ENERGY FIJI LIMITED

BIDDING DOCUMENT

ENGINEERING, PROCUREMENT AND CONSTRUCTION (EPC) OF

11kV/33kV SUBSTATION

for 30MW POWER STATION AT VUDA

TENDER NO: MR 121/ 2024

INVITATION FOR BIDS

Date: 2nd April, 2024
Tender No: MR 121 / 2024

Energy Fiji Limited (EFL/"The Employer") invites sealed bids from reputable Contractors to carry out engineering, procurement, construction and commissioning of new 11kV/33kV Substation at Vuda in the Western region of the main island Viti Levu

The bidder is required to submit a bid for:

The complete Engineering, Procurement and Construction of 11kV/33kV Substation at Vuda:

All bids for the contract shall be submitted on the appropriate forms provided and shall include the completed price schedule, technical schedule and schedules of experience etc. The bid shall be on the basis of a lump sum contract based on firm prices.

Bidders may obtain further information from, and inspect and acquire the bidding documents, for Vuda Greenfield 11kV/33kV Substation at

Energy Fiji Limited
The Secretary Tender Committee
2 Marlow Street, Suva, FIJI.
Suva

The deadline for submission of bids shall be 1600hrs (local time) on Wednesday, 22nd May, 2024.

During evaluation of bids, the Employer may invite a bidder or bidders for discussions, presentations and any necessary clarification before awarding the contract price proposal.

A site visit is planned for 17th April, 2024 and 01st of May, 2024 from 11.00am Fiji Time. Interested bidders are required to inform EFL three working days in advance so appropriate time slot for site visit is arranged for all bidders. Contractors will be required to meet at the EFL's Vuda Depot in Vuda, Lautoka, Viti Levu. PPEs are mandatory for site visit (Safety Shoes, Reflector Vest and Hard Hat).

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Instructions to Bidder

1.0 Section 1

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1.2 Instructions to Bidders

A. General

1. Scope of Bid

1.1 The Energy Fiji Limited has advertised EPC tender for the Greenfield Vuda 11/33kV Substation. The Substation will have 3 x 11kV/33kV step up transformers, NER along with 33kV switchgear. Power Station will have total 30MW diesel power plant generating sets. This power station will be connected via 3 x 11kV/33kV step up transformers and into 11kV/33kV Substation where the Substation is part of this Contract.

1.2 The Energy Fiji Limited (hereinafter referred to as "the Employer"), wishes to receive bids for Engineering, Procurement, Construction and Commission of VUDA GREENFIELD 11KV/33kV Substation as defined in these bidding documents (hereinafter referred to as "the Works").

1.3 The successful bidder will be expected to complete the Works within 18 months from the date of commencement of the Works. The works should be completed by January 2026.

2. Source of Funds

2.1 Energy Fiji Limited has a capital works program which is self-funded and intends to use part of the funds for the contract ("the Contract") for which this Invitation to Bid is issued.

3. Eligible Bidders

3.1 This invitation is open to all Bidders who have sound Financial Background, and have previous experience in handling such turnkey projects. Bidders shall have completed at least four (4) 11kV/33kV or higher voltage Substation or Substation development projects in the last four years.

3.2 Bidders shall provide such evidence of their continued eligibility satisfactory to the Employer as the Employer shall reasonably request.

3.3 Bidders shall not be under a declaration of ineligibility for corrupt or fraudulent practice.

4. Eligible Materials, Equipment and Services

4.1 The materials, plant, equipment, and services to be supplied under the Contract shall have their origin from reputable companies as specified by EFL and from various countries and all expenditures made under the Contract will be limited to such materials, plant, equipment, and services. Upon request, bidders may be required to provide evidence of the origin of materials, equipment, and services.

4.2 For purposes of Sub-Clause 4.1 above, "services" means the works and all project-related services including design services.

4.3 For purposes of Sub-Clause 4.1 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 commercial recognized product results that is substantially different in basic characteristics or in purpose or utility from its components.

4.4 The materials, plant, equipment and services to be supplied under the Contract shall not infringe or violate any industrial property or intellectual property rights or claim of any third party.

5. Qualification of the Bidder

5.1 To be qualified for award of Contract, bidders shall:

(a) Submit a written power of attorney authorizing the signatory of the bid to commit the bidder; and
(b) Specify joint venture memberships, certification and qualification as equipment manufacturer, financial capability, technical capability, supplies and installation facilities with comparable technical parameters, manufacturing and installation capability, work in hand, future commitments and current litigation.
(c) Submit proposals regarding work methods, scheduling and resourcing which shall be, provided in sufficient detail to confirm the bidder’s capability to complete the works in accordance with the specifications and the time for completion.

5.2 Bids submitted by a joint venture of two or more firms as partners shall comply with the following requirements:

(a) the bid, and in case of a successful bid, the Form of Contract Agreement, shall be signed so as to be legally binding on all partners;
(b) one of the partners shall be authorized to be in charge; and this authorization shall be evidenced by submitting a power of attorney signed by legally authorized signatories of all the partners;
(c) the partner in charge shall be authorized to incur liabilities, receive payments and receive instructions for and on behalf of any or all partners of the joint venture and the entire execution of the Contract;
(d) all partners of the joint venture shall be jointly and severally liable for the execution of the Contract in accordance with the Contract terms, and a relevant statement to this effect shall be included in the authorization mentioned under (b) above as well as in the

Bid Form and the Form of Contract Agreement (in case of a successful bid); and

(e) a copy of the agreement entered into by the joint venture partners shall be submitted with the bid.

5.3 Bidders shall also submit proposals of work methods and schedule in sufficient detail to demonstrate the adequacy of the bidders' proposals to meet the Employer's Requirements and the completion time referred to in Sub-Clause 1.3 above.

6. One Bid per Bidder

6.1 Each bidder shall submit only one bid either by itself, or as a partner in a joint venture. A bidder who submits or participates in more than one bid will cause all those bids to be rejected.

7. Cost of Bidding

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

8. Site Visit

8.1 The bidder is advised to visit and examine the Site of Works and its surroundings and obtain for itself on its own responsibility all information that may be necessary for preparing the bid and entering into a contract for the design-build and completion of the Works. The costs of visiting the Site shall be at the bidder's own expense. The pre-bid meeting is scheduled on Wednesday 17th of April and 1st of May at 11.00am at the EFL Vuda Substation, Lautoka.

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

B. Bidding Documents

9. Content of Bidding Documents

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

	Invitation for Bids
Section 1	Instructions to Bidders
Section 2	Part I - General Conditions
Section 3	Part II - Conditions of Particular Application
Section 4	Employer's Requirements
Section 5	Forms of Proposals and Appendices
Section 6	Sample Forms
Section 7	Schedule of Prices
Section 8	Supplementary Information
Section 9	Drawings

9.2 The bidder is expected to examine carefully the contents of the Bidding documents. Failure to comply with the requirements of bid submission will be at the bidder's own risk. Pursuant to Clause 29, bids which are not substantially responsive to the requirements of the bidding documents will be rejected.

10. Clarification of Bidding Documents

10.1 A prospective bidder requiring any clarification of the bidding documents may notify the Employer in writing by Email (hereinafter the term “Email" is deemed to include electronic transmission. The Prospective bidder is to email at the Employer's address indicated in the Invitation for Bids. The Employer will respond to any request for clarification which it receives earlier than 10 days prior to the deadline for submission of bids. Copies of the Employer's response, including a description of the inquiry, will be forwarded to all purchasers of the bidding documents.

11. Amendment of Bidding Documents

11.1 At any time prior to the deadline for submission of bids, the Employer may, for any reason, whether at its own initiative or in response to a clarification requested by a prospective bidder, modify the bidding documents by issuing addenda.

11.2 Any addendum thus issued shall be part of the bidding documents pursuant to Sub-Clause 9.1, and shall be communicated in writing or by fax to all purchasers of the bidding documents. Prospective bidders shall acknowledge receipt of each addendum by email and fax to the Employer.

11.3 To afford prospective bidders reasonable time in which to take an addendum into account in preparing their bids, the Employer may extend the deadline for submission of bids, in accordance with Clause 23.

C. Preparation of Bids

12. Language of Bid

12.1 The bid, and all correspondence and documents related to the bid, exchanged between the bidder and the Employer shall be typed and written in the English language. **No hand written bids will be accepted.**

13. Documents Comprising the Bid

13.1 The bid submitted by the bidder shall containing both the technical proposal and the financial proposal.

13.2 The technical proposal shall contain the following:

- (i) Bid Form for Technical Proposal and Appendix to Technical Proposal;
- (ii) Form of Bid Security;
- (iii) Power of Attorney;
- (iv) Information on Qualification;
- (v) Confirmation of Eligibility;
- (vi) Schedule of Major Items of Equipment;
- (vii) Schedule of Manufacturers, Place of Manufacture and Testing
- (viii) Schedule of Technical Particulars & Guarantees
- (ix) Schedule of Time for Delivery & Completion and Contract completion times;
- (x) Schedule for Departures from Specification;
- (xi) Schedule of Manufacturers & Subcontractors Statement of Experience;
- (xii) Schedule of Bidders Tools & Equipment;
- (xiii) Schedule of Contractors Health & Safety Plan;
- (xiv) Schedule of Other Documents and Drawings to be submitted with the bid;
- (xv) Any other materials required to be completed and submitted by bidders in accordance with these Instructions to Bidders;
- (xvi) Schedule of Work Programme
- (xvii) Schedule of Bidder's Statement of Experience
- (xviii) Schedule of Financial Information
- (xix) Schedule of Bio Data for Bidder's Personnel to be engaged in Project

13.3 The Financial proposal shall contain the following

- (i) Bid Form for Price Proposal and Appendix to Price Proposal;
- (ii) Schedules of Prices (as per Section 7, Part I):
  - I. Design, Drawings and Documentation
  - II. Plant and Equipment, including Mandatory Spare Parts Supplied;
  - III. Civil Works, Installation and Other Services;
  - IV. Grand Summary; and

V. Recommended Spare Parts.

(iii) Any other materials required to be completed and submitted by bidders in accordance with these Instructions to Bidders.

14. Bid Form and Price Schedules

14.1 The Bidder shall complete the Bid Form and the appropriate Price Schedules furnished in the bidding documents in the manner and detail indicated therein, following the requirements of Clauses 15 and 16.

15. Bid Prices

15.1 Unless specified otherwise in Employer's Requirements, Bidders shall quote for the entire facilities on a "single responsibility" basis such that the total bid price covers all the Contractor's obligations mentioned in or to be reasonably inferred from the bidding documents in respect of the design, manufacture, including procurement and subcontracting (if any), delivery, construction, installation and completion of the facilities. This includes all requirements under the Contractor's responsibilities for testing, pre-commissioning and commissioning of the facilities and, where so required by the bidding documents, the acquisition of all permits, approvals and licenses, etc., operation maintenance and training services and such other items and services as may be specified in the bidding documents, all in accordance with the requirements of the Conditions of Contract.

15.2 Bidders shall give a breakdown of the prices in the manner and detail called for in the Schedules of Prices.

15.3 In the Schedules, Bidders shall give the required details and a breakdown of their prices, including all taxes, duties, levies, and charges payable in the Employer's country as of twenty eight (28) days prior to the deadline for submission of bids, as follows:

(a) Design including all necessary drawings and documentation for the Work.

(b) Plant and equipment to be supplied from outside the Employer's country (Schedules of Prices: II) shall be quoted on a DDU to Site. In addition, estimated ocean freight charges, local transport, insurance, installation charges, the FOB price and import duties and taxes shall also be indicated separately in foreign currency and in local currency.

(c) Civil Works, Installation and Other Services shall be quoted separately in Fijian Dollars (Schedules of Prices: III) and shall include rates or prices for all labour, contractor's equipment, temporary works, materials, consumables and all matters and things of whatsoever nature, including

local transportation, operations and maintenance services, the provision of operations and maintenance manuals, training, etc. where identified In the bidding documents, as necessary for the proper execution of the Civil Works, Installation and Other Services.

(d) Recommended spare parts shall be quoted separately (Schedules of Prices: V) as specified in either subparagraph (b) or (c) above in accordance with the origin of the spare parts. It will assumed that the requested spares will be provided if not quoted.

(e) Tenderers are strongly advised to check with the Fiji Islands Revenue and Customs Services, Lot 1 Corner of Queen Elizabeth Drive ,Nasese, Ratu Sukuna Rd, Suva, regarding income tax and corporate tax which may become payable in Fiji, and to make particular note of arrangements and procedures which are necessary because of the existence or nonexistence of taxation agreements between Fiji and other countries. Tel No. (679) 3301551 Fax No. (679) 3315537

(f) Services shall include rates or prices for all labour, contractor's equipment, materials, consumables and all matters and things of whatsoever nature, the provision of operations and maintenance manuals, training, etc. where identified In the bidding documents, as necessary for the proper execution of the Installation works and Other Services.

15.4 The term DDU shall be governed by the rules prescribed in the current edition of "Incoterms", published by the International Chamber of Commerce, Paris.

15.5 Prices quoted by the bidder shall be on a fixed lump sum basis and shall not be adjusted for changes in the cost of labour, material or other matters except only for changes in legislation in accordance to Sub-Clause 13.16 of the General Conditions of Contract.

16. Bid Currencies

16.1 Prices shall be quoted in the following currencies:

(a) the prices shall be quoted in the Fijian currency and either in the currency of the bidder's home country, or in Australian and New Zealand Dollar Currency:

(b) A bidder expecting to incur a portion of its expenditures in the performance of the Contract in more than one currency, and wishing to be paid accordingly, shall so indicate in its Bid; and.

(c) If some of the contract expenditures related to Civil Works, Installation and Other Services pursuant to Clause 15.3(d) are to be incurred in the Employers country, such expenditures shall be quoted in Fijian dollars.

16.2 Bidders shall indicate their expected foreign currency requirements in the Appendix to Price Proposal.

16.3 Bidders may be required by the Employer to clarify their local and foreign currency requirements, and to substantiate that the amounts included in the Schedule of Prices and shown in the Appendix to Price Proposal are reasonable and responsive to Sub-Clause 15.1 in which case a detailed breakdown of its foreign currency requirements shall be provided by the bidder.

16.4 During the progress of the Works, the foreign currency portions of the outstanding balance of the Contract Price may be adjusted by agreement between the Employer and the Contractor to reflect any changes in foreign currency requirements for the Contract, in accordance with Clause 13.15 of the Conditions of Particular Application. Any such adjustment shall be effected by comparing the amounts quoted in the bid with the amounts already used in the Works and the Contractor's future needs for imported items.

17. Bid Validity

17.1 Bids shall remain valid for a period of **180 days** from the date of Deadline for Submission of Bids specified in Sub-Clause 26.1.

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

18. Bid Security

18.1 No bid security required as part of submission.

19. Alternative Proposals by Bidders

19.1 Bidders wishing to offer other alternatives to the Employer's Requirements of the bidding documents must first price the Employer's Requirements as described in the bidding documents and shall further provide all information necessary for a complete evaluation of the alternative by the Employer, including drawings, design calculations, technical specifications, breakdown of prices, and proposed construction methods. Only the technical alternatives, if any, of the lowest evaluated bidder conforming to the basic technical requirements shall be considered by the Employer.

20. Pre-Bid Meeting

20.1 The bidder or its official representative is invited to attend a pre-bid meeting which will take place at:

EFL Vuda Depot, Lautoka on Wednesday 17th of April and 01st of July at 11.00am

Bidders are required to attend a meeting at any one time out of the two scheduled site visits.

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

20.4 The bidder is requested to submit any questions in writing or by email, to reach the Employer not later than one week before the meeting.

20.5 Minutes of the meeting, including the text of the questions raised and the responses given, will be transmitted without delay to all purchasers of the bidding documents. Any modification of the bidding documents listed in Sub-Clause 9.1 which may become necessary as a result of the pre-bid meeting shall be made by the Employer exclusively through the issue of an Addendum pursuant to Clause 11 and not through the minutes of the pre-bid meeting.

21. Format and Signing of Bid

21.1 The bid shall be typed in indelible ink (in the case of copies, Photostats are also acceptable) and shall be signed by a person or persons duly authorized to sign on behalf of the bidder, pursuant to Sub-Clauses 5.1 (a) or 5.2 (b), as the case may be. All pages of the bid where entries or amendments have been made shall be initialled by the person or persons signing the bid.

21.2 The bidder shall furnish information as described in the Form of Bid on commission or gratuities, if any, paid or to be paid relating to this Bid, and to Contract execution if the bidder is awarded the Contract.

D. Submission of Bids

22. Bid Submission

22.1 Bids shall be submitted in the following manner:

Bidders are requested to upload electronic copies via Tender Link by registering their interest at: https://www.tenderlink.com/efl. EFL will not accept any hard copy submission.

For further information or clarification please contact our Supply Chain Office on phone (+679) 3224360 or (+679) 9992400 or email us on tenders@efl.com.fj.

The bidders must ensure that their bid is inclusive of all Taxes payable under Fiji Income Tax Act. The lowest bid will not necessarily be accepted as the successful bid.

The Tender Bids particularly the "Price" must be typed and not hand written. Any request for the extension of the closing date must be addressed to EFL in writing three (3) working days prior to the tender closing date.

Tender Submission via email or fax will not be accepted

23. Deadline for Submission of Bids

23.1 Bids must be received by the Employer at the address specified above no later than **1600 hours (Fiji Time) Wednesday 22nd May, 2024.**

23.2 The Employer may, at its discretion, extend the deadline for submission of bids by issuing an addendum in accordance with Clause 11, in which case all rights and obligations of the Employer and the bidders previously subject to the original deadline will thereafter be subject to the deadlines extended.

24. Late Bids

24.1 Any bid received by the Employer after the deadline for submission of bids prescribed in Clause 23 will be rejected and returned unopened to the bidder.

25. Modification and Withdrawal of Bids

25.1 The bidder may modify or withdraw its bid after bid submission, provided that written notice of the modification or withdrawal is received by the Employer prior to the deadline for submission of bids.

25.2 No bid may be modified by the bidder after the deadline for submission of bids, except in accordance with Sub-Clauses 25.2 and 30.2.

E. Bid Opening and Evaluation

26. Opening of Bids

26.1 The Employer will open the bids, including modifications made pursuant to Clause 23, at the earliest suitable date and time after closing of the bids, at the following location:

Energy Fiji Limited
2 Marlow St,
Suva
Fiji

27. Process to Be Confidential

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

28. Clarification of Bids and Contacting the Employer

28.1 To assist in the examination, evaluation and comparison of bids, the Employer may, at its discretion, ask any bidder for clarification of its bid. The request for clarification and the response shall be in writing or by fax, but no change in the price or substance of the bid shall be sought, offered or permitted except as required to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the bids in, accordance with Clause 30.

28.2 Subject to Sub-clause 28.1, no bidder shall contact the Employer on any matter relating to its bid from the time of the bid opening to the time the Contract is awarded. If the bidder wishes to bring additional information to the notice of the Employer, it should do so in writing.

28.3 Any effort by the bidder to influence the Employer in the Employer's bid evaluation, bid comparison or Contract award decisions may result in the rejection of the bidder's bid.

29. Preliminary Examination of Bids and Determination of Responsiveness

29.1 Prior to the detailed evaluation of bids, the Employer will determine whether each bid (i) meets the eligibility criteria; (ii) has been properly signed; (iii) is accompanied by the required securities; (iv) is substantially responsive to the requirements of the bidding documents; (v) is conforming to Clause 15; and (vi) provides any clarification and/or substantiation that the Employer may require pursuant to Clause 28.

29.2 A substantially responsive bid is one which conforms to all the terms, conditions and requirements of the bidding

documents, without material deviation or reservation. A material deviation of reservation is one (i) which affects in any substantial way the scope, quality or performance of the Works; (ii) which limits in any substantial way, inconsistent with the bidding documents, the Employer's rights or the bidder's obligations under the Contract; or (iii) whose rectification would affect unfairly the competitive position of other bidders presenting substantially responsive bids.

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

30. Correction of Errors

30.1 Bids determined to be substantially responsive will be checked by the Employer for any arithmetic errors. Arithmetic errors will be rectified on the following basis. If there is a discrepancy between the unit rate and the total cost that is obtained by multiplying the unit rate and quantity, the unit rate shall prevail and the total cost will be corrected unless in the opinion of the Employer there is an obvious misplacement of the decimal point in the unit rate, in which case the total cost as quoted will govern and the unit rate corrected. If there is a discrepancy between the total bid amount and the sum of total costs, the sum of the total costs shall prevail and the total bid amount will be corrected.

30.2 The amount stated in the Form of Bid will be adjusted by the Employer 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 corrected amount of bid, its bid will be rejected.

31. Conversion to Single Currency

31.1 The Employer will convert the amounts in various currencies in which the Bid Price is payable to the currency of the Employer's country at the selling exchange rates officially prescribed for similar transactions as established by the Reserve Bank of Fiji on the date of opening of bids.

32. Evaluation and Comparison of Bid

32.1 The Employer will evaluate and compare only the bids determined to be substantially responsive in accordance with Clause 29.

32.2 For plant and equipment, the comparison shall be of the DDU to Site price of plant and equipment offered. The Employer's comparison will also include the costs resulting from application of the evaluation procedures described in Sub-Clause 32.4.

32.3 The Employer will carry out a detailed evaluation of the bids in order to determine whether the bidders confirm to meet the

prequalification requirements and whether the bids are substantially responsive to the requirements set forth in the bidding documents. In order to reach such a determination, the Employer will examine the information supplied by the Bidders and other requirements in the bidding documents, taking into account the following factors

(a) Qualification

(i) the determination will take into account the Bidder's updated financial technical and production capabilities and past performance; it will be based upon an examination of the documentary evidence submitted by the Bidder, pursuant to Sub-Clause 5.1(b), as well as such other information as the Employer deems necessary and appropriate; and

(ii) An affirmative determination will be a prerequisite for the Employer to continue with the evaluation of the bid; a negative determination will result in rejection of the Bidder's bid.

(b) Technical

(i) overall completeness and compliance with the Employer's Requirements; the technical merits of plant and equipment offered and deviations from the Employer's Requirements; suitability of the facilities offered in relation to the environmental and climatic conditions prevailing at the site; quality, function and operation of any process control concept included in the bid;

(ii) achievement of specified performance criteria by the facilities;

(iii) type, quantity and long-term availability of spare parts and maintenance services;

(c) Commercial

(i) the cost of all quantifiable deviation and omissions from the contractual and commercial conditions and the Employer's Requirements as identified in the bid, and other deviations and omissions not so identified;

(ii) compliance with the time schedule called for in Appendix to Bid and evidenced as needed milestone schedule provided in the bid;

(iii) the functional guarantees of the facilities offered;

(iv) The extra cost of work, services, facilities etc., required to be provided by the Employer or their parties.

(v) Fixed Lump Sum Price with zero variation

32.4 Pursuant to Sub-Clause 32.3, the following evaluation methods will be followed:

(a) Contractual and commercial deviations: The evaluation shall be based on the evaluated cost for fulfilling the Contract in compliance with all commercial, contractual and technical obligations under this bidding document. The Employer will make its own assessment of the cost of any deviations for the purpose of ensuring fair comparison.
(b) Time Schedule: The plant and equipment covered by this bidding are required to be shipped, installed, tested and commissioned and all other associated works completed within the period specified in Sub-Clause 1.2 and the Appendix to the Bid.

Bidders submitting bids which deviate from the time schedule specified will be rejected.

(c) The price of recommended spare parts quoted in Schedule of Prices shall not be considered for evaluation.
(d) Functional Guarantee of the facilities:
(e) Bidders shall state the functional guarantees (e.g. Performance, efficiency, etc.) of the proposed facilities in response to the Employer's Requirements. Plant and equipment offered shall have a minimum (or a maximum, as the case may be) level of functional guarantees specified in the Employer's Requirements to be considered responsive. Bids offering plant and equipment with functional guarantees less (or more) than the minimum (or maximum) specified shall be rejected.
(f) Work, services, facilities etc., to be provided by the Employer:
Where bids include for the undertaking of work or the provision of services or facilities by the Employer in excess of the provisions allowed for in the bidding documents, the Employer 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.

32.5 (a) Any adjustments in price which result from the above procedures shall be added, for purposes of Comparative evaluation only, to arrive at an "Evaluated Bid Price" Bid prices quoted by Bidders shall remain unaltered.

(b) The Employer reserves the right to accept or reject any variation, deviation or alternative offer. Variations, deviations, and other factors which are in excess of the requirements of the bidding documents or otherwise result in the accrual of unsolicited benefits to the Employer shall not be taken into account in bid evaluation.

(c) The estimated effect of the price adjustment provisions of the Conditions of Particular Application, applied over the period or execution of the Contract, shall not be taken into account in bid evaluation.

(d) If the bid of the successful bidder is substantially below the Employer's estimate for the Contract, the Employer may require the bidder to produce detailed price analyses to demonstrate the internal consistency of those prices. After evaluation of the price analysis, the Employer may require that the amount of the performance security set forth in Clause 38 be increased at the expense of the successful bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful bidder under the Contract.

33. Domestic Preference

33.1 No preference shall be given for domestic contractor or joint venture partners.

F Award of Contract

34. Award

34.1 Subject to Clause 35, the Employer will award the Contract to the bidder whose bid has been determined to be substantially responsive to the bidding documents and who has offered the Best Value for Money, provided that such bidder has been determined to be (i) eligible in accordance with the provisions of Clause 3; and (ii) qualified in accordance with the provisions of Clause 5.

34.2 The bidder may be required to attend meetings at the Employer's office for techno-commercial discussions prior to the signing of the Contract at no cost to the Employer.

35. Employer's Right to Accept any Bid and to Reject any or all Bids

35.1 Notwithstanding Clause 34, the Employer reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids, at any time prior to award of Contract, without thereby incurring any liability to the affected bidder or bidders or any obligation to inform the affected bidder or bidders of the grounds for the Employer's action.

36. Notification of Award

36.1 Prior to expiration of the period of bid validity prescribed by the Employer, the Employer will notify the successful bidder by fax, confirmed by registered letter, that its bid has been accepted. This letter (hereinafter and in the Conditions of Contract called the "Letter of Acceptance") shall name the sum which the Employer will pay the Contractor in consideration of the execution, completion and maintenance of the Works by the Contractor as prescribed by the Contract (hereinafter and in the Conditions of Contract called "the Contract Price").

36.2 The notification of award will constitute the formation of the Contract.

36.3 Upon the furnishing by the successful bidder of a performance security, the Employer will promptly notify the other bidders that their bids have been unsuccessful

37. Signing of Contract Agreement

37.1 At the same time that he notifies the successful bidder that its bid has been accepted, the Employer will send the bidder the Form of Contract Agreement provided in the bidding documents, incorporating all agreements between the parties.

37.2 Within 28 days of receipt of the Form of Agreement, the successful bidder shall sign the Form and return it to the Employer.

38. Performance Security

38.1 Within 28 days of receipt of the notification of award from the Employer, the successful bidder shall furnish to the Employer a performance security in an amount of 10 percent of the Contract Price in accordance with the Conditions of Contract.

The form of performance security provided in Section 6 of the bidding documents shall be used.

38.2 Failure of the successful bidder to comply with the requirements of Clauses 37 or 38 shall constitute sufficient grounds for the annulment of the award.

39. Corrupt or Fraudulent Practices

39.1 The Employer requires that the Contractor observe the highest standard of ethics during the procurement and execution of such contracts. In Pursuance of this policy, the Employer:

(a) defines, for the purposes of this provision, the terms set forth below as follows:

(i) "corrupt practice" means behaviour on the part of officials in the public or private sectors by which they improperly and unlawfully enrich themselves and/or those close to them, or induce others to do so, by misusing the position in which they are placed, and it includes the offering, giving, receiving or soliciting of anything of value to influence the action of any such official in the procurement process or in contract execution; and

(ii) "fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Employer, and includes collusive practice among bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the Employer of the benefits of free and open competition;

(b) will reject a proposal for award if it determines that the bidder recommended for award has engaged in corrupt or fraudulent practices in competing for the contract in question;

39.2 Furthermore, bidders shall be aware of the provision stated in Sub-Clause 1.16 and Sub-Clause 15.5 of the Conditions of Contract, Part II - Conditions of Particular Application.

Section 2
General Conditions of Contract

2.0 Section 2

2.1 General Conditions of Contract

FIDIC CONDITIONS OF CONTRACT

For

PLANT and DESIGN-BUILD

FOR ELECTRICAL & MECHANICAL PLANT, AND FOR BUILDING AND ENGINEERING WORKS, DESIGNED BY THE CONTRACTOR

Second Edition, 2017
A Publication of The International Federation of Consulting Engineers

Notes on the Conditions of Contract

The Conditions of Contract comprise two parts: Part I - General Conditions (Section 2 of this document), and Part II - Conditions of Particular Application (Section 3 – To be issued via an addendum).

Copies of the FIDIC Conditions of Contract can be obtained from:

FIDIC Secretariat
P.O. Box 86 1000
Lausanne 12 Switzerland
Facsimile: 41 21 653 5432
Telephone: 41 21 653 5003

Section 3
Conditions of Particular Applications

3.0 Section 3

3.1 Conditions of Particular Applications

To be confirmed via addendum

Section 4

Employer's Requirements – Part I Scope of Works

4.0 Section 4 - Employer's Requirements – Part I - Scope of Works

1.0 General Information

This contract is on a turnkey basis & includes the site survey, design, manufacture, inspecting and testing, insurance, packing for export, shipment, clearing from port, delivery to site, unloading, complete erection, finishing, painting, site testing, training and commissioning of the Plant described herein.

The Contractor shall be responsible for making good for any defective material design or workmanship for a period of twelve months after taking over. The Contractor is to co-operate with other contractors (if any) and EFL operating staff as may be necessary.

The Contractor is responsible for design, supplying and erecting all plant such that the complete function is guaranteed, without necessity for any additional works to be initiated by the Engineer, unless specifically excluded in these Bidding Documents or agreed upon in writing. That includes among others e.g.: protection and other studies, manufacture, type tests, testing at factory and at site, insurance, packing, transportation and delivery to site, erection and commissioning.

Works must fully interact with each other in every respect. Additionally, they must properly interact with any other Contractor's work as far as an interfacing is specified or mentioned herein.

In case the Contractor finds any parts of these Specifications incomplete, contradictory or defective, he shall be responsible to immediately bring this to the notice of the Employer and make a proposal for the Employer's approval, for making good such incompleteness or defect at the stage of bidding. No additional cost to the Employer shall arise out of such rectification.

Main design data given in these Specifications and general layouts of the substations are available in the Drawings.

The New Vuda 11kV/33kV Substation is a new construction and installation that is required to provide connectivity for a new 30MW power station EFL is constructing. The Contractor shall be responsible for Engineering, Procurement, Construction and Commission before hand over. It shall consist of the following mandatory main Electrical items and the contractor shall comply with the scope of works listed below:

1. 36 kV Indoor GIS type switchgear as per specifications complete with arc flash protection from Schneider (VAMP 231 series), arc vents and bus zone protection comprising of :
    - 4 Nos. Line feeder bays
    - 3 Nos. Power Transformer bays
    - 2 Nos. BUS VT (For BUS 1 & 2) and bus earth switch.
    - 2 Nos. Bus Section bay (2000A Busbar, Including Bus Section Breaker)
    - 2 Nos. Spare
2. Design and Construction of Cable trench to accommodate 10 x 3 phase 33kV Circuits to divert existing overhead 33kV lines falling in the proximity of new Power Station and Substation site. The 33kV cables will be 630MM single core Aluminum XLPE PVC Cable.
3. Provide 11kV cables, installation, testing and terminations from the three 11kV Circuit Breakers to the LV side of 3 x 11/33kV Transformers.
4. Provide 33kV cables, installation, testing and terminations from 3 x 11/33kV transformers HV side to the respective 33kV circuit breakers
5. Provide 33kV cables, installation, testing and termination for all outgoing interconnectors
6. The plants and equipment to be supplied must in line with the conceptual design submitted (refer section 9.1) for the Substation portion of the works.
7. A Substation Control Building is to be constructed followed by the installation and commissioning of all mandatory Electrical Equipment's i.e 33kV switchgear, Transformer, Protection panels, Battery, SCADA etc

8. Construction of Concrete Pad, Bund wall and blast wall for 3 x 12/15MVA transformers complete with excavation, backfilling, form works, concrete works and reinforcement bars. Construction of Triple interceptor pit and oil containment for the Transformers.
9. Construction of foundation for Neutral Earthing Resistor (NER) complete with excavation, backfilling, form works, concrete works and reinforcement bars.
10. The Substation building to have a separate battery room. 110V DC system and 415 LVAC Control panels. The 110V DC Battery Bank and Charger & LVAC system to be provided by EFL approved vendor and should be in line with the specifications herein this document.
    a. 2 Sets. X DC 110 V Maintenance free battery banks to suit – minimum capacity 600Ahr
    b. 2 Nos. 3Ø Battery charger equipment Selector switch to suit
    c. 110V DC Auto-changer over board.
    d. 110V DC Distribution board with 48 TPN
11. The substation building to have inert Gas Fire Suppression system which shall be provided and installed by the Contractor. Gas Inert fire Suppression system with NFA USA standards
12. All Protection, Metering and Control Equipment's shall be provided by the Contractor.
13. All Protection Relays, Annunciators, RTU 3555 are to be of Schweitzer Engineering Laboratories (SEL) type relays and be sourced via Frasier Engineering NZ
14. All SCADA and Communications equipment minimum DNP3.0 and IEC 68150 protocol
15. SEL3555 RTU to be provided to suit – 33kV panel and Transformer REG DA
16. 3 X REG – DA Germany Tap Changer Control from HV Power of New Zealand
17. Power and Control cables including terminations from OLEX cables from New Zealand.
18. Substation grounding and lightening protection system.
19. Substation Earthing, Earthing test and modeling by AECOM Australia
20. All Electrical, Civil and Mechanical works required for proper installation of all plant and equipment's associated with the Substation.
21. Contractor is to provide all mandatory drawings for the substation, switchgear layout, cable trenching and other mandatory drawings within one month of Contract signing.
22. Geo Tech Studies to be carried out if required.
23. List of critical and recommended Spare parts with price breakdown.
24. Contractor to cater for all the mandatory items required for Engineering, Procurement, Construction and Commissioning of the proposed Greenfield 11/33kV Substation.

1.2 Insurance

The contractor shall provide for 100% insurance cover for the equipment supply, transport and contractor's personnel, including third-party liabilities and Contractors All Risk (CAR) insurance for the equipment scope and consequential damage insurance to existing facilities due to contractor activity/negligence. They shall include the EFL and their representatives as co-insured and hold them harmless from all liabilities and claims.

1.3 Change Orders

The EFL may at any time, by written order given to the Contractor, make changes within the general scope of the Contract any one or more of the following:

a) Drawings, Designs or Specifications.
b) Where the goods that are to be furnished under the Contract needs to be modified by the EFL.
c) The method of shipment or packing.
d) The place of delivery.

If any such change causes an increase or decrease in the cost of, or the time required for the Contractor's performance of any part of the work under the Contract Price or Delivery Schedule, or both, the Contract shall accordingly be amended. Any claim by the Contractor for adjustment under this Clause must be issued to the EFL within thirty (30) days from the date of the Contractor's receipt of the EFL's change order.

1.4 Delays in the Supplier's Performance

Delivery of the Goods, installation & commissioning shall be made by the Contractor in accordance with time schedule specified by the Contractor in his tender.

An unexecuted prolonged delay by the Contractor in the performance of his delivery obligations shall render the Contractor liable for any or all of the following sanctions, damages, forfeiture of its performance security, and/or termination of the Contract for default.

If at any time during the performance of the Contract, the Contractor should encounter conditions impacting timely performance of the work. The Contractor shall immediately notify the EFL in writing of any delays, its likely duration and its cause(s). As soon as practicable after receipt of the Contractor's notice, the EFL shall evaluate the Contractor's case and determine if an extension in time for performance of the contract is justifiable. Any extension granted shall be ratified by both parties by an amendment to the Contract. Unless the extension and changes in performance has been duly authorized by the EFL in writing, the delay shall be at the Contractors risk.

1.5 Termination for Default

The EFL may, without prejudice to any other remedy for breach of Contract, by written notice of default sent to the Contractor, terminate this Contract on the following grounds:

a) If the Contractor fails to deliver any or all of the Goods within the time period(s) specified in the Contract, or any extension thereof granted by the EFL.
b) Fails to perform any other obligation(s) under the Contract.
c) If the Contractor fails to comply within a period of ten days (or any such period as the EFL may authorise in writing) after receipt of default notice from the EFL.

1.6 Applicable Law

The Contract shall be interpreted in accordance with the laws of Fiji.

1.7 Notices

Any notice given by one party to the other, pursuant to this Contract shall be sent in writing to the address specified for that purpose in the Contract.

A notice shall be effective when delivered or on the notice's effective date, whichever is later.

1.8 Acceptance or Rejection of Tender

The EFL shall not be bound to accept the lowest or any tender nor assign any reason for the rejection of a tender and reserves the right to waive any formality in the tender.

1.9 Warranty

The Contractor warrants that all Goods supplied, installed and commissioned under this Contract shall have no defect arising from material used, workmanship or from any act or omission of the Contractor, that may develop under normal use of the supplied Goods in the conditions prevailing in the country of final destination.

The Contractor shall clearly specify the Warranty period of the installed and commissioned Goods supplied under this contract and such period shall be referred to as the Warranty and shall not be any period less than 12 months or 8,000 machine operating hours, whichever comes first from the date of commissioning (Formal

or Official acceptance of the completed installation by the EFL). The contractor shall ensure that the equipment supplied under this Contract shall operate within specified guaranteed performance levels during the warranty period.

The EFL shall promptly notify the Contractor in writing of any claims arising under this Warranty. Upon receipt of such notice, the Contractor shall, with all reasonable speed, repair or replace the defective Goods or parts thereof, including transport, duty, and local Fiji charges, without any cost to the EFL.

1.10 Associated Plant Details

The given particulars elsewhere in this document are those anticipated for plant being provided under other Contracts or already existing and should be used in the preparation of the Bid. They are, however, subject to confirmation and where they are considered to have an effect on the final design of equipment being provided under this Contract, the Contractor is to obtain figures from the Engineer before proceeding with designs.

1.11 Service Conditions

The Service Conditions applicable in Fiji Islands, at the location of substation site are given below:

Daily average ambient temperature	32^0C
Max ambient temperature	40^0C
Annual average ambient temperature	30^0C
Minimum ambient temperature	5^0C
Relative Humidity	90%
Altitude	100m
Maximum Wind Speed (under cyclonic conditions)	85m/sec - gusting (under cyclonic conditions)
Isokeraunic Level	50
Seismic Level	7 on the open ended Richter scale
Average Rainfall per year	2663mm

Note: Fiji is situated in a region where cyclones are experienced frequently. All plant and equipment shall be designed and constructed to withstand these extreme conditions. All plant and equipment shall be rust proof, vermin proof and weather proof and designed to be suitable for a damp, tropical climate, which may be experienced simultaneously.

1.12 ELECTRICAL DESIGN CRITERIA

1.12.1 System Conditions

System Particulars for 33kV & 11kV system applicable in Fiji Islands are stated below:		
	33kV	*11kV*
Normal system voltage	33 kV	11 kV
System Highest voltage	36 kV	12 kV
Frequency	50 Hz	50 Hz
Earthing of Neutral point	Earthed via Neutral Earthing Resistor	Directly earthed with or without resistor

1.12.2 Power supply for electrical operation

1.0 Control /alarm /emergency	DC Voltage	110 V
2.0 Supply voltage of auxiliary equipment	AC Voltage	415/240V
3.0 Supply voltage for auxiliary equipment	DC Voltage	110V

1.12.3 Minimum Substation Clearances

Air insulated outdoor and indoor busbars and connections shall have electrical clearances as listed in the following table: -

Highest system voltages between phases	36 kV
Minimum clearance between live metal and earth	325 mm
Minimum clearance between live metal of different phases	325 mm
Minimum safety clearance between the nearest point not at earth potential of an insulator to ground(Pedestrian Access)	2300 mm
Minimum safety clearance between live metal and positions to which access is permissible with other conductive equipment	2625 mm

Clearances shall be maximum of what is outlined above or provided in Australian standard AS 2067.

1.13 Electricity, Water, Gas and Other Services

The Contractor shall at his expense, provide all electricity, water, gas and other services necessary to execute and complete the Works on site. Prevailing tariff and service connection procedure shall be applicable.

1.14 Major Plant & Material Including Spare Parts.

1.14.1 Indoor 33kV Switchgear

1.14.1.1 Feeder Bays

4 No. 1,250A, 36 kV, 31.5 kA, 3 phase GIS type circuit breaker Complete with housing panel

4 fdr No. Three phase voltage transformers, ratio to be furnished during detail engineering for Metering and Protection

4 x 3 sets of. 36 kV Current Transformers, Class and Ratio to be furnished during detail engineering for Metering and Protection.

1.14.1.2 Generating Transformer Bays comprising

3 No. 800A, 36 kV, 31.5 kA, 3 phase GIS type circuit breaker Complete with housing LV panel

3 No. Three phase voltage transformers, ratio to be furnished during detail engineering for Metering and Protection

3 x 3 sets of 36 kV Current Transformers, Class and Ratio to be furnished during detail engineering for Metering and Protection.

1.14.1.3 BUS VT and Earth Switch

2 No. BUS VT (For BUS 1 & BUS 2). Bus 1 and Bus 2 shall also have earth switch. Ratio to be furnished during detail engineering for Metering and Protection

1.14.1.4 36 kV Bus Section Bay comprising

1 No. 2000A, 36 kV, 31.5 kA, 3 phase GIS type circuit breaker Complete with housing LV panel

3 sets of. 36 kV Current Transformers, Class and Ratio to be furnished during detail engineering for Metering and Protection

1.14.2 110V DC Batteries, Chargers & Distribution Boards

2 Sets Maintenance free battery banks to suit and from EFL approved Vendor. – minimum 600 A-hr rated banks.

2 Sets Charging equipment with automatic switch-over function.

1 Set Selector switch for chargers 1 and 2. DC distribution board with automatic change over and minimum 48 circuits.

1.14.3 Others

10 Sets 33 kV Control Panel to house relays, indications and manual controls. Control panel to come complete with LED's, switches, etc.

4 set Substation with Air condition unit to suit, with cooling maintained in the event of failure of at least one unit

1 set Separate Battery room with Air condition unit to suit.

2 Sets submergible water pumps for cable trench 1 set separate trench for 415V LV cables leading to 33kV CBs, Transformers and street lighting

1 set separate trench for DC cables for 33kV CBs, Transformers and street lighting

1 set separate trench for fiber optic and communication cables

1 set separate trench for 33kV HV cables with 8 sets of cable ladder racks

All the cable terminations (33kV, 11kV, 0.415kV) are part of this scope of works. The cable termination are to suit the 33kV and 11kV terminations as required and approved by EFL.

2 Sets Arc Flash Protection System for busbar, circuit breaker and panel etc. Light and Current Arc Flash Protection With optic fibre Opto link and sensor fibre and can Initiates to trip using Overcurrent Relay Schneider VAMP 321

2 sets Arcing Vents for 33kV Switchgear

1 Set Fire protection scheme

1 set Inert gas fire protection system

1.14.4 Communications Equipment

1 Package SEL 3555RTU with all mandatory SCADA and COMMs equipment.

2 Sets Optic fiber equipment and terminations.

2 Sets Maintenance free DC battery banks to suit and from EFL approved vendor.

2 Sets Charging equipment with automatic switch-over function.

1 Set Selector switch for chargers 1 and 2. DC distribution board with automatic change over and 48 circuits.

1 set SEL 2488 GPS Clock with display unit and IRIG-B time distribution to all protection, control and metering devices

1.14.5 Substation Earthing

Substation Earthing Studies, modeling and Analysis and site audit service, testing and identification and modeling to ensure that protection systems on high voltage installations will operate appropriately during a fault and to prevent damage to Network asset and personnel using BS 7430 and IEEE80. Suitable for at least 40kA fault level.

a. Soil resistivity to assess the impedance of the soil surrounding the electrodes
b. resistance to check the integrity of the earthing system
c. continuity to ensure that all equipment is bonded together and to earth
d. connectivity to ensure all connections to plants and equipment's are connected properly with almost zero micro-ohms
e. step and touch protection as per IEEE standard
f. Grounding System including connections of all steel structures and electrical apparatus to earth mesh and grounding electrodes.

Computer modeling & design - To provide survey data on 3D computer model with a simulation of the earthing system's performance under fault conditions and the effects of changes in the system on performance. The earthing of all equipment and the provision of earthing systems, electrodes and connections shall be in accordance with the recommendations in the "Guide for safety in Substation Grounding" IEEE No. 80 and the requirements of this Chapter. Steelworks and supporting structures shall be bonded and earthed to the substation earthing system. Earth connections shall be made approximately 250 mm above the top of the finished foundation level. Connections shall be made also to the earth terminals of operating mechanisms, control cubicles and marshalling kiosks. Except where the earth connection is bonded to the steelwork, insulated clamps shall be provided for supporting the earthing connection to high level equipment and the earth screen. There shall be an extension of the earth bar system into the substation buildings for connecting to indoor switchgear, control, relay and ancillary equipment. All necessary studs, connectors and earth bars shall be provided to permit the connection of each switchboard, motor or other electrical equipment supplies under the Contract to the substation general earthing system. The provision for earthing shall be such that no reliance is to be placed on the conductivity of metal to metal joints without the use of special connectors however lightning arresters must be directly connected to the earthing grid.

1.14.5.1 Extent of Work

The Contract includes the Complete design of the substation earthing system including, connections of Plant supplied under this Contract to the main earthing system and all Site Tests as specified in this specification.

The main earth system shall be installed prior to the construction of the building, transformer and equipment foundations. The Contractor will be required to prepare installation drawings and schedules of material to be provided. These drawings and schedules shall be submitted to the Employer's Representative for approval together with calculations of step, touch and mesh potentials. The contractor shall connect the new earthing grid to the existing earthing grids if available. The Employer's Representative shall approve the position at which the connections are made and the number of connections.

1.14.5.2 Design of Earthing Systems

The grounding system shall be designed according to the guideline given in ANSI/IEEE Standard 80. The site shall be provided with earth grid of buried conductors designed for an earth fault current specified for duration of 3 second, keeping the step and touch voltages within the limits as recommended in the guide

ANSI/IEEE std. 80. The design of earth grid over the area occupied by outdoor switchgear and associated apparatus shall be based on ANSI/IEEE std. 80.

The Contractor shall carry out Site tests of the ground resistivity not later than one month after the award of the Contract and his final design of the earthing system shall be submitted and approved prior to foundation excavation works. Earthing points shall be provided by the Contractor such that the combined resistance of the earth grid and earthing points does not exceed 1 ohm, however combined resistance shall be considered for acceptance provided that the conditions recommended above are satisfied. It is the Contractor's responsibility to provide design calculations and also consider life of the plant and earthing system.

1.14.5.3 Construction of Earth Grids

The earth grids shall be of hard drawn high conductivity copper conductor, and shall be installed at a depth approved by the Employer's Representative below the ground level. After the construction of footings and foundations the area shall be backfilled. Cadweld shall be used where two earth wires are to be joined. Connections for the transformer neutrals shall be provided.

1.14.5.4 Earthing Points

The number of earthing points shall be verified by Site earth resistivity tests after the letting of the Contract. Each will consist of at least 15mm diameter copper rod electrodes, driven into undisturbed soil. Each electrode will be complete with approved non-ferrous clamps for the connection of earthing conductors and with a hardened steel tip and cap driving by means of a power hammer. Test link chambers and covers for each earthing point are to be provided and the Contractor for the approval of the Employer's Representative shall submit a drawing showing the proposed arrangement.

1.14.5.5 Connections of Earthing Points and System Neutrals

The electrodes of an earthing point shall be connected to the test link and there shall be duplicate conductors from each test link to the earth grid. Any neutral points for high voltage systems within the substation will have duplicate connections to earth grid.

Any neutral points for high voltage systems within the substation will have duplicate connections to earth grid. Conductors interconnecting the electrodes to a test link and between the test links and the earth grid will have a cross-sectional area of not less than 150 sq. mm. There will be at least two connections from each steel support etc. to the earth grid. Duplicate connections may be in the form of rings.

Earthing conductors will be of soft annealed high conductivity copper stranded in accordance with Table 4 in BS.6346. Earthing conductors will normally be buried directly in the ground but where necessary they may be cleated to walls, fixed to cable racks or laid in the cable trenches as convenient.

1.14.6 Earthing of Equipment

The frames of all electrical apparatus and the bases of all structural steelwork shall be connected by branches running to a group of equipment. All isolator bases, earth terminals and earthing switches, neutral current transformers shall be connected to the earth grid. An earth electrode, which may be part of the grid, shall be provided as near as practicable to each set of surge arresters.

Earthing of 36 kV switchgear room shall be properly performed with copper strip, which enable connection to the equipment installed in and linked to main grid with more than two wires.

1.14.6.1 Jointing and Bonding

Connections to plant and equipment shall be made using the earthing terminals specified in the Contract. Where a strip has to be drilled to fit an earth terminal the hole shall not be greater than half the width of the strip. Joints in earthing strip shall employ chemical welding or high compression joints.

1.14.7 Concrete

The Contractor shall submit not less than 4 weeks before the commencement of manufacture of preliminary trial design mixes the following information to the Employer's Representative in respect of each grade of concrete.

(1) Grade of concrete

(2) Title of particular trial mix.

(3) The grading of the aggregates.

(4) The ratio by weight of all the constituents of the concrete.

(5) The expected compacting factor and slump.

(6) Full details of the proposed site quality control.

(7) Full details of the proposed laboratory for testing.

The Contractor shall also confirm his proposed testing regime and acceptance criteria for the Preliminary Trial Mixes. If the proposals not be approved by the Employer's Representative, and then the Contractor shall comply with the paragraph on preliminary test cubes and the two following paragraphs.

At least six weeks before commencing any Concreting in the Works, the Contractor shall make trial mixes using samples of aggregates and cements typical of those to be used. If possible, the Concreting plant and the means of transport to be employed in the Works shall be used to make the trial mixes and to transport them a representative distance. A clean dry mixer shall be used to make the trial mixes and the first batch shall be discarded. Preliminary test cylinders/cubes shall be taken from the proposed mixes as follows: For each grade, a set of 6 cylinder/cubes shall be made from each of 3 consecutive batches. Three from each set of six shall be tested at an age of seven days and three at an age of 28 days. The cubes shall be made, cured, stored, transported and tested in compression in accordance with BS 1881. The test shall be carried out in a laboratory shall be approved by the Employer's Representative.

If it is proposed to use an admixture in the mix then for each grade of concrete a batch shall be made with a double dose of the additive. For each of these batches 3 cubes shall be made and one tested at 7 days and 2 at 28 days to determine the likely effect of error in dispensing. The trial design mix proportions shall be approved if the average strength of a set of 9 cubes tested at 28 days exceeded the specified characteristic compressive strength by current margin less 3.5 N/mm^2. The results of the seven-day cube tests shall be used to given an indication for future use of the strengths likely to be achieved at 28 days. They shall not be used to satisfy the 28 days preliminary test cube strength requirements.

