ENERGY FIJI LIMITED

BIDDING DOCUMENT

QELELOA 11kV/33kV SUBSTATION EXTENSION

TENDER NO: MR 350/ 2024

REVISION SCHEDULE:

Date	Notes	Prepared By		Rev No.
04/10/24	Draft tender specification for review	Ram Maharaj		1

INVITATION FOR BIDS

Date: 19th October, 2024
Tender No: MR 350 / 2024

Energy Fiji Limited ("The Employer") invites sealed bids from reputable contractors, suitable switchgear manufacturers or suppliers to carry out extension of Qeleloa 11kV/33kV Substation project in Nadi.

The bidder is required to submit a bid for:

The complete design, manufacture, supply, installation and commissioning of 11kV and 33kV busbar extension, one (1) 11kV and one (1) 33kV line feeder bay with complete switchgear, associated metering, protection, AC & DC controls circuits and other associated requirement of an extension to the existing 11kV and 33kV busbar at Qeleloa Substation site in Nadi.

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, 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, 27th November, 2024.

During evaluation of bids the Authority 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 6th November, 2024 from 9.00am Fiji Time. Interested bidders are required to inform EFL three working days in advance so appropriate time slot for site visit is arrange for all bidders. Contractors will be required to meet at the EFL's Qeleloa Substation in Nadi, Viti Levu. PPE's are mandatory for site visit (Safety Shoes, Reflector Vest and Hard Hat.

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EFL's Qeleloa Substation Location – (-17.829442, 177.422434)

Section 1

Instructions to Bidder

1.0 Section 1

1.1 Table of Clauses

1.2 Instructions to Bidder

A. General

1. Scope of Bid

1.1 The Energy Fiji Limited (hereinafter referred to as "the Employer"), wishes to receive bids for the design-build and completion of 11kV & 33kV bus extension at its Qeleloa Substation, as defined in these bidding documents (hereinafter referred to as "the works")

1.2 The successful bidder will be expected to complete the Works within 10 months from the date of commencement of the Works. The works should be completed by November 2024.

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 extension 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 6th of November at 11.00am at Qeleloa Substation, Nadi.
	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) Power of Attorney;
- (iii) Information on Qualification;
- (iv) Confirmation of Eligibility;
- (v) Schedule of Major Items of Equipment;
- (vi) Schedule of Manufacturers, Place of Manufacture and Testing
- (vii) Schedule of Technical Particulars & Guarantees
- (viii) Schedule of Time for Delivery & Completion and Contract completion times;
- (ix) Schedule for Departures from Specification;
- (x) Schedule of Manufacturers & Subcontractors Statement of Experience;
- (xi) Schedule of Bidders Tools & Equipment;
- (xii) Schedule of Contractors Health & Safety Plan;
- (xiii) Schedule of Other Documents and Drawings to be submitted with the bid;
- (xiv) Any other materials required to be completed and submitted by bidders in accordance with these Instructions to Bidders;
- (xv) Schedule of Work Programme
- (xvi) Schedule of Bidder's Statement of Experience
- (xvii) Schedule of Financial Information
- (xviii) 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. Price Schedule of Main Items
  - II. Alternative Offers
  - III. Recommended Tools & Spare Parts
  - IV. Summary of Prices
- (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 Authority, 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 will invited to attend a pre-bid meeting if required.

The location and time of the meeting will be communicated to the bidders via email.

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 two parts in the following manners:
- 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 27th November, 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 exchange 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:

i. Bidders shall state the functional guarantees (e.g. Performance, efficiency, consumption) 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.

(e) 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;

37.2 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

EPC/DESIGN, BUILD & TURNKEY

First Edition, 1995

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 of this document).

The International Federation of Consulting Engineers (FIDIC), has recently prepared the First Edition (1995) of Conditions of Contract for Design-Build and Turnkey Contracts. FIDIC Part I - General Conditions is included herein, complete and without any changes as Section 2 of these documents.

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

Section 3 Part II - Conditions of Particular Application	
Sub-Clause 1.1 Definitions	adding the Amend subpara 1.1.1.3 of Sub-Clause 1.1 by following words at the end: "The word 'tender' is synonymous with bid'." Amend subpara 1.1.1.4 of Sub-Clause 1.1 by following words at the end: "The words 'Appendix to Tender' are synonymous with the words 'Appendix to Technical Proposal' and 'Appendix to Price Proposal'." Add the following subparagraph to Sub-Clause 1.1: "1.1.2.7 "EFL" means the Energy Fiji Limited
Sub-Clause 1.4 Law and Language	Replace the text of Sub-Clause 1.4 and add the following: "The Contract shall be governed by and construed in accordance with the Laws of Fiji. The language is the English language." Substitute the wordings in Part I with the following: "A Contract Agreement in the form annexed, with such modifications as may be necessary to record the agreement reached shall be executed. The costs of stamp duties and similar charges imposed by the law shall be borne by the Employer."
Sub-Clause 1.5 Contract Agreement	Replace the list of documents listed under (a) to (j) and add the following: a) the Contract Agreement; b) the Letter of Acceptance; c) the Employer's Requirements; d) the Conditions of Contract, Part II; e) the Conditions of Contract, Part I; f) the Schedules; g) the Drawings; h) the Contractor's Proposal; and i) the Correspondences During Tender Evaluation the Bid;
Sub-Clause 1.15 Confidentiality	Additional sub-clause: "The Contractor shall treat the details of the Contract as private and confidential, except to the extent necessary to carry out its obligations under it. The Contractor shall not publish, permit to be published or disclose any particulars of the Contract in any trade or technical paper or elsewhere without the prior consent in writing of the Employer."

Sub-Clause 1.16 Inspections and Audit by the Employer	Add the following sub-clause: "The Contractor shall permit the Employer to inspect the Contractor's accounts and records relating to the performance of the Contract and to have them audited by auditors appointed by the Employer, if so required by the Employer."
Sub Clause 2.5 Customs and Import Duties	(a) The Contractor shall pay for all customs and import duties including clearing, handling charges, port dues and demurrage except only for customs and import duties in respect of Plant and for tools and spare parts to be supplied under the Contract which shall be the responsibility of the Employer. (b) Customs and import duties if any in respect of the Contractor's Equipment shall be borne by the Contractor. (c) Notwithstanding Sub Clauses 2.5(a) and 2.5 (b) above, the Contractor shall ensure that all customs and import duties and taxes are paid on time (including making payment for duties and taxes which are the responsibility of the Employer and invoicing the Employer therefor after the fact). For the avoidance of doubt the Contractor shall not be entitled to any extension of time as a result of any delayed payments of import duties and taxes which was within its control.
Sub-Clause 3.1 Employer Representative's Duties and Authority	Add the following clause as required: "The Employer's Representative shall obtain the specific approval of the Employer before taking action under the following clauses of the Conditions of Contract Part I. (a) approving sub-contracting of any part of the Works under Sub-Clause 4.5. (b) certifying additional cost to the Contract Price. (c) granting an extension of time for completion under Sub- Clause 8.3. (d) suspending progress of part or all of the Works under Sub-Clause 8.8. (e) than FJD 50,000. (f) issuing Taking-Over Certificate for the whole of the Works under Sub-Clause 10.1. (g) issuing Performance Certificate for the Works under Sub-Clause 12.9. Notwithstanding the obligation to obtain approval as set out above, if in the opinion of the Employer's Representative, an emergency occurs affecting the safety of life or of the Works or of adjoining property, it may, without relieving the Contractor of any of its duties and responsibilities under the Contract, instruct the Contractor to execute all such work or to do all such things as may, in the opinion of the Employer's Representative be necessary to abate or reduce the risk. The Contractor shall forthwith comply with the instructions of the Employer's Representative despite the absence of approval of the Employer. The Employer's Representative shall determine the extra cost to the Contractor for carrying out of such instruction and obtain the Employer's approval for an addition to the Contract Price."

Sub-Clause 4.1 General Obligations	Add the following sentence to precede the existing text under Sub-Clause 4.1: "Notwithstanding any other provision to the contrary, the Contractor is required to check the design criteria and calculations (if any) included in the Employer's Requirements, to confirm their correctness, in its bid and to assume full responsibility for them."
Sub-Clause 4.2 Performance Security	Replace the first paragraph of Sub-Clause 4.2 with the following: "The Contractor Shall provide security for its proper performance of the Contract to the Employer within 28 days after the receipt of the Letter of Acceptance. The performance security shall be in the form of a bank guarantee, issued either (a) by a bank located in the country of the Employer or a foreign bank through a correspondent bank located in the country of the Employer, or (b) directly by a foreign bank acceptable to the Employer. The performance security shall be denominated in the types and proportions of currencies in which the Contract Price is payable. When providing such security to the Employer, the Contractor shall notify the Employer's Representative of so doing."
Sub-Clause 4.3 Contractor's Representative	At the end of Sub-Clause 4.3 add: "The Contractor's Representative must be fluent (both spoken and written) in the English language."
Sub-Clause 4.4 Co-ordination of the Works	Modify the first sentence of Sub-Clause 4.4 to read: "The Contractor shall be responsible for the co-ordination and proper execution of the Works, including co-ordination with other contractors and organizations to the extent specified in the Employer's Requirements."
Sub-Clause 4.14 Program	Delete the third sentence of Sub-Clause 4.14 indicated below: "Unless otherwise stated ..... and late finish dates". In the fifth line of the second paragraph of sub-clause 5.2 replace "21" with "28".
Sub-Clause 5.2 Construction Documents	In Sub-Clause 5.2 delete sub-paragraph (a) and substitute: "(a) Construction shall not commence until the Contractor receives from the Employer's Representative approval of the Construction Documents relevant to the design and construction of such parts; provided always that: (i) if the Employer's Representative fails to give his ruling within 21 days, the Contractor shall give written notice (for the purpose of this sub-clause "Contractor's Notice") to the Employer's Representative of such failure; and (ii) if the Employer's Representative fails to give his ruling within 7 days of receipt of the Contractor's Notice, then the Contractor may proceed with the construction as though approval had been given".
Sub-Clause 5.4 Technical Standards & Regulations	Add the following sentence to the end of the Sub-Clause 5.4: "In respect of technical specifications and standards, IEC (International Electrotechincal Commission based in 3, rue de Varembe, PO Box 131, CH-1211 Geneva 20, Switzerland) standards are to be adopted in general. Any national or international

	standards which promise to confer equal or better quality than the standards specified will also be acceptable. In all instances a copy of the relevant standards should be forwarded to the Employer's Representative".
Sub-Clause 6.7 Health and Safety	To sub-clause 6.7 add the following paragraph: The Contractor must, at all times during the execution of the Work, comply with : the Health and Safety at Work Act 1996, The Electricity Act Cap 180, the Energy Fiji Limited "Safety Manual" - Safety Rules and First aid For Employees Of the Authority.
Sub-Clause 6.8 Contractor's Superintendence	At the end of Sub-Clause 6.8 add: "All the Contractors superintending staff shall have a working knowledge of the English language."
Sub-Clause 6.11 Foreign staff and Labour	"The Contractor may import such staff, and labourers as are required in order to execute the Works. The Contractor must ensure that all such staff and labour are provided with the required visas and work permits. The Contractor shall be responsible for the return to the place where they were recruited or to their domicile of all persons whom the Contractor recruited and employed for the purpose of or in connection with the Contract. The Contractor shall be responsible for such persons as are to be returned until they shall have left the Site or, in the case of foreign nationals who have been recruited outside the Country, shall have left it."
Sub-Clause 6.12 Measures against Insect & Pest Nuisance	"The Contractor shall at all times take the necessary precautions to protect all staff and labour employed on the Site from insect and pest nuisance, and to reduce the dangers to health and the general nuisance occasioned by the same. The Contractor shall provide its staff and labour with suitable prophylactics for the prevention of malaria and dengue fever and take steps to prevent the formation of stagnant pools of water. The Contractor shall comply with all the regulations of the local health authorities and shall arrange to spray thoroughly with approved insecticide all buildings erected on the Site. Such treatment shall be carried out at least once a year or as instructed by such authorities."
Sub-Clause 6.13 Epidemics	"In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with and carry out such regulations, orders and requirements as may be made by the Government or the local medical or sanitary authorities, for the purpose of dealing and overcoming the same."
Sub-Clause 6.14 Alcoholic Liquors or Drug	"The Contractor shall not import, sell, give, barter or otherwise dispose of any alcoholic liquor or drugs, or permit or suffer any such importation, sale, gift, barter or disposal by his Subcontractors, agents staff or labour."
Sub-Clause 6.15 Arms and Ammunition	"The Contractor shall not give, barter or otherwise dispose of to any person or persons, any arms or ammunition of any kind or permit or suffer to the same as aforesaid."

