



MR 24/2021

**SUPPLY OF STATION DC DISTRIBUTION SYSTEM
FOR NEW 33KV/11kV SUBSTATION AT WAITOLU,
NAITASIRI**

ENERGY FIJI LIMITED

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REVISION HISTORY & DOCUMENT CONTROL

Rev No.	Notes	Prepared By	Reviewed & Approved By	Date of Issue
1	Issued for tender	KDP (ULSSP)		3/02/21

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1 INVITATION FOR TENDER

Energy Fiji Limited (“EFL”) is responsible for generation, transmission and distribution of electricity in Viti Levu, Vanua Levu, Ovalau and Tavueni in Fiji. It owns over twenty (20) power stations and twenty (20) substations and switching stations on the islands of Viti Levu, Vanua Levu, Taveuni and Ovalau.

EFL is developing a new 33kV/11kV zone substation in Waitolu, Naitasiri. As part of this substation development, EFL is seeking bids from reputable manufacturers and suppliers for design, manufacture, testing and supply of the substation DC supply equipment.

All tenders 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. Bids without completed returnable schedules will be viewed as unresponsive and will not be considered for evaluation.

During evaluation of tenders EFL may invite a tenderer or tenderers for discussions, presentations and any necessary clarification before awarding of the contract.

The tender submissions close at 1600hrs on 24th February 2021, Fiji Time.

Further information for this tender may be acquired from:

Jitendra Reddy
Unit Leader Strategic Procurement and Inventories
2 Marlow Street, Suva, FIJI.
Phone: 679 3224 320
Facsimile: 679 331 6773
Email: JReddy@efl.com.fj

2 INSTRUCTIONS TO TENDERERS

2.1 Eligible Tenderers

This invitation is open to all Tenderers who have sound Financial Background, and have previous experience in supply of such equipment. Tenderers who are not manufacturers shall provide a letter of declaration from the manufacturer authorizing them to represent the nominated manufacturer.

Tenderers shall provide such evidence of their continued eligibility satisfactory to EFL as EFL shall reasonably request, using the forms provided in the Schedules.

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

2.2 Eligible Materials, Equipment and Services

The materials, 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, equipment, and services. Tenderers shall be required to provide evidence of the origin of materials, equipment, and services in their bids.

For purposes of this Contract, "services" means the works and all project-related services including design services.

For purposes of this Contract, "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.

The materials, 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.

2.3 One Bid Per Tenderer

Each Tenderer shall submit only one bid. A Tenderer who submits or participates in more than one bid will cause all those bids to be rejected.

2.4 Cost of Bidding

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

2.5 Site Visits

No site visits are required for this tender.

2.6 Contents of Bidding Documents

The Tenderer is expected to examine carefully the contents of this Bidding document. Failure to comply with the requirements of bid submission will be at the Tenderer's own risk. Bids which are not substantially responsive to the requirements of the bidding documents will be rejected.

2.7 Clarification of Bidding Documents

A prospective Tenderer requiring any clarification of the bidding documents may notify EFL in writing by fax (hereinafter the term "fax" is deemed to include electronic transmission such as facsimile, cable and telex), or email addressed to:

Jitendra Reddy
Unit Leader Strategic Procurement and Inventories
2 Marlow Street, Suva, FIJI.
Phone: 679 3224 320
Facsimile: 679 331 6773
Email: JReddy@efl.com.fj

EFL will respond to any request for clarification which it receives earlier than five (5) days prior to the deadline for submission of bids.

2.8 Amendment of Bidding Document

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

2.9 Language of Bid

The bid, and all correspondence and documents related to the bid, exchanged between the Tenderer and the EFL shall be written in the English language.

2.10 Bid Prices

Unless specified otherwise, Tenderers shall quote for the entire facilities on a "single responsibility" basis such that the total bid price covers all the Supplier'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), testing and delivery.

Tenderers shall give a breakdown of the prices in the manner and detail called for in the Schedules of this bidding document, or any issued addenda.

Bids shall be given on DDU basis. The point of delivery shall be EFL's Kinoya Depot in Kinoya, Suva. The term DDU shall be governed by the rules prescribed in the current edition of Incoterms, published by the International Chamber of Commerce, Paris.

2.11 Bid Currencies

Prices shall be quoted in a single currency only.

2.12 Bid Validity

Bids shall remain valid for a period of **90 days** from the date of Deadline for Submission of Bids specified in Sub-Clause 2.15.

2.13 Format and Signing of Bids

The Tenderer shall prepare one original and one (1) copies of the technical and financial proposals, clearly marking each one as: "ORIGINAL-TECHNICAL & PRICE PROPOSAL", "COPY NO. 1 - TECHNICAL & PRICE PROPOSAL", etc. as appropriate. In the event of discrepancy between the original and any copy, the original shall prevail.

The original and all copies of the bid shall be typed or written 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 Tenderer. All pages of the bid where entries or amendments have been made shall be initialed by the person or persons signing the bid.

The Tenderer shall also provide one electronic copy of the Technical and Financial proposals on EFL's electronic tender hosting website, <https://www.tenderlink.com/efl> or on a portable storage device with the printed submissions.

The bid shall contain no alterations, omissions or additions, except those to comply with instructions issued by EFL, or as necessary to correct errors made by the Tenderer, in which case such corrections shall be initialed by the person or persons signing the bid.

2.14 Sealing and Marking of Bids

The Tenderer shall seal the original copy of the technical proposal and the original copy of the price proposal and each copy of the technical proposal and each copy of the price proposal in separate envelopes clearly marking each one as: "ORIGINAL-TECHNICAL & PRICE PROPOSAL", "COPY NO. 1 - TECHNICAL & PRICE PROPOSAL", etc. as appropriate.

The Tenderer shall seal the original bids and each copy of the bids in an inner and an outer envelope, duly marking the envelopes as "ORIGINAL", "COPY No. 1", etc.

The inner and outer envelopes shall

- a) be addressed to EFL at the following address:

Jitendra Reddy
Unit Leader Strategic Procurement and Inventories
2 Marlow Street, Suva, FIJI.
Phone: 679 3224 320
Facsimile: 679 331 6773
Email: jreddy@efl.com.fj

And

- b) bear the following identification:

- Bid for: SUPPLY OF STATION DC DISTRIBUTION SYSTEM FOR NEW 33KV/11KV SUBSTATION AT WAITOLU, NAITASIRI
- Bid Tender Number: MR 24/2021
- DO NOT OPEN BEFORE: 1600hrs on 24th February 2021

In addition to the identification required, the inner envelope shall indicate the name and address of the Tenderer to enable the bid to be returned unopened in case it is declared "late" pursuant to Deadline for Submission of Bids.

If the outer envelope is not sealed and marked as above, EFL will assume no responsibility for the misplacement or premature opening of the bid.

2.15 Deadline for Submission of Bids

Bids must be received by EFL at the address specified above no later than 1600 hours (Fiji Time) 24th February 2021.

EFL may, at its discretion, extend the deadline for submission of bids by issuing an addendum, in which case all rights and obligations of EFL and the Tenderers previously subject to the original deadline will thereafter be subject to the deadlines extended.

2.16 Late Bids

Any bid received by EFL after the deadline for submission of bids prescribed above will be rejected and returned unopened to the Tenderer.

2.17 Modification and Withdrawal of Bids

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

The Tenderer's modification or withdrawal notice shall be prepared, sealed, marked and delivered in accordance with Sealing and Marking of Bids, with the outer and inner envelopes additionally marked "MODIFICATION" or "WITHDRAWAL", as appropriate. A withdrawal notice may also be sent by fax but must be followed by a signed confirmation copy.

No bid may be modified by the Tenderer after the deadline for submission of bids.

2.18 Rejection of One or All Bids

EFL 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 Tenderer or Tenderers or any obligation to inform the affected Tenderer or Tenderers of the grounds for the rejection.

2.19 Process to be Confidential

Information relating to the examination, clarification, evaluation and comparison of bids and recommendations for the award of a contract shall not be disclosed to Tenderers or any other persons not officially concerned with such process.

Any effort by a Tenderer to influence EFL's processing of bids or award decisions may result in the rejection of the Tenderer's bid.

Lowest bid will not necessarily be accepted as successful bid.

2.20 Clarification of Bids

To assist in the examination, evaluation and comparison of bids, EFL may, at its discretion, ask any Tenderer 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 EFL in the evaluation of the bids.

2.21 Compliance with Specifications

The tender shall be based on the equipment and work specified and shall be in accordance with the Technical Specification. It should be noted that unless departures from specifications are detailed in Schedule G of the Technical Specification, the tender would be taken as conforming to the Specification in its entirety. The Tenderer shall tender for the whole of the Works included in the Specification.

2.22 Signature of Tenderer

A tender submitted by a Partnership shall be signed by one of the members of the Partnership and shall be accompanied by a certified authorization of all the partners authorizing the individual partner to sign on behalf of the Partnership. A tender submitted by a Corporation to the Contract and shall be accompanied by a certified resolution of the Board of Directors authorizing the individual to sign on behalf of the Corporation.

2.23 Insurance

The Tenderer is to confirm that they have in effect the insurance policies below and provide copies of valid certificates with the bid:

1. Public and Products Liability Insurance
2. Insurance for Workmen's Compensation

3 GENERAL CONDITIONS OF CONTRACT

The General Conditions of Contract shall be based upon AS 4911 – 2002 General Conditions of Contract for Supply of Equipment Without Installation.

The Conditions of Contract comprises two parts:

1. Part 1 – General Conditions; and
2. Part 2 – Conditions of Particular Application

4 CONDITIONS OF PARTICULAR APPLICATION

1. Interpretation and Construction of Contract

Add the following:

“Bid has the same meaning as tender.”

Replace

“qualifying cause of delay means

- a) any act, default or omission of the Purchaser, its consultants, agents or other contractors (not being employed by the Supplier); or*
- b) other than*
 - i) a breach or omission by the Supplier;*
 - ii) industrial conditions or inclement weather occurring after the due for delivery; and*
 - iii) stated in item 22”*

With

“qualifying cause of delay means a cause of delay other than that caused by

- a) a breach or omission by Supplier;*
- b) industrial conditions or inclement weather occurring after the due for delivery; and*
- c) a cause stated in item 22 “*

5. Service of notices

Replace *“ ii) confirmation of correct transmission of fax”*

With *“ ii) confirmation of correct electronic transmission”*

6. Contract Documents

Under 6 Contract Documents, make the following change:

Replace *“6.1 Discrepancies”* and contents in subclause 6.1 Discrepancies with the following,

“6.1 Discrepancies and Priority of Documents

The following priority of documents applies if there is any ambiguity, discrepancy or inconsistency in the documents comprising the Contract:

- a) Letter of Acceptance from Supplier*

- b) *Conditional Award Letter from Purchaser*
- c) *EFL Tender Addenda (if any issued, if not, remove this item from list)*
- d) *EFL Tender Specifications, including drawings*
- e) *Conditions of Particular Application to AS 4911-2003*
- f) *General Conditions of Contract AS 4911-2003*
- g) *Supplier's Tender Clarifications (if any provided by Supplier during tender evaluation, if not, remove this item from list)*
- h) *Supplier's Bid Document*

If either party discovers any inconsistency, ambiguity or discrepancy in any document prepared for the purpose of performing the Contract that party shall give the other party written notice of it. The Purchaser, thereupon, and upon otherwise becoming aware, shall direct the Supplier as to the interpretation and construction to be followed, with the priority order of documents above.

If compliance with any such direction under this subclause causes the Supplier to incur more or less cost than otherwise would have been incurred had the direction not been given, the difference shall be assessed by the Purchaser and added to deducted from the contract sum."