The current margin for each particular type of concrete mix should be determined; it may be taken as having the smaller of the values given by (1) or (2).

(a) 1.64 times the standard deviation of cylinder/cube tests on at least 100 separate batches of concrete of nominally similar proportions of similar materials and produced over a period not exceeding 12 months by the same plant under similar supervision, but not less than 1/6 of the characteristic strength for concrete of grade 7, 20 or 15, or 3.75 N/mm^2 for concrete of grade 20 or above.

(b) 1.64 time the standard deviation of cube tests on at least 40 separate batches of concrete of nominally similar proportions of similar materials and produced over a period exceeding 5 days but not exceeding 6 months by the same plant under similar supervision, but not less than 1/3 of the characteristic strength for concrete of grade 7, 10 or 15, or 7.5 N/mm^2 for concrete of grade 20 or above.

Where there are insufficient data to satisfy (1) or (2) above, the margin for the initial mix design should be taken as two-thirds of the characteristic strength for concrete of grade 7, 10 or 15, or 15 N/mm^2 for concrete of grade 20 or above. This margin should be used as the current margin only until sufficient data are available to satisfy (1) or (2) above. However, when the required characteristic strength approaches the maximum

possible strength of concrete made with a particular aggregate, a smaller margin but not less than 7.5 N/mm2 may have to be permitted for the initial mix design.

At each test no cylinder/cube strength shall fall below the appropriate minimum specified in the Contractor's designs. Before commencing the Works the Contractor shall submit to the Employer's Representative for his approval full details of the mixes he proposes to use, with their anticipated average strength, which must be based on the satisfactory results of these preliminary tests. The Employer's Representative shall if he so desires be present at all preliminary tests. The Contractor shall inform the Employer's Representative of his intention to carry out such tests and the time and place of the tests at least 24 hours before they take place. Neither the mix proportions nor the source of supply of materials shall be altered without the prior approval of the Employer's Representative except that the Contractor shall adjust the proportions of the mix as required to take account of permitted variations in the materials. Such approval shall be subject to the execution, to the Employer's Representative's satisfaction, of trial mix procedures set out herein.

1.14.7.1 Ready-Mixed Concrete

Ready-mixed concrete as defined in BS 5328, which batched off the Site, may be used only with the agreement of the Employer's Representative and comply with all requirements of the Contract. The concrete shall be carried in purpose made agitators operating continuously, or truck mixers. The concrete shall be compacted and in its final position within 2 hours of the introduction of cement to the aggregates, unless a longer time is agreed by the Employer's Representative. The time of such introduction shall be recorded on the delivery note together with the weight of the constituents of each mix. When truck-mixed concrete is used, water shall be added under supervision, either at the Site or at the central batching plant, as agreed by the Employer's Representative but in no circumstances shall water be added in transit. Unless otherwise agreed by the Employer's Representative, truck mixer units and their mixing and discharge performance shall comply with the requirements of BS 5328 part 3. Earthing & Auxiliary Transformer pad shall be Reinforced concrete.

Slump Test to be carried out in Accordance with Australian Standard AS 1012 Pt 3 –(1998) in accordance with the sampling plan of Clause 4.3 and as directed by the Engineer. These tests may be carried out by suitably trained manufacture’s personnel and the manufacture shall provide all equipment’s and pay all associated cost.

The consistency of the concrete shall be such as to produce a slump under test within the range shown for the specific grade of concrete.

Consistency of the concrete shall not be adjusted by the further addition of water to the mix.

The minimum Testing Frequency for sampling concrete shall be in accordance with the frequency specified in AS 1379-1973 and shall be distributed evenly over the number of truckloads being delivered, namely;

One Truck	one sample
2-5 trucks	two samples
6-10 trucks	three samples
11-12 trucks	four samples

Each sample to consist of 3 cylinder, which are to be tested one on 7 days and two on 28 days.

1.14.8 Lightning Protection

Approved earthed screens, generally in accordance with the Tender Drawings, shall be provided to protect the equipment from direct lightning strikes. The screens shall be of stranded hard drawn copper wires of not less than 35sq.mm total cross section, or stranded galvanised steel wires of not less than 7/3.5mm cross section and connected to provide low impedance paths to earth.

The layout of the earth wires shall be such that generally, equipment's to be protected lie within areas bounded by lines drawn from the earth wire at 300 to the vertical in a plane perpendicular to the axis of the earth wire. The earth screens shall be suitable for extension to protect the substation equipment's to be

installed in future stages of development. Connections shall be made of copper strip of 30mm x 5mm cross-section between the overhead earthed screen wire and the main substation earthling system at each support. Earth wires shall be held in clamps with free, pin type joints between clamps and supports. Connections shall be provided for the terminations of the earth wires of the overhead lines including bimetal connectors where necessary.

The necessary stays, fittings and anchors shall be provided under this Contract including, if required, flying stays and additional masts to ensure clearance of not less than 9144 mm (30 ft.) over roadways for breaker or transformer removal.

6 Lot	Design and erection of lightning protection system with earth MAST.
2 Lot	Galvanised E.H.S steel wires of size 7/3.35 complete with accessories, for lightning protection of entire substation.

A complete lightning protection system for the control building shall be constructed in compliance with BS 6651. An air termination network shall be installed on the surfaces of the roofs. No part of the roofs shall be further away than 10m from the nearest horizontal protective conductor. Salient points of the structure such as air conditioning installations, vent pipes railings, gutters, and steel constructions etc. shall be connected to the network.

Down conductors shall be distributed around the outside walls of the building with a maximum distance of 20m and all main metal parts near the down conductors shall be connected there to. Each down conductor shall; be provided with test joints in such positions that periodic testing is easily possible.

All connections and joints shall be installed mechanically and electrically effective (clamped, screwed or welded) to suit the local climatic conditions.

For every building, at least, one ring of ground conductors shall be installed and interconnected.

Materials;	
Air terminations:	Tinned copper 8mm diameter
Earth terminations:	Copper 8mm diameter with lead coating minimum 1.2mm thick as protection against corrosion Ground rods:Tinned copper weld or stainless steel 3000x30mm diameter Potential equalizing bars: tinned copper 500x50x5mm All support and connections shall be made of best suitable materials.

1.14.9 Copper

Copper and copper alloys shall comply with the British Standards and approved standard relevant to the form and use for which the material is intended.

Copper components shall be placed so that neither in no case shall they come in direct contact with aluminum nor shall it be possible for water or consideration to pass off copper on to aluminum.

1.14.10 Power & Control Cables

1 Lot	All low voltage AC power cables and terminations
1 lots	4 X 3phase power 32A outside the building
3 lots	3phase 100A on the fire wall of oil filter plants
1 Lot	All DC power and control cables and terminations
1 Lot	Power and lighting cable for all works, including indoor and outdoor lighting and auxiliary supply

1.14.11 Inter-Changeability

Corresponding items or parts shall be interchangeable as far as possible.

1.14.12 Maintainability

All plant and equipment supplied under this contract shall be maintainable. The contractor in adequate number of copies shall provide all necessary tools and equipment and operations and maintenance manuals required for this purpose. All special tools shall be supplied by the Contractor in 2 sets.

1.14.13 Ventilation

Kiosks, cubicles and similar enclosed compartments shall be adequately ventilated to restrict condensation. All contactors, relay coils, etc. shall be suitably protected against corrosion and fully tropicalized.

1.14.14 Risk of Fire

All apparatus, connections and cabling shall be designed and arranged to minimize the risk of fire and any damage, which might be caused in the event of fire.

1.15 Civil Works, Installation & Other Services

1.15.1 Civil Works

1.15.1.1 Preliminary Works

Site Survey as per Technical Specifications

Sub-Soil investigation per Technical Specifications

1.15.1.2 Geotechnical Study

A detailed geotechnical study is to be conducted on the identified site to determine feasibility for the construction of 11/33kV substation, three transformer pads, NER pad, access road, fence, bund walls, fire walls, casting of HV cable trenches, laying of earth mat and laying HV cable conduits as shown on layout drawing.

1.0. The study shall be undertaken by a qualified geotechnical engineer. The said engineer will be tasked with the responsibility of undertaking the geotechnical investigations and providing the necessary geotechnical design parameters that will be used for foundation design and construction.

2.0. Samples shall be taken from a minimum of fifty (50) borings to determine soil bearing capacities. These shall be tested to determine the physical and chemical characteristics of various strata and of the ground water. A safe bearing capacity shall be determined for the purpose of foundation design. If the geotechnical engineer determines additional borings and testing are required to conclude accurate data, there will be NO COST implication to the Employer.

3.0. A report of the investigation and study carried out shall be submitted. This will serve to clearly inform of the current suitability of the on-site materials for construction of the new transformer yard and building accounting for a total designed load of 80 Tons per transformer. The study will clearly advise on the sites ability to hold up without fail the combined installation load on the green patch and issue recommendations on type of foundation design.

4.0. The report must also serve to clearly inform the Employer of any remedial works that will need to be undertaken so as to ensure the suitability of the site to hold up for the transformers without fail for its projected 60 years' of service life. Detailed excavation work specifications and drawings for all remedial works shall be submitted together with the report.

5.0. The employer's written approval is to be given prior to commencing of any remedial earth works.

6.0. The safe bearing capacity of the sub-strata may be modified at the final design stage when the full site survey and investigation have been completed and the final layout, structural details etc. agreed. No variation in contract price will be made due to any variation in the bearing capacity leading to modification of foundation design at the final design stage. Special attention shall be paid to the ground water table and chemical composition of the ground water and soil in the substation area.

7.0. The following shall be considered as a minimum requirement, assuming uniform conditions over the Site. This shall be extended if significant inconsistencies arise.

a. Depth of boreholes shall be continued up to bedrock if it does not meet the hard stratum of N-value more than 50.

b. Borehole records shall describe and indicate level of all soils encountered and indicate the natural water table level. Rock core records shall specify total core recovery, solid core recovery and quality of the rock cored.

c. Where applicable, samples of soil shall be obtained from all soil strata or at 2 meters intervals in a single stratum and tested to determine physical and chemical properties, particularly with respect to substances, which would react with concrete or other materials to be used for the foundation works.

d. Where applicable, in situ soil tests shall be completed for all soil strata or at 2 meter intervals in a single stratum. Standard Penetration test in non-cohesive soils, field vane tests in sensitive cohesive soils.

e. Ground water samples shall be obtained from each bore-hole and tested in accordance with approved practice.

f. Electrical resistivity of the soil shall be verified on four samples, in accordance with approved practice (IEEE 80-2004 : IEEE Guide for Safety in AC Substation Grounding).

1.15.1.3 Site Clearing

a. Cutting and removing all trees & shrubs.
b. Removal of Big trees, shrubs and boulders.

1.15.1.4 Site formation and up keeping

a. Cutting and filling earth.
Formation levels shall be approved by Employer's Representative. Total area required including future bays to be formed.

b. Concrete retaining structures
Concrete retaining walls
Rubble pitching work

c. Earth retaining structures
Earth Retaining walls
Rubble pitching work

d. Landscaping & Tree Planting
As required for the layout
Weed control mat

e. Surface Chipping
Area covered by the earth mat.

1.15.1.5 Landscaping

a. As required for the layout complete with concrete and crushed metal with weed mats
b. Weed control mat entire substation perimeter

1.15.1.6 Surface Chipping

a. Area covered by the earth mat.

1.15.1.7 Cable Trenches & Ducts

b. Provision shall be made for all 10 sets future cables. The future cables can be assumed to be 630MM single core Aluminum 33kV XLPE PVC Cable.

1.15.1.8 Lightning protection

Lightning protection system to IEC standard

1.15.1.9 Water supply & drainage system

a. Water supply system
Plumbing system to be connected to public water supply system as indicated in the layout (Section 9 - Single Line – Diagram & Site Drawing, 9.2). If public water system is NOT available, then organize a storage system using tank & pump.
b. Waste water sewerage system
Waste water pit, septic tank and soakage pit as per the specifications. Location of the septic tank to be furnished during detail engineering.
c. Surface water drainage system
Internal surface water drainage system shall be directed as per the Environmental Management Plan. Concrete V drainage with depth 30mm across all four sides of the fence and Substation Building

1.15.1.10 Construction of Concrete Access Roads

Construction of Concrete Access Roads and entries to the Substation & Transformer bays and ample concrete driveway to allow for a 10 wheeler entry and to reverse inside the Substation and transformer bay

a. Concrete Approach Road
b. Structures for approach road.
c. Access road and structures

1.15.1.11 Fence & Gates – to IEC standards – to be adapted according to design

1.15.1.12 External Lighting to AS/IEC standards

Shall include all Yard and Switchyard lighting on street galvanized tubular poles (minimum 10m height X 10 dual lights) with separate Daylight switch for each light. Termination accessible from the bottom terminal box. Tubular poles from INGAL or BHP Australia.

1.15.1.13 Miscellaneous Works

- Any work other than listed above.

1.15.1.14 Construction Substation Building (General)

To be as per detailed specification as mentioned herein this document.

Must have the following;

a. Switching and Control Building at Vuda.
b. Minimum 3 x 6mm thick Steel Doors
c. Aluminum sliding windows with Grills and mosquito screen with grills for flying debris during cyclones.
d. Remote motorized Roller shutter door 4m wide X 4m high 2.56mm thick colour bond
e. False steel ceiling
f. Heat insulation and water-proofing
g. Painting & Glazing
h. Water basin for the battery room
i. Separate Room for ICT communication and fibre panels
j. Room for inert gas pressure system
k. Building to have inert gas pressure system
l. Concrete Fire wall X 5m high
m. 1 x Male Toilet
n. 1 x Female Toilet
o. 1 x Uni-Sex Shower
p. 1 x Hand Basin
q. Work Station for 4 people (This to include desk & chairs)
r. AC installation in switching and control building
s. Door lock (barrel) to be provided by EFL at the time of taking over. Prior to that site security remains the responsibility of the contractor.
t. Any other works leading to scopes mentioned herein this document.

1.15.1.15 Construction of Building Services

a. Fire protection
b. Internal Lighting & small power supply services.
c. Inert Gas fire protection System
d. Any other works leading to scopes mentioned herein this document.

1.15.1.16 Civil Works, Installation & Other Services

All civil works, Installations and other services as mentioned shall be carried out by the Contractor.

The Contractor shall work with EFL and other EFL Contractors (if any) during the Construction works to ensure installation of electrical equipment is facilitated without any hindrance. The Contractor shall be required to cooperate with EFL and other EFL Contractors (if any) in developing the civil designs for the building and associated works accordingly.

1.16 Quality of Materials And Workmanship

All materials used under this contract shall be new and of the quality and class most suitable for working under the conditions specified and shall withstand the variations of temperature, atmospheric conditions arising under working conditions without distortion or deterioration or the setting up of undue stresses in

any part and also without affecting the strength and suitability of the various parts of the work which they have to perform.

All work shall be carried out and completed in a neat and professional manner to the approval of the Employer's Representative.

1.17 Standards

IEC Standards are to be adopted in general. British or Australian standards too may be applied wherever necessary. Any other national or international standard may be used if such standards are not less exacting than corresponding IEC Standard. In all instances a copy of the relevant standard adopted should be forwarded to the Engineer. All civil works should be carried out in conformity with Fiji Building Code.

The Works shall be constructed in accordance with the laws of Fiji and associated Acts and Regulations. These include:

The Electricity Act (2017) and Electricity Regulations (2019)
Building Code of Fiji
Health and Safety at Work Act – 1996
Environment Management Act and subsidiary Regulations

In order to achieve Regulatory compliance under the Electricity Act, the Works shall comply with the Electricity Regulations and AS/NZS 3000:2018 “Wiring Rules”.

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	1768	Lightning Protection
AS	1824	Insulation coordination – Definitions, principles and rules
AS	1940	The storage and handling of flammable and combustible liquids
AS	2067	High voltage Installations
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	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	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/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	60529	Degrees of protection provided by enclosures (IP Code)
AS/NZS	60898	Electrical accessories - Circuit-breakers for overcurrent protection for household and similar installations - Circuit-breakers for a.c. operation

AS	HB101	Coordination of power and telecommunications - Low Frequency Induction (LFI): Code of practice for the mitigation of hazardous voltages induced into telecommunications lines.
AS	1345	Identification of the contents of pipes, conduits and ducts
AS/NZS	2053	Conduits and fittings for electrical installations (all parts)
AS	2700	Color standards for general purpose

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	60269	Low-voltage fuses
IEC	60304	Standard colours for insulation for low frequency cables and wires
IEC	60364	Electrical installations of buildings
IEC	60934	Circuit breakers for equipment
IEC	61009	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs)
IEC	61089	Round wire concentric lay overhead electrical stranded conductors
IEC	61232	20SA/A Aluminium clad wires for electrical purposes
		British Standards (BS)
BS	EN ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles
BS	6231	Specification for PVC-insulated cables for switchgear and control gear 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.

1.18 Detailed Design of Plant and Equipment

The detailed design of plant and equipment including plant layout, civil works designs etc. shall be carried out by the contractor in accordance with acceptable standards and codes of practice.

Notwithstanding the specifications, technical schedules or plant requirements specified by the tender document, the successful contractor shall be fully responsible for ensuring that the design, manufacture or construction of all items of plant and equipment under this contract to be fully functional, compatible with each other technically and otherwise, complying with IEC and/or other relevant standards, and other safety regulations applicable, and to have the installation complete in all respects including finishing, painting, labelling etc.

The successful contractor shall from the commencement of his contract submit to the Employer's Representative, his conceptual design, detailed designs, technical submissions, design, manufacture and construction drawings, etc. for approval at each stage until the completion of the project.

The Employer's Representative will ensure that any revisions required, or in the absence of any such revisions the approval for such drawings technical submissions, designs or proposals shall be notified to the contractor within a reasonable time period.

1.19 Plant and Equipment to be supplied

All items of plant and equipment supplied under this contract shall be of proven design, manufacture and construction, and shall have been in commercial operation for at least five (5) years. Tenderer should furnish a list of past orders, indicating the type of equipment, location, country etc. in support of this. Type test certificates, or other certificates from independent international organizations may also be furnished.

The Contractor shall guarantee the availability of spare parts for all items of plant and equipment for a period of at least 15 years.

1.20 Inspection and Testing

Type test certificates shall be furnished for all items of plant and equipment with the tender. The Contractor at his cost shall carry out all routine tests as per relevant IEC or Australian standards.

The preparation of a list of commissioning tests for each item of plant and equipment will be agreed upon with the Employer's Representative at a later stage of the project. All costs of carrying out commissioning tests shall be borne by the Contractor.

The Contractor shall provide all facilities for such tests or inspections to be carried out by the EFL's representatives, and the Contractor shall meet all such costs.

1.21 Spares

The tenderer shall forward a list of manufacturer's mandatory spare parts required for operation and maintenance of the plant and equipment supplied under this contract for a period of 5 years. The cost of supply of these spare parts shall form part of the contract. The tenderer shall also forward a list of optional spare parts which shall not form part of the contract but should be shown in a separate price schedule.

The successful contractor shall ensure the availability of spare parts for operation and maintenance of all the items of equipment for a period of at least 15 years.

1.22 Technical Literature – Operations And Maintenance Manuals

Tenderers shall furnish all technical literature, including catalogues, test certificates etc. in support of plant and equipment offered by him with the tender. The successful tenderer is to interface existing and new equipment drawings and a set of original drawings.

Successful contractor shall forward 6 copies of all operations and maintenance manuals, spare parts catalogues, detailed schematic and wiring diagrams and all other documents required for satisfactory operation and maintenance of plant. The originals of the drawings in AutoCAD format are required to be handed over. As built drawings are required to be furnished in 6 copies before the works are taken over as per Clause 5.6 & 5.7 of FIDIC Document (Conditions of Contract for Plant & Design Build) second edition 2017.

During the design and manufacture stage the contractor shall submit all design calculations, design drawings, technical submissions at each stage of design or manufacture for the approval of the Employer's Representative.

The manuals shall include the following sections:

1.22.1 Plant Specification and Description

The Plant Specification and Description Section shall include the specification and description of each plant item and system.

1.22.2 Installation and Commissioning

The Installation and Commissioning Section shall include step-by-step procedures for the unloading, unpacking, transport, handling, assembly, erection, adjustment, alignment, preparation for service and testing of the plant.

1.22.3 Operation

The Operation Section shall describe in detail the procedures for the preparation into service, setting, adjusting, checking before and during operation, routine testing and operating of the plant to be supplied. It shall provide complete information on operating limitations, allowable rates of temperature change,

allowable temperature differentials and any other information required by operating staff to ensure the safe and efficient operation of the plant.

1.22.4 Maintenance

The Maintenance Section shall contain sufficient detail to enable maintenance personnel to maintain the plant in good working condition and overhaul the plant from time to time. It shall describe and include pictorial representation of step-by-step procedures for dismantling, reassembly, alignment, replacement and adjustment of all components of the plant. This Section shall also include standards of workmanship, tolerances, air gaps, electrical resistance values, limits of wear, periodic adjustments, material specifications including special procedures (e.g. heat treatment), weights of large items, details and uses of special tools, test equipment, jigs, gauges and tightening torque values for bolts.

The Tenderer shall set down recommendations for preventive or condition based maintenance, including frequency of inspection and guidance in locating and rectifying faults and condition monitoring or diagnostic testing which may be performed on a regular basis.

Similarly lubrication routines shall be specified including locations, recommended frequency and recommended type of lubricants.

1.23 Type Test Certificates

Copies of Type Test certificates for all plant and equipment shall be furnished as evidence in support of compliance with the specification.

The Contractor shall furnish copies of certificates of all routine tests, inspection tests and any other type tests, which would have to be performed at a later stage.

1.24 Site Conditions

The tenderer is required to ascertain for himself the Site Conditions, including limitations of space, geographical, climatic or other considerations. The tenderer shall satisfy himself of the suitability of the Sites for the erection of the plant and equipment to be supplied.

1.25 Site Office

The successful contractor is required to ascertain for himself the site conditions, including limitations of space, geographical, climatic or other considerations. The tenderer shall satisfy himself of the Sites for the erection of the plant and equipment to be supplied.

1.26 Packing

Equipment shall be carefully packed for transport and shipment in such a manner that it is protected from all dust and climatic conditions during loading, transport, unloading and subsequent storage in the open.

Equipment shall be suitably packed and protected against vibration, movement and shock which may occur during loading and transport. Particular care in packing shall be taken when the apparatus is transported by road.

Instruments and fragile items shall be packed separately. All items, which include delicate equipment, shall be sealed in polythene sheeting and silica gel desiccant or vapour corrosion preventive shall be inserted within the polythene packing. Straw shall not be used as packing material. The packaging should be neatly labelled to allow customs clearance if EFL has to clear the equipment. The signage on the packaging will be discussed at the time of award.

1.27 Programme And Progress Of Work

Programme

Within 14 days of acceptance of the Tender the Contractor shall provide the Employer's Representative with (2) copies of the Programme of work covering design, manufacture, delivery and erection.

The programme shall conform to the general requirements of Schedule IX unless otherwise approved by the Employer's Representative.

The programme shall separately detail each item of equipment that is to be transported and delivered separately.

Progress Reports
The programme of work shall be reviewed monthly and three copies of a comprehensive progress report shall be submitted monthly to reach the Employer's Representative by the 25th day of each calendar month or as mutually agreed If in the judgement of the Employer's Representative the situation demands, the Contractor shall report at more frequent intervals.

These reports shall include for each item of plant manufacture, delivery and erection;

(i) The status at the last reporting date
(ii) The activities completed during the period
(iii) The current status of activities and progress
(iv) The start and completion date

The Employer's Representative shall be afforded such reasonable means of access to the Contractor or his Sub Contractors as may be required to confirm progress and delivery information.

1.28 Liquidated Damages

To be confirmed.

1.29 Design Review, Inspection and Testing for all Major Equipment's of Substation

Type test certificates shall be furnished for all items of plant and equipment with the tender. The Contractor at his cost shall carry out all routine tests as per relevant IEC or other standards.

EFL will require two (2) of its representative to finalise the design with the factory Engineers at the factory offered by the successful tenderer, before approval for construction.

EFL will also require two (2) of its representative to inspect and carry out Factory Acceptance test the plant/equipment offered by the successful tenderer, before shipment, under this contract and to witness.

ALL of the type tests (if type test reports of the particular model are not provided, then they shall be carried out for the plant manufactured and supplied) including routine tests and test specified in the specification. The associated cost, including return airfare including international/domestic, accommodation, meals, and transportation from the hotel to the factory test site and airports shall be included in the tender price in the appropriate section.

All commissioning tests shall be carried out in accordance with the relevant IEC or other standards and tender specification. All tools and equipment and instruments for carrying out such tests shall be made available by the Contractor to Employer. The contractor shall provide the employer with a list of tools, equipment and test equipment required for commissioning the transformer.

The preparation of a list of pre-commissioning and commissioning tests for each item of plant and equipment will be agreed upon with the Employer's Representative at a later stage of the project. The pre-commissioning test and commissioning tests shall be carried out by the Contractor and the Employer's representative. Results of the pre-commissioning tests shall be forwarded to the Employer for approval prior to

commissioning of the transformers. All costs of carrying out the pre-commissioning and commissioning tests shall be borne by the Contractor.

The Contractor shall provide all facilities for such tests or inspections to be carried out by the EFL's representatives.

EFL preferred major Equipment's are as follows but not limited to the following;

1. 33kV Switchgears (Including CT,CVT, Protection, Metering and Control)
2. Batteries and Battery Charger
3. LVAC Distribution board
4. Structural Steel (if purchased from Overseas)

Section 4

Employer's Requirements
Part 2
33kV Indoor GIS Circuit breaker

4.0 Section 4 - Employer's Requirements - Part 2 - 33kV Indoor GIS Circuit breaker

2.0 Scope of Works

2.1 General Description

The scope of works for this contract for New Vuda 11kV/33kV Substation is for complete design, manufacture, supply, delivery, insurance to site, installation and commissioning of new 33kV indoor circuit breaker switchgears, controls and protection relay panels for the complete installation of the new switchgear.

The main items for supply and installation under the scope include:

1. 33kV Indoor switchgear at New Vuda Substation will comprise of:
   - 4 Nos Line feeder bays
   - 3 Nos Generating Transformer bays
   - 2 Nos BUS VT (For BUS 1 & 2) and bus earth switch.
   - 1 No Bus Section bay
   - 2 Nos. Bus Section bay (2000A Busbar)

2. Control, Metering, Monitoring and Protection Equipment, Arc Flash Protection System for busbar, circuit breaker and panel etc.
3. Spare Parts

The contract also covers the maintenance for the defect liability period and all other works incidental thereto, whether specified in detail or not, necessary for securing efficient operation of the 33kV switchgear and SCADA system, and associated control and SEL relay equipment for a period of 24 months.

The contractor shall also submit a design of the VAMP 321 arc flash protection system and bus zone protection to be integrated with the protection schedule for approval by the Employer's representative.

2.2 Major Plant & Material Including Spare Parts

2.2.1 Indoor 33kV Switchgear

2.2.1.1 Feeder Bays

4 No. 1,250A, 36 kV, 31.5 kA, 3 phase GIS type circuit breaker Complete with housing panel

4 No. Three phase voltage transformers, ratio to be furnished during detail engineering for Metering and Protection

4 x 3 sets of. 36 kV Current Transformers, Class and Ratio to be furnished during detail engineering for Metering and Protection.

2.2.1.2 Generating Transformer Bays comprising

3 No. 800A, 36 kV, 31.5 kA, 3 phase GIS type circuit breaker Complete with housing LV panel

3 No. Three phase voltage transformers, ratio to be furnished during detail engineering for Metering and Protection

3 x 3 sets of 36 kV Current Transformers, Class and Ratio to be furnished during detail engineering for Metering and Protection.

2.2.1.3 BUS VT and Earth Switch

2 No. BUS VT (For BUS 1 & BUS 2). Bus 1 and Bus 2 shall also have earth switch. Ratio to be furnished during detail engineering for Metering and Protection

2.2.1.4 36 kV Bus Section Bay comprising

1 No. 2000A, 36 kV, 31.5 kA, 3 phase GIS type circuit breaker Complete with housing LV panel

3 sets of. 36 kV Current Transformers, Class and Ratio to be furnished during detail engineering for Metering and Protection

2.2.2 Energy Metering

Shall be installed on the transformer 33kV panel for energy metering (local and remote). Preferred Energy meter type is Shark 200 v6.

2.2.3 Local and Remote Metering

All metering will be carried out via the SEL relays (or alternative), and additional:

a) Transformer panel Current, Circuit Voltage and Bus Voltage indicators shall be provided using and Shark 200 V6.

2.2.4 Arc Protection

Contractor shall specify the modules and the number of each that is to be used for each panel, busbar. EFL preference is VAMP 321 model.

2.3 Installation and Other Services

2.3.1 Switchgear Installation

Ten (10) GIS 33kV indoor busbar and Circuit breaker switchgear combined with Current and Voltage Transformers, Controls and protection relays as listed in the detailed specifications for Vuda Substation will be carried out by the contractor. Installation of the new switchgear will be carried out by the contractor.

2.3.2 33kV Protection Relays

Programming of the protection relay settings on the SEL relays, communications processors (SEL3555 with SEL2701 Ethernet cards), and the connection to the SCADA switches installed at Vuda 33kV Substation will be carried out by the Contractor after EFL approvals. The protection scheme design of arc protection system shall be done by the Contractor.

2.3.3 Other Services

2.3.3.1 Training on Indoor 33kV Switchgears

Basic Contents:

- Installation of switchgears.
- Testing & commissioning of switchgears.
- Testing of electrical and mechanical interlocking schemes.
- Maintenance practices for the supplied equipment as recommended by the Manufacturer
- Hands on training on test equipment, which are required for maintenance of installed equipment
- Hands on training on periodic adjustment required, and parts replacement procedure in circuit breaker mechanism.

2.4 Extent of Contract

(i) Definite Work

This Contract is suitable for Switchgear Manufacturers & includes the design, manufacture, inspecting and testing, insurance, packing for export, shipment to Lautoka Port, Transportation to Vuda site, complete erection, installation, panel wiring site testing, pre-commissioning, commissioning and training of the Plant described herein.

The Contractor shall be responsible for making good for any defective material design or workmanship for a period of twenty four (24) months after taking over. The Contractor is to co-operate with other contractors and EFL operating staff as may be necessary.

In case the Contractor finds any parts of these Specifications incomplete, contradictory or defective, he shall be responsible to immediately bring this to the notice of the Employer and make a proposal for the Employer's approval, for making good such incompleteness or defect at the stage of bidding. No additional cost to the Employer shall arise out of such rectification.

Main design data given in these Specifications and general layouts of the Substation are available in the Drawings.

2.5 Associated Plant Details

The given particulars elsewhere in this document are those anticipated for plant being provided under the contracts and should be used in the preparation of the Bid. They are, however, subject to confirmation and where they are considered to have an effect on the final design of equipment being provided under this Contract, the Contractor is to obtain figures from the Engineer before proceeding with designs.

2.6 Electrical Design Criteria

2.6.1 System Conditions

System Particulars for 33kV & 11kV system applicable in Fiji Islands are stated in the table below:

	33 kV	11 kV
Normal system voltage	33 kV	11 kV
System Highest voltage	36 kV	12 kV
Frequency	50 Hz	50 Hz
Earthing of Neutral point	Earthed through earthing Transformer	Directly earthed with or without resistor
Design Symmetrical fault level	1125 MVA	250 MVA
	40 kA	40 kA

2.6.2 Service Conditions

The Service Conditions applicable in Fiji Islands, at the location of Substation site are given below:

Daily average ambient temperature	32ºC
Max ambient temperature	50ºC
Annual average ambient temperature	30ºC
Minimum ambient temperature	30ºC
Relative Humidity	90%
Altitude	15m
Maximum Wind Speed (under cyclonic conditions)	85m/sec - gusting (under cyclonic conditions)
Isokeraunic Level	100
Seismic Level	7 on the open ended Richter scale
Average Rainfall per year	2663mm

Note: Fiji is situated in a region where cyclones are experienced frequently. All plant and equipment shall be designed and constructed to withstand these extreme conditions.

All plant and equipment shall be rust proof, vermin proof and weather proof and designed to be suitable for a damp, tropical climate, which may be experienced simultaneously.

2.6.3 Power supply for electrical operation

1.0 Control /alarm /emergency	DC Voltage	110 V
2.0 Supply voltage of auxiliary equipment	AC Voltage	415/240V
3.0 Supply voltage for auxiliary equipment	DC Voltage	110V

2.6.4 Pollution levels of Insulators and Bushings

For Grid Substations - 51.7mm/kV

2.6.5 Insulation Co-ordination

The design of plant and equipment shall be such that insulation co-ordination is provided not only between different items of plant such as transmission line, surge arrestors, transformers, circuit breakers, but also between different components of items within a particular item of equipment.

2.6.6 Inter-Changeability

Corresponding items or parts shall be interchangeable as far as possible.

2.6.7 Maintainability

All plant and equipment supplied under this contract shall be maintainable. The contractor in adequate number of copies shall provide all necessary tools and equipment and operations and maintenance manuals required for this purpose. All special tools shall be supplied by the Contractor in 2 sets.

2.6.8 Ventilation

Kiosks, cubicles and similar enclosed compartments shall be adequately ventilated to restrict condensation. All contactors, relay coils, etc. shall be suitably protected against corrosion and fully tropicalized.

2.6.9 Risk of Fire

All apparatus, connections and cabling shall be designed and arranged to minimize the risk of fire and any damage, which might be caused in the event of fire.

2.7 Quality of Materials and Workmanship

All materials used under this contract shall be new and of the quality and class most suitable for working under the conditions specified and shall withstand the variations of temperature, atmospheric conditions arising under working conditions without distortion or deterioration or the setting up of undue stresses in any part and also without affecting the strength and suitability of the various parts of the work which they have to perform.

All work shall be carried out and completed in a neat and professional manner to the approval of the Employer's Representative.

2.8 Standards

IEC Standards are to be adopted in general. British or Australian standards too may be applied wherever necessary. Any other national or international standard may be used if such standards are not less exacting than corresponding IEC Standard subject to the Employer's approval. In all instances a copy of the relevant standard adopted should be forwarded to the Engineer.

The Works shall be constructed in accordance with the laws of Fiji and associated Acts and Regulations. These include:

The Electricity Act (Chapter 180) – 1985
Health and Safety at Work Act – 1996
Environment Management Act

In order to achieve Regulatory compliance under the Fiji Electricity Act, the Works shall comply with the Electricity Regulations and AS/NZS 3000:2000 "Wiring Rules .In the absence of specific standards being nominated in the specifications, the following standards shall apply:

Australian/New Zealand Standards

AS	1154	Insulator and conductor fittings for overhead power lines
AS/NZS	1170	Structural Design Actions
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	AS/NZS 2373 Electric cables – Twisted pair for control and protection circuits
AS/NZS	2650	Common specifications for high-voltage switchgear and control gear standards
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 control gear 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/NZS	60265.1	High-voltage switches - Switches for rated voltages above 1 kV and less than 52 kV
AS	60265.2	High-voltage switches - High-voltage switches for rated voltages of 52 kV and above
AS	60529	Degrees of protection provided by enclosures (IP Code)
AS	60870	Tele-control 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	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 4 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	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	60354	Loading Guide For Oil Immersed Transformers
IEC	60364	Electrical installations of buildings
IEC	60372	Locking devices for ball and socket couplings of string insulator
IEC	60383	Insulators for overhead lines with a nominal voltage above 1000 V
IEC	60437	Radio interference test on high-voltage insulators (RFI)
IEC	60551	Determination Of Transformer And Reactor Sound Levels
IEC	60664	Insulation coordination for equipment within low-voltage systems (All Parts)
IEC	60694	Common Specifications for high-voltage switchgear and controlgear standards
IEC	60715	Dimensions of low voltage switchgear and control gear
IEC	60895	Ed. 2.0 b:2002 Live working - Conductive clothing for use at nominal voltage up to 800 kV a.c. and +/- 600 kV d.c.
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	61089	Round wire concentric lay overhead electrical stranded conductors
IEC	61232	20SA/A Aluminium clad wires for electrical purposes
IEC	61477	Ed. 1.2 b:2005 "Live working - Minimum requirements for the utilization of tools, devices and equipment"
IEC	61634	High-voltage switchgear and controlgear - Use and handling of sulphur hexafluoride (SF6) in highvoltage switchgear and controlgear
IEC	61660	Short-circuit currents in DC auxiliary installations in power plants and Power Stations
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	62285	Application guide for non-linear coefficient measuring methods
IEC	62305	Protection against Lightning

Institute of Electrical and Electronic Engineers (IEEE)

IEEE	C37.110	Guide for the Application of Current Transformers Used for Protective Relaying Purposes
IEEE	C57.13	Standard Requirements for Instrument Transformers
ANSI/IEEE	C62.1	IEEE Standard for Surge Arresters for Alternating-Current Power Circuits
ANSI/IEEE Std	100	Standard Dictionary of Electrical and Electronic Terms
ANSI/IEEE Std	100	Standard Dictionary of Electrical and Electronic Terms
ANSI/IEEE Std	1050	Guide for Instrumentation and Control Equipment Grounding in Generating Stations
ANSI/IEEE Std	1100	Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
ANSI/IEEE Std	141	Recommended Practice for Electrical Power Distribution for Industrial Plants
ANSI/IEEE Std	142	Recommended Practice for Grounding of Industrial and Commercial Power Systems
ANSI/IEEE Std	242	Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
ANSI/IEEE Std	367	Recommended Practice for Determining the Electric Power Station Ground Potential Rise and Induced Voltage from a Power Fault
ANSI/IEEE Std	399	Recommended Practice for Industrial and Commercial Power Systems Analysis
ANSI/IEEE Std	446	Recommended Practice for Emergency and Standby Power Systems
ANSI/IEEE Std	450	Recommended Practice for Maintenance, Testing and Replacement of Large Lead Storage Batteries for Generating Stations and Power Stations
ANSI/IEEE Std	665	Guide for Generating Station Grounding
ANSI/IEEE Std	80	Guide for Safety in AC Power Station 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

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.

2.9 Detailed Design of Plant And Equipment

The detailed design of plant and equipment including plant layout, protection, control, supervisory interface equipment, earthing, etc. shall be carried out by the contractor in accordance with acceptable standards and codes of practice.

Notwithstanding the specifications, technical schedules or plant requirements specified by the tender document, the successful contractor shall be fully responsible for ensuring that the design, manufacture or

construction of all items of plant and equipment under this contract to be fully functional, compatible with each other technically and otherwise, complying with IEC and/or other relevant standards, and other safety regulations applicable, and to have the installation complete in all respects including finishing, painting, labelling etc.

The successful contractor shall from the commencement of his contract submit to the Employer's Representative, his conceptual design, detailed designs, technical submissions, design, manufacture and construction drawings, etc. for approval at each stage until the completion of the project.

The Employer's Representative will ensure that any revisions required, or in the absence of any such revisions the approval for such drawings technical submissions, designs or proposals shall be notified to the contractor within a reasonable time period.

2.10 Plant and Equipment to Be Supplied

All items of plant and equipment supplied under this contract shall be of proven design, manufacture and construction, and shall have been in commercial operation for at least twenty (20) years. Tenderer should furnish a list of past orders, indicating the type of equipment, location, country etc. in support of this. Type test certificates or other certificates from independent international organizations may also be furnished.

The Contractor shall guarantee the availability of spare parts for all items of plant and equipment for a period of at least 15 years.

2.11 Design Review, Inspection and Testing

Type test certificates shall be furnished for all items of plant and equipment with the tender. The Contractor at his cost shall carry out all routine tests as per relevant IEC or other standards.

EFL will require two (2) of its representative to finalise the design with the factory Engineers at the factory offered by the successful tenderer, before approval for construction.

EFL will also require two (2) of its representative to inspect and carry out Factory Acceptance test the plant/equipment offered by the successful tenderer, before shipment, under this contract and to witness.

ALL of the type tests (if type test reports of the particular model are not provided, then they shall be carried out for the plant manufactured and supplied) including routine tests and test specified in the specification. The associated cost, including return airfare including international/domestic, accommodation, meals, and transportation from the hotel to the factory test site and airports shall be included in the tender price in the appropriate section.

All commissioning tests shall be carried out in accordance with the relevant IEC or other standards and tender specification. All tools and equipment and instruments for carrying out such tests shall be made available by the Contractor to Employer. The contractor shall provide the employer with a list of tools, equipment and test equipment required for commissioning the transformer.

The preparation of a list of pre-commissioning and commissioning tests for each item of plant and equipment will be agreed upon with the Employer’s Representative at a later stage of the project. The pre-commissioning test and commissioning tests shall be carried out by the Contractor and the Employer’s representative. Results of the pre-commissioning tests shall be forwarded to the Employer for approval prior to commissioning of the transformers. All costs of carrying out the pre-commissioning and commissioning tests shall be borne by the Contractor.

The Contractor shall provide all facilities for such tests or inspections to be carried out by the EFL’s representatives.

2.12 Tools and Equipment

The tenderer shall forward a list of tools and equipment required for operation and maintenance of the installation and include the cost of supplying such tools and equipment in the price Schedules.

2.13 Spares

The tenderer shall forward a list of manufacturer‘s mandatory spare parts required for operation and maintenance of the plant and equipment supplied under this contract for a period of 5 years. The cost of supply of these spare parts shall form part of the contract. The tenderer shall also forward a list of optional spare parts which shall not form part of the contract but should be shown in a separate price schedule.

The successful contractor shall ensure the availability of spare parts for operation and maintenance of all the items of equipment for a period of at least 15 years.

2.14 Technical Literature - Operations and Maintenance Manuals

Bidders shall furnish all technical literature, including catalogues, test certificates etc. in support of plant and equipment offered by him with the tender. The successful bidder is to interface existing and new equipment drawings and a set of original drawings.

Successful contractor shall forward 6 (six) binded hard copies of all operations and maintenance manuals, spare parts catalogues, detailed schematic and wiring diagrams and all other documents required for satisfactory operation and maintenance of plant. The originals of the drawings on CD in AutoCAD format 2018 version are required as part of hand over. As built drawings are required to be furnished in 6 copies before the works are taken over as per Clause 5.6 & 5.7 of FIDIC Document (Conditions of Contract for Plant & Design Build) Second edition 2017

During the design and manufacture stage the contractor shall submit all design calculations, design drawings, technical submissions at each stage of design or manufacture for the approval of the Employer's Representative.

The manuals shall include the following sections:

2.14.1 Plant Specification and Description

The Plant Specification and Description Section shall include the specification and description of each plant item and system.

2.14.2 Installation and Commissioning

The Installation and Commissioning Section shall include step-by-step procedures for the unloading, unpacking, transport, handling, assembly, erection, adjustment, alignment, preparation for service and testing of the plant.

2.14.3 Operation

The Operation Section shall describe in detail the procedures for the preparation into service, setting, adjusting, checking before and during operation, routine testing and operating of the plant to be supplied. It shall provide complete information on operating limitations, allowable rates of temperature change, allowable temperature differentials and any other information required by operating staff to ensure the safe and efficient operation of the plant.

2.14.4 Maintenance

The Maintenance Section shall contain sufficient detail to enable maintenance personnel to maintain the plant in good working condition and overhaul the plant from time to time. It shall describe and include pictorial representation of step-by-step procedures for dismantling, reassembly, alignment, replacement and adjustment of all components of the plant.

This Section shall also include standards of workmanship, tolerances, air gaps, electrical resistance values, limits of wear, periodic adjustments, material specifications including special procedures (eg, heat treatment), weights of large items, details and uses of special tools, test equipment, jigs, gauges and tightening torque values.

The Tenderer shall set down recommendations for preventive or condition based maintenance, including frequency of inspection and guidance in locating and rectifying faults and condition monitoring or diagnostic testing which may be performed on a regular basis.

Similarly lubrication routines shall be specified including locations, recommended frequency and recommended type of lubricants.

2.15 Type Test Certificates

Copies of Type Test certificates for all same plant and equipment shall be furnished as evidence in support of compliance with the specification.

The Contractor shall furnish copies of certificates of all routine tests, inspection tests and any other type tests, which would have to be performed at a later stage.

2.16 Site Conditions

The tenderer is required to ascertain for himself the Site Conditions, including limitations of space, geographical, climatic or other considerations. The tenderer shall satisfy himself of the suitability of the Sites for the erection of the plant and equipment to be supplied.

2.17 Packing

Equipment shall be carefully packed for transport and shipment in such a manner that it is protected from all dust and climatic conditions during loading, transport, unloading and subsequent storage in the open.

Equipment shall be suitably packed and protected against vibration, movement and shock which may occur during loading and transport. Particular care in packing shall be taken when the apparatus is transported by road.

The contractor must use install vibrator 5G rated monitors on each panel and inspect with EFL representative on arrival of shipment at Knolly St Substation.

Instruments and fragile items shall be packed separately. All items, which include delicate equipment, shall be sealed in polythene sheeting and silica gel desiccant or vapour corrosion preventive shall be inserted within the polythene packing. Straw shall not be used as packing material.

2.18 Programme And Progress Of Work

2.18.1 Programme

Within 14 days of acceptance of the Tender the Contractor shall provide the Employer's Representative with two hard copies and one soft copy of the Programme of work covering design, manufacture, delivery and erection.

The programme shall conform to the general requirements of Schedule 7 unless otherwise approved by the Employer's Representative.

The programme shall separately detail each item of equipment that is to be transported and delivered separately

2.19 Switchgear - General

This part of the Specification covers the design, ratings, testing, shipping, installation and commissioning of factory assembled, type tested 33kV switchgear. Spare parts, if required by the Bidder for operation & maintenance, shall be quoted, separately as required by the Schedules of Rates & Prices. The complete documentation, drawings, manuals, etc. shall be included in the Supply and will be subject to the approval of the Employer's Representative according to the requirements of these Specifications.

If a substantial improvement of any or all of the specified requirements expressed or implied herein is available from the Bidder, and this improved design offers economical advantages to the Employer, this should be offered as an alternative, together with the basic proposal which shall conform to the requirements of these Specifications.

2.20 Performance, Standards and Codes

The switchgear shall operate satisfactorily within its rated values in the environment specified in Part 1 of this specification. The switchgear is planned to be installed indoors (inside Substation building) with a service temperature of +50°C. Routine maintenance to any of its external components, including the protective relays and instrument transformers, shall not be required in less than five year intervals; internal components shall be maintenance-free for at least ten years.

Performance, testing and rating of the switchgear shall conform to the latest edition of all relevant IEC Publications. Bidder's proposing other than the above standards must specifically indicate the standards to which his switchgear conforms, and indicate all deviations (if any) from the above codes that affect performance and rating.

Compliance of the switchgear manufacturer and the Contractor with the provisions of this Specification does not relieve the Contractor of the responsibility of furnishing switchgear and accessories of proper design, electrically and mechanically suited to meet the operating guarantees at the specified service conditions.

The General requirements of the switchgear panels are as outlined in the table below (detailed enquiry data sheet is provided in the schedules for the bidder to fill in.

General Requirements	Description
Rated Voltage and System	36kV, 3 phase, 3 wire, 50Hz
Switchgear Type	Indoor, air insulated, metal-clad, floor mounted. Dead-front, withdrawal or fixed type Vacuum circuit breakers
Rated Lightning impulse withstand	170kV peak
Rated 1 minute power frequency withstand	70kV rms
Short circuit rms breaking current	31.5kA
Short time current duration	3s
Supply voltage of opening and closing devices and aux circuits	110V DC
Busbar Rating	2000A
Degree of enclosure protection	IPX4
Operating mechanism	Magnetic Actuator or Spring Charge type
Light and Current Arc Flash Protection	Bus bar, Circuit and Cable terminations
With optic fibre	Circuit breaker area protection
Opto link and sensor fibre	Cable area protection
Initiates to trip using Overcurrent Relay	

2.21 Design and Construction

2.21.1 Electrical Data and General Requirements

a. Electrical key data as required by this Specification are stated in Schedule of Technical Particulars for main parts of plant and equipment and in the enclosed single line diagram.

b. The switchboard, when installed and operating under the ambient conditions shall perform satisfactorily and safely under all normal and fault conditions. Even repeated operations under full rated fault conditions shall not lead to diminished performance or significantly shortened useful life of the switchgear. Arc faults caused by external reasons shall be positively confined to the originating compartment and shall not spread to other parts of the switchgear.

c. Temperature rise of current carrying parts shall be limited to the values stipulated in IEC 60694, i.e. +105°C for silver-plated contacts, +115°C for silver-plated connections, and +90°C for all other exposed parts, under rated current and the environmental conditions.

d. Lightning Impulse withstand capability and power frequency withstand capability for the entire switchboard shall be in accordance with IEC 60694, Table I.

e. Thermal rating for all current carrying parts shall be a minimum of one second for the rated symmetrical short circuit current. If the maximum short circuit time must be extended, the I2 x t value shall remain constant.

f. The auxiliary voltages as per Part 1 are to be considered for the design, in particular for the Motor control voltage, the Alarm voltage, the Close and trip voltage and the Space heater voltage.

g. The switchgear shall be of the free-standing, self-supporting, dead front design with all high voltage equipment installed inside metallic and earthed enclosures, suitably divided into individual compartments, at least for the
   - busbar system(s)
   - circuit breaker
   - cable connections
   - low voltage compartment

h. Partitions between feeder bays or panels are required to avoid fault spreading from one feeder bay or panel to the other one and to the outside.

i. The row(s) of bays or panels shall be earthed through a suitable copper bar, which is to run along the full length of the switchgear, and to be connected to the station earthing, at least at two points.

j. The erection of the switchgear shall not require any cutting, welding or drilling of material on site. Each line-up of switchgear shall be prepared for future extension on either end without any drilling, cutting or welding on the existing equipment.

k. The design shall provide for maximum levels of reliability, ease of operation and maintenance, and maximum flexibility. The possibility of field repairs and exchange of enclosure parts shall be taken into account. The panels shall be constructed identically to ensure that equivalent switchgear parts can be interchanged. Design of the switchgear must allow for the removal of individual breaker bays, or parts thereof, without disturbing the remaining bays. It shall be possible to exchange an entire feeder, with or without its busbar section, without dismantling neighbouring bays.

l. Busbars and their enclosures shall take thermal expansion of the entire switchboard into account. Suitable mounting facilities, bellows and compensators shall be provided where necessary.

2.21.2 Safety Requirements

a. The switchgear shall offer a maximum degree of safety for the operators and by-standers under all normal operating and fault conditions. In particular, it must be impossible to unwillingly, i.e. without the use of tools, touch live parts of the switchgear, or perform operations that lead to arcing faults. For mechanical protection of the switchgear elements, panels with a minimum of Protection Class IP 41 is required, i.e. enclosed and inaccessible for granular foreign bodies during normal operation and protection against vertically falling water droplets. All high voltage carrying parts shall be totally protected against contact with live parts.

b. Should internal arcing occur, the release of pressurised air or gas by suitable pressure relieve devices into the atmosphere must occur in such a way that personnel standing at the operating position of the switchgear will not be injured. Furthermore, no part of the enclosure or any loose parts may fly off the switchgear in such an event, and no holes may burn through enclosures. All earthing connections must remain operational during and after an arc fault.

c. All interlocks (Electrical and mechanical) which prevent potentially dangerous fail-operations must be constructed such, that they cannot be by-passed easily, i.e. the operator must use tools or force to bypass them.

d. Energy storing mechanism of breakers must be totally enclosed with the switchgear in the operating condition.

e. All low voltage terminals remaining "live" after the main feeder has been disconnected shall be wired to particularly marked terminal blocks and shall carry suitable warning tags.