Sub-Clause 6.16 Burial of the Dead	The Contractor shall make all necessary arrangements for the transport, to any place as required for burial, of any of his expatriate employees or members of their families who may die in the Country. The Contractor shall also be responsible, to the extent required by local regulations, for making any arrangements with regard to burial of any of his local employees who may die while engaged upon the Works.
Festivals and Religious Customs	"The Contractor shall in all dealings with his staff and labour have due regard to all recognized festivals, days of rest and religious or other customs."
Sub-Clause 7.3 Inspection	To sub - clause 7.3 add the following paragraphs: The Employer and the Contractor shall carry out a joint walk through inspection to identify and document any defects/ deficiencies of the Works prior to commissioning, after which the Contractor shall rectify all the identified defects. The Employer and the Employer's Representative shall be entitled at any time during the term of this Contract to inspect any part of the Works and the Contractor shall give them full opportunity and access to conduct such inspection.
Sub-Clause 7.7 Restriction on Eligibility	(a) Any materials, equipment, services or design services which will be incorporated in or required for the Contract, as well as the Contractor's Equipment and other supplies, shall have their origin from reputable source countries acceptable to the Employer. (b) For the purpose of this clause, "services" means the works and all project-related services including design services. (c) For the purposes of this clause, "origin" means the place where the materials and equipment were mined, grown, produced, or manufactured, or from which the services are provided. (d) The origin of Goods and Services is distinct from the nationality of the Supplier."
Sub-Clause 12.11 Warranty	“The Employer shall be entitled to all applicable manufacturers’ warranties for the Plant and equipment supplied by the Contractor. The Contractor warrants the Equipment to be free from defects in workmanship and material used in their manufacture and installation. This warranty will cover Equipment for claims for such defects and workmanship made during the Warranty Period, being 12 months from completion of defects liability period and issuing of performance certificate
Sub-Clause 13.2 Advance Payment	Modify the third sentence of this Sub-Clause to read: "The Employer's Representative shall issue an Interim Payment Certificate for the first instalment after (i) execution of the Contract Agreement by the parties hereto (ii) provision of the Performance Security in accordance with Sub-Clause 4.2 by the Contractor and (iii) provision of an unconditional bank guarantee by the Contractor in a form and by a bank acceptable to the Employer in amounts and currencies equal to the advance payment."

Sub-Clause 13.4 Schedule of Payments	To Sub-Clause 13.4 add: The payments will be made according to the following schedule: (a) Ten Percent (10%) advance payment (b) Ten Percent (10%) payment upon arrival of plant and equipment to Lautoka Port (c) Sixty Percent (60%) upon commissioning of all equipment supplied and submission of As-builts, O&M Manuals and completion of training. (d) Ten Percent (10%) upon completion of all civil works and issue of performance certificate (e) Ten Percent (10%) retention, 12 months after issuing of performance certificate
Sub-Clause 13.15 Calculation of Payments in Foreign Currency	Delete Clause 13.15 and add the following: "The Contract shall be paid in the currencies stated in the Appendix to Bid and shall be in accordance with Schedule of Prices and Conditions of Payment without any exchange variation clause. The foreign and local currency portions of the balance of the Contract Price shall be amended by agreement between the Employer and the Contractor to reflect any substantial changes of more than 5% in the expected foreign and local currency requirements of the Contractor during the execution of the Works, provided that: (a) the Contractor shall inform the Employer and the Employer's Representative whenever any such substantial change may occur; or (b) the Employer's Representative may recommend a review of such expected requirements if in its judgment there is evidence of a change in the country of origin of equipment, materials, plants, or services to be provided under the Contract which should result in any substantial change of such expected requirements. Any such amendment shall be affected 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." To sub-clause 13.15 add the following paragraph: The local (Fijian) component of the Contract Price shall not be subjected to any currency exchange rate variation.
Sub-Clause 13.17 Taxation	"(i) The prices bid by the Contractor shall include all taxes, duties and other changes imposed outside the Employer's country on the production, manufacture, sale and transport of the Contractor's equipment, Plant, materials and supplies to be used on or furnished under the Contract, and on the services performance under the Contract. (ii) The prices bid by the Contractor shall include all customs duties, import duties, business taxes, income and other taxes that may be levied in accordance to the laws and regulations in being as of the date 28 days prior to the closing date for submission of bids in the Employer's country on the Contractor's Equipment, Plant, materials

	and supplies (permanent, temporary and consumable) acquired for the purpose of the Contract and on the services performed under the Contract. Nothing in the Contract shall relieve the Contractor from its responsibility to pay any tax that may be levied in the Employer's country on profits made by it in respect of the Contract."
Sub-Clause 15.5 Corrupt or Fraudulent Practices	Delete the existing Sub-Clause 15.5 and substitute the following: "If in the judgment of the Employer the Contractor has engaged in corrupt or fraudulent practices, in competing for or in executing the Contract, then the Employer may, after having given 14 days notice to the Contractor, terminate the Contractor's employment under the Contract and expel the Contractor from the Site, and the provisions of Clause 15 shall apply as if such expulsion had been made under Sub-Clause 15.2."
Sub-Clause 17.3 Employer's Risks	"The Employer's risks are: (a) insofar as they directly affect the execution of the Works in the country where the Permanent Works are to be executed: (i) war and hostilities (whether war be declared or not), invasion, act of foreign enemies in the Country; (ii) rebellion, revolution, insurrection, or military or usurped power, or civil war in the Country; (iii) ionizing radiations, or contamination by radioactivity from any nuclear fuel, or from any nuclear waste from the combustion of nuclear fuel, radioactive toxic explosive or hazardous properties of any explosive nuclear assembly or nuclear component thereof in the Country; (iv) pressure waves caused by aircraft or other aerial devised travelling at sonic or supersonic speeds in the Country; (v) riot, commotion or disorder, unless solely restricted to the employees of the Contractor or of its Subcontractors and arising from the conduct of the Works in the Country; (b) loss or damage due to the use or occupation by the Employer of any Section or part of the Permanent Works, except as may be provided for in the Contract; (c) any operation of the forces of nature (insofar as it occurs on the Site) which an experienced Contractor: (i) could not have reasonably foreseen, or (ii) could reasonably have foreseen, but against which he could not reasonably have taken appropriate measures to prevent loss or damage to physical property occurring."
Sub-Clause 18.2 Insurance for Works and Contractor's Equipment	(i) Amend the second sentence of the first and second paragraphs to read: "This insurance shall cover loss or damage from any cause other than the Employer's risks listed in amended Sub-Clause 17.3 paras. (a)(i) to (iv) in Part II of the Conditions of Contracts". (ii) Amend the fourth sentence of the first paragraph to read: "Such insurance shall cover the Employer and the Contractor from the first working day after the Commencement Date until the date of issue of the Taking-Over Certificate for the Works."

Section 4

Employer's Requirements – Part I
Scope of Works

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

4.1 General Information

The scope of works for this contract for Qeleloa 11kV and 33 kV Substation Extension Project is for design, manufacture, supply, transport, installation and commissioning of new indoor 12kV and 36kV busbar extension, circuit breaker and associated switchgear, complete with local & remote control, protection and SCADA, and carry out any other necessary works required inside the substation building in preparation for the installation of the new indoor switchgear and its protection and control systems.

Qeleloa Substation is an existing operational substation site. The main items for supply and installation under the scope includes:

1. 36 kV Switchgear comprising of

   1 No. Line feeder bay, complete with circuit breaker, disconnectors, earth switch, voltage and current transformers and associated equipment.
   1 Set of Bus Bar extension kit to suit the interconnection between the existing ABB UniGear ZS3.2 switchgear with the proposed new 36/40.5kV line feeder bay indoor switchgear unit.

2. 12 kV switchgear comprising of

   1 No. Line feeder bay, complete with circuit breaker, disconnectors, earth switch, voltage and current transformers and associated equipment
   1 Set of Bus Bar extension kit to suit the interconnection between the existing ABB UniGear ZS1 switchgear with the proposed new 12/17.5kV line feeder bay indoor switchgear unit.

3. Modification to existing 36kV and 12kV switchgears for the addition of a new 36kV and 12kV Line feeder bay with current transformers, and associated protection and control relays, panel and equipment.
4. Control, Metering, Monitoring and Protection equipment, etc.
5. SCADA and Communications equipment.
6. Power and Control cables including terminations.
7. All Electrical, Civil and Mechanical works required for new 36 kV line feeder bay and bus bar extension kit to suit the interconnection between the existing ABB UniGear ZS3.2 switchgear with the proposed new 36/40.5kV line feeder bay indoor switchgear unit.
8. All Electrical, Civil and Mechanical works required for new 12 kV line feeder bay and bus bar extension kit to suit the interconnection between the existing ABB UniGear ZS1 switchgear with the proposed new 12/17.5kV line feeder bay indoor switchgear unit
9. Supply of all mandatory spare parts.

4.2 Terminal Points

The following shall be the Contract Terminal points:

a) 36 kV interface

The Contractor shall be responsible for installing and commissioning all 36 kV Switchgear and associated cables.

b) 12 kV Indoor Switchgear interface

The Contractor shall be responsible for installing and commissioning all 12 kV Switchgear and associated cables.

c) LVAC Supply

Not applicable – there is existing LVAC services at the substation site.

d) Environmental Conditions

	Value	*Unit*
Altitude of site above sea level not exceeding	50	M
Maximum ambient air temperature	40	^{o}C
Minimum ambient air temperature	5	^{o}C
Average ambient air temperature over 24 hours	32	^{o}C
Average yearly temperature	31	^{o}C
Relative humidity (24 Hours)	90	%
Average annual rainfall	2663	mm
Maximum recorded rainfall for 24 hours	390	mm
Maximum Wind Speed	85 m/sec	
Average isokeraunic level	50	

e) Electricity, Water, Gas and other Services

EFL shall make available to the Contractor electricity and water for Construction purposes at the Qeleloa Substation site.

4.3 Major Plant & Material Including Spare Parts

4.3.1 Indoor 36kV Switchgear

4.3.1.1 1 No. 36 kV New Line Feeder Bay comprising

1 No.	3150A, 36kV, 31.5kA, 3 phase circuit breaker complete with housing panel.
1 No.	36 kV line-side disconnector
1 No.	36 kV line-side earth switch
1 No.	Three phase voltage transformers, ratio to be furnished during detail engineering for Metering and Protection
3 Set	36 kV Current Transformers, Class and Ratio to be furnished during detail engineering for Metering and Protection.

4.3.2 Indoor 12kV Switchgear

4.3.2.1 1 No. 12 kV New Line Feeder Bay comprising

1 No.	1250A, 12kV, 31.5kA, 3 phase circuit breaker complete with housing panel.
1 No.	11 kV bus-side disconnector
1 No.	11 kV bus-side earth switch
1 No.	Three phase voltage transformers, ratio to be furnished during detail engineering for Metering and Protection

3 Set	12 kV Current Transformers, Class and Ratio to be furnished during detail engineering for Metering and Protection.

4.3.3 Protection, Metering & Control

4.3.3.1 33 KV Relays

1 Nos.	SEL 311L
1 Nos.	SEL 351 – 7
1 Nos.	Alstom MMLG-02 Test Blocks

4.3.3.2 12 KV Relays

1 Nos.	SEL 351 – 7
1 Nos.	Alstom MMLG-02 Test Blocks

4.3.3.3 Power & Control Cables

1 Lot	All low voltage AC power cables and terminations
1 Lot	All DC power and control cables and terminations
1 Lot	Power and lighting cable for all works, including lighting and auxiliary supply

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, 11kV switchgear and SCADA system, and associated control and relay equipment for a period of 12 months.

Note: To enable continuous supply to our consumers during execution of such works, planned outage will be organised to maintain system reliability.

4.4 Civil Works, Installation & Other Services

All civil works relating to the installation of the new switchgears shall be carried out by the Contractor.

All civil works relating to the installation of the new panels in the substation control building shall be carried out by the Contractor.

Existing cable trench and ducting system in the substation control building shall be utilized where possible.

4.5 Other Services

4.5.1 Training

Training shall be provided before commencing the installation and commissioning of the relevant equipment at site. The contractor shall therefore submit the training program for each category along with the installation/erection and commissioning program.

4.5.1.1 Objective of Training Modules

The training authority shall have a well-equipped training facility to provide hands-on training for the full range of offered High Voltage switchgears, Protection & Controls system. The program shall cover

the installation, commissioning and maintenance aspects of the above categories as the trainee personnel will be responsible for commissioning witness by approving the tests & practices from the client's side during the project implementation period and they also will be responsible for maintenance of such equipment after the expiry of defect liability period of the project. The training shall be held at the same time as the witness testing and shall be conducted by an authority approved by the Manufacturer, if not the Manufacturer itself.

Training for Switchgears (to be provided on site): 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.
- Inspection and parts replacement procedure in the arcing chamber of the SF_6 Circuit breaker if supplied.

Section 4

Employer's Requirements – Part II
Technical Specifications

5.0 Section 4 - Employer's Requirements – Part II – Technical Specifications

5.1 Extent of Contract

(i) Definite Work

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, 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 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.

5.2 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.

5.3 Electrical Design Criteria

5.3.1 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	Solidly earthed	Directly earthed with or without resistor
Design Symmetrical fault level	31.5kA	31.5kA

5.3.2 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	50m
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.

5.3.3 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

5.3.4 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

5.3.5 Pollution levels of Insulators and Bushings

For Grid Substations - 41mm/kV

5.3.6 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.

5.3.7 Inter-Changeability

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

5.3.8 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.

5.3.9 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.

5.3.10 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.

