	**C3**	**C4**	**F1**	**P1**	**P2**	**P3**	**G1**
Description	Water tanks	Water tanks	Fibreglass and plastic	Penstock - inside	Penstock - embedded	Penstock – exposed / outdoor	Gates
Substrate	Concrete	Concrete	Fibreglass or plastic	Steel	Steel	Steel	Steel
Typical Application	Water tank internals	Water tank external	Roof fans	Penstock - inside	Penstock - embedded	Penstock outside	Gates
Reference Standard			Must be compatible with the substrate				
Surface Preparation			As required by paint manufacturer	SA 2 ½	SA 2 ½	SA 2 ½	SA 2 ½

Coat 1	Epoxy filler / sealer	Epoxy filler / sealer	Epoxy primer	SA 2 ½	Denso Primer D	Denso ST epoxy (grey)	Epoxy Zinc Rich Paint (TH-4A)
DFT (µm)	As required	As required	50	250	100	250	100
Coat 2	High build epoxy	High build epoxy	Polyurethane gloss	Denso ST epoxy (grey)	Densopol 80 HT anti-corrosion tape	Denso ST epoxy (white)	Epoxy MIO Paint (TH-10A)
DFT (µm)	500	2x 500 = 1000	50	250	--	250	150
Coat 3	High build epoxy	Polyurethane gloss	--	--	--	Weatherseal acrylic (Denso recommendation)	Epoxy Abrasion Resistant Paint (TH-9A)
DFT (µm)	500	50				40	150
Total DFT (µm)	1000	1050	100	500	--	540	400

2.6.21.27 Lubricants and Hydraulic Fluid

Oil for the hydraulic power units shall preferably be of the same type used for the thrust and guide bearings. Grease, lubricating oil and hydraulic fluid required for initial filling of all of the equipment plus 10% shall be furnished. Upon completion of the design, a tabulation confirming the quantities of lubricating oil, grease, and hydraulic fluid required for initial application for each item of equipment shall be furnished. Final selection of the grease, lubricating oil, and hydraulic fluid shall be coordinated with the Project Manager to rationalize the oil inventory and to ensure that the selected brands are available locally.

2.6.22 **General Electrical Requirements**

2.6.22.1 General

Unless otherwise specified, auxiliary electrical equipment shall conform to all applicable standards of the authorities as specified in Section 6 Part 2.1.6.3 Standards. Note that in the Samoa the requirements of the Australian wiring regulations AS/NZ3000:2007 and referenced standards are the paramount requirements.

The Samoa electricity system uses a Multiple Earthed Neutral (MEN) system which is described as a TN-C-S under IEC60364.

2.6.22.2 Phase Rotation

Generator and motor phase rotation will be designated as R for the 1st phase (U-X), S the 2nd phase (V-Y), and T for the 3rd phase (W-Z). Power phase rotation will be designed as R-S-T. R-S-T type bus arrangements, left-to-right, top-to-bottom and front-to-rear, will be used throughout to assure convenient and safe testing and maintenance.

2.6.22.3 Control Equipment Electrical Ratings

2.6.22.3.1 Voltage Ratings

Control equipment shall be designed for operation at the following voltages:

- Nominal rating 110-V DC with an operating range of ±20%, ungrounded from the station battery.
- Nominal rating single-phase 240-V AC, 50-Hz, grounded, with an operating range of ±10%.

2.6.22.3.2 Electrical Contact Ratings

- Contacts shall be suitable for the application and have current and voltage ratings that will not be exceeded when applied in the control circuits.
- Contacts intended for use in the control circuits shall be electrically-independent, ungrounded, dry contacts, field changeable from "normally-open" to "normally-closed" and have the following ratings:
- Maximum Design Voltage. 415/240-V AC and 110-V DC.
- Continuous Current. 5-A AC or DC.
- Maximum Interrupting Current. Inductive (when L/R≥5000), 1.5-A at 240-V AC and 1.1-A at 110-V DC.
- Maximum Making Current. Inductive (when L/R≥5000), 15-A at 240-V AC and 1.1-A at 110-V DC.

2.6.22.4 Motors

2.6.22.4.1 Standards

Motors shall comply with IEC 60034 as regards performance and testing.

2.6.22.4.2 Ratings and Characteristics

- Frequency (AC motors): 50-Hz.
- Voltage (AC motors): 0.75-kW and above, 3-phase, 415-V; less than 0.75 kW, 1-phase, 240-V
- Insulation: Class B, nonhygroscopic.
- Enclosure: totally-enclosed, fan-cooled, (TEFC) unless otherwise specified.
- Accessories. The following accessories shall be provided:
- Non-ferrous, metal guard screens on all ventilating openings.
- Lifting eyes (eye bolts) on all motors weighing more than 50 kg.
- Space heaters for motors above 50 kW shall be factory mounted in an accessible location under the stator frames and rated to maintain internal temperature approximately 10°C above

ambient temperature specified. Heater leads shall be wired to a separate terminal box mounted on the motor. Heaters shall be low watt-density and connected to the motor starter control circuit. Heaters shall be automatically energized when the motor is shut down.

- Ground pads with tapped bolt holes on 2-hole standard centres for motors rated 15 kW and above. Pad locations shall be near the base and shall be shown on manufacturer's motor or assembly outline Drawings.
- Soleplates and hold down bolts, where required.
- Gasketed motor terminal boxes, sized to accommodate external cable and lugs, and suitable for conduit connections. They shall be suitable for rotating in 90º steps.

2.6.22.4.3 Service Factor

All motors shall be sized to permit the driven equipment to develop its specified capacity continuously without exceeding the rated temperature and using no more than 85% of rated motor kW capacity (1.15 Service Factor). The intent of this requirement is that the motor kW capacity be sized above the maximum continuous duty required by the driven equipment.

2.6.22.4.4 Bearings

- Bearings shall be liberal in size, suitable for continuous service under the conditions specified, sealed against the entrance of dirt and the escapement of the lubricant.
- Fitted openings shall be provided on the bearing housing for applying and draining the lubricant. Filler and drain extensions shall be furnished where necessary to give ready accessibility.
- Wherever necessary, the bearings shall be insulated to prevent the passage of shaft currents through the bearings.
- The thrust bearing for vertical motors shall be of the antifriction type, capable of supporting the weight of the motor and driven equipment rotating parts plus hydraulic thrust due to load. Bearings shall be grease lubricated with provisions for greasing. Provisions shall be made to prevent over-greasing where excess lubrication may cause damage.

2.6.22.4.5 Starting

- Except where specifically indicated otherwise, motors shall be suitable for full-voltage, across-the-line starting.
- Motors shall accelerate the driven equipment to rated speed with 80% of the motor nameplate voltage applied at the terminals. Unless otherwise approved, the maximum starting current shall not exceed 6 times the rated full-load current.
- Motors shall withstand without adverse effects, a full voltage, dead-bus transfer from one source to another. The minimum “dead time” for this transfer shall be considered to be 1 second.
- Where repetitive starting is necessary, the permissible number of starts shall be clearly indicated on the nameplate.

2.6.22.4.6 Finish

Motors for use indoors shall have the manufacturer's standard finish unless otherwise specified. Motors for outdoor use shall have corrosion-resisting hardware and corrosion-resisting finish on the rotor and shaft.

2.6.22.5 Cabling Installation Practice

2.6.22.5.1 General

All cables shall be run parallel to walls and either truly vertical or horizontal as appropriate. Agree all exposed cable routes with the Project Manager prior to commencing work. All holes through structural members shall be approved by the Project Manager before drilling commences.

Ensure that all cables are supported to avoid undue strain on cables or on terminations. All cabling shall be neatly dressed, run in single layers and identified as to function at terminating points. All cabling shall be installed in a manner which permits its convenient withdrawal and replacement. No cable shall be cast directly into concrete.

Sharp edges to steel or sheet metal shall be removed and such work shall be arranged to avoid accidental injury to personnel, or damage to insulation. Provide insulated bushes at all points where cables enter metal enclosures.

2.6.22.5.2 Cable Identification

Each cable shall be labelled with a permanent identification number as indicated on the Contractors cable schedules. All cable cores shall be numbered.

2.6.22.5.3 Underground Cables

All underground cables are to be buried in a trench at a minimum depth of 600mm, bedded on not less than 100mm of fine washed sand and covered by a further 100mm of sand. The cables are to be laid free of kinks and twists and laid in flat formation without interlacing.

The trench shall be backfilled with 150mm of soil, consolidated and a protective layer of 150 x 25 RS ground retention tanalith treated timber, or approved proprietary cable protection covering is to be placed over the full length of the trench.

Cabling is to be completed covered by timber or equal protection.

Lay on Orange PVC signal strip 100mm wide with “Electric cable below” or equal labelling, above cables over fully length of route, at a depth of 250mm. Locations of underground cables are to be accurately marked on the Contract drawings. Where underground cables enter building a warning sign indicating “danger buried cable” is to be fastened to the building 200mm above ground level.

2.6.22.5.4 Cable Ladder

Provide all necessary cable ladder to support cables. All cable ladder width shall be sufficient for the work plus 30% spare capacity.

Cable ladder shall be manufactured from aluminium and shall be of NEMA 12A type.

Cable ladder shall be stood off the wall on galvanised spacers or brackets or suspended from the ceiling using a proprietary cable ladder hanger system. Maximum spacing of supports, brackets and hangers shall be 2 meter. Cable ladder shall be capable of supporting 12.5 kg/m per 100mm, i.e. a 600mm wide cable ladder must be capable of supporting 75 kg/m.

All runs of ladders shall be continuously bonded and earthed.

For all HV cabling, proprietary cable clamps must be used.

Ladders shall not be mounted directly onto flat surfaces. Install on suitable brackets clear of the surface to allow for cleaning and sufficient space for air circulation around and through the ladders.

2.6.22.5.5 Cable Installation Practice (HV Cables)

Single core cables shall be laid in trefoil formation using approved trefoil clamps at intervals of no more than 1m. All cables shall be pulled, supported and terminated in accordance with manufacturer’s instructions.

All copper wire screens and steel wire armour shall be bonded and earthed at both ends.

Joints in cable runs shall not be permitted.

All exposed cables shall be run parallel to walls and either truly vertical or horizontal as appropriate.

Cables to transformers may be supported as necessary using galvanised saddles fixed to the equipment frame but on no account shall penetrations be made in tanks containing oil.

At termination boxes cables shall be glanded. All terminations shall use compression terminals.

The Contractor shall ensure that:

a. All cables shall be glanded using stainless steel glands incorporating a waterproofing seal. All terminations shall use pressure crimp lugs, compressed using the correct tool.

b. Glanding and termination of cable is carried out strictly in accordance with manufacturer's instructions.

c. All bolts used in termination shall be stainless steel fitted with plain washer and two nuts. The torque of all bolted connections for cables over 70mm2 shall be recorded.

d. PVC shrouds are fitted to outdoor cables and/or that any future creepage will not leave armouring exposed.

e. Two locknuts are fitted to each gland and that each gland is fitted to a gland plate or bracket.

f. Bushes are fitted on each gland.

g. Cable glands and cable sheaths are effectively connected to the earthing system. Earth connections must have a cross section not less than 50% of the cross section of a core of the associated cable.

h. Under no circumstances shall copper and aluminium conductors be directly connected.

2.6.22.5.6 Cabling Installation Practice (LV Cables)

All exposed cables shall be run parallel to walls and either truly vertical or horizontal as appropriate. Cables shall be run on either cable ladder or floor ducts as appropriate.

Cables shall be sized to achieve a voltage drop of less than 2.5% of the nominal voltage between the distribution board and fitting. The maximum voltage drop from the station services transformers to the final sub circuit shall be no more than 5%.

Ensure that all cables are supported to avoid undue strain on cables or on terminations. All cabling shall be neatly dressed, run in single layers and identified as to function at terminating points. All cabling shall be installed in a manner which permits its convenient withdrawal and replacement. No cable shall be cast directly into concrete. In such areas install cables in conduit or ducting. Draw wires shall be installed in conduits or pipes where necessary for later cable installation.

Sharp edges to steel or sheet metal shall be removed and such work shall be arranged to avoid accidental injury to personnel, or damage to insulation. Provide insulated bushes at all points where cables enter metal enclosures.

After installation but before connection, all power cables shall be tested for insulation resistance. Cabling shall be cleated at centres not exceeding:-

	:	450 mm horizontally
	:	900 mm vertically

On no account shall plastic sheathed cables be run in any situation where timbers have been treated or likely to be treated with tar-oil, creosote or allied products.

No ordinary grade PVC insulated cables shall be run in any location where the temperature is likely to exceed 45^{o}C. No high temperature grade PVC shall be run in locations where the temperature is likely to exceed 75^{o}C. Mineral insulated cable shall be used where the temperature may exceed 75°C.

Wiring which supplies equipment liable to overheat and cause rapid deterioration of the wiring, shall have the tails made off with heat resisting sleeves to protect the permanent wiring in a conduit box. The conduit box shall be fitted with terminals and mounted adjacent to the fitting or equipment with a run of heat resistant cabling from the box.

2.6.22.5.7 Cable Installation Practice (Instrumentation Cables)

The following installation practice shall be used:

- Cable shields shall be electrically continuous. When two lengths of shielded cable are connected together at a terminal block, an insulated point on the terminal block shall be used for connecting the shields.
- Shields shall be isolated and insulated except at their selected grounding point to prevent stray and multiple grounds to the shield.
- At the point of termination, the shield shall not be stripped back any further than necessary from the terminal block.
- For signal circuits, the shield must not be part of the signal circuit.
- Signal circuits shall be grounded at only one point.
- Digital signal circuits shall be grounded only at the power supply.
- Analogue signal circuits shall be grounded only at the control panel and on a clean earth.
- Analogue signal cables shall be physically segregated from all power and control cables and from unshielded cables carrying digital or pulse type signals.
- All signal circuits to outdoor equipment shall be fitted with transient filters for protection against lightning.

2.6.22.6 Cabling

2.6.22.6.1 240/415VCables

Cables shall be a minimum of 600/1,000 volt rating for 415 volt line voltage use.
All low voltage power cables are to have copper conductors and are to be run in accordance with NZS 3000 : 2007. Cables shall comply with the following standards:-

PVC insulated	:	NZS 6401
	:	AS/NZS 4961
	:	AS/NZS 5000.1
XLPE insulated	:	AS/NZS 5000.1
	:	AS/NZS 4026
	:	AS/NZS 4961
Neutral Screened	:	AS/NZS 3155

All cables shall be installed in accordance with AS/NZS 3000 and shall be rated in accordance with AS/NZS 3008.1.2.