2.22 Earthing Switches and Earthing Panel

a. Means to safely isolate and ground any feeder in the switchgear shall be provided. Earth switch shall be suitably interlocked electrically and mechanically with the breaker.

b. Isolation shall be designed to withstand the rated and fault current of the largest breaker interrupter element that can be fitted into the switchgear.

c. View-ports or mechanical indicators connected directly and permanently to the operating shaft are required to positively display the actual switch position. Indirect position indicators are not acceptable.

d. Mechanical locking the circuit earth switches using a key switch for earthing each bus bar.

e. Bus bar mechanical locking all CBs using the key switch

2.23 Circuit Breakers

a. Vacuum circuit breakers with totally enclosed and maintenance-free contact system with actuator node of closing shall only be acceptable.

b. Circuit breakers shall conform to Publication IEC 60056 in terms of rating, testing and performance, but they may conform to the standards of the country of manufacture for construction requirements, provided these standards do not conflict with the corresponding IEC 60056 rules and are acceptable to the Employer's Representative.

c. Each breaker shall be capable of having the following positions:

I. Normal Service (connected)

II. Disconnected (Isolated)

III. Withdrawn

IV. Circuit Earth

V. Bus Earthed

In the withdrawn position a facility shall be provided for the circuit breaker control and auxiliary circuits to be connected and the breaker to be operated without the main power circuits being connected. This facility shall also inhibit all interacting electrical interlocks to and from other equipment.

d. Breaker operating mechanisms shall be of the magnetic actuator or spring charger, stored energy type, with provisions for manual operation in case of control power failure. All breakers must be electrically trip-free and have anti pumping circuits.

e. A manually operable local trip push-button (mechanically working onto the trip shaft) shall be available, and all breakers shall be suitable for remote control. Manual, mechanical ON-switching shall be prevented if interlocking condition exists. Mechanical indicators shall be provided to shown the ON/OFF position of the breaker contacts. Operation counters shall be provided.

f. Maintenance intervals of circuit breakers shall not be less than 100 full rated short circuit interruptions, 10,000 rated current interruptions, or 5 years, whichever comes first. Replacement of the breaker interrupter must be possible.

g. Spare auxiliary contacts (6 N/O and 6 N/C) shall be provided in addition to those required for breaker operation. These contacts shall be wired to the terminal blocks for use at the LDC terminal cubicles. Additional contacts as required, e.g. for interlocking, shall be provided and incorporated in the control system

h. Rated nominal current of circuit breakers shall be selected to the rated values listed in the schedules in order to reach the required rating, once the breaker is installed inside its enclosure. The feeder nameplate shall indicate the actual site rating of the feeder at maximum ambient temperature in addition to the nominal rating of the breaker.

2.24 Interlocking System

Electrical and mechanical interlocking, which shall at least fulfil the conditions as listed below, shall be provided. The final interlocking scheme shall be proposed by the Contractor and shall be subject to the approval of the Employer's Representative.

a. The interlock system must positively prevent an operator from reaching or creating unintentionally a dangerous or potentially dangerous condition. Systems that can be by-passed without the use of tools and/or force are not acceptable.

b. All necessary electrical interlocks shall be provided as specified and approved by the Employer. Reference is made to the related sections of the High-Voltage switchgear of this Specification.

c. When the manual emergency crank for the breaker is in use, it shall be impossible to control the breaker electrically (provision of limit-switch or de-clutching of the crank).

d. All breakers for remote control shall have a key-operated selector switch, allowing the selection of LOCAL - REMOTE operation modes mounted on the CB control cubicle.

Additionally the following has to be included for safe operation:

- Mechanical interlock preventing the circuit breaker from being racked-in or withdrawn if it is closed.
- Mechanical interlock preventing closing of circuit breaker either manually or electrically at any position between connected and disconnected.

- Mechanical interlock preventing the circuit breaker from being racked-in if the corresponding built-in earthing switch is closed.
- Mechanical interlocks preventing closing of earth switch if the corresponding circuit breaker is in service position.
- Electrical interlock to allow closing of bus earth switch only if all circuit breakers in respective bus section are in open and disconnected position.
- Electrical Interlock preventing the closing of transformer circuit breakers without synchronism, except for Dead Bar Close.
- Interlock preventing the closing of circuit breaker if it is Earth Position.
- Interlock to prevent closing of any breaker if bus earth switch is closed.
- Mechanical interlock preventing the manual closing of the circuit breaker unless the secondary circuits plug is connected and secured to the socket and blocking the removal of the plug if circuit breaker is closed.
- Electrical circuit preventing the remote closing of the circuit breaker if it is disconnected.
- BUS bar maintenance required mechanical key locks of ALL circuit breakers to a Key box. Once all CB keys are in the key box, allows for the bus bar earthing to proceed.

The following position displays shall be provided for each circuit breaker;

CB in Closed Position	–	'ON' to be marked in white lettering on a RED background
CB in Open Position	–	'OFF' to be marked in white lettering on a GREEN background
Earth Switch In Open Position	–	"E/S OPEN" in black lettering in yellow background
Earth Switch In Closed Position	–	"E/S CLOSED" in white lettering in green background

2.25 Enclosures

a) Metal enclosures shall be made from steel or aluminium, offering mechanical and thermal properties suitable for this application. Enclosures shall withstand the full rated fault current during arcing faults without puncturing for at least 1 second or means have to be provided to trip any such fault current prior to puncturing (e.g. busbar protection).

b) In no case shall arcing cause holes in the outer freely accessible sides of the enclosed feeder compartment. Gases and vapours escaping under pressure shall be deflected by front and side covers in a direction such as to minimize the danger to an operator performing his normal operation duty.

c) Assembled enclosures must withstand at least twice their rated internal operating pressure. This fact must be proven on each individual section of the switchgear.

d) Each breaker bay shall consist of at least the following high voltage compartments:

I. Busbars

II. Breakers

III. Cable termination compartment

IV. LV compartment

e) Design of the switchgear must allow for the removal of individual breaker bays, or parts thereof, without disturbing the remaining bays.

f) All operating elements and indicators of the switchgear must be located on, or be visible from the front side of the equipment.

g) For withdrawable type circuit breaker, a set of shutters shall be provided on each busbar and circuit chamber assembly to cover 3-phase group of stationary isolating contacts. The shutters shall open or close automatically by a positive drive coincident with the withdrawal or insertion of the associated circuit breaker. Each set shall be capable of being individually operated and padlocked closed using mechanical bars. When padlocked the shutters shall prevent access to the stationary isolating contacts. To facilitate testing, a device shall be provided for fixing (but not padlocking) the shutters in the open position and subsequently for releasing them to the closed position. This device shall be designed so as to be cancelled by the moving portion, to ensure restoration of the automatic features of the shutters. For fixed type circuit breaker, provision has to be made for accessing of the busbar and circuit for testing

h) Shall be fully arc protected to IEC standards with arc protection system.

i) Withdrawable circuit breakers shall have provisions for closed-door mechanical operation (mechanical open and close of the circuit breaker shall be done with the door closed to maintain the arc fault protection rating).

j) All enclosures shall be IP41 rated

2.26 Busbars

a. The fully enclosed busbars shall be made from electrolytic drawn copper. They shall be rated for the continuous current of the switchgear under the site conditions and shall be braced for the maximum peak short circuit current or the minimum of 2.5 times the rated symmetrical short circuit current whichever is higher. Busbars and connection shall be fully insulated for working voltage with adequate phase/ground clearances. All busbars shall be insulated. All joints and tap-offs shall be poured with cast resin or be provided with removable shrouds.

b. The busbars shall be air insulated completely enclosed in an earthed metal chamber. If removable panels are fitted to give access to the busbar chamber, the removal of these panels shall not give access to any incoming or outgoing circuits, which may be electrically energised from their remote ends.

c. The busbars shall be so constructed that it shall be provision to extend the switchboard at either end by adding further panels.

d. Partitions shall be provided to divide the switchboard busbars into panel compartments to prevent the passage of fault producing ionised gasses.

e. Bus bar chamber and the switchgear panels shall be vermin and rodent proof adequately to prevent against ingress of moisture.

2.27 Instrument Transformers

a. All instrument transformers must be suitable for continuous operation for 20% overload when installed in the switchgear under the ambient site conditions and for service under all rated and fault conditions.

b. Accuracy classes and burdens shall be in accordance with IEC 61869, IEC 60186 and schedules of the tender document for current- and voltage-transformers.

c. Cores for measuring instruments shall have accuracy classes of not less than 0.2 % and saturation factors below 5, cores for relaying shall have accuracies better than 5 % and saturation factors of more than 20.

d. Current transformer ratios (secondary side) shall be as indicated in the Schedule B of this Tender.

e. Current transformers must have shorting type secondary terminals. The current transformer-rating plate and the terminals must be accessible after power cables have been installed.

f. Current transformers of the epoxy type, mounted inside the high voltage enclosure on ground potential are preferred; other designs require the approval of Employer's Representative.

g. Potential transformers must be able to withstand the full rated power frequency withstand and lightning impulse capability.

h. Potential transformers for busbar metering shall be of the inductive type, mounted on the bus coupler/sectionalizer switchgear bay panel or at the end of the busbars. The ratio shall be as per single line diagram, the rated burden suitable for the measuring and metering equipment connected, however, with a maximum of 100 VA.

i. The potential transformer shall be of the metal-enclosed, gas-insulated type or approved equal.

j. Potential transformers on the line side of incoming feeders or the load side of outgoing feeders shall be of the inductive type, suitable for the measuring and metering equipment connected to it. They may be mounted at or within the cable connection compartment.

k. All voltage transformers to be provided with an identification label giving Manufacturer, Address, type, ratio, class, output, burden serial number, EFL contract number, frequency, rated IL, rated voltage factor, and the IEC/AS/BS standard number.

l. All current transformers to be provided with an identification label giving Manufacturer, Address, type, ratio, class, Winding Resistance, burden, serial number, EFL contract number, frequency, rated IL, rated voltage factor, and the IEC/AS/BS standard number. Magnetisation curves for all current transformer to be supplied with the equipment.

2.28 Auxiliary Switches

a. Auxiliary switches in addition to those required for the control of the circuit breaker shall be supplied to control circuits with spare contacts. Four of these spare circuits shall close when the circuit breaker closes and the other four shall close when the circuit breaker opens.
b. The drum type of switch with wiping contacts is preferred but the type offered shall be capable of adjustment relative to the operating position of the circuit breaker. Contacts shall be rated to withstand 120V 10A D.C. continuously.

2.29 Operation Counter

a. Each circuit breaker shall be fitted with an operation counter actuated from the mechanism. The counter reading shall be clearly visible to enable readings to be taken without opening the panel doors.

2.30 Isolating Contact For Auxiliary Circuits

a. The connections in the auxiliary circuits between the fixed and moving portions of the equipment shall be by means of either self-aligning plugs and sockets or a flexible interconnecting harness.

2.31 Interchangeability

a. Circuit breakers of a particular current rating shall be completely interchangeable with others of the same and different rating.

2.32 Control and Indication

2.32.1 Circuit Breaker Control

a. Circuit Breaker shall be electrically controlled from the following control points.
   I. Local Control - Located adjacent to the item of plant to facilitate maintenance, test operation and emergency operation on feeder panels only.

II. Remote/Supervisory Control - Located at National Control Centre where principal items of the systems are monitored and remotely controlled by SCADA system.

b. Note: All external interlocks and remote indications are defeated in the "test" operation.

2.32.2 Control Switches and Pushbuttons

a. Control switches shall be of discrepancy type and arranged to operate clockwise when closing the circuit breakers and anti-clockwise when opening them. They shall be designed to prevent accidental operation. Two independent movements shall affect operation of switches of the discrepancy type. Control switches for circuit breakers shall be of the non-locking type with spring return to the "neutral" position. The contacts of switches shall be strong and have a positive wiping action when operated. Control switches shall be provided with labels to give clear indication as to the direction of each operation, for example, "Open" "Close" etc.

b. Pushbuttons shall be oil tight, and with the exception of emergency stop-buttons shall be the shrouded type. Pushbuttons shall provide weatherproof seal where they pass through panels and enclosures. Contacts shall be of the double air-break, self-cleaning and aligning type with silver surfaces and a minimum rating of 10 amps at 110V D.C. It shall be possible to modify the contact arrangements by changing contact blocks.

c. Remotely controlled breakers shall have key-operated selector switches installed in their low voltage compartment with the following functions. The key shall be removable in a "remote" position only.

The switch shall have these positions/functions:

LOCAL :	The breaker can only be operated locally by its push-buttons or mechanically.
TEST :	The breaker cannot be operated electrically.
REMOTE :	The breaker can only be operated from the remote control room location.

2.33 Switchgear Indication and Alarm

a. Trip Circuit Healthy lamp (white) and push button with normally open contacts shall be provided connected across trip supply to enable the tripping circuit to be tested while the tripping supply is maintained and the circuit breaker is closed. A resistance shall be included in the circuit to prevent inadvertent tripping of the breaker should the healthy trip lamp become short circuited. Automatic tripping of a circuit breaker shall energise a remote alarm circuit and illuminate the auto trip lamp on the tripped panel. The auto trip lamp shall remain energised until the protection relay has been manually reset.

b. Alarm indications, when initiated by a maintained contact, shall continue until automatically cancelled by the opening of the initiating contact. When initiated by a fleeting contact the indication shall continue until cancelled by hand.

c. Clear and reliable indication shall be provided of the position of the contacts/switches of the primary circuit in case of non-visible contacts. It shall be possible to easily check the state of the position indicating device when operating locally.

2.34 Indicating Lamps (LEDs) and Fittings

a. Indicating lamps fitted into the facial of switch and instrument cubicles or panels shall be adequately ventilated.

b. All Indicating lamps should be of LIGHT EMITTING DIODE with low wattage

c. Lamps shall be easily removed and replaced from the front of the panel by manual means not requiring the use of extractors. The bezel of metal or other approved materials holding the lamp glass shall be easily removable from the body of the fitting so as to permit access to the lamp and lamp glass.

d. The lamps shall be clear and must fit into an accepted standard form of lamp holder. The rated lamp voltages should be 25 percent in excess of the auxiliary supply voltage.

e. The lamp glasses shall be in standard colours, red, green, white and amber. The colour shall be in the glass and the different coloured glasses shall be interchangeable. Transparent synthetic materials may be used instead of glass, provided such materials have fast colours and are completely suitable for use in tropical climate.

2.35 Earthing

a. The switchboard shall be fitted with a copper earth bar of not less than 150mm² section, running the whole length of the switchboard, to which shall be effectively connected all metal parts not intended to be alive.

b. The Contractor shall provide 60mm x 4mm copper bar connection between the main earth bar of the switchboard and an earthing terminal at the bottom of each cable box.

c. Facilities shall be provided for earthing either the circuit or busbars through the earthing switch for withdrawable type circuit breakerwithout the use of any loose earthing device, and with the use of a three position switch with integral earthing for fixed type circuit breaker.

d. The secondary circuit of each current transformer shall be earthed at one point only. The yellow phase of the three phase voltage transformer secondary winding shall be earthed. Means shall be provided for these earth connections to be disconnected at a readily accessible position for testing.

2.36 Low Voltage Equipment and Control Circuits

2.36.1 Secondary Wiring

a. All secondary control wiring in circuit breakers, panel wiring and the like 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.

b. In all cases, the sequence of the wiring terminals shall be such that the junction between multi-core cables and the terminals is effected without crossover. Claw washers or crimped connectors of approved type shall be used to terminate all small wiring. Insulating bushings shall be provided where necessary to prevent the chafing of wiring.

c. All PVC insulated panel wiring shall comply with the requirements of BS 6231 Type A or B as appropriate.

d. Conductors shall generally have a minimum cross section equivalent to 50/0.25mm (2.5mm²) but single stranded conductors should only be employed for rigid connections which are not subject to movement of vibration during shipment, operation or maintenance. Flexible conductors equivalent to 30/0.25mm (1.5mm²) or small sizes generally shall only be employed with written approval of the purchaser. All cables will be PVC-PVC type with steel wire armour.

e. Each CB and its associated equipment shall have one marshalling box for all the necessary wiring connections to separate panels. At the marshalling point, junction boxes shall be fitted with removable covers so that the terminals and connections can be made readily accessible. All control circuit wiring and auxiliary switch contacts shall be brought out to these junction boxes. The ends and taps of each CT secondary winding shall be brought out to the terminal strip where selection of CT ratios will be made as required. These terminals should be of the type, which has the provision for CT shorting.

f. Terminal strips of the line-up type are preferred for all control wiring requiring external connections. Terminals must be corrosion-proof, and use indirect pressure, captive screw type mechanisms. Internal wiring terminations of the push-on type, e.g. AMP plugs, are acceptable, and wire-wrap connections are preferred for matrix-connections on electronic sub-assemblies. All secondary wiring to be performed at Site shall enter the terminal block at one side only.

g. Terminal strips for different voltage levels must be physically separated from each other and suitably identified. Terminals carrying dangerous voltages even when the main breakers are OFF, must be marked with a particular colour and carry suitable warning labels. Further terminals shall be provided for the current transformers, which shall permit instruments to be connected without interrupting the secondary current transformer circuits.

h. Wire colours shall be as follows:

Wire Colour	Circuit Particulars
Brown Grey	DC Indication Circuits DC Circuits, other than Indication circuits
Red	A Phase connections in CT circuits
White	B Phase connections in CT circuits
Blue	C Phase connections in CT circuits
Green with Yellow Stripes	Connections to earth
Black	AC Neutral connections to the secondary circuits of CTs
Any other colours	Connections other than above

i. All wires shall be fitted with numbered ferrules of approved type at each termination. At points of interconnection between wiring, where a change of numbering cannot be avoided, this shall be clearly indicated on the wiring diagram and both ferrules of approved type at each termination. At points of interconnection between wiring, where a change of numbering cannot be avoided, this shall be clearly indicated on the wiring diagram and both ferrule numbers shall appear at each end of each wire.

j. The ferrules on all wiring directly connected to circuit breaker trip coils, tripping switches, etc. shall be of a colour, preferably red, different from that of the remainder and marked "T" or "trip". No wires may be tied or jointed between terminal points.

k. Bus wiring between control panels etc, shall be fully insulated and be completely segregated from the main panel wiring.

l. All metallic cases of instruments, control switches, relays etc, mounted on panels shall be connected by means of green with yellow stripes PVC insulated copper conductors of not less than 2.5mm² sections to the nearest earth bar. The breaker panel circuits, which are extended for remote operation of alarm, indication and control functions shall be wired to terminals on the terminal board.

2.36.2 Miniature Circuit Breakers and Links

a. Facilities shall be provided for protection and isolation of circuits associated with protection control and instruments. They shall be of approved type and grouped, as far as possible, according to their functions. They shall be clearly labelled, both on the panels and the associated wiring diagrams.

b. Facilities shall be provided to enable the control circuits for circuit breaker to be individually isolated for maintenance purposes.

c. A label shall be fixed immediately below each CB clearly showing the rating of the fuse link and its function.

2.37 Gland Plates and Cable Terminations

a. Switchgear shall be designed for cable entry from the bottom. Sufficient space shall be provided for ease of termination and connection.

b. All provisions and accessories shall be furnished for termination and connection of cables, including removable gland plates, cables supports, crimping type lugs, brass compression glands with tapered washer (Power cables only) and terminal blocks.

2.38 Wiring & Schematic Tables and Diagrams

a. Wiring diagrams or tables shall be provided and shall show exactly how the equipment is wired and must show both wiring and terminal numbers. Wires carrying main supplies must be indicated and show whether the supply is for protection or control etc. All diagrams shall be drawn as viewed from the back of the panel.

b. Schematic diagrams shall be provided and shall include all the wiring in all the plant supplied. Layouts shall be schematic and not geographical. Terminal numbers must be clearly shown and the equipment to which they belong clearly identified and the location of the equipment able to be determined. Where a relay coil is shown all contacts must be indicated adjacent to it. All contacts illustrated on other parts of the diagrams must be cross referenced and a brief description of their purpose given. The use of dotted lines to associate a contact with its coil is acceptable.

2.39 Bushing and Insulators

a. Self-contained bushings within the scope of IEC 137 shall be separately rated and tested in accordance with that standard. The Tenderer shall also show by partial discharge dissipation factor measurements (maximum of 1%) or by other means that the bushing, when mounted in a complete circuit breaker, have a satisfactory electrical stress distribution pattern.

b. The Tenderer shall supply drawings showing the construction and mounting of all terminals and bushings or equivalent insulation in sufficient detail to indicate the mechanical strength characteristics of the solid insulation characteristics of the solid insulation material used. Bushing construction shall be such as to allow free expansion of the central conductor.

2.40 Auxiliary Supplies

Single phase, 240V, 50Hz AC supply is to be used for panel heating and indication via step down transformer of adequate rating. The electricity supplies for auxiliaries will be:

I. 240V AC Single Phase for panel heaters.
II. Auxiliary supplies for essential indication
III. 110V DC control supply for controls, protection, alarms and circuit breaker closing. 110V DC shall be obtained from 110V DC station battery bank. All DC supply to the panels should be wired to the terminal block.

The circuit breaker shall be capable of operating reliably at voltages down to 50% for circuit breaker tripping and 80% for other circuits.

2.41 Anti-Condensation Heaters

Any major items of the breaker panel which are liable to suffer from internal condensation due to atmospheric or load variations shall be fitted with heating devices controlled by thermostats suitable for electrical operation at 240 Volts A.C 50Hz single phase of sufficient capacity to raise the internal ambient temperature by 5ºC. The electrical apparatus so protected shall be designed so that the maximum permitted rise in temperature is not exceeded if the heaters are energised while the apparatus is in operation. Where fitted, a suitable terminal box and control switch shall be provided and mounted in an accessible position. All bus bar chambers should have heaters with provision to switch On when required and possibility of being maintained when Circuit is livened.

2.42 Nameplates

Each breaker bay shall be identified with its feeder designation engraved on laminated plastic tags of at least 40 x 100mm size. Tag information will be supplied by the Employer's Representative at site. The tags must be bolted or riveted onto a non-removable part of the cubicle. Stick-on or glued labels are not acceptable for this purpose. Each cubicle shall have a rating plate with the information required by IEC 60298, i.e. at least the following

- manufacturer's name
- type number

- serial number
- rated voltage
- rated frequency
- rated current
- rated interrupt power
- actual rating at site conditions.

Each device installed in the breaker bay, each terminal strip, and each indicating and operating element shall be identified with permanently attached plastic tags or labels of approved design. Inscriptions on these tags must coincide with those used on the drawings. Each circuit breaker must have its own rating plate with information according to IEC 60056, i.e. at least the following:
- manufacturer's name
- Date of manufacture
- type and serial number
- rated voltage
- rated insulation level
- rated frequency
- rated normal current
- rated short circuit breaking current
- weight - rated duration of short circuit, if different from 1second
- rated supply voltage of closing and opening devices
- rated supply voltage and frequency of auxiliary circuits
- actual rating at site conditions.

2.43 Corrosion Protection

The switchgear shall be treated and protected to withstand at least five years of operation after final taking over, under the site conditions without sustaining significant corrosion or attacks from fungus or rodents, provided the surfaces remain mechanically undamaged. Reference is made to Technical Specification – Grid Power Station „Protective Treatment for structural steel works" of this Specifications and requirements specified there shall be fulfilled provided they are not contradictory to those below.

As a minimum painting standard for all steel surfaces, the following is applicable:
- cleaning to the bare metal by mechanical and/or chemical means
- phosphatising, or priming with at least one coat of zinc or lead-based primer
- finish painting shall preferably consist of electro-statically applied and oven-dried epoxy-powder to a thickness of at least 80 microns. Alternatively, at least two coats of epoxy-based compound lacquer may be spray-applied.

If approved by the Employer's Representative, manufacturers standard paint colour may be used, but a light grey finish with high scratch resistance is preferred. All hardware used in the assembly of the switchgear must be either of corrosion proof material, or be hot dip galvanized.

2.44 Inspection and Testing

The switchgear is subject to inspection during manufacture. Routine testing of each switchgear bay shall be performed according to IEC 60694. The Contractor shall submit proposals for special tests, subject to the approval of the Employer's Representative.

Tests shall be performed generally at independent institutes, at the Contractor's premises if approved by the Employer's Representative, and at site (if applicable) in the presence of the Employer's Representative and further in strict accordance with:

- IEC 60298 for all the switchgear and control gear (Note: For internal arc tests to be regarded as type test, performance shall be according to the IEC 60298 Appendix AA)
- IEC 60056, IEC 60267, IEC 60427 and IEC 60694 for the circuit breakers
- IEC 60265 for MV switches

- IEC 60044- and IEC 60186 for current and voltage transformers
- IEC 60060, and others, as applicable.

Hereby, all test results and calculations evidencing the ratings under site conditions have to be submitted for approval to the satisfaction of the Employer's Representative.

The following table lists the acceptable values for certain tests performed on the switchgear:

Test Description	Minimum Acceptance Criteria
Partial Discharge Measurements	< 250pC
Dissipation Factor Measurement	< 0.02
Contact resistance of main circuit	< 50μΩ
Dielectric Absorption test	ratio > 1.6
Insulation Resistance tests at 5kV	> 20GΩ

2.44.1 Type Tests:

Type tests shall be performed on switchgear bays and circuit breakers of each different type if type test certificates are not made available with the Tender Proposal. Circuit Breakers shall be covered by type test reports issued by a recognised short-circuit testing station certifying the operation of the circuit -breaker at duties corresponding to the operation of the rated breaking capacities of the circuit breakers. The test duties shall not be less than the requirements of IEC 60056. Test certificates shall be submitted with the Bid.

Type tests may be waived if satisfactory type test certificates are submitted with the tender. All defects detected as a result of testing shall be repaired by the manufacturer at their expense and shall be documented and corrected prior to shipment. If, in the opinion of the Employer's Representative, re-testing is required after such repairs, this shall also be at the expense of the Contractor. Acceptance by the Employer's Representative of any equipment shall not relieve the manufacturer and the Contractor from any of his performance guarantees, or from any of his other obligations resulting from this contract.

2.44.2 Routine Tests (Factory Tests)

Routine tests of each switchgear bay have to be successfully carried out in accordance with the IEC recommendations. Special tests may be agreed upon between the Employer's Representative and the Contractor prior to order placement.

Routine factory tests, minimum:
- Pressure test on each enclosure. The test pressure for all cast housings shall be twice and for all welded housing 1.5 times the design pressure- At least 10% of welds must be subjected to non-destructive X-ray or ultra-sonic methods (random checks, according to pressure vessels regulations).
- Partial discharge test on each insulator before insulation in the switchgear. No measurable partial discharge (less than 7pC) shall occur on the insulator when 110% of rated voltage is applied. This test must be carried out on each post type insulator and bushing used in the switchgear.

The following test shall also form a part of the routine tests. These tests may be witnessed by buyer's authorised representatives on a non-interference basis:

- Power frequency voltage withstand test
- Rated voltage test on all auxiliary circuits
- Insulation resistance test with 2 kV on all auxiliary circuits
- Insulation resistance test with 5kV on all primary circuits including CB, CT, VT
- Dielectric Absorption Test
- Dissipation factor test
- Timing/Speed Test
- Contact Timing test
- Contact Resistance Test 100A

- Pressure test
- Primary and secondary injection tests
- Complete mechanical operation test
- Function tests of all auxiliary devices, including all protective relays, alarm and trip circuits
- Verification of wiring against drawings and specifications

The Employer's Representative must be informed at least three (3) weeks in advance regarding tests, which he desires to witness. The purchaser shall immediately be informed of any changes in the testing schedule.

Employer's Representative or his representatives shall be allowed access to all those areas in the manufacturer's factory where the equipment covered by this contract is produced at all reasonable times for purpose of inspection and obtaining information of the progress of work.

Acceptance by the Employer's Representative or his representatives of any equipment shall not relieve the manufacturer of his performance guarantees or from any of his other obligations resulting from the order.

2.44.3 Acceptance Test (Commissioning)

The following tests to be carried out as a minimum after installation of the switchgear at the site for commissioning purposes:

- Rated Voltage test on all auxiliary circuits - Insulation Resistance test with 2 kV on all auxiliary circuits
- Insulation Resistance test with 5kV on all primary circuits including CB, CT, VT
- Dielectric Absorption Test
- Dissipation Factor test
- Contact Resistance Test at 100A test current
- High Pressure test
- Primary and Secondary Injection tests
- Circuit Breaker Timing test
- Complete Mechanical Operation test
- Current transformer ratio, polarity, magnetisation curve, voltage withstand of secondary wiring
- Voltage transformer ratio, polarity, voltage withstand of secondary wiring
- Function tests of all auxiliary devices, including all protective relays, alarm and trip circuits
- Testing of SCADA IO points
- Control locally using HMI computers

2.45 Switchboard Communication Requirements Schedule

The switchboard has to consist of the following items, but not limited to:

Communications Relays

2 – SEL 3555 (one for each busbar) 32 port
1 – SEL 2488 GPS clock kit with time synchronization distribution equipment
4 X Annunciator (10)

2.46 Protection, Metering And Control

2.46.1 SEL Protection Relays (compliant to DNP3.0 and IEC68150)

All protection relays offered shall be of the SEL make. Protection scheme shall be compatible with the existing Protection system in EFL. The protection relays shall comply with the requirements of BS 142 and as specified in this specification. The Tenderer shall confirm the suitability of the protection schemes and EFL shall be providing appropriate design calculations settings. The bidder can propose alternative protection relay with full training and backup service for 5 years, however, the prerogative to accept shall be EFL's and EFL is under no obligation to consider alternative or justify rejection.

The protection relays for each circuit breaker shall be flush mounted and fitted to the switchgear panel. Relay elements shall be robust and compact in form, but not subject to distortion due to temperature, humidity or other service conditions and shall not mal-operate when subjected to reasonable mechanical shock and the earthquake forces.

Elements shall be arranged for ease of inspection and adjustment. Relay terminals shall be located on the rear of the cases to ensure that no wiring is visible on the panel faces.

Details marked on relay nameplate shall be in the English language. Each relay shall be provided with visual indication of operation so that the station can be satisfactorily run as an unmanned station.

The relays shall have sufficient auxiliary contacts for tripping, remote alarm and future data processing circuits. At least two contacts on all relays shall be self-resetting for trip and alarm and one hand reset for auto trip lamp. The hand reset flag indicator shall be capable of being reset without opening the case or having to enter passwords in the case of SEL relays. However, it shall not be possible to operate any relay by hand without opening the case or in the case of SEL relays the settings shall be password protected.

For transmission feeder protection, over current and earth fault protection shall be implemented using SEL 311L relays. CB Fail protection, auto-reclosing and sync-check (where applicable) shall also be incorporated within the same relay.

The following elements shall be made available for the transformer protection:

- Differential protection, which internally facilitate the ratio and vector group compensation.
- Restricted earth fault (REF) protection, which also facilitate internal current transformer ratio compensation.
- Earth fault protection (stand by earth fault for low voltage winding, Neutral earth fault for high voltage winding etc.)
- Backup overcurrent protection
- Tripping interface shall be provided such that any protection relay's tripping on the higher voltage side shall trip the lower voltage side's circuit breaker and vice versa for transformer faults. Back-up protection for other than transformer faults (external faults), installed at the low voltage side of the transformer shall only trip the low voltage side's circuit breaker and keep the transformer energized from the primary network side.
- A lockout relay shall be installed to avoid reclosing when a unit protection device has operated. The closing of breaker after a tripping due to a unit protection element shall only be done after a visual inspection has been carried out. An Areva MVAJ type lockout relay shall be used to provide this functionality.

EFL shall employ a bus zone scheme on the 33kV board. The scheme will provide all incomer instantaneous elements on fault pickup from feeders, auxiliary transformer and the bus section. Circuit breaker fail scheme will only trip the faulty section of the bus and the bus section VCB.

Notwithstanding the technical particulars such as current ratio or voltage ratio or the number of secondaries indicated in these drawing and listed in the schedules, the successful contractor shall provide the adequate numbers of CT, interposing CT with adequate numbers of secondaries of sufficient ratings to ensure proper functioning of the Protection Scheme specified.

Test facilities shall be provided to allow input quantities to be injected into each protective relay, and the operation of the relay checked. The removal of wiring from terminals for testing purposes is not acceptable. All necessary plugs, sockets, leads and any other apparatus required to be used with the above test facilities shall be included in the tender. The Tenderer shall provide test block of type SEL for testing purpose.

The individual SEL relays on each busbar have to be wired up to a SEL3555 relay (with SEL2701 Ethernet card) dedicated for that busbar (1 x SEL3555 in total (32 port)) using approved SEL connectors (fibre or serial). The RTU SEL3555 relays have to be wired to the CISCO switch and will communicate to the NCC via optic

fibre/ethernet. All protection relay alarms, indications and other required information shown in the table of SCADA input output (IO) listing.

All protection relays and other equipment manufacturers shall be clearly informed of EFL being the end user and EFL's contact details shall be left with the manufacturer for any future correspondence regarding their product.

2.46.2 Arc Protection System

All arc protection modules offered shall be of the Schneider Electric VAMP make. Protection scheme shall be compatible with the existing Protection system in EFL. The protection modules shall comply with the requirements of IEC 60255 and as specified in this specification. Contractor can propose competitive or better alternative

The Contractor shall submit a design of the arc protection system for approval by the Employer's representative. To be included in this is a single line diagram detailing integration of the VAMP 321 arc protection system clearly showing the zones being protected with its dedicated VAMP 321 modules. The design shall also include the arrangement of the modules on the general layout design of the switchgear panel, the arrangement of arc sensors and modules, the length of each cable linking the sensors to the modules and all other relevant information.

The arc protection system will cover the 3 chambers. These are the busbar, circuit breaker and the cable termination chambers. Where possible, the arc protection modules must be set so as to allow inspection of the chambers with the use of a flash-light.

The Contractor shall be responsible for design, program and install the arc protection system onto the switchgears ready for commissioning. All designs of the arc protection system for the 36kV switchgears shall be first approved by the Employer's representative before being implemented.

2.47 Supervisory Equipment

The 33kV switchgears at the new Vuda 33kV Substation shall also be operated completely unmanned and centrally controlled from the National Control Centre at Vuda.

The medium of Communication shall be single mode optic fibre cable. This will be provided by the employer and is not in the scope of the contract. Local/Remote control switches will be used for control circuits and shall be wired via the SEL relays.

EFL intends to bring all 33kV controls and metering to the SCADA via a SEL3555/IEC 68150 communication relay together with SEL2701 Ethernet Card connected on each section of the bus. All the SEL relays connected to each section of the busbar shall be connected to the dedicated SEL3555 communications processor. The two SEL3555 relays used at this Vuda 33kV Substation will be connected to a new SCADA termination equipment.

EFL uses IFIX system at its SCADA Master Station in Vuda. EFL's SCADA system is standardising on DNP3 as its standard protocol. All intelligent electronic devices (IEDs) connected to the SCADA network shall comply with this protocol.

The programming of the SEL protection relays and the SEL communications processor/RTU will be EFL responsibility; however the EFL will provide the protection settings and be responsible for the verifying the correctness of the programming and its suitability. This should also include the remote access programming. Remote operation of the switchgear shall be tested by the contractor in conjunction with EFL.

General guidelines for the Employers SCADA input output (IO) points required are as per the list below. The SCADA IO listing will be finalised during detailed design stage after considering the design of the offered circuit breaker and control circuits. The contractor shall provide the I/O list with DNP3 addresses to EFL for programming at the Master Station.

2.48 36 kV IO Points

ITEM	33kV GEN/TRANSFORMER CB CONTROL		33kV FEEDER CB CONTROL		33kV BUS-SECTION CB CONTROL		STATION	
CONTROL	LOCAL	SCADA	LOCAL	LOCAL	LOCAL	SCADA	LOCAL	SCADA
Open/Close	✓	✓	✓	✓	✓	✓		
Dead Bar Close	✓	✓			✓	✓		
AutoSync	✓	✓			✓	✓		
Generator Start/Stop					✓	✓		
Generator Speed Raise/Lower								
Generator Volts Raise/Lower								
Protection On	✓	✓	✓	✓	✓	✓	✓	✓
Protection Off	✓	✓	✓	✓	✓	✓	✓	✓
Reset Protection Relay	✓	✓	✓	✓				
OLTC Auto/Manual								
OLTC Raise/Lower								
OLTC Master/Follower								
INDICATIONS	LOCAL	SCADA	LOCAL	SCADA	LOCAL	SCADA	LOCAL	SCADA
Open/Close	✓	✓	✓	✓	✓	✓		
Dead Bar Close	✓	✓	✓	✓	✓	✓		
Synchronising in Progress	✓	✓	✓	✓	✓	✓		
Synchronise Fail	✓	✓	✓	✓	✓	✓		
Distance to Fault Location								
TX Intertrip								
Station Local/Remote Control	✓	✓	✓	✓	✓	✓	✓	✓
Auto Reclose In								
Auto Reclose Out								
Auto Reclose in progress								
Protection On	✓	✓	✓	✓	✓	✓		
Protection Off			✓	✓				
Protection Fault								
OLTC Auto/Manual								
Tap Position								
Battery Charger DC fail							✓	✓
Station A/C Supply fail							✓	✓
Spring Charged	✓	✓	✓	✓	✓	✓		
MEASUREMENT	LOCAL	SCADA	LOCAL	SCADA	LOCAL	SCADA	LOCAL	SCADA
MW	✓	✓	✓	✓	✓	✓		
MVar	✓	✓	✓	✓	✓	✓		
Import/Export MW							✓	✓
Import/Export Mvar							✓	✓
Import/Export MWh							✓	✓

Import/Export Mvarh							✓	✓
Frequency					✓	✓	✓	✓
Incomimg/Existing Frequency					✓	✓		
Delta Frequency					✓	✓		
R-ph Amps	✓	✓	✓	✓	✓	✓		
Y-ph Amps	✓	✓	✓	✓	✓	✓		
B-ph Amps	✓	✓	✓	✓	✓	✓		
Kilovolts	✓	✓	✓	✓	✓	✓	✓	✓
ALARM	LOCAL	SCADA	LOCAL	SCADA	LOCAL	SCADA	LOCAL	SCADA
R-ph Overcurrent Trip	✓	✓	✓	✓	✓	✓		
Y-ph Overcurrent Trip	✓	✓	✓	✓	✓	✓		
B-Ph Overcurrent Trip	✓	✓	✓	✓	✓	✓		
Earth Fault Trip	✓	✓	✓	✓	✓	✓		
Pilot Cable Translay Protection Trip								
Distance Protection Phase Trip								
Distance Protection Zone 1 Trip								
Distance Protection Zone 2 Trip								
Distance Protection Zone 3 Trip								
Distance Protection Faulty								
AutoRecloser -Operated	✓	✓	✓	✓				
Auto Reclose Lockout	✓	✓	✓	✓				
AutoRecloser RelayFailed	✓	✓	✓	✓				
SBEF Trip	✓	✓						
LV Earth Fault Trip	✓	✓						
LV REF Trip	✓	✓						
HV REF Trip	✓	✓						
REF Trip	✓	✓						
R-ph Differential Protection Trip	✓	✓	✓	✓	✓	✓		
Y-ph Diifferential Protection Trip	✓	✓	✓	✓	✓	✓		
B-ph Diifferential Protection Trip	✓	✓	✓	✓	✓	✓		
Bucholz Gas Alarm	✓	✓	✓	✓				
Main TX Bucholz Surge Trip	✓	✓						
Main TX Winding Temp High Warning	✓	✓						
Main TX Winding Temp Trip	✓	✓						
Generator Warning Alarms								
Generator Shutdown Alarms								

Zone Protection Trip	✓	✓	✓	✓	✓	✓		
Zone Protection Fail	✓	✓	✓	✓	✓	✓		
Overvoltage Trip								
Recloser Trip/Reclose								
Recloser Lockout								
Spring Charge Fail	✓	✓	✓	✓	✓	✓		
CB Fail	✓	✓	✓	✓	✓	✓		
LocalRemote	✓	✓	✓	✓	✓	✓		
Protection Fail	✓	✓	✓	✓	✓	✓		
Remote Control Blocked	✓	✓	✓	✓	✓	✓		

2.49 Manufacturers, Places of Manufacture & Testing

ITEM	MANUFACTURER	PLACE OF MANUFACTURE	PLACE OF TESTING & INSPECTION
33kV Circuit Breakers	ABB / Siemens	Germany	Germany
33kV Copper Busbar	ABB / Siemens	Germany	Germany
33kV Current Transformers	ABB / Siemens	Germany	Germany
33kV Voltage Transformers	ABB / Siemens	Germany	Germany
33kV Switch Panels	ABB / Siemens	Germany	Germany
Protection Relays	SEL	USA	
Meters	Shark 200 v6		
Anti-Condensation heaters			
Arc Protection	Schneider VAMP 321		
OPTOLINK	Schneider		
SENSOR	Schneider		
MCBs	Schneider		
Control and selector switches	KRAUS & NAIMER		
Interlock relay	Sprecher+Schuh		
Indication lamps	Schneider ZB5AV		
Push buttons	Schneider XB5		
Measuring disconnect terminal	Weidmuller WTL 6/1/STB		
Terminals of type	Phoenix Contact UK2.5B		
Cable trunking	Critchley Betaduct		
DIN Rail	Weidmuller TS35		
240/120VAC, 250VA Control transformer	Legrand 442 65		
Transformer lockout relay	Areva MVAJ13R1BB0756F		
Bus zone lockout relay	Areva MVAJ13T1GB0789A		
Test blocks	SEL	USA	USA

2.50 Technical Particulars and Guarantees

2.50.1 Busbars

	Item	*Units*	*Required*	*Tendered*
			36 kV	*36 kV*
1.	Rated Normal Current	A	2000	
2.	Rated current at Max. ambient temperature	A	2000A	
3.	Conductor Material		Cu	
4.	Standard Applicable		IEC	
5.	Single conductor Cross section	mm2		
6.	Insulation material			
7.	Fire Certification (IEC 60466, etc)			

2.50.2 Circuit Breakers

	Item	Units	Required	Tendered
			36kV	36kV
1	Manufacturer's Name			
2	Country of Manufacture			
3	Place of Testing			
4	Applicable Standards – IEC62271,IEC60694, etc			
5	Manufacturer's type designation, and type ref or model number			
6	Type tested	Yes/No	Yes	
7	Type test Report, Ref No.			
8	Rated Voltage	kV	36	
9	Rated Frequency	Hz	50	
10	Rated Normal Current at 20oC			
	- Line feeder circuit breaker	A	1250	
	- Transformer circuit breaker	A	1600	
	- Bus section circuit breaker	A	2000	
11	Rated Current at Max. ambient temperature			
	- Line feeder circuit breaker	A		
	- Transformer circuit breaker	A		
	- Bus section circuit breaker	A		
12	Rated Lightning Impulse Withstand	kV	170	
13	Rated 1 min Power Frequency Withstand	kV	70	
14	Rated short circuit breaking current (symmetrical, r.m.s)	kA	31.5	
15	Rated short circuit breaking current (asymmetrical, r.m.s)	kA	35.4	
16	Rated making current (peak)	kA	82	
17	Rated Duration of Short Circuit Current	s	3	
18	Rated cable charging breaking current	A		
19	Rated line charging breaking current	A		
20	Rated small inductive breaking current	A		

21	Voltage drop across terminals of one pole at rated current	mV		
22	Amplitude factor			
23	First pole-to-clear fault			
24	Rated operating sequence		O-0.3 sec CO-3 min-CO	
25	Min. time t" between two successful three phase auto reclosures at full rated breaking current (sequence O-0.3-C-t"-O-0.3-C)	min		
26	Closing time	ms		
	- tolerances	ms		
27	Dead time (max)	ms		
	- tolerances	ms		
28	Break time (max.) at full rated breaking current	ms		
	- tolerances	ms		
29	Make time (max.)	ms		
	- tolerances	ms		
30	Arcing time (max.) at full short circuit duty	ms		
	- tolerances	ms		
31	Life duration of main contacts (no load mechanical operations)	Operations	120,000	
32	Number of switching operations at rated breaking capacity before contact maintenance becomes necessary	No.	Min 100	
33	Auxiliary contacts:			
	- number NO/NC		12	
	- voltage rating	VDC	110	
	- current rating	ADC		
34	Making coil			
	- Rated voltage	VDC	110	
	- min. operating voltage	V	93	
	- Rated power each	W		
35	Trip coil			
	- Rated voltage	VDC	110	
	- min. operating voltage	V	55	
	- Rated power each	W		
36	Motor Voltage	VDC	110	
37	Motor Power	W		
38	Max. temperature rise of contacts at rated normal Current	K		
39	Arc quenching medium		Vacuum only	
40	Material of main contacts			
41	Maximum Shock load imposed on floor or foundation when opening under fault conditions (compression or tension)	N		
42	Minimum Clearances in air			
	(a) Between phases	mm		

	(b) Phase to earth	mm		
	(c) Across CB poles	mm		
43	Material of filter employed for the absorption of the products of combustion			
44	Method of controlling voltage distribution between breaks (capacitor, resistor etc.)			
45	Weight of complete 3 pole breaker	Kg		
46	Weight of heaviest part for shipment	Kg		
47	Period the equipment has been in commercial operation	years	>5	

2.50.3 Current Transformer

	Item	Units	Required	Tendered
			36kV	36kV
1	Manufacturer		ABB/Siemens	
2	Type			
3	Applicable Standards - IEC		60044-1	
4	Rated secondary current	A	1	
5	Rated lightning impulse withstand voltage (primary)	kV	170	
6	Rated Power Frequency withstand voltage (primary)	Kv	70	
7	Rated short-time current			
8	Protection cores (Transformer Diff):			
	- Rated Primary Current	A	1250/800/400	
	- Accuracy class	Class	0.1PX	
	- Resistance of secondary winding at 75oC	Ohms	< 3	
	- Rated Burden	VA	5	
9	Protection cores (Transformer Diff):			
	- Rated Primary Current	A	1250/800/400	
	- Accuracy class	Class	1M	
	- Resistance of secondary winding at 75oC	Ohms	< 3	
	- Rated Burden	VA	5	
10	Protection cores(Line Differential, OC & EF for feeders):			
	- Rated Primary Current	A	1250/800/400	
	- Accuracy class	Class	PX	
	- Resistance of secondary winding protection cores at 75oC	Ohms	< 3	
	- Rated Burden	VA	5	
11	Protection cores(Bus Section):			
	- Rated Primary Current	A	1800/1250	
	- Accuracy class	Class	0.1PX	

	- Resistance of secondary winding protection cores at 75oC	Ohms	< 3	
	- Rated Burden	VA	Min 5	
12	Number of Cores	No.	See scope of works and Drawings	
13	Knee point e.m.f. of protection cores	V	Min 450	
14	Knee point e.m.f. of busbar protection cores	V	Min 415	
15	Insulation material for windings			
16	Limits on exciting current	A		
17	Partial discharge	pC	<10	

2.50.4 Voltage Transformer

	Item	Units	Required	Tendered
			36kV	36kV
1	Manufacturer		ABB/Siemens	
2	Type		Magnetic	
3	Applicable Standards - IEC		6044-2	
4	Method of transformation		Inductive	
5	System Voltage	kV	36	
6	Type of supply		3 Phase	
7	Frequency	Hz	50	
8	Basic Insulation Level	kV	170	
9	Creepage distances	mm		
10	Transformation ratio			
11	Class of accuracy		0.1	
12	Class of insulation			
13	Number of secondaries and accuracy class		See scope of works & drawings	
14	Thermal capacity of ground-fault detection winding	A/h		
15	Rated burden (total on all secondaries)	VA		
16	Partial discharge		Acc. IEC 60044-4	
17	Height	mm		
18	Weight of single pole unit	kg		

2.50.5 Switch Panels

	Item	Units	Required	Tendered
			36kV	36kV
1	Manufacturer		ABB/Siemens	
2	Type			
3	rated voltage	kV	36	
4	Applicable Standards - IEC		IEC 62271-200	
5	Impulse withstand voltage kV peak	kV	170	
6	Power frequency withstand voltage	kV	70	
7	Thickness	mm		
8	Short time rating, 3 sec	kA	31.5	
9	Integral earthing switch for feeder and busbar	Yes/No	Yes	
10	Short circuit rating of earth switch			
11	Making capacity of earth switch			
12	Transducer and Local Energy Meter (Transformer)			
	- Manufacturer and model		Nemo HD+	
	- protocol		DNP3	
13	Transducer and Local Meter			
	- Manufacturer and model		Nemo HD+	
	- protocol		DNP3	
14	Anti-Condensation heater			
	- Manufacturer			
	- Heater voltage			
	- Heater Output	W		
	Is heater switch provided		Yes	
15	Material			
	Surface Finish			
	Dimensions			
	Length	mm		
	Width	mm		
	Height	mm		
16	Total Net Weight	Kg		

Section 4

Employer's Technical Requirements
Part 3

TWO Units of 110V DC Battery Bank and Charger with Auto changer and Distribution board

TWO Units of SCADA Batteries with auto charger

Two units UPS

4.0 Section 4 - Employer's Technical Requirements - Part 3 - 110V DC Battery Bank and Charger with Auto changer & Distribution board

3.0 Scope of Works

3.1 Supply and Install of 2 Units 3ø 110V DC Battery Banks And Chargers With 2 X Automatic Change Over DC Distribution Board

1. Two (2) units, N+1 switch mode 110V DC battery bank complete with battery charger, IP41DC Distribution boards with Automatic changeover board
2. 110V DC Distribution switchboards with DC miniature circuit breakers and main switch to suit.
3. Training and manuals for the installation, maintenance and troubleshooting of battery banks, battery chargers settings.
4. Recommended Spares
5. Installation, Testing and commissioning of the new battery banks complete with load discharge test.

General

All batteries, chargers and distribution equipment shall be suitable for switchgear tripping and closing duties, alarm and indications, emergency lighting, and all other items of equipment covered by this specification.

Battery and battery charger systems must be designed for the purpose intended and to meet the requirements of all applicable AS/NZ standards. Minimum design life of 15 years is required. The primary role of the substation battery system is to provide a source of energy that is independent of the primary ac supply, so that in the event of the loss of the primary supply the substation control systems that require energy to operate can still do so safely.

The battery is required to supply the DC electrical requirements of the substation, including SCADA, control, protection indication, communications and circuit breaker switching operations when there is no output from the battery charger. This may be due to a loss of AC supply to the substation or a fault in the battery charger. Under these conditions the battery shall supply the DC loads for a minimum period of 24 hours after which time the battery should then be able to supply trip-close-trip operations of a HV circuit breaker which would typically restore supply to the battery charger.

