



Tender Document – MR 96/2017

Supply & Commission of 10 x 1MW Prime Diesel Generating Sets

Fiji Electricity Authority
Generation
May 5, 2017

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1 INSTRUCTIONS TO BIDDERS

1.1 GENERAL

1.1.1 SCOPE OF BID

The Fiji Electricity Authority (hereinafter referred to as "the Employer"), wishes to receive bids for Supply of Ten (10) 1000KW Prime Diesel Generator sets.

1.1.2 ELIGIBLE BIDDERS

1.1.2.1 This Invitation to Bid is open to bidders who have sound financial background and have previous experience in handling such turnkey projects.

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

1.1.2.3 Bidders shall not be under a declaration of ineligibility for corrupt or fraudulent practices.

1.1.3 QUALIFICATION OF THE BIDDER

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

1.1.3.2 submit a written power of attorney authorizing the signatory of the bid to commit the bidder; and

1.1.3.3 Submit proposals regarding work methods, scheduling and resourcing which shall be, provided in sufficient detail to confirm the bidders' capability to complete the works in accordance with the specifications and the time for completion.

1.1.3.4 Bidders shall also submit proposals of work methods and schedule in sufficient detail to demonstrate the adequacy of the bidders' proposals to meet the Employer's Requirements and the completion time referred to in Sub-Clause 1.1.1 above.

1.1.4 COST OF BIDDING

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

1.1.5 SITE VISIT

Site Visit is not required.

1.2 BID DOCUMENT

1.2.1 CLARIFICATION OF BIDDING DOCUMENT

A prospective bidder requiring any clarification of the bidding documents may notify the Employer in writing or email at the Employer's address indicated in the Invitation for Bids. The Employer will respond to any request for clarification which it receives earlier than 5 days prior to the deadline for submission of bids.

1.3 PREPARATION OF BIDS

1.3.1 DOCUMENTS COMPRISING THE BID

1.3.1.1 The bid submitted by the bidder shall comprise two submissions simultaneously, one containing only the technical proposal and the other the price proposal.

1.3.1.2 The technical proposal shall contain the following:

- (i) Bid Form for Technical Proposal and Appendix to Technical Proposal
- (ii) Form of Bid Security;
- (iii) Power of Attorney;
- (iv) Information on Qualification;
- (v) Confirmation of Eligibility;
- (vi) Schedule of Major Items of Equipment
- (vii) Schedule of 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.

1.3.1.3 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 until 8,000hrs
- (iii) Any other materials required to be completed and submitted by bidders in accordance with these Instructions to Bidders.

1.3.2 BID PRICE

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

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

1.3.2.3 Prices quoted by the bidder shall be on a fixed lump sum basis and shall not be adjusted for changes in the cost of labour, material or other matters

1.3.3 BID CURRENCIES

All prices shall be quoted in Fijian currency

1.3.4 BID VALIDITY

Bids shall remain valid for a period of 90 days after the date of opening of technical proposals.

1.4 SUBMISSION OF BIDS

1.4.1 SEALING AND MARKING OF BIDS

Tender can be submitted via electronic tender box or sealed hardcopies in tender box.

1.4.2 DEADLINE FOR SUBMISSION OF BIDS

Bids must be received by the Employer at the address specified in the advertisement.

1.4.3 LATE BIDS

Any bid received by the Employer after the deadline for submission of bids prescribed in Clause 16.1 will be rejected and returned unopened to the bidder.

2 GENERAL CONDITIONS OF CONTRACT

2.1 STANDARDS

The Goods supplied under this Contract shall conform to international ISO / DIN standards for mechanical and IEC standards for electrical work.

2.2 PERFORMANCE BOND

- 2.2.1 Within 21 Days After the Contractor's Receipt of Notification Of Award Of The Contract Or Upon Contract Signing And Down Payment, The Contractor Shall Furnish A Performance Bond To The Employer In The Amount Of 10% Of The Tendered Price.
- 2.2.2 Within 21 days after the Contractor's receipt of notification of award of the contract or upon contract signing and down payment, the Contractor shall furnish a performance bond to the Employer in the amount of 10% of the tendered price.
- 2.2.3 The performance bond shall be denominated in the currency of the Contract or in another freely convertible currency acceptable to the Employer, and shall be in one of the following forms:
- 2.2.4 A performance bond issued by a surety acceptable to the Employer and in the form provided in the Tender Documents.
- 2.2.5 A Bank Guarantee issued by a bank located in the Employer's country or abroad acceptable to the Employer, and in the form provided in the Tender Documents.
- 2.2.6 A cashier's cheque, certified cheque, irrevocable letter of Credit or Cash.
- 2.2.7 The Performance Bond will be discharged by the Employer not later than 90 days following the date of completion of the Contractor's performance obligations, including any warranty obligations under the Contract.

2.3 PROGRAMME TO BE FURNISHED

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.

2.4 INSPECTION AND TESTS

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.