All power cables shall have stranded copper conductors.

2.6.22.6.2 Instrumentation Cabling

Type.	Twisted pairs or triads (RTD's) with an overall shield.
Conductor	Stranded, tinned copper, 0.5 mm2 or larger.
Insulation Type	PVC
Rated Voltage (not less than)	150-V DC
Continuous operating temperature	105°C (dry)

The insulated conductors shall have an overall aluminium foil shield bonded to a mylar or polyester film with a stranded, tinned copper, continuous drain wire outside of the shield.
Each pair/triple shall be marked with indelible numbering.
Analogue signals shall be run in separate cables from digital signals.

2.6.22.6.3 Control Cabling

Type	Unarmoured, circular, multicore with an integral earth conductor.
Conductor	Stranded, copper, 1.5 mm2 or larger.
Insulation Type	PVC
Rated Voltage (not less than)	1000-V AC
Continuous operating temperature	90°C

Each core shall be marked with indelible numbering.

All cores in one cable shall operate at the same voltage.

2.6.22.7 Earthing and Equipotential Bonding

Effective protective earthing and equipotential bonding shall be provided, in accordance with AS/NZS 3000, for all electrical equipment installed under this contract. The Contractor must ensure all metal work encasing electrical work is bonded to earth. This shall include bonding all trays, ladders, trunking and electrical equipment.

2.6.22.8 Panel and Switchboard Construction

2.6.22.8.1 General

Panels and switchboards shall comply with AS/NZS 3439.1:2002: Low-voltage switchgear and controlgear assemblies - Type-tested and partially type-tested assemblies.

2.6.22.8.2 Metalwork

All enclosures used to house electrical equipment shall be gasketed, vermin proof and protected to the class specified in accordance with IEC 60947-1. If not stated, the minimum class shall be IP42. The maximum height above floor level of all instruments, control switches and relays shall allow for easy operation of the Plant and shall not exceed 1.80 m.

Enclosures shall consist of rigid, self-supporting, steel panels with a minimum thickness of 1.5 mm steel that have full-length, hinged and gasketed doors, located to provide easy access to the equipment. A tamper-proof lock shall be provided on each door of the enclosure. Interior panels shall be provided inside the enclosures for mounting items of electrical equipment.

All panels shall be located on a 75mm high plinth made of steel or concrete, as applicable to the general construction.

Mild steel panels are not permitted. All panels shall with use grade 316 stainless steel or galvanized steel construction. Steel shall be passivated, powder coated finished with baked enamel paint. Any outdoor panels, or panels in a damp area shall be grade 316 stainless steel.

Full height doors shall be provided with door stays to prevent swinging when open. All panel doors shall be hinged and shall be provided with T'bar locks. At least one T'bar on each compartment shall be key lockable. The same key pattern shall be used for every lock on the whole assembly and a set of keys (minimum of 10) shall be provided with the assembly.

All fastenings shall be integral with the panel or door and provision made for locking. Doors shall be rigid and fitted with weatherproof sealing material suitable for the climatic conditions specified. No door shall be wider than 1200mm without the permission of the Project Manager. Panel positions in general and door sizes and positions when open, shall not impinge on the safety and operability requirements of these clauses.
Outdoor panels shall be well ventilated through vermin-proof louvres comprising a filter screen attached to a frame and secured to the inside of the panel. Divisions between compartments within the panel shall be perforated to assist air circulation. If required, ventilation fans shall be used.

2.6.22.8.3 Terminals

All terminals shall be mounted in accessible positions. Adjacent terminals shall be adequately spaced to each other and to the incoming cable gland plate. Separate terminations shall be provided on each terminal strip for the cores of incoming and outgoing cables including all spare cores.

All terminals having a circuit voltage of 240V or higher shall be separated from lower voltages by a space created with partitions or end plates combined with end brackets and shall be shielded with an insulated cover marked with a warning notice "Danger ..... Volts". Where necessary, the different 240V / 415V phases shall be shielded from each other with partitions (i.e. where the in-service or under-maintenance breaking of a phase-wire can result in a phase to phase short circuit due to the type of terminal used).
Terminal blocks shall not be located less than 200mm from cable gland plates.

Only one conductor shall be terminated in each side of the terminal block.

Shorting straps shall be used between terminal blocks to bridge identical conductor terminals. Cubicles shall have at least 10% spare terminals and enough extra space on mounting bars for another 20% terminals.

2.6.22.8.4 Neutral & Earth Bars

These shall be a generous size to enable convenient termination of all neutral and earth conductors. Neutral and earth bars shall be provided with purpose made terminations sufficient for all connections with 25% spare. The bars shall be brass, tunnel type with slotted grub screw termination fixing and shall be rated at not less than the full current carrying capacity of the main supply. Terminations are to be provided for incoming neutral and earth cables of sizes shown on the drawings or as required by AS/NZS 3000.

Busbars and connected circuits shall be capable of carrying continuously a total load equal to the rated capacity of the incoming switch isolator without the temperature rise of any component mounted with or on a board exceeding 20°C.

The earth and neutral bar shall be located well clear of incoming cables and other connections.

2.6.22.8.5 Busbars& Connections

Busbars and connections thereto shall be fully insulated and shall comply with AS/NZS 3439.2. Busbars shall be capable of carrying the continuous rated current with a maximum temperature rise of 30°C above an ambient temperature of 40°C.

Clearances are to be maintained when a current equal to the specified short circuit rating is flowing in the busbars and connections and shall be capable of withstanding the specified test voltages. Busbars shall be rated at not less than the maximum current rating as indicated on the drawings and braced to withstand fault levels, which can be safely cleared by the section isolators.

2.6.22.8.6 Moulded Case Circuit Breakers (MCCBs)

Moulded case circuit breakers shall comply with IEC 60947-2.

The service breaking capacity (Ics) shall be 100% of the ultimate breaking capacity (Icu). The rated ultimate breaking capacity (Icu) of each moulded-case circuit breaker shall be equal to at least the value of the short-circuit current (Isc) at the point of installation on the electric circuit, unless the upstream circuit breaker makes it possible to ensure coordination as defined in Appendix A of IEC 60947-2.

MCCBs shall be of circuit breaker disconnector type and shall have a rated operational voltage of 690V AC (50/60Hz).

The rated insulation voltage of the circuit breakers shall be 750V AC (50/60Hz).
The MCCBs shall provide class II insulation (to IEC 664) between the front and internal power circuits.

The operating mechanism shall be of the quick make quick break type, with the speed of operation independent of the operator, and shall be trip free.

The breakers shall be operated by a toggle or a handle as specified which shall clearly indicate the three fundamental positions ON, and OFF and TRIPPED. If required, rotary handles shall be fitted to the breaker.

The operating mechanism shall be designed in such a way that the position of the operating handle of the circuit breaker indicates the real position of the main contacts (i.e. positive contact indication), even if the circuit breaker is equipped with a rotary handle.

Isolation shall be provided by a double break on the main circuit.

It shall be possible to lock the circuit breaker in the isolated position only with the use of a locking device and padlocks.

MCCBs shall have clearly accessible from the front face:

- Markings of rating
- Marked as suitable for isolation
- Push-to-trip test button to test operation of poles
- Contact position indicator

The MCCB shall provide double insulation of the front face to allow on-site installation of auxiliaries without de-energising the installation or circuit. All electrical auxiliaries and accessories including voltage releases (shunt or under-voltage) and auxiliary contacts shall be designed for easy on-site installation. All electrical auxiliaries shall be equipped with terminal blocks and shall be of the snap-in type. All electrical auxiliaries shall be separated from power circuits and their addition shall not increase the MCCB volume.

2.6.22.8.7 Fuses

Fuses shall be high rupturing capacity and type gG as defined in IEC 60269-1, IEC 60269-2-1 and have minimum breaking capacities equal to 80kA or greater. Fuses to be used for motor protection may be type aM.

In any case fuses shall have a minimum interrupting volt-ampere capacity at least equal to the fault rating at the switchboard specified herein.
Fuse ratings and the phase to which they are connected are to be legibly marked on holder and base. Provide (6) spare fuse links of each size and type used on the switchboard and locate in a purpose made compartment. Provide all spare fuse bases as indicated.

2.6.22.8.8 Miniature Circuit Breakers (MCBs)

Miniature circuit breakers (MCBs) shall comply fully with AS/NZS 60898.1. They shall be removable from the in-service position without removing adjacent circuit breakers and shall be of the trip-free type. The range available shall include breakers with B, C, D and MA tripping curves and shall be available in 6kA, 10kA and 15kA fault ratings. The breaker combinations of MCCB followed by MCB and further downstream MCBs shall provide full discrimination right through the circuit breaker installation.
MCBs shall have a fault rating of not less than the fault level of the distribution system at the point of connection in the switchboard but not less than 10KA. The use of cascading is permitted to provide an increase in a breaker’s fault rating.

MCBs shall be capable of being padlocked open using suitable attachments.
A minimum of 25% spare ways shall be provided to allow for the future MCBs.

2.6.22.8.9 Discrimination Function

Discrimination shall be provided to comply with IEC 60947-2 and shall be total discrimination. This means that for faults from overloads up to the full prospective short circuit level of the system, only the circuit breaker immediately upstream of the fault shall operate to clear the fault and all other circuit breakers shall remain closed.

The Contractor shall provide computer-generated calculations in the form of an easily read report that proves discrimination. In the short circuit region, the results shall be based on tests that the protective device manufacturer has carried out that have been incorporated into computer model.

2.6.22.8.10Motor Starters

Low voltage motor starters shall be of the combination type as defined in IEC 60947 - Part 4 and shall comprise:

- Fused combination unit (disconnector and fuse switch) or moulded case circuit breaker (AC23 minimum utilisation category).
- AC contactor (AC3 minimum utilisation category).

All motor starters associated with a turbine generator ‘unit’ shall be located in a single Motor Control Centre dedicated to that unit. The Motor Control Centre may be a separate cubicle within the Unit PLC panel.

The operating mechanism of the isolating device shall be mounted on the front of the cubicle, operated by a pistol grip type handle. The mechanism shall be interlocked with the door to prevent opening when in the on position. The mechanism shall be padlockable in the off position.

The rated operational current of the starter (Ie) shall be not less than the full-load current of the motor. The starter shall be rated for uninterruptible duty.

Thermal overload relays shall be Type 3c as defined in Clause 5.7.2 of IEC 60947-4-1. Time/current characteristics shall be supplied, by the manufacturer, on 28mm x 56mm logarithmic decades. These curves shall have a tolerance not exceeding + 10%.

Co-ordination of short circuit and overload protective devices shall be type 2 fully co-ordinated as defined in Clause 7.2.5 of IEC 60947-4-1 for a prospective short-circuit current not less than the value determined by the electrical system design. For this purpose the short circuit protection device shall be fitted with the maximum rating of motor circuit fuse.

Motor starters shall be suitable for both automatic and non-automatic methods of control.

Unless otherwise specified, motor starter control circuits shall be operated from a 240V AC supply, taken from the incoming supply to each motor starter cell, via a suitably rated MCB. All control and indication circuits between the motor starter cell and remote equipment (eg Unit PLC panels etc), must use 24V DC and suitably rated interposing relays to interface with the starter 240V AC controls shall be provided in the motor starter cell.

Power factor correction capacitors shall be provided in motor starters to correct the motor power factor to a minimum of 0.93. Separate contactors shall be used to switch the motor circuit and power factor correction equipment.

Where assisted start motor starters are required in order to reduce motor starting currents, electronic soft start units shall be used. Electronic soft start units shall be provided complete with bypass contactor. Assisted start operation shall be automatic changeover with adjustable time delays to suit the motor conditions.

Contactors shall be provided with auxiliary contacts to provide all required control and signalling functions and shall be provided with two additional spare normally open and two spare normally closed contacts.
Each starter shall be provided with the following local controls and indications as a minimum:-

- Supply Isolator.
- Running lamp.
- Stopped lamp.
- Fault lamp.
- Run/off/auto selector switch,

Each starter shall have the following interfaces with the Plant control system
- Motor Run - DI.
- Motor Auto - DI.
- Motor Fault - DI.
- Motor Start – DO
- Motor Stop DO

2.6.22.8.11 Relays

All relays are to be of best quality with contacts rated for a continuous duty of not less than 10A at 24V DC. They shall be encased in hermetically sealed enclosures and shall be free from discernible noise when energised. Auxiliary contacts are to be self-cleaning.

2.6.22.8.12 Isolators

All electrical panels, including motor control centers and distribution boards, must have an isolation switch on the incoming supply to comply with the AS/NZS3000 isolation requirements.

Any panel that is supplied from more than one 240/415V source must have a danger label affixed to the front warning that the panel is supplied from X sources and identifying the location of each of the sources.

All live side terminals of these isolators shall be shrouded to prevent accidental contact.

Isolators shall be rated for the continuous load current and for the maximum fault duty, which may be reached. Isolators shall not be smaller than sizes shown on the drawings.

Isolators shall be capable of being locked in the open or closed position. Isolators shall comply with IEC 60947-3 for AC 23 duty.

2.6.22.8.13 Pushbuttons and Pushbutton Switches

Pushbuttons and pushbutton switches shall be heavy-duty, oil-tight, complete with engraved legend plates, operators, and contact blocks. Legend plate engravings shall be selected by the Contractor and will be subject to the Project Manager's approval.

Contact Ratings

- Maximum Design Voltage. 500/300-V AC and 110-V DC.
- Continuous Current. 10-A AC or DC.
- Maximum Interrupting Current, Inductive. 3-A at 240-V AC and 2.2-A at 110-V DC.
- Maximum Making Current, Inductive. 30-A at 240-V AC and 2.2-A at 110-V DC.

2.6.22.8.14 Control and Selector Switches

Control and selector switches shall be heavy-duty, rotary type complying with the requirements of IEC 60947-5-1 for AC 11 duty.

Ratings

Maximum Design Voltage.	500/300-V AC and 240-V DC.
Continuous Current.	10-A AC or DC.
Maximum Interrupting Current, Inductive.	3-A at 240-V AC and 2.2-A at 110-V DC.
Maximum Making Current, Inductive.	30-A at 240-V AC and 2.2-A at 110-V DC.

Each switch shall be provided with an escutcheon plate clearly marked to show each operating position. Escutcheon plate markings shall be selected by the Contractor and will be subject to the Project Manager's approval.

The type and colour of the switch handle shall be selected by the Contractor and will be subject to the Project Manager's approval.