Namely, each battery charger and battery shall be capable of delivering the entire rated load of minimum 60A for 10 hours and at the end of the 10 hours the following emergency loads such as: Two operations of tripping of all 33kV feeders and subsequent restoration (auto re-closing and/or busbar change for all feeder isolators whichever is the maximum load), plus spring charging motors (10 coils) used for breaker closing. The above shall be accounted for by an additional 10% reserve AHr capacity on top of the required minimum AHr capacity calculated for supplying the minimum rated full load amps (60A) for the stipulated duration (10Hr). Additionally, the battery bank shall be oversized by an additional 30% spare capacity in order to cater for ageing of the battery.

The capacity of each battery bank shall be on the basis that when charged to 80% of its rated capacity at the start of the following duties, it shall be sufficient to supply the following demands simultaneously with the charger disconnected

a) The normal DC load of the Protection/Controls/Metering systems of 10 Amperes for 24hours.
b) The nominal DC loading of the SCADA system of 10 Amperes for 24 hours.

The battery charger(s) and DC distribution board shall be provided in separate self-contained units housed in separate cubicles of minimum IP41 or NEMA 12 rating. The battery bank shall be modular and suitable for indoor installation in a separate battery room.

The batteries will be located in battery rooms which are naturally ventilated and not air-conditioned. The battery rooms will not be providing a controlled and conditioned atmosphere to the batteries. The battery rooms will be having natural ventilation and an exhaust system to cycle out air in the room. The batteries will be exposed to dust and ambient atmospheric conditions. The typical ambient conditions are:

The temperature range: 10° C to 50°C
Relative Humidity: 60% - 95%

In any event, the DC load voltage shall not drop below 90% of its nominal value, after the battery has taken the full continuous load for 10 hours and at the end of 10 hours, the above emergency load.

The battery under boost charge and the corresponding charger shall be disconnected from the distribution board by use of selector switches and power contactors.

Metering circuits shall be wired for remote & SCADA indication. The batteries shall be protected against over-discharging. Earth fault detectors for each DC busbar shall be provided.

3.2 Operating Tolerances

The battery/charger/distribution equipment shall be designed such that the voltage at the distribution board terminal is always within ±10% of nominal voltage (110V) using voltage dropping diodes in multiple stages. The ripple content of the DC voltage shall not exceed 3.0% peak to peak with the battery disconnected and shall be less than 1.0% with the battery connected.

3.3 Type of Batteries

The batteries shall be rugged and high performance, sealed type, and maintenance free batteries complying with IEEE 1189-1996 and/or IEC.60623 wither from GNB USA and shall be designed for a life expectancy of at least 20 years under the conditions of service likely to be encountered by the equipment as mentioned in this specification. The batteries shall be sealed batteries of Valve Regulated Lead Acid Battery (VRLA) type or Nickel. The batteries shall be designed to be mounted in both vertical and horizontal orientations for normal operation.

The electrolyte capacity and general design of the batteries shall be such that inspection and maintenance shall be at intervals of not less than twelve months. A complete set of:

Each set of 100% duty battery with 600 AH minimum capacity normally operating in parallel each rated to give 100% of the entire DC load on a Ten (10) hour discharge rate basis and under the site environmental conditions. The battery bank shall be oversized by an additional 30% spare capacity in order to cater for ageing of the battery. The battery bank sizing shall meet all requirements of IEEE 485-1997 and shall meet or exceed the requirements as detailed by this document.

1. Test and manufacture accessories suitably boxed, shall be provided for each.

2. Instruction schedules shall be included in each set.
3. The batteries must have provision for carrying out partial discharge test.
4. Battery cases are of high impact translucent plastic.
5. Cells shall be permanently marked with the following information.

- Manufacture's reference number and code
- All batteries shall be numbered.
- Year and month of manufacture
- Voltage and nominal capacity at the 10 hour discharge rate

The cell containers shall be of robust, impact resistant construction in translucent material permitting visual inspection of electrolyte and shall be having built-in vent caps.

They shall be mounted on appropriate steel stands while ensuring that

- a minimum floor area is taken up and a ground clearance of 300 mm from the floor is provided
- each cell is readily accessible and can be removed from its position without having to remove or shift adjacent cells
- the lead or nickel plated intercell connectors as well as the cell terminals are suitably insulated by PVC shrouds, sleeving or cover plates

3.4 Battery Earthing

110V DC station batteries shall operate unearthed. Means shall be provided to detect low insulation resistance of all the wiring connected to the battery by the following method and to give an earth fault alarm. Separate alarm indications shall be given for both positive and negative poles. The earth fault detection circuit shall consist in principle of a resistance connected across the battery output on the distribution side of the fuses with a relay connected between the centre point of this resistance and the earth terminal. Any unbalanced leakage current due to the low insulation resistance of the wiring connected to either pole of the battery shall cause a current to flow in the relay, which will operate at a predetermined value. The earth fault relay shall be equipped with a minimum of six normally open contacts for local indication and remote alarm circuits for each bank.

3.5 Battery Chargers + DNP3.0 SCADA control

The Battery Charger shall operate on 240V Single Phase AC @ 50Hz or 415V Three phase AC @50Hz with instruction card for each set. Means shall be provided using diodes to prevent excess voltage causing damage to connected apparatus when a battery is being charged.

Each battery charger and battery bank shall be capable of delivering the entire rated load of 60A for 10 hours and in any event, the DC load voltage shall not drop below 90% of its nominal value of 110V, after the battery has taken the full continuous load for 10 hours. The battery under boost charge and the corresponding charger shall be disconnected from the distribution board by use of selector switches and power contactors. The batteries shall be protected against over-discharging. Earth fault detectors for each DC busbar shall be provided. Metering circuits shall be provided and wired for remote & SCADA indication.

Separate identical 100% duty charger having boost & float facilities shall be offered for each battery. Each charger unit shall be suitable for supplying the initial charging requirements, boost charging the battery subsequent to an emergency discharge and supplying the maximum load whilst on float. The chargers shall each be housed in a separate cubicle, which shall at least be of Protection Class IP 56. The equipment shall satisfy the requirements of corrosion protection as specified. For wiring, contactors,

terminals, etc. reference shall be made to the respective sections of the Specification. The chargers shall be provided with natural ventilation. Forced ventilation is not acceptable. Cubicle sizes and overall views shall be co-ordinated with DC distribution panels as they could possibly be erected in the same room.

3.6 Switch mode (N+1) with SCADA DNP3.0 protocol with Ethernet

EFL is embarking on condition monitoring of the battery banks using the intelligent chargers therefore is seeking:

(a) Switch mode (N+1) with SCADA DNP3.0

Each battery charging equipment shall comply with the requirements of BS.EN 60146-1-1, BS EN 60146-1-3 (IEC. 60146).

The charger system all housed in one cabinet consisting of includes:

- Rectifiers
- Contactor coil
- Current transducer · Minirack
- CT Cable · Operates with 110V DC
- Necessary Software and Training
- Battery breaker · All Auxiliary contact
- Battery cell condition monitor unit
- Site Monitor module
- Vented blanking panel

All details and necessary information regarding above must be provided for evaluation process.

1. Communication protocol DNP3.0
2. Ethernet and able to have fibre connectivity
3. Current and voltage monitoring for each cell
4. ability to perform discharge test on its own
5. Temperature compensation
6. N+1 switch mode

Chargers of high efficiency, short control response time, low output ripple without battery being connected and rated for continuous output short circuit operation, shall be of solid state full wave fully controlled using silicon and N+1 rectifiers and complete with all switches, miniature CBs, fuses, contacts and instruments. The output voltage shall be regulated from 0 to 100% load even with ±10% variations in input AC supply voltage and ±5% frequency variations. The battery chargers shall be of the constant voltage float type each with boost charge facilities. Each charger shall be capable of maintaining the

battery fully charged and delivering the DC load output when operating alone but will normally work in parallel in case of double battery bank system. For single battery system, the charger shall be capable of maintaining the battery fully charged and delivering the DC load output. The charger shall:

1. Be designed for ambient temperature 50°C.
2. Have the possibility to adjust and set the charger output voltage and current
3. Limit values separately for each operating mode of the charger. The adjustable range shall be the limits of maximum and minimum outputs.
4. Automatically switch into the boost charging mode when the battery has discharged above a preset value. A battery charge/discharge ampere-hour sensing device shall be provided to control the boost mode on/off switching as well as the boost charging time.
5. Be capable of recharging within ten hours the battery bank to a condition enabling the battery for another cycle of emergency discharge.
6. Simultaneously, the charger shall be capable of feeding the rated load of the entire DC busbars.
7. Have alarms grouped and connected to the alarm fascia locally and to the remote control panel & SCADA DNP3.0 protocol, as required by EFL during design.
8. Indication of the signal "Charger faulty" shall be suppressed in case of a failure of the AC supply to the charger.
9. Have operating characteristic in accordance with DIN 41772/DIN 41773 or equivalent. The charging characteristic shall be to the approval by EFL.
10. However, the battery manufacturer's recommendations for float/trickle, equalizing and boost charging shall be taken into consideration.
11. Have output voltage failure detection insensitive to switching surges or transient loss of voltage due to faults on the power system, or during auto-changeover of the input AC supply.
12. Have load sharing and current limiting circuits built-in each module.
13. Have a soft start feature.
14. Have RFI- Interference protection at least equal to mode "N" according to DIN VDE 0875.
15. Maintenance and operation instruction manuals and spare parts reference list shall be supplied.

6.7 Battery Charger Alarm Devices

The following shall be provided:

1. Over voltage detection equipment to give local indication and remote alarm when the charger voltage rises more than two volts above its normal automatic float voltage. This alarm shall be disconnected whenever the charger is operating on boost charge.
2. Under voltage detection equipment to give local indication and remote alarm when the system voltage falls below 90% of its normal automatic float charge. A time delay shall be incorporated to prevent initiation during temporary voltage drops caused by transient conditions including circuit-breaker closing operations.
3. Charger fails detection equipment to give local indication and remote alarm if the voltage from the charger falls below the nominal floating charge voltage. Suitable blocking diodes shall be provided to prevent the battery voltage being supplied to the equipment so that only the charger voltage is effective in causing the alarm. The device shall not operate on switching surges or transient loss of voltage due to faults on the AC system. The voltage at which the alarm operates shall be adjustable for operation over a range to be approved by the Employer's Representative.

4. Rectifier: fuse operation detection equipment to give local indication and remote alarm of diode/thyristor and surge circuit protection fuse operation.
5. Earth leakage detection equipment to give local indication and remote alarm of the occurrence of an earth fault and to give discrimination between positive and negative earth faults. Test circuits shall incorporate to simulate positive and negative faults by-operation of test pushbuttons. Provision of "local Indication" by lamps on the front of the charger cubicle and provision for "Remote Alarm" by changeover contacts (rated at 5A for voltages between 30 and 250V AC or DC) on the devices to energise a group alarm relay.

3.8 Battery Charger Instrumentation and Controls

In addition to the necessary controls for float and boost charging, the following are to be provided on the front of the cubicle:

1. Charger Output/ battery Voltmeter with Changeover Switch.
2. Charger D.C. Load Ammeter
3. Centre Zero Battery Ammeter with Retroactive Switch.
4. AC Supply MCB. A link shall be provided in the supply neutral.
5. Charger operating on Boost Charge indicating lamp (Amber).
6. Isolating switches for each battery bank.

3.9 Dc Switchboard

The distribution switchboard shall be of cubicle type or otherwise incorporated in the cubicles for battery chargers. Two-pole miniature type circuit breakers shall be fitted to the D.C. Switchboard required by substation services. The DC installation should comprise the control panel and battery charging equipment. The DC Switchboard shall be of metal clad type 2.5mm thickness and complete with indication instruments, controls, protective devices (battery earth fault protection, etc.) and switches as necessary, including battery earth fault alarm reset switch

Each circuit shall be adequately labelled with its requirement function. The switchboard shall comply with the requirements of BS.EN 60439-1 (IEC. 60439). DC bus-bar voltage shall be monitored continuously and shall give an alarm (operated by AC) in the event of DC failure. Digital monitoring device will be preferred.

3.10 Test at Manufacture's Work

Battery - Type test in accordance with IEC 60623. - In addition the Contractor shall demonstrate that the battery will perform the duties specified.

Battery Charger - Type and Routine Tests according IEC 60146
DC Switchboard - Type and Routine Tests according to IEC.60439

3.11 Test at Site pre-commissioning and commissioning

Battery – charge and discharge test with load bank of 40A/60A
Battery Charger - Routine Tests according IEC 60146, and to be agreed by EFL

DC Switchboard - Routine Tests according to IEC.60439 and to be agreed by EFL

3.12 Warranty

A guarantee to EFL of batteries will be free of defects in materials and workmanship for a period of 5 years from the date of installed, operated and maintained as per the manufacturers Operation and Installation Instructions and as per Australian Standard 2676.2 – 1992.

A guarantee to EFL of battery charger will be free of defects in materials and workmanship for a period of 5 years from the date of installed, operated and maintained as per the manufacturers Operation and Installation Instructions and as per Australian Standard 2676.2 – 1992.

3.13 Applicable Standards

IEC 623: Vented nickel cadmium rechargeable single cells
BS 5634: Testing potassium hydroxide used in alkaline cells.
BS 381C: Specification for colours for identification coding and special purposes.
BS 4417: Specification for semiconductor rectifier equipment's.
IEC 146: Semiconductor convertors.
BS 88: Cartridge fuses for voltages up to and including 1000V AC and 500V DC
IEEE 1189-1996: Guide for Selection of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications

3.14 Spares

A list of all spares required to be provided with the tender and inclusive of the quotation.

3.15 Technical Schedule

The tender shall submit with his bid the completed schedule together with a compliance statement. The tender shall be valid for 6 month or effective till up to June 2024.

1. DC switchboard

Overall Dimension of unit	
Height	mm
Width	mm
Depth	mm
Weight of switchboard and charger	kg

2. Batteries

Type	
Manufacturer	
Number of cells	
Discharge capacity at one-hour rate	
Discharge capacity at ten-hour rate	
Normal charging rate	
Maximum charging rate	

Battery Dimension	
Length	
Width	
Height	
Battery sealed and maintenance free	
Expected value of life under service in section (1)	
Warranty period	
Some examples where this battery has been used in Substation duty and contact.	

3. Battery Charger

Type	
Manufacturer	
Continuous rated output	
Nominal output voltage	
Efficiency	
Input voltage	
Output voltage adjustment range	
- Float voltage	
- boost voltage	
Number of outgoing circuits	

4. Schedule for DC System

Item	**Required**	**Tendered**
Country of manufacture of charger		
Country of manufacture of batteries		
Country of manufacture of DC switchboard		
Country of manufacture of MCBs		
Country of manufacture of DC system monitoring		
DC System Panel Make & Country of Make		
DC Batteries:		
Type of battery	VRLA	
Normal Capacity for 10h Discharge to 1.8V Per Cell	600Ahr	
Design Service Life at 25deg C	>10yrs	
Nominal Voltage	110V	

Number of 2V Cells	min. 54	
Operating ambient temperature Range	10 - 40 degC	
Dimensions of each cell	Text	
Weight per Cell	Text	
Weight of complete bank	Text	
Short Circuit Current	Number	
Maximum charge current		
Terminal Type		
Number of discharge cycles over service life	>200 full discharges	
Capacity affected by temperature		
Internal resistance		
Self-discharge rate	< 3% per 30 days	
Discharge rate datasheet provided for storage		
Minimum storage life without discharge	> 3 months	
Flame retardant category to IEC 60707 for plastic components	IEC 60707	
Type of battery rack		
Battery Charger		
Charger make & model		
Rated Output Current	max 100A	
Numbr of Chargers offered as per design	Min 2	
Charger Type to AS 4044 (can operate without battery bank)	AS 4044 compliance	
Design life at 25deg C	>25yrs	
Mains supply voltage	400V or 230V, ±10%	
Mains supply frequency	50Hz, ±2.5Hz	
Minimum power factor when supplying rated current at nominal output voltage	Pf > 0.8	
Reference float charge voltage (without temperature compensation)		
Float charge voltage temperature compensation capability required	Yes or No	
Temperature compensation reference temperature	25 deg C	
Float charge voltage temperature compensation coefficient	mV/ deg C / cell	

Maximum float charge voltage (under temperature compensated float charge conditions)	> 131 Vdc	
Maximum ripple voltage in charger output with battery and load connected	max 2%	
Maximum ripple voltage in charger output without battery and load connected	max 2%	
AC to DC Isolation	≥ 2000 V	
DC output to earthed frame isolation	≥ 2000 V	
Enclosure degree of protection	IP 52 or better	
Maximum noise level at 1.5m < 55 dB (A)	<55 dB(A)	
Cooling type	Natural air	
DC System Monitoring		
Type of monitoring device/make/model		
Battery System Voltage is monitored	Yes	
Battery Charger Output Current monitoring available?	Yes	
Battery Bank Charge/Discharge Current monitoring available ?	Yes	
Load Current monitoring available	Yes	
Earth Fault monitoring available	Yes	
Battery Cell Monitoring		
Type of Battery Monitoring	individual cell / mid-point / other	
Monitors individual cell impedance	Yes	
Monitors battery bank temperature	Yes	
Individual cell voltage measured and logged	Yes	
Individual cel charge/discharge characteristic can be monitored and logged	Yes	
Hard Wired Watch-dog Alarm available		
DC Distribution Board		
Manufacturer's Type and model		
Main DC busbar rating		
Confirm Operational life of all Switchboards and shall be 25 years.		
Complete Board Dimensions: W x H x D		
Switchboard weight		
Circuit Breaker Mounting Chassis: Manufacturer		
Circuit Breaker Mounting Chassis: Type		

Circuit Breaker Mounting Chassis: Continuous current rating		
Location of cable entry	Bottom	
Standard to which board is designed and constructed	AS 61439	
DC Switchboard Panel		
Switchboard is IP51 rated with doors shut	IP51 or better	
IP 2x behind opened doors or panels	IP2X	
Material of switchboard panel is G316 S/Steel or better	S/Steel or Metal, >3mm	
Colour of panel	RAL7035	

Section 4

Employer's Requirements
Technical Requirement
Part 4
PROTECTION, METERING AND CONTROL

4.0 Section 4 - Employer's Requirements – Part 4 - Protection, Metering and Control

4.0 Protection, Metering and Control

4.1 Arrangement of Facilities

Protection and control equipment shall be mounted on panels and boards as specified and shall be erected in permanent buildings on the substation sites.

Panels provided as extensions or for erection in the same room as existing panels shall be of similar design and appearance to the existing panels. If existing protection is required to be modified for any reason, e.g. in order to operate with newly installed equipment, the Contractor shall supply all the necessary relays, panels, wiring terminals, wiring, etc. in order to ensure satisfactory performance. This shall include the modification of the "remote end" (other station and/or other switchgear part) of any protected circuit. The Contractor shall also modify / improve the corresponding drawings, erect all necessary equipment and perform the commissioning in accordance with the requirements shown in these Tender Documents.

Where additional relay equipment is to be installed in an existing station, it is the responsibility of the Contractor to ensure that the existing batteries and chargers have sufficient capacity to meet the additional load requirements of the new equipment. The characteristics and the appearance of all such equipment shall be to the approval of the Employer's Representative. Control panels shall incorporate all necessary control and indication facilities for the operation of equipment at the associated substation. A design concept shall be applied using decentralized modules for alarm (monitoring) and tripping functions operating independently of each other. All components shall be suitable for the local climate and the control and protection panels shall be dust and moisture-proof to withstand all prevailing climatic conditions. The specified maximum ambient temperature shall be taken into consideration in closed rooms, as the perfect operation of the air-condition system in the rooms shall be assumed as not guaranteed. The Contractor shall design the systems and select equipment accordingly. Open-air installed parts shall be protected against sun radiation by means of adequate and almost totally corrosion free steel covers, and shall be able to withstand all other prevailing climatic conditions.

All instrumentation and control equipment shall be capable of continuous satisfactory operation, within the specified accuracy ranges, during a change of the supply voltage within the specified limits.

All equipment as well as the terminals of the panels shall be easily accessible. Space for at least one panel at each row of panels in addition to the final extension stage shall also be provided.

The instruments, relays, switches etc. on the front of the panels shall be arranged in such a way that a good overview, reading and maintenance will be guaranteed. Furthermore all instruments, relays, etc. shall be clearly labelled in relation to their functions and to the equipment to be protected or supervised, or to the location of any measuring point. Labelling shall be identical in panels and on drawings. The front panel shall also contain a test block for testing purposes.

Where appropriate, each item of the plant is to be equipped with all necessary auxiliary switches, contactors and mechanisms for indication, protection, metering, control, and interlocking, supervisory and other services. All auxiliary switches are to be wired up to a terminal board on the fixed portion of

the plant, whether they are in use or not in the first instance. For maintenance purposes, it must be possible to individually isolate the protection and control circuits.

4.2 Construction of Cubicles

The interior of each cubicle shall be finished with a mat light coloured surface and an interior lamp suitable for the local LVAC supply and controlled by a door operating switch, shall be fitted at the top of each cubicle. Anti-condensation heaters shall also be fitted in each cubicle and each cubicle shall be well ventilated top and bottom through vermin proof louvers fitted with brass gauze screens. Each protection cubicle shall also be equipped with a built in AC supply socket out let of single phase, three wire rated 10 A at 240 V, 50 Hz. The cubicles shall be of the self-standing, floor-mounted type and shall be provided with ways and means for floor fixing and anchoring devices. They shall be supplied completely with their fixing and lifting racks and eye bolts.

Equipment and terminals shall be readily accessible and shall require a minimum of disturbance of associated adjacent equipment for access. The arrangement of panel wiring and multicore cable terminal boards shall be in accordance with ASNZ Standard.

Enclosures shall be provided for bottom entry of power and multi core cables via gland plates. Removable gland plates shall be located within the cubicles so as to provide adequate working clearance for terminating the cables.

Where relay movements and other sensitive equipment are mounted on hinged front panels, these shall be designed to minimize shock and wiring shall be so arranged as to impose no strain on terminations. No equipment whatsoever shall be mounted on rear access doors. All sections of a composite cubicle shall be suitably labelled in accordance with the Specification and labels at the rear shall also readily identify each section or panel with the access doors either opens or close.

Each protection relay panel shall be of the swing rack type including 19" swing frame and a front cover door equipped with a glass window and each control panel shall be of the enclosed type . Indoor cubicles and panels shall be of at least IP 41 protection class, and all outdoor local control cubicles shall be of IP54 with sun/rain shades of adequate size. Each door shall be fitted with suitable earth straps of at least 16mm2 highly flexible stranded copper wire with insulation in green-yellow colour.

Doors are to be arranged so that every individual door or frame can be opened without moving doors of adjacent cubicles. Doors shall be of 2 mm thick sheet steel, equipped with 120° concealed hinges, with foamed-in seal and shall be provided with a stable, bolted, rectangular tube frame, with pre-punched holes at 25 mm pitch for fixing channels, covers, cable harnesses, wiring plan pockets and etc. In each outdoor cubicle at least one door shall be equipped with sheet steel wiring plan pocket. If required, cross rails shall be fixed additionally. The doorstopper at the end of the throw shall be provided. All cubicles shall have rear doors, for easy maintenance and repair of the main- and auxiliary equipment accommodated in the interior.

The Contractor shall perform a calculation for the heat dissipation for enclosures with the maximum installed heat-losses and shall propose a suitable temperature control method. However the method has to be approved by the Employer's Representative. Control and relay cubicles and -cabinets are to be installed in totally air-conditioned control rooms.

All enclosures and accessories, such as swing frames shall be corrosion protected by electrophoresisdip-coat primers and final coats by an approved procedure as to suit the surrounding conditions at Site. The

arrangement and mounting of all indicating devices, control switches, relays and other apparatus shall be to the approval of the Employer's Representative. The exterior and interior finish and colour of all cubicles shall be to the approval of the Employer's Representative.

4.3 Cabling and Wiring

In selecting cable and wire sizes, due regard shall be paid to the appropriate de-rating factors in relation to the climatic conditions at site. All cables and wires shall continuously carry their rated currents under the worst temperature conditions, and shall also withstand maximum fault currents without damage or deterioration.

All secondary copper wiring within panels, racks, boards, etc. shall be in accordance with the pertaining IEC, it shall be carried out for the fully rated distribution voltage (2 kV AC/ 1 min. test voltage), and shall consist of copper wires. The bare ends of stranded wires shall be provided with squeezed sleeves.

The minimum cross-section of each copper wire shall be at least as given below:

- mm2 for current transformer circuits and heavy power consumers up to 20 A
- 2.5 mm2 for all power consumers such as motors, heaters, lighting, etc. up to 10A
- 1.5 mm2 for all instrument and control wiring, however, the maximum permissible Voltage drop is < 5 % for the furthest point at full load.
- 0.6 mm2 for all telephones wiring.

Wiring shall be neatly run in PVC rigid plastic wire-ways, clear of any metal panels and filled not more than 70 %, or bundles with no bunch containing more than 12 wires. Both ends of every wire core and all secondary panel wiring (at the screwed terminal side for external connection as well as at the screwed device sides in the panel) shall be fitted with numbered slip-on ferrules of moisture and oilresisting insulation material having a glossy finish, and with their identification numbers clearly engraved, each being the same as for the relevant terminal.

Wiring shall be neatly run in PVC rigid plastic wire-ways, clear of any metal panels and filled not more than 70 %, or bundles with no bunch containing more than 12 wires. Both ends of every wire core and all secondary panel wiring (at the screwed terminal side for external connection as well as at the screwed device sides in the panel) shall be fitted with numbered slip-on ferrules of moisture and oil-resisting insulation material having a glossy finish, and with their identification numbers clearly engraved, each being the same as for the relevant terminal.

All secondary wiring to be performed at Site shall enter the terminal block at one side only. The panel wiring shall terminate in one or more terminal blocks accommodated on the front of each panel. Internal wiring between instruments or other devices not using the terminal block shall be permitted within the same cubicle only.

At all times armoured and shielded cables and/or groups of cores shall be provided for control, protection and supervisory equipment. Cables carrying analogue signals shall be suitably twisted in pairs and the pairs shall be screened. Generally for wiring, the cable tails shall be so bound that each wire may be traced back to its associated cable without difficulty. Cores in pairs or groups shall be terminated together. All incoming control cables shall contain minimum 20% spare cores and be connected to terminal blocks, with 20% spare terminals of each type. Any further spare cores shall be numbered, and shall be sealed in further spare terminals.

Terminal blocks shall be numbered consecutively in both sides, preferably beginning with TB1, from left to right or top to bottom.

Terminal blocks shall consist of single "insertion" type terminals of non-tracking, non-inflammable synthetic plastic, or ceramic of an approved type, lined up in one row. Polyamide terminal blocks are not acceptable.

All terminals shall have two separate pressure clamping plates suitable for connection of incoming or outgoing stranded or solid conductors, respectively. However, only one wire per terminal will be accepted. Terminals with clamping screws in direct contact with the conductor are not acceptable. The following minimum categories of terminals shall be used:

- Terminals for power circuits of 10 mm 2 ' 6 mm2 and 2.52 mm size.
- Terminals with short circuit facilities for current transformer circuits of 4 mm size, and earthing-link terminals of current transformer and voltage transformer circuits, all provided with insulated testing sockets.
- Terminals for wiring of 1.5 mm2 and 0.6 mm2 size with bridging facilities to the neighbouring terminals.

Insulating barriers shall be provided between each group of power circuit terminals and between the terminal categories, the height and the spacing being such as to give adequate protection to the terminals.

Control and relay circuits, current and voltage transformer secondary circuits, battery and auxiliary power supply wiring, supervisory, alarm and communication circuits shall be protected against conductive, electrostatic and electromagnetic influences.

4.4 Labels on Instruments and Relays

Labels written in English shall be provided for all instruments, relays, control switches, push-buttons, indication lights, breakers, etc. In the case of instruments, switches and control switches where the function is indicated on the dial plate or on the switch escutcheon plate, no label is required.

Relays shall be clearly labelled according to their function in the circuits, and to their related equipment, which shall be identical to the designations as used in the circuit manuals. Each label shall be fitted both on relay front and on relay assembly. Instruction plates in English language showing the sequence diagrams or cautions for maintenance shall be fitted inside of the front door of the electrical switchboards. Sample of writings shall be submitted for approval to the Employer's Representative.

4.5 Test and Earthing Facilities

4.5.1 Earthing Facilities

Each control or relay panel shall be provided with a copper earth bar of not less than 80 mm2 cross-section and arranged so that the bars of adjacent panels can be joined together to form a common bus. The common earthing bus bar of control and relay panels shall be connected to the main station earthing system via a copper earthing connection of not less than 80 mm2 . Each current transformer secondary circuit shall be earthed through a removable link at one point only.

4.5.2 Test Facilities

All tests shall be carried out through a test block with a use of a test plug. The test block shall be mounted on the front of the panels for easy access.

4.5.3 Protection Devices

Protection equipment shall be designed and applied to provide maximum discrimination between faulty and healthy circuits. All equipment's are to remain inoperative during transient phenomena which may arise during switching or other disturbances to the system except power system faults.

The performance of the protection system and the performed coordination with the current transformer design shall be ensured. The Contractor shall submit a comprehensive technical report, which shall ensure that current transformer's and relays are designed saturation free under both transient and steady state fault conditions.

Current transformers, where possible, are to be located so as to include the associated circuit breaker within the protected zone and shall be located generally as indicated on schematic drawings.

4.6 SEL Relays

Relays shall be of approved types complying with latest version of the IEC 60255, and shall have approved characteristics. Only SEL from USA protective relays will be accepted.

The protection relays, shall be located in specified panels and shall be flush-mounted in dust and moisture proof cases with protection class IP54 and of the draw out type with rear connections. The protection class of the cover for all relays, or protection systems, in which the modules are mounted in 19" racks shall be IP55 or better.

Relays shall be of approved construction and shall be arranged so that adjustments, testing and replacement can be effected with the minimum of time and labour. Relays of the hand reset type shall be capable of being reset without opening the case.

Electrical protective relays shall be only of numerical type. Numerical protection shall be designed in such a way that in case of a failure of DC auxiliary in feed, the full information needs to be maintained for at least 24 hrs. After a recovery of DC auxiliary in feed the last information and alarms will be displayed and the alarm "failure of DC auxiliary in feed" released. The relay reset shall not erase the relay memory.

The protection functions shall be in the form of software such that additional or different functions, application specific logic etc. can be readily implemented without changes to the existing hardware.

All the numerical type protective relays shall be possible to program / parameterise directly (locally) and remotely by a portable computer (PC). All accessories equipment needed to communicate with the relays shall be provided. The relays shall be connected to the substation LAN which could be remotely accessed for required interrogation/download. The relay internal clock should have the provision to be updated by the EFL SCADA master clock. A GPS clock should be utilised to update the relay internal clock in case this provision is not available. The relay event log, disturbance records should be time tagged and these should be able to retrieve both locally and remotely by the substation LAN. The accuracy of time tagging shall be within ±1 ms. All the main protection relays shall have disturbance recorder and an event recorder in-built to them. Events shall be time tagged in the order of millisecond accuracy and the capacity shall be at least 100 events. The disturbance recorder shall include at least 6 analogue channels and 10 binary channels and the recording duration shall be at least 3 seconds.

Relay contacts shall be suitable for making and breaking the maximum currents which they may be required to control in normal service but where contacts of the protective relays are unable to deal directly with the tripping currents, approved auxiliary contacts, relays or auxiliary switches shall be provided. In such cases the number of auxiliary contacts or tripping relays operating in tandem shall be

kept to the minimum in order to achieve fast fault clearance times. Separate contacts shall be provided for alarm and tripping functions. Relay contacts shall make firmly without bounce and the whole of the relay mechanisms shall be as far as possible unaffected by vibration, shock and bump or external magnetic fields. Relays which rely for their operation on an external DC supply shall utilise for this purpose the same DC supply as the trip supply of the associated circuit-breaker trip coil. This supply shall be monitored and an alarm provided in event of failure.

Any auxiliary supplies needed shall be drawn from the main station batteries and not from separate internal batteries in the protection equipment.

Relays shall utilise a DC-DC converter type regulated power supply to provide transient surge isolation between the station battery and protection equipment. Each DC supply shall be designed to protect it from high voltage and surge and provide electrically isolated contacts for annunciation.

Relays with provision for manual operation from outside the case, other than for resetting, will not be accepted.

Relays shall be provided with clearly inscribed labels describing their application, version, type, serial number and rating etc. in addition to the general purpose labels. The protection schemes shall incorporate interface facilities to transform any offered low rated input/output signals of required equipment, to the necessary rated input/output signal. Unless otherwise specified, tripping shall always be directly from the relevant measuring relay.

Any tripping relay, which completes the protection relays' initiated tripping of a circuit breaker, shall have an operations indicator. The tripping-contactors' operation must be guaranteed also with 50 % of the rated DC voltage (pick-up at 80 % of DC, self-holding down to 50 % of DC). All protection relays shall be equipped with dedicated DC supply via MCB. The DC supply of all the protection relays shall be maintained by means of an auxiliary contact of the related MCB, which provide alarm in case of loss of supply.

Any interruption of the DC supply to relays (internal and external) shall initiate an alarm. Converters and inverters used for feeding relays shall have their outputs monitored and shall initiate an alarm in the event they fail. These devices shall be of short circuit proof design.

Section 4

Employer's Requirements
Technical Requirement
Part 5
Power and Control Cables

4.0 Section 4 - Employer's Requirements - Technical Requirement - Part 5 - Power and Control Cables

5.1 GENERAL

This Chapter of the Specification applies to single core and multicore solid dielectric insulated power cables and control cables. Polyvinyl Chloride (PVC) insulated cables shall generally be supplied for conductor cross-sections smaller or equal to 16 mm^2. Cross-linked polyethylene (XLPE) cables shall be generally supplied for larger cross-section than 16 mm^2.

5.2 L.V. 1000V Solid Dielectric Power Cables

5.2.1 Conductors

Conductors smaller or equal to 16 mm^2 shall consist of solid annealed copper or solid aluminium. They shall comply with IEC 60228, 60229, 60287 and 60811. Non-circular stranded conductors shall be pre-spiralled and compacted. Conductors of cross-section area larger than 16mm^2 shall be of stranded copper.

5.2.2 Insulation

Insulation shall be in accordance with IEC 60502 Clause 4.

5.2.3 Laying-Up

Laying-up of multi-core cables shall be in accordance with BS 5467 Clause 9.

5.2.4 Fillers

Where fillers are necessary to make a circular compact cable, for PVC insulated cable they shall be of PVC, for XLPE cable they shall be of PVC or cross-linked polyethylene. Textile and other hygroscopic materials are not permitted.

5.2.5 Core Identification

The cores shall be colour identified in accordance with Clause 7 of BS 6346, or Clause 8 of BS 5467.

5.2.6 Voltage Identification

The PVC outer sheath shall be embossed' "ELECTRIC CABLES" followed by the voltage, in accordance with Clause 15.2 of BS. 5467.

5.2.7 Screening

Conductor and insulation screening shall comply with IEC 60502 Clauses 5.2 and 5.3 and copper screens to Clause 8 of the same publication.

5.2.8 Armour

Armour bedding on multi-core cables shall comply with IEC 60502 Clause 6.6 and steel wire armour with Clause 11.

5.2.9 Oversheath

PVC outer covering type 9 (BS. 6746) shall be in accordance with IEC 60502 Clause 12.

5.2.10 Jointing

Jointing of LV cable is not permitted.

5.2.11 Sealing And Drumming

Immediately after the cable laying and testing, both end of the cable shall be sealed against the ingress of moisture, dirt and insects. The end projecting from the drum shall be similarly sealed and adequately protected against mechanical damage during handling.

5.2.12 Jointing Accessories

Jointing accessories for stranded copper conductor cables shall be designed for indentation ferrules. Solid aluminium conductors may be jointed with soldered ferrule. Conductor temperature during the soldering process shall be carefully monitored as not to exceed the maximum insulation temperature stated in the Technical particulars and Guarantees.

5.3 PVC Insulated Control Cables

5.3.1 Scope

This part of the Chapter is for control cables with stranded copper conductors, PVC insulated, shielded if required and PVC sheathed overall. The cable design shall generally be in accordance with IEC 60228 & IEC 60287.

5.3.2 Conductors

Conductors shall be of plain copper and have a cross sectional area of 2.5 mm_2 made up of 50/0.25mm strands or 4mm_2 made up of 56/0.30mm strands. Copper conductors shall meet the requirements of IEC 60028.

5.3.3 Laying Up

Multicore control cables shall contain one of the following standard numbers of cores - 4, 7, 12, 27, 37 & 48. For control cables having more than seven cores, the direction of lay shall alternate for each successive layer. A PTP binder tape 0.013mm thick applied over the laid up cores may be used at the discretion of the manufacturer.

5.3.4 Fillers

Where fillers are necessary to make circular compact PVC insulated cable, they shall be of PVC. Textile and other hygroscopic materials are not permitted.

5.3.5 Core Identification

The cores of control cables shall be identified in accordance with Employer's Standards for control wiring. These standards shall be provided to the Contractor upon request. When numerals are used, they shall be printed in black on the white core insulation at intervals not greater than 75mm throughout the length of the core. The print shall be permanent and not easily removed.

5.3.6 Voltage Identification

The PVC outer sheath of control cables shall be embossed with the legend "ELECTRIC LV CONTROL CABLE". The letter shall be raised and consist of upright block characters in accordance with the requirements of BS 6346.

5.3.7 Jointing Accessories

Details of the jointing method shall be given by the Contractor with the jointing accessory designs. Jointing of control cables is normally not permitted but in exceptional circumstances may be allowed subject to the Employer's Representative's approval. In this case stranded copper conductors may be

jointed together by crimped type ferrules and the single wires to be insulated by heat shrinkable tubes, which shall also be applied as an overall sheath for the jointed cable.

5.3.8 Armour

Armour bedding on multi-core cables shall comply with IEC 60502 Clause 6.6 and steel wire armour with Clause 11.

5.3.9 Oversheath

PVC outer covering shall be in accordance with IEC 60502.

5.4 Polyethylene Insulated Telephone Type Cables

5.4.1 Design

Telephone type multipair underground type and catenary type cables shall be of the filled type and shall have plain copper conductors insulated with polyethylene, armoured (underground type) and shall be sheathed overall with PVC. They shall be suitable for internal and external use in a tropical climate. Catenary type cables shall be suitable for an induced voltage up to 15kV.

5.4.2 Conductors

Each conductor shall consist of a single annealed copper wire, to BS. 6360 or IEC 60228 in so far as applicable for plain annealed copper wires and shall have a standard diameter of.

Underground type cable - 0.9mm
Catenary type cable - 1.38mm

The DC resistance per km of each conductor in the finished cable at 20_0C shall not exceed 29.67 ohms and 13.61 ohms respectively.

5.4.3 Insulation

The conductor insulation shall be of extruded polyethylene type 03 in accordance with BS. 6234. The radial thickness of insulation shall be:

0.80mm +/- 0.14 for both catenary type cables.

The insulation thickness shall be determined in accordance with Clause 18 of BS 6346.

5.4.4 Identification of Cores

The cable shall be made with twin twisted pairs. Cores shall be clearly colour identified as per attached Table 1.

5.4.5 Twinning and Laying Up

The insulated conductors shall be uniformly twisted together in pairs with a right hand lay. The length of lay shall not exceed 150mm and the lays of pairs which are adjacent within the finished cable shall differ in length and shall be so chosen that cross talk is as small as possible. In the case of two pair cables, the cores shall be laid in quad formation.

5.4.6 Fillers

Where Fillers are necessary for the satisfactory laying up of the cable pairs. They shall be of Polyethylene. Textile fillers are prohibited.

5.4.7 Binders

A polyethylene terephthalate (PTP) tape having a thickness of not less than 0.013mm shall be applied as an open helix over the centre cores if more than one pair and over each successive layer except the out layer over which the tape shall be applied with a 50 per cent overlap.

5.4.8 Bedding

Cables shall be provided with a bedding of extruded polyethylene type 03C in accordance with BS 6234. The armour bedding of underground type cables shall have a radial thickness in accordance with Table. 2. The bedding thickness of catenary type cables shall be 1.8mm.

5.4.9 Armour (Underground Type Cables Only)

The armour shall consist of one layer of galvanised steel or aluminium wires complying with the requirements of BS EN 10257 Part 1 and BS 2627 (condition H68) where appropriate. The size of armour wires shall be in accordance with Table 2.

5.4.10 Screening (Catenary Type Cables Only)

A screen consisting of a helical lapping of aluminium tape, which shall be, electrically continuous, shall be applied with a thirty percent overlap over the polyethylene bedding. The aluminium tape shall be 0.08mm thick and for cables of five pairs or more, of a width not exceeding the diameter of the laid up pairs plus 6mm tolerance. Alternatively, two tapes each applied with a gap not exceeding 3mm and breaking joint, or a polyethylene/aluminium laminate tape applied longitudinally may be used.

5.4.11 Oversheath (Underground Type Cables Only)

The outer protective covering shall consist of an extruded PVC compound shall be type TM 1 and coloured black in accordance with BS 6746. The sheath radial thickness shall comply with Table 2 and shall be determined in accordance with Clause 19 of BS 6346.

5.4.12 Integral Suspension String (Catenary Type Cables Only)

Catenary type cables shall incorporate an integral suspension strand which shall be of galvanised wire to BS 183 (Grade 1150), 7./1.25mm for cables with a diameter not exceeding 20mm and 7/1.60mm for cables having a greater diameter. The oversheath shall be PVC type TM1, coloured over the cable cores and the suspension wire to form a dumbbell cross section with a suitable dimensioned web for each size of cable. Dimensions to be supplied in Technical Particulars and Guarantees.

5.4.13 Identification of Manufacturer

The PVC oversheath shall be embossed with the name of the manufacturer and year of manufacture followed by

ELECTRIC CABLE - TELE

Embossing shall comply with Clause 14.2 of BS 5346.

5.4.14 Cable Lengths

The cables shall be supplied in drum lengths of not less than 500m unless shorter lengths are specified or are required to complete a specific order.

5.4.15 Jointing And Terminating Accessories

Straight through jointing accessories for telephone type control cables shall be designed or the accommodation of crimped ferrules. Straight through jointing of short cable lengths is normally not

permitted but, in exceptional circumstances, may be allowed subject to the Employer's Representative's approval.

5.5 Laying Direct In Ground

5.5.1 Excavation Of Trenches

The exact location of each trench shall be agreed at the site with the Employer's Representative before the installation work begins. Permits for excavation shall be obtained from the Employer's Representative. Trenches shall be kept as straight as possible and shall be excavated to approved formations and dimensions. Trenches shall have vertical sides and shall be close timbered and strutted where necessary to prevent subsidence.

The depth of excavated trenches for the installation of HV cables and MV cables shall be according to the Employer's Standards. The Employer's Representative shall make these standards available to the Contractor upon his request. The Contractor shall use no power excavation tools for excavation with in outdoor switchgear. The contractor shall take all precautions to avoid damaging any other power cables along the cable route. All excavation, cable laying and back filling shall be carried out only under the direct supervision of a responsible officer and only in the presence of a representative of the Employer's Representative.

5.5.2 Cable Laying And Protection

Before the cables are laid, the bottom of the trench shall be lined with approved soften sand well tamped down to a minimum depth of 50 mm to form a bed. After the cable are laid, the first cover of backfill shall consist of approved soften sand, well tamped down. A minimum depth of 80 mm of backfill shall be provided over the cables, over which the cable protective covers shall be placed. Cable protective covers shall be of reinforced concrete and otherwise approved, shall be 300 mm wide 50mm thick and 1000mm long. The reinforced concrete shall be tested and approved by the Employer's Representative. Alternative cable protective covers shall require approval form the Employer's representative. Each cover shall have cable route mark embossed in the concrete. They shall be design interlocking one with the other, both vertically and laterally. Special covers shall be provided where required for short radius bends. All cable protective covers shall meet the requirements of BS 2484 or equivalent IEC or ISO standard. The contractor shall provide GPS coordinates of cable route and joint locations. The Contractor shall place approved markers where joints have been made. These markers are to be on the surface and clearly visible from a distance. The joint markers shall have "EFL JOINT' marked clearly in large fonts.

5.5.3 Backfilling

The back filling of the trench shall be carried out in 150 mm thick layers, which shall be well rammed and consolidated. The Contractor shall supply any backfill material necessary to achieve the specified thermal resistivity in replacement of any unsuitable excavated material and the cost of removing and supplying the required material shall be included in the contract price. Marker tape shall be installed at a depth of 300mm from the top of the trench.

Section 4

Employer's Requirements
Technical Requirement
Part 6
INSPECTION AND TESTING

4.0 Section 4 - Employer's Requirements - Technical Requirement - Part 6 - Inspection and Testing

6.1 General Requirements

The plant covered by this Contract will be subjected to inspection and test witnessed by the Employer/Employer's Representative during manufacture and on completion. The approval of the Employer/Employer's Representative or the passing of any such inspection or test will not, however, prejudice the right of the Purchaser to reject the Plant if it does not comply with the Specification when erected to give complete satisfaction in service. The costs of all tests and inspection shall be borne by the Contractor and shall be deemed to be included in the Contract Price.

Before any plant is packed or dispatched from the Main or Sub-Contractor's works, all tests called shall have been successfully carried out to the satisfaction of the Employer/Employer's Representative. Adequate notice shall be given when the plant is ready for inspection or test and every facility shall be provided by the Contractor and his Sub-Contractors to enable the Employer/Employer's Representative to participate at the necessary inspection and tests.

6.2 Tests at Manufacturer's Works

Works tests shall include all routine electrical, mechanical and hydraulic tests in accordance with the relevant IEC Standard except where departures therefrom and modifications thereto embodied in this Specification. For plant not covered by any ISO or IEC or specially mentioned in this Specification, such tests as are relevant shall be agreed with the Employer/Employer's Representative. Should the Plant or any portion thereof fail under test to give the required performance, further tests, which are considered necessary by the Employer/Employer's Representative, shall be carried out by the Contractor and the whole costs of the repeated tests will be borne by the Contractor. This applies also to tests carried out at the Sub-Contractor's works. No item of Plant is to be dispatched to Site until the Employer's Representative has given his approval in writing.

6.2.1 Sub-Contractors

Within two months of acceptance of the Tender, the Contractor shall forward to the Employer's Representative, a list of all sub-orders placed or intended. The contractor shall submit three copies of all sub-orders as selected by the Employer's Representative for progress or inspection. One copy of all drawings referred to in the sub-orders is to be submitted, unless otherwise agreed by the Employer's Representative. The drawings and sub-orders submitted to the Employer's Representative shall cover all components, which are subjected to electrical & mechanical pressure or stress when the plant is in operation and also those items, which will be dispatched to Site direct from the sub-Contractor's works. For the purpose of this clause, inter works orders shall be treated as sub-orders. Sub-ordered shall include a statement advising the Sub-Contractor that the items being ordered will be subject to inspection and test by the Employer/Employer's Representative.

It is important that all copies of sub-orders are clearly marked with the name of the contractor and the following references:

Employer's Name:
Contract Number:

Sub-Contractors shall comply with all the applicable requirements of this Specification and, in particular, with this Chapter. Orders issued by the Sub-Contractor shall also include the Main Contractor's name and reference on their sub-order in addition to the above-mentioned heading.

6.2.2 Material Tests

The contractor shall provide test pieces as required by the Employer's Representative to enable him to determine the quality of the material supplied under this contract. Such test pieces shall be prepared and supplied free of charge and any cost of the tests shall be borne by the contractor. If any test piece fails to comply with the requirements of the appropriate specifications for the material in question, the Employer's Representative may reject the whole of the material represented by that test piece: the Contractor's designers and metallurgists will be consulted before any material is so rejected.
In the event of the Employer's Representative being furnished with certified particulars of tests, which have been carried out for the Contractor by the suppliers of materials, they may, at their own discretion, dispense with the previously mentioned test entirely.

6.2.3 Test Certificates

Triplicate sets of all principal test records, test certificates and performance curves shall be supplied for all tests carried out in accordance with the provision of this Contract. These test records, certificates and performance curves shall be supplied for all tests, whether or not they have been witnessed by the Employer/Employer's Representative. The information given in such test certificates and curves shall be sufficient to identify the material or equipment to which the certificate.

6.3 Site Tests and Commissioning Tests

Tests on completion of erection shall be carried out by the Contractor in accordance with Clauses 28 of the General conditions of Contract (FIDIC). Test equipment shall be provided by the Contractor. The contractor shall state in the Schedule of "Special Tools and Appliances", any special testing equipment he thinks necessary.

The Contract Price shall include the hire of the equipment but the Schedule of Prices shall include the cost of the equipment so that the Employer's Representative may have option to buy the equipment on completion of the Contract.

Section 4

Employer's Requirements
Technical Requirement
Part 7
GENERAL REQUIREMENTS

4.0 Section 4 - Employer's Requirements - Technical Requirement - Part 7 - GENERAL REQUIREMENTS

7.1 General

7.1.1 General Design of Equipment

In complying with the requirements of the specification, design shall conform to the best current engineering practice. Each component part of the Plant shall be to the maker's standard design provided that this design is in general accordance with the Specification. Generally, all equipment and materials shall be in accordance with the International Electrotechnical Commission (IEC) standards, International Standardization Organization (ISO) standards or standards especially indicated in the respective Chapters. The issues of standards valid for the contract shall be the latest issues (including amendments) current at the Tender closing date.

Wherever in these specifications the requirements are stricter than those in the standards, these specifications represent an additional requirement above that of the standard. The essence of design should be simplicity and reliability in order to give long continuous service with high economy and low maintenance costs. Particular attention should be paid to internal and external access in order to facilitate inspection, cleaning and maintenance. The design, dimensions and materials of all parts are to be such that they will not suffer damage as a result of stresses under the most severe service conditions. Fully detailed specifications of the component parts of the plant are to be submitted describing particularly the materials to be used. Works shown upon the drawings and not mentioned or described in the specification, and works described in the specification and not shown on the drawing will nevertheless be held to be included in this contract and their execution shall be covered by the contract price in the same manner as if they have been expressly shown upon the drawings and described in the specification. The materials used in the construction of the Plant shall be of the highest quality and selected particularly to meet the duties required to them. Mechanisms shall be constructed to avoid sticking due to rust or corrosion. Workmanship and general finish shall be of the highest quality throughout.

All similar parts of the Plant shall be interchangeable. All apparatus shall operate without undue vibration and with the least practicable amount of noise. All equipment shall be designed to minimise the risk of fire and any damage, which may be caused in the event of fire, shall be as minimal as possible. All apparatus shall be designed to prevent the risk of accidental short circuit, malfunction or damage due to vermin. All items of equipment, which may have to be lifted for erection or maintenance, shall be provided with lifting eyes, jacking pads or alternative handling facilities. The Contractor shall also abide by the Project Manual which documents the project organisation, details the form and handling of correspondence and documents including a numbering system, procedures for meetings and document approval, gives some guidelines on quality assurance, time scheduling and progress monitoring.

7.1.2 Quality Assurance

The quality of the design, manufacturing and erection processes shall be assured by the Contractor in accordance with the ISO 9000 series standards. The Contractor must prove his possession of the respective certificates.

The Tenderer shall prove that the quality of the design, manufacturing and erection is done in accordance with the ISO 9001. The Tenderer shall submit respective certificates issued by an International Organisation for major materials used in the project.