2.5 INSURANCE

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

2.6 PAYMENT

Payment shall be on a percentage of completion basis up to 90% of contract sum till initial commissioning date, 5% retention till successful completion of site tests and final 5% retention after warranty period expires.

The Contractor's request for payment shall be made to the Employer in writing, accompanied by invoice(s) describing as appropriate, the Goods delivered and services performed together with shipping and other documents as may be required by the Employer. Payments shall be made promptly within ten (10) days, but no later than thirty (30) days of submission of an invoice/claim made by the Contractor, upon approval of the invoice.

2.7 TERMINATION FOR DEFAULT

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

2.7.1.1 If the Contractor fails to deliver any or all of the Goods within the time period(s) specified in the Contract, or any extension thereof granted by the Employer.

2.7.2 Fails to perform any other obligation(s) under the Contract.

2.8 FORCE MAJEURE

In this Clause Force Majeure means any event or circumstance (whether arising from natural causes, human agency or otherwise) beyond the control of the Contractor including (in so far as beyond such control but without prejudice to the generality of the foregoing expression) strikes, lockouts or other labour disputes, riot, civil commotion, aircraft fire, flood, drought loss, delay at sea, breakdown or war.

2.9 EXPLANATIONS

If the Tender needs any clarifications, the inquiry should be made in writing to:

Mr Tuvitu Delairewa
The Supply Chain Manager
Fiji Electricity Authority
Private Mail Bag
Suva
FIJI
Telephone: (+679) 3311 133 Fax: (+679) 3311882
E-mail: TDelairewa@fea.com.fj

All explanations to the clarifications shall be answered in writing.

2.10 ARBITRATION

All questions or differences what so ever which may at any time hereafter arise between the parties hereto or their respective representatives attached to this agreement or the subject matter or construction hereof or the rights and duties of the parties hereunder, shall be referred to a single arbitrator if the parties agree or otherwise, to four arbitrators, one to be appointed by each party and in either case, in accordance with and subject to the provisions of the Arbitration Act Cap. 38 of the Laws of Fiji or of any statutory modification or re-enactment thereof for the time being in force. Such person to be an arbitrator will be nominated by the Fiji Institute of Engineers.

2.11 WARRANTY

- 2.11.1 The Contractor warrants that all Goods supplied, installed and commissioned under this Contract shall have no defect arising from material used workmanship or from any act or omission of the Contractor, that may develop under normal use of the supplied Goods in the conditions prevailing in the country of final destination.
- 2.11.2 The Contractor shall clearly specify the Warranty period of the installed and commissioned Goods supplied under this contract and such period shall be referred to as the Warranty and shall not be any period less than 24 months or 2,000 machine operating hours, whichever comes first from the date of commissioning (Formal or Official acceptance of the completed installation by the Employer). The contractor shall ensure that the equipment supplied under this Contract shall operate within specified guaranteed performance levels during the warranty period.
- 2.11.3 The Employer shall promptly notify the Contractor in writing of any claims arising under this Warranty. Upon receipt of such notice, the Contractor shall, with all reasonable speed, repair or replace the defective Goods or parts thereof, including transport, duty, and local Fiji charges, without any cost to the Employer.

2.12 GENERAL CONDITIONS'

General conditions of this contract shall be governed by the Built & Turnkey of the Federation Internationale Des Ingenieurs Conseil (FIDIC) first edition 1995. (Copies can be obtained from FIDIC PO Box 86 CH 1000 Lausanne, 12 Switzerland. Fax 41-21-653 5432)

3 SPECIFICATION

3.1 INFORMATION TO TENDERS

3.1.1 SCOPE OF SUPPLY

The contract includes for the Supply of Ten (10) 1000 KW(e), 415V, 50Hz three phase Prime Diesel generating set. The generator is to be supplied in a Sound Attenuated Canopy.

The contract also includes:

- (i) Three Hard copies and one soft copy of Operating, Servicing and Maintenance Instructions and Spare Parts Manuals.
- (ii) Computer programs within 3 x Laptop (Software/hardware) used in the operation, monitoring, setting and /or maintenance of all the equipment supplied through this contract
- (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.

3.1.2 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 1.1 iii) above.

- f) A maintenance programme in terms of machine operating hours, indicating when minor and major servicing, 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.

3.1.3 DRAWING AND INFORMATION TO BE SUPPLIED BY CONTRACTOR

3.1.3.1 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 tool lists and spare parts list with pricing required for operation and maintenance

3.1.3.2 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) Combined Instrumentation and piping diagram with operational parameters.
- (v) Certification of all the final design calculations, drawings and evidence of compliance to such design parameters.

3.1.3.3 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.

3.1.4 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

3.1.5 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.

3.1.6 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.

3.1.7 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.

3.1.8 INSURANCE

The Tenderer shall deliver the complete equipment supply, Delivered Duty Unpaid to the transfer point identified in the Tender specification.