9. Warranties

Replace "9. *Designated Items*" and its contents with the following

9. Warranties

9.1 Ownership

The Supplier represents and warrants that:

- a) *It is the legal and beneficial owner of the goods; and*
- b) *that upon payment of the contract sum no person other than the Purchaser will be entitled to hold any interests in, or hold any encumbrance over, the goods.*

9.2 Supplier's Warranty

The Supplier represents and warrants that the goods will upon delivery:

- a) *comply in all respects with the Contract;*
- b) *be suitable for the purpose stated in Item 5;*
- c) *be of merchantable quality;*
- d) *conform to any sample provided by the Supplier and approved by the Purchaser.*
- e) *in the absence of any specific provision of the Contract, meet any relevant Australian Standard and industry best practice;*
- f) *be free of design defects;*
- g) *be, unless otherwise agreed, new.*

If the Supplier is in breach of any of the warranties in this clause 9, the Purchaser may, in addition to the Purchaser's other rights and remedies, at any time give 7 days' written notice to the Supplier to rectify such breach, and if the Supplier fails to comply with such notice, the Purchaser may employ others to carry out works required to satisfy the warranty. The cost thereby incurred shall be moneys due and payable to the Purchaser.

The representation and warranties in this clause survive the completion or earlier termination of the Contract and each warranty in this clause is independent of, and is not limited by, reference to any other warranty.

The Supplier shall obtain all warranties relevant to the goods from manufacturer or suppliers or as otherwise specified in the Contract, including any warranties that are provided by any sub-contract and ensure that the Purchaser has the benefit of those warranties. "

14. Directions

Add the following to 14 Directions, at the end,

"The Purchaser may appoint the individual stated in Item 1A to exercise delegated Purchaser's functions. The Purchaser may, from time to time, by notice in writing to the Supplier, substitute or appoint more than one such Purchaser's representative, provided that no aspect of any function shall at any time be the subject of delegation to more than one Purchaser's representative.

Every reference in the Contract to the Purchaser's representative shall include the Purchaser and vice versa."

17. Time

Under 17.2 Claim, make the following change

Replace

" a) delivery is or will be delayed by a qualifying cause of delay; and "

With

" a) delivery is or will be delayed by a qualifying cause of delay that includes but is not limited to any act, default or omission of the Purchaser, its consultants, agents or other contractors (not being employed by the Supplier; and "

19. Delivery

Add the following to 19.1 Mode of and Date and Place for Delivery, at the end,

"The Supplier must ensure that all goods are properly, safely and securely packaged and labeled for identification and safety as follows:

- a) the goods must be individually packaged for transport so that they are protected from all reasonably foreseeable condition which might cause corrosion, deterioration or physical or bearing damage during handlings and transport. All packaging and preservation materials must be supplied by the Supplier; and*
- b) each package must be clearly and indelibly inscribed with the Purchaser's name, the address of the delivery place, the Purchaser's contract number and any safety warnings for the contents."*

21. Acceptance or Rejection of Equipment

Add the following to 21.1 Notification, at the end,

"The Purchaser shall be under no obligation to give written notice to the Supplier that the Equipment is acceptable unless:

- a) *the Purchaser is satisfied that the Equipment is satisfactory and complies with the “as manufactured” drawings approved by the Purchaser; and*
- b) *all drawings and manuals required to be supplied by the Supplier, have been duly supplied by the Supplier. “*

24. Payment

Replace “24.1 Invoices and time for payment” with “24.1 Claim for Payment and time for payment”

Under 24.1 Claim for Payment and Time for Payment, make the following change.

Replace all occurrences of “an invoice” with “written claim for payment”.

26. Termination by frustration

Under 26 Termination by frustration, make the following change.

Replace all occurrences of “an invoice” with “written claim for payment”.

27. Notification of claims

Under 27.1 Communication of claims, make the following change

Replace

“As soon as practicable after a party becomes aware of any claim in connection with the subject matter of the Contract, that party shall give to the other party the prescribed notice of a notice of dispute under subclause 28.1.”

With

“As soon as practicable and in any event not later than seven (7) consecutive days after a party becomes aware of any claim in connection with the subject matter of the Contract, that party shall give to the other party the prescribed notice of a notice of dispute under subclause 28.1.”

28. Dispute Resolution

Replace “28.2 Conference” and contents with the following:

“28.2 Conference

Within 14 days after receiving a notice of dispute, the parties shall confer at least once to resolve the dispute or to agree on methods of doing so, including, but not limited to, mediation, conciliation, binding expert determination and arbitration, of the whole of any part of the dispute. Where arbitration is agreed method of resolution, the arbitration shall be conducted in accordance with the rules of Item 38(b) and the arbitrator, unless otherwise agreed, shall be nominated by the President of the Fiji Institute of Engineers.

At every such conference, each part shall be represented by a person having authority to agree to such resolution or methods. All aspects of every such conference except the fact of occurrence shall be privileged.

If the dispute has not been resolved nor a method of resolution agreed within 56 days of service of the notice of dispute, that dispute shall be dealt with in accordance with subclause 28.3.”

Replace “28.3 Arbitration” and contents with the following

“28.3 Elevation of Disputes

If the parties are unable to resolve the dispute or agree a method of resolution in accordance with sub clause 28.2:

- a) *the dispute shall be referred to the Chief Executive Officer, or a duly authorized representative, of the Purchaser and the Chief Executive Officer/Managing Director, or a duly authorized representative, of the Supplier to resolve the dispute or agree on a method of resolution;*
- b) *the individuals referred to in sub clause 28.3 (a) shall meet within 14 days after referral of the dispute in an effort to resolve the dispute or agree a method of resolution;*
- c) *if the individuals referred to in sub clause 28.3 (b) are unable to resolve the dispute but agree at that meeting on a method of resolution, they shall also nominate a timeframe for the commencement and conclusion of the method of resolution; and*
- d) *if the individuals so referred to in sub clause 28.3(b) are unable to resolve the dispute or agree a method of resolution, each within 14 days of the dispute being referred, either parts may give written notice to the other stating that the parties have been unable to resolve the dispute or agree a method of resolution.*

Where arbitration is the agreed method of resolution, the arbitration shall be conducted in accordance with the Rules stated in Item 38(b) and the arbitrator, unless otherwise agreed, shall be nominated by the President of the Fiji Institute of Engineers.”

Replace “28.4 Summary Relief” and the contents with the following:

“28.4 Instituting Proceedings

Neither party shall proceed to resolve a dispute by instituting court proceedings until issuing to, or receiving from, the other party, a notice in accordance with sub clause 28.3(d).”

Add the following after 28.4 Institutional Proceedings

“28.5 Summary Relief

Nothing herein shall prejudice the right of a party to institute proceedings to enforce payment due under the Contract or to seek injunctive or urgent declaratory relief.”

Annexure A

Replace Annexure A Part A with the form provided in Schedule C.

5 REFERENCES

5.1 Applicable Standards

The DC supply equipment shall be manufactured and tested in accordance with the following Standards and all amendments issued prior to the date of closing of tenders except where varied by this Specifications.

AS 1100.101	Technical Drawings – Part 101
AS 1319	Safety Signs for the Occupational Environment
AS 2067	Substations and High Voltage Installations Exceeding 1kV AC
AS 2676.2	Guide to Installation, Maintenance, Testing and Replacement of Secondary Batteries in Buildings – sealed cells
AS 2700	Colour Standards for General Purpose
AS 3000	Electrical installations (known as the Australian/New Zealand Wiring Rules)
AS 3011.2	Electrical Installations – Secondary Batteries installed in buildings – sealed cells
AS 3731.2	Stationary Batteries – Nickel Cadmium valve regulated
AS 4044	Battery Chargers for Stationary Batteries
AS 4680	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
AS 60146.2	Semiconductor converters – self-commutated semiconductor converters including direct d.c. converters
AS 60529	Degrees of protection provided by enclosures (IP Code)
AS/NZS 3100	Approval and test specification – General requirements for electrical equipment
AS/NZS 3820	Essential safety requirements for electrical equipment
AS/NZS 4029.2	Stationary batteries – lead acid valve regulated type
AS/NZS 4680	Hot dip galvanized coatings on fabricated ferrous articles
AS/NZS 60079.14	Explosive atmospheres – electrical installations design, selection and erection
AS 61000	Electromagnetic Compatibility – Parts 1.1, 3.2, 6.4
AS 61439	Low-voltage switchgear and control gear assemblies – Parts 1, 2, 3
AS 61588	Safety of power transformers, power supplies, reactors and similar products for supply voltages up to 1100V
IEC 17025	General requirements for the competence of testing and calibration laboratories
IEC 60297-3-100	Mechanical structures for electronic equipment
IEC 60664-1	Insulation coordination for equipment within low-voltage systems
IEC 60668	Electrical measuring transducers for converting A.C. and D.C. electrical quantities to analogue or digital signals
IEC 62485-2	Safety requirements for secondary batteries and battery installations –secondary batteries
IEC 60352	Solderless Connections – Part 2; Crimped Connections – General Requirements, Test Methods and Practical Guidance
IEC 60529	Degrees of Protection provided by Enclosures (IP Code)
IEC 60947	Low Voltage switchgear and controlgear assemblies
IEE 485	Recommended practice for sizing lead acid batteries for stationary applications
IEE 1635	Ventilation and Thermal Management of Batteries for Stationary Applications
ISO 9001	Quality Systems Model for Quality Assurance in Design, Development, Production, Installation and Servicing
ISO 45001	Occupational Health and Safety Systems Management

Should inconsistencies be defined between Standards and this Specifications, this Specification will take precedence. However, significant inconsistencies shall be referred to EFL for resolution.

5.2 Applicable Laws

The Tenderer warrants (without limiting any other warranties or conditions implied by law) that all Goods have been produced, sold and delivered to EFL in compliance with all applicable laws (including all workplace health and safety and electrical safety legislations and codes of conduct).

6 SERVICE CONDITIONS

6.1 Environmental Conditions

The equipment shall be manufactured to withstand the following service conditions of:

Atmosphere	:	Saliferous, corrosive and dusty
Ambient temperature	:	Peak : 40°C
	:	24 Hour Average: 30°C
	:	Annual Average: 22°C
	:	Minimum: 10°C
Relative Humidity (Average)	:	85%
Annual Average Rainfall	:	1900 mm
Wind Speed	:	Sustained : 55 m/s
	:	Gusts : 70 – 110 m/s
Isokeraunic Level	:	60 Thunder days per year
Seismic	:	To a maximum of 7 on the open-ended Richter Scale
Low voltage Supply Ratings	:	Control/Alarm/Emergency – 89V to 132V, 110V nominal Supply voltage of auxiliary equipment – 415V/240V ±5% Supply voltage of auxiliary equipment - 89V to 132V, 110V nominal

Note: 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.

6.2 System Conditions

The rated frequency of EFL's power system is 50 Hz.

	System Voltages
Particulars	230V/415V
Nominal System Voltage	230V (p-n), 415V (p-p)
Highest (Equivalent) System Voltage:	244V (p-n),

	440V (p-p)
Number of phases:	1 or 3
Impulse Withstand voltage (peak):	AC 10kV rms
Power frequency withstand voltage:	

EFL's 11kV system is 3 phase, 3 wire, 50 Hz. The transformer 415V neutral is generally solidly grounded.

6.3 Seismic Disturbances

The equipment shall be designed to withstand the most onerous seismic events over its operating life. The design shall meet the requirements as shown in table below and shall be in accordance with AS 1170.4 and the Building Code of Fiji.

Seismic requirements	Particular Detail
Earthquake structural design criteria (AS 1170.4, 2007)	Structure Importance Level 4 Probability factor $k_p = 1.5$ Hazard Factor $Z = 0.12$ Structural Ductility Factor

6.4 Standard Voltages

The standard nominal voltage for new substation plant and equipment is 110 V d.c.

The minimum discharge voltage based on a 12 h autonomy time shall be 1.80 V per cell and the maximum charge voltage shall be the battery cell reference voltage compensated for operation at 0 °C.

Battery cells shall be used in a series arrangement to make up battery strings of nominal voltage.

The standard voltage variation for the system shall be as shown in table below.