2.6.22.8.15 Test Blocks

Plug type test blocks shall be provided on all protection circuits for testing CT, CT and trip circuits.

2.6.22.8.16 Electrical Digital and Analogue Indicating Instruments

Instruments shall be of the flush mounting type with non-reflecting glass. They shall be calibrated and suitable for the application. Electrical measuring instruments generally shall be 96 x 96 mm but may be 72 x 72 mm if approved by the Project Manager. Analogue instruments shall be of the 270° full-scale deflection type.

Digital instruments shall have the following features:

- Bright orange LED display.
- Minimum 4-digit, 12 mm-high, readout.

- Black bezel with hardware and accessories for front-of-panel mounting.
- 1% accuracy

Indicating instruments shall conform to IEC 60051, class index 1.5.
Scale markings shall be selected by the Contractor and will be subject to the Project Manager's approval. Where instruments are connected to instrument transformer secondaries, the scale markings shall be selected to read the electrical quantities on the transformer primary.

2.6.22.8.17 Transducers and Transmitters

Transducers and transmitters shall be suitable for accurately measuring the specified quantities. Outputs shall be a dc current signal ranging from 4 to 20-mA full scale, suitable for termination in a load resistance up to 750Ω.

Unless specified otherwise, the maximum allowable error shall not exceed ±0.25% of full scale at 25°C, and the error resulting from a temperature variation between -20°C and 60°C shall not exceed ±0.5% of full scale. AC output ripple shall not exceed 1%. The units shall be provided with a 10% full scale calibration adjustment, and the response time shall be 400 ms or better from 0 to 99%. There shall be electrical isolation between input, output, external power supply if used, and the case ground connection. All transducers and transmitters shall have a dielectric test voltage rating conforming to IEC SWC test requirements.

2.6.22.8.18 Indicating Lamps

Lamps shall be light emitting diode (led) type, 22.5mm diameter with press to test facility.
The indicating lamps and resistors shall be rated to operate at 240-V AC or 24-V DC.

2.6.22.8.19 Heaters

Enclosures containing electrical control and switching equipment shall be equipped with electric space heaters for moisture control. The construction of the enclosures and the placement of the heaters shall assure effective circulation of air and prevent damage to equipment by overheating. Heaters shall be rated 240-V AC, single-phase. They shall be provided with thermostatically operated controls with “on-off” switches mounted inside the enclosure.

2.6.22.8.20 Lighting and Receptacles

Enclosures larger than 1.0 m^2 (vertical, front-of-panel surface area) shall be provided with a light and receptacle inside the enclosure to facilitate operation and maintenance. The light shall be incandescent type, with wire-guard and “on-off” switch. The receptacle shall be a duplex type, 2-pole, 3-wire. Power supply to the light and receptacle will be from a single-phase, 240-V AC, circuit.

2.6.22.8.21 Panel Wiring

All panel wiring shall be carried out in a neat and systematic manner with cable supported clear of the panels and other surfaces at all points to obtain free circulation of air.

All PVC insulated panel wiring shall comply with the requirements of BS 6231 Type BK. Conductors shall generally have a minimum cross section equivalent to 3/0.77mm (1.5mm^2), 7/0.67mm (2.5mm^2) but single stranded conductors should only be employed for rigid connections which are not subject to movement or vibration during shipment, operation or maintenance.

The Contractor shall propose a panel wire colour system to be used and shall submit to the Project Manager for approval. The colour system adopted must clearly:-

- Use different colours for 240/415V AC phase and neutral conductor.

- Differentiate 24V DC positive and negative conductors.
- Clearly identify RTD and analogue signal conductors.
- Green and Green/Yellow insulation may only be used for earthing conductors.

Wiring to doors shall be anchored at the panel side and sufficient length shall be provided to enable the door to swing fully open without strain on cabling.

All panel wiring shall be number ferruled using slide on cable markers with indelible markings. Wiring systems that rely on terminal number identification only are prohibited.

All outgoing control / controlled field wiring shall be brought out to terminals to facilitate ease of termination. Termination of all wiring at these terminals shall be effected using pre-insulated crimped ferrules or lugs of the correct size to suit cable and terminal capacity. Segregation shall be provided between 415/240V AC, 24V DC signal, 24V control and RTD/analogue terminals.
No wires may be teed or jointed between terminal points.

Bus wiring between adjacent panels, cubicles, etc, shall be terminated in each panel, with cables used for the interconnection. The use of panel wiring between adjacent cubicles not permitted

2.6.22.8.22 Panel Earthing

All metallic cases of instruments, control switches, relays, etc, mounted in panels, steel or otherwise, shall be connected by means of green with yellow stripes PVC insulated copper conductors of not less than 2.5mm² cross section to the nearest earth bar.

All metalwork shall be bonded to the main earth bar. All hinged panels shall be bonded with flexible copper.

All cable sheaths and earthing conductors shall be bonded to the earth bar. Use compression type conductor lugs for all earth connections with bolted joints. Ensure that all connections are tightened.
Earth continuity shall not depend upon metal joints. For panel earthing use starred washers between screw and panel.

2.6.22.8.23 Panel Labelling

All panels shall be fitted with an identification/rating plate displaying the following information: site name; rated voltage, phasing, frequency, current, etc; panel/equipment manufacturer; and contract number.
Labels shall consist of white lettering engraved on black traffolyte. Lettering shall be 12 mm high for main panel labels and 5 mm high for circuit descriptive labels. All labels shall be fixed with chromium plated or stainless steel screws.

The requirement for labels includes, but is not limited to, the following:

- All switchboards, panels, boxes, cabinets, cubicles or enclosures.
- Equipment mounted in or on the above items including relays, contactors, starters, sounders, motors, switches, sockets, controllers and luminaires.
- All instrumentation

2.6.22.9 Quality Control Requirements

2.6.22.9.1 Factory Tests

Each item of equipment and all similar equipment supplied as spare parts shall be given the manufacturer's routine factory tests to ensure successful operation of all parts of the assemblies. Factory tests shall include all routine tests required by the relevant IEC Standard. Test equipment and test methods (including equipment calibration and certification) shall conform to the applicable requirements of the test standard.

Operational tests shall be performed on all of the equipment or devices insofar as practicable to demonstrate that they function properly. Adjustable devices shall be checked for range of adjustment and given final adjustment, insofar as possible, in the shop.

Insulation resistance and voltage withstand tests in accordance with applicable provisions of the IEC standards shall be undertaken on all electrical circuits including control, instrument and protection circuits.

2.6.22.9.2 Field Tests

The equipment shall be installed, field tested and placed in operation by the Contractor as directed by the manufacturer's supervising erectors and test engineers. All necessary assistance, tools, and facilities required for the supervising erectors and test engineers shall be provided.

Field tests shall include all routine field tests required by the relevant Australian/New Zealand and/or IEC Standards.

Prior to watering the turbine, operational tests shall be performed on all of the equipment or devices insofar as practicable to demonstrate that they function properly. Adjustable devices shall be checked for range of adjustment and final settings applied.

3 Drawings

310103216-01-001-C001 A ‘Concept Plan – Option 1 (Head pond)’

4 Supplementary Information

Supplementary to the Specifications, the following reports and documents are available on request from the Project Manager:

- Alaoa Multipurpose Dam Project, Factual Geological /Geotechnical Report, Entura, 9 August 2018.
- Initial Environmental Examination for Fuluasou and Tiapapata Small Hydropower Projects, EPC Samoa, Final Draft, 22 May 2015.
- Tiapapata Hydropower Station Feasibility Study, EGIS, 2011
- Tiapapata Basis of Design, Stantec NZ, February 2020.

PART 3
– Conditions of Contract and Contract Forms

Section VII - General Conditions of Contract

These General Conditions of Contract ("GCC"), read together with the Special Conditions of Contract ("SCC") and other documents listed therein, shall be a complete document expressing fairly the rights and obligations of the Parties.

Table of Clauses

General Conditions of Contract

A. General

1. Definitions

1.1 Boldface type is used to identify defined terms.

(a) The **Accepted Contract Amount** means the amount accepted in the Letter of Acceptance for the execution and completion of the Works and the remedying of any defects.

(b) The **Activity Schedule** is a schedule of the activities comprising the construction, installation, testing, and commissioning of the Works in a lump sum contract. **It includes a lump sum price for each activity**, which is used for valuations and for assessing the effects of Variations and Compensation Events.

(c) The **Adjudicator** is the person appointed jointly by the Principal and the Contractor to resolve disputes in the first instance as provided for in Clause 23.

(d) **Bill of Quantities** means the priced and completed Bill of Quantities forming part of the Tender.

(e) **Compensation Events** are those defined in Clause 41 hereunder.

(f) The **Completion Date** is the date of completion of the Works as certified by the Engineer in accordance with Clause 52.1.

(g) The **Contract** is the Contract between the Principal and the Contractor to execute, complete, and maintain the Works. It consists of the documents listed in Clause 2.3 below.

(h) The **Contractor** is the party whose Tender to carry out the Works has been accepted by the Principal.

(i) The **Contractor's Tender** is the completed tender document submitted by the Contractor to the Principal.

(j) The **Contract Price** is the Accepted Contract Amount stated in the Letter of Acceptance and thereafter as adjusted in accordance with the terms and conditions of Contract.

(k) **Days** are calendar days; months are calendar months.

(l) **Dayworks** are varied work inputs subject to payment on a time basis for the Contractor's employees and Equipment, in addition to payments for associated Materials and Plant.

(m) A **Defect** is any part of the Works not completed in accordance with the Contract and identified by the Principal and notified to the Contractor, either before or after end of the Contract.

(n) The **Defects Liability Certificate** is the certificate issued by the **Engineer** upon correction of defects by the Contractor.

(o) The **Defects Liability Period** is the period **named in the SCC** 33.1 and calculated from the Completion Date.

(p) **Drawings** means the drawings of the Works, as included in the Contract, and any additional and modified drawings issued by (or on behalf of) the Principal in accordance with the Contract, and includes calculations and other information provided or approved by the Engineer for the execution of the Contract.

(q) The **Principal** is the party who contracts the Contractor to carry out the Works, **as specified in the SCC**.

(r) The **Engineer** is the person **named in the SCC** (or any other competent person appointed by the Principal and notified to the Contractor, to act in replacement of the Engineer) who is responsible for supervising the execution of the Works and administering the Contract.

(s) **Equipment** is the Contractor's machinery and vehicles brought temporarily to the Site to construct the Works.

(t) **Force Majeure** means an exceptional event or circumstance which is beyond a Party's control; which such Party could not reasonably have provided against before entering into the Contract; which, having arisen, such Party could not reasonably have avoided or overcome; and, which is not substantially attributable to the Party.

(u) **"In writing"** or **"written"** means hand-written, type-written, printed or electronically made and resulting in a permanent record;

(v) The **Initial Contract Price** is the Contract Price listed in the Principal's Letter of Acceptance.

(w) The **Intended Completion Date** is the date on which it is intended that the Contractor shall complete the Works. The Intended Completion Date is **specified in the SCC**. The Intended Completion Date may be revised only by the Engineer by issuing an extension of time or an acceleration order.

(x) **Letter of Acceptance** means the formal acceptance by the Principal of the Tender and denotes the formation of the Contract at the date of the acceptance.

(y) **Materials** are all supplies, including consumables used by the Contractor for incorporation in the Works.

(z) **Party** means the Principal or the Contractor as the context requires.

(aa) **Plant** is any integral part of the Works that shall have a mechanical, electrical, chemical, or biological function.

(bb) The **Registered Engineer** is the professionally qualified engineer appointed by the Contractor to assume responsibility for the engineering management, design and implementation of the Works (as applicable) in accordance with the Professional Engineers (Registrations) Act, 1998.

(cc) **SCC** means the Special Conditions of the Contract.

(dd) The **Site** is the area **defined as such in the SCC**.

(ee) **Site Investigation Reports** are those that were included in the Tender Documents and are factual and interpretative reports about the surface and subsurface conditions at the Site.

(ff) **Specification** means the Specification of the Works included in the Contract and any modification or addition made or approved by the Engineer.

(gg) The **Start Date** is **given in the SCC**. It is the latest date when the Contractor shall commence execution of the Works. It does not necessarily coincide with any of the Site Possession Dates.

(hh) A **Subcontractor** is a person or corporate body who has a Contract with the Contractor to carry out a part of the Works in the Contract which includes work on the Site.

(ii) **Temporary Works** are works designed, constructed, installed, and removed by the Contractor that are needed for construction or installation of the Works.

(jj) A **Variation** is an instruction given by the Engineer at the direction of the Principal which varies the Works.

(kk) The **Works** are what the Contract requires the Contractor to construct, install, and turn over to the Principal **as defined in the SCC**.

2. Interpretation

2.1 In interpreting these GCC, words indicating one gender include all genders. Words indicating the singular also include the plural and words indicating the plural also include the singular. Headings have no significance. Words have their normal meaning under the language of the Contract unless specifically defined. The Engineer shall provide instructions clarifying queries about these GCC.

2.2 If sectional completion is **specified in the SCC**, references in the GCC to the Works, the Completion Date, and the Intended Completion Date apply to any Section of the Works (other than references to the Completion Date and Intended Completion Date for the whole of the Works).

2.3 The documents forming the Contract shall be interpreted in the following order of priority:

(a) Contract Agreement;
(b) Letter of Acceptance;
(c) Special Conditions of Contract (“GCC”);
(d) General Conditions of Contract (“SCC”);
(e) Annex A - Contractor’s Tender;
(f) Annex B - Specifications;
(g) Annex C - Drawings;
(h) Annex D - Bill of Quantities; and
(i) any other document **listed in the SCC** as forming part of the Contract.

3. Language and Law

3.1 The language of the Contract and the law governing the Contract are **stated in the SCC**.

4. Engineer’s Decisions

4.1 Except where otherwise specifically stated, the Engineer shall in consultation with the Principal, decide contractual matters between the Principal and the Contractor in the role of representing the Principal and to ensure that, the Works is carried out and completed in accordance with the Contract.

5. Delegation

5.1 Unless otherwise **specified in the SCC**, the Engineer may, with the prior approval of the Principal, delegate any of his/her duties and responsibilities to other people, except to the Adjudicator after notifying the Contractor, and may revoke any delegation after notifying the Contractor.

6. Communications

6.1 Communications between parties that are referred to in the Conditions shall be effective only when in writing. A notice shall be effective only when it is delivered.

