

Energy Fiji Limited



Tender Document

Tender No. : MR 390/2024

Supply, Installation and Commissioning of 2MW
to 5MW Diesel Generator at EFL's Labasa
Power Station

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1.0 INVITATION FOR TENDERS

Energy Fiji Limited is inviting bids for Supply, Installation and Commissioning of 2MW to 5MW Diesel Generator at EFL's Labasa Power Station. The Detailed scope of supply is listed in the following pages.

Interested bidders may obtain tender documents from EFL website www.efl.com.fj or Tenderlink website <https://www.tenderlink.com/efl>

All tenders shall submit all documents required including spares pricing as per price template.

During evaluation of tenders, the Authority will invite a tenderer or tenderers for discussions, presentations and necessary clarification before awarding of the contract

The tender submissions close on the 18/12/24

2.0 INSTRUCTION TO BIDDERS

2.1 Eligible Bidders

- 2.1.1. This invitation is open to all Bidders who have sound Financial Background, and have previous experience in supply of generating equipment & accessories.
- 2.1.2. Bidders shall provide such evidence of their continued eligibility satisfactory to EFL as EFL shall reasonably request.
- 2.1.3. Bidders shall not be under a declaration of ineligibility for corrupt or fraudulent practice.

2.2 Eligible Materials, Equipment and Services

- 2.2.1. 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. Upon request, bidders may be required to provide evidence of the origin of materials, equipment, and services.
- 2.2.2. For purposes of this Contract, "services" means the works and all project-related services including design services.
- 2.2.3. 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.
- 2.2.4. 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 Bidder

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

2.4 Cost of Bidding

- 2.4.1. The bidder 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

- 2.5.1. Site visit as per advertised date and time.

2.6 Contents of the Bidding Documents

- 2.6.1. The technical proposal shall contain the following:
 - (i) Bid Form for Technical Proposal and Appendix to Technical Proposal
 - (ii) Form of Bid Security;

- (iii) Power of Attorney;
- (iv) Information on Qualification;
- (v) Confirmation of Eligibility;
- (vi) Schedule of Major Items of Equipment
- (vii) Schedule of Technical Particulars & Guarantees
- (viii) Schedule of Times for Delivery & Completion and Contract completion times
- (ix) Schedule of Subcontractors Statement of Experience
- (x) Schedule of Bidders Tools & Equipment
- (xi) Schedule of Contractors Health & Safety Plan
- (xii) Schedule of Other Documents and Drawings to be submitted with the bid
- (xiii) Any other materials required to be completed and submitted by bidders in accordance with these Instructions to Bidders.

2.6.2. The Financial proposal shall contain the following:

- (i) Bid Form for Price Proposal and Appendix to Price Proposal.
- (ii) Schedules of Prices:
 - I. Design, Drawings and Documentation
 - II. Civil Works, Installation and Other Services.
 - III. Grand Summary; and
 - IV. Recommended Spare Parts for Generator maintenance
- (iii) Any other materials required to be completed and submitted by bidders in accordance with these Instructions to Bidders.

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

2.6.4. The following are the mandatory submission of a successful tender bid;

- Pricing Schedule
- Program of Works
- Company Profile (Detail profile to be provided)
 - Work History - Project/ Work done with referee, EFL work history.
 - Company background
 - Bidder available resources e.g. Manpower, Machines & Equipment.
 - OHS Policies or Plan
- Fiji Revenue & Customs Service (FRCA) compliance

- Fiji National Provident Fund (FNPF) compliance
- Signed checklist declaration (Appendix 5.1)

Failure to submit required documents may affect bid compliance even make it non-compliance.

2.7 Clarification of Bidding Documents

- 2.7.1. A prospective bidder requiring any clarification of the bidding documents may notify EFL in writing by email addressed to:

Jitendra Reddy
Manager Procurement, Inventory and Supply Chain
2 Marlow Street,
Suva, Fiji
Phone: +679 3224 360
Email: tenders@efl.com.fj

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

2.8 Amendment of Bidding Document

- 2.8.1. 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 bidder, modify the bidding documents by issuing addenda.

2.9 Language of Bid

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

2.10 Bid Price

- 2.10.1. Unless specified otherwise, Bidders 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.
- 2.10.2. Bidders shall give a breakdown of the prices in the manner and detail called for in this bidding document, or any issued addenda.
- 2.10.3. For Oversea Suppliers, bids shall be given on Cost and Freight (CFR) basis the point of delivery shall be Suva/Lautoka port for Sea or Nadi Airport for Air. The term CFR shall be governed by the rules prescribed in the current edition of Incoterms.
- 2.10.4. For Local Bidders, bids should be submitted in VIP price.

2.11 Bid Currencies

- 2.11.1. Prices shall be quoted in a single currency only.

2.12 Bid Validity

- 2.12.1. Bids shall remain valid for a period of 180 days from the date of Deadline for Submission of Bids specified in Sub-Clause 2.15.

2.13 Format and Signing of Bids

- 2.13.1. The bidder shall provide one electronic copy of the Technical and Financial proposals on EFL's electronic tender hosting website; <https://www.tenderlink.com/efl>
- 2.13.2. 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 bidder, in which case such corrections shall be initialled by the person or persons signing the bid.

2.14 Sealing and Marking of Bids

- 2.14.1. Bidders are to submit bid via Tender link Portal.

2.15 Deadline for Submission of Bids

- 2.15.1. Bids must be received by EFL at the address specified above no later than 1600 hours (Fiji Time) 18/12/24.
- 2.15.2. 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 bidders previously subject to the original deadline will thereafter be subject to the deadlines extended.

2.16 Late Bids

- 2.16.1. Any bid received by EFL after the deadline for submission of bids prescribed above will be rejected.

2.17 Modification and Withdrawal of Bids

- 2.17.1. The bidder 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.
- 2.17.2. No bid may be modified by the bidder after the deadline for submission of bids.

2.18 Rejection of one or all Bids

- 2.18.1. 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 bidder or bidders or any obligation to inform the affected bidder or bidders of the grounds for the rejection.

2.19 Process to be Confidential

- 2.19.1. Information relating to the examination, clarification, evaluation and comparison of bids and recommendations for the award of a contract shall not be disclosed to bidders or any other persons not officially concerned with such process.
- 2.19.2. Any effort by a bidder to influence EFL's processing of bids or award decisions may result in the rejection of the bidder's bid.
- 2.19.3. Lowest bid will not necessarily be accepted as successful bid.

2.20 Clarification of Bids

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

2.21 Preliminary Examination

- 2.21.1. Energy Fiji Limited (EFL) will examine the tenders to determine whether they are complete, whether any computational errors have been made, whether the documents have been properly signed, and whether the tenders are generally in order.
- 2.21.2. Arithmetical errors will be rectified on the following basis. If there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail, and the total price shall be corrected. If the tenderer does not accept the correction of the errors, its tender will be rejected. If there is a discrepancy between words and figures, the amount in words will prevail.
- 2.21.3. Energy Fiji Limited may waive any minor informality or non-conformity or irregularity in a tender which does not constitute a material deviation, provided such waiver does not prejudice or affect the relative ranking of any tenderer.
- 2.21.4. Prior to the detailed evaluation, pursuant to Clause 21, Energy Fiji Limited will determine the substantial responsiveness of each tender to the tender document. For purposes of these paragraphs, a substantially responsive tender is one, which conforms to all the terms and conditions of the tender document without material deviation Energy Fiji Limited's determination of a tender's responsiveness is to be based on the contents of the tender itself without recourse to extrinsic evidence.
- 2.21.5. If a tender is not substantially responsive, it will be rejected by Energy Fiji Limited and may not subsequently be made responsive by the tenderer by correction of the nonconformity.

3.0 GENERAL CONDITIONS OF CONTRACT

3.1 General Conditions

Energy Fiji Limited uses Federation Internationale Des Ingenieurs Conseil (FIDIC) Contract template. General conditions of this contract shall be governed by it.

3.2 Definitions

3.2.1. In this Contract, the following terms shall be interpreted as indicated:

- “The Contract” means the agreement entered into between Energy Fiji Limited and the Supplier, as recorded in the Contract Form signed by the parties, including all attachments and appendices thereto and all documents incorporated by reference therein.
- “The Contract Price” means the price payable to the Supplier under the Contract for the full and proper performance of its contractual obligations.
- “The Supplier” means the individual or firm supplying the goods under this Contract.
- “The Goods” means all of the equipment, machinery, and/or other materials, which the Supplier is required to supply to Energy Fiji Limited under this Contract.

3.3 Application

3.3.1. These General Conditions shall apply in all Contracts made by Energy Fiji Limited for the procurement of goods.

3.4 Country of Origin

3.4.1. For purposes of this Clause, “origin” means the place where the Goods were manufactured or produced.

3.4.2. The origin of the Goods is distinct from the nationality of the Supplier.

3.5 Standards

3.5.1. The Goods supplied under this Contract shall conform to the standards mentioned in the Technical Specifications.

3.6 Use of Contract Documents and Information

3.6.1. The Supplier shall not, without Energy Fiji Limited's prior written consent, disclose the Contract, or any provision thereof, or any specification, plan, drawing, pattern, sample, or

information furnished by or on behalf of Energy Fiji Limited in connection therewith, to any person other than a person employed by the Supplier in the performance of the Contract.

- 3.6.2. The Supplier shall not, without Energy Fiji Limited's prior written consent, make use of any document or information enumerated in Clause 3.2 above.
- 3.6.3. Any document, other than the Contract itself, enumerated in Clause 3.2 shall remain the property of Energy Fiji Limited and shall be returned (all copies) to Energy Fiji Limited on completion of the Supplier's performance obligations under the Contract if so required by Energy Fiji Limited.

3.7 Performance Bond

- 3.7.1. Performance Bond will be 10% of the Contract Sum.

3.8 Programme to be Furnished

- 3.8.1. Within 20 days of the acceptance of this tender the Contractor shall submit to the Employer, for approval, a programme showing the order in which he proposes to carry out the works, including design, manufacture and delivery.

3.9 Inspection and Tests

- 3.9.1. The Employer's Engineer or his representative shall have the right to inspect and/or to witness test the Goods at the factory or place of manufacture, for their conformity to the Contract Specifications. The Employer shall notify the Contractor in writing of the identity of its Engineer(s) or representative(s) retained for these purposes. The contractor shall provide the Employer with a detailed program for the inspections and/or witness tests and notice of at least 7 days of notice when the materials, equipment, system is ready for inspection & testing. Nothing in this clause shall in any way release the Contractor from any warranty or other obligations under this Contract in delivering a fully functional plant as specified elsewhere in this document or the contractors' design and specifications.

3.10 Patent Rights

- 3.10.1. The Supplier shall indemnify Energy Fiji Limited against all third-party claims of infringement of patent, trademark, or industrial design rights arising from use of the Goods or any part thereof in Fiji.

3.11 Packing

- 3.11.1. The Supplier shall provide such packing of the Goods as is required to prevent their damage or deterioration during transit to their final destination, as indicated in the Contract.
- 3.11.2. The packing, marking, and documentation within and outside the packages shall comply strictly with such special requirements as shall be expressly provided for in the Contract.

3.12 Delivery and Documents

- 3.12.1. Delivery of the Goods shall be made by the Supplier in accordance with the terms specified by Energy Fiji Limited in its Schedule of Requirements and the Special Conditions of Contract.
- 3.12.2. The supplier shall provide Sea Freight Charges.

3.13 Insurance

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

3.14 Warranty

- 3.14.1. The Supplier warrants that the Goods supplied under the Contract are new, unused, of the most recent or current models and they incorporate all recent improvements in design and materials unless provided otherwise in the Contract. The Supplier further warrants that all Goods supplied under this Contract shall have no defect, arising from design, materials, workmanship, or from any act or omission of the Supplier, that may develop under normal use of the supplied Goods in the conditions prevailing in the country.
- 3.14.2. This warranty shall remain valid for minimum of twelve (12) months after the Goods, or any portion thereof as the case may be, have been delivered to and accepted at the final destination indicated in the Contract.
- 3.14.3. Energy Fiji Limited shall promptly notify the Supplier in writing of any claims arising under this warranty
- 3.14.4. Upon receipt of such notice, the Supplier shall, within a period of 30 days, and with all reasonable speed, repair or replace the defective Goods or parts thereof, without costs to Energy Fiji Limited.
- 3.14.5. If the Supplier, having been notified, fails to remedy the defect(s) within the period specified in 10.4 above, within a reasonable period, Energy Fiji Limited may proceed to take such remedial action as may be necessary, at the Supplier's risk and expense and without prejudice to any other rights which Energy Fiji Limited may have against the Supplier under the Contract.

3.15 Payment

- 3.15.1. The method and conditions of payment to be made to the Supplier under this Contract shall be specified in Special Conditions of Contract.
- 3.15.2. Payments shall be made promptly by Energy Fiji Limited as specified in the Contract.

3.16 Prices

- 3.16.1. Prices charged by the Supplier for Goods delivered under the Contract shall not, with the exception of any price adjustments authorized in Special Conditions of Contract, vary from the prices quoted by the Supplier in its tender.

3.17 Assignment

- 3.17.1. The Supplier shall not assign, in whole or in part, its obligations to perform under this Contract, except with Energy Fiji Limited's prior written consent.

3.18 Subcontracts

- 3.18.1. The Supplier shall notify Energy Fiji Limited in writing of all subcontracts awarded under this Contract if not already specified in the tender. Such notification, in the original tender or later, shall not relieve the Supplier from any liability or obligation under the Contract.

3.19 Termination for Default

- 3.19.1. Energy Fiji Limited may, without prejudice to any other remedy for breach of Contract, by written notice of default sent to the Supplier, terminate this Contract in whole or in part:
- a) If the Supplier fails to deliver the Goods within the period(s) specified in the Contract, or within any extension thereof granted by Energy Fiji Limited.
 - b) If the Supplier fails to perform any other obligation(s) under the Contract.
 - c) If the Supplier, in the judgment of Energy Fiji Limited has engaged in corrupt or fraudulent practices in competing for or in executing the Contract.
- 3.19.2. In the event Energy Fiji Limited terminates the Contract in whole or in part, it may procure, upon such terms and in such manner, as it deems appropriate, Goods similar to those undelivered, and the Supplier shall be liable to Energy Fiji Limited for any excess costs for such Goods.

3.20 Liquidated Damages

- 3.20.1. If the Supplier fails to deliver the Goods within the period(s) specified in the Contract, Energy Fiji Limited shall claim for Liquidated Damages, without prejudice to its other remedies under the Contract.

3.21 Resolution of Disputes

- 3.21.1. Energy Fiji Limited and the Supplier shall make every effort to resolve amicably by direct informal negotiation any disagreement or dispute arising between them under or in connection with the Contract.
- 3.21.2. If, after thirty (30) days from the commencement of such informal negotiations both parties have been unable to resolve amicably a Contract dispute, either party may require that the dispute be referred for resolution to formal mechanisms. These mechanisms include, but are not restricted to, conciliation by a third party, adjudication in an agreed national or international forum, and/or international arbitration.

3.22 Language and Law

3.22.1. The language of the Contract and the law governing the Contract shall be English language and the Laws of Fiji respectively unless otherwise stated.

3.23 Force Majeure

The Supplier shall not be liable for forfeiture of termination for default if and to the extent that it's delay in performance or other failure to perform its obligations under the Contract is the result of an event of Force Majeure.

3.24 Schedule of Requirements

Schedule	Description of materials
A	Supply, Installation and Commissioning of 2MW to 5MW Diesel Generator at EFL's Labasa Power Station

Schedule on performance to be completed by all Bidders.

Past performance of delivery of similar items.

Item No.	Types of Diesel Generator Set	Name of Company delivered to	Date of Order	Delivery Time	Fully or partial or not delivered

4.0 SPECIAL CONDITIONS OF CONTRACT

4.1 Definitions

"The Purchaser" is Energy Fiji Limited, 2 Marlow Street, Private Mail Bag, Suva, and includes its legal representatives, successors or assigns.

4.2 Application

The following Special Conditions of Contract shall supplement the General Conditions of Contract. Whenever there is a conflict, the provisions herein shall prevail over those in the General Conditions of Contract.

4.3 Proof of Successful Completion of Previous Similar Contracts

Tenderers shall provide proof of successful completion within the stipulated delivery period of similar contracts undertaken in the past.

4.4 Delivery Period

The Generators shall be delivered and commissioned within **18 Months** after the date of contract award. Delivery must be for a complete schedule. Partial delivery shall not be accepted.

4.5 Payment Terms and Conditions

Energy Fiji Limited's payment terms are 30 days upon receipt of certified invoices and delivery notes confirming that the invoiced material has been delivered and are in accordance with the contract. Payment shall be made for the amount of contract.

4.6 Advance Payment

Any advance payment will require a bank guarantee.

4.7 Prices

Prices shall be fixed during the Supplier's performance of the Contract and not subject to variation on any account.

5.0 TECHNICAL SPECIFICATION

5.1 Employer's Requirements

The contract includes for the Design, Supply, Installation and Commissioning of a medium speed 2MW to 5MW Diesel Generator Dual Fuel type (IDO/HFO) at EFL's Labasa Power Station.

The contract also includes:

- (i) Inspection and testing, insurance, packing for export, shipment, clearing from port, delivery to site, unloading, complete erection, finishing, painting, site testing, training and commissioning of the Plant described herein
- (ii) Three print copies of Operating, Servicing and Maintenance Manuals. A set of printed Spare Parts Manuals. Additionally, a softcopy of all the Manuals to be provided.
- (iii) Any necessary erection materials including a complete set of special tools and equipment necessary to erect, operate, service and maintain the Genset.
- (iv) A list and price of spare parts for operating and maintaining the Plant up to 8,000 hrs, to include but not limited to the following:
 - Normal maintenance spares for engines and all other auxiliaries
 - Emergency and safety spares for engine and all other auxiliaries
 - General and special tools for engine and all other auxiliaries
 - Test and calibration tools for engine and all other controls and auxiliaries
 - Cleaning/reconditioning/remanufacturing tools for engine components and auxiliaries
 - Machine shop tools
 - Duplicates of software/programs, licenses, software keys, passwords, etc. supplied in this contract shall be hand over and shall form part of the completed installation.
- (v) Detailed design calculations, specifications and drawings used in the contract.

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

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

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

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

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

5.1.1 Information with Tender

Tenders must fill in all Schedules and give all particulars pertaining to the Diesel Generating Plant offered.

In particular, they shall supply the following in their tender:

- a) Preliminary performance schedule, which shall form the basis of the contract performance program.
- b) Drawings showing all dimensions of the complete Diesel Generating Plant.
- c) Drawings or Schedules showing the shipping dimensions and weights.
- d) One copy in the English Language of the Design Codes to which the tenderer elects to design the Diesel Generating Plant and its ancillaries.
- e) A list of recommended maintenance, safety, and emergency spares for engines and auxiliary equipment for a service period of 8,000 hrs with all prices quoted. Other parts, tools and equipment specified in clause 4.1.

A maintenance programme in terms of machine operating hours, indicating when minor and major maintenance, such as oil change periods, filter changes, protection tests, top overhauls and major overhauls, are to be carried out. The programme should also include the spare parts anticipated to be changed and the time and manpower required to carry out the work.

5.1.2 Drawing and Information to be supplied by Contractor.

5.1.2.1 The following must be submitted with the tender:

- (i) General arrangements for the plant, giving dimensions, weights and basic specifications of diesel engine and generator and other equipment.
- (ii) Illustrations and printed matter showing constructional details and details of instrumentation, protection and accessories.
- (iii) Life cycle cost calculations.
- (iv) Preliminary Project Schedule.
- (v) List of spare parts, tools, diagnostic & calibration tools instruments and other equipment necessary to carry out maintenance, overhauls, inspections, and repairs expeditiously.
- (vi) Special tools list and spare parts list with pricing required for operation and maintenance

5.1.2.2 The following drawings are to be submitted with the contract, in printed and electronic/AutoCAD formats:

- (i) Certified general arrangement drawings showing all fittings and accessories provided and including dimensions and weights and the specifications for diesel engines, generator and accessories.
- (ii) Electrical and instrument diagrams showing the local/auto start, stop and output control circuit and the protection, instrument systems, auto voltage and governor controls.

- (iii) Excitation System and AVR detailed drawings.
- (iv) Governor details (Type, Model, Block diagram and optional droop settings if any).
- (v) Combined Instrumentation and piping diagram with operational parameters.
- (vi) Certification of all the final design calculations, drawings and evidence of compliance to such design parameters.

5.1.2.3 Submission of Drawing

All drawings submitted pursuant to this clause, shall form part of the contract, after approval by the Engineer. The sequence of submission of all drawings shall be such that all information is available for checking each drawing when it is received.

Notation on drawings shall be in the English language.

5.1.3 Design and Standardisation

The generating plants together with its auxiliaries shall be designed and manufactured to ensure:

- (i) Satisfactory operation under prevailing atmospheric conditions at the site.
- (ii) Safety of operation and maintenance personnel.
- (iii) Facilitate economical, easy and simple inspection, maintenance and operations

5.1.4 Tools and Instruments

The Contractor shall supply all special tools and instruments which may be necessary to carry out the installation, commissioning, operation maintenance, overhauls, inspections and repairs expeditiously, for all the equipment supplied through this contract. These tools and instruments should cover:

- Normal maintenance, emergency, and insurance spares for engines and auxiliary equipment.
- General and special tools for engine, auxiliary mechanical & electrical equipment.
- Testing and calibration tools for control & instrumentation on engine, mechanical and electrical equipment.
- Computer programs (Software/hardware) used in the operation, monitoring, setting and /or maintenance of all the equipment supplied through this contract

Exceptions and items required but not supplied must be highlighted along with the current market rate for each of such items. Unless the Employer has granted any relief or exemption, the contractor is expected to include all such tools and instruments in the bid price. List of such tools and instruments should be provided with the Tender with their unit prices.

5.1.5 Provision for Handling the Plant

All heavy parts of the plant supplied under the contract shall have provisions for lifting, slinging and handling during delivery, erection, maintenance and overhauls. A legible name plate indicating the safe limits shall be prominently displayed where possible.

5.1.6 Packing

All material and equipment are to be packed to be transported to the site so that they are protected against climatic conditions and handling to which they may be subjected to in transit and storage at the site.

Spare parts or components supplied shall be individually and suitably preserved, packed and sealed to withstand tropical weather conditions. The packing shall be sufficient to withstand, rough handling during transit and exposure to extreme temperatures, salt, high humidity and precipitation during transit and open or prolonged storage. Preservation chemicals/agents may be employed to ensure that goods delivered are received in good shape and that they can be stored for long durations without fear of corrosion or contamination.

All markings within the inside and on the outside of casings or packaging are to be either of a water proof ink, material or protected by Shellac or varnish to protect obliteration in transit, handling and storage.

5.1.7 Insurance

The Tenderer shall deliver the complete equipment supply, Delivered At Place (DAP) to the power station or a specified transfer point. The Tenderer shall deliver the complete equipment supply to the transfer point identified in the Tender specifications. While the Tenderer is on-site at Labasa Power Station or has any activities in Fiji, Tenderer shall provide and maintain in full force at all times during the term of this engagement the usual complement of insurance policies including but not limited to: Worker's compensation, Commercial General Liability, Comprehensive Automobile Liability and All Risk Physical Damage insurance, naming the EFL (while at the Labasa Power Station site) with indemnification.

5.1.8 Taxes

The EFL shall pay all customs, duties, excise taxes and other related fees associated with the importation of the off-shore equipment scope. The Tenderer shall be responsible for paying any and all Fiji Government taxes, VAT, income taxes, normal business permit, fees, or taxes related to the on-shore "Fiji" related installation work including but not limited to Fiji purchases, all Fiji related construction, consultancy, sub-contracting, transportation, commissioning, training, warranty or other work or activities while in Fiji.

5.2 Scope of Work

The scope of work to be carried out under the terms of this specification comprises:

1. The supply, delivery to site, installation and commissioning of a new medium Speed Dual Fuel type (IDO/HFO) Generating set with a net plant rated capacity of 2MW to 5MW(e) at 0.8 PF lagging, complete with all necessary mechanical and electrical auxiliaries including but not limited to, excitation equipment, cooling system, motor control center, engine alarm control panel - both local and provisions for remote control, alternator protection, metering and instrumentation to couple with 11KV switch gear bus bar, engine auxiliary drives, associated pipe work, associated controls and suitable building and crane rail extensions, where applicable.
2. The supply of 11KV cables, installation, testing and termination from the Generator to the respective 11KV Circuit Breakers

3. Power and Control cables including terminations to suit
4. Power Station grounding and lightening protection system
5. Earthing test and modelling to suit and from EFL approved Vendor
6. All Electrical, Civil and Mechanical works required for proper installation of all plant and equipment's associated with the Power Station.
7. Contractor is to provide all mandatory drawings for the power station, generating sets layout, cable trenching and other mandatory drawings within one month of Contract signing.
8. Geo Tech Studies to be carried out if required.
9. List of critical and recommended Spare parts.
10. Contractor to cater for all the mandatory items required for Engineering, Procurement, Construction and Commissioning of the proposed plant.

5.3 Design Requirements

The work performed and equipment offered to this specification shall have a proven track record of satisfactory service in similar applications under site conditions, similar or more severe than those specified herein. The contractor shall provide a detailed schedule of each of the equipment having met the required design criteria and standards and include deviations from the current standards used in the design. The decision of the Employer in certifying and acceptance of the result shall be one of the main factors in evaluation and certifying completion of the contractor's performance and settling the payments due to the contractor for the performance.

The specification provided in the tender document is for guidance; however, the contractor is allowed to improve on such conditions and indicate in the tender documents if the intent of such deviations establishes that the products provided are equal to or better than what is mentioned in the tender document.

5.4 Reference Conditions

The following environmental conditions are applicable to this site.

- i. Elevation above mean sea level
 - 100 meters
- ii. Ambient air temperature
 - Design Temperature 45 °C
 - Minimum 15 °C
- iii. Relative Humidity
 - Maximum relative humidity 95%
 - Minimum relative humidity 80%
- iv. Average Rainfall per year 2500mm
- v. Maximum Wind Speed (under cyclonic 85m/sec - gusting (under conditions cyclonic conditions)
 - a. Note: Fiji is situated in a region where cyclones are experienced frequently. All plant and equipment shall be designed and constructed to withstand these extreme conditions. All plant and equipment shall be rust proof, vermin proof and weather proof and designed to be suitable for a damp, tropical climate, which may be experienced simultaneously.
- vi. Seismic Level 7 on the open ended Richter scale
 - Seismic Condition All equipment shall be capable of withstanding an acceleration of 3.3 m/sec² in any direction without sustaining any damage.

The temperature of the fresh water supply is always less than 30°C at the site. The following is an analysis of the supply water available:

pH	8.3
Alkalinity	mg CaCO ₃ /Ltr 68.2
Chloride	mg/Ltr 7.3
Sulphate	mg SO ₄ /Ltr 8.4
Free CO ₂	mg/Ltr 0.62
Temporary Hardness	mg/Ltr 3.6
Permanent Hardness	mg/Ltr 64.0
Total Hardness	mg CaCO ₃ /Ltr 68.2
Total suspension solids	mg/Ltr < 1
Total dissolved solids	mg/ltr 126

5.5 Electrical Design Criteria

5.5.1 System Conditions

System Particulars for 33kV & 11kV system applicable in Fiji Islands are stated below:		
	33kV	11kV
<i>Normal system voltage</i>	33 kV	11 kV
<i>System Highest voltage</i>	36 kV	12 kV
<i>Frequency</i>	50 Hz	50 Hz
<i>Earthing of Neutral point</i>	Solidly earthed	Directly earthed with or without resistor

5.5.2 Power supply for electrical operation

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

5.5.3 Connections of Earthing Points and System Neutrals

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

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

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

5.5.4 Earthing of Equipment

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

5.5.5 Jointing and Bonding

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

5.6 Concrete

The Contractor shall submit not less than 3 weeks before the commencement of manufacture of preliminary trial design mixes the following information to the Employer's Representative in respect of each grade of concrete.

- (1) Grade of concrete
- (2) Title of particular trial mix.
- (3) The grading of the aggregates.
- (4) The ratio by weight of all the constituents of the concrete.
- (5) The expected compacting factor and slump.
- (6) Full details of the proposed site quality control.
- (7) Full details of the proposed laboratory for testing.

The Contractor shall also confirm his proposed testing regime and acceptance criteria for the Preliminary Trial Mixes. If the proposals not be approved by the Employer's Representative, and then the Contractor shall comply with the paragraph on preliminary test cubes and the two following paragraphs. At least four weeks before commencing any Concreting in the Works, the Contractor shall make trial mixes using samples of aggregates and cements typical of those to be used. If possible, the Concreting plant and the means of transport to be employed in the Works shall be used to make the trial mixes and to transport them a representative distance. A clean dry mixer shall be used to make the trial mixes and the first batch shall be discarded. Preliminary test cubes shall be taken from the proposed mixes as follows: For each grade, a set of 6 cubes shall be made from each of 3 consecutive batches. Three from each set of six shall be tested at an age of 7 days and three at an age of 28 days. The cubes shall be made, cured, stored, transported and tested in compression in accordance with AS 1012 & NZS 3104:2021. The test shall be carried out in a laboratory shall be approved by the Employer's Representative.

If it is proposed to use an admixture in the mix then for each grade of concrete a batch shall be made with a double dose of the additive. For each of these batches (each truck denotes a batch) 3 cubes shall be made and one tested at 7 days and 2 at 28 days to determine the likely effect of error in dispensing. The trial design mix proportions shall be approved if the average strength of a set of 9 cubes tested at 28 days exceeded the specified characteristic compressive strength by current margin less 3.5 N/mm². The results of the seven-day cube tests shall be used to give an indication for future use of the strengths likely to be achieved at 28 days. They shall not be used to satisfy the 28 days preliminary test cube strength requirements as per NZS 3104:2021.

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

- (a) 1.64 times the standard deviation of cube tests on at least 100 separate batches of concrete of nominally similar proportions of similar materials and produced over a period not exceeding 12 months by the same plant under similar supervision, but not less than $1/6$ of the characteristic strength for concrete of grade 7, 20 or 15, or 3.75 N/mm^2 for concrete of grade 20 or above.
- (b) 1.64 time the standard deviation of cube tests on at least 40 separate batches of concrete of nominally similar proportions of similar materials and produced over a period exceeding 5 days but not exceeding 6 months by the same plant under similar supervision, but not less than $1/3$ of the characteristic strength for concrete of grade 7, 10 or 15, or 7.5 N/mm^2 for concrete of grade 20 or above.

Where there are insufficient data to satisfy (1) or (2) above, the margin for the initial mix design should be taken as two-thirds of the characteristic strength for concrete of grade 7, 10 or 15, or 15 N/mm^2 for concrete of grade 20 or above. This margin should be used as the current margin only until sufficient data are available to satisfy (1) or (2) above. However, when the required characteristic strength approaches the maximum possible strength of concrete made with a particular aggregate, a smaller margin but not less than 7.5 N/mm^2 may have to be permitted for the initial mix design.

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

5.6.1 Ready-Mixed Concrete

Ready-mixed concrete as defined in NZS 3104, which batched off the Site, may be used only with the agreement of the Employer's Representative and comply with all requirements of the Contract. The concrete shall be carried in purpose made agitators operating continuously, or truck mixers. The concrete shall be compacted and in its final position within 2 hours of the introduction of cement to the aggregates, unless a longer time is agreed by the Employer's Representative. The time of such introduction shall be recorded on the delivery note together with the weight of the constituents of each mix. When truck-mixed concrete is used, water shall be added under supervision, either at the Site or at the central batching plant, as agreed by the Employer's Representative but in no circumstances shall water be added in transit. Unless otherwise agreed by the Employer's Representative, truck mixer units and their mixing and discharge performance shall comply with the requirements of BS 5328 part 3. Earthing & Auxiliary Transformer Shall be Reinforced concrete.

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

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

Consistency of the concrete shall not be adjusted by the further addition of water to the mix. The minimum Testing Frequency for sampling concrete shall be in accordance with the frequency specified in AS 1379-1973 and shall be distributed evenly over the number of truckloads being delivered, namely;

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

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

5.7 Copper

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

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

5.8 Maintainability

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

5.9 Ventilation

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

5.10 Risk of Fire

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

5.11 Civil Works, Installation & Other Services

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

5.12 Quality of Materials And Workmanship

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

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

5.13 Standards

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

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

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

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

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

Australian/New Zealand Standards

AS/NZS	1170	Structural Design Actions
AS/NZS	1768	Lightning Protection
AS	1824	Insulation coordination – Definitions, principles and rules
AS	1940	The storage and handling of flammable and combustible liquids
AS/NZS	2312	Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings
AS/NZS	2373	Electric cables – Twisted pair for control and protection circuits
AS/NZS	3000	Wiring Rules
AS/NZS	3008.1.1	Electrical installations – Selection of cables – Cables for alternating voltages up to and including 0.6/1 (1.2) kV.
AS	3011.2	Electrical installations – Secondary batteries installed in buildings, Part 2: Sealed cells
AS/NZS	3080	Telecommunications installations - Generic cabling for commercial premises
AS/NZS	3155	Approval and test specification - Electric cables - Neutral screened – For working voltages up to and including 0.6/1 kV
AS/NZS	3191	Electric flexible cords
AS/NZS	3439.1	Low voltage switchgear and control gear assemblies
AS/NZS	3439.2	Low-voltage switchgear and controlgear assemblies - Particular requirements for busbar trunking systems (busways)
AS/NZS	3835	Earth potential rise - Protection of telecommunications network users, personnel and plant
AS/NZS	3947	Low voltage switchgear and control gear, (all relevant parts)
AS	4024.1	Safety of machinery, (all relevant parts)

AS/NZS	4026	Electric cables - For underground residential distribution systems
AS	60529	Degrees of protection provided by enclosures (IP Code)
AS/NZS	60898	Electrical accessories - Circuit-breakers for overcurrent protection for household and similar installations - Circuit-breakers for a.c. operation
AS	HB101	Coordination of power and telecommunications - Low Frequency Induction (LFI): Code of practice for the mitigation of hazardous voltages induced into telecommunications lines.
AS	1345	Identification of the contents of pipes, conduits and ducts
AS/NZS	2053	Conduits and fittings for electrical installations (all parts)
AS	2700	Color standards for general purpose

International Electro technical Commission (IEC)

IEC	11801	Information technology – Generic cabling for customer premises
IEC	14763	Information technology – Implementation and operation of customer premises cabling
IEC	24702	Information technology – Generic cabling – Industrial premises
IEC	60269	Low-voltage fuses
IEC	60304	Standard colours for insulation for low frequency cables and wires
IEC	60364	Electrical installations of buildings
IEC	60934	Circuit breakers for equipment
IEC	61009	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs)
IEC	61089	Round wire concentric lay overhead electrical stranded conductors
IEC	61232	20SA/A Aluminium clad wires for electrical purposes
		British Standards (BS)
BS	EN ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles
BS	6231	Specification for PVC-insulated cables for switchgear and control gear wiring
BS	6651	Protection of structures against lightning.
BS	7354	Code of Practice for Design of high-voltage open-terminals stations, Section 7: Earthing.
BS	7430	Code of Practice for Earthing.

5.14 Detailed Design of Plant and Equipment

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

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

The successful contractor shall from the commencement of his contract submit to the Employer's Representative, his conceptual design, detailed designs, technical submissions, design, manufacture and

construction drawings, etc. for approval at each stage until the completion of the project.

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

5.15 Plant and Equipment to be supplied

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

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

5.16 Inspection and Testing

The Contractor at his cost shall carry out all routine tests as per relevant IEC or Australian standards.

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

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

5.17 Spares

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

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

5.18 Technical Literature – Operations And Maintenance Manuals

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

Successful contractor shall forward 3 copies of all operations and maintenance manuals, spare parts catalogues, detailed schematic and wiring diagrams and all other documents required for satisfactory operation and maintenance of plant. The originals of the drawings in AutoCAD format are required to be handed over. As built drawings are required to be furnished in 3 copies within 2 weeks of the works being taken over.

During the design and manufacture stage the contractor shall submit all design calculations, design drawings,

technical submissions at each stage of design or manufacture for the approval of the Employer's representative.

The manuals shall include the following sections:

5.18.1 Plant Specification and Description

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

5.18.2 Installation and Commissioning

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

5.18.3 Operation

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

5.18.4 Maintenance

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

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

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

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

5.18.5 Site Conditions

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

5.18.6 Packing

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

Equipment shall be suitably packed and protected against vibration, movement and shock which may occur

during loading and transport. Particular care in packing shall be taken when the apparatus is transported by road.

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

5.18.7 Programme And Progress Of Work

Programme

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

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

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

Progress Reports

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

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

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

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

5.18.8 Design Review, Inspection and Testing for all Major Equipment's of Power Station

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

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

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

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

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

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

5.19 Capacity and Rating

5.19.1 Genset Capacity

The net maximum continuous site rated capacity of the generating plant shall not be less than 2MW to 5MW (e) at the specified reference conditions and 0.8 power factor lagging. The output shall be 3 phase and 11,000 Volts at 50 hertz and medium speed.

The net maximum continuous site rated capacity of the diesel generating Genset shall be defined as the electrical output available at the alternator output terminals LESS the sum of rated full load electrical power requirements of all auxiliaries.

The dual fuel (IDO/HFO) generating units shall be designed to operate at 100% continuous base load operation for +8,000 hours per year, Utility operation. Gensets will operate in parallel with a weak Utility system, or may operate independently in Island mode.

The engine shall be commissioned and put into commercial operation at 100% base load

5.19.2 Rating

The maximum continuous and short time rating of the alternator at the specified site conditions shall comply with AS1359 and shall be sufficient to enable the maximum continuous site rated capacity of the Genset to be obtained at the specified reference conditions.

The continuous and overload rating of the diesel engine shall be in accordance with ISO 3046 Part I and shall be sufficient to enable specified maximum continuous rated capacity and overload capacity of the Genset to be obtained at the specified reference conditions in accordance with the adjustment provisions of ISO 3046 Part I.

In determining the ratings of individual items of the equipment, reference shall be taken of the conditions at the Power Station as specified in clause 5.4.

5.20 Plant Layout Requirements

5.20.1 Plant Layout and Safety Aspects

The plant layout shall be arranged generally to suit the site conditions. The existing plant layout will be provided to show the proposed location of the installation. All items of the equipment shall inherently be designed for safe operation and the plant shall be designed such that, the plant may be operated in compliance with the Health and Safety Act Work Act 1996 of the Republic of Fiji, or existing OHS regulations in Australia/New Zealand.

5.21 Control

All panels, cubicles, mountings, instruments, protective devices, control equipment and connections necessary for the safe, convenient and reliable operation of the generating plant and for effective fault indication shall be provided and installed. Effective dissipation of heat generated by components shall be provided.

Where appropriate, solid state electrical circuitry is preferred. Relays shall be of the plug-in type, fitted with retaining clips and provided with adequate dust covers. Relays shall have a reliability of operation appropriate to the application.

All switches and switch controls shall be identified and labelled with a mechanically fixed, engraved plate mounted on the control panel which describes the switch function. All positions of switch controls shall be engraved on a mechanically fixed nameplate to identify the option selected. All control components shall be clearly identified and labeled in accordance with a scheme. Cable identification shall be of the slip on type sized to fit neatly over the cables.

Indication of the status of the control system shall be displayed on the diesel generator control board (and duplicated as specified at the remote control panel).

The control system shall disable operation of the generating units under fault conditions. All indicating and alarm lamps shall be coloured in accordance with the requirements of ISO /DIN or IEC.

5.21.1 Control System

A control system shall be provided to enable control of the generating unit, through start, run, synchronize, load, unload and stop, to be exercised from engine room or control room and this control mode shall be defined as local control. Provision for remote operation/control of this control system shall be provided to enable remote control from EFL's National Control Center located at Vuda, Viti Levu. Remote control capability must be provided.

This Control System shall be a PLC type with a local HMI mounted in a control Panel located near the Engine. The PLC Control system with the local HMI shall be interphase with the Local Control IFix Scada system or have its own stand-alone SCADA system in the local common EFL Control Room.

5.22 IDO/HFO Engine and Auxiliary Equipment

5.22.1 General

The IDO/HFO engine shall operate satisfactorily on the fuel oil as specified in 8.4 of this section. The IDO/HFO engine shall be generally in accordance to ISO 3046, unless specified otherwise.

The IDO/HFO engine shall be equipped with all ancillary equipment required to satisfactorily achieve the required performance under the specified site conditions.

The engines shall be medium speed, and operate at 750 rpm or less.

5.22.2 Engine Governing

The engine shall be provided with an electro-hydraulic controlled actuator/governor having programmable provisions/adjustment of droop, speed synchronizing, load limiting and synchronizing indications.

For engine speed control, it shall be set up for direct-acting operation whereby a loss or interruption of electrical/electronic signal to the actuator will move the fuel rack to minimum fuel and cause engine shutdown.

The governor shall be capable of parallel operation with other gensets within the power plant, or other gensets in the national grid.

The governing requirements must comply with ISO 3046, class M2, the genset to comply with ISO 8528-5, class G2.

5.22.3 Engine combustion air System

Engine combustion air shall be drawn from outside the plant room through an oil bath filter. The oil bath filter shall be greater than 96% efficient. Alarm indication to warn of blocked filters to be provided.

The automatic oil bath air filter shall be capable of removing all particles, the ingestion of which would cause damage or abnormal wear to the engine. The oil bath air filter shall have sufficient capacity to enable the engine to operate continuously at maximum continuous site rated capacity.

An air intake silencer shall also be fitted so as to minimise the level of noise generated with a critical grade (35 db reduction) silencer. In addition, there should be provisions for the air intake silencer to be regularly inspected and cleaned.

Localised instrumentation required shall be analogue temperature and pressure gauges located before and after the air cooler. These gauges should be able to withstand any vibration caused by the intake system. In addition, these gauges should be extended to the common engine control panel. The charge air temperature high alarm must be extended to the engine common control and alarm panel.

There shall be an automatic drain-off for the condensate with provisions for manual operation (if required) prior to charge air entering the engine.

Exhaust gas driven turbochargers are to be provided. The turbocharger rotor shall be statically and dynamically balanced to ensure a smooth and vibration free operation. The turbocharger shall have a self-lubricating oil pump and a sight glass for visual indication of the lubricating oil in the reservoir. Provisions for visual inspection of the lubricating oil spray should also be provided. Lubricating oil drain and filling should be possible with ease. A turbocharger speed monitoring device on the remote engine control panel shall be provided.

5.23 Engine Fuel Oil System

Specification of Industrial IDO Fuel available for use is as follows :

Characteristic	Clear and Bright at Ambient Temp	Test Method	Average of last 12 months
Colour	4.0 max	D1500	2.0
Density @ 15o C (Kg / m3)	920 max	D1298/D4052	851.0

Ash (% by mass)	0.01 max	D482	< 0.01
Carbon residue	0.2 max	D189/D4530	< 0.20
Cetane number	35 min	D613	-
Cetane index	35 min	D4737	54
Cold filter plugging point (oC)	11 max	IP309	9
Flash point (oC)	65 min	D93	80
Sulphur (% by mass)	1.0 max	IP336	0.45
Water (% by volume)	0.1 max	D95	0.07
Sediment (% by mass)	0.02 max	D473	< 0.02
Viscosity @ 40o C (mm ² / s)	1.8 - 5.8	D445	3.1
Neutralisation Value (Strong Acid #) (MgKoH/g)	nil	D664/D974	nil
Conductivity @ 23o C (Ex refinery) (pS / m)	100 - 450	D2624	200
Conductivity @ 23oC (Within terminal) (pS / m)	70 - 450		-

Specification of Industrial HFO Fuel available for use is as follows:

Sample Number	54011
Product	Fuel Oil
Product Grade	PE HFO
Sample Site	PE Vuda Terminal
Sampling Point	Tank V8
Sampled Date	14.04.2023
Specification	

Method	Notes	Component	Unit	Specification	
ISO12185	(1)	Upper Density @ 15°C	kg/L	0.9000 - 0.9910	0.9679
ISO12185		Middle Density @ 15°C	kg/L	0.9000 - 0.9910	0.9679
ISO12185		Lower Density @ 15°C	kg/L	0.9000 - 0.9910	0.9681
ISO12185		Average Density @ 15°C	kg/L		0.9680
ISO12185	(1)	Density @ 15°C	kg/L	0.9000 - 0.9910	0.9678
ISO12185		Calculated Density at 15°C	kg/L		0.9658
D93	(2)	PMCC Flash Point	°C	min 65.0	97.0
D97		Pour Point (Upper)	°C	max 10	-6
D445		Viscosity Auto @ 50°C	cSt	max 180.0	168.8
D445		Viscosity @ 18°C	cP		1551
D4294		Sulphur	%mass	max 3.500	2.88
ISO8217-ANNEX	(1)	Gross Specific Energy	MJ/Kg	min 41.9	42.8
D95		Water	%vol	max 0.50	0.25
D974	(1)	Observed Colour	-	Orange	Orange
D974		Strong Acid Number	mg KOH/g	Nil	Nil
D664		Total Acid Number	mg KOH/g	max 3.00	0.23
D4530		Micro Carbon Residue	%mass	max 15.00	10.66
D482		Ash	%mass	max 0.100	0.0340
IP375	(1)	Total Sediment	%mass	max 0.10	0.01
IP390	(1)	Total Potential Sediment	%mass	max 0.10	0.01
ISO8217-ANNEX	(1)	Calculated Carbon Aromaticity Index	-		838
IP501		Sodium	mg/kg		25
IP501		Vanadium	mg/kg	max 200	100
IP501		Aluminium + Silicon	mg/kg	max 70	23
IP501		Calcium	mg/kg		6
IP501		Phosphorus	mg/kg		<1
IP501		Zinc	mg/kg		1
IP501		Used Lubricating Oil	-		Not Present
D5185	(1) (3)	Lead	mg/kg		<1

Product/Brand Name: Marine Fuel Oil 180 Fiji

PROPERTY	UNITS	PSS LIMITS	TEST METHODS ASTM/ OTHER	NO
Composition			ISO 8217	No
Density @ 15°C	kg/m ³	max. 900.0 - 991.0	D1298/IP385	No
Viscosity @ 50°C	mm ² /s	max. 180	D445	No
Flash Point	°C	min. 65	D93	
Pour Point	°C	max. 10	D97	
Calculated Carbon Aromaticity Index (CCAI)		Report	ISO 8217	No
Sulphur	% mass	max. 4.0	D2622/D4294/IP336	
Water	% vol	max. 0.5	D95	
Ash	% mass	max. 0.10	D482	
Conradson Carbon Residue	% mass	max. 15.0	D189/ D4530	
Strong Acid Number	mg KOH/g	max. Nil	D974	
Total Acid Number	mg KOH/g	max. 3.0	D664	
Aluminium & Silicon	mg/kg	max. 70	D5184	
Lead	mg/kg	Report	D5185	
Vanadium	mg/kg	max. 200	D5863/IP288/GR354	
Sodium	mg/kg	Report	D5863/IP288	
Existent HFT	% mass	max. 0.10	D4870/IP375	
Accelerated HFT	% mass	max. 0.10	D4870/IP390	
Differential, Total Sediment (Potential minus Existent)	% mass	max. 0.05	Calculation	
Zinc	mg/kg	max. 15	IP501	No
and Phosphorus	mg/kg	max. 15	IP501	
and Calcium	mg/kg	max. 30	IP501	

Contractor shall evaluate the requirement of additional oil tankage (Bunker /Day tank) and include such details in the tender. Height difference between the floor level and the existing tank bottom is approximately 15 meters (EPC Contractor to Verify during design stage). The station fuel supply shall consist of a 100 mm ring main system with provisions to connect each engine from the mains.

A fuel centrifuge/separator and primary plant supply duplex cleanable strainer with provisions for automatic bleeding of water is to be provided dedicated for this plant. A bypass and isolating valve arrangement is required for maintenance purposes.

A temperature compensated, totaliser fuel flow meter with provisions for isolation and bypass is to be provided for each genset. Error on the meter must be less than 1%.

The fuel filters shall be of duplex (cleanable) type with changeover valves to permit the removal and replacement of one filter while the engine is operating at the maximum continuous site rating. A bypass arrangement is also required together with two differential pressure gauges located locally and a differential pressure switch to activate an alarm at the engine control panel. Filters shall be capable of removing all foreign matter above a particle size of 5 microns and shall have a capacity sufficient to ensure 1000 hours full load operation between servicing.

At the end of the fuel rail on the engine, a local pressure gauge is required with a pressure switch for activating low fuel rail pressure at the engine control panel.

The injector leak off should be piped such that it is not registered twice by the fuel flow meter. It is preferred that this be connected through a non-return valve after the fuel flow meter on the engine side. However the engine manufacturer's discretion is required as to whether this arrangement would be suitable for the design chosen to operate at the maximum continuous site rating.

The engine genset fuel pump tappet drains shall be designed such that they collect at a common drain tank and under no circumstances should be allowed to enter engine lubricating oil sump. A fuel tappet drain tank high level alarm is required. The drain tank shall be capable of accommodate at least one day's fuel pump tappet leak off.

Fuel valves shall be suitable for operation at the working pressures and temperatures of the fuel oil being handled and be fire safe. Valves shall be installed such that ready and safe access for operation and maintenance is obtained.

5.24 Compressed Air System

The engine shall be started by a compressed air system. A control air interlock must be provided when the barring gear is engaged. As a backup, an electrical starting control interlock will be required for the same purpose to avoid engine being started up when the barring gear is engaged. Upon successful starting, the compressed air supply should automatically isolate initiated by an engine speed sensing device to avoid unnecessary wastage of compressed air.

The air receivers shall be complete with inspection doors, inlet non return valve, inlet and outlet isolating valves, automatic drain plug, relief valve, pressure gauge and a pressure switch to indicate low starting air pressure alarm and actual pressure at remote engine control panel. Shutoff Valves and gauges shall be readily accessible for servicing, maintenance, and for emergencies. Furthermore, air/oil water separator with isolating valves must be provided at the inlet of the receiver. The receiver shall be fitted with an automatic drainage system and bypass with appropriate isolating valves. Each genset shall have a suitable sized air receiver sufficient for

three (3) starts per engine. A minimum of 2 electrically driven fully automatic starting air compressors is required.

A separate, fully independent, low-pressure compressed air system for required engine controls and instrumentations, as well as for auxiliaries shall be provided. It shall be fitted with automatic condensate draining system, an air dryer and automatic oiler, if required. The compressor and the receiver shall have sufficient capacity to support the engine instrumentations as well as the use of normal pneumatic tools used during servicing and maintenances. A provision for connection to the high pressure starting air system through a pressure regulating valve shall be provided for emergency purposes.

5.25 Engine Lubricating Oil System

The engine shall be equipped with a positive pressure forced-feed lubrication system to all moving parts of the engine. There shall be no moving part which requires manual lubrication whilst in operation. The engine lubricating oil system pressurizing pump shall be attached to and driven from the engine. It shall be of the positive displacement type and shall be equipped with a pressure relief valve (with provisions to adjust the pressure) to regulate oil pressure at the engine bearings and to prevent a build-up of excessive pressure within the system. In the event that the engine driven pump failure, an alarm should be initiated and the electric motor driven priming pump should start automatically to supply the lubricating oil until the engine is stopped.

For priming of the lubricating oil system prior to starting, an electric motor driven lubricating oil priming pump of positive displacement type, fitted with a non-return valve on the discharge side and an isolating valve on the inlet side is required. The electric motor driven priming pump should cut-off automatically on confirmation on registering of a nominal engine running oil pressure.

Provisions to check the oil level with a graduated dipstick while engine is running should be provided. A lubricating oil header tank must be provided to cater for five days continuous operation at the maximum continuous site rating. Provisions to isolate the tank must be available as well. A low lubricating oil level alarm must be provided on the tank together with a visual level indicator. Filtration and metering system shall be incorporated in the design and supply.

An centrifuge/separator and primary plant supply duplex cleanable strainer with provisions for automatic bleeding of water is to be provided dedicated for this plant. A bypass and isolating valve arrangement is required for maintenance purposes.

If the engine sump is wet type a sump drain facility shall be provided with positive locking against accidental opening.

Clean and Dirty Waste Oil Storage Tanks shall be provided of minimum capacity to fully drain or fill three (3) completed engine sumps. The plant lube oil system shall be provided with suitable pumps and controls.

The engine shall be fitted with full flow type lubricating oil filters. The Tenderer is required to specify the type of lubricating oil filter recommended with its economic justification. Mobil, Pacific Energy, or Total presently provides lubrication oil in Fiji. Tenderer is asked to specify at least one type of recommended lubrication oil from each lube oil supplier.

The filter shall be of duplex type with change over valves to permit removal and cleaning of one filter element while engine is running. The engine shall be fitted with on board centrifugal filters on both banks and shall have provisions for removal/cleaning while the engine is running. Differential pressure gauges with alarm to indicate a blocked filter must be provided. The filter medium and sizes shall have a capacity to operate for at least 1000 hours operation between servicing.

A thermostatically controlled valve shall be fitted in the lubricating oil circuit to raise the temperature of the engine to the required operating temperature during engine start up.

An electric motor driven centrifuge complete with drive, control panel, heater and associated pipe work with isolating valves should also be provided per engine.

5.26 Instruments & Protection

All engine sensors, gauges, automation/instrumentation shall be mounted/located in a manner allowing ease of access for service, testing, maintenance, troubleshooting and replacement of faulty components. Mounting of control panels and terminal boxes on the engine shall be extremely minimal and where it cannot be avoided, they shall be fitted with vibration mounts. Instrumentation and Control wires/cables as well as connection plugs and terminations to be used shall be double insulated and additional measures taken to avoid damage caused by excessive heat and vibration. Sufficient spare plugs, terminal lugs, and/or jackets shall be provided.

5.26.1 Local engine instrumentation should include at a minimum:

- a) Pressure and temperature readings at the outlet of the engine driven lubricating oil pump and electric motor driven lubricating pump.
- b) Lubricating oil temperature and pressure at engine inlet and outlet to the engine.
- c) Jacket water outlet temperature in/out.
- d) Jacket water outlet pressure in/out
- e) Engine inlet charge air temperature & pressure
- f) Turbocharger speed.
- g) Crankcase pressure.
- h) Fuel filter differential.
- i) Fuel rail pressure.
- j) Lubricating oil filter differential.
- k) Control air pressure
- l) Bearing temperature.
- m) Starting air pressure.
- n) Cylinder exhausts temperature.
- o) Stator winding and alternator bearing temperature.

5.26.2 Pre-warning alarms (5 deg C or 5 PSI below the shutdown settings) required are :

An audible and visual alarm shall be provided for the following engine conditions:

- a) Jacket water outlet temperature high
- b) Jacket water outlet pressure low
- c) Engine inlet charge air temperature high
- d) Turbocharger vibration high
- e) High crankcase pressure
- f) Fuel filter differential high
- g) Low fuel rail pressure
- h) Lubricating oil filter differential high
- i) Bearing temperature high.
- j) High cylinder exhausts temperature
- k) Stator winding and bearing temperature high

In addition, provisions must be provided for a remote engine alarm as per above list. All alarm indications are to be mounted on an annunciation panel with facility for TEST, MUTE and RESET.

5.26.3 Engine shutdowns shall be required for :

- a) Jacket water outlet temperature high
- b) Jacket water outlet pressure low
- c) Generator bearing temperature high.
- d) Engine lubricating oil pressure low.
- e) Engine lubricating oil temperature high.
- f) Turbocharger vibration high
- g) High crankcase pressure
- h) Engine driven lubricating oil pump fail
- i) Engine bearing temperature high.
- j) High cylinder exhaust temperature high
- k) Overspeed trip (Electrical, which shall be set lower than mechanical overspeed).
- l) Electrical fault which is a group into a shutdown with alarm for electrical fault on the generator.
- m) Emergency stop both local and remote.
- n) Control supply failed.

On the operation of any one of the above :

- a) The engine should shut down completely.
- b) The generator circuit breaker should trip and display C/B open remote alarm.
- c) Data logging with time sequence of all alarms.

Cooling down circulating and radiator fan operation should continue to a designed pre-set time.

To avoid the engine restarting when the trip is reset, the engine override shutdown timer should be locked out to the desired stop down time.

In addition a provision must be available for remote engine shutdown as per above list.

5.26.4 Alarms at engine control panel to include :

- a) Jacket water outlet temperature high
- b) Jacket water outlet pressure low
- c) Make up tank level low.
- d) Jacket water header tank level low
- e) Engine inlet charge air temperature high
- f) Turbocharger vibration high
- g) High crankcase pressure
- h) Fuel filter differential high
- i) Low fuel rail pressure
- j) Lubricating oil header tank level low
- k) Lubricating oil filter differential high
- l) Engine driven lubricating oil pump fail
- m) Engine bearing temperature high.
- n) Starting air pressure low
- o) High cylinder exhausts temperature

- p) Engine ready to start (on confirmation of all engine pre start conditions)
- q) Stator winding temperature high
- r) Engine over speed trip- Mechanical/Electrical

Provisions for remote indications of all above alarms shall be provided by the Tenderer

5.26.5 Engine Protection (Mechanical)

The engine shall be fitted with all protection devices necessary to ensure safe operation of the engine under the specified operating conditions. Such devices shall, where applicable, be integrated with other protection devices specified.

The following protection equipment is a minimum requirement. However, the tenderer shall also include any additional items deemed necessary to satisfy the requirements of this section.

a) Crankcase Explosion Doors

The engine crankcase shall be fitted with automatic quick acting self-opening relief valves to protect the engine against explosion damage. The valves shall be of manufacturer's standard supply provided that the total combined free area of the relief valves shall be in accordance with Lloyds Rules and Regulations.

b) Cylinder Relief Valves

Where possible, each cylinder of the engine shall be fitted with an approved type pressure relief valve.

c) Overspeed Trip

The engine shall be provided with an over-speed trip which shall operate independently of the normal speed governor and shall act directly upon the supply fuel to the engine. Operation of the over-speed trip shall also operate auxiliary contacts for the initiation of all alarms and for switchgear tripping. A shaft operated mechanical device is preferred. The operation of the mechanical over-speed shall be above the electrical over-speed protection but still below the safe speed limit of the engine.

d) Low lubricating oil pressure shutdown

The engine shall be provided with a mechanically operated device which shall operate independently of normal speed governor and shall act directly upon the engine fuel supply. Operation of this trip shall also operate auxiliary contacts for the initiation of all alarms and for switchgear tripping. The setting pressure of the device shall be much lower than the electrically operated device but above the safe operational requirements.

All instrumentation shall have an error of less than 2%.

All remote instrumentation and Engine controls shall be housed in a common engine control panel. The panel shall be freestanding with anti-vibration mounts and shall have provisions for outgoing cables.

5.26.6 Engine Crankcase Ventilation

The engines shall be equipped with an engine crankcase extractor fan or condensation trap, together with associated electrics, valves and pipe work to effectively condense lubricating oil fumes so that no lubricating oil is discharged outside the power station. At a suitable location in the pipe work a non-return valve together with

a butterfly valve to maintain the recommended crankcase pressure/vacuum at different loading shall be provided. A manometer for engine crankcase pressure/vacuum is required.

Provisions must also be available for supplementing back to the engine any lubricating oil condensed. Engine crankcase outside vent must have a filter outside the station to prevent ingress of dirt. The circuitry shall be equipped with a pressure switch which in the event of high crankcase pressure will initiate an alarm on the engine control panel.

5.26.7 Engine Exhaust System

The engine shall be provided with an exhaust system comprising; steel exhaust piping, flexible steel expansion bellows, exhaust silencers and all necessary hangers and supports for a vertical mounted arrangement. The exhaust piping shall be of thick walled steel sized in accordance with the engine manufacturer's requirements.

Critical grade (35 dBA) Exhaust Silencer(s) grade shall be provided and shall be located vertically outside the power station on support stand and shall be supported on adequately designed anti-vibration devices to prevent transmission of noise and vibration to the building structure. Where piping penetrates the wall of the power station or the ceiling, approved pipe sleeves shall be provided.

Provisions for the water to be collected and be drained shall be provided at the base of exhaust silencer. A spark arrester shall be installed within the exhaust silencer to quench out flames that may be discharged from the silencers during abnormal combustion.

All exposed piping and silencer(s) installed inside the building shall be thermally insulated with high temperature insulation. Insulation shall be suitable for service temperatures of up to 650°C and should yield a surface temperature of 65°C when in service. Asbestos should not be used. Insulation sections shall fit the exhaust piping and flange joints accurately without gaps and shall be adequately secured and shall be of removable and reusable insulation blanket type.

The exhaust silencers and associated pipe work located outside the power station, shall be appropriately cleaned using grit blasting techniques followed by application of undercoat and silver heat resistant paint capable of withstanding continuous service conditions of 650°C. The anticipated service life of the paint should be at least 5 years.

Individual engine cylinder exhaust temperature probes are required together with the associated temperature metering unit and cables to remote engine control panel. An audible alarm is also required for abnormally high cylinder temperatures to be incorporated in the exhaust temperature metering device as mentioned above. Pyrometers are required on the turbo charger intakes.

The noise level outside the power station due to the complete equipment scope offered shall be less than 85 dBA at a distance of 7 metres from building walls or externally mounted equipment.

5.26.8 Engine Cooling System

The engine shall be water cooled. The radiators shall be horizontally mounted with induced draft low energy consumption electric fan motors. The radiators shall be of the heavy duty and pressurised type protected for humid tropical heavy rain and salt air conditions and shall be designed with adequate core cooling capacity. The radiators shall have a cooling capacity under the specified site conditions of 40 deg C, sufficient to adequately satisfy the cooling requirements of the IDO/HFO engine operating at 100% of continuous site rating at 40 degC. In the design of the radiator, an allowance of not less than 20% shall be made for reduction in heat transfer capacity by fouling. Sizing calculations are to be provided with engineering submittals.

The radiator fan shall be axial flow aerofoils and shall be coupled to low energy consumption electric motor whose controls shall be such that the number of motors/fans operating changes automatically depending upon lubricating oil, charge air or jacket water cooling requirements. Furthermore the control of the fan shall be such that upon engine shutdown or normal stopping it shall continue to operate until engine water, lubricating oil temperature have been cooled down to acceptable levels.

All radiators must be equipped with isolating valves and provisions for manual bleeding. Pressure loss in radiators is to be kept to a minimum. Differential pressure gauges must be provided on each section of the radiators to indicate amount of pressure drop across the cooling tubes. It is preferred to have alarms when the pressure drop exceeds the designed parameters.

Flow indicators with flow switches and alarms are required for jacket water inlet, turbocharger inlet cooling water and charge air cooling water (if available).

A Coolant water conditioning system shall be provided to adequately maintain cool water chemistry.

A thermostatically controlled diverting device shall be installed in the cooling water circuit to maintain the temperature of the water entering the engine jacket at the required level and to facilitate rapid warming up of the engine during start up.

An expansion/make up tank of adequate capacity shall be provided, located above the engine level which should be connected to the suction side of circulating pump. The tank shall be complete with inlet & outlet connections, over flow drain, and float switch for high/low alarm indications to the control panel. It should also have a visual contents indicator.

An electric motor driven cooling down pump together with associated drive and controls is to be provided. This pump would cut-in the event of an abnormal shutdown during operation, when cooling is required until the engine temperatures have reached acceptable levels to prevent metal fatigue.

The cooling system shall be complete with maintenance drain tank and all necessary piping, valves and fittings. The valves shall be suitable for operation at the working temperatures and pressures of the water being handled. Valves shall be installed such that safe and ready access is obtained for operation and maintenance. After installation at site, sufficient inhibitor as recommended by the manufacturer shall be added to the cooling water at the time of filling so that it adequately protects the engine jackets and passage-ways from corrosion.

All rigid piping shall have provisions to absorb shock and vibration caused by the engine while running.

5.26.9 Barring Gear

An electric motor driven barring gear with a pendant hand control with cable length sufficient to move round the engine is to be provided. A mechanical interlock for isolation of barring gear and provisions for electrical and pneumatic interlock to prevent accidental starting of the engine when the barring gear is engaged, must be provided.

Cylinder pressure indicating cocks should be supplied to each cylinder for the following reasons:

- a) Relieve the cylinder pressure during barring.
- b) Taking compression and peak pressures while the engine is running.
- c) Draining out any condensate from cylinders.

5.26.10 Motor Control Center

All auxiliary motor drives, contactors, overloads, isolators and circuit distribution boards with the main isolator and individual motor metering shall be housed in a free standing motor control panel with suitable anti-vibration mountings. The provision for cable entry and outgoing cables shall be provided by the contractor. Provisions for an emergency black start generator and emergency bus shall be included within the MCC.

All drives shall be of Direct On Line (DOL) contactors with suitable protection against high winding temperature, Over current and Single Phasing. (The contactor coil control voltage is preferred to be 110 VAC). Other standard motor starters like Variable Speed Drives should be considered for motors over 30KW rating.

5.26.11 Automatic Voltage Regulator Panel

A separate free standing panel or a panel incorporate within the control panel with anti-vibration mountings to house a Thyristor divert Automatic Voltage Regulator (or manufacturers standard), with a field circuit breaker (if required) and associated instruments and indications as listed below are required :

- a) Generator volts
- b) Field volts
- c) Divert current
- d) Field current
- e) Field circuit breaker trip indicator

Note: A separate field suppression switch will be required if an alternative Automatic Voltage Regulator is used. The Contractor will have to supply information on the type and make of the automatic voltage regulator and provide the installation details.

5.26.12 Alternator & Excitation

5.26.12.1 Alternator

The alternator shall be flexibly connected to the prime mover. The alternator cover and vent openings shall

have screens to protect any foreign objects from entry. The main rotor shall be of a rotating field type fitted with damper windings and should be self-ventilated. The alternator offered shall be suitable for parallel operation with other generators in the National grid. The phase rotation of the existing plant is Red, Yellow, Blue or A, B, C.

Windings shall be star connected with both ends of each winding brought out to separate terminals for external star connection for appropriate neutral earthing resistor and isolator. Suitably sized switchgear and resistor shall be provided. The Neutral earthing system supplied shall be designed in manner that overheating of the resistor or associated connection accessories due to harmonics or load unbalance is minimized.

Each phase winding shall incorporate positive temperature coefficient thermistor for over temperature detection and Partial discharge detection coils (ROGOWSKI). The latter is optional and should be quoted separately if it is not a standard fitting. A complete spare set of thermistors shall be incorporated and terminated adjacent to the terminals of its corresponding element and a temperature monitoring device shall be provided in the remote engine control panel.

A terminal box shall be fitted to the stator frame to enclose the winding and thermistor terminals. The terminal box shall be suitable for right angle termination of main cables in the alternator on either side of the stator.

The alternator frame earthing shall be external to the terminal box or to a suitable location within stator frame.

The Stator and Rotor windings shall be insulated to Class F standard or higher.

The wave form of the output voltage shall be sinusoidal for the full range of loads and power factors and should comply with IEC standards. The zero sequence reactance of the alternator shall not exceed 30%.

Winding temperature rise above reference conditions shall remain within the limits stated in IEC under specified load and a 1 hour overload condition.

The rotor shall be statically balanced and remain in dynamic balance up to 125% of rated speed.

Electric heating shall be provided to maintain insulation resistance to a safe value during the periods of machine shut down and it's switching shall be automatic, initiated by the operation of the generator circuit breaker.

5.26.12.2 **Excitation**

If the alternator is provided with a direct coupled shunt wound exciter, adequate access to the brush gear for inspection and maintenance shall be provided.

A Brushless type Excitation is preferred that is fitted with protection for the diodes. Diode failure indication shall be provided and the machine shall continue to operate in the event of a single diode failure. Excitation transformer shall be protected by fuse and located in the alternator pit. It may be oil or air insulated.

Preference will be given to a dynamic excitation system.

Windings shall be insulated to Class F standard or higher.

Provisions for the connection of automatic field suppression shall be provided.

5.26.12.3 Voltage Regulation

The regulated voltage shall remain within $\pm 1.5\%$ of the set value under all specified steady load conditions for frequencies between 46 and 54 hertz. The engine-generator shall be able to operate on-load without limitation on the above-specified frequencies as per condition specified in (d) below.

The output voltage shall be adjustable within $\pm 10\%$ of nominal.

The regulated voltage shall be taken as the average of phase to neutral RMS voltages of the three windings excluding cases where the current ratio between highest and lowest phases exceeds 2:1.

Under the condition of sudden application of (Specify Maximum Allowed) xx% rated load or the removal of full load, the voltage shall remain within a minimum of $\pm 7\%$ and a maximum of $\pm 10\%$ of the set value with 99% recovery affected within 0.5 seconds and full recovery within 1 second for frequencies between 46 and 54 Hertz. Tenderer shall provide performance test results of proposed equipment impact loading/load rejection capability.

The Contractor could provide, if possible, a value better than the above voltage regulation.

The maximum deviation in voltage shall conform to the requirements of IEC34.

Additional manual field regulation shall be provided with the selector and controls mounted on the front of the AVR panel (if available).

Voltage regulation equipment shall be suitable for parallel operation of alternators in the Fiji National Grid.

Equivalent characteristics for voltage regulation must be provided with a clear statement describing the type of voltage regulation offered so that reactive power loading can be shared equally or as desired between the existing generators and the one offered.

Control, Protection and Monitoring requirements are specified elsewhere. Alternator output shall collapse on short circuiting the output terminals in a manner which operates the protection relays.

Set voltage shall be re-established within 2 seconds of removing the short circuit. The differences in phase to neutral voltages for an out of balance loading between any two phases should not exceed $\pm 2.15\%$ of nominal voltage.

On start-up, with automatic voltage control on and with a resistive load of 30% rated capacity applied to the output voltage, regulation shall be achieved within 3 seconds of the genset reaching a shaft speed corresponding to 46 Hz.

5.26.13 Other Electrical Components

5.26.13.1 Design Standards for Electrical Plant

All electrical components shall be designed for continuous operation when the plant is operating at full rated output under the conditions specified. Design standard for electrical works shall be IEC

Except for the Alternator and Exciter, the electrical components and cables shall be selected such that, under full rated plant output, the current and voltage conditions for the components do not exceed 80% of the manufacturer's safe working rating.

The temperature rise of the air within the enclosed cubicles shall not exceed 30°C at the full rated output at the specified reference conditions. The IEC Wiring Regulations shall apply to all electrical works. All capacitors used, shall be designed to withstand 2.5 times the test voltage for 1 minute at its rated values. Electrolytic capacitors could only be used in printed circuit boards according to the design.

Synchronising facilities for parallel operation of the generating plant should be provided.

The tenderer shall provide an independent DC system for the new generation equipment controls and instrumentation.

All circuit components shall have provisions for testing, fault tracing and shall have Test/Disconnect terminal blocks with relevant drawings.

5.26.13.2 **Wiring, Cables and Connections**

All wiring work shall be carried out neatly to the satisfaction of the EFL and in accordance with the SAA regulations or better.

Insulation shall be non-flammable, non-hygroscopic, fungus resistant and shall not be affected by normal plant operating temperatures or by oils and lubricants.

Insulation resistance shall not be less than 100 Megohm at a voltage which is the greater than 500 V dc or equivalent to a DC voltage equal to twice the peak working voltage.

Wiring for control and monitoring system shall be colour coded PVC insulated complete with wire numbers inserted and enclosed in "galvanised screwed conduits" terminating in terminal boxes. The connections should also be water tight.

5.26.13.3 **Cable size**

The minimum cable size shall be:

- a) Control Wiring, 1.5 mm²
- b) Power Wiring, 2.5 mm²

A copper Busbar or multi strand soft drawn copper cable shall be used where the cross sectional area of conductor exceeds 95 mm².

Wiring terminations shall be identified according to the wiring diagrams and the conductors shall be securely clamped in approved terminal blocks by means of self-locking screwed clamps.

High voltage cables shall be XLPE and armoured with steel wire.

5.26.14 Motors and Starting

The Power supply to each motor shall be through circuit breakers and appropriate isolating equipment located at the motor control centre. All external switches/isolators on the panels and MCC shall have padlock provisions. Where motors are not physically visible from the MCC or nearest power connection, a local lockable isolator or manual disconnect switch shall be provided at or near the motor for safety and maintenance purposes.

All AC motors shall be of 3 phase squirrel cage, totally enclosed waterproof construction arranged for direct-on-line starting by contactors and should be provided with thermal overload (CEF-11), single phasing and high temperature protection. All motors must be fully sealed and weather protected. Motors for hazardous applications or when installed in hazardous areas shall be explosion-proof.

All motors above 30 HP with PTC type thermistors shall be provided with winding protection in each phase. The contactor (Drive) Operating coils Voltage shall be 110 volts AC.

5.27 Overall Operation and Maintenance

5.27.1 Personnel Training

The contractor shall provide on-site training for up to 12 persons nominated by the EFL in the correct operation of plant installed for a period of one week prior to preliminary site testing of the gensets is completed. In addition, the contractor shall provide on-site training for up to 12 nominated persons in the maintenance and fault tracing techniques applicable over a period of one week six months after commissioning.

The tenderer shall include this training cost in their proposal.

Operating and Maintenance Manuals as specified shall be made available by the contractor before such training is commenced.

During erection, overhaul, commissioning and testing, the contractor shall assist and permit the EFL's staff to observe procedures for the purpose of gaining familiarity with operating and maintenance aspects of the plant.

The Tenderer shall provide operation and maintenance software that provides the means to inventory and control spare parts, procurement and inventory of spare parts (engine and auxiliary systems, generation of work orders/schedules, log maintenance performed, and other O&M tasks.

5.27.2 Miscellaneous Installation and Erection Requirements

The manufacturer's rating plate showing type, serial number and rating details shall be attached to each equipment in a position where it will be readily observed during the installation.

Radio interference from a radio frequency radiation emanating from the equipment shall be prevented or suppressed. Interference to the correct operation of the installed plant from outside radio frequency sources shall be prevented. All metal parts shall be earth bonded. The requirements of IEC shall be met.

Fire protection requirements and equipment required to comply with the OHS regulations in order to ensure safe operation of the new contractor supplied plant or the integrated facility.

The Contractor shall be responsible for the total generating plant overhaul, installation and commissioning. It is anticipated that specialised personnel consisting of at least one mechanical engineer and one electrical engineer would be sent by the Contractor for the installation and commissioning works. However the EFL will nominate from its pool of engineers, technicians and tradesmen, a team for assisting in the works. Tenderer is to specify the number of trade personnel required at site.

The contractor shall make suitable arrangements for ducts and any additional channels, openings and trenches that may be required. Ventilation fans, louvered vents, etc. shall be designed and equipped with noise insulation materials and shall restrict ingress of rain water. Building ventilation shall be pressurised, with a design temperature rise of less than 5 deg C with all engines and auxiliary equipment operating at 100% load. Intake and discharge ducts shall be fitted with hush ducts to minimize external noise levels.

All items of equipment and all wiring terminations and terminals shall be clearly identified by means of engraved labels. Adhesive labels will be considered unsatisfactory. The identification shall be in accordance with the circuit and wiring diagrams.

5.28 Testing and Commissioning

5.28.1 General Requirements

The Contractor shall be responsible for performing all required tests free of cost to the EFL, including the provision of materials, test equipment, measuring equipment and any specific arrangements that may be deemed necessary by the EFL to achieve the testing required with the exception of the supply and cost of fuel, electricity and water required for site preliminary and acceptance tests. The required tests are specified in the following sections of this specification.

5.28.2 The testing programme shall generally consist of:

Tests prior to delivery to the site. Such tests are intended to ensure no faulty or unsuitable items are delivered to site.

Preliminary tests at site for individual and assembled components. Such tests shall demonstrate the ability of components to perform their designed function in accordance with the Specification and performance.

Commissioning tests on the completed installation. Such tests shall demonstrate that the performance of the installation that meets the Specification and guaranteed performances.

The sequence of tests shall be subject to the prior approval of the EFL. The proposed programme of tests shall be submitted to the EFL at least 6 weeks before the commencement of the commissioning tests.

The Contractor shall perform any additional tests that the EFL may deem necessary to satisfy that the plant complies with the Specification.

All tests shall be performed in the presence of and to the satisfaction of the EFL or nominated representative. The limits of accuracy shall be as specified in ISO 3046/111.

The results of all tests shall be recorded and certified by the Contractor and copies of the certified results delivered to the EFL within 2 weeks of the completion of the tests.

Defects revealed during testing shall be rectified at the Contractor's expense and the tests subsequently repeated until all defects are eliminated.

Live load shall be available at the site to provide suitable loading conditions at the time of testing.

The frequency of measurements proposed during the tests shall be subject to an agreement by the EFL in advance.

A regulatory certificate and approval required for the installation and equipment shall be obtained by the Contractor on the EFL's behalf and supplied to the EFL prior to operation of that equipment.

Calibration of any permanently installed panel instrument used in tests shall be carried out within 4 weeks of the commencement of the tests.

5.28.3 Site Tests

The Contractor shall give the EFL at least 10 consecutive working days prior notice of the commencement of the tests.

The fuel used in the engine shall be in compliance to Part 4, Section 8.4 of Technical Specifications of this Specification. Initial engine system fills (engine lube oil, coolant conditioner) and fuel will for testing will be provided by the EFL. If additional system fills are required due to re-testing, they shall be provided by the Contractor.

5.28.4 The TEST for the generating plant shall comprise:

- a) A general inspection of the equipment to check its compliance with the specified requirements.
- b) Measurement of the cold resistance of the electrical windings.
- c) Determination of the alternator open circuit and short circuit characteristics.
- d) A cold crankshaft deflection.
- e) Pre-starting and start-up procedures, alarm and shutdown tests, synchronising tests and engine compression tests.
- f) A continuous trial sequence of:
 - 0.5 hour at 50% rated load
 - 0.5 hour at 60% rated load
 - 0.5 hour at 70% rated load
 - 0.5 hour at 80% rated load
 - 0.5 hour at 90% rated load
 - 4 hours at 100% rated load

At the above mentioned loads, all the parameters listed in the local instrumentation and those in remote engine control panel shall be monitored. The accuracy of the measurements shall be as in ISO 3046. In addition, the specific fuel consumption and the specific lubricating oil consumption shall be calculated and provided with the tender document.

5.28.5 The continuous test run shall comprise of:

1. Compression pressure readings at 100% load.
 - a. Exhaust temperatures at 50, 70, 80, 90, and 100 % of rated load.
 - b. Noise level tests outside to meet the Silencer Grading requirement.
 - c. Exhaust emission (NOx as NO2) characteristics at 100% of rated load.
 - d. Measured Functional check of vibration frequencies and amplitudes at prescribed rotational speeds.
 - e. Turbocharger vibration levels – within manufacturer performance tolerance.
2. After completion of the continuous trial runs, the genset shall be returned to 100% rated load for a length of time sufficient for the alternator and exciter temperatures to stabilise. The genset shall then be shut down and measurements and readings taken immediately of the alternator and exciter winding temperatures and hot winding resistances.
3. Determination of frequency and voltage transient and permanent changes and response times under the following instantaneous load changes:
 - a. No load to 50% of rated load (or maximum allowed by manufacturer)
 - b. 100% rated load to no load (rejection test)
 - c. No load to 100% rated load in steps of 25% of rated load (or maximum allowed by manufacturer).
4. Operation of all protective circuits and devices together with verification of the settings of the associated sensors.
5. Insulation resistances and high voltage checks.
6. Crankshaft deflection tests while the engine is warm and cold.

The parameters to be measured on the engine shall be in accordance with Table 2, List A of ISO3046/II appropriate to the engine group number as defined in Table 1 of ISO3046/II. Where no provision exists on the engine for the measurement of any particular parameter, this shall be stated in the tender. The accuracy of measurement of all engine parameters shall be in accordance with ISO3046/III.

For any witness tests by the client, the Contractor shall arrange at no extra cost, the removal of all necessary covers to permit adequate visual inspection of components of the equipment to facilitate these tests.

The Contractor will also be required to arrange for the inspection of valve faces and combustion components using an inspection endoscope. In addition, the EFL may nominate one cylinder head, piston and connecting rod assembly to be removed for inspection. Furthermore a pair of main bearings shall also be opened and inspected.

If the condition of components inspected is considered satisfactory, the generating plant shall be re-assembled.

If the condition of components removed is considered unsatisfactory by the EFL, a complete strip down of such engine or generating unit may be required to determine the cause of failure of components. The necessary remedial action shall be taken by the Contractor and the appropriate test repeated until satisfactory results are obtained. Such work shall be at the expense of the Contractor.

The Contractor shall repair or replace any equipment that fails in service. Penalties for late delivery of the each genset shall apply until the repaired/replaced equipment becomes fully operational.

5.28.6 Preliminary Site Tests (Pre-Commissioning Test)

The Contractor shall give 10 day's notice to the EFL prior to all formal preliminary site tests that are to be witnessed.

5.28.7 Functional tests

The following functional tests shall be satisfactorily completed before plant and equipment is operated at the working levels:

- i) Insulation resistance of all windings and high voltage cabling shall be tested with appropriate equipment from 500 to 5000 V dc.
- ii) High voltage testing of all high voltage windings, cables and equipment.
- iii) Primary and secondary injection tests on all protection equipment and devices.
- iv) Off line checks of all protection equipment settings.
- v) Operating characteristics of all interlocks and measuring instruments.
- vi) Pressure testing of all pressure vessels and components including fuel, lubrication, cooling, and compressed air systems to twice normal working pressure or 700 kPa whichever is greater.
- vii) Coupling alignments and crankshaft alignment check, tappet adjustments.
- viii) Uniformity of alternator air gap.
- ix) The correct setting of each mechanical or electrical device or component.

The results of these tests shall be fully documented on proper log and data sheets supplied by the Contractor.

Separate functional operation of all auxiliary systems and equipment including pumps, fan motors, compressors, etc, shall be completed and tested before operating the generating unit as a whole.

On satisfactory completion of functional tests, the Contractor shall run the plant as a whole to complete adjustments and to demonstrate that its operation and characteristics are in conformity with the Specification and that formal Commissioning Tests may proceed. The results of all preliminary tests shall be submitted to the EFL.

On satisfactory completion of all preliminary tests, the circumstances under which the plant may be operated to meet installation requirements and the conditions, issue of a Certificate of Practical Completion will be agreed by the two parties.

5.28.8 Commissioning Tests

The Contractor shall submit to the EFL for approval, at least 4 weeks prior to the proposed date of commencement of the tests, proposals for the provision for testing the equipment, live loads, operators and labour for the carrying out of the tests.

The Contractor shall give the EFL at least 10 consecutive working days prior notice of the commencement of the tests.

5.28.9 The Tests shall consist of:

- a. Inspection and verification of the complete plant to determine the overall compliance, correctness of all adjustments and settings, operational suitability of the installation against the specified requirements and shall include checking the tightness of all connections and fastening devices.
- b. Verification of the correctness of operation of all protection devices and systems, including the related relative sensors settings. Induced faults imposed to simulate the responses shall be as close as possible to the actual fault conditions.
- c. A continuous trial on each genset shall be the same as site tests as described in 17.2.1 (f).
- d. During the continuous trial the following parameters shall be measured at intervals not exceeding 30 minutes.
 - i. Alternator output, kW or kVA.
 - ii. Alternator output voltage
 - iii. Alternator output current and Temperatures
 - iv. Alternator output frequency
 - v. Power factor
 - vi. Exciter voltage
 - vii. Exciter current
 - viii. Engine parameters as specified
 - ix. Electrical power requirements of all continuously running electric motor driven ancillaries and auxiliaries.
- e. Determination of frequency and voltage transient and permanent changes and response times under the following instantaneous load changes for the generating unit :
 - i. No load to 100% of rated load (or maximum manufacturer allowed step load)
 - ii. 100% of rated load to no load (rejection test)
 - iii. No load to 100% rated load in increments of 25% of the rated load.
- f. Verification of the correctness of operation of all starting, synchronising, paralleling, and stopping control systems, both automatic and manual.
- g. Verification of compliance with the total harmonic distortions as specified.
- h. Verification of specific fuel and specific lubricating oil consumption.

The Contractor shall carry out such further tests as the EFL may require further satisfaction that the Contractor's installation meets all the specified requirements.

At the completion of the above commissioning tests, the Contractor shall be required to arrange, at no extra cost, for the removal of all covers to permit adequate visual inspection of the equipment.

The Contractor will be required to arrange for the inspection of valve faces and combustion components using an inspection endoscope. In addition, based on the inspection results, operational performance and crankshaft deflection readings; the EFL will nominate one cylinder head, piston and connecting rod assembly to be removed and inspected. Furthermore a pair of main bearings shall also be opened and inspected.

If the condition of components inspected is considered satisfactory by the EFL, the generating unit shall be reassembled.

If the condition of components inspected is considered unsatisfactory by the EFL, a complete strip down of such engine or generating plant may be required to determine the cause of failure. The necessary remedial action shall be taken by the Contractor and the appropriate test repeated until satisfactory results are obtained. All such work shall be at the expense of the Contractor.

5.29 Guaranteed Performance and Service

5.29.1 Performance

The successful tenderer shall guarantee that the performance of the equipment to be supplied, shall not be less than that provided in the schedules in this tender.

The successful tenderer shall guarantee that the final installation of all equipment to be supplied in the bid shall meet the specified requirements.

In terms of performance guarantee, the successful tenderer shall provide a guarantee of 8000 machine operating hours or 12 months operation whichever comes first. If there are any noncompliance or faults arising from the tests, the Contractor shall meet costs of providing spare parts and a professional service person to diagnose and rectify the fault. Where the spare parts need to be imported from the factory, the Contractor shall bare the cost of air freighting the parts in the shortest possible time. The EFL shall only supplement local labour all other costs shall be borne by the Contractor.

During the guarantee period, no claims shall be made for lack of performance if the fault is rectified within 120 hours from the time of the failure. For any down time exceeding this, claims of F\$450.00 per hour would be made due to loss in revenue.

During the site performance tests, if the specific fuel consumption and specific lubricating oil consumption is more than +/- 0.0% of guaranteed values for specified loads, then claims for a 10 year service life and 80% operating time shall be made as follows :

a) Specific Fuel Consumption Penalty

$$\text{Fuel Penalty (\$)} = [\% \text{ deviation (tolerance } +0.0\%) \text{ in the specific fuel consumption at } 100\% \text{ rated load }] \times [\text{ Specific fuel consumption in Tonnes/MWh }] \times [\text{ Fuel cost/tonne (at the time of test) }] \times [85\% \text{ of installed capacity (MW) }] \times [0.8] \times [10 \text{ years }] \times [8760 \text{ hours/year }]$$

b) Lubricating Oil Consumption Penalty

$$\text{Lube oil Penalty (\$)} = [\% \text{ deviation in the specific lube oil consumption (tolerance } \pm 0.0\% \text{ @ } 100\% \text{ load) }] \times [\text{ Specific lube oil consumption in litres/MWh }] \times [\text{ lube oil cost/litre (at the time of test) }] \times [85\% \text{ of installed capacity (MW) }] \times [0.8] \times [10 \text{ years }] \times [8760 \text{ hours/year }]$$

The lubricating oil and fuel cost shall be an average of the last 12 months from the date of test.

Note Power consumption for all auxiliaries during power generation is to be subtracted from the gross generation prior to calculating the specific fuel oil consumptions.

5.29.2 Service

The tenderer shall nominate the type and extent of the servicing facilities, the availability of spare parts, and numbers of field service engineers trained and certified to supervise service work on the engines offered.

The tenderer shall indicate the anticipated long term availability of spare parts.

The Tenderer shall include for one (1) year after commissioning and completion of punch list items, an on-site warranty service engineer who will provide factory service support, on the job training, administer warranty claims, and generally be available to assist with new power plant operations.

The Tenderer shall offer an extended 8,000 engine hour warranty (8,000 engine hour new + 8,000 engine hour extended = 16,000 engine hour total warranty) or 36 months whichever occurs first for the engine and all auxiliary systems supplied.

5.29.3 Surface Protection

All equipment supplied against this Specification shall be painted or otherwise protected against moisture and corrosion.

The extent of painting, materials and workmanship shall be in accordance with the requirements of Standard Engineering Practices.

Piping identification shall be in accordance with Section 25 (Pipe work).

All supports, hangers, anchors, stands, etc. shall be painted in the colour of their respective service.

The internal surface of the crankcase of engine shall be thoroughly cleaned and then painted with two coats of an approved light coloured detergent oil resistant paint.

All damaged or defective paint work shall be rectified immediately following completion of the Commissioning Tests.

Any parts of the plant found to be corroding or degrading during the defects liability period, shall be thoroughly cleaned and painted by the Contractor to the approval of the Engineer before the expiration of the defects liability period.

5.29.4 Spare Parts

The tenderer shall provide a guarantee from the Manufacturers that all spare parts, materials and components used in all the equipment supplied in this tender shall be available for procurement for a period of 20 years after the equipment has been successfully commissioned and accepted by the EFL. Furthermore a list of spareparts together with part numbers and Ex-Works cost shall be provided for 80,000 engine hours of operation. Ex-Works spare parts costs indicated shall remain valid for three years after commissioning with price adjustments only based upon Ex-Works global parts pricing.

5.29.5 Obsolete parts

Contractor shall obtain undertakings from Manufactures that in the event of termination of production of the spare parts:

- i. Advance notification to the EFL of the pending termination, sufficient to permit the EFL to procure needed requirements.
- ii. Following such termination, furnish at no cost to the EFL, the blue prints, drawings and specifications of replacement spare parts, if and when requested.

5.29.6 Valves

Each pipe work shall be supplied with control and balancing valves necessary for the safe and efficient operation of the system.

Sufficient maintenance valves shall also be supplied to provide an alternate path for the working medium and enable individual items of equipment to be maintained without having to drain the complete system.

Valves shall be installed such that they are easily and safely accessible for operating and maintenance. All valves shall be closed by a clockwise rotation of the hand wheel or handle. The hand wheel of each valve shall be clearly marked with the words OPEN and SHUT with appropriate arrows to indicate the appropriate direction of rotation.

5.29.7 Valve Schedule

A valve schedule is to be provided for every valve used in the installation. The schedule should make reference to:

- a) Valve designation
- b) Type of valve
- c) Make of valve
- d) Size of valve
- e) Type of end, i.e. flanged or screwed
- f) Type of body
- g) Type of seat
- h) Method of operation i.e. manual or electrically actuated
- l) It's normal status
- j) Safe working pressure
- k) Safe working temperature

5.29.8 Designation

Designation of the following codes are to be used for the various systems.

- | | | |
|----|-----|--------------------------|
| a) | CW | for Jacket Cooling Water |
| b) | LO | for Lubricating Oil |
| c) | CA | for Compressed Air |
| d) | EXH | for Exhaust System |
| e) | FO | for Fuel Oil |

5.29.9 Valve labels

Valve labels shall be located on each valve indicating the designation and the valve number according to the drawings. Correspondingly, a combined piping and instrument diagram showing all valves, local and remote instrumentation with valve designations is to be provided in the engine room for operations and maintenance purposes.

5.29.10 Pipe Work

All pipe work required for the safe and efficient operation of the equipment to be supplied against this specification shall generally comply with the requirements of British Standards and should have standard flange connections. All pipe connections between skid mounted equipment and stationary piping shall have suitable flexible joints or vibration isolation joints to minimize vibration transmission.

5.29.11 Corrosion limits

The corrosion allowances for pipes shall be as follows:

- | | | |
|----|----------------------------|-----------------|
| a) | Steel fuel oil pipes | 1 mm |
| b) | Steel engine exhaust pipes | 2 mm |
| c) | Steel compressed air pipes | depth of thread |
| d) | Steel cooling water pipes | 1 mm |

5.29.12 Painting

All equipment supplied shall be surface cleaned by grit blasting where applicable and painted using oil and heat resisting paint to give a service life of 5 years. Welding slag etc on all pipe work is to be removed, surfaces grit blasted painted. All interior surfaces shall be pickled free of any dirt or debris.

5.29.13 Paint colour coding

The paint colours for the various systems shall be as follows:

- | | | |
|----|------------------------------------|---|
| a) | Basic engine | Spotlight green (Other Color can be specified) |
| b) | Jacket water piping & tanks | Sky blue |
| c) | Lubricating oil pipes and tanks | Orange |
| d) | Fuel oil pipes | Light brown |
| e) | Compressed air system | White |
| f) | Hand railings and safety equipment | Sun Yellow |
| g) | Drainage and ladder treads | Black |

Arrows are required to indicate direction of flow together with labels with the name of fluid written in either black or white.

5.30 Fuel Type

IDO (Industrial Diesel Oil) will be used as fuel.

5.30.1 Fuel Oil Auto Filter

The system is equipped with a fully automatic back flushing filter unit with a by-pass duplex filter. Under normal operating condition the system should not be operated with the back flushing filter by passed.

5.30.2 By-pass Filter

The system is equipped with a set of duplex filter with mesh size of 34 microns connected in parallel with the auto back flush filter. The by-pass filter is provided to facilitate isolation of the back flush filter and to be only used when back flush filter maintenance is necessary while the engines are running. The by-pass filter unit comprises of,

Two filter chambers with filter elements, One change over cock, and, One vent line.

5.30.3 Fuel Flow Meter

Each unit is provided with a micro motion flow meter to constantly measure flow of fuel delivered to the engines covered by the relevant booster unit. The flow meter is located between the filter unit and the mixing column and fitted with a by-pass valve. The flow meter can register the following information, Cumulative mass flow in kg

Flow rate in kg/hr or litres/hr Fuel pressure Fuel temperature

Note The flow meter is capable of registering negative flow rate but the cumulative mass flow is always incremental.

If booster units are operated with the inter connection valves open and if there is any re circulation of fuel through any of the booster units due pressure difference then the flow meter will register incorrect (excess) cumulative mass flow readings.

6.0 DELIVERABLES

6.1 New Generating Set for Labasa Power Station

Three fully completed copies of schedules shall be provided by the contactor in his tender dossier. Where alternative offers are also submitted, Tenderers shall lodge three completed copies of the schedules for each alternative. (Contractor to include additional items as required)

The Tenderer shall set out the details herein required for the plants offered and in so far as they are not inconsistent with the specification, they shall form part of the description of the plant to be supplied and work to be carried out.

The mention of any manufacture's or sub contractor's name in this schedule shall not relieve the contractor of his obligation to supply strictly in accordance with the specification and capable of meeting the specified testing and performance requirements.

Each page of this schedule shall be signed by the tenderer.

6.2 SCHEDULE 1 of 9 Schedules

Technical Particulars.

1. Tender's Name: _____
2. Names of proposed Sub-Contractors (If applicable)
 - 2.0.1 IDO/HFO Engine _____
 - 2.0.2 Alternators _____
 - 2.0.3 Mechanical Work _____
 - 2.0.4 Electrical Work _____
 - 2.0.5 Control System _____
 - 2.0.6 Others (Specify) _____
 - 2.0.7 Fiji Engineering & Design _____
 - 2.0.8 Site Civil Work _____
 - 2.0.9 Building Expansion _____
 - 2.0.10 Electrical Installation _____
 - 2.0.11 Mechanical Installation _____
 - 2.0.12 Fiji Transport Port to Site _____

3.0.0 IDO/HFO Generator Plants

- 3.0.1 Make of Engine/s _____
 Type of Engine/s _____
 Year of Manufacture _____
 Make of Alternator _____
 Type of Alternator _____
 Rated Speed (rpm) _____
- 3.0.2 Engine/s manufactured by and Country _____
 Alternator/s manufacture and Country _____
- 3.0.3 Continuous rated output at Alternator terminals:
 - i) ISO 3046/1 Conditions _____
 - ii) At specified site conditions _____

6.2.1 Fuel Consumption Guarantee

- i. Based on fuel oil having a net calorific value of 42,700 kJ/kg and specific gravity of 0.84 at ISO 3046/1 conditions in kJ/kWe, net plant :

% of Full Load	Specific Fuel Consumption in kJ/kWh net Electrical Output for fuel type specified	
	Net kJ/kWe measured at alternator terminals	Net Plant kJ/kWe measured at 11 KV bus
75		
85		
100		

- ii. 0% Tolerance in above consumption at rated load per ISO 3046/1

6.2.2 Lubricating Oil Consumption Guarantee

- a. Lubricating oil consumption

% of Full Load	Specific Lubricating Oil Consumption Litres/kWh
100	

- b. 0% Tolerance in above lube oil consumption at 100% load

6.2.3 Ancillary Power

The continuous net site rating should be measured with all the electrical driven engine ancillaries and auxiliaries when the IDO/HFO generating plant is operating at maximum continuous rating.

State the electrical power required for each auxiliary and ancillary

- a) Radiator fan motor _____ kW
- b) Cooling water pump _____ kW
- c) Crankcase extractor fan _____ kW
- d) Building Ventilation fan _____ kW
- e) Building Lighting _____ kW
- f) Other (list) electrical loads _____ kW

6.2.4 Engine governor

- a) Manufacturer _____
- b) Model _____
- c) Type _____
- d) Conforms to Class A Regulations [Yes / No]
If no, please specify _____

- e) Is the load control motor
24V dc, 3 wire system
If no, please specify _____

[Yes / No]

6.2.5 Load Acceptance characteristics

% of Full Rated Load Accepted	Governor Recovery Period in seconds	Minimum Speed Reached (rpm)
50		
75		
100		

6.2.6 Load Rejection characteristics

% of Full Rated Load Rejected	Governor Recovery Period in seconds	Maximum Speed Reached (rpm)
50		
75		
100		

6.2.7 Installation Data

- i) Overall Dimensions of the plant

Length _____ mm

Width _____ mm

Height _____ mm

- ii) Total weight of engine and alternator _____ kg

- iii) Minimum turning radius for the assembled plant _____ mm

- iv) Weight of heaviest part to be lifted for :

installation _____ kg

maintenance _____ kg

- v) Minimum recommended clear access space for operation and/or maintenance at :

free end of engine _____ mm

sides of plant _____ mm

excitor end of plant _____ mm

10

- x) Type of installation selected i.e. solidly mounted or with a combined under base : _____

- xi) Justification for type of design chosen : _____

- xii) Detail modifications required to adapt the plant in the existing foundation : _____

6.2.8 Vibration Characteristics

- a) Anti-Vibration Mounting (if applicable)
 - i) Make and type _____
 - ii) Number per genset _____
 - iii) Isolation efficiency over a range of frequencies (%) _____

6.2.9 IDO/HFO Engine

- a) Number of cylinders _____
- b) Bore, Stroke _____, _____ mm
- c) Speed _____ rpm
- d) Type of aspiration _____
- e) I.S.O. Standard Power at ISO 3046/1 conditions (MW) _____
- f) Recommended lubricating oil _____
- g) Method of starting _____

Signature of the Tenderer

Date

6.2.10 Alternator

Type _____ Make _____
 Maximum continuous rating _____ MW at U.PF
 _____ MW at 0.8 PF
 Rated Voltage _____ kV
 Rated Frequency _____ Hz
 Full rated load current _____ Amps
 State compliance to what Standard to which the alternator is made and tested _____
 Insulation class of Rotor _____ and Stator _____
 Temperature rise at max continuous rating _____ °C
 Temperature rise after 10% overload for one hour _____ °C
 Efficiencies

% of Maximum Continuous Rating	Efficiency at Unity pf	Efficiency at 0.8 pf
100		
90		
80		
70		
60		
50		

Signature of the Tenderer

Date

Voltage wave form on open circuit (Ph - Ph) _____ Volts
 (Ph - N) _____ Volts
 Amplitude of 3rd Harmonics _____
 Amplitude of 5th Harmonics _____
 Amplitude of 7th Harmonics _____
 Amplitude of 9th Harmonics _____
 Amplitude of 11th Harmonics _____
 Amplitude of 13th Harmonics _____

Inherent Regulation at rated voltage at unity pf _____
 at 0.8 pf _____

Reactance

- a) Reactance at full rated voltage _____
- b) Leakage reactance X_L _____
- c) Direct axis synchronous reactance X_d _____
- d) Quadrature axis synchronous reactance X_q _____
- e) Direct axis transient reactance X'_d _____
- f) Direct axis sub-transient reactance X''_d _____
- g) Quadrature axis sub-transient reactance X''_q _____
- h) Negative phase sequence reactance X_2 _____
- i) Zero phase sequence reactance X_0 _____

Time Constants

- a) Direct axis transient open circuit T'_{do} _____
- b) Direct axis transient short circuit T'_d _____
- c) Direct axis transient sub transient short circuit T''_d _____

Characteristic Curves

Tenderer to enclose following:

- 1) Manufacturer's Generator Characteristic Curves showing :
 - i) Open Circuit Saturation
 - ii) Short Circuit Saturation
 - iii) Air Gap Line
 - iv) Rated Current Saturation at 0.8 pf
- 2) V-Curves at rated voltage
- 3) Capability Curves at rated voltage.

Excitation voltage at max continuous generator output volts

Excitation current at max continuous generator output amps

Type and make of stator winding temperature monitoring device

Range °C to °C _____ to _____
 Accuracy ± °C _____

Signature of the Tenderer

Date

6.2.11 Excitor

Make and type _____

Type of Enclosure _____

Rated output _____ Amps _____ Volts

Maximum voltage _____

Class of Insulation _____

Alternator Noise

Frequency Hz	163	125	250	500	1000	2000	4000	8000	Total
Sound dB(A)									

Excitor winding Temperature rise at maximum continuous rating _____ °C

6.2.12 Automatic Voltage Regulator

a) Make and type _____

b) Regulated voltage range under all specified steady load conditions for frequencies between 46 and 54 hertz. _____ to _____ volts

c) Does the voltage remain within a minimum of ± 7% and a maximum of ± 10% of the set value with 99% recovery effected within 0.5 seconds and full recovery within 1 second with a sudden application of 60% of full load. [Yes / No]

If No, please specify _____

d) Does the voltage remain within a minimum of ± 7% and a maximum of ± 10% of the set value with 99% recovery effected within 0.5 seconds and full recovery within 1 second with a sudden removal of 100% load. [Yes / No]

If No, please specify _____

e) Does the maximum deviation in voltage conform to the requirements of AS1359. [Yes / No]

If No, please specify _____

f) Is a manual field regulation provided with the selector and controls mounted on the front of the AVR panel. [Yes / No]

If No, please specify _____

g) Is voltage regulation equipment suitable for parallel operation of alternators. [Yes / No]

If No, please specify _____

Signature of the Tenderer

Date

- h) Does the regulation equipment have the following :
- | | |
|---------------------------------|--------------|
| i) Droop adjustment | [Yes / No] |
| ii) Voltage level adjustment | [Yes / No] |
| iii) Gain setting control | [Yes / No] |
| iv) Stabilising quality control | [Yes / No] |
- i) Does the alternator output collapse on short circuiting the output terminals in a manner which operates the over current, differential, reverse power and earth fault protection relays.
[Yes / No]
- j) Can the Set voltage be re-established within 2 seconds of removing the short circuit (as in 7.0 I above).
[Yes / No]
- k) What is the percentage difference in phase to neutral voltage for an out of balance loading between any two phases : \pm _____% of nominal voltage.
- l) Can voltage regulation be achieved within 3 seconds of the genset reaching a shaft speed corresponding to 46 Hz upon starting with a resistive load of 30%?
[Yes / No]

If No, please specify _____

6.2.13 Engine Protection Devices

Are there any provisions for the termination of remote alarms for :

- | | |
|---|--------------|
| a) Low lubricating oil pressure | [Yes / No] |
| b) Low fuel pressure | [Yes / No] |
| c) High Cooling water temperature | [Yes / No] |
| d) High Lubricating oil temperature | [Yes / No] |
| e) Engine overspeed | [Yes / No] |
| f) Cooling water flow fail | [Yes / No] |
| g) Tank level abnormal (Jacket water, fuel, lube oil etc) | [Yes / No] |
| h) Radiator cooling fan motor fail | [Yes / No] |
| l) Turbocharger vibration level high | [Yes / No] |

6.2.14 Instrumentation

Are the following Engine monitoring provided at the engine control and alarm panel :

- | | |
|---|--------------|
| a) Jacket water pressure inlet/outlet | [Yes / No] |
| b) Jacket water temperature inlet/out | [Yes / No] |
| c) Valve cage cooling water pressure | [Yes / No] |
| d) Lube oil pressure | [Yes / No] |
| e) Lube oil temperature inlet/outlet | [Yes / No] |
| f) Turbocharger Speed | [Yes / No] |
| g) Engine speed indicator | [Yes / No] |
| h) Alternator Winding temperature with switch | [Yes / No] |
| l) Alternator hot air temperature | [Yes / No] |
| j) Individual cylinder Exhaust temperature | [Yes / No] |
| k) High crankcase pressure alarm | [Yes / No] |

Are the following Alternator monitoring parameters provided at the engine common control desk and for remote metering:

Signature of the Tenderer

Date

- | | Bidding | Document: |
|-----------------------------------|---------|--------------|
| a) Generator MW | | [Yes / No] |
| b) Generator MVar | | [Yes / No] |
| c) Generator Field current | | [Yes / No] |
| d) Generator Field divert current | | [Yes / No] |
| e) Generator Output Volts | | [Yes / No] |
| f) Generator Output Amps | | [Yes / No] |
| g) Generator Output Power Factor | | [Yes / No] |
| h) Generator Output Frequency | | [Yes / No] |

6.2.15 Engine Starting System

Type of engine starting system together with any technical advantages.

Normal Starting Air Pressure (if applicable) _____ kPa
 Air receiver capacity _____ m³
 How many engine starts are possible with only one charge of air in the receiver _____

6.2.16 Turbocharger

Make _____
 Type _____
 Maximum speed _____ rpm
 Maximum operating temperature _____ °C
 Boost pressure ratio _____
 Type of vibration level monitoring device provided _____

6.2.17 Air Intake System

Air Intake Filter

- Make and type _____
- Smallest particle allowed to pass through the filter _____ microns
- Pressure loss across filter _____ kPa
- Is a Service Indicator provided [Yes / No]

Charge Air Bypass Valve

- Type and make _____
- Valve Opening temperature range _____ °C to _____ °C

Air Intake Silencer

- Make and type _____
- Pressure loss across attenuator _____ kPa

6.2.18 Fuel System

Fuel Water/Separator

- Make and model _____
- Efficiency _____ %

Fuel Flow Meter

- Make and model _____
- Flow rate range _____ to _____ m/s
- Pressure drop across the flow meter at engine full rated load _____ kPa

Signature of the Tenderer

Date

d) Accuracy of flow meter \pm _____ %

Engine Fuel Supply Filter

- a) Make and Type _____
- b) Pressure drop across filter at engine full rated load _____ kPa
- c) Degree filtration _____ microns
- d) Are service indicators provided [Yes / No]

6.2.19 Lubricating Oil System

Type of Engine Lubricating Oil _____

Type of Priming Pump provided to start engine without auxiliary power supply, in case of an emergency

Are Full flow Lubricating Oil Filters provided [Yes / No]

- a) Degree of filtration _____ microns

Are Bypass Lubricating Oil Filters provided [Yes / No]

- a) Degree of filtration _____ microns
- b) Are differential pressure gauges provided [Yes / No]
- c) Is there any provision to extend the differential pressure set points to the engine common alarm panel [Yes / No]

Are Lubricating oil Magnetic Filters provided [Yes / No]

- a) Degree of filtration _____ microns

Is Lubricating Oil Heating Element provided [Yes / No]

Are there any Lubricating Oil Flow indicator/s [Yes / No]

Lubricating Oil Centrifuge

- a) Make and type _____
- b) Centrifuge rate _____ litres/sec
- c) Drive and pump power _____ kW

6.2.20 Engine Exhaust System

Silencers attenuation rating _____ dBa

- a) Temperature Monitoring Unit _____
- b) Make and Type _____
- c) Range _____ to _____ °C
- d) Accuracy \pm _____ %

Type of exhaust Insulation blanket Material _____

6.2.21 Engine Crankcase Extraction

Are there any local Crankcase pressure indicators [Yes / No]

What are the safety devices for preventing a build up of excessive crankcase pressure

Signature of the Tenderer

Date

Crankcase Extraction Fan

- a) Make and Type _____
 b) Capacity _____ 1/sec
 c) Power rating _____ kW

6.2.22 Engine Cooling System

Engine Cooling Radiator

- a) Type _____
 b) System pressure _____ kPa

Radiator Drive

- a) Number of Drives _____
 b) Is temperature dependent, variable speed or motor control provided [Yes / No]
 c) Motor power rating at full load _____ kW

Engine Motor Control Centre

- a) Length _____ mm
 b) Width _____ mm
 c) Depth _____ mm
 d) Weight _____ kg
 e) Are anti vibration mountings provided [Yes / No]
 f) Is the control voltage 24V dc [Yes / No]
 g) Is single phase protection provided for all motors [Yes / No]
 h) Is over current protection provided for all motors [Yes / No]
 i) Is winding over temperature protection provided for motors > 5HP [Yes / No]
 j) Indication for any protection that has operated on any motor [Yes / No]

Signature of the Tenderer

Date

6.2.23 Main Cable Termination

- a) Cable Type _____
- b) Type of Entry _____
- c) Cable size _____
- d) Main cable gland type _____
- e) Type of Cable Lugs _____
- f) Type of Control Cable Termination: _____

6.2.24 Protection Relays

Are the following protection relays provided :

- a) Overcurrent [Yes / No]
- b) Earth fault [Yes / No]
- c) Reverse Power [Yes / No]
- d) Differential [Yes / No]

6.2.25 Metres & Indication

Are the following metres provided on the switch gear panel :

- a) kWh [Yes / No]
- b) Watt [Yes / No]
- c) PF [Yes / No]
- d) Volts [Yes / No]
- e) Amps [Yes / No]

6.2.26 Transducers

Are the following transducers provided :

- a) Current [Yes / No]
- b) Power [Yes / No]
- c) Power Factor [Yes / No]
- d) Manufactured by _____
- e) Type _____
- f) Input current _____ Amps
- g) Output current _____ mAmps
- h) Aux Supply voltage _____ Volts

6.2.27 Instruments

Are the following instruments provided :

- a) Volt [Yes / No]

Signature of the Tenderer

Date

- | | |
|-------------|--------------|
| b) Ammeter | [Yes / No] |
| c) K Watt | [Yes / No] |
| d) P/Factor | [Yes / No] |

6.2.28 Selector Switches

Are the following selector switches provided :

- | | |
|-----------------------------|--------------|
| a) Ammeter phase selection | [Yes / No] |
| b) Local / Remote Selection | [Yes / No] |

6.2.29 Indication Lamps

Are the following indicator lamps provided :

- | | |
|-------------------------|--------------|
| a) C B Open | [Yes / No] |
| b) C B Closed | [Yes / No] |
| c) Trip Circuit Healthy | [Yes / No] |

6.2.30 Test Links

Are Relay test links provided on the panels [Yes / No]

6.2.31 Synchronising Plugs

Can the synchronising circuit offered be inter phased to the existing setup [Yes / No]

6.2.32 Panel Heater

Are Panel heaters provided [Yes / No]

6.2.33 Miscellaneous Information

- a) Auxiliary Supply Voltage _____
- b) Erection and Maintenance Tools and Equipment provided _____
- c) Technical Information supplied _____
- d) Provisions for padlocking switchgear _____
- e) Earthing circuit provided _____
- f) Calculated heat rejection from equipment within the engine hall _____ kW
- g) Calculated required air volume to minimize temperature delta within engine hall _____ m³/h
- h) Calculated temperature rise within engine hall at full load, & all auxiliaries _____ °C

Signature of the Tenderer

Date

6.3 Schedule 2 OF 9 Schedules

Price List of recommended spares

The tenderer shall list below the spare parts which he would recommend should be stored at the facility to ensure 10 years of operation and servicing , at 8, 000 hours per year at 90% load for the gensets and auxiliary equipment offered for mechanical, electrical and electronic systems in the tender.

Description of Item	Unit	Recommended Qty	Rate ExW	Total Cost

6.5 Schedule 4 of 9 SchedulesDeviations

The tenderer shall list below all deviations from the specifications and tender document.

Where no such deviation from specification is listed, full compliance with specification will be required.

Specification Clause #	Deviation	Justification

6.6 Schedule 5 of 9 Schedules

Comparable Applications

The tenderer shall list details of installations where equipment of similar (same cylinder, bore and RPM) configuration to that being offered has been installed and accumulated more than 40,000 engine operating hours.

Genset Hours	Site Rating (MW)	RPM	Client Contact and Location	Fuel Type	Date Installed

6.7 Schedule 6 of 9 Schedules

Personnel

The Tenderer shall list details of personnel who will be sent to work at site and also list below the Fiji sub-contractors required for the installation and commissioning work.

Schedule 6A Fiji Subcontractor List

Number Required	Skill/Position/Task	Duration

Note : The above list shall be approved by the EFL.

Schedule 6B Personnel Supplied by Contractor

Number Supplied	Skill Level	Duration

Schedule 6C Engine Manufacturer’s Primary & Secondary Parts & Service Facilities that will support this Installation, with indications of the following:

Service Facility	Primary	Secondary
Contact Person		
Address		
Phone		
Fax		
E-mail		
Mobile		
Number of Service engineers certified at this location on identical engine type offered in this proposal?		
Total number of service engineers based at this location?		
Total Population of identical (genset) engine type offered in this proposal serviced by this facility?		
High/Low value of spare parts specific to the engine offered stocked at this facility?		
Total High/Low value of all spare parts stocked at this facility?		
24 hour Order/Fill ratio % from this location?		
Are parts refurbished or remanufactured at this facility?		
Other services offered at this location?		

6.8 SCHEDULE 7 OF 9 Schedules

Overhaul and Expected Life Time Of Components

Component	Time Between Overhauls Hours	Expected Life Time Hours
Piston		
Cylinder Liner		
Cylinder Head		
Inlet Valve		
Exhaust Valve		
Injector Nozzle		
Injector Pump		
Main Bearing		
Large End Bearing		
Turbocharger		

6.9 Schedule 8 of 9 Schedules

Maintenance Schedule In Terms Of Machine Hour

Provide a detailed maintenance program in terms of machine operating hours, indicating when servicing and replacing of parts is required along with expected labour hours for each task. The schedule should include the spare parts that are anticipated to be replaced, time required to carry out the task and the manpower requirements. Assume 90% loading, 8,000 hours per year operation over a 10-year time period. All spare parts prices should be for new parts, delivered EX Works. If a remanufactured parts program is available, separate alternative life cycle costs schedules should be provided along with clear conditions/terms/warranty for remanufactured components. Assume a labour hour cost of USD\$10.00 per hour for labour hour calculations and an estimated % of labour hours required for factory authorized service supervisory or service engineers (typically required to supervise this work).

6.10 Schedule 9 of 9 Schedules

5 MW(e) IDO/HFO GENERATING SET FOR LABASA POWER STATION

LIFE CYCLE COST EVALUATION

Description		* \$ Amount
1	80,000 engine hour life cycle spare parts cost for prime mover **	
2	80,000 engine hour life cycle spare parts cost for balance of plant**	
3	80,000 engine hour life cycle service man hour hours required**	
4	Other tool or spare parts recommendations**	

- Amount in the currency in which payment is required.
- Tenderer shall provide detailed life cycle cost assumption, details & recommendations following tender specifications. Assume all new parts costs and provide alternative life cycle costing if factory remanufactured parts is available

6.10.1 Schedule 9a of 9 Schedules

- **2MW to 5MW(e) IDO/HFO Generating Set For Labasa Power Station**

Responsibility Check List

Tenderer shall complete the responsibility check list for all tasks of items required to complete this project, indicating who, when, or where responsibility is

Item	Description	Qty	Responsibility	

6.10.2 Schedule 9b of 9 Schedules

- **2MW to 5MW(e) IDO/HFO Generating Set For Labasa Power Station**

Price – Complete Equipment Delivery

Description		* \$ Amount
1	2MW(e) to 5MW(e) Medium Speed Dual Fuel Capable (IDO/HFO) power plant equipment with its auxiliaries, switch gears, computer system & controls, cables, pipes and fittings including factory performance tests, and 8,000 engine hours or 24 month warranty.	
2	Manufacturer’s Project Management, site visits, customer coordination	
3	Manufacturer’s Supervision required for site installation. Site Supervision Mechanical & Electrical, 2 trips each trade, 1 month each trade/trip	
4	Start-up, site testing and commissioning	
5	Site Training	
6	24,000 hour spare parts & Service Tools	
7	Freight, transportation cost, Insurance, Delivered Duty Unpaid, Suva, Dock	
8	On-site 1-Year Warranty Engineer	
10	Four sets of Spare parts manuals, Operation & Maintenance manuals, drawings, design & technical information required for site installation, software, and other documentation as per tender	
11	Other (Please specify)	
	Total, Off-Shore Equipment Supply 9B ***	

- Amount in the currency in which payment is required.
- Liquidated Damages Apply
- Exclusive of Fiji Import Customs Duty, taxes or other Fiji government related charges.

Note The EFL reserves the right to exclude any item at his discretion; total price shall be adjusted accordingly.

6.10.3 Schedule 9c OF 9 Schedules

- **2MW to 5MW(e) IDO/HFO Generating Set For Labasa Power Station**

Price – Complete Equipment Installation

The EFL encourages the contractor to break down price schedules and facilitate the participation of the local contractors as much as possible. The contractor therefore shall list individual item and activity they propose to include as Local (Fijian) component.

Description	* \$ Amount
1	Total of Schedule 9B, Complete Equipment Delivery – 10 Month Schedule
2	LOCAL FIJI RELATED INSTALLATION COSTS
4	Local Fiji business licenses, permits, taxes, duties and other fees required by contractors operating in Fiji.
5	Overall design, engineering, required for building/construction permits
6	Project Management and Site Construction Management Team
7	Transport of all equipment and materials from Suva Port to Labasa Power station
8	Site Civil and Foundation work as required
9	New Power Plant Building Expansion as required
10	Mechanical Installation
11	Electrical Installation
12	Electronic & Controls, Computer Software Installation
13	Fiji Related Contractor All Risk (CAR) Insurance, employee insurance, and other contractor related insurance coverage required by Fiji law
14	Installation Warranty on Building, Foundations and other site -civil works
15	Other (activity or material required for a turnkey working installation) Please specify on a separate sheet if required.
16	Total, Local Fiji Related Installation Costs – 9C***
9B + 9C	TOTAL (Line 1 + Line 16) Turnkey Equipment Delivery, Installation & Commissioning – 12 Months to Commissioning

- Amount in the currency in which payment is required.
- Liquidated Damages Apply
- Inclusive of all applicable Fiji taxes, and subject to all Fiji Laws and regulations

Note EFL reserves the right to exclude any item at his discretion; total price shall be adjusted accordingly.

Form of Tender

ENERGY FIJI LIMITED (EFL)

IDO/HFO GENERATING SETS.... kW_e each
FOR Labasa Power Station

TO : ENERGY FIJI LIMITED (EFL), SUVA, FIJI

Gentlemen,

1. We.....do hereby tender for the supply of IDO/ HFO Generating Set/s kW(e) for Labasa Power Station in accordance with the Conditions of Contract, Specification and Schedules for the sum specified in the Schedule of Prices, annexed hereto and to complete the same in accordance with the programme of works on "TURN KEY" basis .
2. The total fixed price of this Tender, (in words)
Option 9A: Supply of Equipment and Supervision :.....(in words :
(.....))
3. If our Tender is accepted we will, if required, obtain the guarantee of an Insurance Company or Bank or other sureties (to be approved by you) to be jointly and severally bound with us in a sum not exceeding 20 per cent of the above named tender amount for the due performance of the Contract under the terms of a bond to be approved by you.
4. We agree abide by this Tender for the period of ninety days from the date fixed for receiving the same and it shall remain binding on us and may be accepted at any time before the expiry of the said 180 days.
5. Unless and until a formal Agreement is prepared and executed this Tender, together with your written acceptance thereof, shall constitute a binding Contract between us.
6. We understand that you are not bound to accept the lowest or any Tender you may receive.

Dated this day of 2024

Signature in the capacity of

duly authorised to sign tenders for and on behalf of (Company title in

Block Capitals).Address

.....
.....
.....

Witness

Address

Occupation

.....

TENDER CHECKLIST

The Bidders must ensure that the details and documentation mention below must be submitted as part of their tender Bid

Tender Number _____

Tender Name _____

1. Full Company / Business Name: _____

(Attach copy of Registration Certificate)

2. Director/Owner(s): _____

3. Postal Address: _____

4. Phone Contact: _____

5. Fax Number: _____

6. Email address: _____

7. Office Location: _____

8. TIN Number: _____

(Attach copy of the VAT/TIN Registration Certificate - Local Bidders Only (Mandatory))

9. FNPF Employer Registration Number: _____ **(For Local Bidders only) (Mandatory)**

10. **Provide a copy of Valid FNPF Compliance Certificate (Mandatory- Local Bidders only)**

11. **Provide a copy of Valid FRCS (Tax) Compliance Certificate (Mandatory Local Bidders only)**

12. **Provide a copy of Valid FNU Compliance Certificate (Mandatory Local Bidders only)**

13. Contact Person: _____

I declare that all the above information is correct.

Name: _____

Position: _____

Sign: _____

Date: _____

7.0 SUBMISSION TO TENDER

Bidders are requested to upload electronic copies via Tender Link by registering their interest at: <https://www.tenderlink.com/efl>

EFL will not accept any hard copy submission to be dropped in the tender box at EFL Head Office in Suva.

This tender closes at 4.00pm (1600hrs) on Wednesday 18th December, 2024.

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

The bidders must ensure that their bid is inclusive of all Taxes payable under Fiji Income Tax Act. Bidders are to clearly state the percentage of VAT that is applicable to the bid prices.

The lowest bid will not necessarily be accepted as the successful bid.

The Tender Bids particularly the “Price” must be typed and not hand written.

Any request for the extension of the closing date must be addressed to EFL in writing three (3) working days prior to the tender closing date.

Tender Submission via email or fax will not be accepted.