3.2 SPECIFICATION TECHNICAL

3.2.1 SCOPE OF WORK

The scope of work to be carried out under the terms of this specification comprises the Supply of Ten (10) only new Prime Diesel Generating sets with a maximum Prime rated capacity of 1000KW(e) at 0.8 PF lagging, 415 volt, complete with all necessary mechanical and electrical auxiliaries including but not limited to, excitation equipment, cooling system, engine alarm control panel - both local and provisions for remote starting, metering and instrumentation, generator alternator and engine protection, engine auxiliary drives and associated controls.

3.2.2 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.

3.2.3 REFERENCE CONDITIONS

The following environmental conditions are applicable to this site.

- (i) Environment Type – Topical Climate
- (ii) Elevation above mean sea level
 - 800 meters
- (iii) Ambient air temperature
 - Design Temperature 45 °C
 - Minimum 15 °C
- (iv) Relative Humidity
 - Maximum relative humidity 95%
 - Minimum relative humidity 70%
- (v) Seismic Condition
 - All equipment shall be capable of withstanding an acceleration of 3.3m/sec² in any direction without sustaining any damage.

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

pH	8.3
Alkalinity	mg CaCO ₃ B/Ltr68.2
Chloride	mg/Ltr7.3
Sulphate	mg SOB ₄ B/Ltr 8.4
Free CO ₂ B	mg/Ltr0.62
Temporary Hardness	mg/Ltr3.6
Permanent Hardness	mg/Ltr64.0
Total Hardness	mg CaCO ₃ B/Ltr68.2
Total suspension solids	mg/Ltr<1
Total dissolved solids	mg/ltr126

3.2.4 CAPCITY AND RATING

3.2.4.1 Genset Capacity

The net maximum continuous site rated capacity of the generating plant shall not be less than 1000KWB(e)B at the specified reference conditions and 0.8 power factor lagging. The output shall be 3 phase and 415 volts at 50 hertz.

The net maximum continuous site rated capacity of the diesel generating gensets 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.

3.2.4.2 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 and overload capacity of the gen set 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 3.

3.2.5 PLANT LAYOUT REQUIREMENTS

3.2.5.1 Safety Aspects

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.

3.2.6 CONTROL

3.2.6.1 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.

3.2.6.2 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.

3.2.6.3 All control components shall be clearly identified and labelled in accordance with a scheme. Cable identification shall be of the slip on type sized to fit neatly over the cables.

3.2.6.4 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).

3.2.6.5 The control system shall disable operation of the generating units under fault conditions.

3.2.6.6 Control System

A control system shall be provided to enable control of the diesel generating unit, through start, run, load, unload and stop, to be exercised from engine room or control room and this control mode shall be defined as local control.

3.2.7 DIESEL ENGINE AND AUXILIARY EQUIPMENT

3.2.7.1 Compliance

The diesel engine shall operate satisfactorily on the fuel oil as specified in 3.2.7.4 Engine Fuel Oil System and generally in accordance to ISO 3046, unless specified otherwise. The diesel engine shall be equipped with all ancillary equipment required to satisfactorily achieve the required performance under the specified site conditions.

Generator shall be provided with following installation for protection and safety of machine:

- (i) Generator system;
 - Anti-condensation space heaters
 - Coastal Insulation protection
- (ii) Charging system;
 - 24 volts, 45 amps charging alternator
 - Battery disconnection switch
 - Battery charger

3.2.7.2 Engine Governing

The engine shall be provided with an electronic controlled actuator/governor having programmable provisions/adjustment of droop, speed synchronizing, load sharing and limiting, and isochronous operation 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, the fuel shutoff valve will shut off fuel and cause engine shutdown.

The governor shall be capable of parallel operation with other gensets within the power plant.

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

3.2.7.3 Engine combustion air system and Silencer

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 generator supplied must be weather and soundproof to meet noise level: 50Hz –85dBA @ 1m @80% Load. A 'critical grade' silencing is required.

3.2.7.4 Engine Fuel Oil System

Specification of Industrial Diesel 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 @ 15°C (Kg /m ³)	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 (°C)	11 max.	IP309	9
Flash point (°C)	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 @ 40°C (mm²/ s)	1.8 - 5.8	D445	3.1
Neutralisation Value (Strong Acid #) (MgKoH/g)	nil	D664/D974	nil
Conductivity @ 23°C (Ex refinery) (pS/m)	100 - 450	D2624	200
Conductivity @ 23°C (Within terminal) (pS/m)	70 - 450		-

3.2.7.5 Engine Lubrication Oil System

- a) 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 pressurising 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
- b) Provisions to check the oil level with a graduated dipstick while engine is running should be provided.
- c) If the engine sump is wet type a sump drain facility shall be provided with positive locking against accidental opening. A high and low oil level shall be provided on the oil sump to allow shutting down of generating set in case of very low oil level and very high oil level due to fuel or water leakage into oil sump.
- d) 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, and TOTAL presently provide lubrication oil in Fiji. Tenderer is asked to specify at least one type of recommended lubrication oil from each lube oil supplier.

3.2.7.6 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.