7. Subcontracting

7.1 The Contractor may subcontract with the approval of the Engineer up to a maximum of fifty percent (50%) of the accepted Contract amount. Subcontracting shall not alter the Contractor's obligations. The Contractor may not assign the Contract without the prior written approval of the Engineer in consultation with the Principal.

7.2 The Contractor shall be responsible for the acts, defaults and neglects of any approved sub-contractors.

8. Other Contractors

8.1 The Contractor shall cooperate and share the Site with other contractors, public authorities, utilities, and the Principal between the dates given in the Schedule of Other Contractors, as **referred to in the SCC.** The Contractor shall also provide facilities and services for them as described in the Schedule. The Principal may modify the Schedule of Other Contractors and shall notify the Contractor of any such modification.

9. Personnel and Equipment

9.1 The Contractor shall employ the key personnel and use the equipment identified in its Tender, to carry out the Works or other personnel and equipment approved by the Engineer. The Engineer shall approve any proposed replacement of key personnel and equipment only if their relevant qualifications or characteristics are substantially equal to or better than those listed in the Tender at no additional cost to the Principal.

9.2 The Contractor shall appoint a Registered Engineer for the duration of the Works. The Registered Engineer shall be a fully qualified corporate member of the Institute of Professional Engineers Samoa ("IPES") or be in possession of an alternative professional qualification recognized by IPES as qualifying for corporate membership of IPES and who will register as a member of IPES within twenty-eight (28) days of the Commencement Date.

9.3 If the Engineer asks the Contractor to remove a person who is a member of the Contractor's staff or work force, stating the reasons, the Contractor shall ensure that the person leaves the Site within seven (7) days and has no further connection with the work in the Contract.

10. Principal's and Contractor's Risks

10.1 The Principal carries the risks which this Contract states are Principal's risks, and the Contractor carries the risks which this Contract states are Contractor's risks.

11. Principal's Risks

11.1 From the Start Date until the Defects Liability Certificate has been issued, the following are the Principal's risks:

(a) The risk of personal injury, death, or loss of or damage to property (excluding the Works, Plant, Materials, and Equipment), which are due to –

(i) use or occupation of the Site by the Works or for the purpose of the Works, which is the unavoidable result of the Works; or

(ii) negligence, breach of statutory duty, or interference with any legal right by the Principal or by any person employed by or contracted to him except the Contractor.

(b) The risk of damage to the Works, Plant, Materials, and Equipment to the extent that it is due to a fault of the Principal or in the Principal's design, or due to war or radioactive contamination directly affecting the country where the Works are to be executed.

(c) The risk of the Principal pursuant to sub-clause (a) above does not extend to include losses of that nature brought about by the Contractor's employees or subcontractors.

11.2 From the Completion Date until the Defects Liability Certificate has been issued, the risk of loss of or damage to the Works, Plant, and Materials is the Principal's risk except loss or damage due to:

(a) a Defect which existed on the Completion Date;

(b) an event occurring before the Completion Date, which was not itself a Principal's risk; or

(c) the activities of the Contractor on the Site after the Completion Date.

12. Contractor's Risks

12.1 From the Starting Date until the Defects Liability Certificate has been issued, the risks of personal injury, death, and loss of or damage to property (including, without limitation, the Works, Plant, Materials, and Equipment) which are not Principal's risks are Contractor's risks.

13. Insurance

13.1 The Contractor shall provide, in the joint names of the Principal and the Contractor, insurance cover from the Start Date to the end of the Defects Liability Period or an open insurance cover to extend after the Defects Liability Period until all defects have been rectified to the satisfaction of the Principal (whichever period is longer), in the amounts and deductibles **stated in the SCC** for the following events which are due to the Contractor's risks:

(a) loss of or damage to the Works, Plant, and Materials;
(b) loss of or damage to Equipment;
(c) loss of or damage to property (except the Works, Plant, Materials, and Equipment) in connection with the Contract; and
(d) personal injury or death.

13.2 Policies and certificates for insurance shall be delivered by the Contractor to the Engineer for the Engineer's written approval in consultation with the Principal, before the Start Date. All such insurance shall provide for compensation to be payable in the types and proportions of currencies required to rectify the loss or damage incurred.

13.3 If the Contractor does not provide any of the policies and certificates required, the Principal may effect the insurance which the Contractor should have provided and recover the premiums the Principal has paid from payments otherwise due to the Contractor or, if no payment is due, the payment of the premiums shall be a debt due.

13.4 Alterations to the terms of an insurance policy shall not be made without the prior written approval of the Engineer in consultation with the Principal.

13.5 The Parties shall comply with any conditions of the insurance policies.

14. Site Data

14.1 The Contractor shall be deemed to have examined any Site Data **referred to in the SCC**, supplemented by any information available to the Contractor.

15. Contractor to Construct the Works

15.1 The Contractor shall construct and install the Works in accordance with the Specifications and Drawings which forms part of this Contract.

15.2 The Contractor shall, in consideration for the Contract Price, execute and complete the Works with due care, skill and diligence and in a sound, proper and workman like manner in accordance with the terms and conditions of this Contract and in conformity with all directions and requirements of the Engineer.

15.3 In performing the Works, the Contractor shall use high quality materials which are suitable for the Works. If the Engineer is of the opinion that any materials or work are unsatisfactory and do not comply with the quality requirements of this Contact, the Engineer may direct the Contractor, at no extra cost to the Principal, to remove the materials, demolish or reconstruct the Works, replace or correct the material or Works as the case may be.

16. The Works to Be Completed by the Intended Completion Date

16.1 The Contractor may commence execution of the Works on the Start Date and shall carry out the Works in accordance with the Program submitted by the Contractor, as updated with the approval of the Engineer, and complete them by the Intended Completion Date.

17. Approval by the Engineer

17.1 The Contractor shall submit Specifications and Drawings showing the proposed Temporary Works to the Engineer for his approval.

17.2 The Contractor shall be responsible for design of Temporary Works.

17.3 The Engineer’s approval shall not alter the Contractor’s responsibility for design of the Temporary Works.

17.4 The Contractor shall obtain approval of third parties to the design of the Temporary Works, where required.

17.5 All Drawings prepared by the Contractor for the execution of the temporary or permanent Works, are subject to prior approval by the Engineer before this use.

18. Safety

18.1 The Contractor shall be responsible for the safety of all activities on the Site. The Contractor shall implement sound and appropriate safety measures to protect members of the public and other third parties from any harm whatsoever and in accordance with all relevant occupational health and safety legislation applicable to the Site and for the purposes of such legislation the Contractor shall be deemed to be in control of the Site at all times for the duration of the Contract.

18.2 The Contractor shall ensure that the Site of the Works is well secured and protected at all times from any unauthorised entry or any other harm or damage during both working and non-working hours for the duration of the Works. The Contractor shall pay for any damages or losses whatsoever resulting from any failure to properly secure the Site.

19. Discoveries

19.1 Anything of historical or other interest or of significant value unexpectedly discovered on the Site shall be the property of the Principal. The Contractor shall notify the Engineer of such discoveries and carry out the Engineer’s instructions for dealing with them.

20. Possession of the Site

20.1 The Principal shall give possession of all parts of the Site to the Contractor. If possession of a part is not given by the date **stated in the SCC,** the Principal shall be deemed to have delayed the start of the relevant activities, and this shall be a Compensation Event.

21. Access to the Site

21.1 The Contractor shall allow the Engineer and any person authorized by the Engineer access to the Site and to any place where work in connection with the Contract is being carried out or is intended to be carried out.

22. Instructions, Inspections and Audits

22.1 The Contractor shall carry out all instructions of the Engineer which comply with the applicable laws where the Site is located.

22.2 The Contractor shall permit and shall cause its Subcontractors and sub consultants to permit the Principal and/or persons appointed by the Principal to inspect the Site and/or the accounts and records of the Contractor and its sub-contractors relating to the performance of the Contract and the submission of the Tender, and to have such accounts and records audited by auditors appointed by the Principal if requested by the Principal.

22.3 The Contractor's and its Subcontractors' and sub consultants' attention is drawn to Clause 57.1 which provides, *inter alia*, that acts intended to materially impede the exercise of the Principal's inspection and audit rights provided for under Clause 22.2 constitute a prohibited practice subject to contract termination (as well as to a determination of ineligibility pursuant to the Principal's prevailing sanctions procedures).

23. Appointment of the Adjudicator

23.1 The Adjudicator shall be appointed jointly by the Principal and the Contractor, at the time of the Principal's issuance of the Letter of Acceptance. If, in the Letter of Acceptance, the Principal does not agree on the appointment of the Adjudicator, the Principal will request the Appointing Authority **designated in the SCC**, to appoint the Adjudicator within fourteen (14) days of receipt of such request.

23.2 Should the Adjudicator resign or die or should the Principal and the Contractor agree that the Adjudicator is not functioning in accordance with the provisions of the Contract, a new Adjudicator shall be jointly appointed by the Principal and the Contractor. In case of disagreement between the Principal and the Contractor, within thirty (30) days, the Adjudicator shall be designated by the Appointing Authority **designated in the SCC** at the request of either party, within fourteen (14) days of receipt of such request.

24. Procedure for Disputes

24.1 If the Contractor believes that a decision taken by the Engineer was either outside the authority given to the Engineer by this Contract or that the decision was wrongly taken, the Contractor shall notify the Principal and thereafter first enter into good faith negotiations to resolve the dispute in a fair and equitable manner without the need for adjudication or arbitration.

24.2 If the good faith negotiations, in accordance with sub-clause 24.1 do not result in an acceptable resolution within fourteen (14) days of the Contractor notifying the Principal of a disagreement with the Engineer's decision, the decision shall immediately be referred to the Adjudicator.

24.3 The Adjudicator shall give a decision in writing within twenty-eight (28) days of receipt of a notification of a dispute.

24.4 The Adjudicator shall be paid by the hour at the **rate specified in the SCC,** together with reimbursable expenses of the types **specified in the SCC**, and the cost shall be divided equally between the Principal and the Contractor, whatever decision is reached by the Adjudicator. Either Party may refer a decision of the Adjudicator to an Arbitrator within twenty-eight (28) days of the Adjudicator's written decision. If neither Party refers the dispute to arbitration within the above twenty-eight (28) days, the Adjudicator's decision shall be final and binding.

24.5 The arbitration shall be conducted in accordance with the arbitration procedures published by the institution named and, in the place, specified **in the SCC.**

B. Time Control

25. Program

25.1 Within the time **stated in the SCC**, after the date of the Letter of Acceptance, the Contractor shall submit to the Engineer for approval a Program showing the general methods, arrangements, order, and timing for all the activities in the Works. In the case of a lump sum contract, the activities in the Program shall be consistent with those in the Activity Schedule.

25.2 An update of the Program shall be a program showing the actual progress achieved on each activity and the effect of the progress achieved on the timing of the remaining work, including any changes to the sequence of the activities.

25.3 The Contractor shall submit to the Engineer for approval an updated Program at intervals no longer than the period **stated in the SCC.** If the Contractor does not submit an updated Program within this period, the Engineer may withhold the amount **stated in the SCC** from the next payment certificate and continue to withhold this amount until the next payment after the date on which the overdue Program has been submitted. In the case of a lump sum contract, the Contractor shall provide an updated Activity Schedule within fourteen (14) days of being instructed to by the Engineer.

25.4 The Engineer's approval of the Program shall not alter the Contractor's obligations. The Contractor may revise the Program and submit it to the Engineer again at any time. A revised Program shall show the effect of Variations and Compensation Events.

26. Extension of the Intended Completion Date

26.1 The Engineer shall extend the Intended Completion Date if a Compensation Event occurs or a Variation is issued which makes it impossible for Completion to be achieved by the Intended Completion Date without the Contractor taking steps to accelerate the remaining work, which would cause the Contractor to incur additional cost.

26.2 The Engineer shall decide whether and by how much to extend the Intended Completion Date within twenty-one (21) days of the Contractor asking the Engineer for a decision upon the effect of a Compensation Event or Variation and submitting full supporting information. If the Contractor has failed to give early warning of a delay or has failed to cooperate in dealing with a delay, the delay by this failure shall not be considered in assessing the new Intended Completion Date.

27. Acceleration

27.1 When the Principal wants the Contractor to finish before the Intended Completion Date, the Engineer shall obtain priced proposals for achieving the necessary acceleration from the Contractor. If the Principal accepts these proposals, the Intended Completion Date shall be adjusted accordingly and confirmed in writing by both the Principal and the Contractor.

27.2 If the Contractor's priced proposals for an acceleration are accepted by the Principal, they are incorporated into the Contract Price and treated as a Variation.

28. Delays Ordered by the Engineer

28.1 The Engineer may instruct the Contractor to delay the start or progress of any activity within the Works at the direction of the Principal.

29. Management Meetings

29.1 Either the Engineer or the Contractor may require the other to attend a management meeting. The business of a management meeting shall be to review the plans for remaining work and to deal with matters raised in accordance with the early warning procedure.

29.2 The Engineer shall record the business of management meetings and provide copies of the record to those attending the meeting and to the Principal. The responsibility of the parties for actions to be taken shall be decided by the Engineer either at the management meeting or after the management meeting and stated in writing to all who attended the meeting.

30. Early Warning

30.1 The Contractor shall warn the Engineer at the earliest opportunity of specific likely future events or circumstances that may adversely affect the quality of the work, increase the Contract Price, or delay the execution of the Works. The Engineer may require the Contractor to provide an estimate of the expected effect of the future event or circumstance on the Contract Price and Completion Date. The estimate shall be provided by the Contractor as soon as reasonably possible.

30.2 The Contractor shall cooperate with the Engineer in making and considering proposals for how the effect of such an event or circumstance can be avoided or reduced by anyone involved in the work and in carrying out any resulting instruction of the Engineer.

C. Quality Control

31. Identifying Defects

31.1 The Engineer shall check the Contractor's work and notify the Contractor of any Defects that are found. Such checking shall not affect the Contractor's responsibilities. The Engineer may instruct the Contractor to search for a Defect and to uncover and test any work that the Engineer considers may have a Defect. Notification of defects may either be before or after end of the Contract and such defects must be rectified within the Defects Liability Period or until such time that the Principal is satisfied with rectification completed (whichever is the longer period).

32. Tests

32.1 If the Engineer instructs the Contractor to carry out a test not specified in the Specification to check whether any work has a Defect and the test shows that it does, the Contractor shall pay for the test and any samples. If there is no Defect, the test shall be a Compensation Event.

33. Correction of Defects

33.1 The Engineer shall give notice to the Contractor of any Defects before the end of the Defects Liability Period, which begins at Completion Date, and is **defined in the SCC.** The Defects Liability Period shall be extended for as long as Defects remain to be corrected and to the satisfaction of the Principal.