Number of 2V Cells in Series	Nominal Voltage	Typical Float Voltage at 25deg C	Operating Voltage Limits	
			Minimum	Maximum
54	110V	122.9V	97.2V	130V

6.5 Operational Life

The operational life of power system plant and equipment is the recommended age limit to predict the end of life for specific components for asset management.

Asset operational life for DC equipment is:

- Batteries shall have a design life of minimum 10 years at 25°C.
- DC chargers shall have an operational life of minimum 25 years.
- Distribution boards shall have an operational life of 40 years.

The Tenderer shall submit details of all necessary maintenance that is required to be performed by the EFL on the equipment to ensure validity of the warranty. The Tenderer shall also disclose to EFL any special obligations or requirements to ensure continuity of the warranty.

The Tenderer shall submit details of all necessary maintenance that is required to ensure continued safe and effective operation during its remaining design life. All batteries shall be recycled at the end of their useful life.

7 DESIGN, PERFORMANCE AND CONSTRUCTION REQUIREMENTS

7.1 General

The DC system, including battery chargers, battery banks and switchboards will be used for substation protection, control, SCADA and communication systems. For details relating to ratings and requirements refer to Appendix D.

7.2 VRLA Stationary Battery Banks

VRLA Stationary Battery Banks and their mounting racks / enclosures shall be designed to the service conditions and common design requirements detailed in this section.

All batteries under this contract are to be of Valve Regulated Lead Acid (VRLA) AGM type conforming to Australian standard AS/NZS 4029.2.

However, Tenderers can offer alternative technology where available. For alternative offers to be considered, departures of these items from this Specification shall be fully detailed including advantages of the alternative technology. Cadmium batteries will not be considered.

Battery bank consisting of one battery string is required. The batteries shall preferably be constructed using an electrolyte suspension system such that there is no free electrolyte in the event of a cracked case. The batteries shall be constructed such that they may be operated in any orientation without loss of capacity, electrolyte or service life.

Batteries will be installed and managed in ambient conditions with temperature compensation if required. Recommended charging voltages shall be stated and the temperature correction factor for continuous automatic voltage adjustment shall be stated.

For management of the risk from high short circuit currents the following is required:

- battery connections shall be shrouded with removable, reusable insulating covers, and
- all other connections and cables shall be insulated;

Refer to Appendix D for additional requirements.

7.2.1 Battery Labels, Signage and Safety Data

Suitable warning signs to be installed on site, shall be provided. These signs will state the battery voltage and prospective short circuit current in conformance with AS 2676.2. Full details shall be provided with the tender.

Each individual battery shall have a label on it detailing each of the following:

- Manufacturer name
- Manufacturer model number
- Manufacturer serial Number
- Date of manufacture written as DD/MM/YYYY format (manufacturer date codes will not be accepted)
- Battery mass

The appropriate material safety data sheet (MSDS) shall be provided in hard copy and electronic format for each type of battery. Label is to be clearly visible on each cell once installed. Above details can be printed on the cell or on a label.

7.2.2 Recharge Time

The batteries shall attain a minimum capacity of 75% within 8 hours from a fully discharged condition using the battery manufacturer's recommended float voltage at 25 °C and attain 100% capacity within 24 hours. The battery manufacturers recommended maximum float voltage shall not be exceeded.

7.2.3 Mounting and Enclosure

Batteries shall be suitable for installation in substation buildings and be:

- stand-alone battery bank, or
- battery bank including a rack/stand
- battery bank including an enclosed rack/stand with appropriate ventilation.

The batteries shall be suitable to be installed in accordance with AS 3000, AS 3011.2 and AS 2676.2.

The battery rack shall be:

- free standing,
- steel framed
- suitable for mounting adjacent to a wall,
- capable of fixing to the floor by bolting,
- capable of front access to fastening locations,
- capable of being fastened within the footprint of the rack.
- designed with adequate battery ventilation.

The battery rack shall be designed to meet seismic requirements of AS 1170.4 as per Section 6. Battery cases shall be restrained with suitable straps to the frame or shelf for earthquake restraint.

7.2.4 Battery Connections

Inter-cell and inter-tier or inter-row connections shall be flexible with suitably sized insulation and be supplied pre-cut, lugged, and complete with nuts, bolts and washers. Bolts, nuts, washers and inter-connections shall be of an inherently corrosion resistant material or otherwise protected against corrosion in an acceptable manner.

7.2.5 Required Capacity

The required capacity is 200 A-hrs. Periodically, during circuit breaker tripping and closing operations, the load on the DC system may considerably exceed the charger rating. Typical substation switchgear operating duty requires up to 100 A at 110 V DC for 0.5 seconds.

7.3 Battery Chargers

Battery Chargers and their mounting racks / enclosures shall be designed to the service conditions detailed under these specifications.

The battery chargers shall be type two (2) for use without the battery connected according to AS 4044. The battery charger shall be capable of maintaining DC supply without batteries connected.

Battery chargers shall be capable of continuous operation whilst supplying rated output current at maximum temperature compensated float charge voltage, with a minimum design life of 25 years in the above-specified environmental conditions.

Typical DC system drawings in the Appendices show in the connection of the charger with the remainder of the DC system. The battery charger shall be constructed in modules and incorporate redundancy;

such that failure of any one component does not reduce the battery charger capacity to less than its ratings.

Each component shall be individually protected by appropriately selected and designed MCBs. MCBs shall be clearly marked and identified in coordination with schematics and manuals.

All rectifier's power modules shall use Switched Mode power supply technology. Bridge Rectifier controlled chargers shall not be accepted.

Battery chargers shall be designed for rapid repair by replacement on a modular component basis. Similar components shall be used across all battery chargers to minimise the holding of spares. Fault finding and replacement of components shall be possible from the front of the panel. It is preferable that the power modules be hot pluggable.

The design and construction of the battery charger shall have control, indication, metering and alarm facilities as indicated in this sub-section below.

Key dc system status and parameters shall be remotely accessible and generate alarms under fault conditions to the EFL SCADA system. The battery chargers shall allow for ratings and performance requirements not less than those specified in Appendix D.

7.3.1 Supply Voltage

The battery chargers shall operate satisfactorily from either a three phase 415V or a single phase 230 V, 50 Hz AC supply with voltage limits of $\pm 10\%$. Appropriately sized, rated and shrouded terminals shall be provided to facilitate the necessary supply configuration.

7.3.2 DC Output Voltage and Current

The battery charger shall be of the automatic constant voltage type capable of maintaining the battery at the temperature compensated float charge voltage as determined by the combination of set voltage, reference temperature and temperature compensation coefficient.

The battery charger shall provide for automatic linear temperature compensation in the determination of the float charging voltage. The range of adjustable temperature coefficients shall be suitable for commercially available batteries. A suitable battery temperature transducer and cabling shall be included as part of the battery charger.

Following discharge, batteries should be charged at 1.1 times the 10 hour rated capacity. The depth of the previous discharge will determine the length of time the charger will operate in the pre-set constant current mode.

When the battery bank voltage reaches the float voltage setting the battery will be at approximately 75 – 80% capacity. From this constant voltage stage onwards, the remaining charger current will steadily decline until it eventually drops to a small residual trickle current.

A suitable battery string current transducer and cabling for each battery string shall be included as part of the battery charger. The battery charger will be matched to the batteries to achieve the recharge times.

The output voltage setting shall be capable of being manually adjusted between the limits of 2.000 Vpc to 2.600 Vpc at the battery reference temperature.

The output voltage shall not deviate by more than +/- 1% from the temperature compensated float charge voltage for any of the following conditions:

- i. Any variation in temperature in the environmental conditions identified in Section 6
- ii. Variations in the AC supply voltage of up to +/- 10%.
- iii. Output currents varying between 0 and 100% of rated output current.

Suitable means shall be incorporated into the charger to prevent overcurrent or overvoltage in excess of the battery manufacturer's recommendations (thermal runaway protection). Operation of such protection shall be alarmed locally and on SCADA.

The initial output voltage, upon switching on the charger, shall not exceed 110% of the set output voltage for any initial value of load current between 0% and 100% of rated output current.

The battery charger shall be capable of operating with the battery disconnected indefinitely without damage.

The maximum output current under short circuited output conditions shall be limited to a maximum of 400% of rated output current.

The chargers shall be capable of continuous operation whilst supplying rated output current at maximum float voltage.

7.3.3 DC Power Management System

The battery charger shall include an automatic and configurable DC Power Management System. The system shall provide management of the battery charger and interface with local PCs, remote SCADA and engineering access.

The battery charger is required to connect to EFL SCADA systems via the following methods:

- a) Alarm Relay outputs, voltage free and configurable to urgent, non-urgent and battery bank alarm groups as per Section 8.2.9,
- b) Local PC interface using Ethernet TCP/IP cable or USB or Serial RS485/232 copper cable.
- c) Remote SCADA system interface using Ethernet TCP/IP cable utilising SNMP and DNP3 and IEC 61850 MMS.

Fibre optic connections are preferred for remote/SCADA connections. The battery charger shall include a local HMI capable of full functional access to all parameters and alarms.

The DC Power Management System, shall at a minimum, provide control and monitoring of the following:

- Output voltage
- Load current
- Temperature compensation
- Supply voltage (AC) disconnection (watchdog)
- Battery Bank monitoring
- Battery Bank diagnostic tests, initiated either automatically or remotely
- Local/Remote engineering access
- All alarms
- Event logging

7.3.4 Local control and indication

A HMI shall be provided at the front of the battery charger. The HMI shall indicate the status of the battery charger and provide a means to change battery charger settings locally. Local setting changes

shall require application of a password. Battery charger settings shall be able to be applied from the HMI or by loading a settings file via a local PC.

7.3.5 Metering and Alarms

The following metering shall be provided on the front panel via the HMI, preferably on a digital read out with a minimum digit size of 6mm in height.

- DC Output Voltage
- Battery Charger Output Current
- Battery String A Current
- DC System Load Current
- Ambient Temperature
- Battery Temperature

All instruments shall conform to the Electrical measuring transducers for converting A.C. and D.C. electrical quantities to analogue or digital signals IEC standard IEC 60688 and meet Class Index 1 performance.

Alarms shall be suitable to monitor all parameters required for DC supply and battery charging duties. A minimum of four output relays shall be provided to be used to connect to the EFL SCADA system to alert the NCC Team of anomalies. Each relay shall have both a normally open and normally closed switched voltage free contact available. All alarms to SCADA shall be non-latching (Operator indications at the battery charger HMI may be latching). DC voltage, current and temperature alarm limits shall be settable. Details of available alarms and ranges of alarm limits are to be provided by the Tenderer.

The following alarms are the minimum that shall be provided:

- AC supply failed (one or more phases)
- Battery charger failed
- Control module failed
- DC output CB tripped
- Battery temperature high (adjustable)
- DC voltage high
- DC voltage low
- Battery discharge test functions
- Battery string CB tripped
- Battery charger power module failed (one or more)
- DC earth leakage detection

7.3.6 Settings and configuration management

The following are the minimum requirements for a proprietary configuration management solution.

The Configuration Management System shall support the following requirements:

- Upload configuration from Battery Charger
- Compare configuration with known good configuration and report on differences
- Upload event logs
- Perform single setting changes
- Retrieve firmware version

The configuration management shall be able to be performed using a local PC or using a serial communications link that is tunnelled over the operational communications network. The software package required to perform the above functionality shall be provided at no cost under a licencing agreement that allows EFL and its contractors to manage the charger for the life of the installation.

7.3.7 Battery Bank Monitoring

The Battery Charger shall be capable of monitoring battery bank connections and have the capability to detect:

- a failed or open circuit cell,
- a failed or open circuit connection and
- estimated remaining capacity.

7.3.8 Insulation characteristics

The AC input shall be capable of withstanding a 10kV 1.2/50 microsecond impulse test between all phases and earth as provided for in the insulation coordination for equipment within low voltage systems IEC standard IEC 60664-1.

The DC output shall be capable of withstanding a 1.2/50 microsecond impulse test between all polarities and earth, at a impulse withstand voltage of 2500 Volts as provided for in the insulation coordination for equipment within low voltage systems IEC standard IEC 60664-1, 2007.

The AC input shall be capable of withstanding a 5kV 50 Hz insulation test for one minute between all phases and earth, as provided for in the semiconductor converter Australian standard AS 60146.2 clause 7.3.

The DC output shall be capable of withstanding a 1000 Volts, 50 Hz insulation test for one minute between all polarities and earth, as provided for in the semiconductor converter Australian standard AS 60146.2 clause 7.3.3.

The above requirements may need to be modified for electronic equipment. Details of equipment likely to be damaged by the above tests are to be supplied in the offer.

7.3.9 AC Input Power Factor, Circuit Protection and Efficiency

The battery chargers shall be designed to operate with an input power factor of not less than 0.8 lagging when supplying rated output at nominal output voltage. Efficiency for the battery charger at nominal output voltage and 30-100% rated output current shall be provided by the Tenderer.

Adequate AC protection and isolation shall be provided in the form of a panel mounted circuit breaker or equivalent. DC output protection and isolation shall be provided in the form of a suitably rated double pole circuit breaker.

7.3.10 Output filtering

The RMS value of the output ripple voltage shall not exceed 0.2% of the nominal DC output voltage when the battery charger is tested in accordance with the battery chargers for stationary batteries Australian standard AS 4044. The battery charger ripple limitation is to suit valve regulated lead acid batteries.

7.3.11 Earthing

The DC output of battery chargers shall be unearthed.

All exposed conductive parts of the battery charger shall be bonded to an earth bar as provided. Provision shall be made for this by the Supplier.

An additional insulated earth terminal able to take a 16 mm² cable shall be provided near the AC input terminals for termination of the AC supply cable earth.

The battery charger shall have an earthing bar for electrical bonding to an earthing system provided on the site. Items to be bonded to the earthing bar using wire will include the following:

- Cubicle Frames
- All exposed metal enclosing electrical equipment or wiring
- Earth terminal of all sockets and plugs
- All panels and door frames

All earthing and bonding wire shall be sized for any potential earth fault and shall be run direct and as straight as possible.

7.3.12 Battery charger safety requirements

The battery charger shall meet general safety requirements according to the following Australian standards:

- Wiring rules AS/NZS 3000
- Sealed batteries installed in buildings AS 3011.2
- Electrical equipment safety requirements AS/NZS 3820
- Battery chargers AS 4044
- Safety of power transformers, power supplies and similar products AS/NZS 61558.1, AS/NZS 61558.2.4, AS/NZS 61558.2.16, AS/NZS 61558.2.17.

7.3.13 Mounting and enclosure

The battery charger may be mounted in a free-standing rack mount type cabinet. Metering and alarm indications shall be visible from the front of the panel. Alternatively, the battery charger may be mounted in a non-rack mount type cabinet of robust metal construction and fitted with a door on the front. The rack mount cabinet shall have a protective door on the rear. A rack mount type installation may allow for front and rear access. A non-rack mount cabinet shall be suitable for front access only and mounting adjacent to a wall.

The battery charger shall have an enclosure degree of protection rating of IP31 as per AS 60529. This is to allow for airflow for natural ventilation. Dust entry through the top of the equipment shall be inhibited.

Cabinets shall be capable of fixing to a concrete floor by suitable floor fasteners within the cabinet frame. Floor fasteners shall be accessible from the front of the cabinet and be capable of withstanding earth quake forces arising from the criteria identified earlier in this Specifications.

All low voltage terminals in the battery charger shall be suitably shrouded. In addition, any equipment mounted on hinged panels shall have all rear terminals or active parts effectively shrouded by clear perspex covers to provide safe working access to equipment located behind such panels.

All components including external cable terminations, requiring attention during commissioning or maintenance shall be accessible through doors.

The door/s shall be fitted with a restraint to hold the door in open position of 120-135 degrees. The door/s shall be capable of removal without affecting correct operation. All transducer cables running external to the battery charger enclosure shall be double insulated and screened to prevent interference.

7.3.14 Terminals

The DC output terminals of the battery charger shall be suitably sized to accept a cable rated for the continuous operation of the battery charger. As a minimum the terminals shall be suitable for the termination of 70 mm² copper stranded conductor.

The AC input terminals shall be a screwed tunnel type suitable for two 4 mm² copper conductors. The DC alarm terminals shall be a screwed tunnel type suitable for two 2.5 mm² copper conductors. All terminals shall be accessible for installation and maintenance purposes. Terminal screws shall not bear directly on the conductor.

Adequate space shall be provided in the cable connection zone(s) for entry and termination of cables.

7.3.15 Components

The component parts of the equipment shall be readily available either from the manufacturer or established suppliers. In particular, all semi-conductors and fuses are to be readily available from Australian, New Zealand or Fijian suppliers. The manufacturer shall list the types used in the equipment, together with one alternative type available from another source.

Resin or gel filled components or circuits shall not be accepted. Wiring shall be colour coded and/or individually identified by Brady Durasleeve™ (or equivalent) wire markers. Clip on type wire markers are not acceptable. A printed wire number shall be fitted into the label section of the PVC sleeve to uniquely identify each end of all wires. Hand written wire markers are not acceptable.

7.3.16 Cooling

Preference shall be given to battery charger arranged for natural air cooling. Dust entry into the equipment shall be inhibited. The charger shall have a rating of no less than IP51.

Forced ventilation solutions will only be considered where the following requirements are met:

- Forced ventilation shall operate only when power output requires additional cooling
- Forced ventilation failure rates are better/lower than failure rates of power sections
- Reduced power output is available with forced ventilation failure
- Physical arrangement is suitable for long term operation with failure of forced ventilation,
- Local and remote indication of forced ventilation failure is available.

7.3.17 Nameplate and labelling

All external and internal controls, indications, relays and terminals shall be clearly and adequately identified using Traffolyte or equivalent engraved labels (black lettering on a white background).

The battery charger shall be fitted with:

- A Nameplate showing at least the item number, date of manufacture, the manufacturer's name and reference number and serial number.
- A Rating plate showing at least the rated input voltage and frequency, nominal output voltage and rated output current.

The nameplate and rating plate shall be securely fixed to a non-removable portion of the battery charger. Markings and labelling shall be provided according to the battery chargers for stationary batteries Australian standard AS 4044.

7.3.18 Mechanical noise

The maximum noise level at 1.5 metres from the battery charger shall not exceed 55 dB(A).

7.4 DC Switchboard

DC switchboards shall be designed to the service conditions detailed in section 6. The DC switchboard shall be built to a type tested design.

In a multi-cubicle assembly, the main switchboard section shall conform to Form 3b segregation and the distribution section shall conform to Form 2bi segregation, according to the low voltage switchgear and control gear assemblies, Australian standard AS/NZS 61439.1.

The switchboard may be a 19 in rack mount type IEC 60297-3-100, or non-rack mount type free standing or wall mounted cabinet.

All switchgear for DC circuits shall have a minimum voltage rating of 125 V DC. All circuit breakers shall include thermally operated overload trips and instantaneous magnetic trips for short circuit protection. Disconnecting switches for the incoming DC supplies and circuit breakers from the battery charger shall include devices for locking in the open position. Blocking diodes shall not be used.

The electrical equipment installed in the switchboard shall be new equipment complying with relevant Australian Standards and be suitable for the duty as defined in this specification.

The equipment shall be installed so that it has the rating shown on the drawings when the switchboard is in its fully operational and fully loaded condition i.e. all covers and doors are closed, all circuits are at full load (as defined in this specification), and ambient temperature is at maximum as defined in this specification).

7.4.1 Indication and Metering

Metering shall not be provided on the front of the panel. Devices shall be installed for remote metering and indication via the EFL SCADA system.

All instruments shall meet Class Index 1 performance of the Electrical measuring transducers for converting A.C. and D.C. electrical quantities to analogue or digital signals IEC standard IEC 60688.

7.4.2 Construction

The DC switchboard shall have:

- A free standing steel frame panel, designed for mounting adjacent to a wall, meeting AS/NZS 61439.1, AS/NZS 61439.2, AS/NZS 61439.3, with front access. In either case it shall have an enclosure degree of protection rating AS 60529 of no less than IP51. Removable eye bolts suitable for slinging of the cabinet shall be provided on top of any cabinet with a mass in excess of 75kg.
- A fault withstand rating of 20 kA minimum for 1 second.
- Busbars and internal polarity conductors colour coded red, and black. All control wires shall be grey.
- A double pole isolation/protection device for incoming battery string, battery chargers; with a normally closed auxiliary contact wired back to a terminal block. The status of this contact will be monitored by the DC Management System (preferably with the chargers). Devices must be suitable for 70mm² cable.
- 2 x Anderson plug (SB175) and Anderson weatherproof boot (3-6036P1) shall be provided for connecting temporary chargers and batteries.
- Hall Effect current transformers and associated transducers for measuring DC system load current, battery string A current and provision for battery string B current.

Voltage transducer
3 x 4mm test posts

- Double pole breakers on all output circuits.
- A chassis suitable for clip in breakers in the distribution section.

- Access to the circuit breaker chassis by either a clipped on or hinged front escutcheon fabricated in sheet steel fitted with handles or pulls to allow for handling or opening the escutcheon. Access for wiring shall be from the front only for wall mounted panels.
- All exposed conductive parts bonded to an earth bar.
- Each circuit within the switchboard labelled.
- A circuit record card large enough for all circuits connected to the switchboard.
- Framing to house and protect the circuit card.
- All terminals accessible for installation and maintenance purposes.
- Adequate space provided in the cable connection zone(s) for bottom entry and termination of cables.
- Adequate space for metering, transducers, Hall effect CTs.

In respect of clauses 8.4.6.2.3 and 8.4.6.2.4 of AS/NZS 61439.1 the design of the distribution board shall be such that connection and disconnection of outgoing cables may be performed in relative safety by competent authorised persons, and consequently the distribution board shall incorporate protective measures as outlined in clause 8.4.6.2.4 of AS/NZS 61439.1.

7.4.3 Mounting and Enclosure

The distribution board shall be:

- free standing,
- suitable for mounting adjacent to a wall,
- fitted with access doors on the front,
- indications visible from the front,
- capable of fixing to the floor by bolting (M12 bolts preferable, Supplier to provide),.
- capable of front access to fastening locations,
- fastening locations within the footprint of the distribution boards.
- able to have any hinged door reversed to swing from the opposite side.

7.4.4 Maximum Temperature Rise

When operating at distribution panel board rated full load, the maximum temperature rise within the distribution panel board enclosure shall not exceed 15oC above outside ambient temperature.

7.4.5 Rated Impulse Withstand Voltage

The distribution panel board shall have a withstand voltage rating of 6kV.

7.4.6 Short Circuit Protection

The distribution panel board shall be rated for connection to a supply with a prospective fault level of \leq 10 kA.

7.4.7 Protection of persons against electric shock

The means of providing protection against electric shock including the integration of the ASSEMBLY into the installation are given in IEC 60364-4-41.

The following methods shall be used for protection against contact with live parts are integral to the protection of persons against electric shock; these are described in terms of:

- basic protection (protection against direct contact);
- fault protection (protection against indirect contact).

7.4.7.1 Basic protection (protection against direct contact)

Basic protection shall be achieved by the following constructional measures within the ASSEMBLY with the inclusion of switchboards being installed in locations where access is only permitted for authorized personnel.

7.4.7.2 Basic insulation provided by insulating material

Hazardous live parts shall be completely covered with insulation that can only be removed by destruction. The insulation is required to be made of suitable materials capable of withstanding the mechanical, electrical and thermal stresses to which the insulation may be subjected in normal service.

7.4.7.3 Barriers or enclosures

Air insulated live parts shall be inside enclosures or behind barriers providing at least a degree of protection of IP 2X. Horizontal top surfaces of accessible enclosures having a height equal to or lower than 1.6 m above the standing area, will provide a degree of protection of at least IP 4X.

The manufacturer shall construct the ASSEMBLY so as to enable it to be opened or barriers be removed for maintenance with either:

- a. a key or tool is required to open the door, remove the cover or override an interlock;
- b. an intermediate barrier providing a degree of protection at least IP 2X prevents contact with live parts, the removal of the barrier requiring the use of a key or tool.

7.4.7.4 Fault protection (protection against indirect contact)

Fault protection is intended to protect against the consequences of a fault within the ASSEMBLY and those of a fault within an external circuit supplied through the ASSEMBLY. The ASSEMBLY will normally include protective measures and be suitable for installation in a network designed to be in accordance with IEC 60364-4-41.

7.4.7.5 Faults within the ASSEMBLY

For an adequate protective circuit all exposed conductive parts of the ASSEMBLY will be interconnected together, noting the following:

- a. when a part of the ASSEMBLY is removed, the protective circuits (earth continuity) for the remainder of the ASSEMBLY should not be interrupted;
- b. for lids, doors, cover plates and the like, the usual metal screwed connections and metal hinges are considered sufficient to ensure continuity provided that no electrical equipment exceeding the limits of extra low voltage is attached to them.
- c. If apparatus with a voltage exceeding the limits of extra-low voltage are attached to lids, doors, or cover plates; a protective conductor (PE) or an equivalent electrical connection especially designed and verified for this purpose shall be used.
- d. Exposed conductive parts of a device that cannot be connected to the protective circuit by the fixing means of the device will be connected to the protective circuit of the ASSEMBLY by a conductor of adequate cross-sectional area.
- e. Minor exposed conductive parts (not exceeding 50 mm x 50 mm) of an ASSEMBLY that do not constitute a danger need not be connected to a protective conductor. This applies to screws, rivets, nameplates, parts of small devices, and similar.
- f. Connection of an exposed conductive part to the incoming protective circuit is considered sufficient if the resistance of this connection is less than 0.1Ω.

7.4.7.6 Faults in external circuits supplied through the ASSEMBLY

The Contractor shall provide a protective circuit within the ASSEMBLY capable of withstanding the highest thermal and dynamic stresses that may occur at the place of installation of the ASSEMBLY, for faults in external circuits supplied through the ASSEMBLY. The protective circuit provided may be the ASSEMBLY'S enclosure or frame and/or a separate conductor. The protective conductors within an ASSEMBLY will not include a disconnecting device such as switches or disconnectors.

7.4.7.7 Protection by total insulation

Protection by total insulation shall be used to provide adequate protection against electric shock. The construction of ASSEMBLIES that are protected by total insulation shall include specific features so that adequate protection against electric shock is provided under all anticipated operating conditions. These features shall include:

- a. Completely enclosing all apparatus in insulating material that is equivalent of double or reinforced insulation and marked accordingly.
- b. No conducting parts pierce the enclosure and no point should be pierced by conducting parts in such a manner that there is the possibility of a fault voltage being brought out of the enclosure. This requirement includes metal parts such as actuator shafts unless they are suitably insulated.
- c. Arrangements such that when the ASSEMBLY is ready for operation and connected to the supply, all live parts, exposed conductive parts and parts belonging to a protective circuit will be enclosed to at least IP 2X so that they cannot be touched.
- d. Exposed conductive parts within the ASSEMBLY shall not be connected to the protective circuit.
- e. Where doors or covers of the enclosure can be opened without the use of a key or tool, a secondary barrier, made from insulating material, shall be provided behind the door or cover. This shall provide protection against unintentional contact with the accessible live parts and with the exposed conductive parts that would otherwise become accessible, after the door or cover has been opened.

7.5 Miniature Circuit Breakers

Miniature Circuit-Breakers shall be in accordance with all relevant parts of AS/NZS 60898.1 or AS/NZS 60898.2 Circuit-breakers for a.c. and/or d.c. operation or AS/NZS 60947.2.

Miniature Circuit-Breakers shall have been type tested in accordance with AS/NZS 60898.1 or AS/NZS 60898.2 or AS/NZS 60947.2 in order to verify all performance values quoted and type test certificates shall be available to verify such testing.

MCBs are to be of the current limiting type with both magnetic and thermal over-current releases.

MCBs compliant with AS/NZS 60898.1:2004 shall be calibrated at 30°C, with a working ambient temperature range between -25°C and +55°C.

MCBs shall be suitable for cascade protection in accordance with the manufacturer's approved selection charts.

Standard MCBs shall be available with appropriate sizes and operating characteristics for ratings.

Standard MCBs shall be available in single, double, triple pole variants.

Standard MCBs should be manufactured to a nominal modular width of 18mm to DIN dimensions.

All devices should be indelibly marked in accordance with the marking requirements of the relevant standards.

7.5.1 MCB Mechanisms

- a. MCB mechanisms are required to be trip free to prevent the MCBs being held in the 'ON' position.
- b. A fool proof Positive Contact Indicator, which can be viewed under a window on the front of the MCB, is required to provide assurance of the isolation function.
- c. Toggle can be sealed in ON or OFF position.
- d. Toggle can be padlocked OFF with use of an optional accessory.
- e. MCBs shall have a red coloured ON indication toggle marker when in the ON position
- f. MCBs shall have a green coloured OFF indication toggle marker when in the OFF position
- g. Mechanical endurance shall be a minimum of 20,000 operations.

7.5.2 Cable Terminals

- a. MCB cable terminals should consist of box type clamps to provide a secure method of termination for cables from 1mm² up to and including 25mm².
- b. Termination screws should be IP2X protected against finger contact.

7.6 Cables

7.6.1 Cable Colour Coding

As required by AS/NZS61439.1 all conductors shall be identified by either colour coding or symbols.

- a. If identification of conductors is to be by colour coding, the colour coding system used throughout the whole switchboard shall preferably be in accordance with the following colour coding system:
 - i. Red Phase Red
 - ii. White Phase White
 - iii. Blue Phase Blue (Bright Blue to AS2700)
 - iv. A.C. Neutral Black
 - v. Earth Green/Yellow
- b. Where a special proprietary cable having a non-conforming colour coding system is required to be used, cable terminations shall be fitted with coloured sleeving in accordance with the above colour coding system.

7.6.2 Power Interconnecting Cables

- c. Power cables and flexible insulated busbars interconnecting switchgear mounted within the switchboard shall be at least insulated single core copper conductor type with thermoplastic, elastomer, or XLPE insulation having a voltage rating of not less than 0.6/1 kV.
- d. All such cables and flexible insulated busbars shall have a site current rating not less than the onsite current rating of the equipment to which these cables are connected.
- e. At rated current, the temperature of the above conductors and the associated switchgear terminals shall not exceed the normal use operating temperature of the associated insulation, or the permissible maximum operating temperature of the associated switchgear terminals, whichever is the least.
- f. Regardless of length, all such power cables shall have short circuit ratings not less than the energy let through (I₂t) of the line side short circuit protective device.

7.6.3 Marking and Identification of Small Conductors and Auxiliary Terminals

- a. All conductors and terminals shall be marked and permanently identified by the use of ferrules at both ends.
- b. The wire marker shall be the same on both end of a wire except where suffixes are used then the suffixes can be different.
- c. The numbering scheme shall be in accordance with AS 2067 Appendix E.
- d. Wire markers shall be printed; hand written wire markers shall not be accepted.
- e. The ferrule shall be made from Grafoplast System or approved equivalent that is non-deteriorating and is capable of being renumbered without removal of the ferrule.
- f. The ferrule shall be of the correct size for the conductor.
- g. Conductor identification system shall consist of plastic sleeves with pre-printed alpha/numeric element inserts. Plastic sleeves shall fully encircle the conductor. Clip-on wire marks shall not be accepted. Locate the plastic sleeves within 15mm of the wire or cable termination.
- h. The wire numbers shall be fully legible and fitted such that they may all be read from one direction only in each group of wiring, normally-left to-right for horizontal connections and bottom-to-top for vertical connections.
- i. The alpha/numeric element inserts shall largely be white with black figuring.

7.6.4 Protection of Cable Insulation

Further to the requirements of AS3000, wherever practical, appropriate grommets or glands shall be used to protect cable insulation where such cables pass through holes in panels or cubicles. Such devices shall be selected so as not to reduce the required IP rating of the cubicle.

7.6.5 Support of Electrical Equipment Cubicle Wiring

- a. Electrical equipment cubicle wiring shall be neatly grouped and harnessed or, where practical enclosed in PVC duct.
- b. Wiring shall be straight and run parallel when in cable duct. A minimum clearance of 50 mm shall be maintained between terminals and associated cable duct. When not run in cable duct, spiral band lacing and/or cable ties shall be used to form the looms. Looms shall be installed square with the cubicle and frequently supported.
- c. Duct shall be arranged to allow wiring passing through the slots to be taken as directly to the terminals as possible
- d. Duct fixings shall not have sharp projections inside the duct which could damage cable insulation.
- e. Wiring, wiring looms and cable duct shall be arranged so that, as far as is practical, equipment labels and/or terminal markings are not obscured.
- f. The weight of wiring looms shall not cause any undue strain on the conductor strands or insulation.
- g. Cable looms connecting hinged panels shall be supported either side of the hinge, and the loom arranged between such supports in a generous loop so as to prevent cable strain when the hinged panel is moved.

7.6.6 Cable Screening and Segregation

To the extent that is practical, signal cables including electronic instrumentation analogue signal cables and RTU and alarm/indication cables and optical fibres shall be loomed and terminated separately from mains voltage cables.

7.7 Busbars

7.7.1 Arrangement of Cable Main Connections to Equipment

Unless agreed otherwise, equipment cable main connections which are substantially in one plane, shall be arranged in the order Red-Black as follows:

- a. When the run of terminals is vertical, Red shall be top.
- b. When the run of terminals is horizontal, Red shall be left or farthest away as viewed from the front of the particular item of equipment to which connection is being made.

7.7.2 Arrangement of Busbars

Unless agreed otherwise, busbars which are substantially in one plane shall be arranged in the order Red-Black as follows:

- a. When the run of busbars is horizontal, Red shall be top, or to the left, or farthest away as viewed from the front of the electrical equipment cubicle.
- b. When the run of busbars is vertical, the Red shall be left or farthest away as viewed from the front of the switchboard cubicle.
- c. When the neutral busbar is in the same plane as the phase busbars, the neutral shall occupy an outer position, and shall be readily distinguishable from phase busbars.

7.7.3 Continuous Current Rating of Busbars

- a. Busbars shall be sized such that the busbar on site maximum operating temperature does not exceed whichever is the least of the following:
 - i) 90 deg C for bare copper conductors,
 - ii) 105 deg C for tin or silve- plated copper conductors,

- iii) the maximum temperature rating of the cables or equipment connected to the busbars.
- b. The continuous rating of the main busbars shall be not less than the maximum continuous rating of the incoming circuit breaker(s) or main fuses.
- c. All busbar droppers shall be rated to withstand without damage the short time withstand current specified for the whole switchboard.
- d. Busbar droppers to major outgoing circuits shall have a rating not less than 120% rating of the outgoing circuit.

7.8 Secondary Terminations

- a. All secondary panel terminations shall meet IP2X "finger-safe" requirements in accordance with AS 60529.
- b. At all times the Supplier/Contractor shall adhere to the manufacturer's link or terminal requirements for wiring terminations. The maximum conductor size specified by a link or terminal manufacturer shall not be exceeded. Should the design require that a larger wire size be used than what the manufacturer specifies for that terminal or link, then the Supplier shall discuss these with EFL.
- c. A maximum of two wires only is permitted for a tunnel type (screw-type) link and terminal
- d. When more than two wires need to be terminated to the same point, additional terminals (with the same terminal number) shall be added next to and bridged to the original designed terminals.
- e. Seven strand field cables shall be terminated with no crimping lugs with one exception: high current AC and DC supply wires terminated to switchgear (breakers, etc.) where the switch gear manufacturer requires a particular type of lug.
- f. The IP2x integrity of any termination shall not be compromised by the bootlace or lug.
- g. Upon request, the Manufacturer shall demonstrate to EFL, if alternatives are proposed, that good quality lugs: suitable lug types and correct crimping tools and methods are used for all terminations.
- h. Mid-run cable connections or straight-through cable joints shall not be used.
- i. Terminal bridging shall be done with matching top insertion bridges
- j. Screw terminals bridging shall be done with top screw bridges and all adjacent terminals are bridged.
- k. Comb-style rigid bridges fitted on the terminal side sharing the connection point with wires shall not be used.

7.8.1 Small Terminals and Terminal Assemblies

- a. All items, which EFL must connect to remote equipment, shall be wired to terminal blocks conveniently located for connection by means of multi-core control cables. These items include:
 - i. All current transformer secondary connections
 - ii. All voltage transformer secondary connections
 - iii. All controls and indications and
 - iv. All alarm connections
- b. Terminal blocks shall where possible be of the tunnel type and capable of accepting up to 6 mm² control cable cores.
- c. Where the nominal voltage of any circuit exceeds 50 V ac or 120 V dc, the wiring shall be segregated from other wiring and all related terminals shall be shrouded.
- d. Terminal types will be Weidmuller Type SAKC10 (CT & potential wiring terminals) and Weidmuller Type SAK6N or equivalent for all other terminals.
- e. The connections for purposes of remote status indication or alarms shall be terminated using isolating link (Phoenix PT 2.5-MT or equivalent).
- f. Where stud type terminals are used on any item suitable spring washers must be fitted.

- g. Non-bused external connections shall be made at a multicore cable connection block, which is distinguishable from the LV compartment terminals. A minimum clearance of 100 mm at the terminals shall be provided for external connections.
- h. Where equipment is mounted on the hinged panel, all rear terminals of active parts shall be effectively shrouded by transparent safety covers.
- i. All terminals shall be grouped into clearly labelled assemblies, and arranged left to right or top to bottom within these assemblies as per their numerical order. Terminal number markers shall be placed on the terminal so as to be visible.
- j. All terminal assemblies shall be separated by Weidmuller type SCHAT5 2924.6 rail mounted group marking carriers or equivalent. Each assembly shall consist of a minimum of two (2) rail mounted group marking carriers, the first shall designate the assembly number (A110, A120, etc.), and the second shall provide a brief functional description of the terminals. All groups of terminals shall be labelled. The numbering sequence used shall start at A100. Subsequent terminals assemblies shall be incremented in lots of ten (10) to allow additional terminals assemblies to be inserted at a later date.
- k. Terminals assemblies for separate functions i.e. CT wiring, CB control, shall be arranged in a physically separate groups and from other terminals by Phoenix TS-K Separating barriers or equivalent
- l. All assemblies for external cable connection shall be readily accessible at panel. Assemblies sharing a common mounting rail shall be isolated from each other, either by barriers (Phoenix E/UK or equivalent) or by rail mounted group markers. All terminal assemblies shall have at least one end plate.
- m. When a terminal assembly changes due to a change in type of terminal an end or partition plate shall be used to separate each type of terminal.
- n. End clamps shall be placed at the beginning and the end of a terminal assembly.
- o. Terminals shall be grouped into logical multiples of 5. i.e. do not install 12 terminals in an assembly, round this up to 15. The exceptions to this shall be CT, VT terminals and Bus Wiring Terminals.
- p. Spare terminals shall be shown on the schematic diagrams.

7.9 Earthing

7.9.1 Main Power Earth Bar

- a. The Switchboard shall be provided with a suitably rated earth bar. Tenderers shall provide details of this in their bid.
- b. The earth bar will be connected to the installation main earthing system by EFL or its Contractors, so it must have provision for it to be done on site.
- c. All cables connecting to the main earth bar shall be labelled according to their function.
- d. The earth bar should be located to allow easy access for cables leaving the switchroom or equipment, and be adequately sized for the prospective fault current and the number of connections required.

7.9.2 Metalwork Earth Bonding

- a. All mounting panels within cubicles, including cubicle doors shall be bonded electrically to the cubicle frames and hence to the cubicle protective earth bar.
- b. Within cubicles containing electronic signalling or measuring equipment, such bonding shall be achieved by:
 - i. welded connections
 - ii. bare aluminium to bare aluminium bolted connections
 - iii. bare zinc plated steel to bare zinc plated steel bolted connection
 - iv. bare stainless steel to bare stainless steel bolted connections, or
 - v. braided conductor bonded connections.

- c. The resistance between the cubicle frame or any mounting panel and the cubicle protective earth bar shall be not more than 0.2 ohm.

7.10 Mechanical Construction

7.10.1 Fixings and Supports

All fixings and support necessary to support or hold equipment in place shall be supplied.

7.10.2 Miscellaneous Fittings

- a. All threaded components, including metal threads, screws and bolts used throughout the electrical equipment cubicle shall be stainless steel; or non-ferrous metal; or nickel chromium electroplated steel to AS1192; or zinc electroplated steel to AS1897 and AS1791.
- b. All saddles, clamps and miscellaneous fastenings shall be non-ferrous metal, stainless steel, zinc plated steel, nylon or P.V.C. Adhesive fixings shall not be used.

7.10.3 Silicone Based Components

- a. Unless specified otherwise on the drawings, greases, jellies and/or sealing compounds which include silicone based compounds shall not be used inside switchboard enclosures.

7.10.4 Lifting and Transport Facilities

- a. Clearly marked (with a permanent label or stencil), fully rated lifting and hold down points will be provided on the LV Board to facilitate the hoisting and holding down during transport.
- b. Two lifting lugs marked "LV Board Lifting Point" with a minimum hole diameter of 26 mm will be provided suitable for lifting the LV Board. These lugs will arranged so that any slings attached do not foul any part of the LV Board and when suspended by them, the LV Board will hang without tilting.
- c. All parts of the LV Board weighing in excess of 15 kg that will be removed for inspection or repair will be fitted with lifting points suitable for use with shackles and slings.
- d. Clear and legible Safe Working Load (SWL) markings should be provided on all lifting points.

7.10.5 Earthing Points when installed within Outdoor Cubicle

- a. An earthing point (flag) shall be provided near the bottom of the cubicle. The earthing point shall comprise a flat surface not less than 50 x 100 mm drilled with two 14 mm diameter holes on 50 mm centres. The surface shall be arranged to facilitate an effective and non-corrodible earthing connection. There shall be ample access to both sides of the earthing point for the insertion of bolts and nuts for connection to the earth grid. The earthing point shall be marked with the "earth" symbol or stamped 'earth'.
- b. Additional earth flags will be provided where necessary to permit the earthing of the steel base (where fitted).

7.11 Finish and painting

All surfaces of Assemblies shall be finished with an appropriate coating system which will provide the necessary protection against corrosion, with minimal maintenance, for the design life of the cabinet. All surface preparation and protective coating shall be done in the manufacturer's works. The only work in this regard after delivery would be reinstatement of any coating damage sustained in transport or work on site.

If any part of the installation requires galvanising, this shall be in accordance with the hot-dipped galvanised coatings on ferrous articles Australian standard (AS/NZS 4680, 2017).

Any painting of metallic surfaces shall be in accordance with the following procedure:

- a. After fabrication of each section of equipment is completed, and before any paint is applied, the surface of the parts to be painted shall be thoroughly cleaned of all rust, oil, grease, dirt or other foreign matter.
- b. The painting shall consist of at least one primary coat, one undercoat and one finishing coat each continuously and evenly applied. The three coats of paint shall be of different colours with the external finishing coat being gloss enamel.
- c. Alternatively the surfaces may be powder coated to a minimum thickness of 75 micron.

The final external preferred colour is "N42 - STORM GREY" according to the general purpose colours Australian standard (AS 2700, 2011). However, if a more cost-effective colour exists, Suppliers/Tenderers can propose.

All paint shall be non-corrosive, heat and oil resistant. It shall be made by a reputable paint manufacturer and shall be applied in accordance with the manufacturer's recommendations.

7.11.1 Paint Coatings for Steel

The paint system to be used for steel shall be:

- a. All surface visible rust, scale and other foreign matter shall be removed completely in accordance with AS1627 so that the surface is suitable for the application of a gloss finish. All cleaning solutions shall be removed completely by thorough rinsing.
- b. Immediately prior to priming, all surfaces shall be solvent wiped to remove any handling grime.
- c. A gloss paint system providing medium term protection in accordance with AS2312 (industrial and marine) environments shall be applied.
- d. All paint used in the paint system shall be from the same manufacturer who shall certify their compatibility

7.11.2 Powder Coatings for Steel

- a. Powder coatings shall not be used on bare steel.
- b. Powder coatings shall not be used on zinc (or zinc alloy) coated steel on which the coating has been damaged by welding or any other means.
- c. Powder coatings shall be applied to zinc (or zinc alloy) coated steel and shall be gloss thermoset powder coating in accordance with AS/NZS 4506 Cat 5 employing a chromate or zinc phosphate pre-treatment and resulting in a powder coating DFT of not less than 60microns.

7.11.3 Cubicle Metals

All stainless steel and aluminium sheet used in the construction of switchboard cubicles and panels shall be marine grade. Aluminium sheet thickness shall be not less than 3mm. Steel and stainless steel sheet thickness shall be not less than 2mm for doors, hinged panels and equipment mounting panels, and shall not be less than 1.2mm elsewhere.

7.11.4 Adjacent Dissimilar Metals

Where dissimilar metals are positioned adjacent to one another, bimetallic corrosion shall be prevented by the use of metallic plating or by other approved methods. Screws and bolts penetrating external aluminium surfaces shall be stainless steel, as shall be any associated nuts and any associated external or internal washers. Screws, bolts and washers in contact with internal aluminium surfaces shall be stainless steel or shall be nickel, chromium or passivated zinc plated steel.

7.11.5 Additional Supports

Sufficient bracing shall be provided to doors and panels to ensure that the equipment mounted thereon is supported properly. Where doors and panels are weakened by drilling or cutting during construction of the switchboard, such sections shall be reinforced by additional bracing.

7.11.6 Welding

All butt joints shall be fully seal welded and all such welds shall be ground flush and smoothed.

7.11.7 Corrosion

Clause 8.1.2 of AS/NZS 61439.1 is applicable with the following additions.

- a. All internal and external surface treatments shall provide a minimum of 35 years protection against corrosion induced by service and environmental conditions specified above.
- b. Coatings shall be oil resistant, heat resistant and non-corrosive.

7.12 Labelling

7.12.1 General

Bidders shall provide comprehensive details for panel and device labelling including label positions, label size, label text and label materials.

The following are some general requirements unless otherwise specified:

- a. The labels shall be engraved on laminated plastic sheets (Gravoply or equivalent).
- b. The label text shall be black on white background for general purposes and white on red background for warning labels.
- c. The label sizes and text sizes shall follow the drawing specification, otherwise shall be appropriate to the particular application, taking into account the text content (abbreviations are only permitted after EFL acceptance).
- d. Labels should be fastened to surfaces using screws. If this is not possible then labels maybe adhered to the surface with "Scotch" brand 4032 doubled sided tape or approved equivalent. On certain surfaces such as Perspex covers, additional reinforcing plastic rivets may be used to ensure the security of label fitting.

Additional warning labels shall be fitted according to relevant Australian standards. The labels shall include Danger and Warning labels to AS 1319.

The Tenderer shall provide a copy of engraved label set up files for each panel to EFL on delivery for future label replacement and modification.

The switchboard nameplate shall include the information as detailed in Section 6 of IEC 61439.1 with the following additions:

- a. Space for the EFL's identifier number (up to seven digits).
- b. This Contract number.
- c. Any agreed upon information from Sect 5 of IEC 61439.1.
- d. Any special service conditions per Sect 7.2 of IEC 61439.1 to be nominated.

Each item of equipment, including terminals and terminal rails, shall be clearly labelled. The inscription on the label shall correspond with the designation given on the drawings. Colours shall be permanent and free from fading. Unless otherwise approved all designation labels shall be engraved with black lettering on a white background. "Warning" labels shall have black lettering and a yellow background. The minimum lettering height shall be 3mm. Rating plates shall be fitted to each item of equipment and shall provide the information specified in the relevant standard to which the item of equipment has been manufactured.

7.12.2 Isolation Labelling

Labelling shall be fitted to the switchboard which describes clearly the safe isolation procedures for the main circuit sections of the switchboard and explains all of the interlocking involved.

7.12.3 Control Circuit Labelling

The control power feeds into each switchboard compartment shall be labelled with a warning label at the control power feeder isolating devices within the compartment.

8 ELECTROMAGNETIC IMMUNITY AND ELECTROMAGNETIC EMISSIONS

EFL's fundamental requirement with respect to electromagnetic compatibility is for the equipment to:

- i) Comply with the mandated standards (refer to legislation)
- ii) be sufficiently robust with respect to interference and not generate interference at levels that interfere with other local equipment

Target (preferred) compliance is to AS IEC 61000.6.5:2017 Generic standards—Immunity for equipment used in power station and substation. The minimum acceptable level for EMC compliance is the generic industrial immunity and emissions standards.

Tenderer's shall explicitly and individually identify any equipment ports excluded from immunity or emissions testing (e.g. signal ports where cable length is constrained to less than the length at which the tests are required, or signal ports normally covered).

Tenderer's shall explicitly identify any measures required for installations (such as cable shielding termination constraints) that are required to achieve compliance of the product for either immunity or emissions using the products offered. Electromagnetic Immunity

While there is currently no legislative requirement for electromagnetic immunity within Fiji, it is still a key consideration for suitability of equipment.

Any port (as defined under AS IEC 61000.6.5) that has been excluded from type testing based on manufacturer's functional specification of total cable length or on any other basis shall each be explicitly, individually identified in the Tenderer's offer with the rationale for the exclusion.

As mandated by legislation, all equipment supplied shall not have emissions greater than permitted by the applicable mandatory emission standard identified by the ACMA for the product.

Notwithstanding the above, the equipment supplied shall not have emissions greater than permitted by: AS/NZS 61000.6.4 Electromagnetic compatibility (EMC) – Part 6.4: Generic standards – Emission standard for industrial environments, (noting that in line with ACMA mandated standards, compliance with the Harmonics and Flicker emission limits is not required).

9 TESTING AND INSPECTIONS

9.1 Testing Requirements

Prior to delivery, the DC system shall have completed the type, routine and accuracy tests and inspections as required by the relevant Australian standards. The passing of such tests shall not prejudice the right of EFL to reject the Equipment if it does not comply with the Specification when received or installed.

All testing shall be undertaken by an IEC 17025 accredited test house. The Tenderer shall submit evidence showing IEC 17025 compliance. A formal report covering the outcome of the different tests shall be made available to EFL.

The Tenderer shall submit a copy of Inspection and Test Plan (ITP) for the Equipment with its Bid.

9.2 AS/NZS 61439 Design Verification

Design verification of the switchboard design in respect to short circuit strength of the protective circuit in the main incoming circuit breaker cubicle, the main busbar chamber, the distribution busbar chamber and in outgoing units with short circuit protective devices having an I_{2t} let through of greater than 6*10⁶ amp² sec. shall be by testing in accordance with AS/NZS 61439.1 Clause 10.11.5, or by comparison

with a reference design in accordance with AS/NZS 61439.1 Clause 10.11.4 utilising the check list specified in AS/NZS 61439.1 Table 13.

Similarly design verification of the switchboard design in respect to short circuit strength of the three phase circuit in the main incoming circuit breaker cubicle, the main busbar chamber, the distribution busbar chamber and in outgoing units with short circuit protective devices having an I_{2t} let through of greater than 6*106 amp² sec. shall be by testing in accordance with AS/NZS 61439.1 Clause 10.11.5, or by comparison with a reference design in accordance with AS/NZS 61439.1 Clause 10.11.4 utilising the check list specified in AS/NZS 61439.1 Table 13.

Design verification shall not be required of the short circuit strength of the protective circuit and the three phase circuit in outgoing units with short circuit protective devices having an I_{2t} let through less than 3*105 amp²sec.

Except as above, the design verification of the project switchboard design in respect to the requirements of AS/NZS 61439 may be by testing, or may be by comparison with a reference design provided that the project switchboard enclosure(s) are the same as used in the reference switchboard design.

9.3 Type Tests

Type test certificates shall be supplied with the submitted documents showing that equipment identical in all respects with the plant being offered has successfully passed all the type tests set out in the standards for each type of plant and equipment referred to in this specification. Any equipment which undergoes any design or constructional modifications shall be type tested again or tested to the satisfaction of EFL.

Suppliers that offer the plant and equipment referred to in this specification, which have not been type-tested in accordance with relevant standards may not be considered.

9.3.1 Batteries

Type Tests required, in accordance with the valve regulated lead acid battery Australian standard AS/NZS 4029.2, include:

- Capacity test
- Suitability for floating battery operation test
- Endurance in cycles test
- Charge retention test
- Short-circuit current and internal resistance test
- Seal integrity test
- Gas emission test – float charge conditions
- Gas emission test – overcharge float conditions

9.3.2 Battery Charger

Type Tests required, in accordance with the battery charger Australian standard AS 4044, include:

- Thermal rating test
- Audible noise test
- Efficiency at 30% 80% and 100% of specified rating test
- Ripple voltage test at 30% of specified rating and 100% of rated output test
- Power factor with distorted current waveforms test
- Supply current harmonic content at 0%, 30%, 80% and 100% of specified rating and 100% of rated output test

9.3.3 Distribution Board

Type tests required, in accordance with the low voltage switchgear and control gear assemblies Australian standard AS/NZS 61439.1, include:

- Verification of temperature-rise limits
- Verification of dielectric properties
- Verification of short-circuit withstand strength
- Verification of effectiveness of the protective circuit
- Verification of clearances and creepage distances
- Verification of mechanical operation
- Verification of degree of protection and internal separation
- Verification of increased security against the effects of internal arcing

9.4 Routine Tests

All materials, components and items of auxiliary equipment shall be subjected, during the course of manufacture, to all the tests prescribed in the relevant Australian or IEC Standards in that order. All tests considered necessary by either the Manufacturer or Customer shall be performed to prove compliance with the performance figures stated in this Specification and associated Schedules.

9.4.1 Batteries

The supplier shall test the battery for rated capacity at the 3-hour rate according to clause 5.1 of the valve regulated lead acid battery Australian standard AS/NZS 4029.2. The supplier shall supply routine test certificates of results obtained, including those obtained during the pre-cycling process for each cycle, thus showing that the requirements of clause 5.1.10 of the valve regulated lead acid battery Australian standard AS/NZS 4029.2, have been satisfied.

9.4.2 Battery Charger

Routine Tests required, in accordance with the battery charger Australian standard AS 4044, include:

- Software Version
- Alarm function and operation (front panel LED and menu, output contacts and remote interrogation) test
- Instrument accuracies (transducers and displayed values) test
- DC output characteristics test
- Voltage adjustment test
- Temperature compensated voltage characteristics test
- Overvoltage shutdown test
- Load voltage regulation test
- Line voltage regulation test
- Output power limit test
- Short-circuit current limit
- Power factor measurement 30% and 100% of specified rating test
- Start-up test
- Alternating current power restoration test
- Dynamic response test
- Insulation resistance test

9.4.3 Distribution Board

Routine tests shall be undertaken according to the low voltage switchgear and control gear assemblies Australian standard to AS/NZS 61439.1, include:

- Inspection of the assembly including inspection of wiring and, if necessary, electrical operation test
- Dielectric test
- Checking of protective measures and of the electrical continuity of the protective circuit
- Point to point wiring checks and earth continuity tests

9.5 Test Certificates

Upon completion of any test, the Supplier shall provide the certified test reports detailing the testing methods, instruments used, results and engineers responsible, to EFL. If the results of any Test Certificates are found to be incorrect or incomplete, EFL may reject the plant or equipment.

The plant or equipment shall be considered as substantially incomplete and payment shall not be made until all test certificates have been received.

9.6 Final Inspection Report

Final inspection reports shall be supplied prior to delivery showing plant is suitable for transport and that all associated manuals and test reports are included.

9.7 Tests after Delivery

On completion of the installation and before the plant has been put into use (pre-commissioned), EFL may carry out compliance tests considered necessary to prove that the plant and equipment fulfils the requirements of this specification. The Supplier shall provide list of recommended tests that need to be done on site prior to putting the equipment into service. The Supplier shall also ensure that its staff are available to provide any kind of technical support during this period.

10 TOOLS, SPARES AND ACCESSORIES

Tenderers shall submit a document detailing the price of spare parts and any accessories considered necessary for the lifecycle management of the items. The nominated manufacturers shall guarantee the supply of spare parts for a minimum of 10 years after expiry of the contract.

Tenderers shall submit a document detailing the price of any special tools, gauges and jigs considered necessary for the appropriate installation, commissioning and maintenance of the items.

11 SERVICE HISTORY

Tenderers shall state:

- The period of service of typical items tendered within the Fijian environmental conditions.
- Australian or New Zealand electricity authorities that have a service history of the plant and equipment offered.

No item of plant shall be despatched from the Supplier's works until the Test Certificates have been approved by EFL. Contact names and telephone numbers of relevant employees of those supply authorities who can verify the service performance claimed.

12 PROGRAMME AND PROGRESS OF WORK

The Tenderer shall provide a work program with its bid in the format as given in the Schedules of this specification. Within seven days of the receipt of the official EFL purchase order, the Tenderer shall submit a confirmed programme of work for the entire project upto the delivery. The programme is to conform to the timelines as stipulated in this tender.

The Tenderer shall also be required to submit monthly reports on the status of various activities. Such reports shall be submitted within five (5) calendar days of start of the month.

13 QUALITY REQUIREMENTS

Tenderers shall have a Quality Management System that complies with ISO/AS/NZS 9001, and shall submit evidence of certification.

If the Tenderer is not the manufacturer of the items, documentary evidence shall include the quality system certifications of both the Tenderer and the manufacturer. If this is not possible the Tenderer shall submit a Quality statement detailing how the Quality of products is achieved and maintained over the lifecycle of the plant and equipment.

Once accepted, any deviations shall not be implemented without submission of relevant Quality Assurance documentation and re-qualification test certificates that are acceptable to the Customer and approved in writing by the Customer prior to delivery of goods.

Tenderers shall be required to submit copies of ISO certification of the workshops or laboratories where the Equipment will be assembled and tested.

14 OCCUPATIONAL HEALTH AND SAFETY SYSTEMS

Tenders shall have Occupational Health and Safety Certification as per ISO 45001 or equivalent national certification.

All work shall be undertaken in workshops which have an Occupational Health and Safety certification issued by the local regulatory authority or Ministry of Labour. Tenderers shall be required to provide a copy of this certificate.

Tenderers also need to submit health and safety plans implemented in workshops for assembling and testing protection and control panels, which will be used in this project.

15 TRAINING

Training material in the form of detailed instructions, drawings, and/or audio visuals shall be provided for the items offered to be accepted.

This material shall include but is not limited to the following topics:

1. Handling.
2. Storage.
3. Application (particularly in areas of heavy coastal pollution).
4. Installation and commissioning
5. Maintenance.
6. Environmental performance.
7. Electrical performance.
8. Mechanical performance.
9. Disposal.

Preference is given to computer or web-based training for initial individual training or as a refresher. A minimal assessment after the training with reporting is recommended as evidence of a successful

learning outcome. Web based training for each device should be produced in SCORM package format for use in the Customers online training material.

16 PACKAGING

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.

Should any timber packaging be supplied from overseas manufacturers, then it shall meet all conditions and inspections required by the Biosecurity Authority of Fiji and that all these costs are included in the tendered price.

All plant and equipment shall be at the Supplier's risk until received at the agreed delivery point; any damage in transit shall be the responsibility of the Contractor to replace or repair and prove fit for service.

Each item shall be individually packaged and delivered with fittings, hardware and associated manuals and test reports.

All bright and polished parts and screw threads shall be treated with petroleum jelly or other suitable rust preventative.

The Contractor shall mark all cases of plant which cannot be safely stored outside with the words "FOR INSIDE STORAGE ONLY".

17 DELIVERABLES

17.1 Information to be provided by Tenderer with offer

The Supplier shall provide the following with the offer:

1. Full details of items offered including pricing.
2. Confirm compliance with Legislation, Acts, Regulations, Rules and Codes of Practice.
3. Confirm compliance with the applicable Australian, IEC and IEEE standards.
4. Confirm compliance with all requirements of this Specification.
5. Provide all schedules fully completed.
6. Provide Quality Assurance certification, documentation and evidence.
7. Provide Reliability and Availability details and calculations.
8. Provide all risk assessments and safety documentation.
9. Provide electronic Manuals (PDFs) for all plant and equipment offered
10. Provide electronic copies (PDFs) of Type Test Certificates, examples of Routine Test Reports and examples of Final Inspection Reports
11. Provide electronic copies (PDFs) of drawings of plant and equipment

17.2 Information to be provided by Tenderer

Within two weeks from the date of issue of purchase order, the Supplier shall provide a comprehensive detailed program indicating timing for all activities required to establish the contract and enable sustained agreed performance.

Within six weeks from the date of issue of purchase order, the Supplier shall provide the design reports, drawings and material datasheets. EFL will review drawings and or documentation supplied complies with this Technical Specification in relation to how the plant and equipment meets design, construction, operation, maintenance and other requirements for the operational life of the plant and equipment.

Alterations and or modifications may be requested to meet these requirements. The Supplier shall remain responsible for the safety and reliability aspects of the plant or equipment supplied.

Initial copies of drawings submitted for approval purposes may be supplied in PDF format. Drawings that shall be provided by the Supplier shall include but not be limited to:

- i. Single line operating diagrams
- ii. General arrangement plan and elevations
- iii. Mechanical loadings of plant and terminals
- iv. Materials lists of all major plant and equipment
- v. Logic diagrams
- vi. SCADA and Communications connectivity provisions, wiring and equipment detail diagrams
- vii. Schematic diagrams of all circuitry
- viii. Connection diagrams of all wiring
- ix. Panel layouts of installed equipment and materials
- x. Drawings list of all drawings supplied with drawing numbers and titles

18 PRODUCT WARRANTY PERIOD

The Tenderer shall provide warranty for equipment supplied and workmanship for the Works for a minimum Period of twelve [12] months after delivery of the equipment. For all equipment supplied by third-parties, the contractor is to ensure that the warranties of these equipment are transferred to EFL as the beneficiary.

The Tenderer warrants to the Purchaser that all Works performed and completed in respect of the Warranted Works are in accordance with the standards and quality specified in the Contract or if not otherwise specified, the work is according to good trade practice expected in the energy industry.

SCHEDULE A: LIST OF EXPERIENCE, PERSONNEL & FINANCIAL STATEMENTS

A.1 Previous Experience

The Tenderer is to submit a list of Projects worked under with a similar scope, involving the design and manufacture of DC supply systems in chronological order of year completed.

Client	Project Scope and Description	Approx. Project Value	Year Completed

Authorized Signatory of Tenderer:

Signature:

Name:

Date:

A.2 Project Personnel

The Tenderer is to submit list of personnel who will work on this project and also provide their resumes in its bid.

Name	Designation	Duration of Employment with Company	Years of Experience

Authorized Signatory of Tenderer:

Signature:

Name:

Date:

A.3 Financial Statements

The Tenderer shall also submit past three years audited financial statements and records showing its financial ability to undertake this project.

SCHEDULE B: PRICE AND PAYMENT SCHEDULE

Currency of Tendered Price:

Component	Unit Price	Quantity	Total Price
Design and Manufacture of DC Distribution Board		1	
Manufacture and Supply of DC Charger System with associated DC Management/monitoring System		1 Lot	
Supply of Batteries and Associated Systems		1 Lot	
(Tenderer to add other items as required)			
Total			

The Payment Schedule shall be as per the table below:

Milestone	Percentage	Amount in Dollars
Receipt of Goods by EFL	95%	
Expiry of Warranty period (12 months after receipt of Goods)	5%	

Total Contract Price (in Words):

.....

Authorized Signatory of Tenderer:

Signature:

Name:

Date:

Note: Tenderer shall also provide unit prices for critical components (such as charger etc.)

SCHEDULE C: AS 4911 ANNEX A (TO BE SUBMITTED BY TENDERER)

All Tenderers are required to complete and submit a copy of this form with their bid submissions.

Item		
1	Purchaser (Clause 1)	Energy Fiji Limited (EFL)
1A	Purchaser's Representative (Clause 1A)	To be nominated by EFL at time of contract.
2	Purchaser's Address	2 Marlow Street, Suva
3	Supplier (clause 1)	Supplier to provide
4	Supplier's Address	Supplier to provide
5	Stated purpose for equipment (clause 1 definition of acceptable)	As stated in tender specifications and/or purchase order
6	Period of time for delivery (Clause 1 and Sub-clause 19.1)	Supplier to provide
7	Delivery Place (Clause 1 and Sub-clause 19.1)	EFL's Kinoya Depot, Kinoya, Suva
8	Mode of Delivery (Sub-clause 19.1)	Supplier to provide
9	Governing Law (Clause 1(h))	Laws of Fiji
10	a) Currency (clause 1(g))	Supplier to provide
	b) Place for payments (clause 1 (g))	Supplier to provide
	c) Place of Business of bank (clause 1(d))	Supplier to provide
11	Limits of Quantities to be supplied and delivered (clause 2.2)	As stated in tender specifications and/or purchase order
12	Suppliers security	Not applicable
13	Purchaser's security	Not applicable
14	Purchaser supplied documents (sub-clause 6.2)	Tender specifications and addenda (where issued).
15	Supplier Supplied documents (sub-clause 6.3)	Supplier to provide
16	Time for Purchaser's direction about documents (sub-clause 6.3(c))	14 calendar days
17	Sub-contract work requiring approval (sub-clause 7.2)	All work.
18	Legislative Requirements, those excepted (sub-clause 10.1)	Not applicable
19	Reference date (clause 1, sub-clause 10.2(b))	Deadline for Submission of Bids, as defined in tender specifications
20	Time by which insurance cover for the Equipment is to be effected (sub-clause 13.1)	Prior to tender award.
21	Public and product liability insurance (sub-clause 13.2)	Supplier to provide

22	Qualifying cause of delay, causes for which EOTs will not be granted (page 3, subparagraph (b) (iii) of Clause 1 and subclause 17.2)	None.
23	Liquidated damages, rate (subclause 17.5)	0.5% per day upto 10% of the purchase order value
24	Delay Damages	As assessed by EFL
25	Date for completion of acceptance testing (subclause 18.1 and 21.1)	As stated in tender specification
26	Party responsible for unloading the <i>Equipment</i> (subclause 19.1)	Supplier
27	When risk in the <i>Equipment</i> passes (subclause 20.1)	At time of acceptance by Purchaser.
28	Time at which ownership of the <i>Equipment</i> passes to the Purchaser (subclause 20.2)	At time of acceptance by Purchaser.
29	Period for <i>Purchaser's</i> notice that <i>Equipment</i> are rejected (subclause 21.1)	14 calendar days
30	Period for <i>Purchaser's</i> notice accepting or rejecting <i>Supplier's</i> proposal (subclause 21.4)	14 calendar days
31	Defects liability period (clause 22)	12 months
32	Claim for Payment (subclause 24.1)	Within 5 days of delivery
33	Period for Payment (subclause 24.1)	30 calendar days from time of acceptance by Purchaser
34	Equipment for which prepayment may be claimed (subclause 24.2)	Nil.
35	Interest rate on overdue payments (subclause 24.5)	Nil.
36	Arbitration (subclause 28.3)	
	a) Person to nominate an arbitrator	President of Fiji Institute of Engineers
	b) Rules for arbitration	Laws of Fiji
37	The Supplier's liability is limited as follows (clause 29)	The contract sum as adjusted pursuant to the Contract
38	The Purchaser's liability is limited as follows (clause 29)	The contract sum as adjusted pursuant to the Contract

Authorized Signatory of Tenderer:

Signature:

Name:

Date:

SCHEDULE D: TYPICAL DRAWINGS

Refer to attached drawing of typical DC system.

SCHEDULE E: TECHNICAL PARTICULARS

SCHEDULE F: PROGRAMME OF WORK

The Tenderer is required to state the commencement and completion dates for different components of the project schedule given below. The Tenderer is required to also submit a Gantt chart showing the timelines in weeks for supply of the transformer. The expected date for issue of a purchase order is 26th April 2021.

Component or Work	Commencement Date	Completion Date
1. Receipt of Official Purchase Order		
2. Submit Design Drawings and Design Report		
3. Procurement of Components, Assembly/Manufacture of DC Supply System		
4. Factory Testing of DC System & Components		
5. Dispatch from Factory and Shipping to designated delivery point		
Total Duration of Project in Weeks (from time Purchase Order is issued)		

Authorized Signatory of Tenderer:

Signature:

Name:

Date:

SCHEDULE G: EVALUATION CRITERIA

Tender Evaluation Criteria	
Category	Criteria
Bid Responsiveness	General responsiveness of bid, compliance to submission requirements and documentation
Health, Safety & Environment	Assessment of Tenderer's compliance to health, safety and environmental requirements detailed within the technical specification. Past performance of Tenderers. Manufacturer holds third party accreditation to ISO 14001, ISO 45001
Quality Assurance	Tenderer holds third party Quality Assurance accreditation to ISO/AS/NZS 9001:2015. Tenderer has Quality Management systems in place that are acceptable to Energy Fiji Limited.
Technical Compliance	Does the Tender meet Energy Fiji Limited's minimum technical requirements as outlined in the Technical Specification? <ul style="list-style-type: none"> • Equipment and all components • Performance of equipment and all components • Sustainability and ease of operation • Reliability data • Past experience • Ability to deliver on time / delivery timeframe
Commercial Compliance	Tenderer holds the required current insurance provisions and has provided evidence through valid insurance certificates of currencies. Has the Tenderer submitted Departures to the Terms and Conditions? If so is it likely that Energy Fiji Limited will be able to negotiate agreement without undue delay? Assessment of the Tenderers operational risks including conflicts of interest. Tenderer must comply with statutory requirements, such as that enforced by FRCS, FNPF, FNU, etc. and provide evidence of compliance as required in the specifications.
Energy Fiji Limited Procedures	Tenderer must comply with all relevant Energy Fiji Limited safety and environmental procedures. This is indicated by the Tenderer signing the Form of Tender Schedule, acknowledging all applicable procedures. Tenderer must also comply with the requirements of Electricity Act (2017), Electricity Regulations (2019).
Financial Stability	Assessment of Tenderer's current financial stability and ability to remain financially stable.
Price Evaluation	<ul style="list-style-type: none"> • Base tendered prices; • Other value adding options.

SCHEDULE H: DEPARTURE FROM SPECIFICATIONS

The Tenderer shall nominate the Clause or relevant section of the tender specification and describe the departure.

Tender Specification Reference ⁱ	Departure

ⁱ The Tenderer shall refer to the specific clause of the tender specification.