3.2.7.6.1 Local engine instrumentation should include at a minimum:

- a) Lubricating oil temperature
- b) Lubricating oil pressure
- c) Coolant temperature
- d) Water outlet pressure
- e) Cylinder exhaust temperature.
- f) Operating hours
- g) System DC volts
- h) AC Volts, phase, HZ
- i) Indication to identify when the normal/mains source is supplying and one to indicate when the standby set is online. Also provide indication for both normal and standby source availability.

3.2.7.6.2 Engine shutdowns shall be required for:

- a) Coolant Water outlet temperature high
- b) Alternator bearing temperature high.
- c) Engine lubricating oil pressure low.
- d) Engine lubricating oil temperature high.
- e) Radiator water level low
- f) High oil sump level
- g) Low oil sump level
- h) Overspeed trip (Electrical, which shall be set lower than mechanical overspeed).
- i) Electrical fault which is a group alarm for differential fault on the generator.
- j) Emergency stop both local and remote.
- k) Control supply failed.
- l) Over Cranking

3.2.7.6.3 On the operation of any one of the above Protection

- 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.

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.

3.2.7.7 Engine Protection (Electrical)

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) 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.
- b) 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.
- c) High coolant temperature
- d) Low coolant Level
- e) Failure to start (over crank)
- f) Emergency stop

3.2.7.8 Engine Crankcase Ventilation

The engines shall be equipped with an engine crankcase breather 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.

3.2.7.9 Engine Exhaust System

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

3.2.7.10 Engine Cooling System

- a) The engine shall be water cooled. The radiators shall be engine mounted and cooling fan engine driven. The radiators shall be of the heavy duty and pressurised type protected for humid 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 °C, sufficient to adequately satisfy the cooling requirements of the diesel engine operating at 100% of continuous site rating. 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. Coolant water conditioning system shall be provided to adequately maintain cool water chemistry.
- b) 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.
- c) All rigid piping shall have provisions to absorb shock and vibration caused by the engine while running.

3.2.8 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.

3.2.9 ALTERNATOR, EXCITATION AND CHANGEOVER SWITCHING

3.2.9.1 Alternator

- a) The alternator shall be flexibly connected to the prime mover. The alternator covers 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.
- b) 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.
- 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.
- d) Each phase winding shall incorporate positive temperature coefficient thermistor for over temperature detection
- e) 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.
- f) The alternator frame earthing shall be external to the terminal box or to a suitable location within stator frame.
- g) The Stator and Rotor windings shall be insulated to Class F standard or higher.
- h) The wave form of the output voltage shall be sinusoidal for the full range of loads and power factors and should comply to AS1359. The zero sequence reactance of the alternator shall not exceed 30%.
- i) Winding temperature rise above reference conditions shall remain within the limits stated in AS1359 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

3.2.9.2 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 H standard or higher.

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

3.2.9.3 Voltage Regulation

- a) 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.
- b) The output voltage shall be adjustable within $\pm 10\%$ of nominal.
- c) 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.
- d) 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 effected 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.
- e) The Contractor could provide, if possible, a value better than the above voltage regulation.
- f) The maximum deviation in voltage shall conform to the requirements of IEC34.
- g) Additional manual field regulation shall be provided with the selector and controls mounted on the front of the AVR panel (if available).
- h) Voltage regulation equipment shall be suitable for parallel operation of alternators in the Fiji National Grid.
- i) 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.
- j) 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.
- k) 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.
- l) 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.

3.2.10 OTHER ELECTRICAL COMPONENTS

3.2.10.1 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 30P°PC 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.

Note: Synchronising facilities for parallel operation of the generating plant should be provided with installation. Provision for generating plant to close on dead bus should be provided.

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

3.2.11 WIRING, CABLE AND CONNECTIONS

All wiring work shall be carried out neatly to the satisfaction of the Employer 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.

3.2.11.1 Cable size

The minimum cable size shall be:

- a) Control Wiring, 1.5 mmP2P
- b) Power Wiring, 2.5 mmP2

A copper Busbar or multi strand soft drawn copper cable shall be used where the cross sectional area of conductor exceeds 95 mmP2P.

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.

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

3.2.11.2 Training

The contractor shall provide on-site training for up to 4 persons nominated by the Employer in the correct operation of plant installed for a period of one week prior to preliminary site testing of the gensets is completed. 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.

3.2.12 TESTING AND COMMISSIONING

3.2.12.1 General Requirements

The Contractor shall be responsible for performing all required tests, including the provision of materials, test equipment, measuring equipment and any specific arrangements that may be deemed necessary by the Employer 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.

3.2.12.2 The Testing programme shall generally consist of;

- a) Tests prior to delivery to the site. Such tests are intended to ensure no faulty or unsuitable items are delivered to site.
- b) 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.
- c) 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 Employer. The proposed programme of tests shall be submitted to the Employer at least 6 weeks before the commencement of the commissioning tests. The Contractor shall perform any additional tests that the Employer 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 Employer 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 Employer 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 Employer in advance.

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

3.2.12.3 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 opens circuit and short circuit characteristics.
- d) Pre-starting and start-up procedures, alarm and shutdown tests, synchronising tests and engine compression tests.
- e) A continuous trial sequence shall be performed on site.
- f) Generator Circuit Breaker Closer on Dead Bus and load up

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.