33.2 Every time notice of a Defect is given, the Contractor shall correct the notified Defect within the length of time specified by the Engineer's notice.

34. Uncorrected Defects

34.1 If the Contractor has not corrected a Defect within the time specified in the Engineer's notice, the Engineer shall assess the cost of having the Defect corrected, and the Contractor shall pay this amount.

D. Cost Control

35. Bill of Quantities or Activity Schedule

35.1 In the case of an admeasurement contract (measure and value), the Bill of Quantities shall contain priced items for the Works to be performed by the Contractor.

35.2 The Bill of Quantities is used to calculate the Contract Price. The Contractor will be paid for the quantity of the work accomplished at the rate in the Bill of Quantities for each item.

35.3 In the case of a lump sum contract, the Activity Schedule shall contain the priced activities for the Works to be performed by the Contractor. The Activity Schedule is used to monitor and control the performance of activities on which basis the Contractor will be paid. If payment for Materials on Site shall be made separately, the Contractor shall show delivery of Materials to the Site separately on the Activity Schedule.

36. Changes in the Contract Price

36.1 In the case of an admeasurement (measure and value) contract:

(a) If the final quantity of the work done differs from the quantity in the Bill of Quantities for the particular item by more than twenty-five percent (25%), provided the change exceeds one percent (1%) percent of the Initial Contract Price, the Engineer shall adjust the rate to allow for the change.

(b) The Engineer shall not adjust rates from changes in quantities if thereby the Initial Contract Price is exceeded by more than fifteen percent (15%), except with the prior approval of the Principal.

(c) If requested by the Engineer, the Contractor shall provide the Engineer with a detailed cost breakdown of any rate in the Bill of Quantities.

36.2 In the case of a lump sum contract, the Activity Schedule shall be amended by the Contractor to accommodate changes of Program or method of working made at the Contractor's own discretion. Prices in the Activity Schedule shall not be altered when the Contractor makes such changes to the Activity Schedule.

37. Variations

37.1 No variation of this Contract is binding unless it is agreed to in writing between the Parties.

37.2 All Variations shall be included in updated Programs and in the case of a lump sum contract, also in the Activity Schedule produced by the Contractor and shall form part of this Contract.

37.3 The Contractor shall provide the Engineer with a quotation for carrying out the Variation when requested to do so by the Engineer. The Engineer shall assess the quotation, which shall be given within seven (7) days of the request or within any longer period stated by the Engineer and before the Variation is ordered.

37.4 If the Contractor's quotation is unreasonable, the Engineer may order the Variation and make a change to the Contract Price, which shall be based on the Engineer's own forecast of the effects of the Variation on the Contractor's costs.

37.5 If the Engineer decides that the urgency of varying the work would prevent a quotation being given and considered without delaying the work, no quotation shall be given and the Variation shall be treated as a Compensation Event.

37.6 The Contractor shall not be entitled to additional payment for costs that could have been avoided by giving early warning.

37.7 In the case of an admeasurement (measure and value) contract, if the work in the Variation corresponds to an item description in the Bill of Quantities and if, in the opinion of the Engineer, the quantity of work above the limit stated in Clause 38.1 or the timing of its execution do not cause the cost per unit of quantity to change, the rate in the Bill of Quantities shall be used to calculate the value of the Variation. If the cost per unit of quantity changes, or if the nature or timing of the work in the Variation does not correspond with items in the Bill of Quantities, the quotation by the Contractor shall be in the form of new rates for the relevant items of work.

38. Cash Flow Forecasts

38.1 When the Program, or, in the case of a lump sum contract, the Activity Schedule, is updated, the Contractor shall provide the Engineer with an updated cash flow forecast. The cash flow forecast shall include different currencies, as defined in the Contract, converted as necessary using the Contract exchange rates.

39. Payment Certificates

39.1 The Contractor shall submit to the Engineer monthly statements of the estimated value of the work executed less the cumulative amount certified previously.

39.2 The Engineer shall check the Contractor's monthly statement and certify the amount to be paid to the Contractor.

39.3 The value of work executed shall be determined by the Engineer.

39.4 The value of work executed shall comprise:

(a) In the case of an admeasurement (measure and value) contract, the value of the quantities of work in the Bill of Quantities that have been completed; or

(b) In the case of a lump sum contract, the value of work executed shall comprise the value of completed activities in the Activity Schedule.

39.5 The value of work executed shall include the valuation of Variations and Compensation Events (where applicable).

39.6 The Engineer may exclude any item certified in a previous certificate or reduce the proportion of any item previously certified in any certificate in the light of later information.

39.7 The payment of monies by the Principal in accordance with a Progress Payment shall not be taken as evidence against or as an admission by the Principal that any work specified in such progress certificate has been constructed or carried out in accordance with this Contract as to the value thereof but will be taken to be payment on account only.

40. Payments

40.1 Payments shall be adjusted for deductions for advance payments and retention. The Principal shall pay the Contractor the amounts certified by the Engineer within twenty-eight (28) days of the date of each certificate.

40.2 If an amount certified is increased in a later certificate or as a result of an award by the Adjudicator or an Arbitrator, the Contractor shall be paid interest upon the delayed payment as set out in this clause. Interest shall be calculated from the date upon which the increased amount would have been certified in the absence of dispute.

40.3 Unless otherwise stated, all payments and deductions shall be paid or charged in the proportions of currencies comprising the Contract Price.

40.4 Items of the Works for which no rate or price has been entered in shall not be paid for by the Principal and shall be deemed covered by other rates and prices in the Contract.

41. Compensation Events

41.1 The following shall be Compensation Events:

(a) The Principal does not give access to a part of the Site by the Site Possession Date pursuant to Clause 20.1;

(b) The Principal modifies the Schedule of Other Contractors in a way that affects the work of the Contractor under the Contract;

(c) The Engineer orders a delay or does not issue Drawings, Specifications, or instructions required for execution of the Works on time;

(d) The Engineer instructs the Contractor to uncover or to carry out additional tests upon work, which is then found to have no Defects;

(e) The Engineer unreasonably does not approve a subcontract to be let;

(f) Ground conditions are substantially more adverse than could reasonably have been assumed before issuance of the Letter of Acceptance from the information issued to tenderers (including the Site Investigation Reports), from information available publicly and from a visual inspection of the Site;

(g) The Engineer gives an instruction for dealing with an unforeseen condition, caused by the Principal, or additional work required for safety or other reasons;

(h) Other contractors, public authorities, utilities, or the Principal does not work within the dates and other constraints stated in the Contract, and they cause delay or extra cost to the Contractor;

(i) The advance payment is delayed;

(j) The effects on the Contractor of any of the Principal's Risks;

(k) The Engineer unreasonably delays issuing a Certificate of Completion; and/or

(l) Other Compensation Events as may be described in the Contract or determined by the Engineer shall apply.

41.2 If a Compensation Event would cause additional cost or would prevent the work being completed before the Intended Completion Date, the Contract Price shall be increased and/or the Intended Completion Date shall be extended. The Engineer shall, in consultation with the Principal, decide whether and by how much the Contract Price shall be increased and whether and by how much the Intended Completion Date shall be extended.

41.3 As soon as information demonstrating the effect of each Compensation Event upon the Contractor's forecast cost has been provided by the Contractor, it shall be assessed by the Engineer, and the Contract Price shall be adjusted accordingly. If the Contractor's forecast is deemed unreasonable, the Engineer shall adjust the Contract Price based on the Engineer's own forecast. The Engineer shall assume that the Contractor shall react competently and promptly to the event.

41.4 The Contractor shall not be entitled to compensation to the extent that the Principal's interests are adversely affected by the Contractor not having given early warning or not having cooperated with the Engineer.

42. Tax

42.1 The Engineer shall adjust the Contract Price if applicable taxes, duties, and other levies are changed between the date twenty-eight (28) days before the submission of tenders for the Contract and the date of the last Completion certificate, as confirmed by the relevant authority. The adjustment shall be the change in the amount of tax payable by the Contractor, provided such changes are not already reflected in the Contract Price or are a result of Clause 44.

43. Currencies

43.1 Where payments are made in currencies other than the currency of the Principal's country **specified in the SCC,** the exchange rates used for calculating the amounts to be paid shall be the exchange rates stated in the Contractor's Tender.

44. Price Adjustment

44.1 Prices shall be adjusted for fluctuations in the cost of inputs only if **provided for in the SCC.** If so provided, the amounts certified in each payment certificate, before deducting for Advance Payment, shall be adjusted by applying the respective price adjustment factor to the payment amounts due in each currency. A separate formula of the type indicated below applies to each Contract currency:

$$P_c = A_c + B_c \, Imc/Ioc$$

where:

P_c is the adjustment factor for the portion of the Contract Price payable in a specific currency "c."

A_c and B_c are coefficients[8] **specified in the SCC,** representing the nonadjustable and adjustable portions, respectively, of the Contract Price payable in that specific currency "c;" and

Imc is the index prevailing at the end of the month being invoiced and Ioc is the index prevailing twenty-eight (28) days before Tender opening for inputs payable; both in the specific currency "c."

44.2 If the value of the index is changed after it has been used in a calculation, the calculation shall be corrected and an adjustment made in the next payment certificate. The index value shall be deemed to take account of all changes in cost due to fluctuations in costs.

45. Retention

45.1 The Principal shall retain from each payment due to the Contractor the proportion of the Contract Price **stated in the SCC** until Completion of the whole of the Works.

[8] *The sum of the two coefficients A_c and B_c should be 1 (one) in the formula for each currency. Normally, both coefficients shall be the same in the formulae for all currencies, since coefficient A, for the nonadjustable portion of the payments, is a very approximate figure (usually 0.15) to take account of fixed cost elements or other nonadjustable components. The sum of the adjustments for each currency are added to the Contract Price.*

45.2 Upon the issue of a Certificate of Completion of the Works by the Engineer, in accordance with Clause 51.1, the total amount retained shall be repaid to the Contractor when the Defects Liability Period has passed and the Engineer has certified that all Defects notified by the Engineer to the Contractor before the end of this period have been corrected. The Contractor may substitute retention money with an "on demand" bank guarantee.

46. Liquidated Damages

46.1 The Contractor shall pay liquidated damages to the Principal at the rate per day **stated in the SCC** for each day that the Completion Date is later than the Intended Completion Date. The total amount of liquidated damages shall not exceed the amount **defined in the SCC.** The Principal may deduct liquidated damages from payments due to the Contractor. Payment of liquidated damages shall not affect the Contractor's liabilities.

46.2 If the Intended Completion Date is extended after liquidated damages have been paid, the Engineer shall correct any overpayment of liquidated damages by the Contractor by adjusting the next payment certificate. The Contractor shall be paid interest on the overpayment, calculated from the date of payment to the date of repayment, at the rates specified in Clause 40.1.

47. Bonus

47.1 The Contractor may be paid a Bonus if allowed **in the SCC** calculated at the rate per day stated in the SCC for each day (less any days for which the Contractor is paid for acceleration) that the Completion is earlier than the intended Completion Date. The Engineer shall certify that the Works are complete, although they may not be due to be complete.

48. Advance Payment

48.1 The Principal shall make advance payment to the Contractor of the amounts **stated in the SCC** by the date **stated in the SCC,** against provision by the Contractor of an Unconditional Bank Guarantee in a form and by a bank acceptable to the Principal in amounts and currencies equal to the advance payment. The Guarantee shall remain effective until the advance payment has been repaid, but the amount of the Guarantee shall be progressively reduced by the amounts repaid by the Contractor. Interest shall not be charged on the advance payment.

48.2 The Contractor is to use the advance payment only to pay for Equipment, Plant, Materials, and mobilization expenses required specifically for execution of the Contract. The Contractor shall demonstrate that advance payment has been used in this way by supplying copies of invoices or other documents to the Engineer.

48.3 The advance payment shall be repaid by deducting proportionate amounts from payments otherwise due to the Contractor, following the schedule of completed percentages of the Works on a payment basis. No account shall be taken of the advance payment or its repayment in assessing valuations of work done, Variations, price adjustments, Compensation Events, Bonuses, or Liquidated Damages.

49. Securities

49.1 The Performance Security shall be provided to the Principal no later than the date specified in the Letter of Acceptance and shall be issued in an amount **specified in the SCC,** by a bank or surety acceptable to the Principal, and denominated in the types and proportions of the currencies in which the Contract Price is payable. The Performance Security shall be valid until a date twenty-eight (28) days from the date of issue of the Certificate of Completion in the case of a Bank Guarantee, and until one (1) year from the date of issue of the Completion Certificate in the case of a Performance Bond.

50. Dayworks

50.1 If applicable, the Dayworks rates in the Contractor's Tender shall be used only when the Engineer has given written instructions in advance for additional work to be paid for in that way.

50.2 All work to be paid for as Dayworks shall be recorded by the Contractor on forms approved by the Engineer. Each completed form shall be verified and signed by the Engineer within two (2) days of the work being done.

50.3 The Contractor shall be paid for Dayworks subject to obtaining signed Dayworks forms.

51. Cost of Repairs

51.1 Loss or damage to the Works or Materials to be incorporated in the Works between the Start Date and the end of the Defects Correction periods shall be remedied by the Contractor at the Contractor's cost if the loss or damage arises from the Contractor's acts or omissions.

E. Finishing the Contract

52. Completion

52.1 The Contractor shall request the Engineer to issue a Certificate of Completion of the Works, and the Engineer shall do so upon deciding that the whole of the Works is completed.

53. Taking Over

53.1 The Principal shall take over the Site and the Works within seven (7) days of the Engineer's issuing a certificate of Completion.

54. Final Account

54.1 The Contractor shall supply the Engineer with a detailed account of the total amount that the Contractor considers payable under the Contract before the end of the Defects Liability Period or before completion of rectification of defects to satisfaction of Principal.

54.2 The Engineer shall issue a Defects Liability Certificate and certify any final payment that is due to the Contractor within fifty-six (56) days of receiving the Contractor's account (if it is correct and complete) provided that the Engineer has approved that all defects identified before and after end of Contract have been rectified and that the Principal is satisfied with such rectification. If it is not, the Engineer shall issue within fifty-six (56) days a schedule that states the scope of the corrections or additions that are necessary. If the Final Account is still unsatisfactory after it has been resubmitted, the Engineer shall decide on the amount payable to the Contractor and issue a payment certificate.