5.4 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.

5.5 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 (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 3000:2007 “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 controlgear 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 controlgear assemblies - Particular requirements for busbar trunking systems (busways)
AS	3607	Conductors-Bare overhead, aluminium and aluminium alloy – steel reinforced
AS/NZS	3835	Earth potential rise - Protection of telecommunications network users, personnel and plant
AS/NZS	3947	Low voltage switchgear and control gear, (all relevant parts)
AS	4024.1	Safety of machinery, (all relevant parts)
AS/NZS	4026	Electric cables - For underground residential distribution systems
AS/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	Telecontrol equipment and systems (All parts)
AS/NZS	60898	Electrical accessories - Circuit-breakers for overcurrent protection for household and similar installations - Circuit-breakers for a.c. operation
AS	HB101	Coordination of power and telecommunications - Low Frequency Induction (LFI): Code of practice for the mitigation of hazardous voltages induced into telecommunications lines.

International Electrotechnical Commission (IEC)

IEC	11801	Information technology – Generic cabling for customer premises
IEC	14763	Information technology – Implementation and operation of customer premises cabling
IEC	24702	Information technology – Generic cabling – Industrial premises
IEC	60034	Rotating Electrical Machines – all relevant parts
IEC	60038	IEC Standard Voltages
IEC	60041	Field acceptance tests to determine the hydraulic performance of hydraulic turbines, storage pumps and pump-turbines
IEC	60044	Instrument Transformers
IEC	60051	Direct acting indicating analogue electrical measuring instruments and their accessories
IEC	60060	High Voltage Test Techniques
IEC	60076	Power Transformers
IEC	60085	Thermal Evaluation And Classification of Electrical Insulation.
IEC	60086	Primary Batteries
IEC	60099	Surge Arrestors
IEC	60137	Bushings For Alternating Voltages Above 1,000 V
IEC	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 control gear - Use and handling of sulphur hexafluoride (SF6) in high voltage switchgear and control gear
IEC	61660	Short-circuit currents in DC auxiliary installations in power plants and substations
IEC	62063	High-voltage switchgear and control gear - The use of electronic and associated technologies in auxiliary equipment of switchgear and control gear
IEC	62271	High Voltage Switchgear and Control gear (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 Substations
ANSI/IEEE Std 665 Guide for Generating Station Grounding
ANSI/IEEE Std 80 Guide for Safety in AC Substation Grounding
ANSI/IEEE Std 81 Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Ground System
ANSI/IEEE Std C37.101 Guide for Generator Ground Protection

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 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.

5.6 Detailed Design of Plant and Equipment

The detailed design of plant and equipment including plant layout, protection, control, supervisory interface equipment, earthing, 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.

5.7 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.

5.8 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) representatives to inspect the plant/equipment offered by the successful tenderer, before shipment, under this contract and to witness some of the type tests and routine tests. The associated cost must be included in the tender price.

All commissioning tests shall be carried out in accordance with the relevant IEC or other standards. All tools and equipment and instruments for carrying out such tests shall be made available by the Contractor.

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.

5.9 Training of EFL Personnel

The Authority requires 2 EFL personnel to be attached to be trained on installation, operation, maintenance of primary & secondary equipment to be supplied under this contract.

5.10 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.

5.11 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 Design – Build And Turnkey) edition 1.

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:

Plant Specification and Description

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

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.

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.

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.

5.12 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.

5.13 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.

5.14 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.

5.15 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.

5.16 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.

6.0 Section 4 - Employer's Requirements – Part III – 33kV Indoor Switchgear

6.1 Switchgear

6.1.1 General

This part of the Specification covers the design, ratings, testing, shipping, and installation and commissioning of factory assembled, type tested switchgear for voltages 36 kV.

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. Standard designs and models from the Bidder's manufacturing program are preferred, provided they meet the requirements of these Specifications, serve the intended purpose, and can be shown to have at least five years of successful service in the field.

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.

All the equipment described in these Specifications is intended for continuous duty at the specified ratings under the specified ambient conditions. Unless otherwise noted, the switchgear shall be for front access only during operation and maintenance.

Data and documentation submitted with the Tender Proposal shall enable the Employer's Representative to evaluate the quotation against the requirements of the Specifications. Full descriptive information and filled-in data sheets are required as a minimum.

6.1.2 Switchgear Particulars

The feeder bays or panels shall be delivered completely, including all necessary material for fixing them on suitable plinths or rails.

The switchgear equipment shall be dust-proof and vermin-proof and provision shall be made against condensation, particularly if the load is switched off.

Protection relays and their associated instrument transformers are part of Scope of Supply.

The functions of the protection relays are indicated in the typical single line diagrams in Drawings and their required performance shall be in accordance with Technical Specification. If the Bidder is of the opinion that the indicated protection scheme is not optimal, he shall indicate this fact in his proposal along with suggested improvements.

6.2 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	

6.3 Design and Construction

6.3.1 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.

6.3.2 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.

6.4 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

6.5 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.

6.6 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

6.7 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

6.8 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.

6.9 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 60044, 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.

6.10 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.

6.11 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.

6.12 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.

6.13 Interchangeability

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

6.14 Control and Indication

6.14.1 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.

6.14.2 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.

6.15 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.

6.16 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.

6.17 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.

6.18 Low Voltage Equipment and Control Circuits

6.19.1 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.

6.19.2 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.

6.20 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.

6.21 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.

6.22 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.

6.23 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.

6.24 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.

6.25 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.

6.26 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.

6.27 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

6.27.1 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.

6.27.2 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.

6.27.3 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

6.28 Protection, Metering And Control

6.28.1 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.

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 SEL3530 relay (with SEL2701 Ethernet card) dedicated for that busbar (2 x SEL3530 in total) using approved SEL connectors (fibre or serial). The RTU SEL3530 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.

6.28.2 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.

6.29 Supervisory Equipment

The 33kV switchgears at the new Qeleloa 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 SEL3530/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 SEL3530 communications processor. The two SEL3530 relays used at this Qeleloa 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 SEL3530 communications processor 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.

7.0 Section 4 - Employer's Requirements – Part IV – 12kV Indoor Switchgear

7.1 General

This part of the Specification covers the design, ratings, testing, shipping, and installation and commissioning of factory assembled, type tested switchgear for voltages 12 kV.

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. Standard designs and models from the Bidder's manufacturing program are preferred, provided they meet the requirements of these Specifications, serve the intended purpose, and can be shown to have at least five years of successful service in the field.

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.

All the equipment described in these Specifications is intended for continuous duty at the specified ratings under the specified ambient conditions. Unless otherwise noted, the switchgear shall be for front access only during operation and maintenance.

Data and documentation submitted with the Tender Proposal shall enable the Employer's Representative to evaluate the quotation against the requirements of the Specifications. Full descriptive information and filled-in data sheets are required as a minimum.

7.2 Switchgear Particulars

The feeder bays or panels shall be delivered completely, including all necessary material for fixing them on suitable plinths or rails.

The switchgear equipment shall be dust-proof and vermin-proof and provision shall be made against condensation, particularly if the load is switched off.

Protection relays and their associated instrument transformers are part of Scope of Supply.

The functions of the protection relays are indicated in the typical single line diagrams in Drawings and their required performance shall be in accordance with Technical Specification. If the Bidder is of the opinion that the indicated protection scheme is not optimal, he shall indicate this fact in his proposal along with suggested improvements.

7.3 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 Power Station 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	12kV, 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	75kV peak
Rated 1 minute power frequency withstand	28kV rms
Short circuit rms breaking current	31kA
Short time current duration	3s
Supply voltage of opening and closing devices and aux circuits	110V DC
Busbar Rating	2500A
Degree of enclosure protection	IP41
Operating mechanism	Magnetic Actuator
Light and Current Arc Flash Protection	Bus bar Protection
With optic fibre	Circuit breaker area protection
Opto link and sensor fibre	Cable area protection
Initiates to trip using Overcurrent Relay	

7.4 Design and Construction

7.4.1 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. +65°C for silver-plated contacts, +75°C for silver-plated connections, and +50°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.

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

e) j) 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.

7.5 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

7.6 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, 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 25 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 (4 N/O and4 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.

7.7 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.

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

7.8 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

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).

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

7.10 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 60044, 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.

7.11 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.

7.12 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.

7.13 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.

7.14 Interchangeability

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

7.15 Control and Indication

7.15.1 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.

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

7.15.2 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.

7.16 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.

7.17 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.

7.18 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 25mm x 3mm 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 breaker without 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.

7.19 Low Voltage Equipment and Control Circuits

7.19.1 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	DC Indication Circuits
Grey	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.

7.19.2 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.

7.20 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.

7.21 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.

7.22 Auxiliary Supplies

Single phase, 240V, 50Hz AC supply 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.

7.23 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.

7.24 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.

7.25 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.

7.26 Inspection and Testing (FAT)

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 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 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.

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	> 10GΩ

7.26.1 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.

7.26.2 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 and the Employer's Representative 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.

7.26.3 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

7.27 Protection, Metering and Control

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 advise preferred settings for each relay by providing appropriate design calculations.

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 distribution feeder protection, over current and earth fault protection shall be implemented using SEL 351- 7relays. 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 bedone after a visual inspection has been carried out. An Areva MVAJ 30 relay shall be used to provide this functionality.

EFL intends to employ a blocking scheme and circuit breaker fail scheme on the 11kV board. The blocking scheme will provide blocks to 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.

Not-withstanding 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 SEL3530 relay (with SEL2701 Ethernet card) dedicated for that busbar (3 x SEL3530 in total) using approved SEL connectors. The RTU SEL3530 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 in Part 4 of this Section shall be programmed to be interfaced with the SCADA system.

The SEL relay inputs and outputs shall be used for specific function as outlined in Part 4 of this Section.

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.

7.28 Supervisory Equipment

(this is provided as supplementary information)

The 11kV switchgears at Qeleloa 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 fiber 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.

All 11kV controls and metering to the SCADA via a SEL3530/68150 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 SEL3530 communications processor. The two SEL3530 relays at Qeleloa Substation to be used for integration of new feeder bay.

The programming of the SEL protection relays and the SEL3530 communications processor will be Contractors 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.

8.0 Section 4 - Employer's Requirements – Part V – Small Wiring and Ancillary Electrical Apparatus

8.1 Small Wiring

All control panel wiring, secondary control wiring in circuit-breakers, motor starters, control gear 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 and terminals is affected without crossover. Except where terminals are approved by the Employer's Representative for use with bare conductors, claw washers or crimped connectors of approved type shall be used to terminate all small wiring. Insulating bushes shall be provided where necessary to prevent the chafing of wiring. All panel wiring shall comply with the requirements of BS.6231, Type A or B, as appropriate. Conductors shall be copper and have a minimum cross section equivalent to 50/0.25 mm (2.5 sq. mm), 7/0.67 mm (2.5sq. mm) or 1/1.78 mm (2.5 sq. mm) but single stranded conductors should only be employed for rigid connections which are not subject to movement or vibration during shipment, operating or maintenance. Flexible conductor's equivalent to 30/0.25 mm (1.5 sq. mm) or smaller sizes generally shall only be employed with written approval.

For low voltage cabling and wiring, separate cables shall be used for each of the following groups:

- auxiliary power supply
- control and check back
- measuring
- communication

All control and power cables shall be armoured and all cables except those for auxiliary power supply must be shielded with annealed copper tape. Cables shall conform to IEC 60228, IEC 60228A, IEC 60287, IEC 60811 & IEC 60885.
The minimum cross-section of each copper wire shall be at least as given below:

- 4.0 mm^2 for current transformer circuits and heavy power consumers up to 20 A
- 2.5 mm^2 for all power consumers such as motors, heaters, lighting, etc. up to 10A
- 1.5 mm^2 for all instrument and control wiring, however, the maximum permissible voltage drop is < 5 % for the furthest point at full load.
- 0.6 mm^2 for all telephones wiring.

Wire colours are preferably to comply with British Standard 158, viz.:

Colour of wire	Circuit particulars
Red	Red-phase connections in current and voltage transformer circuits only.
Yellow	Yellow-phase connections in current and voltage transformer circuits only.
Blue	Blue-phase connections in current and voltage transformer circuits only.
Green/Yellow	Connections to earth.
Black	AC neutral connections, earthed or unearthed, connected to the secondary circuit of current and voltage transformers. AC connections other than those above and connections in AC/DC circuits.
Brown	DC indication circuits.
Grey	All other DC circuits.

Alternatively, where equipment is wired in accordance with a manufacturer's standard diagram, wiring may be carried out in a single colour except that all connections to earth shall be green.
Wiring diagrams must indicate wire colours; numbers designated to all equipment/ instruments and shall be drawn as viewed from the back of the panel. All wires shall be fitted with numbered ferrules (hand written numbers are not accepted) of approved type at each termination. At points of inter-connection between wiring, where a change of numbering cannot be avoided, double ferrules shall be provided. Such points shall be clearly indicated on the wiring diagram. 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 at the side or bottom of each panel or compartment.
Internal wiring between instruments or other devices not using the terminal block shall be permitted within the same compartment only. The markers 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 "trip". No wires may be teed or jointed between terminal points. Electrical wiring and instruments shall be so located that leakage of oil or water cannot affect them. Bus wiring between control panels, etc., shall be fully insulated and to be completely segregated from the main panel wiring. Generally, all signal, monitoring and protection circuits as well as shunt trips of circuit breakers shall be fed by DC. All other circuits may be controlled by AC. Also, contactor operating circuits shall be controlled by AC with the contactor solenoids preferably designed for DC with a pre-connected rectifier bridge. All metallic cases of instruments, control switches, relays, etc., mounted on control panels or in cubicles, steel or otherwise, shall be connected by means of copper conductors of not less than 2.5 sq. mm cross section to the nearest earth bar. These conductors may be bare or have insulation coloured green.