3.2.13 COMMISSIONING TESTS

3.2.13.1 The test shall consist of (if applicable):

- 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) 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) Fuel consumption
- d) Verification of the correctness of operation of all starting, synchronising, paralleling, stopping control systems and dead bus closing both automatic and manual.
- e) Verification of compliance with the total harmonic distortions as specified.
- f) Verification of specific fuel and specific lubricating oil consumption.
- g) Verification of the operation of the changeover switching, both automatic and manual. The following must be confirmed:
 - (i) On mains failure, supply be restored from the standby set
 - (ii) Standby set is running and mains is restored
 - (iii) Supply restored via mains, standby set goes in cool down mode

- (iv) Fail mains again and ensure standby set picks up from cool down mode

The Contractor shall carry out such further tests as the Employer may require to satisfy the Contractor's installation meets all the specified requirements.

If the condition of components inspected is considered unsatisfactory by the Employer, 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.

3.2.14 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 10 years after the equipment has been successfully commissioned and accepted by the Employer.

3.3 DELIVERABLES

(To be completed and returned with tender document)

3.3.1 Schedule 1 - Technical Particulars

1. Tender's Name:

2. Diesel Generator Plants

2.1. Make of Engine/s _____

Type of Engine/s _____

Year of Manufacture _____

Make of Alternator _____

Type of Alternator _____

Rated Speed (rpm) _____

2.2. Engine/s manufactured by and Country _____

Alternator/s manufacture and Country _____

2.3. Continuous/standby rated output at Alternator terminals:

(i) ISO 3046/1 Conditions _____

(ii) At specified site conditions _____

3. 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/kWhe, net plant:

% of Full Load	Specific Fuel Consumption in Kg/kwh electrical Output for fuel type specified
	Net kg/kWh measured at alternator terminals
75	
85	

100	
-----	--

(ii) 0% Tolerance in above consumption at rated load per ISO 3046/1

4. Lubricating Oil Consumption Guarantee

(i) Lubricating oil consumption

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

(ii) 0% Tolerance in above lube oil consumption at 100% load

5. Ancillary Power

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

6. Engine governor

- (i) Manufacturer _____
- (ii) Model _____
- (iii) Type _____
- (iv) Conforms to Class a Regulations [Yes / No] _____
 If no, please specify _____
- (v) Is the load control motor _____
 24V dc, 3 wire system [Yes / No] _____
 If no, please specify _____

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

(vi) Type of installation selected i.e. solidly mounted or with a combined under base:

8. Vibration Characteristics

8.1. Anti-Vibration Mounting (if applicable)

(i) Make and type _____

(ii) Number per genset _____

(iii) Isolation efficiency over a range of frequencies (%) _____

9. Diesel Engine

9.1. Specification

(i) Number of cylinders _____

(ii) Bore _____ mm

(iii) Stroke _____ mm

(iv) Speed _____ rpm

(v) Type of aspiration _____

(vi) I.S.O. Standard Power at ISO 3046/1 conditions (MW) _____

(vii) Recommended lubricating oil _____

(viii) Method of starting _____

10. Alternator

(i) Type _____

(ii) Make _____

(iii) Maximum continuous rating:

- _____ KW at U.PF

- _____ KW at 0.8 PF
- (iv) Rated Voltage _____ KV
- (v) Rated Frequency _____ Hz
- (vi) Full rated load current _____ Amps
- (vii) State compliance to what Standard to which the alternator is made and tested

- (viii) Insulation class of:
- Rotor _____
 - Stator _____

- (ix) Temperature rise:
- At max continuous rating _____ °C
 - After 10% overload for one hour _____ °C

(x) Efficiencies

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

- (xi) 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 _____

(xii) Inherent Regulation at rated voltage at:

• unity pf _____

• 0.8 pf _____

(xiii) Reactance

• Reactance at full rated voltage _____

• Leakage reactance X_L _____

• Direct axis synchronous reactance X_d _____

• Quadrature axis synchronous reactance X_q _____

• Direct axis transient reactance X'_d _____

• Direct axis sub-transient reactance X''_d _____

• Quadrature axis sub-transient reactance X''_q _____

• Negative phase sequence reactance X_2 _____

• Zero phase sequence reactance X_0 _____

(xiv) Time Constants

• Direct axis transient open circuit T'_{do} _____

• Direct axis transient short circuit T'_d _____

• Direct axis transient sub transient short circuit T''_d _____

(xv) Characteristic Curves

Tenderer to enclose following:

1) Manufacturer's Generator Characteristic Curves showing:

- a. Open Circuit Saturation
- b. Short Circuit Saturation
- c. Air Gap Line
- d. Rated Current Saturation at 0.8 pf

2) V-Curves at rated voltage

3) Capability Curves at rated voltage.

(xvi) Characteristic Curves

(xvii) Excitation current at max continuous generator output amps

(xviii) Type and make of stator winding temperature monitoring device

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

11. Excitor

(i) Make and type _____

(ii) Type of Enclosure _____

(iii) Rated output _____ Amps _____ Volts

(iv) Maximum voltage _____

(v) Class of Insulation _____

(vi) Alternator Noise

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

(vii) Excitor winding Temperature rise at maximum continuous rating _____ °C

12. Automatic Voltage Regulator

(i) Make and type _____

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

(iii) 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 _____

(v) 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 _____

- (vi) Does the maximum deviation in voltage conform to the requirements of AS1359.
[Yes / No]
If No, please specify _____
- (vii) 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 _____
- (viii) Is voltage regulation equipment suitable for parallel operation of alternators
[Yes / No]
If No, please specify _____
- (ix) Does the regulation equipment have the following:
- Droop adjustment [Yes / No]
 - Voltage level adjustment [Yes / No]
 - Gain setting control [Yes / No]
 - Stabilising quality control [Yes / No]
- (iv) 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]
- (v) Can the Set voltage be re-established within 2 seconds of removing the short circuit (as in 7.0 I above).
[Yes / No]
- (vi) What is the percentage difference in phase to neutral voltage for an out of balance loading between any two phases: \pm _____ % of nominal voltage.
- (vii) 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

13. Engine Protection Devices

- (i) Are there any provisions for the termination of remote alarms for:
- Low lubricating oil pressure [Yes / No]
 - Low fuel pressure [Yes / No]
 - High Cooling water temperature [Yes / No]
 - High Lubricating oil temperature [Yes / No]
 - Engine overspeed [Yes / No]
 - High & low sump level [Yes / No]

14. Instrumentation

- (i) Are the following Engine monitoring provided at the engine control and alarm panel:

- Cooling water pressure inlet [Yes / No]
- Cooling water temperature inlet [Yes / No]
- Lube oil pressure [Yes / No]
- Lube oil temperature inlet [Yes / No]
- Engine speed indicator [Yes / No]
- Alternator Winding temperature with switch [Yes / No]
- Alternator hot air temperature [Yes / No]
- Cylinder Exhaust temperature [Yes / No]

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

- Generator MW [Yes / No]
- Generator Mar [Yes / No]
- Generator Field current [Yes / No]
- Generator Output Volts [Yes / No]
- Generator Output Amps [Yes / No]
- Generator Output Power Factor [Yes / No]
- Generator Output Frequency [Yes / No]

15. Engine Starting System

- (i) Type of engine starting system together with any technical advantages.

16. Turbocharger

- (i) Make _____
- (ii) Type _____
- (iii) Maximum speed _____ rpm
- (iv) Maximum operating temperature _____ °C
- (v) Boost pressure ratio _____ kPa
- (vi) Type of vibration level monitoring device provided

17. Air Intake System

- (i) 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]

18. Fuel System

- (i) Fuel Water/Separator
- Make and model _____
 - Efficiency _____ %
- (ii) Fuel Flow Meter
- Make and model _____
 - Flow rate range _____ to _____ m/s
 - Pressure drop across the flow meter at engine full rated load _____ kPa
 - Accuracy of flow meter ± _____ %
- (iii) Engine Fuel Supply Filter (Primary/Secondary)
- Make and Type _____

- Pressure drop across filter at engine full rated load _____ kPa
- Degree filtration _____ microns
- Are service indicators provided [Yes / No]

19. Lubricating Oil System

(i) Type of Engine Lubricating Oil

- (ii) Are Full Flow Lubricating Oil Filters provided [Yes / No]
- Degree of filtration _____ microns
- (iii) Are Bypass Lubricating Oil Filters provided [Yes / No]
- Degree of filtration _____ microns
 - Are differential pressure gauges provided [Yes / No]
 - Is there any provision to extend the differential pressure set points to the engine common alarm panel [Yes / No]

20. Engine Exhaust System

(i) Silencers attenuation rating _____ dBA

- Temperature Monitoring Unit _____
- Make and Type _____
- Range _____ to _____ °C
- Accuracy ± _____ %

21. Engine Crankcase Extraction

- (i) Are there any local Crankcase pressure indicators [Yes / No]
- (ii) What are the safety devices for preventing a build-up of excessive crankcase pressure.

22. Engine Cooling System

(i) Engine Cooling Radiator

- Type _____
- System pressure _____ KPa

(mechanical, electrical and electronic systems in the tender) over the 8,000hour service life listed above.

3.3.4 Schedule 4 - Deviations

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.

Description of Item	Unit	Recommended Qty	Rate ExW	Total Cost

Specification Clause #	Deviation	Justification

3.3.5 Schedule 5 - 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		

3.3.6 Schedule 6 - Maintenance Schedule in Terms of Machine Hours

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 5-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.

3.3.7 Schedule 7 - Price

Description		\$ Amount Currency: ____
1	10 x 1,000KW Prime Rating generating set with auxiliaries-Continuous Rating	
2	Three sets of Hard & One Softcopy of Spare parts manuals, Operation & Maintenance manuals, drawings, design & technical information required for site installation, software, and other documentation as per tender	
3	Three Copies of Software with individual laptops for Operation, Troubleshooting and Maintenance	
4	Commissioning works	
5	Training for: <ul style="list-style-type: none"> • Operation & Maintenance of the Generator • Diagnostic Software 	
	TOTAL	
6	Engine Spares(8,000hrs)	
7	Warranty Duration	
	TOTAL , Off-Shore cost of Equipment Supply – exclusive of Fiji Import Custom Duty, taxes or other Fiji Government related charges	

Notes:

* Please specify currency (FJD, USD, AUD, NZD)

* Shipment terms: DDU Suva Port, Fiji

3.3.8 Compliance Checklist

Items	Yes	No
Supply of generator with stated spec		
Electrical requirements of the generator		
Training & Manual request		
Supply of Software		
Supply & Comply to Protection Data in Appendix 4.1		
Finance compliance		
Pricing schedule		

4 APPENDIX

4.1 STANDARD PLANNING DATA REQUIRED FOR SYNCHRONOUS GENERATORS

Symbol	Data Description	Units	Value
Power station Technical Data:			
	Generator CB Ratings	A	
	Generator Number		
	Connection Point to Network		
		Diagram	
	Nominal Voltage at connection to Network	Volt	415
		MW (sent out)@pf	
At Connection Point:			
	Maximum 3 phase short circuit infeed calculated by method of AS3851 (1991)		
	Symmetrical	kA	
	Asymmetrical	kA	
	Minimum Zero sequence impedance	% on 100 MVA base	
	Minimum negative sequence impedance	% on 100 MVA base	
Individual Generating Unit Data:			
MBASE	Rated MVA	MVA	
PSO	Rated MW (sent out)	MW (sent out)	
PMAX	Rated MW (Generated)	MW (Gen)	
VT	Nominal Terminal Voltage	kV	
PAUX	Auxiliary load at PMAX	MW	

Qmax	Rated reactive output at Pmax	MVA _r (sent out)	
PMIN	Minimum load (ML)	MW (sent out)	
H	Generator Inertia constant	Mw.s/rated MVA	
GSCR	Short circuit Ratio		
ISTATOR	Rated stator current	A	
IROTOR	Rated rotor current at MVA and Power Factor, Rated terminal volts and rated speed	A	
VROTOR	Rotor Voltage at which IROTOR is achieved	V	
VCEIL	Rotor voltage capable of being supplied for five seconds at rated terminal volts and rated speed		
Generating Unit Resistance:			
RA	Stator Resistance (ohms per phase at 22deg C)	% on MBASE	
Generating Unit Reactance (unsaturated)			
XD	Direct Axis Synchronous Reactance	% on MBASE	
XDD	Direct Axis Transient Reactance	% on MBASE	
XDDD	Direct Axis Sub Transient Reactance	% on MBASE	
XQ	Quadrature Axis Synchronous Reactance	% on MBASE	
XQQ	Quadrature Axis Transient Reactance	% on MBASE	
XQQQ	Quadrature Axis Sub Transient Reactance	% on MBASE	
XL	Stator Leakage Reactance	% on MBASE	
X0	Zero Sequence Reactance	% on MBASE	
XN	Negative Sequence Reactance	% on MBASE	
XP	Potier Reactance	% on MBASE	
Generating Unit Time Constants (unsaturated):			

TDO	Direct Axis Open Circuit Transient	Seconds	
TDDO	Direct Axis Open Circuit Sub-Transient	Seconds	
TKD	Direct Axis Damper Leakage	Seconds	
TQO	Quad Axis Open Circuit Transient	Seconds	
TQQO	Quad Axis Open Circuit Transient	Seconds	
GCD	Capability Chart	Graphic data	
GOCC	Open Circuit Characteristics	Graphic data	
GSCC	Short Circuit Characteristics	Graphic data	
GZPC	Zero Power factor curve	Graphic data	
Generating Unit Transformer			
GTW	Number of Windings	Text	
GTTRn	Rated MVA of each winding	MVA	
GTTRn	Principal tap rated voltages	kV/kV	
GTZ1n	Positive sequence Impedances (each wdg)	(a+jb)% on 100 MVA base	
GTZ2n	Negative sequence Impedances (each wdg)	(a+jb)% on 100 MVA base	
GTZOn	Zero sequence Impedances (each wdg)	(a+jb)% on 100 MVA base	
	Tapped winding	Text	
		Diagram	
GTAPR	Tap change range	kV (low range)	
		kV(high range)	
GTAPS	Tap change size	%	

	Tap Changer Type, On/Off load	On/Off	
	Tap change cycle Time	Seconds	
GTVG	Vector Group	Diagram	
	Earthing Arrangement	Text	
		Diagram	
	Saturation curve	Diagram	
Generating Unit Reactive Capability			
	Lagging Reactive Power at P _{MAX}	MVAr export	
	Lagging Reactive Power at ML [i.e. P _{MIN}]	MVAr export	
	Lagging Reactive Short Time Capability at rated MW, terminal voltage and speed	MVAr (for time)	
	Leading Reactive Power at rated MW	MVAr import	
Generating Unit Excitation Systems			
	Details excitation loop described in block diagram form showing transfer function of individuals elements and measurement units	Diagram	
	DC gain of Excitation control loop	V	
	Rated field voltage at rated MVA and power Factor and rated Terminal volts and speed	V	
	Maximum Field Voltage	V	
	Minimum Field Voltage	V	
	Maximum Rate of change of Field Voltage:	Rising V/s	
	Maximum Rate of change of Field Voltage:	Falling V/s	
Generating Unit and Exciter Saturation			
	Characteristics 50-120%V	Diagram	

	Dynamic Characteristics of over Excitation Limiter	Text	
		Block Diagram	
	Dynamic Characteristics of under Excitation Limiter	Text	
		Block Diagram	
Generating Unit Load Controller			
	Maximum Droop	%	
	Normal Droop	%	
	Minimum Droop	%	
	Maximum <i>Frequency</i> Dead band	Hz	
	Normal <i>Frequency Deadband</i>	Hz	
	Minimum <i>FrequencyDeadband</i>	Hz	
	MW Deadband	MW	
Generating Unit Response Capability:			
	Sustained response to <i>Frequency</i> change	MW/Hz	
	Non – Sustained response to <i>Frequency</i> change	MW/Hz	
	Load Rejection Capability	MW	
Governor:			
	Details of the <i>governor system</i> described in block diagram form, showing transfer functions of individuals elements & measurement units	Diagram	
Mechanical Shaft Model			
(Multi-Stage Steam Turbine Only):			
	Dynamic model of turbine/ <i>Generator</i> shaft system in lumped element form showing component inertias, damping & shaft stiffness	Diagram	

	Natural damping of shaft torsional oscillation modes (each mode)		
	- Modal frequency	Hz	
	- Logarithmic decrement	Nepers/Sec	
Steam Turbine Data			
(Multi-Stage Steam Turbines Only):			
	Fraction of power produced by each stage:		
	Symbols KHP	Per unit of Pmax	
	KIP	Per unit of Pmax	
	KLP1	Per unit of Pmax	
	KLP2	Per unit of Pmax	
	Stage and re-heat time constants:		
	Symbols THP	Seconds	
	TRH	Seconds	
	TIP	Seconds	
	TLP1	Seconds	
	TLP2	Seconds	
Hydraulic Turbine Model			
(Hydro Turbine Generators only)			
	Dynamic model of Turbine/water conduit system in lumped element form or distributed parameter form showing component time constants,damping,loss factors,limits,non-linearity's and gains	Diagram	
General Hydraulic data			
(Hydro Turbine Generators Only)			
	All conduit dimensions	Diagram	

	All surge tank dimensions	Diagram	
	Rated head	m	
	Rated flow as rated head	m ³ /sec	
	Head losses as rated flow	m	
	Calculated water start times	Second	
	Turbine efficiency curve	Diagram	

Generator control and Protection Settings

Data Description	Units	Value
Control Protection Data		
Settings of the following Protections:		
Loss of field	Text	
Under excitation	Text	
	Diagram	
Over excitation	Text	
	Diagram	
Differential	Text	
Settings of the following Controls :		
Automatic Voltage Regulator	Text	
Governor/Speed control	Text	
Over excitation limiter	Text	
	Diagram	
Stator current limiter (if fitted)	Text	

	Diagram	
Manual restrictive limiter (if fitted)	Text	
Load drop compensation/ VAr sharing (if fitted)	Text	
	Diagram	
V/f limiter (if fitted)	Text	
	Diagram	

Tender Submission - Instruction to bidders

It is mandatory for Bidders to upload a copy of their bid in the **TENDER LINK** Electronic Tender Box no later than **4:00pm, on Wednesday 24th May, 2017**.

To register your interest and tender a response, view 'Current Tenders' at: <https://www.tenderlink.com/fea>

For further information contact The Secretary Tender Committee, by e-mail TDelairewa@fea.com.fj

In addition, hard copies of the tender, one original and one copy must be deposited in the tender box located at the FEA Head Office, 2 Marlow Street, Suva, Fiji no later than **4:00pm, on Wednesday 24th May, 2017**- Addressed as

Tender – MR 96/2017 – Supply and Commissioning of 10 x 1MW Prime Diesel Generating Sets

**The Secretary Tender Committee
Fiji Electricity Authority
Head Office
Suva
Fiji**

- **Hard copies of the Tender bid will also be accepted after the closing date and time provided a soft copy is uploaded in the e-Tender Box and it is dispatched before the closing date and time.**

Tenders received after **4:00pm** on the closing date of **Wednesday 24th, 2017**.

- will not be considered.
- Lowest bid will not necessarily be accepted as successful bid.
- **It is the responsibility of the bidder to pay courier charges and all other cost associated with the delivery of the hard copy of the Tender submission including any Duties/Taxes. Hard copies of the Tender submission via Post Box will not be considered.**