55. Operating and Maintenance Manuals

55.1 If "as built" Drawings and/or operating and maintenance manuals are required, the Contractor shall supply them by the dates **stated in the SCC.**

55.2 If the Contractor does not supply the Drawings and/or manuals by the dates **stated in the SCC** pursuant to Clause 55.1**,** or they do not receive the Engineer's approval, the Engineer shall withhold the amount **stated in the SCC** from payments due to the Contractor.

56. Termination

56.1 The Principal or the Contractor may terminate the Contract if the other party causes a fundamental breach of the Contract.

56.2 Fundamental breaches of Contract shall include, but shall not be limited to, the following:

(a) the Contractor stops work for twenty-eight (28) days when no stoppage of work is shown on the current Program and the stoppage has not been authorized by the Engineer;

(b) the Engineer instructs the Contractor to delay the progress of the Works, and the instruction is not withdrawn within twenty-eight (28) days;

(c) the Principal or the Contractor is made bankrupt or goes into liquidation other than for a reconstruction or amalgamation;

(d) a payment certified by the Engineer is not paid by the Principal to the Contractor within eighty-four (84) days of the date of the Engineer's certificate;

(e) the Engineer gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Engineer;

(f) the Contractor does not maintain a Security, which is required;

(g) the Contractor has delayed the completion of the Works by the number of days for which the maximum amount of liquidated damages can be paid, as **defined in the SCC**; or

(h) if the Contractor, in the judgment of the Principal, has engaged in corrupt or fraudulent practices in competing for or in executing the Contract, pursuant to Clause 57.1.

56.3 When either party to the Contract gives notice of a breach of Contract to the Engineer for a cause other than those listed under Clause 56.2 above, the Engineer shall decide whether the breach is fundamental or not.

56.4 Notwithstanding the above, the Principal may terminate the Contract for convenience.

56.5 If the Contract is terminated, the Contractor shall stop work immediately, make the Site safe and secure, and leave the Site as soon as reasonably possible.

57. Fraud and Corruption

57.1 If the Principal determines that the Contractor and/or any of its personnel, or its agents, or its Subcontractors, sub-consultants, services providers, suppliers and/or their employees has engaged in corrupt, fraudulent, collusive, coercive or obstructive practices, in competing for or in executing the Contract, then the Principal may, after giving fourteen (14) days' notice to the Contractor, terminate the Contract and expel the Contractor from the Site, and the provisions of Clause 56 shall apply as if such expulsion had been made under Clause 56.5 [Termination by the Principal].

57.2 Should any employee of the Contractor be determined to have engaged in corrupt, fraudulent, collusive, coercive, or obstructive practice during the execution of the Works, then that employee shall be removed in accordance with Clause 9.

57.3 For the purposes of this paragraph:

(i) "corrupt practice" is the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party[9];

(ii) "fraudulent practice" is any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or

[9] "Another party" refers to a public official acting in relation to the procurement process or contract execution]. In this context, "public official" includes World Bank staff and employees of other organizations taking or reviewing procurement decisions.

to avoid an obligation[10];

(iii) "collusive practice" is an arrangement between two or more parties[11] designed to achieve an improper purpose, including to influence improperly the actions of another party;

(iv) "coercive practice" is impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party[12];

(v) "obstructive practice" is

(aa) deliberately destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede a Government investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; and/or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation; or

(bb) acts intended to materially impede the exercise of the Government's inspection and audit rights provided for under Clause 22.2.

58. Payment upon Termination

58.1 If the Contract is terminated because of a fundamental breach of this Contract by the Contractor, the Engineer shall issue a certificate for the value of the work done and Materials ordered less advance payments received up to the date of the issue of the certificate and less the percentage to apply to the value of the work not completed, as **indicated in the SCC.** Additional Liquidated Damages shall not apply. If the total amount due to the Principal exceeds any payment due to the Contractor, the difference shall be a debt payable to the Principal.

58.2 If the Contract is terminated for the Principal's convenience or because of a fundamental breach of Contract by the Principal, the Engineer shall issue a certificate for the value of the work done, Materials ordered, the reasonable cost of removal of Equipment, repatriation of the Contractor's personnel employed solely on the Works, and the Contractor's costs of protecting and securing the Works, and less advance payments received up to the date of the certificate.

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10 "Party" refers to a public official; the terms "benefit" and "obligation" relate to the procurement process or contract execution; and the "act or omission" is intended to influence the procurement process or contract execution.

11 "Parties" refers to participants in the procurement process (including public officials) attempting to establish bid prices at artificial, non competitive levels.

12 "Party" refers to a participant in the procurement process or contract execution.

59. Property	59.1	All Materials on the Site, Plant, Equipment, Temporary Works, and Works shall be deemed to be the property of the Principal if the Contract is terminated because of the Contractor's default.
60. Release from Performance	60.1	If the Contract is frustrated by the outbreak of war or by any other event entirely outside the control of either the Principal or the Contractor, the Engineer shall certify that the Contract has been frustrated. The Contractor shall make the Site safe and stop work as quickly as possible after receiving this certificate and shall be paid for all work carried out before receiving it and for any work carried out afterwards to which a commitment was made.

61. Suspension of funding

61.1 In the event that the Government suspends the funding to the Principal, from which part of the payments to the Contractor are being made:

(a) The Principal is obligated to notify the Contractor of such suspension within seven (7) days of having received the Government's suspension notice.

(b) If the Contractor has not received sums due it within the twenty-eight (28) days for payment provided for in Clause 40.1, the Contractor may immediately issue a fourteen (14)-days' termination notice.

62. Assignment

62.1 The Contractor shall not assign its obligations and agrees not to assign its rights under this contract without in either case, prior written approval from the Principal.

63. Confidentiality

63.1 The Contractor's and the Principal's personnel shall disclose all such confidential and other information as may be reasonably required in order to verify compliance with the Contract and allow its proper implementation. Each of them shall treat the details of the Contract as private and confidential, except to the extent necessary to carry out their respective obligations under the Contract or to comply with applicable laws.

63.2 Each of them shall not publish or disclose any particulars of the works prepared by the other party without the previous agreement of the other party. However, the Contractor shall be permitted to disclose any publicly available information or information otherwise required to establish his qualifications to complete for other projects.

63.3 Confidential information means, information that:
(a) is by its nature confidential;
(b) is designated by the Principal as confidential; or
(c) the Contractor knows or ought to know is confidential.

64. Indemnity

64.1 The Contractor shall keep the Principal fully and effectively indemnified against all loses, damages or injuries, including but not limited to, legal fees and expenses suffered by the Principal, where such loss, damage or injury is the result of a wrongful action, negligence or breach of this Contract by the Contractor or its agent, servants or representatives, including the use or violation of any copyright work or trademark or literary property or patented invention, article or appliance.

65. Contractor's Acknowledgement

65.1 The Contractor acknowledges that before entering into this Contract, the Contractor was given a copy of the Contract and was advised of the right to seek independent advice on its terms and was given reasonable opportunity to take such advice.

65.2 The Contractor now signs this Contract in agreement to all the terms and conditions set out herein.

66. Counterparts

66.1 The parties may execute this Contract in multiple counterparts, each of which constitute an original and all of which collectively, constitute only one agreement. The signatures of the Parties need not appear on the same counterpart, and delivery of an executed counterpart signature page by facsimile is as effective as executing and delivering this Contract in the presence of the other Party to this Contract. This Contract is effective upon delivery of one executed counterpart from each Party to the other Party.

66.2 This clause shall not apply if counterpart signing is not required.

Section VIII - Special Conditions of Contract

Part A – Contract Data

<table>
<tr><th colspan="4">A. General</th></tr>
<tr><td></td><td colspan="3"></td></tr>
<tr><td rowspan="4">GCC 1.1 (q)</td><td colspan="3">The Principal is: The Government of the Independent State of Samoa acting by and through the Electric Power Corporation</td></tr>
<tr><td>Principal Name</td><td colspan="2">Electric Power Corporation</td></tr>
<tr><td>Address</td><td>Level 5 TATTE Building, Sogi, Apia</td><td>SAMOA</td></tr>
<tr><td>Authorised Representative</td><td colspan="2">Fonoti Perelini Fonoti
Project Manager</td></tr>
<tr><td>GCC 1.1 (r)</td><td colspan="3">The Engineer is: Jonathan Yoshida
Email: yoshidaj@epc.ws</td></tr>
<tr><td>GCC 1.1 (w)</td><td colspan="3">The Intended Completion Date for the whole of the Works shall be [12 Months] calendar days from start date.</td></tr>
<tr><td>GCC 1.1 (dd)</td><td colspan="3">The Site is located at:
Tiapapata, Samoa</td></tr>
<tr><td>GCC 1.1 (gg)</td><td colspan="3">The Start Date shall be notified in writing by the Principal</td></tr>
<tr><td>GCC 1.1 (kk)</td><td colspan="3">The Works consist of:
• excavation of site
• Commissioning and installation of new plant</td></tr>
<tr><td>GCC 2.2</td><td colspan="3">Sectional Completions are: design, mobilize, intake, headrace, headpond, penstock, power station, factory testing of equipment, installation, testing and commissioning, and defect maintenance period.</td></tr>
<tr><td>GCC 2.3(i)</td><td colspan="3">The following documents also form part of the Contract:
• Construction Program
• Methodology Statement</td></tr>
</table>

	• **~~Mobilisation Schedule~~** • **Performance Security under Clause 49.1** • **Evidence of Insurances under Clause 13.2** • **Annex E - Change Order Procedures** In addition to the above documents, also forming part of the Contract are the **Advance Payment Guarantee** (if an advance payment is made) as well as any on-demand bank guarantee submitted by the Contractor for retention money.
GCC 3.1	The language of the contract is **ENGLISH** The law that applies to the Contract is the law of the **Independent State of Samoa**
GCC 5.1	The Engineer **may not** delegate any of his duties and responsibilities.
GCC 8.1	Schedule of sub-contractors: Primary contactor to provide in bid for inclusion in contract.
GCC 13.1	The minimum insurance amounts and deductibles shall be: (a) for loss or damage to the Works, Plant and Materials: ***125% of the Contract Price, with a maximum deductible of SAT$100,000;*** (b) For loss or damage to Equipment: ***SAT$500,000 with a maximum deductible of nil;*** (c) for loss or damage to property (except the Works, Plant, Materials, and Equipment) in connection with Contract: ***SAT$250,000 with a maximum deductible of SAT$50,000; and*** (d) for personal injury or death: **(i)** of the Contractor's employees: *SAT$* ***1,000,000 with a maximum deductible of nil; and*** (ii) of other people: ***SAT$ 1,000,000 with a maximum deductible of nil.***
GCC 14.1	Site Data are: ***[insert]***
GCC 20.1	The Site Possession Date(s) shall be: ***Forty (40) days from commencement date.***
GCC 23.1 & **GCC 23.2**	Appointing Authority for the Adjudicator: **The Institute of Professional Engineers, Samoa**.
GCC 24.4	Hourly rate and types of reimbursable expenses to be paid to the Adjudicator: Rate: **SAT$250/hr.**
GCC 24.5	All disputes arising in connection with this Contract shall be settled under the Arbitration Act 1976 of Samoa ("Act") by one or more arbitrators appointed in accordance with the said Act. The place of arbitration shall be: **Apia, Samoa.**
B. Time Control	
GCC 25.1	The Contractor shall submit for approval a Program for the Works within ***fourteen (14) calendar days*** from the date of the Letter of Acceptance.

GCC 25.3	The period between Program updates is ***seven (7) calendar days*** The amount to be withheld for late submission of an updated Program is: **SAT$1,000.00**
	C. Quality Control
GCC 33.1	The Defects Liability Period is: Twelve (**12) months** from the Completion Date.
	D. Cost Control
GCC 37	The Variation of the Contract shall follow the Change Order Procedures outlined in Annex E – Change Order Procedures.
GCC 43.1	The currency of the Principal's country is: **Samoan Tala (SAT$)**
GCC 44.1	The contract ***is not*** subject to price adjustment in accordance with GCC Clause 44. Information regarding coefficients **does not** apply to this Contract.
GCC 45.1	The proportion of payments retained is: **ten percent (10%)** of the Contract price.
GCC 46.1	The rate for liquidated damage for the whole of the Works is zero-point one percent **(0.10%) of the Contract Price** per day. The maximum amount of liquidated damages for the whole of the Works is **ten percent (10*%)*** of the final Contract Price.
GCC 47.1	There shall be **no Bonus** to this Contract
GCC 48.1	An Advance Payment **will** apply The Advance Payments shall be: ***Ten percent (10%)*** of the Contract Price and shall be paid to the Contractor no later than **twenty-eight (28) calendar days** upon receipt of the Unconditional Bank Guarantee as per clause 48.1.
GCC 49.1	A Performance Security shall apply in the amount of **ten percent (10%) of the Contract Price** and in the form of an unconditional on demand Bank Guarantee. This will be presented to the Principal within ***fourteen (14) calendar days*** of the date of the Principal's Letter of Acceptance.
	E. Finishing the Contract
GCC 55.1	The date by which operating and maintenance manuals are required is: ***[twenty one calendar days (21) days]*** The date by which "as built"drawings are required is: ***Twenty One (21) calendar days prior to the issue of the Certificate of Completion. Final 'as built' drawings shall be submitted within a week after receipt of one-week review by the Principal.***
GCC 55.2	The amount to be withheld for failing to produce "as built" drawings and/or operating and maintenance manuals by the date required in GCC 55.1 is five percent (***5%)*** of the Contract Price.
GCC 56.2 (g)	A fundamental breach **applies**. If applicable the maximum number of days is: **One hundred (100)** working days (consistent with period for liquidated damages)
GCC 58.1	The percentage to apply to the value of the work not completed, representing the Principal's additional cost for completing the Works, is **hundred and twenty five percent (125%).**

ANNEX A – CONTRACTOR'S TENDER

ANNEX B – SPECIFICATIONS

[*Section VI – Principal's Requirements of the Tender document will be inserted here]*

ANNEX C – DRAWINGS

[*Section VI – Principal's Requirements, Part 3 Drawings of the Tender document will be inserted here]*

ANNEX D – BILL OF QUANTITIES

[*Section IV – Tender Forms, Completed Bill of Quantities of Successful Tenderer will be inserted here]*

ANNEX E - Change Order Procedure

1. General

This section provides samples of procedures and forms for implementing changes in the Works during the performance of the Contract in accordance with GCC 37 (Variations) of the General Conditions of Contract.