7.1.3 Units of Measurement

In all correspondence, in all technical schedules and on all drawings metric systems International Units (SI) units shall be used. On drawings where Imperial or other units have been used it will be in order if the equivalent SI units are suitably marked in addition.

7.1.4 Compliance with Specification

Notwithstanding any descriptions, drawings or illustrations which may have been submitted with the Tender, all details other than those shown on the Schedule of Departures will be deemed to be in accordance with the Specification and the standard specifications and codes referred to therein. No departures from the Specification except those shown on the Schedule of Departures and approved by the Employer are to be made without the written approval of the Employer's Representative.

All exceptions shall be clarified and separately itemised. It shall not be necessary for the Purchaser to examine the standard literature and documents of the manufacturer to determine the existence and extend of any exceptions or deviations from specification.

7.1.5 Drawings

Before the work is put in hand, three copies of general drawings and diagrams showing all details of the Plant and materials to be used shall be submitted to the Employer's Representative for approval. The wiring or connection diagrams shall be submitted for approval unless prior approval has been obtained for schematic diagrams, which shall include control and protection schematics, showing the facilities being provided and the working of the schemes. Detailed drawings shall be submitted in quadruplicate as soon as possible after the commencement date and in any case in sufficient time to permit modifications to be made, if such are deemed necessary by the Employer's Representative, without delaying the delivery of the Contract work. The drawings submitted shall be modified as requested by the Employer's Representative and re-submitted for approval. When requested by the Employer's Representative, the Contractor shall supply at his own expense a copy, of any standard pertaining to the material or equipment covered by the contract. Any documentation submitted by the Contractor for approval shall only be in sizes A1, A2, A3 or A4 (210 X 297 mm), preferably A3 and A4. A2 and A1 shall only be used if absolutely necessary. All drawings shall be prepared using AUTOCAD 2018 or better. All documents shall bear a drawing or document title in a form and with a numbering system, which will be explained to the Contractor by Employer's representative. This numbering system will be in a format that is compatible to the existing numbering system of the Employer.

Following documentation shall definitely be included in the documents to be submitted by the Contractor for approval by the Employer's Representative before construction or erection of the respective part of the works may start:

- detailed layout of all areas and equipment
- arrangement drawings of all equipment
- foundation drawings and design calculations
- functional block diagrams for protection
- complete circuit diagrams
- Earthing grid calculation
- Current Transformer calculations
- dimensional drawings of all equipment and installation
- general structural design calculation & drawings of all equipment and all buildings
- detailed construction schedule in form of a bar chart
- cable laying diagram
- building structures
- bending schedules

- drawings of lighting and small power installation

The contractor shall submit a complete list of all drawings listing the drawing number and title, together with the date that the drawing is planned to be submitted for approval, and the date it is required on site. In the same list, the actual dates of submission of each revision as well as date and status of approvals. The Contractor shall update the list at monthly intervals.
If the Contractor requires urgent approval of some drawings to avoid delay in the delivery of the Contract Works, he shall advise the Employer's Representative to such effect when submitting the drawing.

It shall be understood, however, that approval of the drawings will not exonerate the Contractor from any responsibility in connection with the work. After all items of Plant have been manufactured and erected, data file on Auto CAD format or reproducible digitised drawing file, of each drawing previously approved shall be provided together with four prints on heavy gauge white paper from such drawings as may be required to show the detail and arrangement of the Plant as made and installed. All drawings submitted by the Contractor or by any Sub-Contractor shall have the following particulars in the lower right hand corner in addition to the Contractor's name, date, scale, number and title of the drawings:

(i) Site
(ii) Project Name
(iii) Name of Employer – Energy Fiji Limited
(iv) Description of Apparatus
(v) Contract Name
(vi) Contract No.
(vii) Revision No.

The Contractor shall when submitting drawings provide an indexing system for all the drawings divided into sections for each substation and sub-divided for each type of equipment, e.g., indoor switchgear, control and relay panels, wiring diagrams, schematics, ancillary equipment, foundation, steelwork, etc.

The index shall contain the following information for each drawing:

(1) Drawing number
(2) Revision
(3) Title
(4) Data submitted for approval
(5) Date returned for correction
(6) Data approved for construction
(7) Date final drawings submitted
(8) Number of copies
(9) Remarks/distribution column for use by the Employer's Representative.

7.1.5.1 Drawings and Records

The contractor shall keep on site accurate and up to date drawings and records, and shall provide the Employer's Representative with one set of copies each. At the end of every week the Contractor shall submit to the Employer's Representative schedules of labour, plant and materials employed on the site during that week.

7.1.5.2 As built documentation

All documentation approved by the Employer's Representative and any documents used during erection or commissioning shall be updated at the end of the commissioning period to show the as built status. This updating shall be done by hand, clearly marking any changes in red colour. Two sets of complete drawings at least shall be prepared under the responsibility of the contractor's chief commissioning engineer. One set shall remain with the Employer's Representative while the other set is sent to the contractor's office where all modifications will be included in new neat as built documents which shall be distributed to the Employer and to the Employer's Representative. Receipt and acceptance of this documentation shall be a prerequisite for the issuance of the final acceptance. Soft copies of all as-built drawings has to be provided.

7.1.6 Access To Site

The Contractor shall make his own arrangements for handling and transport, and off loading at site, so as no facilities being available for him, free of cost. Plant will generally be delivered to the sites by road. The Contractor is to make his own enquiry as to the suitability, availability and charges for railway cranes, suitability of available wagons for the transport of any loads and any restrictions imposed by clearance gauges. The highways, road and bridges have widely varying load limits and the Contractor shall be responsible for determining the load limits existing at the time and ensuring that his Plant does not exceed such limits.

The Contractor shall be deemed to have included in his costs any temporary measures necessary to allow the transport of the Plant over existing roads and bridges. Before moving any heavy traffic on to highways, road and bridges, the Contractor shall make suitable arrangements with the appropriate Government authorities and obtain their approval for the passage of such traffic. In the event that any permanent reinforcement of road and bridges may be considered necessary for transport of the Plant, the Tenderer shall obtain an estimate of the costs from the Government Department concerned and include this as a provisional sum in the Schedule of Prices. Within the site areas, the Employer will maintain existing roads and the Contractor will be given use of the roads essential to his operations free of charge for normal traffic. Any damage caused by the Contractor's abnormal traffic shall be repaired at his own expense. The contractor shall take into account the fact that the Grid Sub Stations are high security areas, where access is strictly controlled. The contractor shall follow all security procedures adapted at these installations.

7.1.7 Packing

Each item shall be packed properly and protected for shipment and transport from the place of manufacture to Site, and in addition for storage for a minimum of three months under the Site climate conditions. The recommendations of the BS 1133 Packaging Code or equivalent International Standard shall be observed with particular reference to:

Section 5: Protection against spoilage of packages and their contents by microorganisms, insects, mites and rodents.
Section 6 : Temporary protection of metal surfaces against corrosion.
Section 8 : Wooden containers

Tube ends and other similar open ends shall be protected from both, external damage and ingress of dirt and moisture during transit and while awaiting erection at Site. Flanged pipes shall have their open ends protected by adhesive tape or jointing and then be covered with a wooden blank flange secured by service bolts.

Precautions shall be taken to protect shafts and journals where they rest on wooden or other supports likely to contain moisture. At such points, wrappings impregnated with anti-rust composition or vapour phase inhibitors shall be used of sufficient strength to resist chafing and indentation due to movement, which is likely to occur in transit. Protective wrappings and impregnation shall be suitable for a period of three months. In the case of ball or roller bearings installed in any item of Plant, precautions shall be taken to avoid indentation of the bearing races.

Metal bindings of cases shall be of corrosion resistant material and shall be properly tightened and the ends crimped together by means of a purpose made tool.

Contents of cases shall be bolted securely or fastened in position with struts or cross battens preferably supported by cleats fixed to the case so that there shall be no movement. Where parts are required to be bolted to the sides of the case, large washers are to be used to distribute the pressure and the timber shall be strengthened by means of a pad. Where practicable, all indoor items such as electric motors, switch and control gear, instruments and panels, machine components, etc., shall be "cocooned" or covered polyethylene sheeting, sealed at the joints and the enclosure provided internally with desiccators. All delicate equipment e.g. relays and instrument shall be removed from panels and packed separately for transport in the same consignment as the associated panels. The packing shall contain all equipment destined for the same location. Where transformers or similar devices are shipped under oil, the oil level shall be above the core and the windings and a silica gel breather shall be fixed to the tank cover or pipe work for protection against moisture entry during transport.

Each crate or package shall contain a packing list in a waterproof envelope. All items of material are to be clearly marked for easy identification against the packing list. All cases, packages, etc., shall be clearly marked on the outside to indicate the total weight, to show where the weight is bearing and the correct position of the slings and shall bear an identification mark relating to them to the appropriate shipping documents. Stencil marks on the outside of casings shall be indelible.

The Employer's Representative may require to inspect and approve the packing before the items are dispatched but the Contractor shall be entirely responsible for ensuring that the packing is suitable for transit and such inspection will not exonerate the Contractor from a loss or damage due to faulty packing.

7.1.8 Installation, Operating And Maintenance Instructions

When the general arrangements and details of the Plant have been finalised and not later than the erection commences, the Contractor is to submit to the Employer's Representative for approval fully detailed installation instructions.

The details ask to cover the main plant and all associated ancillary equipment as supplied under the Contract. It will not be sufficient to incorporate manufacturers' standard brochures as part of the text unless they refer particularly to the equipment supplied and are free of extraneous matter. The information provided should include essential circuit diagrams, general arrangement and detailed drawings of the installation make mention of special materials, erection apparatus and tools where used and include schedules of lubricants and all ball and roller races employed on the Plant. The drawings and diagrams, which may be approved existing drawings reduced to a convenient size, should be bound into the volume and not inserted into cover pockets. List of contract record drawings shall be included. If the complete text is unduly bulky, then the manual is to be appropriately sub-divided and produced in multi-volume form. When approved, four copies of the complete text, diagrams and drawings as made up in draft form are to be handed to the Employer's Representative for distribution at Site and these are to be provided not later than the erection commences.

Handing over of originals of Operating and Maintenance Instructions shall be as per the General Conditions of Contract. A further four copies are to be reproduced as a book or books of approximately A4 size and bound into durable covers inscribed in permanent form upon the front generally in the form of the title page to this document except that the references to Specification, Conditions of Contract, Drawings, etc., will be replaced by "Operating and Maintenance Instructions". The name of the main Contractor and that of any Sub-Contractor shall also be inscribed upon the cover after the description of the Plant. The name of the Employer and substation or other identification followed by a classification of the plant (e.g. 33 kV Switchgear), is to be inscribed upon the spine of the cover and, if the instructions are contained in several books, these are to be marked with the appropriate volume number.

7.1.9 Cleaning And Painting

7.1.9.1 General

All bright metal parts shall be covered, before shipment, with an approved protective compound and protected adequately during shipment to Site. After erection these parts shall be cleaned with a correct solvent and polished brightly where required. Before testing, all steel pipes shall be thoroughly cleaned by an approved process. Any protective coatings shall be applied after tests have been carried out. Pipes, valves and other similar parts of the Plant which are subject to hydraulic test and are not readily accessible for drying out are on completion of tests at the manufacturer's works to be drained out by washing with approved de-watering oil prior to protection for shipment.

All surfaces shall be prepared before coating in accordance with ISO 1456, ISO 1458 or others as applicable.

All iron and steel structures shall be protected against corrosion in accordance with Chapter 13.Where painting is carried out at the manufacturer's works and where erection at Site is the responsibility of the Contractor, any damage during delivery or erection at Site shall be made good to the requirements of the Employer's Representative including, where deemed necessary, application of a complete finishing coat of an approved colour and quality paint. Where painting is carried out entirely at Site after erection, the whole of the Plant, including bare pipe surfaces and hand railing, shall be well wire brushed down and cleaned after which all parts shall be given one coat of primer, one undercoat and at least one finishing coat of an approved colour and quality paint. All paint shall have appropriate standard finish, requiring at least two finishing coats on prepared surfaces properly filled in to provide a smooth finish. The insides of outdoor control cubicles, cabinets, etc., where condensation is liable to occur, shall receive the same number of coats.

7.1.9.2 Tanks and Accessories

Interiors of oil tanks shall be thoroughly cleaned by shot blasting or other approved methods and, where exposed to corrosion before use, shall be coated with an approved corrosion preventing compound. The internal surfaces of oil tanks that will be exposed to atmosphere in service shall be painted with an epoxy or other approved oil resisting compound. The exterior shall be thorough cleaned by shot blasting or other approved methods and given one coat of primer, two coats of contrasting colour of durable oil and weather resisting paint and a final coat of gloss paint.

7.1.9.3 Radiators

Radiators shall be thoroughly cleaned and treated externally by phosphating or other approved rust inhibiting process and given, preferably by flood painting, the same number and type of coats specified in Sub-Clause 11.1.9.2 of this Clause. Radiators, which are hot dip, galvanised, shall be artificially

weathered and given one coat of zinc chromate primer followed by the same number and type of paint coatings specified in Sub-Clause 11.1.9.2 of this Clause.

7.1.10 Lubrication

The Contractor is to include for the supply of flushing oil for each lubrication system when the item of plant is ready for preliminary tests and the first filling of approved lubricants for the commercial operation of the plant.

A schedule of the oil and other lubricants recommended for all components of the Contract work is to be submitted to the Employer's Representative for approval. The number of different types of lubricants is to be kept to a minimum. Copies of this schedule shall be included in both the draft and final copies of the Operating and Maintenance instructions. In the case of grease lubricated roller type bearing for electrical motors, lithium based grease is preferred. Where lubrication is effected by means of grease, preference will be given to a pressure-gun system with a separate nipple to each point. Where necessary for accessibility, the nipple is to be placed at the end of extension piping, and when a number of such points can be grouped conveniently, the nipples are to be brought to a battery plate mounted in a convenient position. Nipples shall be of the hexagon headed type complying with BS 1486 Part1 table1 type 11B or equivalent IEC/ISO. Where special greases are to be used and where high temperatures are encountered, then 'button' nipples in accordance with BS 1486 or equivalent IEC/ISO are preferably to be used. The Contractor is to supply at least one grease gun equipment for each type of nipple provided. Where more than one special grease is required, a grease gun for each special type is to be supplied and permanently labelled.

7.1.11 Tropicalisation

In choosing materials and their finishes, due regard shall be given to the humid tropical conditions under which equipment is to work, and the recommendations of British Standard Code of Practice 1014 or equivalent IEC/ISO should be observed unless otherwise approved. Some relaxation of the following provisions may be permitted where equipment is hermetically sealed but it is preferred that tropical grade materials should be used wherever possible.

7.1.11.1 Metals

Iron and steel are generally to be painted or galvanised as appropriate. Indoor parts may alternatively have chromium or copper-nickel plating or other approved protective finish. Small iron and steel parts (other than stainless steel) of all instruments and electrical equipment, the cores of electromagnets and the metal parts of relays and mechanisms are to be treated in an approved manner to prevent rusting.

7.1.11.2 Screws, Nuts, Springs, Etc.

The use of iron and steel is to be avoided in instruments and electrical relays wherever possible. Steel screws are to be zinc, cadmium or chromium plated, or when plating is not possible owing to tolerance limitations, are to be of corrosion-resisting steel. Instrument screws (except those forming part of a magnetic circuit) are to be brass or bronze. Springs are to be of non-rusting material, e.g., phosphor bronze or nickel silver, as far as possible. Brass or bronze is preferred.

7.1.11.3 Rubbers

Neoprene and similar synthetic compounds, not subject to deterioration due to the climatic conditions, shall be used for gaskets, sealing rings, diaphragms, and transformer vibrations pads etc.

7.1.12 Tools

Where specified, the Contractor shall supply in steel boxes, complete with keys, any normal tools that are required for making adjustments to equipment during normal operation or maintenance. Any special tools required for erection, commissioning, operation and maintenance of the equipment should be indicated in the price schedule with individual quantities, minimum time for delivery, and prices including the cost of delivery to the Employer's store. These special tools shall be of alloy steel. All tools shall be stamped with an approved identification.

7.1.13 Spares

The Contractor shall state in the Schedule of Spares the spares that he recommends, with individual quantities and CIF prices, together with the cost of the delivery to the project site.The Employer may order all or any of the spares so recommended at his discretion. Those ordered shall be delivered to the Employer's Representative at the Employer's store or on the Site no later than the date of issue of the Taking Over Certificate for the item of Plant or equipment in question. They shall also be delivered within the minimum period stated in Schedule E for the delivery of the spares from the date of receipt of the Employer's order.

These spares will be charged against the Provisional Sum included in the Schedule of Prices and shall be supplied at the prices listed in the Schedule of Spares subject to the qualification that, if any sparesshould be ordered after the date of the Taking Over Certificate in question, the price may be subject to adjustment.

All spares supplied shall be strictly interchangeable with the parts for which they are intended to be replacements of and shall be treated and packed for long storage under the climatic conditions prevailing at the Site. Each spare shall be clearly marked or labelled on the outside of its packing with its description and purpose and, when more than one spare is packed in a single case or other container a general description of its contents shall be shown on the outside of such case or container and a detailed list enclosed inside. All cases, containing and other packages must be suitably marked and numbered for purposes of identification.

7.1.14 Inventory Records For Plant & Material

The Contractor shall forward his inventory records for plant & material at the end of each month to the Employer.

7.2 MECHANICAL

7.2.1 Nuts, Bolts, Studs And Washer

Nuts and bolts for incorporation in the plant are preferably to conform to ISO Metric Coarse to ISO 68,261,262,272,724, 885,888 and 4759 or BS 3643, 3692 and 4190. Other sizes or threads are permitted for threaded parts not to be disturbed in normal use or maintenance. Where the Contract includes nuts and bolts of different standards, then the tools to be provided in accordance with the Specification are to include spanners, taps, and dies for these nuts and bolts. Bolts shall fit in the reamed holes they occupy. They shall have the screwed portion of a diameter such that it will not be damaged in driving and are to be marked in a conspicuous position to ensure correct assembly at Site. On equipment all bolts, nuts and washers shall be non-rusting material where they are in contact with non-ferrous parts in conductor clamps and fittings and elsewhere where specifically required by the Employer's Representative. All washers are to be included under this Contract, including devices and anti-vibration arrangements, which are to be subject to the approval of the Employer's Representative. Taper washers are to be fitted where necessary. Where there is risk of corrosion, bolts and studs shall be finished flush with the surface of the nuts and electro-chemical corrosion shall be avoided by bimetallic plates.

7.2.2 Rivets

Rivets shall conform to the appropriate ISO and general use pan heads are preferred. Rivets on bearing surfaces are to be flat counter-sunk, driven flush. Whenever practicable, riveting is to be done by hydraulic tools and the rivets must completely fill the holes when closed. If loose, or if the heads are badly formed, cracked or eccentric to the shank or do not bear truly on the plate or bar, such rivets are to be cut out and replaced. All surfaces to be riveted must be in close contact throughout.

7.2.3 Forging

All-important forging are to be examined by the latest methods for the detection of defects.

7.2.4 Castings

All castings are to be free from blowholes, flaws and cracks as is practicable. No welding, filling or plugging of defective parts is to be done without the sanction of the Employer's Representative and then only with his approval in writing. All cast-iron is to be of close-grained quality and is to be corrosion-resistant for those parts in contact with seawater. Cast-iron is not to be used for any part of the equipment which is in tension or which is subject to impact stresses. This clause is not intended to prohibit the use of suitable grades of cast-iron for parts where service experience has shown it to be satisfactory.

7.2.5 Welding

Where fabrication welds are liable to be highly stressed, the Contractor is to satisfy the Employer's Representative before such welding commences, that the welders or welding operators are qualified in accordance with the requirements of the appropriate section of BS 4872, Part 1 or equivalent IEC/ISO Standard Specification. The Employer's Representative will inform the Contractor of the stages at which inspection will be required. It will be the Contractor's responsibility to notify the Employer's Representative when one or more of the inspection stages will be reached and no further work is to be carried out until the specified stage has passed the Employer's Representative's inspection. In addition to the above, the Employer's Representative reserves the right to visit the Contractor's Works at any reasonable time during fabrication of the items of Plant and to familiarise himself with the progress made and the quality of the work to date. All tests are to be carried out in accordance with the relevant ISO or other approved standards. Where required by the Employer's Representative, non-destructive examination of the finished weld is to be made. If the examinations be by radiograph means, then the recommendations of BS EN 1435 or equivalent IEC/ISO where applicable are to be followed and the resulting negatives are to be made available to the Employer's Representative.

7.2.6 Chromium Plating

The chromium plating of those components of the Plant where specified and where offered by the contractor is to comply with the requirements of ISO 1456 & 1458 or BS 1224.

Section 4

Employer's Requirements
Technical Requirement
Part 8
CIVIL WORKS

Section 4 - Employer's Requirements - Technical Requirement - Part 8 - Civil Works

The civil works shall include collection of site data, detailed design, production of working drawings, provision of labour, supply of construction plant and materials, construction and rectification of defects during the Warranty Period of the Works.

The Scope of Work shall include, but not be necessarily limited to, the following:

a. Site Works: Site clearance, excavation and filling of the Site to formation level suitable for Civil works including running surplus excavated materials to disposal area, foundations, site roads and surfacing, water supply, sewage treatment, cable ducting, pipe ducting, drainage, landscaping, fencing, boundary wall and gates.
b. Foundation: For all plants and structures supplied under this Contract. Suitable foundations shall be provided for the 33kV switchgears, transformers, NER and all other equipment, buildings and structures.
c. Temporary works as necessary to construct the permanent works. Provision of site office for the Engineer and the Project Director including all services, furnishings, and attendance for the period required by the Engineer but not exceeding one month after the final taking-over date.

8.1 Preliminary Works

8.1.1 Site Survey

Contractor shall collect for himself site levels, sub-soil data and other information to enable him to estimate the bearing capacity, foundation requirements, etc., for use in the preparation of the tender. After the award of the contract, the Contractor must make his own site surveys to collect all the information to prepare layout drawings.

The Contractor shall be responsible for all setting-out, irrespective of any checking by the Employer's Representative.

The Contractor shall survey the site of the new substation to obtain the following.
(1) Location of datum of setting out and levelling.
(2) Establishment of site boundaries and reduced site datum level.
(3) Position and condition of any approaches, bridges and access roads to and over the site, including highest recorded flood level (from local knowledge).
(4) Existing site levels on a 5 meters grid; and resultant contours at a meter vertical interval.
(5) Drainage pattern of the area

The Contractor shall survey the sites of the substations to obtain details of above items. Site survey plan at a scale of 1: 500 shall be prepared, showing the survey results and the proposed layout of the new works. The plan shall be sent to the Employer's Representative for his approval. After completion of the work, the Contractor should do a complete detail survey of the substation including all the parts completed to the date of handing over. The Employer's Representative should be provided with 3 hard copies and a soft copy of the results.

8.1.2 Sub soil Investigations

After award of the contract, the Contractor is to ascertain for himself the nature of the sub-soil conditions of the work sites by means of boreholes and DCP test etc. Samples shall be taken as necessary and tested to determine the physical and chemical characteristics of various strata and of the ground water. The sub-soil investigation should include determination of the design bearing pressure recommendations for foundations type and material to be used for the foundations. The safe bearing capacity of the sub-strata may be modified at his final design stage when the full site survey and investigation have been completed and the final layout, structural details etc. agreed. No variation in contract price will be made due to any variation in the bearing capacity leading to modification of foundation design at the final design stage. Special attention shall be paid to the Ground water table and chemical composition of the ground water and soil in the substation area. The following should be considered as a minimum requirement, assuming uniform conditions over the Site, but should be extended if many inconsistencies are encountered.

(1) Depth of boreholes shall be continued up to bedrock if it does not meet the hard stratum of N- value more than 50.
(2) Borehole records shall describe and indicate level of all soils encountered and indicate the natural water table level. Rock core records shall specify total core recovery, solid core recovery and quality of the rock cored.
(3) Where applicable, samples of soil shall be obtained from all soil strata or at 2 meters intervals in a single stratum and tested to determine physical and chemical properties, particularly with respect to substances, which would react with concrete or other materials to be used for the foundation works.
(4) Where applicable, in situ soil tests shall be applied to all soil strata or at 2 meter intervals in a single stratum. Standard Penetration test in non-cohesive soils, field vane tests in sensitive cohesive soils.
(5) Ground water samples shall be obtained from each Borehole and tested in accordance with approved practice.
(6) Electrical resistivity of the soil shall be verified on four samples, in accordance with approved practice (e.g. IEEE 80).

Appropriate laboratory tests shall be carried out on all soil and ground water samples to an extent approved by the Employer's Representative. All tests shall be in accordance with an approved standard, e.g. British Standard 1377.Records of ground borings and trial excavations, results of in situ tests and laboratory tests to determine the physical and chemical properties of the soil and ground-water samples shall be incorporated into a comprehensive sub-soil investigation report. This shall include recommendations on the type of foundations and on the design bearing capacity of the sub-soil at formation levels for each site. Three copies or records and the report shall be sent to the Employer's Representative. The Sub-soil investigations shall be undertaken by a reputed Institution approved by the Employer's Representative. A qualified geologist or materials engineer shall be in attendance at all times when borings are being driven or samples extracted. Laboratory tests shall be carried out at an establishment approved by the Employer's Representative

8.2 Site Clearance

8.2.1 Cutting and removing trees & shrubs

The Contractor shall clear all areas required for the work. All unwanted materials, debris, etc. shall be removed from the employer's premises. Bushes, undergrowth, trees and hedges which are not specifically noted on the drawings or in the Contract for preservation shall be uprooted and burnt or otherwise disposed of wisely. Holes left by uprooting shall be promptly filled with suitable material and compacted.

8.2.2 Removing/Shifting existing equipment, dismantling steel structures

If any Equipment and support steel structures, which are to be removed shall be remove carefully and handed over to the employer. Removing, dismantling, handling, transporting and handing over shall be done by the contractor as instructed by the Employer's Representative.

8.2.3 Demolishing & removing of existing Masonry/concrete structures

If any unwanted foundations shall be demolished or up-rooted. The Contractor shall clear all areas required for the work. All unwanted materials, debris, etc. shall be removed from the employer's premises.

8.3 Site Formation and Upkeeping

8.3.1 Cutting and filling earth

8.3.1.1 Excavation

The whole of the excavations shall be carried out to the widths, lengths and depths shown on the approved drawings and in accordance with BS CP-8004 and BS 6031 or AS 3789. If top layer of soil is not suitable for the construction it shall be removed or stabilised. The Contractor is to provide all strutting and shoring necessary for the safe execution of the Works. Materials from the excavation may, if approved by the Employer's Representative, be used by the Contractor in the construction Works. Other excavated material shall be back filled where required or deposited where directed by the Employer. Surplus materials shall be removed from the Site by the Contractor. The Contractor shall at all times keep the site free from all surplus materials, rubbish and offensive matter.

The bottom of all excavated areas shall be trimmed, levelled and well rammed. Concrete shall not be deposited thereon until the bottom has been inspected and approved by the Employer's Representative.

8.3.1.2 De-watering

All excavation works are to be kept dry and clean, in order that work is not affected or interfered with by water entering the excavations. The Bidder is to allow in his Tender for the costs of pumping, de-watering or other methods of dealing with the water during and after excavation. No concrete, masonry, brickwork or other materials shall be placed or built until the surfaces are properly drained.

8.3.1.3 Filling and Reinstatement

If it is required to fill the land, the Contractor shall get approval for the filling material and method of construction before the commencement of work. Filling for trenches, excavations and levelling of the site shall be deposited in layers not exceeding 250 mm uncompacted thickness, each layer watered when necessary and well rammed or otherwise compacted to within 95% of the maximum dry density obtained by the use of a Proctor Standard Compaction Test. Any fill material used within 500 mm of concrete structures cement bound materials shall have a soluble sulphate content not exceeding 2.5 g per litter when tested in accordance with BS 1377 or AS 1289, special precautions shall be taken to protect the concrete or cement bound materials to the approval of the Employer's Representative. Where excavations whether in rock or other material, are made to a greater depth than detailed, the intervening space shall be brought up to the proper level in plain concrete at the Contractor's expense.

Any formation encountered in the excavations which is not sufficiently strong to carry the loads which will be imposed on it, shall be excavated to an adequate load bearing stratum and replaced with mass concrete.

Unless otherwise described, directed or permitted, imported filling shall consist of pervious naturally occurring material, free from mud, silt, clay, peat, vegetable or injurious matter and water soluble salts harmful to copper and other metals. Filling shall be imported only from approved areas.

8.3.1.4 Stability of Fill and Embankment

The Contractor shall be responsible for the stability of embankments, which formed either by cutting or filling, and precautions taken to protect the earthworks from deterioration under adverse weather conditions. Wherever applicable the recommendations contained in the following codes of practice shall be followed in calculations, detailing and performance of the earthworks and drainage. The Earthworks standard that should be used is - BS 6031 or AS 3789.All top surfaces of earthwork shall be finished off level and regular and the sides of cuttings and embankments shall be properly trimmed to the detailed slopes. The soil stability of such slops etc. shall be ensured. The Contractor shall construct where necessary open ditches, bunds, culverts, etc., to divert and protect the site in both the short and long-term from flash floods. If any slips occur in the excavations, banks or filling during the execution of the Works or during the period of maintenance from any cause whatsoever, the Contractor shall execute the necessary remedial work in such manner, and with such materials as approved by the Employer's Representative, at the Contractor's expense.

8.3.1.5 Explosives

Explosives may only be used when specified or approved by the Employer's Representative. If approved, their use shall comply with the following:
(1) All local by-laws and regulations.
(2) Proper/safe storage in magazine provided for
(3) Explosives shall handled by qualified personal only
(4) Shall use controlled blasting techniques in all circumstances

8.3.1.6 Earth retaining structures

Retaining structures or turfing to be done to side slopes as specified in BS 6031 or AS 3789.

8.3.1.7 Anti Termite Soil Treatment

Anti termite treatment with more than 10 years guaranty shall be done for the control building area including 3m to either side of the building.

8.3.1.8 Land Scaping & Tree planting

Suitable trees shall be planted in available vacant areas where necessary and grassing to protect erosion.

8.3.1.9 Surface Chipping

Stone chipping used for substation surfacing are to be clean hard crushed blue/grey basalt stone well graded and washed size range from 25 - 45 mm. The formation in areas where stone chipping are to be used shall be well compacted to the approval of the Employer's Representative, and treated with an approved total weed killer, used in accordance with the manufacturer's instructions. Approved weed mats has to be installed in the entire yard before stones chips are installed. Geo mat and geo fabric may also be used in areas where water is present. Stone chipping shall be laid and lightly compacted to a minimum finished thickness of 150 mm.

8.4 Cable Trenches & Ducts

8.4.1 Control and Power Cable Trenches

The Contractor is responsible for all civil works required for cable runs between switchgear and building in concrete cable trenches. Main cable trenches shall be rack types with sufficient working space. Cable entries into buildings shall be through ducts or in concrete cable trenches. Trench covers outside buildings shall be of reinforced concrete designed for the maximum likely imposed loads appropriate to their location. Cable trenches shall be adequately sloped and drained to soak ways of adequate capacity. Cable trench in the substation building should house a submergible pump to remove excess water from the trench. A trench light should also be provided and a steel step to access the bottom of the trench should also be provided.

Power cable which passes under roads, car parking areas, hard standing areas or where they would otherwise be at risk shall be laid in approved ducts. A 100% additional capacity shall be installed for future use and the whole surrounded in a minimum of 150 mm C10 concrete. Conduits provided shall be sized to suite the cables provided. All other main cable trenches shall have additional capacity of 30% future use. Cable entries into buildings shall be sealed using suitable materials to prevent entry of any water, dust, vermin, etc. Cable entry to the control building shall be provided for future requirements.

8.4.2 Ducts

All cable ducts shall be laid in straight lines and regular gradients between cable pits, as directed. All ducts shall be kept clear from earth, debris and other obstructions during and after laying. Cable ducts may be pitch fibber, PVC, plastic or other material approved by the Employer's Representative and obtained from an approved manufacturer.

8.4.3 Concrete Beds and Casings

Concrete beds and casings to cable ducts and under roads, buildings, floors and foundations shall be of lean concrete and of 150mm minimum thickness. Elsewhere the ducts shall be laid on and surrounded with approved granular material of 150mm minimum bed thickness and 300 mm minimum cover.

8.4.4 Cable Pits

Cable pits shall be provided at interval not exceeding 100 meters and also at the bends of all cable ducts. Cable pits may be constructed in situ concrete or precast concrete. In each case, the material shall be in accordance with the relevant sections of this Specification. Cable pits shall be sized according to their depth, to provide sufficient working space and access for maintenance. Galvanised malleable iron steps are to be provided in all cable pits over one meter deep and built in as work proceeds. Rates shall include for all necessary crossings shifting any existing obstructions etc. Power cables shall be laid on and surrounded with sand fill in unlined trenches. Pre-cast concrete cable protection covers & PVC marker tape shall be provided over the full width and length of cables in sand filled trenches. Pre-cast concrete marker posts shall be provided along cable runs at 500 meters intervals. Rates shall include for all necessary crossings shifting existing any obstructions etc.

8.5 Steel Support Structures

8.5.1 Galvanised Steel Support Structures

Galvanised steel structures shall be provided under this Contract for supporting the insulators, switchgear, overhead conductors, bus bars, earth wires and other equipment and fittings generally as shown on drawings.

The structure shall include all necessary access ladders or step bolts to give access to the various levels of equipment and shall incorporate all necessary earthing. The design and arrangement of supporting structures shall be subject to approval of Employer's Representative; such structures shall be rigid and self-bracing against all dead, wind, pull off and other applied loads. At or near ground level, all uprights shall be provided with holding down bolts. Steel sections forming the framework shall be heavily galvanized in accordance with the BS EN ISO 1461 1999 or AS/NZS 2312. The bolts and nuts shall be complying with the ISO 898-1.Bolts and nuts shall be galvanized and fitted with spring washers. Taper washers are to be added where necessary. Threads of bolts shall be spun galvanized and the threads of nuts shall be oiled. All members shall be cut to jig and holes shall be drilled or punched to jig. Parts shall be carefully cut and holes accurately located so that when the members are in position the holes can be accurately aligned before being bolted up. Drifting of holes will not be permitted.

8.5.1.1 Load Combinations for Design Purposes

The design wind speed shall be in accordance to AS 1170.2 for 85m/s for 3sec gust for Building Importance Level 4.The design calculations shall include the computation of stresses in all structural components and shall show how all loads are transferred to the foundations. The structures shall be designed to meet the maximum of the total forces calculated from the following loading.

- Dead weight
- Live weight
- Wind loading
- Short circuit force
- Loads arising during assembly and erection.

Recommended factors of safety for steel structures 2.5
Recommended factor of safety for foundations 2.5

Consideration shall be made in sizing members to eliminate excessive deflection or vibration during service.

All structures shall be designed so that no failure or permanent distortion shall occur when tested with an applied force equal to 2.5 times the loading associated with the simultaneous applications of any of the load combinations.

8.5.1.2 General

The standards of workmanship, materials and design are to be equal to those laid down in the latest editions of BS 5950 or AS 4100. The Contractor shall make the following submittals to the Employer's Representative:
a. Production mill sheet and quality control tests sheets for each delivery of structural steel.
b. Full details of the results of material tests.
c. Full details of steel types and types of nuts and bolts to be used.
d. Full details of erection procedures.
e. Full details of proposals for all main welds, arrangement of welded assemblies and welding procedure.
f. Approval of welders including all tests for welders
g. Full details of protection system to be used for steelwork.
h. Test results for paint thickness.
i. Results for structural deflections under test loads.

The design of all structures shall be as specified and, in addition, is to ensure that in the event breakage of either one earth wire or one stay wire the factor of safety is not less than 1.5.

8.5.2 Supplying & Erecting of steel structures

8.5.2.1 Materials

Samples of all materials shall be tested and copies of the test reports giving physical and chemical properties issued to the Employer's Representative for approval. These tests shall prove the compliance of the material for the purpose intended in accordance with the approved standard. Where tests are carried out by an independent laboratory, the source of origin of the material shall be stated and if different sources of supply are contemplated additional tests shall be carried out.

8.5.2.2 Connections

Shop connections shall generally be electric arc welded or bolted. Site connections shall be bolted as shown on the drawings unless specifically approved by the Employer's Representative. Bracing connections shall develop forces not less than 50 percent of the effective capacity of the member. All connections shall have a minimum of 2 bolts per connections and the gusset plates shall have a minimum thickness of 10 mm. Fabrication and erection shall conform at all stages to the standard approved by the Employer's Representative and allowance should be made for the Employer's Representative to inspect the steelwork during fabrication and before shipment to site.

Bolted construction shall be tested for dimensional accuracy before dispatch to site by the complete assembly of a frame or truss in the shop. Bolted connections shall be fabricated with due attention to the calculated mode of action of the joint and where an eccentricity cannot be avoided members must be adequate to resist the bending stresses induced. All steelwork shall be fabricated to the following tolerances below:
a. On length 1.3 mm
b. Twist and deviation from the required profile shall not exceed 1 in 1000.

8.5.2.3 Welding

Welding of structural steelworks shall be by an electric arc process. The procedure to be followed, plant and equipment to be used and the testing and inspecting to be applied, shall all be to the satisfaction of the Employer's Representative and shall conform generally with BS 5135 or AS 1554 and with further details contained in the Specification. Electrodes for metal arc welding shall comply with BS EN 499 or AS/NZS 4857.Welded construction shall be carried out in workshops under approved conditions by experienced operators and where continuous supervision is exercised. Machine welding will be allowed where approved machines are in use, correctly controlled by qualified operators. Where the Employer's Representative approves site welding, this shall not adversely affect the efficiency of the welding and, where necessary, effective protection and other safeguards, as shall be agreed with the Employer's Representative.

8.5.2.4 Cleaning and Steelwork Protective Coating

The Contractor shall provide all hoists, slings, cradles, ladders , scaffolds, plant and machinery required for the carrying out of the painting and in particular, he should pay special attention to his requirements for painting the structural steelwork on site. The suitability and capacity of all plant and equipment used for the carrying out of the painting shall be to the satisfaction of the Employer's Representative. The Contractor shall select a system of steelwork protection, which shall conform to the recommendations of BS 5493 or AS/NZS 2312 Protective coating of iron and steel structures against corrosion or equivalent standard. The selected system shall have a life to first maintenance of 20 years under the environmental conditions at the site, which shall for purposes of classification by BS 5493 or AS/NZS 2312.

8.5.3 Galvanising

8.5.3.1 General Requirements

This article defines the minimum requirements for galvanizing as well as for surface cleaning and preparation for the protective coating of galvanized steel surfaces. All steel for outdoor use is to be galvanized and further painted if requested by the Employer's Representative. The galvanizing procedure shall be started only after having finished all chipping, trimming, fitting and bending. Also, all drilling punching, cutting and welding shall have been completed and all burns removed. All steel including bolts, nuts and washers, shall be galvanized at the manufacturer's premises by means of hot-dipping in accordance with internationally recognized standards such as BS EN ISO 1461 1999 or AS/NZS 2312.Where members are of such length that they cannot be dipped in one operation, great care shall be exercised to prevent warping. All holes in material shall be free of excess speller after galvanizing. All material shall be safeguarded against embrittlement during galvanizing. Zinc coating shall be uniform in thickness and so applied that it will adhere to the surface of the steel. Major damage to galvanizing shall be cause for rejection. Material on which galvanizing has been damaged shall be re-dipped unless the damage is minor and local and can be repaired by applying galvanizing repair paint, to the satisfaction of the Employer's Representative. If particularly specified for protection during transport and erection, all galvanized steel members shall be coated with a suitable pre-primer with minimum thickness of 60 micron and matching the primer to be applied after erection. If not otherwise specified, galvanized steel surfaces shall be chromated with approximately 3-micron thickness. Single items such as cable trays, fences, etc. may be galvanized and PVC covered if so approved by the Employer's Representative. All galvanized steel to have minimum of 85µm.

8.5.3.2 Painting of Galvanized Towers and Outdoor Steel Structures

After erection/stringing, on all galvanized steel the pre-primer (if any) is to be cleaned by use of a rotating wire brush and washed with fresh water. All galvanized steel must be painted with one layer of primer, one layer of intermediate coat and one layer of final coat with the paints specified in the Technical Data Sheets.

8.5.3.3 Surfaces of Stub Angles and Caps

The stub angles shall be galvanized as described above. Prior to galvanizing, all stub angles shall be sandblasted.
Painting should be applied in the zone 50 cm above and 50 cm below concrete level.
1) 1 coat of primer as described in the Technical Data Sheets to be applied.
2) 3 coats of 125 microns, each to be applied, 2-pack coal tar epoxy paint
3) After setting of the stub angles and concreting foundation caps the sealing of the joint shall be performed by an acrylic type sealer (approximately 1.5cm thickness around the stub angle).
4) 2 coats of 2 pack coal tar epoxy paint, 125 micro each covering approximately10 cm above the concrete level and coating the foundation cap in total (including approximately 5 cm of the vertical surface of the foundation) shall be applied
5) After erection the intermediate and final coat as for the galvanized steel painting shall be applied as described above up to the joint of the stub angle
6) Surfaces of steel piling cases:
Steel pilling cases shall be sandblasted and treated by bituminous fill etc. down to 50 cm below ground level
7) Bidder may propose other measures to protect the stub angles from corrosion, e.g. proposing special type of steel.

8.5.3.4 Transportation and Storage of Steelwork

All steelwork shall be transported, lifted and generally handled in a manner that does not affect the shape or surfaces of the section. Lifting slings shall be of nylon rope; chains and hooks shall not be used in contact with the steelwork. The position of lifting points used on sections shall be such that the stress induced in the sections does not exceed one half of the yield stress of the materials. Steelwork shall be stored in clean, dry conditions off the ground. Separate pieces of steelwork shall have spacer blocks between them.

8.5.3.5 Erection

The Contractor must provide all temporary works, of any kind whatsoever, he shall deem necessary to ensure the correctness f alignment, plumbing and stability of the various frames and members. During erection the work shall be securely bolted or otherwise fastened and, if necessary, temporarily braced to provide safety for all erection stresses and conditions, including those due to erection equipment and its operation. No permanent bolting of high strength friction grip bolts shall be done until proper alignment has been obtained.

8.5.3.6 Inspection and Tests

The Contractor shall supply to the Employer's Representative details of all steelwork and accessories in order that inspection can be effected. Details shall include dates, times and places of manufacturing, rolling, fabricating, painting, galvanising and all other processes. The details shall be given to the Employer's Representative at least 7 days prior to such inspections taking place. All the tests shall be carried out by the Contractor. The Contractor shall prepare test sample to suit the appropriate testing methods all tests and inspection results shall be submitted to the Employer's Representative within 24 hours of the test completion. Inspection and Testing of Welds to be inspected shall not be painted or otherwise obscured until they have been inspected.

8.5.3.7 Inspection and Testing of Paint

Tests shall be carried out to the appropriate sections of BS 3900 or AS 1580.Tests for final dry film thickness (DFT) shall be carried out over 10% of the painted area. Over such test areas, readings shall be taken on a grid 200-mm square and recorded. The contractor shall carry out tests, which are requested by the Employer's Representative as specified in relevant British Standards.

8.5.3.8 Testing of Welding Operators

Only welding operators who satisfy the appropriate tests shall be employed on welding. Should an operator fail in the first test, two further tests shall be undertaken immediately and to qualify the operator must satisfactorily pass both these tests.

8.5.3.9 Responsibility and Guarantees

The Employer's Representative shall have access at all times for inspection of the work and all pertinent materials during preparation and progress of the work. Should any work or material be found to be defective or not in compliance with the Employer's Representative's requirements, correction or replacement shall be done by the contractor at his own cost.

8.6 Foundations

8.6.1 Concrete

General.

Standards of design, materials, and workmanship shall be in conformity with this Specification, AS/NZS Standard or other internationally accepted Standards approved by Employer & Engineer.

For the purpose of the Contract, this Specification shall be applicable to all concrete works to be included in the Civil engineering and Building works.

The Contractor shall submit not less than 3 weeks before the commencement of manufacture of preliminary trial design mixes the following information to the Employer's Representative in respect of each grade of concrete that will not be supplied by an established and reputable ready mix concrete supplier.

(1) Grade of concrete
(2) Title of particular trial mix.
(3) The grading of the aggregates.
(4) The ratio by weight of all the constituents of the concrete.
(5) The expected compacting factor and slump.
(6) Full details of the proposed site quality control.
(7) Full details of the proposed laboratory for testing.

The Contractor shall also confirm his proposed testing regime and acceptance criteria for the Preliminary Trial Mixes. If the proposals not be approved by the Employer's Representative, and then the Contractor shall comply with the paragraph on preliminary test cubes and the two following paragraphs. At least four weeks before commencing any Concreting in the Works, the Contractor shall make trial mixes using samples of aggregates and cements typical of those to be used. If possible, the Concreting plant and the means of transport to be employed in the Works shall be used to make the trial mixes and to transport them a representative distance. A clean dry mixer shall be used to make the trial mixes and the first batch shall be discarded. Preliminary test cubes shall be taken from the proposed mixes as follows:

For each grade, a set of 6 cylinders shall be made from each of 3 consecutive batches. Three from each set of six shall be tested at an age of seven days and three at an age of 28 days. The cylinders shall be made, cured, stored, transported and tested in compression in accordance with BS 1881 or AS 1012. The test shall be carried out in a laboratory shall be approved by the Employer's Representative. If it is proposed to use an admixture in the mix then for each grade of concrete a batch shall be madewith a double dose of the additive. For each of these batches 3 cylinders shall be made and one tested at 7 days and 2 at 28 days to determine the likely effect of error in dispensing.

The trial design mix proportions shall be approved if the average strength of a set of 9 cylinders tested at 28 days exceeded the specified characteristic compressive strength by current margin less 3.5 N/mm_2. The results of the seven-day cylinder tests shall be used to give an indication for future use of the strengths likely to be achieved at 28 days. They shall not be used to satisfy the 28 days preliminary test cylinder strength requirements.

The Contractor shall inform the Employer's Representative of his intention to carry out such tests and the time and place of the tests at least 24 hours before they take place. Neither the mix proportions nor the source of supply of materials shall be altered without the prior approval of the Employer's Representative except that the Contractor shall adjust the proportions of the mix as required to take account of permitted variations in the materials. Such approval shall be subject to the execution, to the Employer's Representative's satisfaction, of trial mix procedures set out herein.

Curing of Concrete, whether site mixed or ready-mixed, shall comply to the requirements of ACI-308

8.6.2 Ready-Mixed Concrete

Ready-mixed concrete, which batched off the Site, may be used only with the agreement of the Employer's Representative and comply with all requirements of the Contract. All ready mix concrete shall be designed, batched and tested in accordance to the requirements of ACI 318.The concrete shall be carried in purpose made agitators operating continuously, or truck mixers. The concrete shall be compacted and in its final position within 2 hours of the introduction of cement to the aggregates, unless a longer time is agreed by the Employer's Representative. The time of such introduction shall be recorded on the delivery note together with the weight of the constituents of each mix. When truck-mixed concrete is used, water shall be added under supervision, either at the Site or at the central batching plant, as agreed by the Employer's Representative but in no circumstances shall water be added in transit. Unless otherwise agreed by the Employer's Representative, truck mixer units and their mixing and discharge performance shall comply with the requirements of BS 5328 part 3.

8.6.3 Composition.

The Contractor shall make trial mixes using samples of aggregates and cements typical of those to be used at least four weeks before commencing any concreting in the Works. The strength requirements for each grade of concrete proposed in the design shall be determined by the Contractor by means of trial mixes to satisfy the conditions specified in the relevant AS/NZS Standards.

8.6.4 Tests.

In order to control the quality of concrete to be placed, samples of concrete for testing shall be taken in cylinders. Three (3) test Cylinders are to be taken from each sample (In accordance with AS 102). One cylinder to be tested at 7 Days, the other 2 at 28 days. Each truck of (5m3) will constitute a batch in applying AS1012.

The mix and delivery of ready mix concrete or concrete mixed in central plant shall comply with:

1. AS 1012 Methods of testing concrete
2. AS 1411 Methods of sampling and testing aggregates
3. AS 1379 Specification and supply of concrete

The following Tests shall be done in accordance with this Specification or equivalent Standards approved by the Energy Fiji Limited Engineer for each Batch of Concrete:

a. Slump test
b. Compression test
c. Any other test which may be specified by Energy Fiji Limited Engineer as specified in the relevant concrete standards.

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The cost of preparing, storing and transporting test specimens to the place of testing and testing shall be borne by the Contractor.

8.6.5 Cement.

All cement shall be of normal Portland cement complying with the requirements of AS 1379 Specification and supply of concrete.

When required by Energy Fiji Limited, the Contractor shall obtain for him the manufacturer's test certificate prior to any delivery. All cement shall be stored dry in a well-ventilated and weatherproof building. The cement shall be furnished either in bulk or in bags from the cement factory approved by Energy Fiji Limited.

8.6.6 Admixture.

The Contractor may use water-reducing and set-retarding agents, but the use of admixture must have the prior approval of Employer & Engineer.

8.6.7 Water.

The water used for making concrete, mortar and grout shall be clean, fresh and free from injurious amounts of oil, organic-matter or any other deleterious substance.

8.6.8 Aggregate.

The fine and coarse aggregates shall be durable, non-reactive hard materials complying with internationally accepted standards approved by Energy Fiji Limited & Engineer. All aggregates shall be washed prior to use in order to remove clay, silt, dust and adherent materials.

The aggregates shall be stored on drained concrete paved areas in such a manner that intermingling of different sizes and types of aggregates is prevented. The stock piles of the aggregates shall be protected from rubbish or windblown dust.

8.6.9 Concrete Mixing.

All concrete except where specifically approved by Energy Fiji Limited & Engineer shall be mixed in weigh batch mixing machines. The machine shall have a Water storage tank with a gauge so that a predetermined quantity of water can be injected direct into the mixer drum.

Site Mixing or Hand mixing of structural component concrete is STRICTLY NOT PERMITED. Any Site mixing of concrete for non-structural use to have prior approval from Energy Fiji Limited & Engineer.

8.6.10 Concrete Placing.

Concrete shall be placed in the positions and sequences indicated on the approved drawings and methodology immediately after mixing under the supervision of Energy Fiji Limited & Engineer.

Prior to placing the concrete all deleterious substance such as organic matter, standing water, flowing water, wood fragments shall be removed from the surf ace against which the concrete is to be placed. When concrete is to be placed against a construction joint or adjacent to a set surface the whole surface shall be thoroughly roughened. It shall be cleared of all loose and foreign matter and washed with water immediately before fresh concrete is placed.

The concrete shall be fully compacted throughout the layer and it shall be thoroughly worked against the formwork and round the reinforcement without displacing them unless otherwise directed by Energy Fiji Limited & Engineer, approved power/mechanical driven vibrators of the immersion type shall be used. Vibrators shall penetrate to the full depth of the concrete layer and shall re-vibrate that layer to ensure that the successive layers are well knitted together. The placing of concrete shall not be permitted under the following conditions unless specifically approved by Energy Fiji Limited & Engineer.

If it rains
If it is poorly illuminated during night work
If ordered to stop by Energy Fiji Limited & Engineer.

8.6.11 Concrete Transportation.

Ready mixed concrete shall be transported speedily to the point of placing by a means that shall be approved by Energy Fiji Limited & Engineer and which shall give little chance for segregation of materials. Generally, the transportation of ready mixed concrete shall be limited to within one hour. Concrete delivered in excess of the time limit shall be rejected. When concrete is observed to have segregated or started solidifying at the transportation of placing, it shall be rejected and replaced.

8.6.12 Concrete Transportation.

Concrete shall be protected during the first stage of hardening from the harmful effects of sunshine, drying winds, hot weather and rain or running water. The concrete shall generally be wet-cured for at least 7 days. The curing method for concrete shall be submitted to the Energy Fiji Limited & Engineer for approval.

8.6.13 Formwork & Timbering.

Formwork and timbering shall be so designed and constructed that the required finishes in concrete works are achieved. Formworks shall be constructed accurately to the required shape, position and level and shall have sufficient strength to withstand the compaction pressure. The materials to be used for formwork, shall be approved by Energy Fiji Limited & Engineer.

Forms shall be removed without damage to the concrete. The use of form oil or other release agents shall be approved by Energy Fiji Limited & Engineer. The removal time of formwork and timbering shall be as follows:

a. Walls, beams, column : 3 days
b. Beam soffits (props left under) : 3 days
c. Slab soffits (props left under) : 4 days

8.6.14 Reinforcement Bars.

The reinforcement bars for the HFO Engine generating units foundation blocks shall be HD steel bars Grade 500E. Dimension, shapes, tensile strength, yield point and other mechanical properties of the reinforcement bars shall comply with relevant approved standards. All reinforcement must be free from oil, grease, paint, dirt, loose scale or rust at the time of concreting.

The physical properties of the reinforcement bar shall have the following values:

a. Yield point : more than 520 MPa
b. Ultimate tensile strength : more than 695MPa
c. Elongation rate over 20% and elongation rate under max tension over 10%.

Reinforcement bars shall be stacked off the ground on sufficient sup-ports to prevent distortion of the bars. Prior to fabricating and placing the reinforcement, the Contractor shall prepare a bar bending schedule, and drawings for submission to the Energy Fiji Limited & Engineer for approval. Reinforcement shall generally be bent cold by an approved means to the dimensions shown on the approved bar bending schedule and shall be rigidly fixed in the positions shown on the approved reinforcement drawings using annealed soft black iron binding wire to prevent movement during concreting. Energy Fiji Limited & Engineer shall have the right to select at any time samples of reinforcement bar for testing

for compliance with the Specifications. The spacer blocks, prior to using, shall be submitted to the Energy Fiji Limited & Engineer for approval.

8.6.15 Roads & Surface.

The Contractor shall furnish all designs and construct the roads, yards, paths, surfacing as necessary for the proper functioning of the substation.

The roads and yards as indicated in the Drawings or directed by the Energy Fiji Limited & Engineer shall be generally designed with raised kerb, in compliance with the approved Standard and to satisfy the following basic design requirement

a. Maximum grade : 7%
b. Pavement width : 5-6m
c. Turning radius: more than 10 m.

8.6.16 Concrete Pavement.

The roads and yards shall be paved with reinforced cement concrete and shall be designed in accordance with the procedures as outlined in the AS/NZS Standard or any other acceptable international standard or Design of Pavement Structures or other internationally accepted methods approved by Energy Fiji Limited & Engineer.

Basic design conditions are as follows:

a. Design load :Minimum 15 ton axle weight
b. Minimum thickness of concrete pavement: 20cm

8.6.17 Landscaping & Turfing.

Areas around the power house building, administration building shall he turfed as shown on the Drawings or as directed by Energy Fiji Limited & Engineer.

Turf shall be freshly cut approved carpet grass free from thorns and weeds. The area to be turfed shall be provided with a layer of 20cm top soil suitable for the growth of the lawn. The Contractor shall maintain and replace all dead turf at his own expense until the end of maintenance period (DNP).

The Contractor shall submit a detailed proposal on landscaping for the Site. Trees, flowers and other plants adaptable to the climate and soil conditions of the Site shall be planted in the open spaces provided adjacent to the control and administration building area and along the perimeter of the boundaries to form a green belt around the substation. A proposal which shall include a landscape drawing with a schedule showing types of trees, planting positions and other details shall be submitted to the Energy Fiji Limited & Engineer for approval.

8.6.18 Drainage System

a. Design Conditions

The design of the storm water drainage system comprising the interceptor, roadside and perimeter drains for buildings, powerhouse, and switchyard shall be submitted to Energy Fiji Limited & Engineer for approval.

The Contractor shall carry out detailed designs of the storm water drains using the rational method or other approved procedures. The work shall be carried out in accordance with the rules and regulations of the local and other authorities.

Design conditions for drainage system shall be as follows:

1. Rainfall intensity: 100 mm/hr
2. Run-off coefficient: 0.6
3. Manning's roughness coefficient for concrete lined channel: 0.013

All drains or channels shall be concrete lined. Concrete sumps, silt traps, screens and drain covers shall be incorporated in the design where it is appropriate.

b. **Drain Laying**

All trenches and drains are to be set out accurately to line and fall as specified. Trenching for pipes shall be excavated with sufficient width to allow adequate working space for pipe jointing. Backfilling of trenches to a height 300 mm above the top of the pipes using selected materials shall be hand packed and well rammed against the side of the pipes.

The laying of each length of drain is to be commenced at the lower end and socketed pipes shall be laid with their sockets at the higher end each pipe is to be accurately levelled and securely held in position before the joint is made.

All surface water channels shall be made from concrete. The Contractor shall keep sumps, drains, trenches and ditches free from water at all times until, in the opinion of Energy Fiji Limited & Engineer the concrete works has hardened. Man-holes, inspection chambers and catch-pits shall be constructed.

8.6.19 Lightning Protection

Approved earthed screens, generally in accordance with the Tender Drawings, shall be provided to protect the equipment from direct lightning strikes. The screens shall be of stranded hard drawn copper wires of not less than 35sq.mm total cross section, or stranded galvanised steel wires of not less than 7/3.5mm cross section and connected to provide low impedance paths to earth. The layout of the earth wires shall be such that generally, equipment's to be protected lie within areas bounded by lines drawn from the earth wire at 300 to the vertical in a plane perpendicular to the axis of the earth wire. The earth screens shall be suitable for extension to protect the substation equipment's to be installed in future stages of development. Connections shall be made of copper strip of 30mm x 5mm cross-section between the overhead earthed screen wire and the main substation earthling system at each support. Earth wires shall be held in clamps with free, pin type joints between clamps and supports. Connections shall be provided for the terminations of the earth wires of the overhead lines including bimetal connectors where necessary. The necessary stays, fittings and anchors shall be provided under this Contract including, if required, flying stays and additional masts to ensure clearance of not less than 9144 mm (30 ft.) over roadways for breaker or transformer removal.

8.6.20 Lightning Protection for control building

A complete lightning protection system for the control building shall be constructed in compliance with BS 6651 or AS 1768.

An air termination network shall be installed on the surfaces of the roofs. No part of the roofs shall be further away than 10m from the nearest horizontal protective conductor. Salient points of the structure such as air conditioning installations, vent pipes railings, gutters, and steel constructions etc. shall be connected to the network. Down conductors shall be distributed around the outside walls of the building with a maximum distance of 20m and all main metal parts near the down conductors shall be connected there to. Each down conductor shall; be provided with test joints in such positions that periodic testing is easily possible.

All connections and joints shall be installed mechanically and electrically effective (clamped, screwed or welded) to suit the local climatic conditions.
For every building, at least, one ring of ground conductors shall be installed and interconnected.

Materials,
Air terminations: Tinned copper 8mm diameter
Earth terminations: Copper 8mm diameter with lead coating minimum 1.2mm thick as protection against corrosion
Ground rods: Tinned copper weld or stainless steel 3000x30mm diameter
Potential equalizing bars: tinned copper 500x50x5mm
All support and connections shall be made of best suitable materials.

8.6.21 Copper

Copper and copper alloys shall comply with the Australian Standards and approved standard relevant to the form and use for which the material is intended. Copper components shall be placed so that neither in no case shall they come in direct contact with aluminium nor shall it be possible for water or consideration to pass off copper on to aluminium.

8.7 Water Supply & Drainage System

8.7.1 Water supply system

The Contractor will be responsible for the provision and installation of a water supply, from a public water supply system, connected to serve the substation buildings. Every cistern, sink, basin etc., shall be provided with a stopcock in the supply pipe adjacent to the fittings. Each basin and sink is to be provided with water. Shaded from direct sunlight, supplying a 1.5 cubic meter header tank, situated within the building. Space and ladder should provide for maintenance of overhead tank.

Layout of the plumbing shall be to approve standards and of the highest workmanship, with all bends to easy sweeps and bores and thickness maintained throughout. Internal plumbing system shall be connected either to public water system.

All plumbing and drainage design, materials and workmanship shall comply to the requirements under AS 3500 and Water Authority of Fiji.

8.7.1.1 Water Pipes

PVC pipes shall generally be used throughout of an approved type. They shall be secured to the structure. Pipes to wash hand basins and WC cisterns shall be 15 mm bore and supply pipes to header tanks 25 mm bore.

Overflow pipes shall be taken from the tops of cisterns and set to discharge in a prominent position.

8.7.1.2 Sanitary Fittings

Wash hand basins shall be supported on cantilever brackets cut and pinned to the walls or screwed to 30mm timber chambered backboards, which shall be plugged and screwed to the walls. They shall be provided with 35mm bottle traps with brass cleaning eye and lining soldered on, or alternatively, similar PVC fittings.

Cistern supporting brackets shall be screwed to 30mm timber chambered backboards, which, shall be plugged and screwed to the walls. Overflow pipes from WC cisterns shall be 20 mm bore. Glazed ware shall be of best quality type and manufacturer shall be approved by the Employer's Representative. Fittings shall be securely fixed in an approved manner. Taps and all visible metal fittings shall be chromium plated, heavy-duty quality. Drinking fountain outlets shall be clearly labelled. All fittings shall be individually isolated with a stopcock in the water supply pipe. On completion of the works, all sanitary fittings shall be left in a clean and proper condition.

After completion, drains shall be subjected to an air test, in which a pressure equal to 150 mm of water is to be applied for a period of five minutes without dropping below 125mm head. Any defects revealed shall be made good at the Contractor's expense.

8.7.2 Waste water sewerage system

8.7.2.1 Drain Pipes

Drain pipes shall be PVC pipes and fittings of approved manufacture and shall be jointed with sleeves or sockets. PVC pipes provided should be black unplasticised PVC.

Concrete beds and casings to drain pipes under roads shall be of week concrete and of 150mm minimum thickness. Elsewhere the pipes and ducts shall be laid on and surrounded with approved granular material.

8.7.2.2 Manholes

Manholes shall be generally in accordance with BS EN 752 or equivalent international standard. Galvanised malleable cast iron step irons are to be provided and built in as work proceeds. Manhole covers shall comply with BS EN 124 or equivalent international standard, and in roadways or heavily loaded areas shall be heavy duty, area with non-vehicular access to be medium duty.

8.7.2.3 Septic Tank& soakage pit

The septic tank, where main drainage is not available, shall be constructed in an agreed position at least 20 meters from any building. The design and installation of the septic tank and soak pit shall comply to the requirements of the Fiji Building Code.

If the location of the septic tank is within the vehicle manoeuvring area, then the top of the tank shall have a reinforced concrete hard stand. If the location of the septic tank is away from the vehicle manoeuvring area, then wooden bollards of 100mm dia and 1.2m above ground, shall be erected to demarcate the tank area.

The system shall be properly ventilated by continuing the soil pipe above the highest branch upwards above roof level.

All drains shall be laid in straight lines and regular gradients as described. Great care shall be exercised in setting out and determining the level of the drains. All drains shall be kept clear from earth, debris, superfluous cement and other obstructions during and after laying and shall be provided with eyes, inspection covers, etc. to ensure that every length can be rodded effectively in the event of a blockage

8.7.3 Surface water drainage system

General

Embankments and cuttings shall have drainage facilities at their top or bottom. The formation level of switchyard area shall be formed with uniform cross-falls of about 1 in 300 in the same direction as the natural drainage path of the surrounding Area Provision shall be made for the disposal of surface water from roads.

A surface water drainage system covering the switchyard shall be installed. The system may be discharged to natural watercourses or to soak ways as approved. Surface water from roofs of buildings shall be drained to down pipes connected with the site drainage system. The number of runs and out falls and pipe sizing must be sufficient to cope with the severest precipitation, with a factor of safety of 1.2 within switchgear and other areas. It is to be ensured by the contractor that the surface water discharged from the substation does not cause any damage to the properties through which such water is discharge up to natural water courses as approved.

The Contractor shall ascertain whether main foul drainage is available locally, and if so, arrangements are to be made to connect the substation toilets into this system. Where main drainage is not available foul drainage shall terminate at suitably dimensioned septic tank and soakage pits. Drains shall be laid with regular gradients, such that full flow velocity exceeds 0.75 m/sec. Manholes shall be provided at each places where change in direction take place and at not greater than 80 m canters.

Materials and Workmanship

All pipes, fittings, jointing materials and valves which are necessary for the complete installation of the system shall be supplied and installed in compliance with the approved standards and workmanship.

The Contractor shall supply all pipe, special fittings, valves, joints, jointing materials and other necessary materials for the complete installation of the system as shown on the approved drawings. The installed system shall be tested to the satisfaction of Energy Fiji Limited & Engineer.

Water Reticulation System

The water supply system shall be designed to serve a dual purpose of providing potable water for domestic consumption, fire-fighting and plant.

8.8 Construction & Maintenance of Roads

8.8.1 General

The Contractor shall ensure that the roads are levelled graded, properly compacted with appropriate rollers, or surfaced with Bitumen or concrete to ensure that the finished road is suitable for the maximum foreseeable imposed loads expected from vehicles transporting the various items of plant and electrical equipment. In detailing the layout of the roads and parking areas, special attention must be given to the travelling of vehicles delivering plant, stores, spares and other materials and equipment. Material for the hard-core shall consist of natural stone broken to pass a 100-mm ring. It shall be free from dust, rubbish, wood, vegetable or other injurious matter.

Broken stones and aggregates shall consist of hard crushed natural stone or gravel of approved sizes. Bituminous Wearing courses shall be suitable for the extreme soil condition in the area and shall comply with an authoritative and approved standard appropriate to the locality of the work. The details and grading of the aggregate and the binder contents shall be submitted to the Employer's Representative for approval. Sealing grit will be applied as required.

8.8.2 Road carriage way

The upper 300-mm of the formation shall be of suitable soil; otherwise the Contractor shall improve it to strength of greater than 156 CBR by blending it with granular materials such as gravel and sand and gap 65.The formation shall be rolled to an even and uniform surface, which shall be parallel to the finished surface of the road or path. Rolling shall be carried out with a 4 to 7 ton power driven roller unless otherwise ordered or permitted by the Employer's Representative.

8.8.3 Sub-Base

After the formation has been properly made, rolled and approved by the Employer's Representative, a sub-base consisting of well graded natural sand, gravel or rock or mixtures thereof shall be laid in accordance with standards to give a finished thickness of at least 200 mm or as described or directed.

8.8.4 Prime Coat

For the prime coat 0.5 to 1.5 lit/m_2 liquid bitumen shall be sprayed on in accordance with the best practice fitting to the locality of the work.

8.8.5 Bituminous Surface

Two layer of bituminous surfacing of 75 mm overall thickness shall be laid in accordance with the approved standard.

8.8.6 Roadsides

In-situ concrete kerbs or pre-cast concrete kerbs set on a concrete bed are to be laid on each side of the roads, to define the limits for vehicular access. All drains, sewers, cable ducts and other necessary work below road formation level shall be completed, inspected and passed by the Employer's Representative before any road work is started. Concrete paving slabs shall comply with a relevant approved standard. Trench covers shall be minimum of 50 mm thick and provided with handles or holes for lifting purposes. They shall be reinforced to the approval of the Employer's Representative. The reinforcement shall be in the middle of the covers with 25mm cover to the edges. Trench covers shall comply with the relevant standard as approved.

Where concrete covers are required for trenches crossing roads, these shall be designed for the heavy wheel loads expected on them and shall be reinforced with mesh fabric or mild steel bars as necessary.

8.8.7 Approach Road

The contractor shall construct or upgrade the approach to site that is road from main road to the gate of the substation to allow heavy vehicles to site. The minimum flat form width shall be 7m and road shall surface with bitumen or concrete.

8.8.8 Structures (Culverts, Bridges retaining walls) for approach road.

The contractor shall follow the guide lines and requirements of the Fiji Road Authority.

8.8.9 Access road and structures

Access roads are the roads within the switchyard area. Road shall properly graded, compacted and surfaced. Access roads shall be either concrete or bituminous wearing surface roads. The Contractor's

proposed site layouts shall allow for 5 m wide vehicular access to the control building and electrical equipment, for installation and subsequent maintenance. Roads shall be surfaced with concrete or bitumen as approved by the Employer's Representative. All the cable trenches crossings canal crossings road side constructions shall be considered.

8.9 Fence

Chain link fences shall be constructed of galvanised steel wire, and shall be of such manufacture that when any one segment is cut, remaining segments within the pattern retain their rigidity. The bottom of the fence shall be fixed down with staples to a continuous concrete sill (in 2 layers of block work), in accordance with BS 1722, Part 10 or AS 1725. All mesh shall be of galvanised steel wire of 3.55 mm diameter, with a length of side not exceeding 50 mm. Line wires shall be of galvanised steel wire of the same gauge to adequately support the mesh rigidly. Line wire shall be provided at the top and bottom of the mesh and at two evenly spaced intermediate levels. The line wires shall be strained tightly by eyebolt strainers or winders at each straining post and secured to intermediate posts of stirrup wires passed through holes in the posts.

The top wire shall be doubled, Mesh and line wires shall comply with BS 4102 or AS 2423. Chain link mesh shall be strained between straining posts by means of stretcher bars and tied to line wires. Straining posts and struts shall be of Galvanised steel to the same standard as above. The posts shall be set in concrete in the ground. The posts shall have cranked tops set at 45_0 to the posts, to which shall be attached three strands of galvanised barbed wire to BS 4102 or AS 2423. Barbed wires shall be strained between straining posts with eyebolts and fixed to intermediate posts with stirrup wires. Droppers shall be fitted at the centre of each Bay of the fence to prevent the wires being bunched together. Intermediate posts shall be provided at centres not exceeding 3 meters. Corner posts and struts shall be provided at all ends, corners, changes in direction, adjacent to gateposts and at intervals not exceeding 35 meters. All fence fittings shall be galvanised. All galvanised post shall have PVC caps installed.

8.9.1 Gates

Gates shall be accordance with the drawings. The gates shall be fitted with a vertical drop bolt on each leaf, a sliding bar lock with padlock eyes and a padlock to prevent movement of the sliding bar lock. The padlocks shall be included in the overall locking system. All these fittings shall be galvanised. The vertical drop bolts are to drop into galvanised steel tubes cast into the road, to secure the gates when in both closed and open positions.

Gateposts shall be made from galvanised steel RHS which shall be capped and set in concrete in the ground. Gate hinges (pivots) shall be heavily galvanised.

8.9.2 Galvanised Barbed Wire Fence & Gate

8.9.2.1 Galvanised Barbed Wire Fencing

The straight spans are to be erected with intermediate posts which are spaced at 10ft**.** centre to centre where the number of intermediate posts in a straight span exceeds ten (10) a strutted post shall be placed. Two corner Posts, supported with 02 strutted posts on either side of the spans shall be used in every corners. Barbed wire shall comply with the requirements of BS 4102 or AS 2423.

8.9.2.2 Gate

A gate consisting of two sashes complete with gateposts & locks, bolts and other accessories as per Drawing shall be supplied and erected at the entrance to the land. The fence of the gate shall be

terminated with two corner posts just adjacent to the gateposts, with suitable adjustments to the foundations of the two corner pots.

Both sashes of the gate and all other accessories of it including bolts, locks & hinges shall be fully galvanized, to the satisfaction of the Employer's Representative. It is preferable if the gate sashes could be galvanized after the fabrication. However, if it is not possible, welding, cuts and any other form of connections done after the galvanizing The gateposts shall be concreted at site, as. Concrete used for posts should be grade 25 while that for foundations shall be Grade 10. Gateposts shall be plastered to a semi rough finish with cement mortar not less than 15mm thick, and applied with two coats of weather sealed paint of which, make and colour to be approved by the Employer's Representative. Galvanised barbed wire shall conform to BS 4102 or similar approved material.

8.10 Miscellaneous Work

Shall be carried out according to the relevant clause of this specification.

8.10.1 Control Building

The Contractor shall be required to produce full design calculations for the foundations, building structures, etc. and detailed working drawings and bending schedules, etc. He shall be responsible for the detailed design, strength and safety of the structures, to meet the structural, acoustic and environmental requirements of the buildings and other works. He will be responsible for ensuring that the design satisfies the requirements of all authorized local and national bodies. Design calculations and detailed drawings must be submitted to the Employer's Representative for approval before the relevant construction work is carried out and at least six weeks before the relevant drawing is required at site. All drawings have to be lodged with the local authority for approval before construction commences. Design calculations shall be in accordance with an approved method of computation and should take account of the design criteria set out in Clause 13.5.1.1.

Civil engineering works and services shall be designed and constructed in accordance with British or Australian Standards and shall comply to the Fiji Building Code.

The Tender shall include a schedule of standards and codes to be followed in design and construction of the works. Copies of these codes and standards shall be made available to the Employer's Representative and Employer during the design and construction period on site. The Standards and/or Codes of Practice employed throughout the Works, where they do not conflict with the local by-laws

As far as practicable the standards or codes adopted shall be consistent throughout any section of the works except in meeting superior specified requirements. The Contractor shall investigate the existence of any regulations and local by-laws governing the proposed works and he shall be deemed to fully comply with such requirements, which are effective 30 days prior to the date of tender submission. The buildings are to be designed with ease of operation and maintenance as a major factor. Materials, workmanship and finishes must be of an appropriately high standard. In considering the various materials, details, construction methods, etc., The Bidder must investigate the availability, delivery and transportation to the sites of all materials, plant, labour, etc., to enable the program to be maintained. A New substation building shall have reinforced concrete frames. If the Bidder wishes to propose an alternative form of construction, any combination of reinforced concrete, structural steelworks, etc. will be considered, provided that the buildings are completely weatherproof and satisfy all other requirements of this specification. All walls and roofs shall be fully insulated, to produce maximum thermal transmittance U. values of 1.14 (watts/$m_2/_0$C for walls and 0.57 for roofs. Architectural treatment of the new buildings shall be satisfied the requirement of relevant local authority or Rural Development Authority. Windows and roller shutter door have to comply with the cyclone ratings.

After the construction of the building has completed in all aspects, the Contractor shall provide a building completion certificate or an Engineers Certificate.

8.10.1.1 Fire criteria

Non-combustible or fire-resistant components shall be used in the construction. To provide resistance to the collapse of the structure in the event of a fire, and also to avoid a fire occurring in one room to spread in to adjacent rooms all structural elements of the building shall have the following minimum fire resistance:

External walls and columns 2 hr
Internal walls and columns 2 hr
Roof Non-combustible
Ceiling 2 hr

Doors and windows shall have a minimum fire resistance of 2 hour that associated with the walls in which they are located or as set out by the Fiji Building Code.

8.10.1.2 Super structure (Structural frame & walls)

Shall have reinforced concrete frames with walls of cement hollow block work. All work shall be carried out in accordance with BS 5628 & BS 8110 or equivalent international standard. Movement joints shall be provided where required. They shall incorporate a joint filling strip and sealant. Gaps in movement joints shall be left free from debris and shall not be pointed with mortar. Walls shall be constructed with an approved metal reinforcement every second course.

Where block work is built against steel columns, provision should be made to tie the block work to the columns every second course, by means of a rod welded to the steel columns and bedded into the block work.

8.10.1.3 Cement

Cement quality shall be as described in the section for concrete. The clause in that section referring to cement storage shall also apply.

8.10.1.4 Doors & windows

Shall be as specified in schedule of finishes. Particular attention must be given in the design of the buildings to fire prevention and safety of the personnel at all times. Access doors and escape doors shall be provided and fitted with panic bolts where necessary, so that operating and maintenance staff can always exit safely from the buildings in fire emergencies of any nature or location. Hydraulic door closures shall be fitted to all doors. Emergency exits should be clearly marked. Exit signs in the substation building should use illuminated lights on the top of the doors.

Aluminium windows and doors shall be obtained from an approved manufacturer and of a type, design, colour and finish to be approved by the Employer’s Representative. All opening windows shall be provided with integral fly-screens, which shall be removable for cleaning, and maintenance. Also a gothic mesh cover should be provided over the window for security reasons. The construction of aluminium windows, including weather-stripping, hardware, etc., is to comply with the requirements of BS 4873 or other approved standard.

Allowance shall be made when fixing frames for expansion to aluminium members so as to prevent distortion of frames or cracking of glass. The perimeter of the frame shall be pointed with approved mastic.

8.10.1.5 Fire resisting steel doors

Doors shall be fabricated from steel sheet covering a framework of angle sections. Steel doors shall be galvanised after fabrication. Doorframes shall also be galvanised steel all fire resistance doors shall be insulated and fitted with panic latches.

Steel doors shall be effectively sealed (including the bottom) to reduce the leakage of heat ingress of dust as far as practicable using heavy duty seals.

8.10.1.6 Door Closures

Door closures shall be of the overhead hydraulic type. They shall be of an approved type and provided with fine-adjusting facilities. The size of the door closer shall be relative to the weight of the door leaf and shall be approved by the Employer's Representative.

8.10.1.6 Door Fittings

All metal fittings such as hinges, locks, door handles, door bolts, etc. shall be made for heavy duty and mounted in adequate numbers.

8.10.1.7 Roof and ceiling

All metals and metalwork components whether fabricated on or off site shall confirm to the requirements of the relevant British Standards or any other standards to the approved by the Employer's

Representative. Metalwork articles shall have a good finish, and be free from scale, rust, damage or other defects. Components shall be properly assembled and jointed in a neat and functional manner. Welded connections shall be ground off as necessary to present a clean smooth finish without detriment to the strength of the connection. Particular attention shall be given to the protection of metalwork from degradation caused by the environment in which it is to be used. Galvanizing, surface coating or such other treatment suitable for the metalwork under consideration shall accomplish this.

8.10.1.8 Floor and trenches

Control building basement and cable trenches shall be waterproofed. A minimum of 1m width openings shall be provided in the falls bottom/cable basement etc. where applicable. Indoor concrete lined cable trenches shall have reinforced concrete beams to support panels with openings to pass cables. Water proof lights have to be provided to illuminate all sides of the trench. A trench sump is to be provided along with stairs to access the bottom of the trench.

8.10.1.9 Checker Plate

Mild steel chequer plate (raised pattern) shall be fabricated from first grade mild steel with a minimum thickness over the plain portion of 6 mm. Weight of individual panels shall not exceed 25 kg. All mild steel chequer plate shall be galvanised after cutting to the required size. Lifting handles to be provided for lifting the checker plate.

8.10.1.10 General

All floor finishes shall be protected from damage by following trades and other causes and any damage, howsoever caused, shall be made good by the Contractor at his own expense to the satisfaction of the Employer's Representative.

8.10.1.11 Damp Proof Course (DPC)

A damp proof course shall be laid in walls, above ground levels so as to exclude rising moisture.

8.10.1.12 Glazed Ceramic Tiling

The glazed ceramic wall and floor tiles shall be of nominal size 150x150x6mm and 300 mm x 300 mm x 6 mm respectively. Colour and manufacturer shall be approved by the Employer's Representative. The ceramic tile fixing and grouting materials shall be obtained from the same source. The Contractor shall ensure that the rendering is accurately formed and has a true, plumb surface, which is free from all high spots and depressions.

8.10.1.13 Finishes and fittings

All internal plastering shall be carried out in accordance with BS 5492 and external rendering with BS 5262 or equivalent international standard.
All proprietary brands of plaster or rendering materials shall be selected and applied strictly in accordance with the manufacturer's instructions regarding the different purposes and backgrounds for which they are intended. Particular attention shall be paid to the manufacturer's instructions regarding the time allowed to elapse between mixing and using.

8.10.1.14 External Rendering

Where walls are to be rendered externally, the concrete frame shall be proud of the block work panel walls.

8.10.1.15 Paints and Other Materials

Paints for priming, undercoating and finishing shall be ready mixed paints of the best quality for the intended use and comply with BS 6150 or equivalent international standard. All paints shall be obtained from an approved manufacturer who shall certify that the paint is suitable for the intended purpose. Paint for use on concrete or block work shall be of a type specially prepared for this purpose.

Control Building Requirement of Finishes

Item	Description	Control, Protection, Auxiliary room	Store room	Battery room	Toilet
1	Floor	Raised modular	Cement rendered painted with floor paint.	Cement rendered painted with anti acidic/alkaline floor painted	Tiled
2	Walls	Emulsion painted	Emulsion painted	Emulsion painted	Tiled
3	Ceiling	Wooden	Wooden	Wooden	Wooden
4	Roof	Sheet metal covering	Sheet metal covering	Wooden	Sheet metal covering
5	Doors	Fire proof steel with panic latches	Aluminium	Fire proof steel with panic latches	Aluminium/PVC
6	Windows	Aluminium with 6mnm clear wired glass shutters with curtain solar lamination			Aluminium with glazed shutters
7	Furniture and fittings	Table & Chairs. File & drawing racks	Racks	Eye washer with shower tray Distilled water plant wash basing	Commode, cistern wash basin shower Mirror & all accessories
8				Exhaust fans	Exhaust fans

8.10.1.16 Supplying and erecting a Crane

Capacity shall be adequate to lift switchgear provided

8.10.2 Site office

Site office shall be either temporary as requested in scope of work. Contractor shall provide all, services, and shall maintain up to the date of handing over the project. This site office shall be erected immediately and shall be available at the time of mobilising in a position as directed by the Employer's Representative outside the chain link fence. If contractor is delayed to provide permanent site office at the time of mobilization he should provide temporary site office to the satisfaction of the Employer's Representative.

The permanent site office shall be as per the given drawing. The site office either permanent or temporary shall be provided all the services water, Electricity, Air conditioning and Telephone facilities to the satisfaction of the Employer's Representative. Service connections to be provided for all the facilities. Toilets shall be draining to a suitably sized septic tank with overflow to an enclosed soak away. The office building shall have a damp-proof floor and be provided a roof. It is to have opening windows fitted with sunblind. The office and toilet facilities and all services shall be provided and maintained to the Employer's Representative's satisfaction. The services and maintenance shall be provided until the taking over date of the work. Contractor shall provide two executive tables four chairs two cupboards

for Employer's Representatives rooms, one conference table eight chairs, and all the equipment for pantry as requested by the Employer's Representative.

8.10.3 Employer's Representatives living Accommodation

Not applicable

8.10.4 Temporary Works (Stores, access, contractors offices etc.)

The Contractor's site office stores for all the substations shall be temporary structure locate outside the chain link fence area. The contractor should demolish it and clear the site as directed by the Employer's Representative.
Any temporary approach or access roads, Drainages or any other temporary structure required by the contractor for the successful completion of the work shall include under this item.

8.11 Ventilating Services

Shall be designed by the Contractor and approved by the Employer's Representative. The following parameters shall be used for designing the ventilation system:

Battery Room

System Description	Wall extract fan. A heat pump unit cools the room.
Heating	None
Cooling	Cool to 24^{o}C
Outdoor Supply air	None
Extract Air	2 AC/hr minimum for fume removal
Control System	All systems run continuously. Local isolators to start/stop the systems. A thermostat controls the cooling. A (separate) room temperature sensor feeds into the Station PLC for remote monitoring.
Action in the Event of a Fire	No Action.

8.12 Fire Safety Facilities

8.12.1 General

Fire Safety Facilities shall be designed for maximum reliability and ease of maintenance. They shall be in accordance with the codes applicable for Fiji. The Tender shall be based upon the Standards named in this Specification. The Contractor may propose equipment in accordance with other relevant published standards, as optional alternatives. The Contractor shall submit copies of such alternative Standards with his proposal.

8.12.2 Project Requirements

All new substations are to be provided with fire safety facilities. For existing substations these facilities are to be provided as specified in the schedules. Portable fire extinguishers shall be provided under this contract. They shall at least

5 – Portable wall mounted BCF extinguishers.
1– Trolley mounted BCF extinguishers.

Portable fire extinguishers shall be provided for control room, protection room, switchgear room, Battery room and at the entrance and guard room appropriately: Mobile trolley extinguishers shall be placed as directed by the Employer's Representative. Smoke detectors are to be strategically placed with the building (including toilet, store & battery room) and connected to a Wormald Fire System that is linked to the National Control Centre.

8.12.3 Design and Liaison of the Work

Design proposed for fire protections shall be in compliance to the applicable standards in Fiji and designer shall submit a design report with the drawings.

8.12.4 Supplying and installation of services

All fire protection equipment shall be of types approved and listed by recognised approval authorities, or approved by the Employer's Representative. Acceptable approval authorities include national standard organisations, official testing laboratories, and testing laboratories of the fire insurers, licensed testing laboratories with specialised experience of fire protection, and recognised marine classification societies.

8.13 Lighting and Small Power Supply Work

8.13.1 General

The completed installations shall comply in all relevant respects with the Regulations issued by the Institution of Electrical and Electronic Engineers (IEEE) (or equivalent applicable in Fiji) with the Codes of Practice issued by the Chartered Institutions of Building Services, or International Electrical Committees Standards, or with such other.

8.13.2 Contractors Responsibilities

The Contractor shall submit to the Employer's Representative for approval copies of all his calculations forming the basis for the designs of the lighting and small power installation which shall be shown on the working drawings, also to be submitted for approval.
Any approval shall not, however, relieve the Contractor of his contractual responsibilities.
The Contractor shall enter into the schedules, a fixed sum for the complete design work and construction works under this section of the Specification and no price variation will be considered.

8.13.3 Project Requirement

This section of the Specification includes for the lighting and small power installations in new buildings and for extensions to the interior, exterior and emergency lighting and diesel generator small power installations where appropriate. All civil works associated with this section of the works shall be deemed to be included either as part of the main civil engineering works or as part of the works in this section. No additional payments will be made for such requirements. The requirements of this section of the works are subjected to the Conditions and Specifications laid down in other sections and volumes of the Tender Documents. The lighting installations shall be designed to give the standard service illuminations set out in the schedule appended to this section. Control and relay room and office room shall have the service illumination measured at 850 mm above finished floor level. All other areas shall have the service illumination measured at floor level.

The installations shall also meet the limiting glare index requirements as set out in the specified codes of practice. The schedule gives proposals for the types of lighting fittings to be used in the area, type of control to be employed, number of socket outlets and the types of mounting expected to be suitable for the respective areas. When 3 phase lighting installations are to be used, contactor switching controlled by pushbuttons located in the areas to be illuminated is preferred. In all rooms and corridors

having two entrances the lighting installation shall have two way switching, the switches / push buttons being located in appropriate positions adjacent to the entrances. Emergency lighting shall be arranged to illuminate all stairways, exits and entrance and provide some illumination in operational areas. Where the DC is system is used, DC contactors are to be used for switching.

8.13.4 Design and liaison of work

Coding System

The Contractor shall when preparing drawings showing the respective designs use a code to identify each lighting fittings and socket outlet.

The code shall comprise letters and figures so compiled that the following information can be readily identified;

(1) The lighting distribution board to which the fitting or socket outlet is connected.

(2) If connected to the normal supplies or to the emergency DC supplies.

(3) The circuit numbers and phase of the distribution board to which the fitting is connected.

(4) The sequence of the fitting in a particular circuit.

8.13.5 Supplying and installation of service

8.13.5.1 AC Distribution boards

Distribution board for substation supplies shall be of the single busbar, air insulated multi-cubicle or multi-box factory built assembly type, incorporating air break, manually operated MCCB units, suitable for installation in the substation building on a 415-230 V, three-phase, four-wire, 50 Hz system, having the neutral earthed through earthing transformer. Unless otherwise specified, distribution boards shall be in accordance with IEC 439 IEC 408 or BS 5486 Part 1 and Part 2 and to BSEN 60947-8 and the degree of protection shall be not less than IP 41 to BSEN 60947-1 or better equivalent of the concerned standards. Incoming supplies to all distribution boards shall be protected at the point of supply by MCCB. All distribution boards should be suitably rated for a prospective short circuit breaking capacity of 25 kA at 600 V. Distribution boards shall each include three-phase busbars, one neutral busbar and an earth bar; all of high conductivity copper supported to withstand the normal and fault condition stresses. The neutral busbars shall have a rating not less than 50% of that of the associated phase busbars. Distribution boards shall have a busbar rating not less than 100 Amperes.

Each distribution board shall consist of a fabricated steel busbar chamber having MCCB, in distribution boards and attached and mounted at a height convenient for the operator. The distribution board shall be of a type, which is readily extensible and suitable for use in a hot humid climate. Each circuit shall be clearly labelled to show the destination of the associated cable, the "ON" and "OFF" positions of the switches being clearly indicated. Cubicle type (metal-enclosed type) distribution boards shall be so arranged that the cubicles housing individual control units are grouped to form a multi-tier arrangement and a further part shall where possible constitute a cabling and wiring chamber of ample dimensions in which terminal boards, cable boxes and cable seal plates shall be located.

Fuses shall be of the HRC cartridge type for operation at a prospective fault level of 25 kA and conforming to BS 88, where applicable. The mountings of the fuses shall be such that they can be readily withdrawn and replaced whilst the associated busbars and circuits are live. Incoming circuits at distribution boards shall not be provided with fuses for prevention of lack of phase. MCCBs shall be of the high speed fault limiting, thermal/magnetic type to IEC, or BS 3871 or equivalent standard, with quick make and quick break trip free mechanisms, which prevent the breaker being held in against overloads or faults. Tripping arrangements shall be such as to ensure simultaneous opening of all phases. Arc extinction shall be by de-ionizing arc chutes. MCCBs on the incoming circuits shall have

facilities for locking in the "off" position. The rupturing capacity of the MCCB shall not be less than that of the switchboard itself.

ACBs or MCCBs shall be provided on the incoming circuits at the respective Substation Services, main distribution boards. These circuit breakers shall be equipped with thermal device shall have an adjustable IDMT characteristic and the magnetic device an adjustable short time delay. Earth metal of distribution boards shall be bonded and earthed to the main station earthing system. Approved MCCB or title labels shall be fitted externally on the front cover of each switch or distribution board giving the function of each circuit. A non-fading printed list of circuits shall be provided on each sub distribution boards, stating the location of the equipment served, rating of the protective unit and the circuit loading. The lists shall be mounted on the inside of the cover door and shall be protected by an acrylic sheet slid into a frame over the circuit list, the list and cover to be easily removable to permit circuit modifications.

The distribution boards for building services shall be manufactured and tested in accordance with the latest standard and be capable of withstanding without injury the mechanical and electrical stresses set up by a fault equivalent to 25 kA at 600V for twice the period required to disconnect such on any circuit. Each distribution board shall have a dust proof metal case of sheet steel with either a galvanised or enamelled finish to IP 41.The colour of the enamel finish shall match the colour of other switchgear. The metal casing shall be provided with a number of knockouts or other approved form of cable entries corresponding to the circuit capacity of the distribution board and a suitable earth busbar. Distribution boards shall also meet the requirements of the appropriate sections of this clause. Distribution boards for exterior use shall be galvanized and weatherproof to IP 54.Distribution boards for use on direct current system shall be double pole types equipped with adequately rated fuses. Mixed capacity board shall be employed and all contactors and control switches associated with the respective outgoing circuits shall be accommodated within the distribution boards.

8.13.5.2 Cables

Cables designated PVC shall be polyvinyl insulated or polyvinyl insulated and sheathed types manufactured and tested to the requirements of BS 6004, 600/1000V grade or equivalent. Sheathed types shall be equipped with an earth continuity conductor. Cables designated XLPE shall be cross-linked polyethylene insulated filled and polyethylene sheathed or polyvinyl chloride sheathed overall and be manufactured and tested in accordance with the requirements of BS 6364, 600/1000 V grade or equivalent. The outer sheath to be coloured black. Jute fillings will not be permitted.

Flexible type cable for pendant cords and final connections to fixed apparatus shall be butyl or silicone rubber insulated and sheathed manufactured and tested in accordance with the requirements or BS 6500, 300/500V or 300/300 V grade as applicable. The conductor shall comprise multi-strand of 0.25 mm or more. The number of strands shall be not less than 30 and in all cases of a number suitable for the protection rating of the respective circuits.

All cables used for lighting and small power shall have copper conductors.

The Contractor shall select conductor sizes for the respective final circuits to meet the following conditions;
1) That the minimum conductor size for lighting circuits shall be 1.5 sq. mm and for socket outlets 2.5mm.^{2}
2) That the size shall be adequate for the current to be carried as set out in the cable manufacturers specification.

That the size is sufficient to keep the voltage drop in the phase and neutral conductors to the farthest lighting or power point, under normal full load conditions, to within the final circuit limit specified in the Australian Wiring Regulations. Diversity will not be allowed.

8.13.5.3 Cable termination

Termination's for XLPE cables shall comprise compression type clamps and bonding clamps to meet the requirements of BS 6121 or equivalent and shall be designed to secure and to provide electrical continuity between the conductor and the threaded fixing component of the clamps. Earth bond terminal attachments shall be provided. Termination for PVC insulated and rubber insulated cables shall comprise compression type clamps as specified for the terminations for XLPE cables mentioned above.

8.13.5.4 Sealing and drumming

Drums and sealing and drumming of XLPE and PVC cables shall generally meet the requirements of the relevant clauses in Section 8.

8.13.5.5 Cable trays

Cable trays where required as part of the Contract supply shall be the perforated galvanized sheet type. Trays shall have upturned edges and be of a width suitable for the number of cables to be supported and shall be supplied with purpose-made galvanized steel brackets suitable for mounting from the building structure and in the trenches.

8.13.5.6 Cable jointing

The Contractor shall be responsible for the sealing and jointing of all cables supplied and installed as part of this Section of the Contract. All jointing and terminations shall comply with the relevant clauses of Section 8.

8.13.5.7 Contactors

Contactors shall comply with BS 5454, IEC 518/1, IEC 518/1A or equivalent and shall be of the electrically held-in types contained in heavy gauge sheet steel case suitable for panel mounting. Each contactor shall be continuously rated and suitable for thirty inductive switching operations per hour and a utilization category of AC2. This should be used in the Dc light system and in the daylight switches for external lighting.

8.13.5.8 Switches and Push buttons

Switches shall be rated for 15A (single phase) or 20 amps (3 phase) and shall be single pole types and be provided with an earth terminal. The oil filtration plant switch will be of 100A mounted near the transformer.

Switches for use in areas designated for surface installation shall be quick-make-quick-break fixed grid industrial types mounted in galvanized malleable iron boxes with protected dolly and arranged where necessary for multigang switching. Switches for use in areas designated for flush installation shall be micro-break types fixed to white plastic cover plates and mounted in galvanized steel flush type boxes. Two way and multigang variations shall be provided as appropriate.

Push-button switches shall either be flush or surface types contained in galvanized steel boxes and are single pole rated for 5 Amps. or more. Push buttons shall be made of non-hygroscopic material be non-

swelling and so fitted as to avoid possibility of sticking. The terminals for all switches shall be adequate to accommodate 2 conductors each 1.5 sq. mm in area.

8.13.5.9 Lighting Fittings

Illustrations and/or samples of all lighting fittings, which the Contractor proposes to purchase, shall be submitted to the Employer's Representative for approval before issuing any sub-orders. Lighting fittings for interior and exterior use shall be manufactured and tested in accordance with the appropriate sections of BS 4533 or equivalent and together with all components shall be suitable for service and operation in the climate stated.

Each fitting shall be complete with all lamp holders, control gear, internal wiring, fused terminal block, earth terminal and reflectors or diffusers as specified. The design of each fitting shall be such as to minimize the effect of glare and such that the ingress of dust, flies and insects is prevented. Where open type fittings are used it shall be impossible for insects to become lodged therein. The control gear for use with fluorescent lamps shall incorporate power factor and interference suppression capacitors. Chokes shall be impregnated and solidly filled with polyester resin or other approved high melting compound and shall be manufactured to restrict the third harmonic content to less than 25% of the uncorrected current value and shall be silent in operation.

Control gear for discharge lamps shall incorporate power factor correction and interference suppression capacitors. Internal connections shall comprise stranded conductors not less than 0.75 esq. covered with heat resistant insulation to the requirements of BS 6500 or equivalent. All internal wiring shall be adequately cleated to the fitting casing with an approved form of cleat. The finish of fittings for interior use shall be impervious to deterioration by atmospheric reaction. Fittings for exterior use shall have a vitreous enamel, natural aluminium or galvanized finish according to the manufacture's standard product. Fittings for housing tungsten lamps exceeding 150 watts rating shall be provided with an approved method of dissipating heat from the lamp cap and terminal housing. Lamp holders as applicable shall be suitable for the lamp specified.

Flood lighting fittings suitable for 250W high-pressure sodium lamps are preferred. Lighting fittings shall be of the type description as generally set out in the schedule appended to this Section of the Specification. The type references used shall be repeated in the Schedule and on the drawings.

8.13.5.10 Lamps

The Contract includes the supply and erection of all lamps and tubes necessary to complete the installation and these shall be included in the prices quoted for the supply and erection of fittings. Fluorescent lamps shall be manufactured and tested in accordance with British Standards 1853; IEC 81 or equivalent shall be bi-pin types and shall be warm white colour. Tungsten lamps shall be manufactured and tested in accordance with BSEN 60064 or equivalent and shall be bayonet cap for lamps up to and including 100 watts. Lamps rated for 150 watts and higher shall have Edison screw caps. Low wattage lamps used in exit signs and emergency lighting units may be small or miniature Edison screw. Discharge lamps shall be manufactured and tested in accordance with British Standard 3677 or equivalent. Mercury vapour lamps shall be fluorescent types having a 10% red ratio colour correction, whenever used.

8.13.5.11 Socket Outlets and Fused Spur Outlets

The Contract shall include suitably located; heavy duty, weatherproof three phase and neutral interlocked switched socket outlets and plugs for supplying the transformer oil filtration units. Ample

single phase outlets shall be located in convenient positions, and at least one three phase and neutral, light duty outlet with plug shall be located in each relay room.

Each socket outlet shall comply with the requirements of the British Standard 1363 or equivalent and shall be the interlocked shuttered and switched types arranged for surface or flush mounting in single or multi gang units as appropriate. Each fused spur outlet shall be equipped with double pole isolator, a fuse to British Standard 1362 or equivalent and where required front entry for flexible connection. Each socket outlet and fused spur outlet shall be equipped with a galvanized metal box with earth terminal. Each group of five socket outlets shall be provided with matching fused plug top. All socket outlets for exterior use shall be galvanized and weatherproof and be equipped with screwed dustproof cap attached to the socket by means of a chain.

8.13.5.12 Conduit and Fittings

Steel conduits shall be manufactured in accordance with BS 4568, Part 1 or equivalent, heavy gauge screwed and welded Class B and shall be galvanized, or an alternative price can be quoted for high impact heavy gauge PVC of similar dimensions.

Fittings for steel conduits shall be manufactured of good quality malleable cast iron and of small circular pattern to BS 4568, Part 2 or equivalent, with internally tapped spouts minimum length 21 mm threaded to the correct length at inter-sections tees, draw through and stop ends.

Conduit fittings of PVC shall be of the plain bore pattern suitable for a push-on compression type joint and shall be sealed with a hard setting vinyl cement to prevent ingress of vermin, water, dust, etc.

8.13.5.13 Poles

Lighting poles shall be of tubular or polygon shaped steel with a base of sufficient section to house an inspection trap, lockable door, cable entry and terminations suitable for the incoming cables and the secondary cables feeding the light sources, all of which shall be supplied with the pole. All poles shall be suitable for burying to a depth of 1.5 m, shall be suitable for embedding in concrete and shall be adequate to withstand the local wind forces with a factor of safety of 2.5.Steel poles shall be galvanized and covered with a bituminous base preservative to cover both the inside and outside of the pole.

8.13.5.14 Interior Installations

Wiring for the lighting and socket outlet installations shall comprise PVC cables drawn into conduits attached to walls, structural or roof steelwork or ceilings as appropriate. All fixings shall be of a type approved by the Employer's Representative and all metal work used shall be galvanized. Fixings to structural steelwork shall be with purpose made brackets or clamps, the drilling of structural steelwork will not be permitted. Cleats with two screw fixings shall be used for supporting conduits at not greater than 2-m intervals. All switch boxes, socket outlet boxes and items of a similar type shall be fixed with two screws or bolts. Switches and push buttons for lighting circuits shall be mounted at 1,300 mm above finished floor level. Socket outlets shall be mounted 500 mm above finished floor level but those for use with workshop benches shall be mounted 150 mm clear of the bench working surface.

Lighting fittings shall be attached to ceilings, walls, trucking or roof steelwork or suspended therefrom as appropriate. Where fittings are to be suspended, rod type suspension units shall be employed.
Final connections to all suspended lighting fittings shall be with heat resistant flexible cable terminated in porcelain clad connectors in the ceiling or junction box which shall also terminate the main circuit cable. The cable length shall be such that the suspension unit supports the full weight of the lighting fittings.

Where recessed type lighting fittings are to be installed suspension units shall be used to prevent the weight of the fittings being applied to the suspended ceiling. It shall be possible to carry out maintenance from the underside of the fitting without disturbing the false ceiling. To facilitate this need the final connection to each fitting shall be with heat resistant flexible cable from a plug in type ceiling rose mounted above the false ceiling.

All cables not contained within conduit shall be terminated with a cable hole sealing to the requirements of Section 8.Where lighting fittings are mounted direct on walls or ceilings the main circuit cables may be connected into the fitting terminal block and where the fittings are mounted flush with the ceiling the final connection shall be taken through ceiling roses. Where terminal blocks do not exist within the lighting fitting flexible heat resistant cable shall be used connected to a separate junction box. Earth continuity shall be maintained throughout the entire wiring installation with separate insulated earth continuity conductors of adequate cross-section ultimately connected to a common earth terminal at the respective distribution board. Each and every trucking route shall be bonded across all joints with external copper bonding links supplied for the purpose.

8.13.5.15 Exterior Installation

Switchyard floodlighting shall preferably be mounted on earth mast structures at a height of 11 meters above ground level and suitable access ladders shall be provided on the masts for maintenance of the lighting fittings. Where this is not feasible the floodlight fittings shall be mounted on poles also at a height of 11 meters above ground.

Roadway lighting shall comprise roadway lanterns mounted on poles at 5.5 meters above the finished road level. All exterior lighting shall be controlled by at least 2 photoelectric cell. A by-pass switch is to be install on each photocell to test the external light periodically.