8.2 Terminal Boards

All terminal boards shall be mounted in accessible positions and, when in enclosed cubicles, are preferably to be inclined towards the door. Spacing of adjacent terminal boards shall be not less than 100 mm and the bottom of each board shall be not less than 200 mm above the incoming cable gland plate. Separate terminations shall be provided on terminal boards for the cores of incoming and outgoing cables including all spare cores. Where cores of multicore cables and internal cubicle wires have crimped ends, not more than two may be connected to any one terminal. When left bare, they shall have individual terminals and where bridging connections are necessary, these shall be incorporated in the terminal boards.

Acceptable types of terminals are:

(i) Screw or stud type used with crimped ring type termination. Screws and studs shall be not less than of size M6, but stainless steel and bronze down to size M5 may be used, provided that the current carrying capacity is adequate. All studs shall be provided with nuts, washers and lock washers.

(ii) Inspection clamp type whereby the standard conductor or crimped termination is clamped between plates by a screw having a suitable locking device. Terminal entries shall be shrouded such that not less than three full threads. Screws shall be of plated steel, stainless steel or phosphor bronze and size M3 or M4.

Terminal assemblies shall be to be of the unit form suitable for mounting collectively on a standard assembly rail, secured from the front and giving the required number of ways plus ten percent spare.
LV AC and DC power circuit terminals shall be segregated from other terminals and shall be fitted with non-flammable plastic covers to prevent contact with any live parts. They shall have warning labels, with red lettering, mounted thereon in a conspicuous position.

All connections shall be made at the front of the terminal boards and no live metal shall be exposed at the back.

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.

8.3 Control Switches and Pushbuttons

Control switches and pushbuttons shall comply with BS EN 60947-5-1 OF 1992 or the relevant IEC standards.

8.3.1 General

Control switches for electrically operated circuit-breakers and motor operated disconnectors shall be of pistol grip or other approved 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. When switches of the discrepancy type are approved, operation is to be effected by two independent movements.

Switches for other apparatus shall be operated by shrouded pushbuttons or to have handles of the spade type, the pistol grip type being reserved for circuit-breaker operation only. Control, reversing, selector and test switches shall be mounted, constructed and wired so as to facilitate the maintenance of contacts without the necessity for disconnecting wiring.

Where necessary, control switches shall be capable of being locked in appropriate positions but control switches for circuit breakers and for motor operated setting devices shall be of the non-locking type with spring return to the “neutral” position. Such switches shall be controlled by independent springs, the use of contact springs alone for restoring not being acceptable.

All pushbuttons shall be of non-retaining type made of non-hygroscopic, materials, non-swelling and fitted to avoid any possibility of sticking.

The contacts of all switches and pushbuttons shall be strong and to have a positive wiping action when operated.

Control switches for use in direct control schemes shall be rated for substation battery voltage.

All control switches shall be provided with labels in addition to clear indication as to the direction of each operation, for example, “open”, “close”, “raise”, “lower”, etc.

8.3.2 Electrical Control Locations

Equipment may be electrically controlled from a number of different control points as specified in the appropriate chapters of this Specification. The control positions shall be designated as follows:

Local Control:	Located adjacent to the item of plant to facilitate maintenance, inspection and emergency operation.
Remote Control:	Located at a substation control room where specified items of Plant are monitored and controlled by direct wire connection.
Supervisory Control:	located at a System Control Centre or where principal items of plant at a number of substations are remotely controlled via a SCADA (Supervisory Control And Data Acquisition) system.

8.4 Starters and Contactors

Where starters shall be provided under this Contract, each motor is to be equipped with two or three pole control gear as appropriate and suitable, unless otherwise specified, for direct starting. Contactors shall be mounted in ventilated metal cubicles. Where two or more contactors are contained in the same cubicle, barriers shall separate them. The cubicles shall be complete with all locks, cable-sealing arrangements for boards and accessories. All secondary wiring shall be so arranged and protected as to prevent its being damaged by arcing.

Starters shall be of the electrically held-in type with integral “start” and “stop” pushbuttons mounted externally on the door, with integral interlocked disconnectors. Where required, auxiliary switches

should be included for the operation of "red" and "green" indicating lights on remote instrument panels. All AC contactor coils shall be connected between phases for 415V working.

All motor contactors and their associated apparatus must be designed to operate for a period of not less than five minutes at a voltage of 25% below the nominal value and at normal frequency without injurious overheating.
Contacts of level switches, pressure switches, temperature switches, limit switches, etc. shall be of the snap action type, the creeping action type and mercury contacts not being acceptable.
Contact devices transforming thermal variables into binary signals for the interlocking system shall be separate, i.e. contact devices serving in common for interlocking and other purposes shall not be accepted.

8.5 Instruments and Meters

8.5.1 Indicating Instruments

All indicating instruments shall be of the flush mounted pattern with dust, venom and moisture proof cases complying with BS.2011, Classification 00/50/04 and shall comply with BS.89 or IEC 60051.Unless otherwise specified, all indicating instruments shall have 72 mm square case to standards. Instrument dials in general should be white with black markings and should preferably be reversible where double scale instruments are specified. Scales shall be of such material that no peeling or discoloration will take place with age under humid tropical conditions. The movements of all instruments shall be of the deadbeat type. The meters and instruments shall be similar and aesthetically compatible with the existing equipment and to the satisfaction of the Employer's Representative. Wherever possible, instrument shall be provided with a readily accessible zero adjustment. Where required, isolating transformers should be used to protect the indicating instruments.

8.5.2 Electrical meters

All electrical meters shall comply with BS. 5685 part 1-4 or IEC 60051 and shall be of industrial grade accuracy. Three-phase power measuring instruments shall be of the three-phase unbalanced load pattern wherever the current and voltage reference permit. Where precision grade metering is specified meters shall be calibrated to precision grade accuracy to BS. 5685: or IEC 60051. Due allowance shall be made for the errors of current and voltage transformers with which they shall work and whose accuracy class shall be Class 0.2.Meters shall be fitted with suitable devices for the transmission of impulse to a summator. Var-hour meters shall be complete with phase shifting transformers as necessary. (The angular deflection of all the meter indicating current, voltage, power, Vars shall be 270 degrees).
Meter dials should be white with black markings and should preferably be reversible where double scale instruments are specified. Centre Zero meters shall be used for Active Power, Reactive Power and Current meters. Where required, isolating transformers should be used to protect the electrical meters.

8.6 Indicating Lamps and Fittings

Indicating lamps shall be of LED type and fitted into the fascias of switch and instrument cubicles or panels shall be adequately ventilated. LED lamps shall be easily removed and replaced from the front of the panel by manual means preferably not requiring the use of extractors, The bezel of metal or other approved material holding the lamp glass shall be of an approved finish so as to permit access to the lamp and lamp glass.

The lamps shall be clear and shall fit into a standard form of lamp holder. The rated lamp voltage should be ten percent in excess of the auxiliary supply voltage, whether AC or DC. Alternatively, low voltage lamps with series resistors will be acceptable.

The lamp glasses shall comply with BS 1376 and BS. 4039 and shall be in standard colours, red, green, blue, white and amber. The colour is to be in the glass and not to 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 climates.

Lamps and relays incorporated in alarm fascia equipment may be arranged for normal operation from the station battery, subject to the approval of the Employer's Representative.

Lamp test facilities shall be provided so that all lamps on one panel can be tested simultaneously by operation of a common push-button. Where alarm fascias are specified, all alarm and monitoring indications (apart from circuit breaker and disconnector position indications) shall be incorporated in the fascia.

8.7 Main Circuit Breakers

The Moulded case circuit breakers or air circuit breakers shall be provided for protection and disconnection of the main circuit of AC power supply system. The circuit breakers shall be of 4 poles, high speed fault limiting, thermal/magnetic type to IEC 60947 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-ionising arc chutes.
The dolly shall have three positions, "on", "off" and "tripped". To reset from the "tripped" position the dolly shall first pass into the "off" position. Circuit Breakers on the main switchboard shall have facilities for locking in the "off: position. The rupturing capacity of the ACB shall not be less than that of the switchboard itself, or if this is not the case back up fuses must be included

8.8 Moulded Case Circuit Breakers (MCCB)

Moulded case circuit breakers shall be provided for each feeder circuit protection and disconnection and mounted in the switchboards. The MCCBs shall be designed to comply with the requirements of IEC 60947. The MCCBs shall be equipped with a padlocking device to lock the MCCB toggle in the "OFF" position. Trip ratings and frame sizes of all MCCBs shall be suitably rated for loads and the available short circuit currents.

8.9 Miniature Circuit Breakers

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, both on the panels and the associated wiring diagrams. Facilities for protection and isolation of control and tripping circuits are preferably to be mounted on the outside of control panels. Miniature circuit breakers shall comply with BS EN 60898 of 1991 or IEC 60947.Where miniature circuit breakers are used on control, protection and alarm supplies, tripping shall cause an alarm to be displayed locally as well as in the remote and supervisory control locations. MCBs shall be positioned at the bottom of the face of relay and control boards.

8.10 Switchfuses and Disconnectors

Each switch-fuse or disconnector switch unit shall be housed in a separate metal compartment and provided with a hinged metal door interlocked with the switch mechanism so that:
(1) The door cannot be opened whilst the switch is closed.
(2) The door, on opening, automatically locks the switch in the "off" position. Facilities shall be incorporated to allow for the deliberate release of this interlock for maintenance purposes, should it be desired to observe the switch in operation. An insulating barrier shall be fitted to segregate the fuses and neutral link from the switch and the connections of the latter shall be effectively shielded by an inner metal screen when the compartment door has been opened to obtain access to the fuses. The switch-fuses may be either of the combination fuse-switch type or of the type with the switch and fuse in separate units. In either case, interlocking shall be provided to prevent access to the fuses until the

associated switch is opened and provision shall be made for padlocking the switch in the “on” and “off” positions. The switch shall have a quick make and quick break action independent of the speed at which handle is operated and shall be entirely suitable for switching the inductive loads associated with motor circuits.

8.11 Fuses

Fuses shall be of the HRC cartridge type for operation at a prospective fault level of not less than 40 kA and conforming to BS 88 or IEC 60269. The mountings of the fuses shall be such that they can be readily withdrawn and replaced whilst the associated busbars and circuits are live.

8.12 Junction Boxes, Terminal Boxes and Marshalling Kiosks

All junction boxes, terminal boxes and marshalling kiosks shall be constructed of steel or cast iron. Each shall be provided with an earth stud. All main equipment shall be arranged so that it is accessible from the front of the box or kiosk. All junction boxes, terminal boxes and marshalling kiosks shall be properly labelled as per the wiring diagrams.

Enclosures for electrical apparatus are to afford the following degrees of protection classified in IEC.60529 of 1992 (BS.5490).

(i) Outdoor marshalling boxes or kiosks - IP54- also provision of a thermostatically controlled 240 VAC anti-condensation heater and having screened drainage holes.

(ii) Auxiliary switches and associated terminals - IP54 - as (I) but with heater control switch common to other apparatus on the same circuit.

(iii) Outdoor junction boxes - IP54.

(iv) Outdoor instruments - IP65.

(v) Outdoor motors - IP54.

(vi) Indoor control relay and low voltage AC & DC cubicles - IP41 - also provision of a thermostatically controlled 240V AC anti-condensation heater and indicating light common to a group of cubicles.

8.13 Gauge Cubicles and Panels

Gauge and instruments shall be grouped whenever possible and housed in suitable cubicles. Where circumstances do not justify cubicle accommodation, they may be secured to flat back panels but in such cases the approval of the Employer’s Representative is first to be obtained. Cubicles shall be sheet metal having a minimum thickness of 2 mm (14SWG). The construction shall employ folding techniques with the use of standard rolled sections or other reinforcement where necessary. The stiffness shall be such as to prevent mal-operation of relays or other apparatus by impact. The front of the panel shall have a smooth well-finished surface.

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

9.1 Arrangement of Facilities

Protection and control equipment shall be mounted in panels as specified and shall be erected in permanent buildings on the substation sites. 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. 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, venom and moisture proof to withstand all prevailing climatic conditions. The specified maximum ambient temperature shall be taken into consideration in closed rooms. 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 on either side 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(MMLG01) 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.

9.2 Construction of Cubicles

The interior of each panel 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 the relevant Clauses of this Technical Specification.

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 sand wiring shall be so arranged as to impose no strain on terminations. No equipment whatsoever shall be mounted on rear access doors and there should be sufficient clearance for working from the back.