2. Change Order Log

The Contractor shall keep an up-to-date Change Order Log to show the current status of Requests for Change and Changes authorized or pending. Entries of the Changes in the Change Order Log shall be made to ensure that the log is up-to-date. The Contractor shall attach a copy of the current Change Order Log in the monthly progress report to be submitted to the Principal.

3. References for Changes

(1) Request for Change as referred to in Clause 37 of the General Conditions of Contract ("GCC") shall be serially numbered CR-X-nnn.

(2) Estimate for Change Proposal as referred to in Clause 37 of the GCC shall be serially numbered CN-X-nnn.

(3) Acceptance of Estimate as referred to in Clause 37 of the GCC shall be serially numbered CA-X-nnn.

(4) Change Proposal as referred to in Clause 37 of the GCC shall be serially numbered CP-X-nnn.

(5) Change Order as referred to in Clause 37 of the GCC shall be serially numbered CO-X-nnn.

Note:

(a) Requests for Change issued from the Principal's Home Office and the Site representatives of the Principal shall have the following respective references:

Home Office	CR-H-nnn
Site	CR-S-nnn

(b) The above number "nnn" is the same for Request for Change, Estimate for Change Proposal, Acceptance of Estimate, Change Proposal and Change Order.

a) Change Order Forms

1. Request for Change Proposal Form

[*Principal's Letterhead*]

To:[*Contractor's name and address*] Date:

Attention:[*Name and title*]

Contract Name:[*Contract name*]
Contract Number:[*Contract number*]

Dear Ladies and/or Gentlemen:

With reference to the captioned Contract, you are requested to prepare and submit a Change Proposal for the Change noted below in accordance with the following instructions within [*number*] days of the date of this letter[or on or before (*date*)].

1. Title of Change:[*Title*]
2. Change Request No./Rev.:[*Number*]
3. Originator of Change:
   Principal:[Name]
   Contractor (by Application for Change Proposal No)
4. Brief Description of Change:[*Description*]
5. Facilities and/or Item No. of equipment related to the requested Change:[*Description*]
6. Reference drawings and/or technical documents for the request of Change:
   Drawing No./Document No. *Description*
7. Detailed conditions or special requirements on the requested Change:[*Description*]
8. General Terms and Conditions:
   (a) Please submit your estimate to us showing what effect the requested Change will have on the Contract Price.
   (b) Your estimate shall include your claim for the additional time, if any, for completion of the requested Change.
   (c) If you have any critical opinion regarding the adoption of the requested Change in connection with the conformability to the other provisions of the Contract or the safety of the W or Works, please inform us of your opinion in your proposal of revised provisions.
   (d) Any increase or decrease in the work of the Contractor relating to the services of its personnel shall be calculated.
   (e) You shall not proceed with the execution of the work for the requested Change until we have accepted and confirmed the amount and nature in writing.

[*Principal's Name*]
[*Signature*]
[*Name of signatory*]
[*Title of signatory*]

2. Estimate for Change Proposal Form

[*Contractor's Letterhead*]

To:[*Principal's name and address*] Date:

Attention:[*Name and title*]

Contract Name:[*Contract name*]
Contract Number:[*Contract number*]

Dear Ladies and/or Gentlemen:

With reference to your Request for Change Proposal, we are pleased to notify you of the approximate cost of preparing the below-referenced Change Proposal in accordance with Clause 37 of the General Conditions of Contract ("GCC"). We acknowledge that your agreement to the cost of preparing the Change Proposal, in accordance with Clause 37 of the GCC, is required before estimating the cost for change work.

1. Title of Change:[*Title*]
2. Change Request No./Rev.:[*Number*]
3. Brief Description of Change:[*Description*]
4. Scheduled Impact of Change:[*Description*]
5. Cost for Preparation of Change Proposal:[*insert costs which shall be in the currencies of the Contract*]

(a) Engineering (Amount)

(i) Engineer ______ hrs x _______________ rate/hr = ______

(ii) Draftsperson ______ hrs x _______________ rate/hr = ______
Sub-total ______ hrs ______
Total Engineering Cost ______

(b) Other Cost ____________

Total Cost (a) + (b) ____________

[*Contractor's Name*]
[*Signature*]
[*Name of signatory*]
[*Title of signatory*]

3. Acceptance of Estimate Form

[*Principal's Letterhead*]

To:[*Contractor's name and address*] Date:

Attention:*[Name and title]*

Contract Name:*[Contract name]*
Contract Number:*[Contract number]*

Dear Ladies and/or Gentlemen:

We hereby accept your Estimate for Change Proposal and agree that you should proceed with the preparation of the Change Proposal.

1. Title of Change:[*Title*]
2. Change Request No./Rev.:[*Request number/revision*]
3. Estimate for Change Proposal No./Rev.:[*Proposal number/revision*]
4. Acceptance of Estimate No./Rev.:[*Estimate number/revision*]
5. Brief Description of Change:[*Description*]
6. Other Terms and Conditions: In the event that we decide not to order the Change accepted, you shall be entitled to compensation for the cost of preparation of Change Proposal described in your Estimate for Change Proposal mentioned in para. 3 above in accordance with Clause 37 of the General Conditions of Contract ("GCC").

[*Principal's Name*]
[*Signature*]
[*Name of signatory*]
[*Title of signatory*]

4. Change Proposal Form

[*Contractor's Letterhead*]

To:[*Principal's name and address*] Date:

Attention:[*Name and title*]

Contract Name:[*Contract name*]
Contract Number:[*Contract number*]

Dear Ladies and/or Gentlemen:

In response to your Request for Change Proposal No. [Number], we hereby submit our proposal as follows:

1. Title of Change:[*Name*]
2. Change Proposal No./Rev.:[*Proposal number/revision*]
3. Originator of Change: Employer:[*Name*] / Contractor:[*Name*]
4. Brief Description of Change:[*Description*]
5. Reasons for Change:[*Reason*]
6. Facilities and/or Item No. of Equipment related to the requested Change:[*Facilities*]
7. Reference drawings and/or technical documents for the requested Change: [*Drawing/Document No./Description*]
8. Estimate of increase/decrease to the Contract Price resulting from Change Proposal:

	Amount [*insert amounts in the currencies of the Contract*]
(a) Direct material	______
(b) Major construction equipment	______
(c) Direct field labor (Total hrs)	______
(d) Subcontracts	______
(e) Indirect material and labor	______
(f) Site supervision	______
(g) Head office technical staff salaries	

Process engineer	______ hrs @ _____ rate/hr	______
Project engineer	______ hrs @______ rate/hr	______
Equipment engineer	______ hrs @ _____ rate/hr	______

Procurement	______ hrs @ _____rate/hr	___________________
Draftsperson	______ hrs @ _____rate/hr	___________________
Total	______hrs	

(h) Extraordinary costs (computer, travel, etc.) ___________________

(i) Fee for general administration, % of Items ___________________

(j) Taxes and customs duties ___________________

Total lump sum cost of Change Proposal [***Sum of items (a) to (j)***]

Cost to prepare Estimate for Change Proposal [***Amount payable if Change is not accepted***]

9. Additional time for Completion required due to Change Proposal

10. Effect on the Functional Guarantees

11. Effect on the other terms and conditions of the Contract

12. Validity of this Proposal: within [Number] days after receipt of this Proposal by the Employer

13. Other terms and conditions of this Change Proposal:

(a) You are requested to notify us of your acceptance, comments or rejection of this detailed Change Proposal within [Number] days from your receipt of this Proposal.

(b) The amount of any increase and/or decrease shall be taken into account in the adjustment of the Contract Price.

(c) Contractor’s cost for preparation of this Change Proposal:[. . . .***insert amount. This cost shall be reimbursed by the Principal in case of Principal’s withdrawal or rejection of this Change Proposal without default of the Contractor in accordance with Clause 37 of the General Conditions of Contract***]

[***Contractor's Name***]
[***Signature***]
[***Name of signatory***]
[***Title of signatory***]

5. Change Order Form

[*Principal's Letterhead*]

To:*[Contractor's name and address]* Date:

Attention:*[Name and title]*

Contract Name:*[Contract name]*
Contract Number:*[Contract number]*

Dear Ladies and/or Gentlemen:

We approve the Change Order for the work specified in the Change Proposal (No. [*number*]), and agree to adjust the Contract Price, Time for Completion and/or other conditions of the Contract in accordance with Clause 37 of the General Conditions of Contract ("GCC").

1. Title of Change:[*Name*]
2. Change Request No./Rev.:[*Request number/revision*]
3. Change Order No./Rev.:[*Order number/revision*]
4. Originator of Change: Principal:[*Name*] / Contractor:[*Name*]
5. Authorized Price:

   Ref. No.:[*Number*] Date:[*Date*]

   Foreign currency portion [*Amount*]plus Local currency portion [*Amount*]
6. Adjustment of Time for Completion

   None Increase [*Number*] days Decrease [*Number*] days
7. Other effects, if any

Authorized by:____ Date:_______________
Principal

Accepted by:____ Date:_______________
Contractor

6. Pending Agreement Change Order Form

[*Principal's Letterhead*]

To:*[Contractor's name and address]* Date:

Attention:*[Name and title]*

Contract Name:*[Contract name]*
Contract Number:*[Contract number]*

Dear Ladies and/or Gentlemen:

We instruct you to carry out the work in the Change Order detailed below in accordance with GC Clause 39 of the General Conditions.

1. Title of Change:[*Name*]
2. Principal's Request for Change Proposal No./Rev.:[*number/revision*] dated:[*date*]
3. Contractor's Change Proposal No./Rev.:[*number/revision*] dated:[*date*]
4. Brief Description of Change:[*Description*]
5. Facilities and/or Item No. of equipment related to the requested Change:[*Facilities*]
6. Reference Drawings and/or technical documents for the requested Change:
   [*Drawing/Document No. / Description*]
7. Adjustment of Time for Completion:
8. Other change in the Contract terms:
9. Other terms and conditions:

[*Principal's Name*]

[*Signature*]

[*Name of signatory*]

[*Title of signatory*]

7. Application for Change Proposal Form

[***Contractor's Letterhead***]

To:[***Principal's name and address***] Date:

Attention:[***Name and title***]

Contract Name:[***Contract name***]
Contract Number:[***Contract number***]

Dear Ladies and/or Gentlemen:

We hereby propose that the below-mentioned work be treated as a Change in the Facilities.

1. Title of Change:[***Name***]
2. Application for Change Proposal No./Rev.:[***Number/revision***] dated:[***Date***]
3. Brief Description of Change:[***Description***]
4. Reasons for Change:
5. Order of Magnitude Estimation (amount in the currencies of the Contract):[***Amount***]
6. Scheduled Impact of Change:
7. Effect on Functional Guarantees, if any:
8. Appendix:

[***Contractor's Name***]

[***Signature***]

[***Name of signatory***]

[***Title of signatory***]

Section IX - Contract Forms

This Section contains forms which, once completed, will form part of the Contract. The forms for Performance Security and Advance Payment Security, when required, shall only be completed by the successful Tenderer after contract award.

Table of Forms

Letter of Acceptance

[on letterhead paper of the** Principal**]

. . . . ***[date]***. . . . . .

To: . . . . ***[name and address of the Contractor]*** . . . .

Subject: . . . . ***[Notification of Award Contract No]***. . . . .

This is to notify you that your Tender dated . . .. ***[insert date] . .*** .. for execution of the . . . . ***[insert name of the contract and identification number, as given in the Appendix to Tender]*** . . . . for the Accepted Contract Amount of the equivalent of . . . . ***. [insert amount in numbers and words and name of currency]***, as corrected and modified in accordance with the Instructions to Tenderers is hereby accepted by our Agency.

You are requested to furnish the Performance Security within twenty eight (28) **calendar days** in accordance with the Conditions of Contract, using for that purpose the Performance Security Form included in **Section IX - Contract Forms** of the Tender Documents.

[Choose one of the following statements:]

We accept that ___________________________ ***[insert the name of Adjudicator proposed by the Tenderer]*** be appointed as the Adjudicator.

[or]

We do not accept that ________________________***[insert the name of the Adjudicator proposed by the Tenderer]*** be appointed as the Adjudicator, and by sending a copy of this Letter of Acceptance to the President of the Institute of Professional Engineers Samoa the Appointing Authority, we are hereby requesting such Authority to appoint the Adjudicator in accordance with ITT 42.1 and GCC 23.1.

Authorized Signature: ....

Name and Title of Signatory: ....

Name of Agency: ....

Contract Agreement

DATED: ____________*(day)______________(month)__________(year).*

PARTIES: **THE GOVERNMENT OF THE INDEPENDENT STATE OF SAMOA** acting by and through the **[insert]** (“Principal”);

AND: [INSERT NAME OF CONTRACTOR] **duly incorporated, whose place of business is at [Insert place] (“Contractor”).**
(collectively referred to as “the Parties”)

WHEREAS the Principal is desirous for the Contractor to [insert] (“Works”);

AND the Principal has accepted a Tender by the Contractor for the execution and completion of the Works in accordance with the terms and conditions set out in this Contract;

AND the Contractor agrees to carry out the Works at the agreed price as set out in this Contract and in accordance with terms and conditions of this Contract.

NOW THEREFORE the Principal and the Contractor (collectively “the Parties”) agree as follows:

1. *In this Contract, words and expressions shall have the same meanings as are respectively assigned to them in the Contract documents referred to, and they shall be deemed to form and be read and construed as part of this Contract.*

2. *In consideration of the payments to be made by the Principal to the Contractor as hereinafter mentioned, the Contractor covenants with the Principal to execute and complete the Works and remedy any defects therein in conformity in all respects with the provisions of the Contract.*

3. *The Principal covenants to pay the Contractor in the amount not exceeding [**INSERT CONTRACT PRICE IN WORDS**] (**INSERT CONTRACT PRICE IN FIGURES**) inclusive of VAGST and other taxes in consideration of the execution and completion of the Works in full compliance and in accordance with the terms and conditions of this Contract including but not limited to the remedying defects.*

4. *The documents forming the Contract shall comprise the following and be interpreted in the following order of priority.*
   (a) Contract Agreement;
   (b) the Letter of Acceptance;
   (c) Special Conditions of Contract (“SCC”);
   (d) General Conditions of Contract (“GCC”);
   (e) Annex A - Contractor’s Tender;
   (f) Annex B - Specifications;
   (g) Annex C - Drawings;
   (h) Annex D - Bill of Quantities;
   (i) Annex E - Change Order Procedure; and
   (i) any other documents listed in the SCC to form part of the Contract.