Cables to exterior lighting shall be XLPE cables laid in concrete trenches or cleated to building structures or into steel conduits galvanized as appropriate to the route requirement. The cables shall be terminated at a cutout located at the base of each support. Wiring between the cut-out and the control gear or lantern shall be with PVC or PE multi-core cables run within poles or drawn into galvanized steel conduit attached to the supporting structure.

This exterior lighting shall be with sodium vapour lamps and shall be supplied by a diesel generator set during emergency.

8.13.5.16 Earthing and Bonding

All equipment being supplied under this Section shall be effectively bonded to ensure earth continuity throughout the system. Continuity may be provided by means of steel conduits but a separate earth continuity conductor shall be included with all wiring in conduits. No reliance shall be placed on metal to metal joints in conduits for each continuity. The earth continuity conductors shall as far as possible be in one continuous length to the furthest part of the installation from the controlling switchboard. The earth conductor shall connect all metal cases housing electrical equipment. The branches shall be connected to the main conductor by permanent exothermic fusion welded joints or crimped joints approved by the Employer’s Representative.

8.13.5.16 Emergency Lighting

Emergency lighting shall be installed in the new substation buildings. The emergency lighting shall be divided into two parts. One part shall have fittings installed in strategic locations to ensure safe

evacuation of the buildings, and shall switch on automatically following a power failure. This part shall not be connected to the substation DC system, but shall have dedicated batteries and chargers.

The other part shall be supplied from the substation DC system and the lighting in each room shall be controlled by a switch located in that room (connected to DC contactor). The illumination level shall be sufficient to enable an operator to undertake emergency inspection and switching duties. At least two rechargeable hand lamps shall be installed at each substation. They shall normally rest on wall mounted brackets incorporating the chargers. Each lamp shall incorporate a small red light to facilitate location following a lighting failure.

Lighting and Small Power Supply Works
Schedule of Requirements

Location	Service Illumination		Type of fittings		Type of fixing	Type of control & switch	Socket outlet	Type of installation
	Lux	Index	Main	Emer			Type, No.	
Switchgear Room	500	19	F6/F7	E4	C	L/A	S1,	F
Battery room	150	-	F5	E4	C	L	S1,	F
Office room All buildings	500	16	F6/F7	E4	C	L/A	S1	F
Auxiliary room	300	16	F8/F9	E4	C	L/A	S1	F
Control, Protection and relay room	300	16	F8/F9	E4	C	L/A	S1	F
Store all buildings	150	-	F1	-	C	L	S2,	S
Corridors all buildings	200	-	F6/F7	E4	C	L/A	S1	F
Exits	-	-	-	E2	W	A	-	F
Switchyard area	10	-	M1	-	P	PEC/ MAN	-	-
Road ways	10	-	J1	-	P	PEC/ MAN	-	-
Building's exterior	10	-	T1	-	W	PEC/ MAN	-	-
Rest room	300	16	F8/F9	-	C	L	S1, 2	F
Toilet all buildings	150	-	T2	-	C	L	-	F
Guard room	300		F6/F7	E4	C	L/A	S1	F
Watchtowers	150		F3		C	PEC/MAN	S1	
Security lighting	10		J1/M1		P	PEC/MAN		

Notes:

2) The above small power outlets are those required over and above the requirements for fans*, water heaters etc. specified here in.*

8.13.5.17 Clocks

Dry battery cell type clocks shall be installed in the control and protection room in new control building. The clock shall be 600 mm in diameter or digital type approved by the Employer's Representative.

8.13.5.18 Maintenance

The Contractor shall be responsible for maintenance of the installations comprising this section of the Specification for the agreed period as set out in this Specification

8.14 Building Works

General

The General Conditions, Tender Drawings, relevant Specifications On materials and workmanship described elsewhere in this Documents, Schedules shall be read in conjunction with this Specification.

8.14.1 Contractor's Responsibilities

This is a turnkey contract which includes all building works and services. The Tender shall cover all requirements of the Tender Documents and any other items not specifically mentioned but which are deemed to be necessary for the complete execution of the Works to the entire satisfaction of Energy Fiji Limited & Engineer. No additional cost will be considered for any item which the Contractor has over looked but are essential for the full completion of the Project in every respect.

The Tender shall include the building works proposal complete without-line drawings indicating any variation or improvement which he deems technically or financially justified for the works mentioned in the Tender Document, schedule of materials and finishes on which the tender has been based. The Building shall generally conform to the sizes fit for purpose & as per approval of Energy Fiji Limited & Engineer.

The Contractor shall be responsible for all performance in the detailed design, supply of material, labour, plants and equipment, construction and relevant works incidental to the completion of the Building Works. The Contractor shall perform the Works thoroughly in accordance with the agreed construction schedule and direction to be made by Energy Fiji Limited & Engineer during the Contract Period.

8.14.2 Building Sub-Contractor

The Contractor may employ a building subcontractor for building works. If the Contractor intends to subcontract the building works design and/or construction, his tender shall include full details of comparable works carried out elsewhere by the subcontractor, together with details of the financial stability and general efficiency of the proposed subcontractor.

The Contractor shall provide full details of any sub-contractor to Energy Fiji Limited & Engineer prior to any works for approval.

8.14.3 Construction Schedule

A preliminary building construction schedule showing the completion time for the building works shall be submitted by the Tenderer based on the overall project implementation schedule. The Contractor shall prepare and submit to Energy Fiji Limited & Engineer for approval a detailed construction schedule for the building works developed from the preliminary building construction schedule before commencement of the Work on the Site.

The approved construction schedule shall not be altered without the written consent of Energy Fiji Limited & Engineer.

8.14.4 Records

The Contractor shall keep accurate and up-to-date records and drawings of the Works at the Site and shall provide Energy Fiji Limited & Engineer with copies of these records. The Contractor shall submit to Energy Fiji Limited & Engineer weekly & Monthly reports of labour, plant and materials employed on the Site.

8.14.5 Samples Testing and Inspection

The Contractor shall perform testing and inspection of materials and shall submit sample materials, test certificates and workmanship details Energy Fiji Limited & Engineer for approval. The costs of all samples and testing shall be borne by the Contractor.

8.14.6 Temporary Services

The Contractor shall be responsible for arranging the provision of electricity, water, drainage, etc. necessary for the proper execution of the Works. All costs for these services shall be borne by the Contractor.

8.14.7 Scope of the Works

The building works shall include collection of the Site information, detailed design, production of working drawings, provision of labour, plant and materials, tests/inspection, construction and remedy of defects during the Warranty Period. The Building shall generally conform to the sizes as mentioned below.

A. Control building, Engine house, Fire Fighting pump house, Emergency Diesel Generator house, Guard house, water supply house, fencing, boundary wall, road etc. shall be constructed by the Contractor within the Site area.
B. Dimensions and number of rooms of the Buildings mentioned shall be to the standard practice based on the size and number of Equipment and acceptable to Energy Fiji Limited & Engineer.

8.15 Design of the Works

8.15.1 Designs and Drawings

The Contractor shall design in accordance with this Specification and prepare complete working drawings as necessary for the construction of the Works. All drawings shall be submitted for the approval of Energy Fiji Limited & Engineer.

8.15.2 Standards and Codes of Practice and Other Design Conditions

Design and construction of building works shall conform to recognize authoritative intentional or national standards and codes of practice. The adopted standards or codes shall be consistent throughout any section of the works unless otherwise specified. The Contractor shall have full responsibility to investigate the existence of any decrees and local bylaws governing the proposed works and to fully comply with such requirements which are effective when the date of tender submission.

As described elsewhere in the documents the Contractor shall indicate in his tender standards and codes to be conformed in design and construction of the Works. Copies of these codes and standards shall be made available to Energy Fiji Limited & Engineer during the design and construction period.

8.15.3 Submission of Designs and Drawings

The Contractor shall be required to produce full design calculations for the foundations, building structures, and detailed working drawings and reinforcement bar bending schedule etc. Design calculations shall be prepared in accordance with an approved method of computation based on the most unfavorable combination of dead load, live load or crane load and wind load. The Contractor shall be responsible for the detailed design, strength and safety of the structures, and ensuring that the design satisfies the requirements of all authorized local and international bodies.

Design calculations and detailed drawings shall be submitted Energy Fiji Limited & Engineer for approval in accordance with the requirement set out in Tender and relevant Standards prevailing in Fiji. Construction on the Site shall only commence after drawings are finally approved.

Notwithstanding Energy Fiji Limited & Engineer’s approval, the Contractor shall be held responsible for the accuracy of his submitted information, designs and drawings.

8.16 Building and Services

8.16.1 Control Room Building

Construction Control Room Building

Main construction materials

a. Frame: Reinforced concrete
b. Roof: Reinforced concrete roof with lime concrete water proofing or Trim Deck.
c. Exterior wall: Reinforced concrete and/or reinforced block wall.
d. Partition wall: reinforced block
e. Floor: Concrete with plastic tile, ordinary tile, troweled mortar finish, etc

Foundation: The Contractor shall examine subsoil condition for design of foundation. Proper foundation shall be designed by the Contractor in accordance with the Specifications and Geo-Tech Engineers recommendation.

Windows:
Aluminum sash shall be provided. Window area shall be generally more than 1/10 of the room floor area unless otherwise indicated. All windows except toilet, store, and cable spread mg room windows shall be fitted with sun blinds of approved made.

Machines and utilities:
Air conditioning system, ventilation system, water supply system, power supply system, drainage system, sanitary system and lighting system shall be provided.

Finishes and room sizes:
The Contractor may submit the layout to suit any particular requirement subject to the approval of Energy Fiji Limited & Engineer.

a. Other Requirement:
-Control room: Noise level shall be kept to a value less than 45 db(A).
-Toilets: Toilets shall be provided with sanitary fittings as follows:
Water closet
Urinal
Hand Basin
Air Dryer
Cabinets.

b. Ventilation and air conditioning
All rooms shall be provided proper ventilation system. The control room, relay room, electronics spares store, shall be provided air conditioning system.

8.16.2 Air Conditioning System.

The detail design of air conditioning system for control building shall be based on the following criteria:
-Outside temperature: 36 Deg. C
-Inside temperature: 16 Deg. C
-Relative humidity: 60%
-Type of system: Package air conditioning units

Design calculations and drawings shall be submitted to Energy Fiji Limited & Engineer for approval prior to commencement of the work.
Details of the equipment proposed shall be submitted with the Tender.

8.16.3 Ventilation System

All rooms in the control building, guard house etc. shall be designed and furnished proper ventilation system in principle.

Unless otherwise specified, natural ventilation will be acceptable for the minor buildings. All toilets, battery room and shall have exhaust fans of approved made.

All fans shall be statically and dynamically balanced to avoid vibration and shall have blades to secure quiet efficient operation.

8.16.4 Plumbing and Sanitary Installation

The whole of the plumbing works in the buildings shall be provided in accordance with the relevant bylaws and to the complete satisfaction of Energy Fiji Limited & Engineer. Pipes shall be connected to each point where water is required, with a minimum head of 2 meters at all outlets.

All PVC pipe works and fittings as are necessary for the complete installation of the sanitary system shall be supplied and installed in accordance with the requirement of the local authorities and other standards approved by Energy Fiji Limited & Engineer.

8.16.5 Lighting

The whole of the power supply and lighting system for the buildings shall be designed and installed in accordance with the requirements of the tender document and relevant AS/NZS standards.

8.16.6 Materials and Workmanship

8.16.7 Structural Steel

a. **General**

Structural steel, bolts and nuts shall comply with the requirement of an approved standard and this Specification in all respects and those shall be fabricated from hot rolled sections unless otherwise specified or agreed in writing by Energy Fiji Limited & Engineer.

b. **Materials**

The materials to be used shall be free from harmful defects and rust. Samples of materials shall be tested, and copies of the test reports giving physical and chemical properties shall be submitted to Energy Fiji Limited & Engineer for approval. The Contractor shall carry out all necessary tests, at his own expenses, to prove that the materials offered for the intended purpose are in compliance with the approved Standard.

In lieu of these tests, mill sheets issued by the authorized manufacturers will be acceptable. The characteristic strength of the structural steel shall have the following values regardless of the standard and code used: -

1. Yield Point : not less than 520 MPa
2. Tensile Strength : not less than 695MPa
3. Elongation : not less than 20%

c. **Bolt and Shear Connector**

High strength bolts, anchor bolts, ordinary bolts and shear connectors to be supplied for the erection of structures shall conform to the Standard AS/NZS and shall be of an approved manufacturer. Specially devised high strength bolts, if used, shall tightened in accordance with the manufacturer's instructions. Any bolt that has been fully, tightened and then un-tightened shall not he used in the permanent Works.

d. **Fabrication**

Fabrication and erection drawings shall be submitted to Energy Fiji Limited & Engineer for approval prior to commencement of any fabrication and erection work. Steelwork shall be fabricated to the required details in a manner approved in the methodology and by Energy Fiji Limited & Engineer. The Contractor shall provide adequate facilities to the Energy Fiji Limited & Engineer to inspect materials and fabrication works in the shop and at the Site when required.

e. Welding

Welding of structural steel shall be performed to the required type and size by an electric arc process by qualified welders under approved conditions.

f. Welding Procedure

Details of the proposed welding procedure, manufacturer, classification on, code type and size of electrodes to be used shall be submitted to Energy Fiji Limited & Engineer for approval. When necessary, welding tests shall include specimen weld details representative of the actual construction which shall be welded in a manner simulating to most unfavorable conditions liable to occur in the particular application. All costs of the tests shall be borne by the Contractor. All welds shall be finished full and made with correct number of runs. Slag and other inclusions shall be cleaned from all welds.

Notwithstanding the approval of welding schedule and procedure by Energy Fiji Limited & Engineer, the Contractor shall bear full responsibility for correct welding and for minimizing the distortion in the finished structure.

- **Preparation of Base Metal**

Surface and edges to be welded shall be smooth, uniform, and free from fins, tears, cracks, and other discontinuities, which will adversely affect the quality or strength of the weld. In the preparation of the fusion faces, shearing shall be limited to metal thickness not greater than 8 mm. All fusion faces shall be pre-pared by machining shall be limited to metal shall be prepared by machining or flame cutting, or where approved, by special oxygen cutting apparatus.

Fusion faces, angle of level, root radius, and the like shall be properly prepared to give the approved weld forms. The parts to be jointed by fillet welds shall be brought in-to contact as close as practicable. The gap between parts shall normally not exceed 4.8 mm (3/16 in.). A butting parts to be joined by butt welds shall be carefully aligned and the correct gap and alignment maintained during the welding operation.

- **Butt Welded Joint**

Ends of the welds shall have full throat thickness by means of runoff tab. Additional metal remaining after the removal of the tab shall be removed by machining, or by other approved means. Ends and surfaces of the welds shall be smoothly finished. All main butt welds shall have complete penetration and, except on tubes or partial penetration Joint, shall be welded from both sides. The back of the first run shall be suitably gouged out.

- **Intermittent Welds**

Intermittent welds shall not be permitted without the approval of Energy Fiji Limited & Engineer.

g. Paint

Prior to delivery after shop inspection, the whole of the steelwork shall be prepared for painting by an approved blast cleaning method.
All rust, grease, mill scale and harmful matter shall be removed. The surface shall be blast cleaned to be ready for first coat. The first coat of primer of recommended by the manufacturer as suitable for use

under the prevailing condition at the application site shall be applied immediately after blast cleaning (or within two hours).

No paint shall be applied to the surfaces to be embedded in concrete, to contact surfaces for joints using high strength friction bolts and to surfaces within 50 mm either side of joints to be welded. Painting shall be carried out in a clean, dry building where air temperature shall not be allowed to drop below 5 deg.C. No paint shall be applied on the steelwork with condensation. Painting shall not be carried out when the relative humidity is over 90%, or if in the open, during rain, fog or mist. The welded areas and the edges of site joints shall be cleaned down, primed and painted' all in accordance with the standards specified, after erection.

Each coat of the paint will be applied in different color. When paintwork is damages it shall be cleaned and re-painted following the procedures as approved by relevant AS/NZS Standards. The manufacturer's instructions regarding inter-coat intervals shall be strictly observed.

h. **Transportation and Storage of Steelwork**

The whole of the steelwork shall be handled in such a manner that the shape and surfaces of the section shall not be damaged during lifting and transportation. The Contractor shall take all necessary measures, to ensure that steelwork members shall be handled, stored and erected without their being subject to stresses in excess of those for which they were designed. Chains and hooks will not be used in contact with the steel work and lifting slings shall be of nylon rope. Steel work shall be stored in clean, dry conditions off the ground. Separate pieces of steelwork shall have spacer blocks between them.

i. **Erection**

The Contractor shall ensure the correctness of alignment, plumbing and stability of the various frames and members. He shall also take all necessary measures, by adequate resistance to wind and stability against collapse, during construction.

No permanent bolting and site welding shall be carried out until proper alignment has been obtained.

8.17 Concrete

The specifications for concrete works under Part 5 are applicable to building works.

8.17.1 Grouting Of Structural Steelwork

1. Materials for Grouting

The aggregate for grouting shall consist of hard siliceous sand, and grained chips, gravel or crushed stone, or other approved inert materials with similar characteristics. The materials shall be clean, free from lumps, soft or flaky particles, shale, crusher dust, silt, alkali, loam, organic matter or other deleterious substances. The aggregate shall be of uniform grading and shall be of such a size that 100% will pass through a 10 mm mesh and not more than 10% will pass through a 120 micron mesh. A pre-mixed non-shrink resin grout may he used. The manufacturer's instructions on mixing and the placing of the grout shall be observed.

2. Admixtures

An admixture which acts as a non-shrinking agent shall be added to the grout only with the Energy Fiji Limited & Engineer’s approval. All proprietary admixtures shall be added and mixed strictly in accordance with the manufacturer's instructions.

3. Surface Treatment

Concrete surface which is to be grouted shall be thoroughly cleaned and all laitance removed from the surface by means of a hammer and chisel. A power hammer shall not be used.

4. Mixing

The Contractor shall submit to Energy Fiji Limited & Engineer for approval details of the mix and the methods he intends to use, prior to the commencement of the grouting.

5. Placing

For cement based grouts the concrete surface to be grouted shall be thoroughly saturated with water at least two times before the commencement of grouting.

8.17.2 Roofing and Blockworks

1. Roofing

Roofing material for administration building shall be of corrugated galvanised iron sheet (
.48 bmt COLORBOND Roofing Trimdek Sheets
). The Contractor shall submit samples and technical details of the roofing material for approval of Energy Fiji Limited & Engineer.

2. Waterproofing

Waterproofing for reinforced concrete flat roofs shall be of lime concrete. The minimum thickness of lime concrete shall be 10 cm.

3. Eaves Gutters and Down Pipes

Eaves gutters shall be of PVC or galvanized steel sheet coated with bitumastic painting to be approved by Energy Fiji Limited & Engineer. Where large section is required, steel sheet is preferable for strength. Down pipes shall be of PVC pipe, galvanized steel pipe or cast iron pipe to be approved by Energy Fiji Limited & Engineer.

4. Block Walls

Blocks to be used for walls shall be Fiji made. Unless otherwise specified or as shown in drawing, the thickness of brick-wall shall be more than 200mm.

Mortar for use with blockwork shall be mixed in the proportions of 1:3 cement, sand or 1:2:5 cement, lime and sand by volume. Mortar should be mixed by machine only. Hand mixing is not allowed. Cement shall be of a quality as described in the Part 5 for concrete. Sand shall be well-graded (2.5 mm down) hard and free from deleterious substances. Lime for mortar shall be pure calcium carbonate properly burned, then hydrated, and finely ground. All joints shall be completely filled with mortar. The thickness of the horizontal mortar Joints shall not exceed 40 mm to every four joints. The mortar shall be used within 2 hours of mixing with water and any mortar not used then shall be discarded.

All block-walls are to be reinforced with approved reinforcing material at every third course.

The damp proof course shall be provided at joint and intersections laid on a bed of cement sand (1:1), bedded in and coated on the upper surface with liquid bitumen. External fair faced wall shall be weather struck; faces or wall which are to be plastered or rendered shall have their joints raked out to form key.

5. Calking

The Contractor shall calk the joints to ensure water tightness of the building structures. Prior to calking materials and working method shall be approved by Energy Fiji Limited & Engineer.

8.17.3 Carpentry and Joinery

1. Timber

All timber shall be of best quality (H4-H5 treated), perfectly dry and well-seasoned, sawn die square, free from sap, shakes, wanly edges, large loose or dead knots and all other defects and shall be to the approval of Energy Fiji Limited & Engineer.

2. Preservative

Timber to be used in shower rooms or in contact with the ground floor, shall be treated with an approved preservative against rot or termite attack. The backs or frames to be fixed to walls and all other bedding surfaces shall be painted with two coats of preservative before fixing. All fixing blocks, pallets, and other hidden timber shall be so treated prior to fixing.

3. Joinery Fittings

All timber for Joinery fitting shall be of selected type properly seasoned and dry to a agreed moisture content not exceeding 18%. Energy Fiji Limited & Engineer shall have the right to check all timbering used and to reject any timber found to have a moisture content exceeding 18%.

Joinery fittings and built-in cabinet are to be constructed exactly as shown on the approved drawings. All work must be carried out by experienced cabinetmakers in a sound and workmanlike manner with properly fabricated joints, dovetailed, mitred or mortised and with concealed pins and screws. All joints shall be glued before pinning or screwing.

4. Faults

Any defect in the wood works such as shrinks splits, fractures, etc shall be removed and replaced to the satisfaction of the Energy Fiji Limited & Engineer.

8.17.4 Doors and Windows

Prior to furnishing and installing, the Contractor shall submit the shop drawings indicating shape, dimensions, material including hard wares and locking method of doors and windows for all buildings for the approval of the Energy Fiji Limited & Engineer. The standard requirements of doors and windows are as follows:

a. Steel doors
Frame and Stile Plates: more than 2.3 mm thick
Stile and Panel: more than l.6mmthick
Thickness: 80 mm
Size: double door 2.0 x 2.0 m
Single door 1.0 x 2.0 m or
Other sizes as shown on the approved drawing

8.17.5 Glazing Works

1. Materials

Sheet glass shall be of good quality, free flow unevenness and strain of bubbles. All the glass used on the ground floor shall be tinted glass (salon-radiation absorbing glass), and all the glass used on the first floor shall be clear glass. Where so required figured glass shall be used. Minimum thickness of tinted glass and clear glass shall be 6 mm. Glazing beads, sealant, putty, clips and setting block shall be of good quality and those recommended by the glass manufacturer. All the glass used in the following rooms shall be tinted wire glass.

Auxiliary room and cable spreading room Warehouse and workshops Stores

All glass shall be installed tightly in accordance with the instructions of the glass manufacturer. Upon completion of the works, glass shall be wiped clean and shall be inspected by Energy Fiji Limited & Engineer.

8.17.6 Metal Works

1. General

The metal works will include handrails, drain pipes, steel ladders, step ladders, cable duct hatch cover plate, removable hatch cover plate, rain water leader, air duct, louver and others. Prior to fabrication work drawings and quality of materials shall be submitted to the Energy Fiji Limited & Engineer for approval.

2. Materials

The materials to be used in the Works shall be free from defects and conform to AS/NZS Standard or relevant Standards approved by the Energy Fiji Limited & Engineer.

3. Workmanship

All plates and sections shall be true to form, free from twist and straightened before any fabrication work is started on them. The works of cutting, fabrication, welding, installation and painting shall be done in accordance with this Specification and relevant Standard. If difference quality metals are in contact with each other, these contact surfaces shall be separated by means of bituminous paint, felt strip, rubber sheet and other material to be approved by the Energy Fiji Limited & Engineer.

8.17.7 Floor-laying

1. PVC Flooring

PVC flooring shall be heat resisting vinyl tiles obtained from an approved manufacturer. The tiles shall be not less than 2.4 mm thick and laid by a specialist to a jointing layout approved by the Energy Fiji Limited & Engineer. A matching PVC cove-type skirting is to be used in conjunction with the floor tiles. The tiles and skirting shall be laid on a flat, clean concrete floor, in strict accordance with the manufacturer’s instructions, using the recommended adhesive.

2. Unglazed Vitreous Ceramic Tiles

The tiles shall be plain and of manufacture and color approved by the Energy Fiji Limited & Engineer. The tiles shall be laid by experienced craftsman, on a concrete slab accurately formed with a true, smooth surf ace. Joints shall be accurately aligned in both directions and matching covered skirtings.

Expansion Joints shall be the same width as tile Joints, approximately 5 mm, and filled with approved filling material. The surface of the base shall be cleaned of all dirt, grease, grit, etc. and the tiles shall be dry and clean.

3. In-situ Terrazzo

In-situ terrazzo paving is to consist of2 1/2 parts 6.5 mm 9.5 mm approved marble chippings, clean and free from dust, mixed with one part of "concrete" or "snowcrete" or approved equivalent according to the background required. The terrazzo shall be laid by a specialist.

The terrazzo is to be trowelled to a dense even surface, rubbed down and polished to approval. Where surface are required to be left rough finish the finishing coat shall be brushed with wire brush while still green to expose the aggregates.

Brass dividing strips 25 mm x 3.2 mm shall be provided at junctions of different floor finishes, finishing flush with flooring non-slip nosing tiles of approved manufacture and colour shall be provided in finishing works for steps and stair.

4. Damp-Proof Membrane

An approved bitumen/PVC water-proof membrane shall be placed on the blinding concrete under concrete slabs, to exclude rising moisture.

8.17.8 Wall and Ceiling Finishes

1. Materials

Cement, sand, hydrated lime, gypsum plaster, expanded metal lathing, flat headed galvanized nails, galvanized staples and wire shall all comply with approved standards. Materials shall be carefully store in a dry weatherproof store until required for use.

2. Preparation of Backgrounds

Backgrounds for plaster work shall be carefully brushed out and removed dust and other deleterious matter likely to impair the bond of the under coat with the structure. When the background surface is dry and undue suction occurs, this shall be sprinkled with water to, prevent drying the applied plaster.

3. Plasterwork

Undercoat shall consist of Portland Cement, hydrated lime and sand gauged in the proportions 1:1:6. The undercoat shall be keyed to take the finishing coat and allowed to dry out completely before the latter is applied.
Finishing coats shall be applied in accordance with the recommendations of the manufacturer of the particular brand to be used. The total thickness of the two coats shall not be less than 15 mm thick.

4. External Rendering

External rendering shall be applied in two coats, with an approved waterproof agent added to the mixes. The walls shall be wetted before the application of the first coat, which shall be finished flat and vertical by straight edge, and scored to form a key. The second coat shall not be applied until the first coat has dried out completely. Immediately before application of the second coat, the surface of the first coat shall be wetted, and the second coat shall be applied by machine, to give a "Tyrolean" finish of uniform thickness and texture.

An approved plasticizer may be used in both coats. All external rendering shall be protected from rain and direct sunlight for period of 7 days.

5. Glazed Ceramic Tiling

Glazed ceramic wall tiles shall be of nominal size 100 mm x 100 mm x 5 mm, colour to be selected. Fittings shall be obtained from a supplier approved by the Energy Fiji Limited & Engineer. The ceramic tile fixing and grouting materials shall be obtained from the same source. The Contractor shall ensure that the rendering is accurately formed and has a true plumb surface which is free from all high spots and depressions.

The rendered backing for tiling shall be cleaned and will be wetted (just enough to prevent it from absorbing water from the fixing bed) immediately prior to tiling. All tiles shall be dipped in water to ensure that they are completely clean prior to fixing. All tiles shall be immersed in water in clean containers for at least half an hour before use. Tiles shall then be stacked lightly together on a clean surfaces to drain with the end tiles, turned glaze outwards. They shall be fixed as soon as all surfaces water has evaporated they must not be allowed to dry out more than this.

Approximately two days after the fixing of the tiles, all joints shall be pointed with neat white grouting cement; the finish shall be flushed and free from all voids and irregularities.
All wall faces shall be finished plumb and flush throughout free from unevenness and irregularities of plain; all angles shall be straight and true. The finished work shall be left clean and free from all materials, which will scratch or in any way impair the finished work. Final polishing shall be done with a dry cloth. The Contractor shall be responsible for the adequate protection of the tiling from all damage until the handling over. Any damage which does occur shall be made good by the Contractor at his own expense. The whole of the work shall be left in a state satisfactory to the Energy Fiji Limited & Engineer.

6. Suspended Ceiling

Materials, samples and drawings showing details of construction of all types of ceiling required shall be submitted to the Energy Fiji Limited & Engineer for approval.

Appropriate size of aluminum tees shall be grided to the module of standard panels to accommodate acoustic boards, or approved equivalent, the odd size panels at perimeter shall then be arranged to equal dimension.

Fixing of hanger to beams, floor slab and soffits must be capable of carrying the load of ceiling boards and ventilation grill should be supported from the strengthened aluminum tee grids.

8.17.9 Painting

1. Materials

All paint distempers and other materials shall be of an approved brand or brands and shall comply with AS/NZS Standard or other, equivalent standard to be approved by the Energy Fiji Limited & Engineer. Paint for use on concrete or brickwork shall be of a type specially prepared for this purpose. Each coat shall be of a distinct color from the preceding one and all colors shall be approved by the Energy Fiji Limited & Engineer. Mixed paint and synthetic resin emulsion paint shall be applied based on the following method:

Application	Metal	Mixed Paint Wood	(unit: kg/sq.m) Synthetic resin Concrete Brick emulsion
First paint (Rust inhibitive paint)	0.14	0.09	0.13
Second paint	0.08	0.11	0.13
Finishing paint	0.04	0.09	0.13

Note: Rust inhibitive paint shall be either red lead or zinc rich lead type.
For painting of structural steelwork following the relevant AS/NZS Standards.

8.17.10 Surface Preparation

Prior to painting, the dust, grease, injurious adherent substance, rust shall be removed from the surface to be painted. The planed grain, interlocked grain, fluff in wood shall be ridded with sandpaper and all cracks, manholes open; duct and other imperfection shall be made good with hard stoppings consisting of paste white lead and gold size stiffened with whiting. Cracks and holes on the concrete surface shall be flattened with cement paste, mortar, or cement filler.

8.17.11 Workmanship

All painting and decoration shall be carried out by skilled workmen according to the best current practice in accordance with manufacturer's instructions.

All materials shall be applied by brush unless otherwise specified or approved.

8.17.12 Priming

All joinery, metal works to be painted shall be primed using appropriate and approved primer before delivery assembly or fixing. No primer is required on surfaces to be distempered or emulsion painted unless otherwise specified.

8.17.13 Number of Coats

Unless otherwise specified, the required finishes shall consist of the following treatments, in addition to preparation, priming etc:-

a. Distempering two coats
b. Emulsion painting two coats
c. Oil painting three coats on woodwork

Two coats on elsewhere

8.17.14 Storage

The Contractor shall furnish an exclusive place for storing the combustible paints. The place for storage shall be fully ventilated. Adequate measures shall be taken against the ingress of dust and direct rays of the sun.

Section 5

415V Station Services Board

5.0 Section 5 - 415V Station Services Board Design, Performance and Construction Requirements

5.1 General

The AC Switchboard shall be indoor, metal clad, dead front assemblies, non-withdrawable type, free standing and rated for a form of separation of Form 4b for Incomer and Feeder Breakers and Form 2b for Distribution Boards.

The distribution board shall be:

- free standing,
- suitable for mounting adjacent to a wall,
- fitted with access doors on the front,
- indications visible from the front,
- capable of fixing to the floor by bolting (M12 bolts preferable, Supplier to provide),.
- capable of front access to fasting locations,
- fastening locations within the footprint of the distribution boards.
- able to have any hinged door reversed to swing from the opposite side.

The AC Switchboard shall be provided complete with properly sized busbars, MCCBs and MCB's, earthing bus bars, CTs and all necessary protection, control and monitoring equipment, with electrical and Mechanical interlocking mechanisms, isolators, auxiliary relays, switches, contactors and any other devices required for safe operation and maintenance as well as be fully arc fault contained.

The cable zone, busbars, auxiliary equipment as well as control compartments shall be enclosed within the fixed housing and be segregated to form 4b. The design of the distribution board shall be such that connection and disconnection of outgoing cables may be performed in relative safety by competent authorised persons, and consequently the distribution board shall incorporate protective measures as outlined in AS/NZS 61439.1.

When operating at distribution panel board rated full load, the maximum temperature rise within the distribution panel board enclosure shall not exceed 15oC above outside ambient temperature.

5.2 Switchboard Interlocks and Transfer Scheme

Electrical and mechanical interlocking shall be provided between auxiliary transformer Incomer and the street supply incomer to prevent operation of both supplies being on simultaneously.

5.3 Switchboard Transfer Scheme Operation

The scheme will be a manual transfer system meaning if the mains voltage drops or fails, the operator shall manually transfer from auxiliary transformer incomer to the street supply incomer. Provision shall be left in the board to automate the changeover in the future should EFL desire to do so.

All MCCB's shall be fitted with adjustable overcurrent relays to adapt settings to the required protection and application levels.

5.4 Switchboard Metering and Indication

A revenue meter is required for metering of the transformer incomer or Generator incomer supplies. Indication is required for the Phase present / healthy indication of Transformer and alternative incoming Supplies. EFL will supply the revenue meter whereas the CTs and wiring for installation of the meter shall be provided by the Supplier. EFL required CT ratio is 400/200/5A, revenue metering grade CT complying to AS 60044.

Digital voltage display on the LVAC board is also required, together with digital display of load in Amps, kW, kVAR and power factor. A Nemo meter shall be installed for this purpose.

5.5 Bus, Earth and Neutral bars

The main circuit equipment shall have a busbar rating of not less than 300 amperes for 3-phase use and feeder circuit equipment with busbar rating of not less than 100 amperes for 3-phase use. At all points where connections or joints occur, the busbars and connecting pieces shall be tinned or silver- plated or the bus bar system should incorporate integral single piece bar and coupling links to avoid chances of hot spot developing as is possible with bolted construction of bus bar and links.

The bus bar system should accept triple pole and single pole MCCB and MCB in any combination of these. The bus bars should be shrouded against accidental contact. The circuit breakers should be arranged in vertical banks with switch levers operating in horizontal planes for on-off switching. The mounting of breakers should be quick snap and easy removal type without disturbing the other breakers. It should be capable of being connected up to at least cable sizes of 35mm2 for phase conductors and 16 mm2 for neutral conductors. At least two conduit entry plates at the top and the bottom should facilitate drilling of holes at site to suit individual requirements. Shall provide at least a 48 pole encapsulated chassis rated for 250A (see MCCB and MCB allocation below)

The resistance of any length of conductor containing a joint shall not be greater than that of an equal length without a joint. The short time withstand capacity of the busbars shall be 40 kA for 0.5 seconds. All busbars will be of tinned copper type.

5.6 Internal wiring

All wiring shall comply with AS/NZS 3000. Wires shall be numbered at both ends of each wire by indelibly marked ferrules.

The AC Switchboard wiring shall be at least V90, 0.6/1kV grade insulated stranded copper conductors complying to the relevant Australian Standards.

All secondary control wiring in circuit breakers, panel wiring, and the like 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. In all cases, the sequence of the wiring terminals shall be such that the junction between multi-core cables and the terminals is affected without crossover. Claw washers or crimped connectors of approved type shall be used to terminate all small wiring. Insulating bushings shall be provided where necessary to prevent the chafing of wiring.

All wiring and apparatus which is, or may become, connected to potential source equal to or greater than 50 volts shall be tested for insulation resistance.

The wiring on each panel shall be subjected for one minute to a voltage equal to the test voltage specified for the apparatus to which it's connected. This test shall take place after the complete assembly of the apparatus, including wiring in panels, cubicles or racks.

5.7 Miniature Circuit Breakers and Links

Facilities shall be provided for protection and isolation of circuits associated with protection control and instruments. They shall be of approved type and grouped, as far as possible, according to their functions. They shall be clearly labelled, both on the panels and the associated wiring diagrams. Facilities shall be provided to enable the control circuits for circuit breaker to be individually isolated for maintenance purposes. A label shall be fixed immediately below each MCB clearly showing the rating of the fuse link and its function.

All MCB's in the AC distribution board will be mounted on a Chassis system.

5.8 Nameplate

Switchgear identification nameplates will contain the following minimum information.

- Manufacturer's name
- Date of manufacture
- Type and serial number
- Form Rating used
- Degree of Protection
- Rated voltage
- Rated frequency
- Rated normal current
- Rated short circuit breaking current
- Rated duration of short circuit current
- AS Standard used to verify board
- Weight

5.9 Protection of persons against electric shock

The means of providing protection against electric shock including the integration of the ASSEMBLY into the installation are given in IEC 60364-4-41.

The following methods shall be used for protection against contact with live parts are integral to the protection of persons against electric shock; these are described in terms of:

- basic protection (protection against direct contact);
- fault protection (protection against indirect contact).

5.9.1 Basic protection (protection against direct contact)

Basic protection shall be achieved by the following constructional measures within the ASSEMBLY with the inclusion of switchboards being installed in locations where access is only permitted for authorized personnel.

5.9.2 Basic insulation provided by insulating material

Hazardous live parts shall be completely covered with insulation that can only be removed by destruction. The insulation is required to be made of suitable materials capable of withstanding the

mechanical, electrical and thermal stresses to which the insulation may be subjected in normal service.

5.9.3 Barriers or enclosures

Air insulated live parts shall be inside enclosures or behind barriers providing at least a degree of protection of IP 2X. Horizontal top surfaces of accessible enclosures having a height equal to or lower than 1.6 m above the standing area, will provide a degree of protection of at least IP 4X.

The manufacturer shall construct the ASSEMBLY so as to enable it to be opened or barriers be removed for maintenance with either:

a. a key or tool is required to open the door, remove the cover or override an interlock;
b. an intermediate barrier providing a degree of protection at least IP 2X prevents contact with live parts, the removal of the barrier requiring the use of a key or tool.

5.9.4 Fault protection (protection against indirect contact)

Fault protection is intended to protect against the consequences of a fault within the ASSEMBLY and those of a fault within an external circuit supplied through the ASSEMBLY. The ASSEMBLY will normally include protective measures and be suitable for installation in a network designed to be in accordance with IEC 60364-4-41.

5.9.5 Faults within the ASSEMBLY

For an adequate protective circuit all exposed conductive parts of the ASSEMBLY will be interconnected together, noting the following:

a. when a part of the ASSEMBLY is removed, the protective circuits (earth continuity) for the remainder of the ASSEMBLY should not be interrupted;
b. for lids, doors, cover plates and the like, the usual metal screwed connections and metal hinges are considered sufficient to ensure continuity provided that no electrical equipment exceeding the limits of extra low voltage is attached to them.
c. If apparatus with a voltage exceeding the limits of extra-low voltage are attached to lids, doors, or cover plates; a protective conductor (PE) or an equivalent electrical connection especially designed and verified for this purpose shall be used.
d. Exposed conductive parts of a device that cannot be connected to the protective circuit by the fixing means of the device will be connected to the protective circuit of the ASSEMBLY by a conductor of adequate cross-sectional area.
e. Minor exposed conductive parts (not exceeding 50 mm x 50 mm) of an ASSEMBLY that do not constitute a danger need not be connected to a protective conductor. This applies to screws, rivets, nameplates, parts of small devices, and similar.
f. Connection of an exposed conductive part to the incoming protective circuit is considered sufficient if the resistance of this connection is less than 0.1Ω.

5.9.6 Faults in external circuits supplied through the ASSEMBLY

The Contractor shall provide a protective circuit within the ASSEMBLY capable of withstanding the highest thermal and dynamic stresses that may occur at the place of installation of the ASSEMBLY, for faults in external circuits supplied through the ASSEMBLY. The protective circuit provided may be the ASSEMBLY'S enclosure or frame and/or a separate conductor. The protective conductors within an within an ASSEMBLY will not include a disconnecting device such as switches or disconnectors.

5.9.7 Protection by total insulation

Protection by total insulation shall be used to provide adequate protection against electric shock. The construction of ASSEMBLIES that are protected by total insulation shall include specific features so that adequate protection against electric shock is provided under all anticipated operating conditions. These features shall include:

a. Completely enclosing all apparatus in insulating material that is equivalent of double or reinforced insulation and marked accordingly.
b. No conducting parts pierce the enclosure and no point should be pierced by conducting parts in such a manner that there is the possibility of a fault voltage being brought out of the enclosure. This requirement includes metal parts such as actuator shafts unless they are suitably insulated.
c. Arrangements such that when the ASSEMBLY is ready for operation and connected to the supply, all live parts, exposed conductive parts and parts belonging to a protective circuit will be enclosed to at least IP 2X so that they cannot be touched.
d. Exposed conductive parts within the ASSEMBLY shall not be connected to the protective circuit.
e. Where doors or covers of the enclosure can be opened without the use of a key or tool, a secondary barrier, made from insulating material, shall be provided behind the door or cover. This shall provide protection against unintentional contact with the accessible live parts and with the exposed conductive parts that would otherwise become accessible, after the door or Cables

5.10 Cable Colour Coding

As required by AS/NZS61439.1 all conductors shall be identified by either colour coding or symbols.

a. If identification of conductors is to be by colour coding, the colour coding system used throughout the whole switchboard shall preferably be in accordance with the following colour coding system:
    i. Red Phase Red
    ii. White Phase White
    iii. Blue Phase Blue (Bright Blue to AS2700)
    iv. A.C. Neutral Black
    v. Earth Green/Yellow

b. Where a special proprietary cable having a non-conforming colour coding system is required to be used, cable terminations shall be fitted with coloured sleeving in accordance with the above colour coding system.

5.11 Protection of Cable Insulation

Further to the requirements of AS3000, wherever practical, appropriate grommets or glands shall be used to protect cable insulation where such cables pass through holes in panels or cubicles. Such devices shall be selected so as not to reduce the required IP rating of the cubicle.

5.12 Support of Electrical Equipment Cubicle Wiring

a. Electrical equipment cubicle wiring shall be neatly grouped and harnessed or, where practical enclosed in PVC duct.
b. Wiring shall be straight and run parallel when in cable duct. A minimum clearance of 50 mm shall be maintained between terminals and associated cable duct. When not run in cable duct, spiral band lacing and/or cable ties shall be used to form the looms. Looms shall be installed square with the cubicle and frequently supported.
c. Duct shall be arranged to allow wiring passing through the slots to be taken as directly to the terminals as possible
d. Duct fixings shall not have sharp projections inside the duct which could damage cable insulation.
e. Wiring, wiring looms and cable duct shall be arranged so that, as far as is practical, equipment labels and/or terminal markings are not obscured.
f. The weight of wiring looms shall not cause any undue strain on the conductor strands or insulation.
g. Cable looms connecting hinged panels shall be supported either side of the hinge, and the loom arranged between such supports in a generous loop so as to prevent cable strain when the hinged panel is moved.

5.13 Secondary Terminations

a. All secondary panel terminations shall meet IP2X "finger-safe" requirements in accordance with AS 60529.
b. At all times the Supplier/Contractor shall adhere to the manufacturer's link or terminal requirements for wiring terminations. The maximum conductor size specified by a link or terminal manufacturer shall not be exceeded. Should the design require that a larger wire size be used than what the manufacturer specifies for that terminal or link, then the Supplier shall discuss these with EFL.
c. A maximum of two wires only is permitted for a tunnel type (screw-type) link and terminal
d. When more than two wires need to be terminated to the same point, additional terminals (with the same terminal number) shall be added next to and bridged to the original designed terminals.
e. Seven strand field cables shall be terminated with no crimping lugs with one exception: high current AC and DC supply wires terminated to switchgear (breakers, etc.) where the switch gear manufacturer requires a particular type of lug.
f. The IP2x integrity of any termination shall not be compromised by the bootlace or lug.

g. Upon request, the Manufacturer shall demonstrate to EFL, if alternatives are proposed, that good quality lugs: suitable lug types and correct crimping tools and methods are used for all terminations.
h. Mid-run cable connections or straight-through cable joints shall not be used.
i. Terminal bridging shall be done with matching top insertion bridges
j. Screw terminals bridging shall be done with top screw bridges and all adjacent terminals are bridged.
k. Comb-style rigid bridges fitted on the terminal side sharing the connection point with wires shall not be used.

5.13.1 Metalwork Earth Bonding

a. All mounting panels within cubicles, including cubicle doors shall be bonded electrically to the cubicle frames and hence to the cubicle protective earth bar.
b. Within cubicles containing electronic signalling or measuring equipment, such bonding shall be achieved by:
    i. welded connections
    ii. bare aluminium to bare aluminium bolted connections
    iii. bare zinc plated steel to bare zinc plated steel bolted connection
    iv. bare stainless steel to bare stainless steel bolted connections, or
    v. braided conductor bonded connections.
c. The resistance between the cubicle frame or any mounting panel and the cubicle protective earth bar shall be not more than 0.2 ohm.

5.14 Mechanical Construction

5.14.1 Fixings and Supports

All fixings and support necessary to support or hold equipment in place shall be supplied.

5.14.2 Miscellaneous Fittings

a. All threaded components, including metal threads, screws and bolts used throughout the electrical equipment cubicle shall be stainless steel; or non-ferrous metal; or nickel chromium electroplated steel to AS1192; or zinc electroplated steel to AS1897 and AS1791.
b. All saddles, clamps and miscellaneous fastenings shall be non-ferrous metal, stainless steel, zinc plated steel, nylon or P.V.C. Adhesive fixings shall not be used.

5.14.3 Silicone Based Components

1. Unless specified otherwise on the drawings, greases, jellies and/or sealing compounds which include silicone based compounds shall not be used inside switchboard enclosures.

5.14.4 Lifting and Transport Facilities

a. Clearly marked (with a permanent label or stencil), fully rated lifting and hold down points

will be provided on the LV Board to facilitate the hoisting and holding down during transport.

b. Two lifting lugs marked "LV Board Lifting Point" with a minimum hole diameter of 26 mm will be provided suitable for lifting the LV Board. These lugs will arranged so that any slings attached do not foul any part of the LV Board and when suspended by them, the LV Board will hang without tilting.
c. All parts of the LV Board weighing in excess of 15 kg that will be removed for inspection or repair will be fitted with lifting points suitable for use with shackles and slings.
d. Clear and legible Safe Working Load (SWL) markings should be provided on all lifting points.

5.14.5 Earthing Points when installed within Outdoor Cubicle

c. An earthing point (flag) shall be provided near the bottom of the cubicle. The earthing point shall comprise a flat surface not less than 50 x 100 mm drilled with two 14 mm diameter holes on 50 mm centres. The surface shall be arranged to facilitate an effective and non-corrodible earthing connection. There shall be ample access to both sides of the earthing point for the insertion of bolts and nuts for connection to the earth grid. The earthing point shall be marked with the "earth" symbol or stamped 'earth'.
d. Additional earth flags will be provided where necessary to permit the earthing of the steel base (where fitted).

5.15 Finish and painting

All surfaces of Assemblies shall be finished with an appropriate coating system which will provide the necessary protection against corrosion, with minimal maintenance, for the design life of the cabinet. All surface preparation and protective coating shall be done in the manufacturer's works. The only work in this regard after delivery would be reinstatement of any coating damage sustained in transport or work on site.

If any part of the installation requires galvanising, this shall be in accordance with the hot-dipped galvanised coatings on ferrous articles Australian standard (AS/NZS 4680, 2017).

Any painting of metallic surfaces shall be in accordance with the following procedure:

a. After fabrication of each section of equipment is completed, and before any paint is applied, the surface of the parts to be painted shall be thoroughly cleaned of all rust, oil, grease, dirt or other foreign matter.
b. The painting shall consist of at least one primary coat, one undercoat and one finishing coat each continuously and evenly applied. The three coats of paint shall be of different colours with the external finishing coat being gloss enamel.
c. Alternatively the surfaces may be powder coated to a minimum thickness of 75 micron.

All paint shall be non-corrosive, heat and oil resistant. It shall be made by a reputable paint manufacturer and shall be applied in accordance with the manufacturer's recommendations.

5.15.1 Paint Coatings for Steel

The paint system to be used for steel shall be:

a. All surface visible rust, scale and other foreign matter shall be removed completely in accordance with AS1627 so that the surface is suitable for the application of a gloss finish. All cleaning solutions shall be removed completely by thorough rinsing.
b. Immediately prior to priming, all surfaces shall be solvent wiped to remove any handling grime.
c. A gloss paint system providing medium term protection in accordance with AS2312 (industrial and marine) environments shall be applied.
d. All paint used in the paint system shall be from the same manufacturer who shall certify their compatibility

5.15.2 Powder Coatings for Steel

a. Powder coatings shall not be used on bare steel.
b. Powder coatings shall not be used on zinc (or zinc alloy) coated steel on which the coating has been damaged by welding or any other means.
c. Powder coatings shall be applied to zinc (or zinc alloy) coated steel and shall be gloss thermoset powder coating in accordance with AS/NZS 4506 Cat 5 employing a chromate or zinc phosphate pre-treatment and resulting in a powder coating DFT of not less than 60microns.

5.15.3 Cubicle Metals

All stainless steel and aluminium sheet used in the construction of switchboard cubicles and panels shall be marine grade. Aluminium sheet thickness shall be not less than 3mm. Steel and stainless steel sheet thickness shall be not less than 2mm for doors, hinged panels and equipment mounting panels, and shall not be less than 1.2mm elsewhere.

5.15.4 Adjacent Dissimilar Metals

Where dissimilar metals are positioned adjacent to one another, bimetallic corrosion shall be prevented by the use of metallic plating or by other approved methods. Screws and bolts penetrating external aluminium surfaces shall be stainless steel, as shall be any associated nuts and any associated external or internal washers. Screws, bolts and washers in contact with internal aluminium surfaces shall be stainless steel or shall be nickel, chromium or passivated zinc plated steel.

5.15.5 Additional Supports

Sufficient bracing shall be provided to doors and panels to ensure that the equipment mounted thereon is supported properly. Where doors and panels are weakened by drilling or cutting during construction of the switchboard, such sections shall be reinforced by additional bracing.

5.15.6 Welding

All butt joints shall be fully seal welded and all such welds shall be ground flush and smoothed.

5.15.7 Corrosion

Clause 8.1.2 of AS/NZS 61439.1 is applicable with the following additions.

a. All internal and external surface treatments shall provide a minimum of 35 years protection against corrosion induced by service and environmental conditions specified above.
b. Coatings shall be oil resistant, heat resistant and non-corrosive.

5.15.8 Labelling

Bidders shall provide comprehensive details for panel and device labelling including label positions, label size, label text and label materials.

Additional warning labels shall be fitted according to relevant Australian standards. The labels shall include Danger and Warning labels to AS 1319.

5.16 Testing and Inspections

5.16.1 Testing Requirements

Prior to delivery, the LVAC board system shall have completed the type, routine and accuracy tests and inspections as required by the relevant Australian standards. The passing of such tests shall not prejudice the right of EFL to reject the Equipment if it does not comply with the Specification when received or installed.

All testing shall be undertaken by an IEC 17025 accredited test house. The Tenderer shall submit evidence showing IEC 17025 compliance. A formal report covering the outcome of the different tests shall be made available to EFL.

The Tenderer shall submit a copy of Inspection and Test Plan (ITP) for the Equipment with its Bid.

5.16.2 AS/NZS 61439 Design Verification

The design verification of the project switchboard design in respect to the requirements of AS/NZS 61439 may be by testing, or may be by comparison with a reference design provided that the project switchboard enclosure(s) are the same as used in the reference switchboard design.

5.16.3 Type Tests

Type test certificates shall be supplied with the submitted documents showing that equipment identical in all respects with the plant being offered has successfully passed all the type tests set out in the standards for each type of plant and equipment referred to in this specification. Any equipment which undergoes any design or constructional modifications shall be type tested again or tested to the satisfaction of EFL.

Type tests required, in accordance with the low voltage switchgear and control gear assemblies Australian standard AS/NZS 61439.1, include:

A. Verification of temperature-rise limits
B. Verification of dielectric properties

C. Verification of short-circuit withstand strength
D. Verification of effectiveness of the protective circuit
E. Verification of clearances and creepage distances
F. Verification of mechanical operation
G. Verification of degree of protection and internal separation
H. Verification of increased security against the effects of internal arcing

5.16.4 Routine Tests

All materials, components and items of auxiliary equipment shall be subjected, during the course of manufacture, to all the tests prescribed in the relevant Australian or IEC Standards in that order. All tests considered necessary by either the Manufacturer or Customer shall be performed to prove compliance with the performance figures stated in this Specification and associated Schedules.

Routine tests shall be undertaken according to the low voltage switchgear and control gear assemblies Australian standard to AS/NZS 61439.1, include:

- Inspection of the assembly including inspection of wiring and, if necessary, electrical operation test
- Dielectric test
- Checking of protective measures and of the electrical continuity of the protective circuit
- Point to point wiring checks and earth continuity tests

5.16.5 Test Certificates

Upon completion of any test, the Supplier shall provide the certified test reports detailing the testing methods, instruments used, results and engineers responsible, to EFL. If the results of any Test Certificates are found to be incorrect or incomplete, EFL may reject the plant or equipment.

The plant or equipment shall be considered as substantially incomplete and payment shall not be made until all test certificates have been received.

5.16.6 Final Inspection Report

Final inspection reports shall be supplied prior to delivery showing plant is suitable for transport and that all associated manuals and test reports are included.

5.16.7 Tests after Delivery

On completion of the installation and before the plant has been put into use (pre-commissioned), EFL may carry out compliance tests considered necessary to prove that the plant and equipment fulfils the requirements of this specification. The Supplier shall provide list of recommended tests that need to be done on site prior to putting the equipment into service. The Supplier shall also ensure that its staff are available to provide any kind of technical support during this period.

5.17 Tools, Spares and Accessories

Tenderers shall submit a document detailing the price of spare parts and any accessories considered necessary for the lifecycle management of the items. The nominated manufacturers shall guarantee the supply of spare parts for a minimum of 10 years after expiry of the contract.

Tenderers shall submit a document detailing the price of any special tools, gauges and jigs considered necessary for the appropriate installation, commissioning and maintenance of the items.

5.18 Service History

Tenderers shall state:

- The period of service of typical items tendered within the Fijian environmental conditions.
- Australian or New Zealand electricity authorities that have a service history of the plant and equipment offered.

No item of plant shall be despatched from the Supplier's works until the Test Certificates have been approved by EFL. Contact names and telephone numbers of relevant employees of those supply authorities who can verify the service performance claimed.

5.19 Technical Particulars

Technical Parameter	Units	Offered
General:		
Type of enclosure		
Mounting Arrangement		
No. of Cubicles inside the enclosure (EFL preference is two with a separate cable compartment)		
IP Rating of enclosure protection		
Country of Manufacture of the enclosure		
Maximum Total Mass	Kg	
Maximum Total Mass including components	Kg	
Maximum Dimensions: Width (including Base) Length Height (including base) *EFL Requirement: (450mm x 1650mm x 2080mm)*	 m m m m m m	
Copy of design drawing of AC board with dimensional details and layout provided		
Material used for enclosure		
Material thickness		

Minimum busbar continuous rating	Amps	250
Switchboard rating	kA	40kA
Switchboard is front open access?		
Location of cable entry		
Type of Bus Bar used inside the enclosure		
Circuit Breaker Mounting Chassis: Manufacturer		
Circuit Breaker Mounting Chassis: Type		
Circuit Breaker Mounting Chassis: Continuous current rating		
All bolts (Fasteners, Studs, etc.) nuts and washers 316/304 grade stainless steel?		
Material of switchboard panel is 316 grade Stainless Steel?		
Nemo meter provided on AC Switchboard		
Provision for Revenue meter on AC Switchboard		
Sample Routine & Type Test Reports Provided and complying with IEC 61439-1:		
Type of Corrosion Protection / Protective Coating Layer Details? Compliance to ???		
Thickness of Layer of Protective Coating		
Internal & External paint colour of the panel		

Section 6

Form of Proposals and Appendices

6.0 Section 6 - Form of Proposals and Appendices

6.1 Form of Tender

To: Jitendra Reddy
Manager Strategic Procurement and Inventories
Energy Fiji Limited
2 Marlow Street, Suva, FIJI.

Contract No: _____
Gentlemen:

We have examined the Conditions of Contract, Employer's Requirements, Schedules, Addenda Nos _____ and the matters set out in the Appendix hereto. We have understood and checked these documents and have not found any errors in them. We accordingly offer to design, execute and complete the said Works and remedy any defects, fit for purpose in conformity with these documents and the enclosed Proposal, for the fixed lump sum of (in currencies, of payment) _____ or other such sums as may be determined in accordance with the terms and conditions of the Contract. The above amounts are in accordance with the Price Schedules herewith and are made part of this bid.

We confirm our agreement with the appointment of (name proposed in Bid Data Sheet or during the clarification meeting of the First Stage bid) as the Adjudicator.

We agree to abide by this Bid until _____ and it shall remain binding upon us and maybe accepted at any time before that date. We acknowledge that the Appendix forms part of our Bid.

If our bid is accepted, we will provide the specified performance security, commence the Works as soon as reasonably possible after receiving the Employer's Representative's notice to commence, and complete the Works in accordance with the above-named documents within the time stated in the Appendix to Technical Proposal.

Unless and until a formal Agreement is prepared and executed this Bid, together with your written acceptance thereof, shall constitute a binding contract between us.

We understand that you are not bound to accept the lowest or any bid you may receive.

Commissions or gratuities, if any, paid or to be paid by us to agents relating to this Bid, and to contract execution if we are awarded the contract, are listed below:

Name and Address of Agent	Amount and Currency	Purpose of Commission or Gratuity
_____	_____	_____
_____	_____	_____
_____	_____	_____

(if none, state “none”).

We are, Gentlemen
Yours faithfully

Signature _____ in the capacity of _____ duly authorized to sign bids for and on behalf of_____

Address
_____
_____

Date _____

6.2 Appendix to Tender

[Note: with the exception of the items for which the Employer's requirements have been inserted, the following information must be completed before the Bid is submitted]

	Sub-Clause	
Employer's name and address	1.1.2.1 & 1.8*	Energy Fiji Limited, Private Mail Bag, Suva, Fiji
Contractor's name and address	1.1.2.2 & 1.8	_____ _____
Name and address of the Employer's Representative	1.1.2.2 & 1.8	General Manager Special Projects, EFL, Private Mail Bag, Suva, Fiji
Time for notice to commence	8.1	28 days
Time for Completion of the Works	1.1.3.4	18 months
Electronic transmission systems	1.8	Email & Facsimile
Confidential details	1.12	Nil
Time for access to the Site	2.2	5 days after the Commencement Date
Amount of performance security	14.2	5% of the Contract Price against a separate Bank Guarantee from an Employer approved Bank.
Time for submission of programme	4.14	14 days after the issue of Letter of Acceptance
Normal working hours	6.5	8.00 am to 4.30pm, Monday to Friday
Liquidated damages for delay	8.6	0.25 % of the Contract Price per day, In the proportions of currencies in which the Contract Price is payable
Limit of liquidated damages for delay	8.7 & 14.15(b)	10% of the Contract Sum
Total amount of advance payments	8.7	Refer to Payment Schedule
Start repayment of advance payment	14.2(a)	when payments are Ten (5) % of the Contract Price
Repayment amortization of advance payment	14.2(b)	10%

Percentage of retention	14.3	TEN (10)% of each of the Interim Payment Certificate amounts
Limit of Retention Money	14.3	TEN (10)% of the Contract Price
Minimum amount of Interim Payment	14.6	Payments shall be done based on the value of works done at the time of the progress claim

If Sub-Clause 13.15 applies:

Payments in Local and Foreign Currencies	1.1.5.3 & 13.15

Currency Unit	Amount Payable in such Currency
Local: _____ [name] Foreign: _____ [name] _____ [name]	_____ _____ _____

Amount of insurance for design	18.1	Full value of the Contract Price
Amount of third party insurance	18.3	FJD 5,000,000 or contractor to propose, $1,000,000 a. Contractors All Risk $5,000,000 b. Public Liability $5,000,000 c. Workmen's Compensation $2,500,000
Periods for submission of insurance:	18.5	
(a) evidence of insurance	*	Not later than Commencement Date. (b) Fourteen (14) days after Commencement Date.
(b) relevant policies	*	
Number of members of Dispute Adjudication Board	20.3*	Three (3)
Arbitration rules	20.6*	International Chamber of Commerce, Rules of Arbitration
Number of Arbitrators	20.6*	Three (3)
Language of arbitration	20.6*	English
Place of arbitration	20.6	Fiji

Initials of signatory of Bid _____

Section 7
Sample Forms

7.0 Section 7 - Sample Forms

7.1 Form of Contract Agreement

This Agreement made this _____ day of _____ 20 _____ between _____ _____ of Energy Fiji Limited (hereinafter called "the Employer") of the one part and_____ of _____ (hereinafter called "the Contractor") of the other part

Whereas the Employer desires that the Works known as _____ should be designed and executed by the Contractor, and has accepted a Bid by the Contractor for the design, execution and completion of such Works and the remedying of any defects therein.

The Employer and the Contractor agree as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.

2. The following documents shall be deemed to form and be read and construed as part of this Agreement:

    a. The Letter of Acceptance dated _____
    b. The Employer's Requirements
    c. The Addenda nos. _____
    d. The Bid dated _____
    e. The Conditions of Contract (Parts I and II)
    f. The completed Schedules, and
    g. The Contractor's Proposal.

3. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to design, execute and complete the Works and remedy any defects therein in conformity in all respects with the provisions of the Contract.
4. The Employer hereby covenants to pay the Contractor, in consideration of the design, execution and completion of the Works and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.
5. This Agreement shall come into effect on signing by both parties.

In Witness whereof the parties hereto have caused this Agreement to be executed the day and year first before written in accordance with their respective laws.

Authorized signature of Contractor SEAL (if any)	Authorized signature of Contractor SEAL (if any)
in the presence of:	in the presence of:
Name_____ Signature _____ Address _____	Name _____ Signature _____ Address _____

7.2 Form of Performance Security (Bank Guarantee)

To:

Jiten Reddy
Manager Strategic Procurement, Inventories and Properties
Energy Fiji Limited
2 Marlow Street, Suva, FIJI.

Tender Name: ENGINEERING, PROCUREMENT AND CONSTRUCTION (EPC) OF 11kV/33kV SUBSTATION for 30MW POWER STATION AT VUDA

Tender No: MR121/2024

*WHEREAS*_____ *[name and address of Contractor]* (hereinafter called "the Contractor") has undertaken, in pursuance of Contract No. _____ dated _____ to execute _____ *[name of Contract and brief description of Works]* (hereinafter called "the Contract");

AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a recognized bank for the sum specified therein as security for compliance with its obligations in accordance with the Contract;
AND WHEREAS we have agreed to give the Contractor such a Bank Guarantee;

NOW THEREFORE we hereby affirm that we are the Guarantor and responsible *to* you, on behalf of the Contractor, up to a total of _____ *[amount of Guarantee]* _____ *[in words],* such sum being payable in the types and proportions of currencies in which the Contract Price is payable, and we undertake to pay you, upon your first written demand and without cavil or argument, any sum or sums within the limits of _____ *[amount of Guarantee]* as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed there under or of any of the Contract documents which may be made between you and the Contractor shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

This guarantee shall be valid until the date of issue of the Performance Certificate.

Signature and Seal of the Guarantor _____

Name of Bank _____

Address _____

Date _____

7.3 Form of Advance Payment Security (Bank Guarantee)

To: _____ *[name of Employer]*
_____ *[address of Employer]*
_____ *[name of Contract]*

Tender Name: ENGINEERING, PROCUREMENT AND CONSTRUCTION (EPC) OF 11kV/33kV SUBSTATION for 30MW POWER STATION AT VUDA
Tender No: MR121/2024

Gentlemen:

In accordance with the provisions of the Conditions of Contract, Sub-Clause 13.2 *("*Advance Payment") of the above-mentioned Contract, _____ *[name and Address of Contractor]* (hereinafter called "the Contractor") shall deposit with _____ *[name of Employer]* a bank guarantee to guarantee its proper and faithful performance under the said Clause of the Contract in an amount of _____ *[amount of Guarantee]*_____ *[in words].*

We, the _____ *[bank* or *financial institution],* as instructed by the Contractor, agree unconditionally and irrevocably to guarantee as primary obligator and not as Surety merely, the payment to _____ *[name of Employer]* on its first demand without whatsoever right of objection on our part and without its first claim to the Contractor, in the amount not exceeding _____ *[amount of Guarantee]* _____ [in words].

We further agree that no change or addition to or other modification of the terms of the Contract or of Works to be performed there under or of any of the Contract documents which may be made between _____*[name of Employer]* and the Contractor, shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

This guarantee shall remain valid and in full effect from the date of the advance payment under the Contract until _____ *[name of Employer]* receives full repayment of the same amount from the Contractor.

Yours truly, _____
Signature and Seal: _____
Name of Bank/Financial Institution: _____
Address: _____

Date: _____

Section 8
Schedules of Prices

8.0 Section 8 - Schedules of Prices

8.1 Notes on Schedules

The Schedules are intended to provide the Employer with essential supplementary information in an organized format. Examples of more commonly used Schedules are given herein. Others may be devised and added in accordance with the requirements of the Instructions to Bidders. All the Schedules are essential for bid evaluation and some in contract execution; they should all be incorporated in the Contract, and appropriate changes introduced with the approval of the Employer or its representative.

The schedules are to be completed and submitted as part of the Tender submission in accordance with the Instructions to Bidders Clause 13, Documents Comprising the Bid.

8.2 Schedule of Prices & Conditions of Payment

8.2.1 Contract Price

The Contract Price is comprehensive in that, in consideration of the Contractor meeting all obligations, conditions and liabilities under the Contract, including the Contractor's allowance for the cost of supply of all labour, materials, plant, supervision required to complete the Contract Works, overheads and profit, subject only such adjustment as is provided for the Contract.

8.2.2 Basis of Schedules

Descriptions of various items contained in the Schedule of Prices are intended to be a complete definition of the scope of the Contract Works, for which reference shall be made to the Specification, Drawings, Basis of Payments and other Contract Documents. The items descriptions on the Schedule of Prices shall be used only for the purpose of calculating progress payments and for valuing variations.

8.2.3 Basis of Payments

The rate or cost of the items shall represent the total cost of designing (where appropriate), checking, approving, purchasing, constructing, installing, commissioning, training the Employer's staff, testing and providing as-built drawings and O&M manuals for the works unless separate items have been included for some of these activities.

8.2.4 Payments Terms

All payments shall be due and payable by the Employer in accordance with the payments terms detailed below. The payments shall be made on value of works done at the time of the progress claim as identified and agreed by both the Employer's Representative and the Contractor.

- Total advance payment(s) – Sub-Clause (14.2) - 5% of the Contract Price against a separate Bank Guarantee from an Employer approved Bank. This Bank Guarantee shall be separate from the Performance Guarantee. One such Bank Guarantee shall be provided separately for each advance payment requested. The Advance Payments shall be made at the discretion of the Engineer and for the sole purpose of facilitating prepayment of major items of supply from offshore sources.

- Number and timing of instalments – Sub-Clause (14.2) - First payment shall be made within 30 days of Commencement Date. The First Payment shall be made for the purpose of facilitating and remunerating the Contractor for site mobilization costs. Subsequent payments shall be done on a monthly basis and based on the value of works done at the time of the progress claim.

- Currencies and proportions – Sub-Clause (14.2) – Fiji Dollars.

- Repayment of Advance payment – Sub-Clause (14.2a) - The advance payment shall be deducted from the Payment Certificate Amounts in proportion of those amounts relative to the Contract Price.

- Percentage of retention – Sub-Clause (14.3) - 10% of each of the Iterim Payment Certificate amounts.

- Limit of Retention Money – Sub-Clause (14.3) - 10% of the Contract Price.

- Minimum Amount of Interim Payment Certificates – Sub-Clause (14.6) - Payments shall be done based on the value of works done at the time of the progress claim.

- Currency/currencies of payment – Sub-Clause (14.15) – Fiji Dollars

8.3 Off - Shore Work

All invoices issued for off-shore work pursuant to this Contract shall be expressed in the foreign currency stated in Appendix to Bid, and will be issued using Contractor's overseas office letterhead. No GST or VAT shall be included in the invoice. Payment of the foreign currency shall be paid at the prevailing exchange rate as at the date of payment.

The Employer shall pay the invoice amount in foreign currency to each overseas bank account nominated by Contractor within 30 days of receipt of the invoice.

8.4 On - Shore Work

All invoices issued for on-shore work pursuant to this Contract shall be expressed in Fiji Dollar currency obtained by converting any foreign currency amounts to Fiji dollars using the corresponding foreign exchange rate prevailing on the date of the invoice. Any Value added Tax (VAT) amount component at the prevailing VAT rate shall be added to indicate the VAT inclusive price (VIP). The invoice shall be issued using Contractor's Fijian registered entity letterhead. The Employer shall pay the amount agreed to be in foreign currency to an overseas bank account nominated by the Contractor. The Employer shall pay the amount agreed to be in Fiji dollars including the VAT amount to a local bank account nominated by the Contractor. The Employer shall pay the invoiced amounts within 30 days of receipt of the invoice.

a) The Contractor shall advise the Employer the details of its Fijian registered entity including the Tax Identification Number, Certificate of Exemption (COE) given by the Fiji Islands Revenue and Customs Authority (FIRCA) as soon as possible after the execution of this Agreement.

b) The Employer shall not be responsible to pay invoices issued by the Contractor or its Fijian registered entity if such invoices are not in conformance with the above stated requirements.

c) If the Employer disputes any portion of the amount claimed in an invoice submitted by the Contractor or by its Fijian registered entity, the Employer shall notify the Contractor in writing of the reasons for disputing the amount and the Employer shall pay that portion of the amount in the invoice that is not in dispute.

d) If any payment due to the Contractor or its Fijian registered entity through a valid invoice submitted to the Employer is not received by the Contractor within 56 working days from the date of receipt by the Employer of any undisputed invoice, the Employer shall pay interest as from the due date at the Reserve Bank of Fiji’s Lending Rate per annum accruing daily.

e) The Contractor hereby agrees that payments made by the Employer in accordance with this Agreement to the Contractor's Fijian registered entity shall be proper consideration deemed to be received by the Contractor.

f) All matters relating to taxation such as income tax, withholding tax, PAYE and other tax issues shall be the responsibility of the Contractor and its Fijian registered entity. Similarly any superannuation related issues such as FNPF liabilities (where applicable) shall be the responsibility of the Contractor and its Fijian registered entity.

8.5 Schedules of Rates & Prices

8.5.1 Notes on Schedules Of Rates And Prices

1. The Schedules are divided into seven separate sections as follows:
   - 3.2 Plant and Equipment Including Mandatory Spare Parts
   - 3.3 Installation and Other Services
   - 3.4 Grand Summary
   - 3.5 Alternative Offer
   - 3.6 Bidders Tools & Equipment
   - 3.7 Recommended Tools and Spare Parts
   - 3.8 Rates for Variation
2. The Schedules do not generally give a full description of the plant and equipment to be supplied and the services to be performed under each item. Bidders shall be deemed to have read the Employer's Requirements and other section of the bidding documents 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 rate and prices shall be deemed to include for the full scope as aforesaid including overheads and profit.

3. Bid prices shall be quoted in the manner indicated and in the currencies specified in the Instructions to Bidders in the bidding documents. For each item, bidder 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 the Employer's Requirements, Drawings or elsewhere in the bidding documents.

4. Items left blank with be deemed to have been included in other items. The TOTAL for each Schedule and TOTAL of the Grand Summary shall be deemed to be the total price for executing the facilities and sections thereof in complete accordance with the Contract.

5. These schedules are intended primarily to provide information for bid evaluation but not intended to be used for the evaluation of work done for the purpose of interim payment. They may however, be used as a reference for the adjustment of the Schedule of Payment should the need arise.

6. These schedules can also be used as a basis to value variations of work done under the Proposal Sum.

8.5.2 Drawings, Design and Documentation

F/C - Foreign Currency, FJD - Fijian Dollars , LS - Lump sum

Item No.	Description	Estimated		Rate		Total Price	
		Qty	Unit	F/C	FJD	F/C	FJD
1	Design Vuda Greenfield 11/33kV Substation						
1.1	ELECTRICAL WORKS						
1.1.1	Design and Liaison of Works	1	LS				
1.1.2	Drawings and Documentation required for Electrical works	1	LS				
1.2	CIVIL WORKS						
1.2.1	Design and Liaison of Works	1	LS				
1.2.2	Drawings and Documentation required for Mechanical works	1	LS				
TOTAL (Transfer to Grand Summary)							

ITEM NO.	DESCRIPTION			DDU FIJI F/C		DDU FIJI FJD		LOCAL TRANSPORT & ERECTION ON SITE FJD		TOTAL AMOUNT (Excluding Taxes & Duties)	
		Qty	Unit	Unit Rate	Amount	Unit Rate	Amount	Unit Rate	Amount	F/C	FJD
				1		2		3		4=1	5=2+3
3	VUDA GREENFIELD 11/33KV SUBSTATION PLANTS AND EQUIPMENT										
3.1	PLANTS AND EQUIPMENT ONLY fully wired										
3.1.1	36 kV Indoor GIS type switchgear as per specifications complete with arc flash protection from Schneider (VAMP 231 series), arc vents and SEL protection relay complete with VT and CT	10	unit								
3.1.2	33kV and 11kV cables, installation, testing and terminations to suit.	1	Lot								
3.1.3	2 X 110VDC Battery Bank and Charger 2 X SCADA Battery Bank and Charger 2 X UPS DC Distribution Board	1	Lot								
3.1.4	SCADA, FIBRE and Communication equipment's	1	Lot								
3.1.5	OPTIC FIBER Optic fiber equipment's Catalyst 2960G -24TC-L Switches (CISCO) Dual Single mode Fiber Transceiver 1000B-LX	1	Lot								
3.1.6	Design and erection of lightning protection system with earth wires as specified.	1	Lot								
3.1.7	Galvanised E.H.S steel wires of size 7/3.35 complete with accessories, for lightning protection of entire substation	1	Lot								
3.1.8	Grounding system including connections of all steel structures and electrical apparatus to earth mesh and grounding electrodes.	1	Lot								

3.1.9	Fire suppression system Gas inert system as per NFA USA standard SIGMA5	1	Lot								
3.1.10	Architectural Works	1	Lot								
3.1.11	Air condition and Ventilation for control building	1	Lot								
3.1.12	Accessories for cable trench (indoor and outdoor)	1	Lot								
3.1.13	Design and Implementation of Substation Earthing	1	Lot								
3.1.14	LVAC & DCDB panels with mandatory equipment's	1	Lot								
3.1.15	Spares										
3.1.16	Any other works Mandatory for EPC (Please Specify)	1	LS								
TOTAL VUDA GREENFIELD 11/33KV SUBSTATION PLANTS AND EQUIPMENT											

Note - Freight, transportation and Insurance to be included in the bid for each equipment (DDU ,Suva)

8.5.3 Electrical Installation & Civil and Architectural Works - Substation

ITEM NO.	DESCRIPTION	ESTIMATE		CONSTRUCTION & INSTALLATION WORKS				Total Amount (Excluding VAT)		VAT	TOTAL AMOUNT (Including VAT)	
		`Qty	Unit	F/C		FJD		FJD	FJD	FJD	F/C	FJD
				Unit Rate	Amount	Unit Rate	Amount	8=6	9=7	10	11=6	12=9+10
				6		7						
5	ELECTRICAL INSTALLATION FOR VUDA GREENFIELD 11kV/33kV SUB STATION											
5.1	ELECTRICAL INSTALLATION (Fully Wired)											
5.1.1	36 kV Indoor GIS type switchgear as per specifications complete with arc flash protection from Schneider (VAMP 231 series), arc vents and SEL protection relay complete with VT and CT	10	Units									
5.1.2	15MVA 33/11kV YNd1 Power Transformer - interfacing of the transformer controls to the protection and control wiring, Including 11kV and 33kV Terminations. (15MVA 33/11kV YNd1 Power Transformer will be supplied by others)	3	Units									
5.1.3	300kVA Pad mount transformer complete installation for Substation Auxiliary. (11/0.415kV, 3 Phase, 300kVA Pad mount transformer will be provided by EFL)											

5.1.4	12kV CFF Switchgear complete installation. (12kV CFF Switchgear will be provided by EFL)											
5.1.5	LVAC & DCDB panels with mandatory equipment's	1	Lot									
5.1.6	2 X 110VDC Battery Bank and Charger 2 X SCADA Battery Bank and Charger 2 X UPS DC Distribution Board	1	Lot									
5.1.7	Neutral Earthing Resistor (NER) - interfacing of the NER controls with the protection and control system.	1	Unit									
5.1.8	SUBSTATION EARTHING The earthing installation rates shall include excavation, backfilling and reinstatement of the ground, driving the earth rods and making of the connections.	1	Lot									
5.1.9	LIGHTNING PROTECTION SYSTEM Design and erection of lightning protection system with earth wires as specified. Galvanised E.H.S steel wires of size 7/3.35 complete with accessories, for lightning protection of entire substation. Grounding system including connections of all steel structures and electrical apparatus to earth mesh and grounding electrodes.	1	Lot									

5.1.10	**LV POWER CABLES and lighting** All low voltage AC power cables and terminations All DC power and control cables and terminations Power and lighting cable for all works, including indoor and outdoor lighting and auxiliary supply	1	Lot									
5.1.11	SCADA and COMS	1	Lot									
5.1.12	Protection and Control	1	Lot									
5.1.13	Pre – commissioning Testing entire Substation	1	Lot									
5.1.14	Commissioning Testing entire Substation	1	Lot									
5.1.15	Any other works Mandatory for EPC (Please Specify)	1	LS									
5.1.16												
TOTAL ELECTRICAL INSTALLATION FOR VUDA GREENFIELD 11kV/33kV SUB STATION												
CIVIL AND ARCHITECTURAL WORKS FOR VUDA GREENFIELD 11kV/33kV SUB STATION												
6	CIVIL AND ARCHITECTURAL WORKS											
6.1	Geo Technical Studies	1	Lot									
6.2	Clearing and site formation	1	Lot									
6.3	Filling of Earth to a height to level	1	Lot									

6.4	Construction of 11kV/33kV Substation inclusive of battery room, cable trench and other essentials as per specification.	1	Lot									
6.5	Firefighting system for control building.	1	Lot									
6.6	Construction of Accessories for cable trench (indoor and outdoor)	1	Lot									
6.7	Construction of Concrete driveway, concrete walls and drainage beside building and fence.	1	Lot									
6.8	Construction of Concrete Pad, Bund wall and blast wall for 33/11 kV YNd1 Power transformer (15MVA) complete with excavation, backfilling, form works, concrete works and reinforcement bars.	3	Unit									
6.9	Construction of Concrete Pad for Neutral Earthing Resistor (NER) – (Neutral Earthing Resistor (NER) will be issued by others)	1	Unit									
6.10	Construction of Concrete Pad for 11/0.415 kV Dyn11 Auxiliary Transformer (630kVA)	2	Unit									

6.11	Construction of concrete pad for 300kVA Pad mount transformer.											
6.12	Consecution of concrete pad for 12kV CFF Switchgear.											
6.13	Construction of Triple interceptor pit and oil containment for the Transformers.	1	Unit									
6.14	Crushed metal entire yard (300mm depth with weed mat – as required as part of Contractors design	1	Lot									
6.15	Earthing and Grounding in this portion of the Contract	1	Lot									
6.16	Design and Construction of Cable trench to accommodate 10 x 3 phase 33kV	1	Lot									
6.17	Any other works Mandatory for EPC (Please Specify)	1	LS									
TOTAL CIVIL AND ARCHITECTURAL WORKS FOR VUDA GREENFIELD 11kV/33kV SUB STATION												

8.6 Grand Summary

ITEM		DESCRIPTION	TOTAL PRICE	
			F/C	FJD
1	Design, Drawings and Documentation - Substation			
2	Plant & Equipment Including Mandatory Spares - Substation			
3	Electrical Installation Works & Other Services (Fully Wired) - Substation			
4	Civil Construction and Architectural Works and other services - Substation			
GRAND TOTAL				

8.7 Bidders Tools & Test Equipment

During the pre-commissioning and commissioning tests, specialised tools and equipment will be required to carry out the testing mentioned in Section 4 Technical Requirements section 6.3.3 of this tender. The bidders shall provide a list of such tools and equipment that they will use and the associated cost including cost of freight. These are the tools and equipment which will be used for commissioning the _____

Item No.	Description	Model No.	Manufacturer	Cost

8.8 Recommended Tools & Spare Parts

As per clause 1.11 of the technical specifications, the bidder is required to provide a list of spare parts as recommended by the Manufacturer. These shall be divided into two categories i.e. Mandatory and Optional. Thus the bidders are required to provide two separate tables for the two categories.

Item No.	Grade of Officer/Workman	Qty	Unit Price		Total Price	
			F/C	FJD	F/C	FJD

8.9 Rates for Variation

The Contractor shall aim to carry out the project without any variations. However, if unforseen circumstances and event warrant any variation, the Contractor shall only proceed with a written approval from the Employer's Representative. The agreed price variation shall be documented.

The rates stated in this schedule shall be applicable to variations ordered by the Employer's Representative and not covered by the Schedule of Prices. These rates shall be deemed to include the cost of construction facilities, professional and technical services, royalties, taxes, transport of equipment, labour and other changes necessary to perform the work. The Contractor shall not be entitled to any allowance above unit rates stated in the schedule by reason of any amount of work being required under such items during the currency of the Contract.

8.10 Materials

Materials required for variations or day work shall be paid for on the basis of the net quantities actually used in accordance with the Employer's Representatives. Payment will be at the cost on site based on evidence of purchased prices after deductions of all trade and bulk discounts, transport, and any other charges applicable to the materials plus the percentage stated below to cover contractor's profit and overheads. Materials supplied by the Contractor will be at prices to be agreed, due regard being paid to the prices for similar materials if supplied from outside sources.

8.11 Labor

Payment of labor shall be in accordance with the table of hourly rates below which shall include Contractor's profit, overheads, superintendence, insurance, time keeping and all clerical and office work and use of hand operated tools and all incidental chargers whatsoever. The time of technicians or leading hands working with the crews will be paid for at rates stated but the time of the supervisors and foremen shall be covered by the overhead component of the hourly rates.

Item No.	Grade of Officer/Workman	Rate/Hour F/C	Rate/Hour FJD

% for Cost of Materials …….

Section 9
Schedules of Supplementary Information

9.0 Supplementary Information

9.1 Work Programme

The bidder is required to state the commencement and completion dates for the following tentative work programme based on an assumed contract signing date of 1st August 2024. The contractor is to also submit a Gantt chart for the programme outlining the activity, duration, start date, completion date, milestones, resources, etc.

	Component	*Start Date*	*Finish Date*
	Tender Award		
	Design of plant and equipment and approval by employer		
	Manufacture of plant		
	Testing at Manufacturer's premises (witness testing)		
	Shipping of plant and equipment		
	Installation of plant and equipment (may be carried out in stages)		
	Completion of wiring for controls and protection equipment		
	Inspection and pre-commissioning tests		
	Testing and commissioning		

Note that the items in the work programme are the responsibility the contractor. Certain items which have been omitted, such as removal of existing switchgear panels, and cable terminations will be carried out by the Employer. of All site tests to be carried out as per the contract are an absolute minimum. Additional tests may be required by the employer's representative.

The Bidder may assume a tender award date of contract signing as above in preparing a work programme.

9.2 Departures from Specifications

(To be completed by the Contractor)
All deviations shall be forwarded in the format given below. Any details that will lead to deductions of final Bid price shall not be inserted.

Section	Clause No.	Proposed Deviations

9.3 Bidders Statement of Experience

Bidder shall state hereunder a brief resume of his experience in carrying out similar works. Experience of nominated subcontractors shall also be provided.

9.4 Schedule Of Financial Information

The Tenderer shall state hereunder:

(a) The full name, business address, nationality and type of organization.

(b) The full name and business address of any Fijian agent.

(c) The date of the Tenderer's formation.

(d) The Tenderer's capitalization and total sales over the preceding three fiscal years.

(e) Details of supply and erection contracts of a similar nature undertaken in the previous five years, giving details of at least three contracts stating the location, purchaser, dates of commencement and completion and value of the contract in the total foreign currency equivalent.

(f) Details of any contracts on which the Tenderer has defaulted or on which liquidated damages have been applied in the previous five years giving location, purchaser, value of the contract, and nature of the default or penalty.

(g) Name and address of two banks and the name and address of an independent accountant, all of whom shall be authorized to provide promptly on request any information about the financial status of the Tenderer which is required by the EFL on the understanding that such information will be kept confidential and will only be used to assess the financial ability of the Tenderer to undertake the Contract.

9.5 Personnel

The tenderer shall provide a detailed bio-data of all the personnel that would be involved in the execution of the project - from the design stage till the completion stage.

The Tenderer shall list herein the personnel he wishes to establish in Fiji for the periods stated, to discharge his responsibilities as laid down in the Specification.

Designation	Name of Nominee	Year of Birth	Required Experience in Similar Works (Years)	Actual Experience in Similar Works (Years)
Headquarters				
Project Director			10	
Project Manager			10	
Engineering Design Staff			7	
Other key staff (Give designation)			7	
Site Office			7	
Site Manager			7	
Deputy Site Manager			7	
Supervising Engineers			7	
Construction Supervisors			7	
Safety Manager			7	
Other key staff			7	
Specialised Staff			7	

9.6 Contractor's Site Personnel

Erection Staff

The contractor shall give below the status and numbers of staff required for erection of the plant and the estimated period for which they will be retained on site.

Supervisory and expatriate staff : -	
(a) Bachelor status	
(b) Married status	

Position	Months
Headquarters	
Project Director	
Project Manager	
Other Key Staff	
Site Office	
Site Manager	
Deputy Site Manager	
Supervising Engineers	
Construction Supervisors	
Other key staff	

9.7 Subcontractors

Item	Element of Work	Approximate Value	Name and Address of Sub Contractor	Statement of Similar works Executed

The Bidder shall enter in this schedule a list of the sections and appropriate value of the work for which the purposes to use sub-contractors, together with the names and addresses of the proposed sub-contractors. The Bidder shall also enter a statement of similar works previously executed by the proposed sub-contractors, including description, location and value of works, year completed, and name and addresses of the Employer. Notwithstanding such information the Bidder, if awarded the contract, shall remain entirely and solely responsible for the satisfactory completion of the Works.

9.8 Contractor Health & Safety Plan

The bidder shall complete the following sub-sections to provide details in relation to the Health and Safety plans for the project.

CONTRACT DETAILS
Contractor Name: _____
Contractor Address: _____
Contractor Representative: _____
Contract Description: _____
Location of Works: _____
Timing of Works (approximate): Start Date:_____ End Date:_____

Responsibilities

Name	*Position Held*	*Safety Responsibilities*	*Contact Number (Direct)*

Emergency Contact Details

Contact	*Name*	*Position*	*Contact Number (Direct)*
First Contact			
Second Contact			
Third Contact			
Forth Contact			

9.8.1 Scope & Task Details

List Major Tasks

Risk Assessment
Risk assessment is a fundamental tool in management of risk. It Involves the identification of hazards and control measures. Describe how you plan to carry out this process for this particular application contract.

9.8.2 Safe Work Procedures

After completing the risk assessment, you must compile a safe system of work describing how you plan to control the hazards you have identified. Complete the following section outlining how you will ensure that all employees and subcontractors understand the Safe Work Procedures (SWP). Also attach copies of the relevant SWP.

9.8.3 Personal Protective Equipment

Where risk assessment identifies the need for personal protective equipment (PPE), then PPE must be made available. List down below the PPE you will require for this project.

9.8.4 Accessing Site/Times Of Work

If work is going to be carried out at EFL premises, then it is important to determine when you will be accessing the Site. You may need to sign a PASS and sign in and out. This will avoid conflicts with other activities which may be continuing on site during contract works. Describe below your site access requirements.

9.8.5 Fencing & Separation Of Work

In order to protect our employees as well as general members of the public, the work areas should, so far as is possible, be physically isolated with barriers like bollards, cones, tapes, netting, etc. Describe below how you will fence or separate your work.

9.8.6 Signs and Warnings

Sufficient signs should be erected or placed so that adequate warning is afforded around the worksite. Describe the kinds of notices you will be putting up and places where you will be putting this.

9.8.7 General Storage & Disposal of Waste

Describe below what waste you anticipate producing and how you plan to store and/or dispose off waste. You must take into account the nature of the waste e.g. hazardous/flammable.

9.8.8 First Aid & Injury Management

A first aid program for contractors is outlined in EFL Safety Manual. Please describe below any additional first aid needs and specific Injury management process for this contract.

9.8.9 Emergency Procedures

Identify specific emergency procedures or equipment required for the contract.

9.8.10 Incident Reporting & Investigation

Describe how incidents will be reported and investigated during the contract.

9.8.11 Specialized Work Or Licensing

List any special licenses required for the contract

9.8.12 Training & Induction Requirements

Training and inductions for contractors are to be completed in accordance with the EFL Training requirements. List any training required for the contract works in relation to safety, for example safe procedure training and attach training certificates:

9.8.13 Safety Monitoring

List any ongoing inspections, hazards management or incident reporting or investigation processes to be used during the works, if relevant.
Describe below your site access requirements.

9.8.14 Subcontractor Management

Complete the attached Subcontractor List detailing the subcontractors to be used and the details of the subcontractor management:

Sub Contractor Name	Sub Contractor Representative Name	Description of Work	Date of Local Induction

9.8.15 Plant & Equipment Register

Complete the following table:

Type	*Registration Include: Design, Design No. Item, Item No.*	*Purpose (Use on Site)*	*Inspection Date and Frequency*	*Inspected by*

Contractor Signature: _____
Date: _____

9.8.16 Contractor Chemical Register

Complete the following table:

Product Name	*Hazard*	*Controls Required*	*Location*	*Quantity*

1 Contractor Signature: _____

2 Date: _____

9.9 Other Documents & Drawings To Be Submitted With Bid

As a minimum, the following documents & drawings shall be submitted with the Bid.

1. Typical plan and section drawings

2. Single line diagrams

3. General structural drawings

4. Foundation drawings including static and dynamic load, General arrangement drawings, plans, sections, elevations.

5. General bar chart of the design, manufacturing, shipping, erection and commissioning schedule

6. Evidence of Bidder's experience in works similar to this

7. Certificates issued by an independent International Organization to ensure compliance with the ISO 9001:2000 standards by Bidder

8. List of standards the Bidder intends to follow, for electrical ,civil and mechanical works

9. Descriptive information for equipment being offered including:

1) List of recommended spare parts with prices.

2) List of special tools or fixtures required for installation, testing, maintaining and operating the equipment

3) List and cost of special tools, lifting devices required for installation, operation and maintenance.

4) List of exceptions to and deviations from this specification. All exceptions shall be clarified and separately itemized. It shall not be necessary for the employer to examine the standard literature and documents of the manufacturer to determine the existence and extent of any exceptions or deviations from this specification.

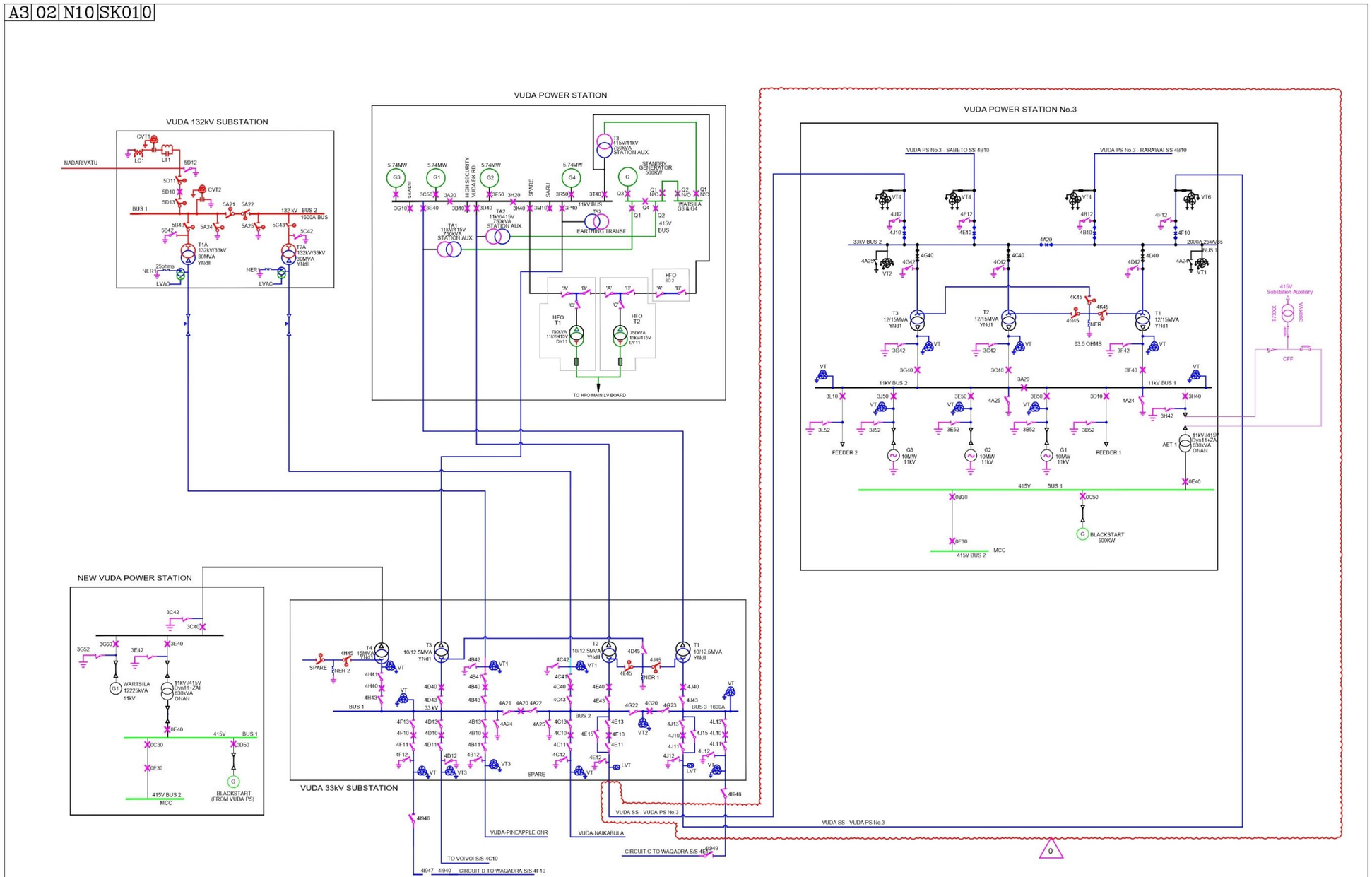
5) Evidence of field service experience of main equipment.

Section 10
Single Line Diagram& Site Drawings

10 Section 10 - Single Line – Diagram & Site Drawings

10.1 Conceptual Design of Vuda PS & SS

A3 02 N10 SK01 0



No.	REVISION	DATE	BY	CHK	PSD	APP	REFERENCE	DRAWING No.	TITLE
0	CONCEPTUAL DESIGN FOR CONNECTION OF 30MW OF NEW GENERATION AT VUDA	04/03/22	JP				A3–02–N10–SK01–0	CONCEPTUAL DESIGN FOR CONNECTION OF 30MW OF NEW GENERATION AT VUDA	

energising our nation

DRAWN	JAMES P	04/03/22
CHECKED	K.PRASAD	
CHIEF DRAUGHTSMAN		
TEAM LEADER		
ENGINEER		
HEAD OF DEPARTMENT		

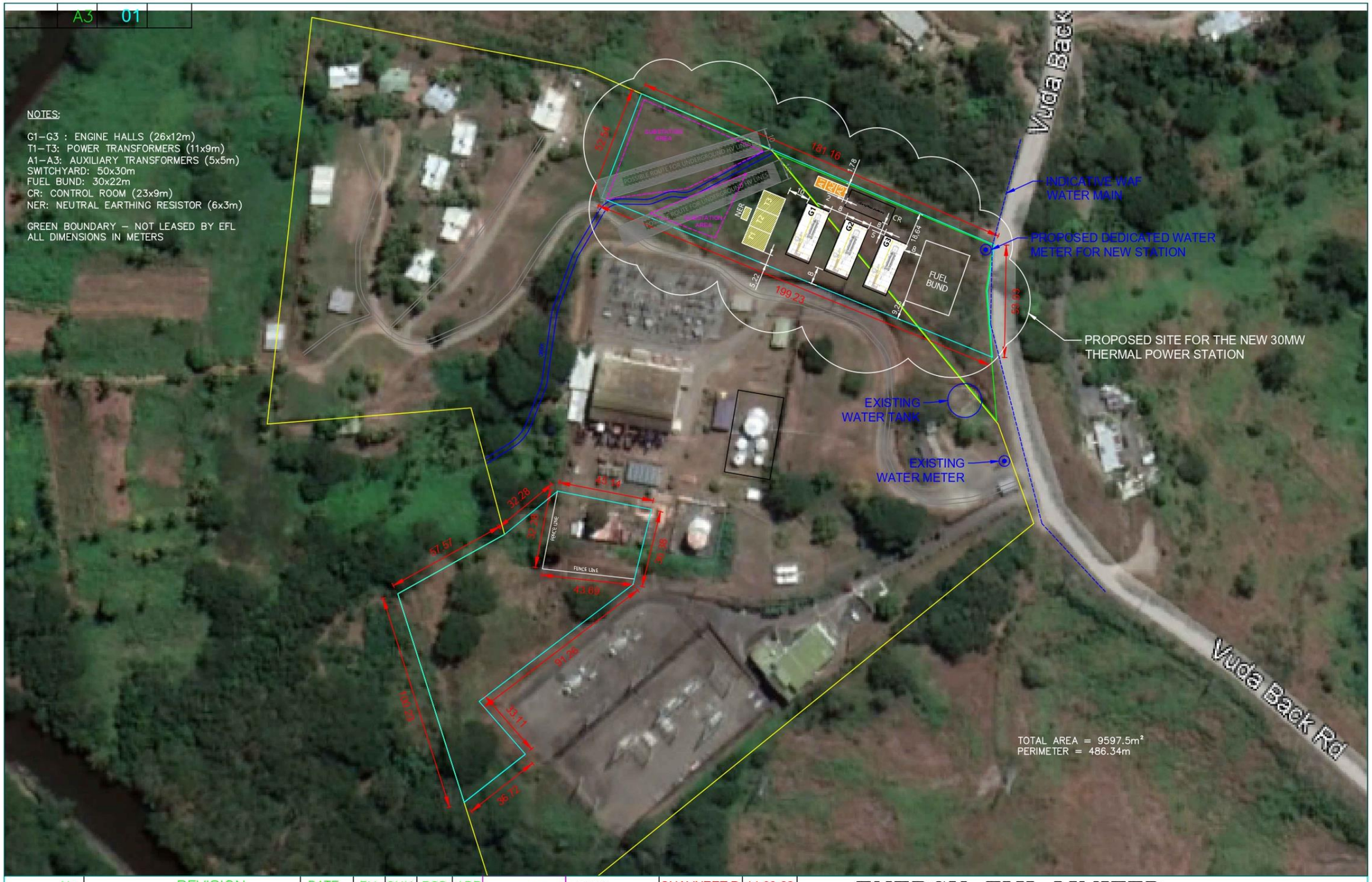
ENERGY FIJI LIMITED

CONCEPYUAL DESIGN FOR CONNECTION OF 30MW OF NEW GENERATION AT VUDA

DRAWING NUMBER: A3 02 N20 SK01 0

SCALE NTS

10.2 Indicative Layout of Existing Vuda Substation with New Generation Project



No.	REVISION	DATE	BY	CHK	PSD	APP

DRAWN	SHAVNEET.P	11.03.22
CHECKED	SHAVNEEL.D	11.03.22
CHIEF DRAUGHTSMAN		
TEAM LEADER DESIGN & PLANNING		
ENGINEER		
HEAD OF DEPARTMENT	KRISHNEEL.P	11.03.22

ENERGY FIJI LIMITED

PROPOSED LAND USAGE FOR THE NEW THERMAL GENERATION PROJECT AT VUDA

DRAWING NUMBER: A3 01

SCALE N.T.S

TENDER CHECKLIST

The Bidders must ensure that the details and documentation mention below must be submitted as part of their tender Bid

Tender Number_____

Tender Name _____

Full Company / Business Name: _____

(Attach copy of Registration Certificate)

2. Director/Owner(s): _____

3. Postal Address: _____

4. Phone Contact:_____

5. Fax Number: _____

6. Email address: _____

7. Office Location: _____

8. TIN Number:_____

(Attach copy of the VAT/TIN Registration Certificate - Local Bidders Only **(Mandatory)**

9. FNPF Employer Registration Number: _____ **(For Local Bidders only) (Mandatory)**

10. **Provide a copy of Valid FNPF Compliance Certificate (Mandatory- Local Bidders only)**

11. **Provide a copy of Valid FRCS (Tax) Compliance Certificate (Mandatory Local Bidders only)**

12. **Provide a copy of Valid FNU Compliance Certificate (Mandatory Local Bidders only)**

13. Contact Person: _____

I declare that all the above information is correct.

Name: _____

Position: _____

Sign: _____

Date: _____

Tender submission

Bidders are requested to upload electronic copies via Tender Link by registering their interest at: https://www.tenderlink.com/efl

EFL will not accept any hard copy submission to be dropped in the tender box at EFL Head Office in Suva.

This tender closes at 4.00pm (1600hrs) on Wednesday 22nd May, 2024.

For further information or clarification please contact our Supply Chain Office on phone **(+679) 3224360 or (+679) 99926520 or (+679) 9983096** or email us on tenders@efl.com.fj

The bidders must ensure that their bid is inclusive of all Taxes payable under Fiji Income Tax Act. Bidders are to clearly state the percentage of VAT that is applicable to the bid prices.

The lowest bid will not necessarily be accepted as the successful bid.

The Tender Bids particularly the "Price" must be typed and not hand written.

Any request for the extension of the closing date must be addressed to EFL in writing three (3) working days prior to the tender closing date.

Tender Submission via email or fax will not be accepted.