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 IP64 with sun/rain shades of adequate size. Each door shall be fitted with suitable earth straps of at least 16mm^2 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.

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. All enclosures and accessories, such as swing frames shall be corrosion protected by electrophoresis dip 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.

9.3 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:

- 4.0 mm^2 for current transformer circuits and heavy power consumers up to 20 A
- 2.5 mm^2 for all power consumers such as motors, heaters, lighting, etc. up to 10A
- 1.5 mm^2 for all instrument and control wiring, however, the maximum permissible voltage drop is< 5 % for the furthest point at full load, with prior written approval.
- 0.6 mm^2 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 oil resisting insulation material having a glossy finish, and with their identification numbers clearly engraved, each being the same as for the relevant terminal.
Ferrules, of white colour with black letters, shall be fitted in such a way that they cannot become detached when the wire is removed from the terminal (i.e. end crimps shall be provided).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. Whenever, required and necessary, 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, 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 mm^2 and 2.5 mm^2 size.
- Terminals with short circuit facilities for current transformer circuits of 4 mm^2 size, and earthing link terminals of current transformer and voltage transformer circuits, all provided with insulated testing sockets.
- Terminals for wiring of 1.5 mm^2 and 0.6 mm^2 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.

9.4 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.

9.5 Test and Earthing Facilities

9.5.1 Earthing Facilities

Each control or relay panel shall be provided with a copper earth bar of not less than 80 mm^2 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 mm^2.Each current transformer secondary circuit shall be earthed through a removable link at one point only.

9.5.2 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.

9.6 Protection Devices

Protection equipment shall be designed and applied to provide maximum discrimination between faulty and healthy circuits. All equipments 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. The ratio of current transformers given in the SLD is a general guideline only. Proper calculations should be used to verify these ratios. 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.

9.7 Relays

Relays shall be of Schweitzer Engineering Laboratories make, as specified. 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 IP40 or better. Relays of the hand reset type shall be capable of being reset without opening the case.

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. 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.

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. All relays shall be adequately protected against damage from incoming surge and shall meet relevant IEC standards.

9.8 Overhead & UG-Cable Protection

9.8.1 36 kV Lines

Main Protection

For sub-transmission lines, main protection scheme of numerical type line distance protection is required. This shall be provided using a SEL 311L relay.

CB Management & Backup Protection

CB Fail protection, Backup over current and Earth fault functions shall be provided through the SEL 351-7 relays. Auto-reclosing & sync-check functions shall also be mounted on SEL351-7 relay. This shall be employed with facilities to achieve single-phase trip and high speed reclose under single phase fault conditions, and three-phase trip with delayed reclose under multi-phase fault conditions, respectively. Auto-reclose shall operate with check synchronizing and dead line charging facilities as required.

Further all close commands to the CB (auto-reclose & close command) shall be routed through this relay and sync-check be performed for all operations.

12kV Lines

CB Management & Backup Protection

CB Fail protection, Backup over current and Earth fault functions shall be provided through the SEL 351-7 relays. Auto-reclosing & sync-check functions shall also be mounted on SEL351-7 relay. This shall be employed with facilities to achieve single-phase trip and high speed reclose under single phase fault conditions, and three-phase trip with delayed reclose under multi-phase fault conditions, respectively. Auto-reclose shall operate with check synchronizing and dead line charging facilities as required.

Further all close commands to the CB (auto-reclose & close command) shall be routed through this relay and sync-check be performed for all operations.

9.9 Auto-Reclosing

9.9.1 36kV Line Auto-reclosing

The auto reclosing function shall be provided within the SEL 351-7 and shall be programmable for all the necessary logic to provide for the following possibilities:

- 1 phase trip and high-speed auto reclose
- 3 phase trip with delayed auto reclose
- 3 phase definitive tripping only

The appropriate voltage transformer signals for synch check shall be automatically selected. Breaker pole discrepancy protection shall also be provided and single phase reclosing shall be coordinated with the settings of this protection. An unsuccessful auto reclose shall be followed by a three phase trip and a lockout.
A developing fault, which becomes multi-phase during the single pole dead time shall cause three pole tripping and abandon reclosing.

9.9.2 Check Synchronising Relay

Sync-check function shall be incorporated into the CB management relay SEL 351-7 for all installations. A voltage check function for checking, energizing conditions shall be provided. All energising options (dead-line/live-bus etc.) shall be selectable for each circuit breaker. The sync-check relay shall only release a closing command to the related circuit breaker, if the voltage amplitudes present at the two sides of the open circuit breaker and the phase angle between them, as well as the frequency difference are within acceptable limits. The required conditions for closing must be present for an adjustable time prior to passing a closing command to the circuit breaker under supervision. Continuous self-supervision of both hardware and software shall be incorporated.

9.10 Bus Bar, Bus Coupler and Bus Section Protection Schemes

9.10.1 Bus Bar Protection 36kV (for each busbar)

NA

9.11 Trip Circuit Supervision

Trip circuit supervision relays shall be provided to monitor each trip circuit (2 for trip & 1 for close) of 12kV & 36kV circuit-breakers and each relay shall have sufficient contacts for visual/audible alarm and indication purposes.

The trip circuit supervision scheme shall provide continuous supervision of the trip coils and trip circuits with the circuit breaker in either the open or closed position. Relay elements shall be delayed on drop-off to prevent false alarms during faults on D.C. wiring on adjacent circuits, or due to operation of a trip relay contact. Series resistance shall be provided in trip circuit supervision circuits to prevent mal-tripping a circuit-breaker if a relay element is short circuited. The trip circuit supervision design shall be such that in the event of a fault in any one component it shall not be possible to inadvertently trip the circuit breaker. The continuous trip circuit supervision relays shall initiate a delayed alarm after several seconds. This alarm shall operate for loss of DC voltage and for any interruption in the trip circuit wiring. Relay alarm elements should be equipped with well resetting flag indicators.

9.12 Tripping Relays

All tripping relays, where specified shall be of the heavy duty type suitable for panel mounting.

Trip relay contacts shall be suitably rated to satisfactorily perform their required duty and relay operating time shall not exceed 10 ms from initiation of trip relay operating coil to contact close. Where specified latching type relays shall have hand or electrically reset contacts and hand reset flag indicators. Resetting of the flag indicator and the contacts shall be possible without having to open the relay case. No time delay for the tripping contacts will be accepted. Where a master trip relay is shown in the specifications, it shall have a maximum tripping time equal to or less than 10 ms. The tripping-contactor 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).

Trip circuits of the protection will not be sensible to mal-operate due to any conductive, electrostatic or electromagnetic influences on their AC or DC created from external current or voltages, high harmonic noise produced by the switching of HV sets together with the capacitance of the DC circuit or due to spikes during connection of DC current. The tripping contacts of a protection relay shall reset automatically if no further fault conditions are present. The signalling and blocking close order of the circuit breaker shall remain uninterrupted in case of operation of bus bar, breaker failure, transformer differential, buchholz and cable protection until operator resets the relay manually.

9.13 Protection Settings

Relay settings with calculations for all unit type protective schemes, over-head line and cable protection relays shall be submitted to the Employer's Representative three month prior to commissioning of any plant / substation for approval.

All system data required for calculating the settings shall be obtained from the Employer's Representative within 3 months of the contract award. The settings of 36kV protection equipment shall be properly coordinated with the existing protection schemes. The settings shall also be provided for breaker failure, auto-recloser and other equipment. The complete trip matrix shall be subjected to Employer's Representative's approval prior to design.

9.14 Factory / Site Tests and Standards

All types of test equipment and tools required by the Contractor for tests at Site and commissioning tests shall be provided and included in the quoted Scope of Work / Scope of Supply, whether specifically mentioned or not. Where work permits are required, the Contractor shall give sufficient notice to the Employer's Representative to allow the necessary outage to be arranged. The results of all tests shall be submitted, in handwritten form immediately following completion of the tests, and within ten days typewritten copies shall be supplied according to the requirements of these Tender Documents. The Contractor shall submit the results (as requested) of any test he may carry out on his own, following manufacture, installation or Site testing, as well as those required herewith. The equipment shall meet the requirement of IEC 60255-11 and their performance shall not be affected under the following conditions:

Interruption to the DC auxiliary supply of duration up to 10 ms
AC. component (ripple) in the DC auxiliary supply up to 5% of rated value

10.0 Section 4 - Employer's Requirements – Part VII – SCADA Equipment

10.1 SCADA System

The existing SCADA system includes the Master Station hardware at the National Control Centre of the Employer and remote Terminal Units at Power Stations and Grid Substations. The Master Station equipment uses iFIX system. EFL uses DNP3 protocol for communications.

Configuration of the new equipment to the existing SCADA system and providing data, information and pictures displayed on the existing monitors at the System Control Centre is a responsibility of the contractor.

For the Qeleloa Substation, the existing RTU is to be configured to use the DNP3 protocol to communicate with the Master Station via a radio link.

10.2 SCADA System Equipment and Devices

10.2.1 General Description

The contractor shall be responsible to use the existing SCADA System equipment and devices currently at the Qeleloa Substation and ensure complete functioning with the rest of the SCADA system. All equipment must correctly interface with one another and also with the existing plant.

10.2.2 The Existing SCADA System at Load Dispatch Centre - Vuda

The Master Station equipment is a iFIX Computer System. The existing Systems communicate with the Master Station using the DNP 3.0 protocol.

10.2.3 Remote Terminal Units (RTU)

10.2.3.1 General

The contractor shall be responsible for the design of all equipment such that the complete functioning with the rest of the SCADA system is guaranteed. The plant connectivity to the RTU shall be designed in such way that 11kV and 33kV plants shall not be connected together on the same RTU.

All equipment must correctly interface with one another and also with the existing plant. SEL 3530 shall be used as the main RTU and SEL 2515 units shall be utilized to connect additional I/O as required.

10.2.3.2 Alarms and Indications

Alarms and indications shall be installed on all relevant equipment. The major alarms shall be so wired that they are visible with the cabinet door closed. Voltage free contacts shall be provided to relay these indications to a remote point. The contractor shall provide a list of alarms available, with the offer.

10.2.4 SCADA I/O Points

All I/O points shall be wired to the RTU and brought back to the Employer's Master station. The Employer will then decide on the points that will be used on the IFIX SCADA system for control and monitoring. The Standard I/O points are given below. A final list will be provided once the contract is finalised

10.2.4.1 11kV & 36kV I/O Points

ITEM	33kV FEEDER CB CONTROL		11kV FEEDER CB CONTROL	
CONTROL	LOCAL	LOCAL	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
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
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
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	✓	✓	✓	✓

10.2.5 External Wiring

All control and instrument panel will be wired with cable having flame retardant insulation and outer sheaths.
The wiring of all indications and controls will be done using multi-stranded, 1.5 mm^2 copper. However for Current Transformer Secondary wiring side, since transducers will have to be wired in series, the wiring will be of 2.5 mm^2 or 4.0 mm^2 copper (where the distances are long) in order to reduce burden. The multi-core cables supplied shall be made up of fine strands of plain copper wire with PVC based insulation and an outer sheath of PVC. Any fillers used to make a circular compact cable shall be non-hygroscopic. The armoured cable shall be similar in construction, but with a galvanized wire armour and outer PVC sheath.

The nominal operating voltage of cables shall be 300 V between core and earth 500 V between cores. This rating shall be stamped on the outer sheath of cable. The cores of control cables shall be identified by means of numerals printed at regular intervals throughout the length of the core. Armoured cable will be used between marshalling kiosk and outdoor equipment. All control and power cables shall include a green/yellow protective core in addition to the specified number of cores. All material required for installation work such as, cable glands, numbering systems, cable ties, terminals etc. should be provided with 10% extra.

10.2.6 System Requirements

The offered equipment shall be in compliance with all facilities existing and or provided by others and their capabilities, also future demands beyond the actual capacity shall be considered within the scope of this project.
It is required that the Bidder submits, together with the technical description of the equipment, proposals for:

- expansion/conversion of transmission equipment for higher multiplexer levels and combined use for public services on telephone and facsimile
- incorporation of the supplied equipment into the existing telecommunication network.

11.0 Section 4 - Employer's Requirements – Part VIII – Power and Control Cables

11.1 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.

11.2 L.V. 1000V Solid Dielectric Power Cables

11.2.1 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.

11.2.2 Insulation

Insulation shall be in accordance with IEC 60502 Clause 4.

11.2.3 Laying-Up

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

11.2.4 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.

11.2.5 Core Identification

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

11.2.6 Voltage Identification

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

11.2.7 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.

11.2.8 Armour

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

11.2.9 Oversheath

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

11.2.10 Jointing

Jointing of LV cable is not permitted.

11.2.11 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.

11.2.12 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.

11.3 PVC Insulated Control Cables

11.3.1 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.

11.3.2 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.

11.3.3 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.

11.3.4 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.

11.3.5 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.

11.3.6 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.

11.3.7 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.

11.3.8 Armour

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

11.3.9 Oversheath

PVC outer covering shall be in accordance with IEC 60502.

11.4 Polyethylene Insulated Telephone Type Cables

11.4.1 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.

11.4.2 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 20^0 C shall not exceed 29.67 ohms and 13.61 ohms respectively.

11.4.3 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.

11.4.4 Identification of Cores

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

11.4.5 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.

11.4.6 Fillers

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

11.4.7 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.

11.4.8 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.

11.4.9 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.

11.4.10 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.

11.4.11 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.

11.4.12 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.

11.4.13 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.

11.4.14 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.

11.4.15 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.

11.5 Laying Direct in Ground

11.5.1 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.

11.5.2 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.

11.5.3 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.

12.0 Section 4 - Employer's Requirements – Part IX – Energy Metering

12.1 General

All metering shall be done using the SEL relays.

12.2 Installation

Contractor shall perform visual inspection to ensure that there is no damage resulting from shipment. The relay shall provide the following minimum readings:

- Ampere
- kV
- MW
- MWh
- MVAR
- Power Factor

The Contractor shall ensure that these readings are able to be monitored locally and remotely. The relay shall be capable of storing the data for downloading.

13.0 Section 4 - Employer's Requirements – Part X – Inspection and Testing

13.1 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.

13.2 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.

13.2.1 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.

13.2.2 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.

13.2.3 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.

13.2.4 Switchgear and Protective Relay Equipment

Refer relevant Chapters.

13.3 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.

13.3.1 General Test Requirements

13.3.1.1 Procedure

A program of tests shall be agreed between the Contractor and the Employer's Representative, and a test program for all Sites agreed in conjunction with the erection and commissioning program approved by the Employer's Representative. Testing shall be carried out during normal working hours as far as is practicable. Tests, which involve existing apparatus and outages, may be carried out outside normal working hours. The Contractor shall give sufficient notice to allow for the necessary outage arrangements to be made in conformity with the testing program. The Contractor shall advice the Employer/Employer's Representative in writing by the time of commencement of site erection of the supplies which will be required for the operation of the test equipment. This should be necessary, to enable the Employer/Employer's Representative to arrange accordingly or to agree alternative arrangements.

The Contractor shall provide the requisite experienced test personnel and all relevant test equipment, unless otherwise agreed by the Employer's Representative or stated in the Employers Requirements. The Employer's Representative shall approve the data of the test equipment provided. The Contractor shall record the results of the tests clearly, in an approved form and with clear reference to the equipment and items to which they refer, so that the record can be used as the basis for the maintenance tests during the working life of the equipment. The required number of site test result records shall be provided by the Contractor to the Employer's Representative as soon as possible after

completion of the tests. The Contractor shall submit the necessary sets of test schedules and copies prior to the commencement of the tests. However, one legible copy of the test results as taken on site immediately after the tests are completed has to be handed over. No tests as agreed under the program of tests shall be waived except upon the instruction of agreement of the Employer's Representative in writing.

13.3.1.2 Standards and Methods

The method of testing, unless otherwise specified in the Employer's Requirements, shall be agreed with the Employer's Representative. Details of the test equipment and instruments used shall be noted in the test sheets in cases where the instrument or equipment characteristics can have influence on the test results.
The Contractor's test equipment shall be of satisfactory quality and condition and, where necessary, shall be appropriately calibrated by an approved authority or standard at the Contractor's expense.
The testing requirements detailed under this Specification may be verified only by instruction of the constructional techniques.

13.3.2 Protection, Control, Alarms, Measurements and Indication Equipment.

13.3.2.1 Wiring

Insulation resistance Tests at 2kV AC for one minute are to be carried out on all protection, control, alarm and indication circuits to ensure that wiring is in satisfactory condition. Visual inspection shall be made on cable glands, cable jointing, fuse or circuit breaker ratings and small panel items, such as indicating lamps.
Static equipment, which may be damaged by the application of test voltages, shall have the appropriate terminals short-circuited. Inter-relay, inter-unit and cubical wiring carried out at site is to be checked to the appropriate circuit and/or wiring diagram. This may be done by using bells or buzzers. DC supplied from the station battery may also be used. Where it is found necessary during pre-commissioning work to make modifications to the secondary wiring, then the diagrams shall be suitably marked as agreed with the Employer's Representative before the circuit is commissioned. Loop resistance measurements are to be made on all current transformer circuits. Separate values are required for current transformer and lead resistance and all measurements are to be recorded on lead resistance diagrams. When pilot cable is used to transmit protection measured values, its impedance and phase angle shall be compensated for properly in the protection settings.

13.3.2.2 Secondary Injection

Secondary injection shall be carried out on all AC relays, using voltage and current of sinusoidal waveform and rated power frequency. For circulating current protection employing high impedance voltage operated relays, the points of injection for relay voltage setting tests shall be across the relay and stabilizing resistance. The fault setting for the type of protection is to be established by secondary injection, where it is impracticable to ascertain this value by primary injection. Injection is to be made across the appropriate relay bus wires with all associated relays, setting resistors, and CT's connected.

13.3.2.3 Current Transformer Magnetizing Tests

The magnetization characteristic of all current transformers shall be checked at the minimum of two points and up to a maximum of five points as necessary to identify the current transformers with reference to the manufacturer's estimated design curve, and to determine the suitability of the current transformer for its intended duty. Special measures may be taken to ensure that the core is fully demagnetized before commencing the test.

13.3.2.4 Primary Injection

Primary current injection tests are to be carried out by the Contractor. The primary injection methods employed for a particular installation are to be agreed with the Employer's Representative.
Tests are to be carried out as follows: -

a) Local primary injection to establish the ratio and polarity of current transformers as a group, care being taken to prove the identity of current transformers of similar ratio.
b) Overall primary injection to prove correct interconnection between current transformer groups and associated relays and the voltage transformers.
c) Fault setting tests to establish the value of current necessary to produce operation of the relays. If not possible these tests are to be carried out by secondary injection applied at the wiring close to the current transformers.

13.3.2.5 DC Operations

Tests are to be carried out to prove the correctness of all DC polarities, the operating levels of DC relays and the correct functioning of DC relay schemes, selection and control switching, indications and alarms.

13.3.2.6 On-Load Tests

In view of the hazards inherent in these tests, they shall be carried out under the direct supervision of the Employer/Employer's Representative and/or the Purchaser. An operation and stability test shall be carried out for on load commissioning. Tests for restraint shall be carried out to prove the characteristic of protective systems with directional characteristics. On load check shall be made after the protective gear has been placed in service to ensure that all connections and test links have been replaced and test leads removed, as well as to confirm the integrity of the current transformer circuits. Where necessary voltage readings shall be taken at the terminals on each relay to ensure that loop connections between the relays are complete. Special attention shall be paid to broken delta voltages and residual current circuits where zero voltage or current respectively may not be proof of the completeness of the circuit.

13.3.3 Switchgear and Ancillary Equipment

Written programs for tests and checks according to points under this paragraph shall be set up and agreed between the parties.

13.3.3.1 General Checks

A general check of all the main switchgear and ancillary equipment shall be made and shall include a check of the completeness, correctness and condition of earth connections, labelling, arcing ring and horn gaps, painted surfaces, cables, wiring, pipe work, valves, blanking, plates and all other auxiliary and ancillary items. Checks shall be made for oil and gas leaks and those insulators are clean and free of external damage. A check shall be made that loose items, which are to be handed over to the Employer's Representative, e.g. blanking plates, tools, spares are in order and are correctly stored or handed over.

13.3.3.2 Circuit-Breaker Tests

Circuit breaker shall be given a visual inspection. Test shall be made also on mechanical and hydraulic operating systems. Contact resistance test shall be carried out. In the case of multi-interrupter circuit-breakers resistance tests will be required at each interrupter or pair of interrupters as well as through the series of interrupters on each pole. Operational tests will include local and remote trip/close, Circuit Breaker timing tests shall be carried out on all circuit breakers. In the case of gas type circuit breakers testing will be required on the gas type system to prove the gas quantity, its dryness and its dielectric strength. The gas leakage shall be measured at factory and checked at site.

13.3.3.3 LVAC Switchboards

Not applicable.

13.3.3.4 Voltage Transformers

The following tests shall be carried out on electromagnetic type voltage transformers: -

a) Insulation tests at 2 kV to earth and between windings.
b) Checks on gas/oil relays, if there are any.

All voltage transformers shall be checked for polarity phasing and for secondary output.

13.3.3.5 Earthing System

Tests shall be made on the effectiveness of the bonding and earthing which will include conductivity tests on selected joints, on the main earthing system, and at the connections to equipment and structures. Checks shall also be made on precautions taken to avoid corrosion attack on the earthing system.

The resistance of the earthing system to the general mass of earth shall be tested and recorded including the method, and equipment used to carry out the tests. Test probes at approximately 300 and 600 meters separation will normally be required to effectively test the earthing system.

Tests of the earthing resistivity shall be carried out as called in Clause 8.3.

The earth resistance shall be measured during the installation and on completion.

a) Each earth rod after driving.
b) The earth grid after completion and backfilling of the trenches.
c) Each group of earth rods or earth point after completion of the connection from the test link terminal.
d) The completed installation without any connections outside the substation.
e) The Contractor shall be called upon to provide assistance in the measurement of each resistance after earth connections to the system have been completed. The test shall be carried out by a method and with equipment approved by the Employer and all tests are to be witnessed.

13.3.3.6 Instruments and Fault Recorders

Instruments and instrument transformer circuits shall be checked for polarity or direction and for calibration including any interposing transformer or transducers. These checks shall be made on all current transformer ratios where applicable. Fault and event recorders shall be tested for printing operation and paper transport. Operation shall be checked by secondary injection and initiating device operation as applicable. Stability and normal operation shall be checked after the main high voltage circuit has been commissioned.

13.3.3.7 Interlocking

All interlocking arrangements both electrical and mechanical shall be fully checked and tested.

13.3.4 Bushing Type Current Transformers

(i) Magnetising Tests

The magnetisation characteristic of all current transformers shall be checked at the minimum of two points and up to a maximum of five points as necessary to identify the current transformers with reference to the manufacturer's estimated design curve, and to determine the suitability of the current transformer for its intended duty. It may note that it is not normally necessary to check the characteristic up to the knee-point for this purpose. Special measures may have to be taken to ensure that the core is fully demagnetised before commencing the test.

(ii) Primary Injection

Primary current injection tests are to be carried out by the Contractor. The primary injection methods employed for a particular installation are to be agreed with the Employer's Representative.

Local primary injection tests are to be carried out to establish the ratio and polarity of current transformers as a group, care being taken to prove the identity of current transformers of similar ratio.

14.0 Section 4 - Employer's Requirements – Part XI – General Requirements

14.1 General

14.1.1 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.

14.1.2 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 at least for the equivalent list below.

(a) Circuit breakers
(c) Current transformers

(d) Voltage transformers
(i) Metering, Protection & Control equipment
(k) Power and Control equipment
(l) Cables & Conductors

14.1.3 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.

14.1.4 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.

14.1.5 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 2010 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
- functional block diagrams for protection
- complete circuit diagrams
- Current Transformer calculations
- dimensional drawings of all equipment and installation
- detailed construction schedule in form of a bar chart
- cable laying diagram

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.

14.1.5.1 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.

14.1.5.2 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.

14.1.6 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.

14.1.7 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.

14.1.8 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 Clause 6.6 of General Condition of FIDIC.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.

14.1.9 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.

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.

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.

14.1.10 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.

14.1.11 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 spares should 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.

14.1.12 Inventory Records For Plant & Material

The Contractor shall forward his inventory records for plant & material at the end of each month to the Employer.

14.1.13 Documents & Drawings to Be Submitted After the Contract Award

As a minimum, the following documents & drawings shall be submitted after the Contract award.

a) General arrangement drawing
b) Single line diagram
c) Bill of material in detail.
d) Description of system components
e) Technical brochures
f) Breaker control elementary diagram
g) Disconnect switch control elementary diagram
h) Schematic and Wiring diagrams

i) Terminal board locations and arrangements
j) Voltage transformer connection diagram
k) Current transformer connection diagram
l) Name plate drawing
m) Protection stability calculations to demonstrate the adequacy of the Current Transformer cores.
n) Detail protection schematic drawings and protection setting calculation
o) Construction Schedule.
p) All relevant civil design calculations and drawings.

Other technical documents

a) Current transformer excitation curves.
b) Routine test reports.
c) Factory test reports
d) Test reports for onsite tests
e) Operation & Maintenance Manuals
f) Documents as required by the Employer's Representative.

14.1.14 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.

15.0 Section 4 - Employer's Requirements – Part XII – Civil Works

15.1 Civil Works

In General the Contractor will be required to carry out the following Civil Works but not limited to:

- Modification of existing switchgear platform to accommodate new 33kV/11kV Switchgear.
- Cable Trenching
- Reinstatement of Switchyard
- Any other works which may be required as per tender specification.

15.2 Preliminary Works

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.

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.

15.3 Site Clearance

All unwanted materials, debris, etc. shall be removed from the employer's premises.

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.

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.

15.4 Site Formation and Up-keeping

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.

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.

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.

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.

Explosives shall not be used.

Stone chipping used for substation surfacing are to be clean hard crushed stone graded from 16 - 40 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 100 mm.

15.5 Cable Trenches & Ducts

15.5.1 Control and Power Cable Trenches

The Contractor is responsible for all civil works required for cable runs between outdoor switchgear and building in concrete cable trenches. 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.

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.

15.5.2 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.

15.5.3 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.

15.5.4 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.

15.5.5 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.

15.6 Galvanising

15.6.1 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 minimum of 85 micron 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 40 micron and matching the primer to be applied after erection. If not otherwise specified, galvanized steel surfaces shall be chromated with approximately 85-micron thickness. Single items such as cable trays, fences, etc. may be galvanized and PVC covered if so approved by the Employer's Representative.

15.6.2 Painting of Galvanized Steel

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.

15.6.3 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.

15.6.4 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.

15.6.5 Erection

The Contractor must provide all temporary works, of any kind whatsoever, he shall deem necessary to ensure the correctness of 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.

15.6.6 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.

15.6.7 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.

15.6.8 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.

15.6.9 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.

15.7 Foundations

15.7.1 Concrete

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 (7) 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 made with 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 NZS 3104, NZS 3112 & AS 1012.

15.7.1.2 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 NZS 3104, NZS 3112 & AS 1012.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.

15.8 Water Supply & Drainage System

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.

15.9 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.

15.9.1 Structures (Culverts, Bridges retaining walls) for approach road.

The contractor shall follow the guide lines and requirements of the Fiji Road Authority.

15.9.2 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.

15.10 Fence

Existing switchyard fence will be removed during the busbar extension works, and circuit realignment works. The Contractor shall be responsible for erecting a new fence for the outdoor switchyard including earthing the fence at every 2nd Post.

15.11 Miscellaneous Work

Shall be carried out according to the relevant clause of this specification.

Section 5

Form of Proposals and Appendices

16.0 Section 5 - Form of Proposals and Appendices

16.1 Form of Tender

To: Jiten Reddy
Manager Strategic Procurement, Inventories and Properties
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 _____

16.2 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	8 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	4.2*	Ten (10%) of the Contract Price and in the proportions of currencies which the Contract Price is payable
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		To be confirmed
Limit of liquidated damages for delay		To be confirmed
Total amount of advance payments	13.2*	Refer to Payment Schedule
Number of instalments	13.2	One (1) upon submission of Advance Payment Guarantee
Start repayment of advance payment	13.2(a)	when payments are Ten (10) % of the Contract Price
Repayment amortization of advance payment	13.2(b)	10%

Percentage of retention	13.3(c)*	TEN (10)%
Limit of Retention Money	13.3(c)*	TEN (10)% of the Contract Price
Minimum amount of Interim Payment Certificates	13.6*	Five (5)% of the Contract Price

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)
(b) relevant policies	*	Fourteen (14) days after Commencement Date.
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 _____

16.3 Form of Price Proposal

To: Mr. Jiten Reddy
Manager Strategic Procurement, Inventories and Properties
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 _____

16.4 Appendix to Price Proposal

[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, 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 Project EFL, Private Mail Bag, Suva, Fiji
Total amount of advance payments	13.2*	Ten (10)% of the Contract Price
Number of instalments	13.2	One (1)
Start repayment of advance payment	13.2(a)	when payments are Ten (10) % of the Contract Price
Repayment amortization of advance payment	13.2(b)	25%
Percentage of retention	13.3(c)*	Five (5)%
Limit of Retention Money	13.3(c)*	Five (5)% of the Contract Price
Minimum amount of Interim Payment Certificates	13.6*	Five (5)% of the Contract Price

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]	_____ _____ _____

Initials of signatory of Bid _____

Section 6
Sample Forms

17.0 Section 6 - Sample Forms

17.1 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 _____

17.2 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: Qeleloa 11kV/33kV Substation Extension
Tender No: MR350/2024

*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 _____

17.3 Form of Advance Payment Security (Bank Guarantee)

To: _____ *[name of Employer]*
_____ *[address of Employer]*
_____ *[name of Contract]*

Tender Name: Qeleloa 11kV/33kV Substation Extension
Tender No: MR350/2024

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 7
Schedules – Part 1
Schedules of Prices

18.0 Section 7 - Schedules of Prices

18.1 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.

18.2 Schedule of Prices & Conditions of Payment

18.2.1 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.

18.2.2 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.

18.2.3 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.

18.2.4 Payments Terms

1. All payments shall be due and payable by the Employer in accordance with the payments terms detailed below.
2. The payments shall be made on completion of milestones as identified and agreed by both the Employer's Representative and the Contractor.
3. The payments will be made based on the following schedule:

	Particulars	*Milestone*	*Payment (% of contract price)*
1	Advance payment	As per clause 13.2 of Section 3 - Conditions of Particular Application	10%
2	Delivery of Plant and Equipment to Suva Port	Upon arrival of plant and equipment to Site	10%

3	Installation and commissioning of new switchgear, isolator/Disconnector, and outdoor structure	Upon completion of installation , commissioning, submission of As-Builts and O&M Manuals	60%
4	Civil Works , fence and resurface switchyard	Upon Completion of all civil works per substation	10%
5	Retention	12 months after issuing of performance certificate	10%

4. Payments to be made under this contract fall into two categories:

i] payments for work carried out off-shore and hence not subject to GST or VAT.

ii] payments for work carried out within Fiji (i.e. on-shore), and hence

shall be subject to Fiji tax, legislation including the VAT Decree 1991.

18.3 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.

18.4 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.

18.5 Schedules of Rates & Prices

18.5.1 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.

18.6 Drawings, Design and Documentation

F/C – Foreign Currency
FJD – Fijian Dollars

Item No.	Description	Estimated		Rate		Total Price	
		Qty	Unit	F/C	FJD	F/C	FJD
1	***QELELOA SUBSTATION 11 kV & 33 kV EXTENSION***						
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 Civil works	1	LS				
TOTAL (Transfer to Grand Summary)							

18.7 Plant Equipment Including Mandatory Spare Parts

ITEM NO.	DESCRIPTION	ESTIMATE QTY	DDU FIJI Foreign Currency		DDU FIJI FJD		ERECTION ON SITE FJD		TOTAL AMOUNT (Excluding Taxes & Duties)	
			Unit Rate	Amount	Unit Rate	Amount	Unit Rate	Amount	F/C	FJD
			(1)		(2)		(3)		(4=1)	(5=2+3)
	QELELOA SUBSTATION EXTENSION									
1	ELECTRICAL PLANT AND EQUIPMENT, INCLUDING MANDATORY SPARES									
1.1	11kV NEW LINE FEEDER BAY									
1.1.1	1250 Amp, 12 kV 3-phase Circuit Breaker complete with housing panel. Inclusive of 12kV bus side disconnector, 12kV bus side earth switch.	1 No								
1.1.2	12kV Busbar Extension kit to suit the interconnection between the existing ABB UniGear ZS1 switchgear with the proposed new 12/17.5kV line feeder bay indoor switchgear unit.	AS								
1.1.3	12kV Current Transformers	AS								
1.1.4	12kV three phase voltage transformers for Metering and Protection	AS								
1.2	33kV NEW LINE FEEDER BAY									
1.2.1	3150 Amp, 36 kV 3-phase Circuit Breaker complete with housing panel. Inclusive of 36kV line side disconnector, 36kV line side earth switch.	1 No								
1.2.2	36kV Busbar Extension to suit the interconnection between the existing ABB UniGear ZS3.2 switchgear with	AS								

	the proposed new 36/40.5kV line feeder bay indoor switchgear unit.									
1.2.3	36kV Current Transformers	AS								
1.2.4	36kV three phase voltage transformers for Metering and Protection	AS								
1.3	11kV and 33kV PROTECTION RELAYS									
1.3.1	SEL311L (Specify Part Number)	1 No.								
1.3.2	SEL351 – 7 (Specify Part Number)	2 No.								
1.3.3	Areva MMLG-02 Test Blocks	2 No								
1.3.4	Serial Cables and SEL relay accessories	AR								
1.4	POWER AND CONTROL CABLES									
1.4.1	All low voltage AC power cables and terminations	1 Lot								
1.4.2	All DC power and control cables and terminations	1 Lot								
1.5	OTHERS									
1.5.1	11kV and 33 kV cable trenches and ducts	1 Lot								
1.5.2	Spares (Detailed spare's list to be provided by the bidder)	1 Lot								
	Contractor to add others as required	AR								
	TOTAL OF EQUIPMENT SUPPLY									

18.8 Civil Works, Installation and other services

ITEM NO.	DESCRIPTION	ESTIMATE QTY	DDU FIJI Foreign Currency		DDU FIJI FJD		ERECTION ON SITE FJD		TOTAL AMOUNT (Excluding Taxes & Duties)	
			Unit Rate	Amount	Unit Rate	Amount	Unit Rate	Amount	F/C	FJD
			(1)		(2)		(3)		(4=1)	(5=2+3)
	QELELOA SUBSTATION EXTENSION									
1	CIVIL WORKS, INSTALLATION AND OTHER SERVICES									
1.1	11kV NEW LINE FEEDER BAY									
1.1.1	1250 Amp, 12 kV 3-phase Circuit Breaker complete with housing panel. Inclusive of 12kV bus side disconnector, 12kV bus side earth switch.	1 No								
1.1.2	12kV Busbar Extension kit to suit the interconnection between the existing ABB UniGear ZS1 switchgear with the proposed new 12/17.5kV line feeder bay indoor switchgear unit.	AS								
1.1.3	12kV Current Transformers	AS								
1.1.4	12kV three phase voltage transformers for Metering and Protection	AS								
1.2	33kV NEW LINE FEEDER BAY									
1.2.1	3150 Amp, 36 kV 3-phase Circuit Breaker complete with housing panel. Inclusive of 36kV line side disconnector, 36kV line side earth switch.	1 No								
1.2.2	36kV Busbar Extension to suit the interconnection between the existing ABB UniGear ZS3.2 switchgear with the proposed new 36/40.5kV line feeder bay indoor switchgear unit.	AS								

1.2.3	36kV Current Transformers	AS								
1.2.4	36kV three phase voltage transformers for Metering and Protection	AS								
1.3	11kV and 33kV PROTECTION RELAYS									
1.3.1	SEL311L (Specify Part Number)	1 No.								
1.3.2	SEL351 – 7 (Specify Part Number)	2 No.								
1.3.3	Areva MMLG-02 Test Blocks	2 No								
1.3.4	Serial Cables and SEL relay accessories	AR								
1.4	POWER AND CONTROL CABLES									
1.4.1	All low voltage AC power cables and terminations	1 Lot								
1.4.2	All DC power and control cables and terminations	1 Lot								
1.5	CIVIL WORKS									
1.5.1	Associated Civil Works relating to the complete installation of the new Switchgears	1 Lot								
1.5.2	11kV and 33 kV cable trenches, ducts and other accessories	1 Lot								
1.6	OTHERS									
	Contractor to add others as required	AR								
	TOTAL OF CIVIL WORKS, INSTALLATION AND OTHER SERVICES									

18.9 Grand summary

ITEM	DESCRIPTION	TOTAL PRICE	
		F/C	FJD
1.0	Design, drawings and documentation		
2.0	Plant and equipment, including mandatory spares		
3.0	Civil Works, installation and other services		
GRAND TOTAL			

18.10 Alternative Offer

The bidders have a choice of providing an alternative offer apart from the main offer. The alternative offer shall only be considered for the bidder whose bid has been identified as the best value for money. For the alternative offer, the bidder shall assume that the Employer will provide the following list of equipment for testing purposes:

- HV AC Test set
- Primary Injection Test Set (2000 amps)
- Megger BM25 Insulation Resistance Tester
- T&R 3 Phase Voltage Test Set
- T&R 3 Phase Current Test Set
- T&R Ductance Tester
- OMICRON CMC256 Secondary Injection Test Set (with Test Universe Software)
- OMICRON CPC100 Primary System Test Set

The Bidder shall thus provide an alternative offer based on the above:

Alternative offer: Local Currency: FJD _____

Foreign Currency:_____

18.11 Recommended Tools & Spare Parts

As per clause 1.10 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	Description	Qty	Unit Price		Total Price	
			F/C	FJD	F/C	FJD

18.12 Summary of *Prices*

	Foreign Cost	Local Cost
1. MAIN OFFER: (a) Qeleloa 33 kV Substation Extension (b) Recommended Spares; Tools &Equipment		
2. ALTERNATIVE OFFERS: (Briefly describe) A. B.		

TOTAL CONTRACT PRICE:

Main Offer: Foreign Currency (in words)

……

and Local Currency (in words)

……

*Alternative A: Foreign Currency (in words)

……

and Local Currency(in words)

……

*Alternative B: Foreign Currency (in words)

……

and Local Currency (in words)

……

Signature of Tenderer ……

Witness ……

Note: Details to be included in Part II of this Section in the Departures from Specifications.

18.13 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

18.14 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.

18.15 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.

18.16 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 8

Schedules – Part II

Schedules of Supplementary Information

19.0 Section 8 - Schedules – Part II Schedules of Supplementary Information

19.1 11kV switchgear

19.1.1 Recommended Supplier and Manufacturers, Places of Manufacture & Testing

ITEM	MANUFACTURER	PLACE OF MANUFACTURE	PLACE OF TESTING & INSPECTION
33kV Circuit Breakers			
33kV Copper Busbar			
33kV Current Transformers			
33kV Voltage Transformers			
33kV Switch Panels			
Protection Relays	SEL		
Meters	NEMO HD+/ Shark 200 v6		
Anti-Condensation heaters			
OPTOLINK	Schneider VAMP		
SENSOR	Schneider VAMP		
Arc flash protection	Schneider VAMP 321		
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		

19.1.2 Technical Particulars and Guarantees

19.1.2.1 Busbars

	Item	Units	Required
			12 kV
1.	Rated Normal Current	A	1250
2.	Rated current at Max. ambient temperature	A	
3.	Conductor Material		Cu
4.	Standard Applicable		
5.	Single conductor Cross section	mm2	
6.	Insulation material		
7.	Fire Certification (IEC 60466, etc)		

19.1.2.2 Circuit Breakers

	Items	Units	Required	Tendered
			12kV	
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	15	
9	Rated Frequency	HZ	50	
10	Rated Normal Current at 20oC			
	- Line feeder circuit breaker	A	1250	
11	Rated Current at Max. ambient temperature			
	- Line feeder circuit breaker	A		
12	Rated Lightning Impulse Withstand	kA	95	
13	Rated 1 min Power Frequency Withstand	kV	35	
14	Rated short circuit breaking current (symmetrical, r.m.s)	kA	31	
15	Rated short circuit breaking current (asymmetrical, r.m.s)	kA	28	
16	Rated making current (peak)	kA	70	
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		1.5	
24	Rated operating sequence		O-0.3 secCO-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		
32	Number of switching operations at rated breaking capacity before contact maintenance becomes necessary	No.	Min 100	
33	Auxiliary contacts:			
	- number NO/NC			
	- voltage rating	V DC	110	
	- current rating	A DC		
34	Making coil			
	- Rated voltage	V DC	110	
	- min. operating voltage	V	88	
	- Rated power each	W		
35	Trip coil			
	Rated voltage	V DC	110	
	- min. operating voltage	V	55	
	- Rated power each	W		
36	Motor Voltage	V DC	110	
37	Motor Power	W		
38	Max. temperature rise of contacts at rated normal Current	K		
39	Arc quenching medium		Vacuum	
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			
	d) Between phases	mm	120	

	(e) Phase to earth	mm	120	
	(f) Across CB poles	mm	120	
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	

19.1.2.3 Current Transformer

	Item	Units	Required	Tendered
			12 kV	
1.	Manufacturer			
2.	Type			
3.	Applicable Standards - IEC		60044-1	
4.	Rated secondary current	A	1	
5.	Rated lightning impulse withstand voltage (primary)	kV	75	
6.	Rated Power Frequency withstand voltage (primary)	kV	28	
7.	Rated short-time current			
8.	Protection cores (Transformer Diff):			
	- Rated Primary Current	A	As per list	
	- Accuracy class	Class	0.1PL	
	- Resistance of secondary winding at 75oC	Ohms	< 3	
	- Rated Burden	VA	15	
9.	Protection cores(OC & EF for feeders):			
	- Rated Primary Current	A	As per list	
	- Accuracy class	Class	5P10	
	- Resistance of secondary winding protection cores at 75oC	Ohms	< 3	
	- Rated Burden	VA	5	
10.	Protection cores(Bus Section):			
	- Rated Primary Current	A	2000/1000	
	- Accuracy class	Class	5P10	
	- Resistance of secondary winding protection cores at 75oC	Ohms	< 3	
	- Rated Burden	VA	Min 5	
11.	Number of Cores	No.	See scope of works and Drawings	

12.	Knee point e.m.f. of protection cores	V	Min 450	
13.	Knee point e.m.f. of busbar protection cores	V	Min 415	
14.	Insulation material for windings			
15.	Limits on exciting current	A		
16.	Partial discharge	pC	< 50	

19.1.2.4 Voltage Transformer

	Item	Units	Required	Tendered
			12 kV	
1.	Manufacturer			
2.	Type		Magnetic actuator	
3.	Applicable Standards - IEC		60044-2	
4.	Method of transformation		inductive	
5.	System Voltage	kV	15	
6.	Type of supply		3 phase	
7.	Frequency	Hz	50	
8.	Basic Insulation Level	kV	75	
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		

19.1.2.5 Switch Panels

	Item	Units	Required	Tendered
			12 kV	
1	Manufacturer			
2	Type		Metal-Clad	
	rated voltage	kv	15	
3	Applicable Standards – IEC		IEC 60694	
	Impulse withstand voltage kV peak	kV	75	
	Power frequency withstand voltage	kV	28	
4	Thickness	mm		
5	Short time rating, 3 sec	kA	25	
6	Integral earthing switch for feeder and busbar	Yes/No	Yes	
7	Short circuit rating of earth switch			
8	Making capacity of earth switch			
9	Transducer and Local Energy Meter (Transformer)			
	- Manufacturer and model		Shark 200	
	- protocol		DNP3	
10	Transducer and Local Meter			
	- Manufacturer and model		Shark 200	
	- protocol		DNP3	
11	Anti Condensation heater			
	- Manufacturer			
	- Heater voltage			
	- Heater Output	W		
	Is heater switch provided		Yes	
12	Material			
	Surface Finish			
	Dimensions			
	Length	mm		
	Width	mm		
	Height	mm		
13	Total Net Weight	Kg		

19.2 36kV Switchgear

19.2.1 Manufacturers, Places of Manufacture & Testing

ITEM	MANUFACTURER	PLACE OF MANUFACTURE	PLACE OF TESTING & INSPECTION
33kV Circuit Breakers			
33kV Copper Busbar			
33kV Current Transformers			
33kV Voltage Transformers			
33kV Switch Panels			
Protection Relays	SEL		
Meters	Shark 200 v6/ NEMO HD+		
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

19.2.2 Technical Particulars and Guarantees

19.2.2.1 Busbars

	Item	*Units*	*Required*	*Tendered*
			36 kV	*36 kV*
1.	Rated Normal Current	A	3150	
2.	Rated current at Max. ambient temperature	A	3150	
3.	Conductor Material		Cu	
4.	Standard Applicable		IEC	
5.	Single conductor Cross section	mm2		
6.	Insulation material			
7.	Fire Certification (IEC 60466, etc)			

19.2.2.2 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	3150	
11	Rated Current at Max. ambient temperature			
	- Line feeder 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	

19.2.2.3 Current Transformer

	Item	Units	Required	Tendered
			36kV	36kV
1	Manufacturer		ABB Germany	
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	

19.2.2.4 Voltage Transformer

	Item	Units	Required	Tendered
			36kV	36kV
1	Manufacturer		ABB Germany	
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		

19.2.2.5 Switch Panels

	Item	Units	Required	Tendered
			36kV	36kV
1	Manufacturer			
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		

19.3 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 November 2023. 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's (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 16th October 2023 in preparing a work programme.

19.4 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

19.5 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.

19.6 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.

19.7 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)				
Site Office				
Site Manager			10	
Deputy Site Manager			7	
Supervising Engineers			7	
Construction Supervisors			7	
Safety Manager			10	
Other key staff				
Specialised Staff				

19.8 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	

19.9 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.

19.10 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			

19.10.1 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.

19.10.2 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.

19.10.3 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.

19.10.4 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.

19.10.5 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.

19.10.6 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.

19.10.7 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.

19.10.8 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.

19.10.9 Emergency Procedures

Identify specific emergency procedures or equipment required for the contract.

19.10.10 Incident Reporting & Investigation

Describe how incidents will be reported and investigated during the contract.

19.10.11 Specialized Work Or Licensing

List any special licenses required for the contract

19.10.12 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:

19.10.13 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.

19.10.14 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

19.10.15 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: _____

19.10.16 Contractor Chemical Register

Complete the following table:

Product Name	*Hazard*	*Controls Required*	*Location*	*Quantity*

1 Contractor Signature: _____

2 Date: _____

19.11 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.

As a minimum, the following documents & drawings shall be submitted with the Bid.

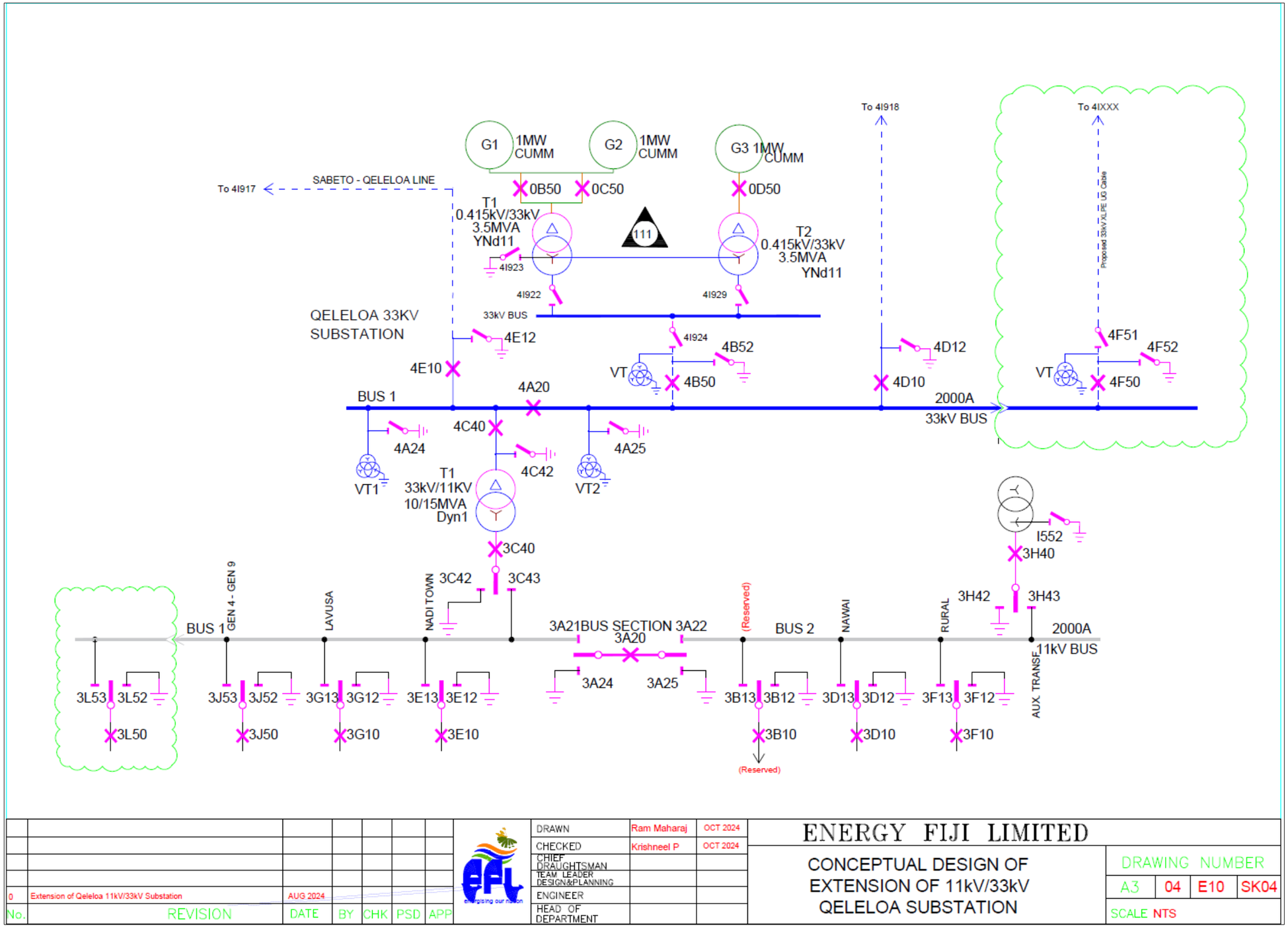
1. Typical plan and section drawings
2. Detail layouts of Indoor 12kV & 36kV Switchgears
3. Single line diagrams
4. Manufacturer's Technical Brochures, type number, reference number and Drawings showing details of construction and dimensions of
    a. Switchgear
    b. Current transformers
    c. Voltage transformers
    d. Energy meters and transducers
    e. All HV cables and accessories
    f. Other major equipment.

5. Typical arrangement drawing of control, metering and relay panel
6. General structural drawings
7. Foundation drawings including static and dynamic load, General arrangement drawings, plans, sections, elevations.
8. Independent type test certificates for,
    i. Switchgear
    ii. Current Transformers
    iii. Voltage Transformers
    iv. All HV cables and accessories
    v. Other major equipment
9. General bar chart of the design, manufacturing, shipping, erection and commissioning schedule
10. Evidence of Bidder's experience in works similar to this
11. Certificates issued by an independent International Organization to ensure compliance with the ISO 9001:2000 standards by Bidder
12. List of standards the Bidder intends to follow, for electrical ,civil and mechanical works
13. 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 9
Single Line Diagram

20.0 Section 9 - Single Line – Diagram & Site Drawings

20.1 Conceptual Design of Qeleloa SS



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 27th November, 2024.

For further information or clarification please contact our Supply Chain Office on phone **(+679) 3224360 or (+679) 99926520** 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.