IN WITNESS WHEREOF, the parties hereto have caused this Contract to be signed by their duly authorized representatives the day and year first above written –

EXECUTED by [insert] responsible for the [insert])
for and on behalf of the **GOVERNMENTOF THE INDEPENDENT)**
STATE OF SAMOA (*"the Principal")*)

In the presence of:

……………………………………………….
(Witness Name & Signature)

……………………………………………….
(Witness Designation)

EXECUTED by **[INSERT SIGNATORY**] for and on behalf of the)
[INSERT CONTRACTOR] **)**

In the presence of:

……………………………………….................
(Director)

…………………………………………………….
(Director/Company Secretary

Performance Security

[Bank's Name, and Address of Issuing Branch or Office]

Beneficiary: ***[beneficiary name]***

Date: ....

Performance Guarantee No.: ....

We have been informed that . . .. ***[name of the Contractor]*** . . .. ("Contractor") has entered into Contract No. . . .. ***[reference number of the Contract]*** . . .. dated . . . . with you, for the execution of . . . . . ***[name of contract and brief description of Works]*** . . .. ("Contract").
Furthermore, we understand that, according to the conditions of the Contract, a performance guarantee is required.

[Issuing Bank to delete whichever is not applicable] We confirm that [we are a financial institution legally authorized to provide this guarantee in the Purchaser's country] [OR] [we are a financial institution located outside the Purchaser's country but have a correspondent financial institution located in the Purchaser's country that will ensure the enforceability of this guarantee. The name of our correspondent bank and contact information is as follows: [provide name, address, phone number, and email address]].

At the request of the Contractor, we . . .. ***[name of the Bank]*** . . .. hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of . . . . ***[name of the currency and amount in figures]*** [1]. . . . . . (. . .. ***[amount in words]*** . . ...) such sum being payable in the types and proportions of currencies in which the Contract Price is payable, upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation(s) under the Contract, without your needing to prove or to show grounds for your demand or the sum specified therein.

This guarantee shall expire, no later than the . . .. Day of . . . ., ... [2], and any demand for payment under it must be received by us at this office on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 458, except that subparagraph (ii) of Sub-article 20(a) is hereby excluded.

. . . .

[Signature(s)]

Note –

All italicised text is for guidance on how to prepare this demand guarantee and shall be deleted from the final document.

[1] *The Guarantor shall insert an amount representing the percentage of the Contract Price specified in the Contract and denominated either in the currency(ies) of the Contract or a freely convertible currency acceptable to the Principal.*

[2] *Insert the date twenty-eight days after the expected completion date. The Principal should note that in the event of an extension of the time for completion of the Contract, the Principal would need to request an extension of this guarantee from the Guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee. In preparing this guarantee, the Principal might consider adding the following text to the form, at the end of the penultimate paragraph: "The Guarantor agrees to a one-time extension of this guarantee for a period not to exceed [six months] [one year], in*

response to the Principal's written request for such extension, such request to be presented to the Guarantor before the expiry of the guarantee."

Advance Payment Security

[Bank's Name, and Address of Issuing Branch or Office]

Beneficiary: .... ***[Insert Name, Address and Contact details]***

Date: ....

Advance Payment Guarantee No.: ....

We have been informed that . . .. ***[name of the Contractor]*** . . .. ("Contractor") has entered into Contract No. . . .. ***[reference number of the Contract]*** . . .. dated . . . . with you, for the execution of . . . . . . ***[name of contract and brief description of Works]*** . . .. ("Contract").
Furthermore, we understand that, according to the Conditions of the Contract, an advance payment in the sum . . .. ***[name of the currency and amount in figures]*** [1]. . . . . . (. . .. ***[amount in words]*** *. . ..)* is to be made against an advance payment guarantee.

[Issuing Bank to delete whichever is not applicable] We confirm that [we are a financial institution legally authorized to provide this guarantee in the Purchaser's country] [OR] [we are a financial institution located outside the Purchaser's country but have a correspondent financial institution located in the Purchaser's country that will ensure the enforceability of this guarantee. The name of our correspondent bank and contact information is as follows: [provide name, address, phone number, and email address]].

At the request of the Contractor, we . . .. ***[name of the Bank]*** . . .. irrevocably undertake to pay you any sum or sums not exceeding in total an amount of . . .. ***[name of the currency and amount in figures] ****. . . . . . (. . .. ***[amount in words]*** *. . ..)* upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation under the Contract because the Contractor used the advance payment for purposes other than the costs of mobilisation in respect of the Works.

It is a condition for any claim and payment under this guarantee to be made that the advance payment referred to above must have been received by the Contractor on its account number . . .. ***[Contractor's account number]*** . . .. at . . .. ***[name and address of the Bank]*** . . . . . .

The maximum amount of this guarantee shall be progressively reduced by the amount of the advance payment repaid by the Contractor as indicated in copies of interim statements or payment certificates which shall be presented to us. This guarantee shall expire, at the latest, upon our receipt of a copy of the interim payment certificate indicating that eighty (80) percent of the Contract Price has been certified for payment, or on the . . . day of . . . ., ... [2], whichever is earlier. Consequently, any demand for payment under this guarantee must be received by us at this office on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 458.

. . . .

[Signature(s)].

Note –

All italicised text is for guidance on how to prepare this demand guarantee and shall be deleted from the final document.

1 The Guarantor shall insert an amount representing the amount of the advance payment denominated either in the currency(ies) of the advance payment as specified in the Contract, or in a freely convertible currency acceptable to the Principal.

2 Insert the expected expiration date of the Time for Completion. The Principal should note that in the event of an extension of the time for completion of the Contract, the Principal would need to request an extension of this guarantee from the Guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee. In preparing this guarantee, the Principal might consider adding the following text to the form, at the end of the penultimate paragraph: "The Guarantor agrees to a one-time extension of this guarantee for a period not to exceed [six months][one year], in response to the Principal's written request for such extension, such request to be presented to the Guarantor before the expiry of the guarantee.

Section X – Evaluation Forms

ADMINISTRATIVE AND TECHNICAL EVALUATION

TOTAL TENDERS RECEIVED: *Enter number received*	**TOTAL TENDERS EVALUATED:** *Enter number evaluated*	**TOTAL TENDERS DISQUALIFIED:** *Enter number disqualified*

TENDERS RECEIVED

Tenderer No	Name of Tenderer (in full including any association or JV details)	Tenderer Contact Details (name, telephone, email)	Accept or reject?
1			
2			
3			
4			
5			
6			
7			
8			

Attach details stating reasons for rejection of Tenders on initial examination

FINANCIAL EVALUATION FORM -2	REQUEST FOR TENDER NO.: *Insert RFT No.*	REQUEST FOR TENDER NAME: *Insert RFT Name:*

	RFT Requirement	Tenderer No. Compliance PASS/FAIL							
		1	2	3	4	5	6	7	8
TENDER									
1.	Submitted no later than Tender deadline?								
2.	Original, two (2) copies & CD_R submitted?								
3.	Fully completed Letter of Tender, signed by authorized signatory?								
4.	Original or certified copy of Power of Attorney to signatory?								
5.	Original or certified copy of Business Licence submitted – valid for at least six (6) months?								
6	Original or certified copy of VAGST Certificate submitted?								
7.	Tender Security provided in correct format and/or value?								
8.	Fully completed Tender Preparation Checklist?								
FINANCIAL PROPOSAL									
9.	Fully priced Bills of Quantity (BOQ) and Dayworks Schedules?								
10.	Tender Price quoted in Letter of Tender and BOQ the same?								
TECHNICAL PROPOSAL SUBMISSION									
11.	FORM PER-1 Key Personnel submitted?								
12.	FORM PER-2 SIGNED CV for EACH nominated Personnel submitted?								
13.	FORM EQ-1 Proposed Equipment submitted?								
14.	Site Organisation proposal submitted								
15.	Method Statement proposal submitted								
16.	Mobilisation Schedule proposal submitted								
17.	Construction Schedule proposal submitted								
	HAS THE TENDERER FULLY COMPLIED WITH TENDER SUBMISSION REQUIREMENTS – PASS/FAIL?								

	RFT Requirement	Tenderer Compliance PASS/FAIL							No.
QUALIFICATION CRITERIA									
18.	FORM ELI-1 – TENDERER INFORMATION SHEET submitted and completed satisfactorily?								
19.	IF APPLICABLE – FORM ELI-2 submitted for EACH additional JV Partner and completed satisfactorily?								
20.	Certified copy of Articles of Association for Tenderer attached AND for each additional JV partner if applicable?								
21.	IF APPLICABLE - Signed copy of JV agreement details as described on Form ELI-1 attached?								
22.	FORM CON-2 – History of Non-Conforming Contracts and Pending Litigation is attached and history is acceptable?								
23.	FORM CCC – List of current contract commitments attached and completed in sufficient detail?								
	DOES THE TENDERER MEET THE ELIGIBILITY AND HISTORICAL CONTRACT PERFORMANCE REQUIREMENTS – PASS/FAIL?								
24.	FORM 3.1 - Historical Financial Performance submitted and completed in detail?								
25.	Audited balance sheets of financial statements for last three (3) years submitted?								
	Does the historical financial performance represent a low risk to SWA – PASS or FAIL?								
26.	FORM FIN 3.2 - Average Annual Turnover submitted and completed in detail?								
	Does Tenderer meet minimum average annual turnover required of SAT$ *1,000,000,000.00 – 7,000,000,000.00 Amount* PASS or FAIL?								
27.	FORM FIN 3.3 – Financial Resources submitted and fully completed								
	Does Tenderer meet minimum Cash Flow								

	RFT Requirement	Tenderer Compliance PASS/FAIL							No.
	requirement of SAT$ *1,000,000,000.00 PASS* or FAIL?								
	DOES THE TENDERER SATISFY THE FINANCIAL CAPACITY AND PERFORMANCE REQUIREMENTS FOR THIS TENDER – PASS OR FAIL?								
28.	FORM EXP-4.1 General Experience over last five (5) years submitted and completed in detail?								
29.	FORM EXP 4.2 (a) Specific Experience submitted for each of at least two (2) projects of a similar nature to this Project at least 80% completed in last five (5) years with a value of at least SAT2,000,000,000.00 – 7,000,000,000.00.								
30	IF APPLICABLE – FORM EXP 4.2 (b) Specific Experience submitted and all experience criteria satisfied?								
	Tenderer reference checks - undertaken?								
	If checked are Tenderer references acceptable?								
	DOES THE TENDERER SATISFY THE EXPERIENCE REQUIREMENTS FOR THIS TENDER – PASS OR FAIL?								
	DOES THE TENDERER MEET THE ADMINISTRATIVE AND QUALIFICATION REQUIREMENTS OF THE TENDER – PASS OR FAIL?								

Approved by the Chairperson of the Tender Evaluation Committee:

Signed: ________________________________ Date: ____________________

Name:

TECHNICAL EVALUATION FORM 1	**REQUEST FOR TENDER NO.:** *Insert RFT No.*	**REQUEST FOR TENDER NAME:** *Insert RFT Name*

Attribute	**Criteria**	**Tenderer No.** (Qualified Responsive Tenderers Only) **Satisfactorily Meets Technical Proposal Criteria – PASS OR FAIL**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1.	**KEY PERSONNEL:** • Is Registered Engineer a member of IPES? • Are the other Key Personnel suitably qualified?								
2.	**PROPOSED EQUIPMENT**: • Does the Equipment proposed meet specified requirements? • Does tender clearly demonstrate that Tenderer either owns or has reasonable access to the Equipment?								
3.	**SITE ORGANISATION:** • Is the proposed organisational structure acceptable? • Are the proposed staff resources and staffing plan adequate to complete the Contract on schedule? • Are any proposed sub-contractors acceptable? • Has evidence of the sub-contractor's commitment to the Project been provided?								
4.	**METHOD STATEMENT:** • Is the Method Statement consistent with the Scope of Works and the other elements								

Attribute	Criteria	Tenderer No. (Qualified Responsive Tenderers Only) Satisfactorily Meets Technical Proposal Criteria – PASS OR FAIL							
	of the Technical Proposal? • Are realistic and achievable milestones proposed? • Are the proposed quality, reporting, environmental, health, safety and traffic management proposals acceptable?								
5.	**MOBILISATION SCHEDULE:** • Does the schedule demonstrate a clear, complete and effective plan for mobilising the proposed personnel, equipment and other facilities to site in a timely manner? • Is the schedule consistent with the other elements of the Technical Proposal?								

6.	**CONSTRUCTION SCHEDULE:** • Has an appropriate bar, Gantt or PERT/CPM chart been provided? • Does the schedule and work plan demonstrate a logical and proper sequencing of activities? • Has a critical path been demonstrated? • Does the schedule show completion of all construction work no later than the Intended Completion Date?								
	OVERALL TECHNICAL PROPOSAL – PASS OR FAIL								

Approved by the Chairperson of the Tender Evaluation Committee:

Signed: ________________________________ Date: ____________________

Name:

FINANCIAL EVALUATION FORM -1	**REQUEST FOR TENDER NO.:** *Insert RFT No.*	**REQUEST FOR TENDER NAME:** *Insert RFT Name*

Tenderer No	**Tender Price** (Technically Responsive Tenders Only)	**Deviations from quantity schedule & specifications**	**Omissions (SAT$ subtotal)**	**Correction of Arithmetical Corrections (SAT$ subtotal)**	**Nett Tender Price (SAT$)**	**RANKING (lowest = No. 1)**
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						

********Schedule attached with full details of deviations, omissions & errors for each tender evaluated as technically responsive*

Approved by the Chairman of the Tender Evaluation Committee:

Signed: ________________________________ Date: ____________________

Name:

FINANCIAL EVALUATION FORM -2 **REQUEST FOR TENDER NO.:** *Insert RFT No.* **REQUEST FOR TENDER NAME:** *Insert RFT Name*

	Criteria	**Tenderer No.** (Technically Responsive Tenders Only) **Satisfactorily Meets Financial Proposal Criteria – PASS or FAIL**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	DAYWORKS SCHEDULES: • Are rates or percentages loaded inappropriately?								
2	BILLS OF QUANTITY: • Are the preliminary and general Items front loaded inappropriately? • Are there any unit rates that are very high or very low relative to the Engineer's Estimate that may indicate a lack of understanding of the work required? • Are any such rates explained in the Technical Proposal or as notes to the Bills? • Are there any exceptions or caveats quoted by the Tenderer? (if so make separate note)								
	FINANCIAL PROPOSAL ACCEPTABLE – YES/NO?								

Approved by the Chairperson of the Tender Evaluation Committee:

Signed: ___________________________________ Date: ______________________

Name: