



**TENDER FOR THE DESIGN, MANUFACTURE, DELIVERY,
INSTALLATION AND COMMISSION OF;**

- 1. 2 x PLC Control System Panels for 1 x Ruston 12RK270 and 1 x Ruston 16RK270 Engines**
- 2. 2 x MCC Switchboard for 1 x Ruston 12RK270 and 1 x Ruston 16RK270 Engines**

TENDER NO. MR 16/2023

Tender Submission - Instruction to bidders

It is mandatory for Bidders to upload an electronic copy of their bid in the **EFL TENDER LINK**, Electronic Tender Box no later than 4:00pm, on Wednesday 15th February, 2023.

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

For further information contact The Secretary Tender Committee, by e-mail **tenders@efl.com.fj**

Only Electronic Tender Bids will be accepted and should be uploaded in the EFL Tender site as per above Tender Link. Tenders should be addressed as

Tender – MR 16/2023 – THE DESIGN, MANUFACTURE, DELIVERY, INSTALLATION AND COMMISSION OF;

- 1. 2 x PLC Control System Panels for 1 x Ruston 12RK270 and 1 x Ruston 16RK270 Engines**
- 2. 2 x MCC Switchboard for 1 x Ruston 12RK270 and 1 x Ruston 16RK270 Engines**

**The Secretary Tender Committee Energy Fiji Limited
Head Office Suva
Fiji**

Tenders received after **4:00pm** on the closing date on Wednesday 15th February, 2023 will not be considered.

SITE VISIT

A site visit is compulsory for Bidders and is schedule;

1. Cawaira Power Station – Monday 30th January 2023, 10am.
2. Other Bidders that are familiar with the Cawaira Power Station and had supplied similar 415V Switchboard and PLC Control Systems to EFL in the last 5years may be exempted from this site visit but needs to get EFLs approval.

1 INSTRUCTIONS TO TENDER

1.1 GENERAL

The Energy Fiji Limited (EFL) is a statutory body vested with the responsibility for the provision of electricity supply throughout Fiji. EFL is currently implementing an upgrade of the Cawaira Power Station G1 and G6 PLC Control System and its associated Motor Control Center (MCC) Panels in Labasa which is located on the second largest main Island of Fiji. The scope for this tender is for the design, supply of upgraded equipment, installation and commissioning.

1.2 TYPE OF TENDER

The Tenderer shall submit a fixed price tender for the two Scope of Works. This requirement shall apply equally to the conforming tender only.

1.3 COMPLIANCE WITH INSTRUCTIONS

The Tender shall be submitted in accordance with these Instructions and the letter of invitation to tender. All the necessary forms and schedules need to be completed and submitted with the tender.

1.4 ADDENDA TO TENDER

Where the EFL finds it necessary to make amendments to or clarify the requirements of the tender documents during the period of tendering three copies of each Addendum will be forwarded. In the Appendix to Tender it shall state the reference number and description of each of the fore said Addenda which has been considered during preparation of the Tender.

1.5 COMPLIANCE WITH SPECIFICATION

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

1.6 DELIVERY PERIODS

The Tenderer shall submit their tender Bids on the basis which will permit the Scope of Supply to be completed under normal circumstances by the delivery dates stated in “2.4 Price and Delivery Schedule” of the Technical Specification. The Upgraded Control and required Hardware, should be supplied CFR Suva or Lautoka ports and it is also the responsible of the Contractor for the local transportation cost to Site.

1.7 CURRENCY AND CURRENCY EQUIVALENT

The tenders shall be in the currency of the Tenderer's home country. For Tender comparison purposes the currency or currencies in which the tender is offered will be valued in terms of Fijian dollars at the exchange rate quoted for the sale of the foreign currency for Fijian dollars quoted by the Reserve Bank of Fiji on the day the tenders are opened. All local companies registered in Fiji shall bid in VIP and Duty inclusive.

1.8 SIGNATURE OF TENDERER

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

1.9 INFORMATION FORMING PART OF THE TENDER

The Tenderer shall supply with each set of the tender copies of the technical, price and information schedules of the Tender Documents duly completed with all missing information and shall also supply any requisite drawings. A copy of the Tenderer's covering letter (if any) shall be submitted with each tender and each tender shall be accompanied by a full set of supporting matter which the Tenderer wishes to have considered by the Authority as supporting information for his tender. It is a mandatory requirement to submit the following documents as part of the tender proposal:

1. Tender Covering Letter with signature/seal of EFL signatory
2. Price & Payment Schedule
3. List of Experience
4. Confirmation of Insurance Policies

1.10 CONFORMING AND ALTERNATIVE TENDERS

No alternative bids shall be accepted.

1.11 NON CONFORMING TENDERS

A tender which does not comply with the Conditions of Tendering or in which the technical price information schedules requiring information to be inserted by the Tenderer have not been completed in all respects may be considered informal will be rejected for these reasons.

1.12 VALIDITY PERIOD OF TENDERS

Tenders shall remain valid for acceptance within **180 days** from the date of opening of tenders and a Tenderer shall not withdraw or amend his tender prior to the expiration of the Validity Period. In exceptional circumstances prior to expiry of the original tender validity period, the Authority may request the Tenderer for an extension in the period of validity. The request and the response thereto shall be in writing. A tenderer agreeing to the request will not be permitted to amend his tender price.

1.13 EXTENSION OF CLOSING TIME FOR TENDERS

The right is reserved to amend the date set for the opening of tenders to any late date. If it is decided to extend the time for submission of tenders all prospective Tenderers to whom tender documents have been issued will be promptly notified.

1.15 DEADLINE FOR SUBMISSION OF BIDS

Only Electronic Tender Bids will be accepted and should be uploaded in the EFL Tender site as per above Tender Link no later than 1600 hours (Fiji Time) on Wednesday 15th February, 2023.

1.16 SITE VISIT

A site visit is compulsory for Bidders and is schedule;

3. Cawaira Power Station – Wednesday 30th January, 2023, 10am.
4. Other Bidders that are familiar with the Cawaira Power Station and had supplied similar 415V Switchboard to EFL in the last 5years may be exempted from this site visit but needs to get EFLs approval.

1.17 TENDER EVALUATION

After a preliminary analysis to ascertain whether or not the tender is in accordance with the requirements of the tender documents each tender will be considered with particular reference to its eligibility as being a manufacturer, offer testing facilities in its workshop, price, completion date, design capability, evidence of past performance on contracts of a similar nature, supply of reliable quality equipment and all other matters affecting the Tenderers ability to complete the Contract in accordance with the Authority's requirements.

1.18 ADJUSTMENT OF ERRORS

The Authority reserves the right to adjust arithmetical or other errors in the Tender. Any adjustments made by the Authority to a Tender will be stated to the Tenderer prior to acceptance of the Tender. In the event of discrepancies appearing between words and figures in the Tender, the words shall prevail.

1.19 ACCEPTANCE OF TENDERS

The Authority shall not be bound to accept the lowest or any tender not to assign any reason for the rejection of a tender and reserves the right to waive any informality in a tender. No tender shall be deemed to have been accepted unless such acceptance is notified to the Tenderer by notice in writing either by handing such notice to the representative of the successful Tenderer or by sending such notice by e-mail, facsimile or airmail post. Such notice shall include any essential identifying details of the tender. The date of acceptance of Tender shall be the date on which the above mentioned notice is given or posted or e-mailed.

1.20 LANGUAGE OF TENDER

All Tenders together with any documents submitted by the Tenderer as part of any Tender shall be written in the English language.

1.21 PAYMENT SCHEDULE

The contract shall be on a lump sum fixed price basis and as per attached payment "Price Schedule B".

1.22 CONDITIONS OF CONTRACT

The Conditions of Contract shall be the AS/NZS 4911:2003 - General Conditions of Contract for the Supply of Equipment, Installation and Commissioning.

1.23 INSURANCE

The Contractor is to confirm that they have in effect the insurance policies below:

1. Public and Products Liability Insurance
2. Industrial Special Risk Insurance

Tender Specifications

Common Tender Scope General Details

This Tender have two parts to the scope of works and the upgrades are to be implemented at the EFL Cawaira Power Station at Labasa;

1. The Design, Manufacture, Delivery, Installation and Commission of 2 x PLC Control System in new Panels to control
 - a) 1 x 12RK270 Ruston Generator and 1 x 16RK270 Ruston Generator
2. The Design, Manufacture, Delivery, Installation and Commission of 2 x Motor Control Center Switchboard – MCC to replace the MCC for G1 and G6 Ruston Generators

Note: The new PLC control system for one generator is required to Control the Ruston Generator and its associated upgraded auxiliary motors in the new MCC panels. This is the reason the two Scope of works shall not be tendered separately.

SCOPE OF WORK A

1 General Requirements

1.1 Location

The two new upgrade PLC Control panels are to be installed at the Cawaira Power Station at Labasa, owned by Energy Fiji Ltd (EFL) one for the generator G1, a Ruston 12RK270 generator and the second is for generator G6, a Ruston 16RK270. The existing PLC System for G1 is a Siemens Model and for G6 is a Allen Bradley model

Cawaira Power Station is located on the second largest Island of Fiji, Vanua Levu and operates 1 x 3.6MW and 1 x 3.0MW Ruston Generator Engine.

1.2 Scope

This scope of the works shall comprise the Design, Manufacture, Factory Testing (witnessed by the EFL representative), Delivery to site, Installation and Commissioning of the following equipment to replace the existing G1 and G6 PLC System in accordance with the Contract and manufacturing requirements of AS, NZS and IEC standards.

- 2 x new PLC System Control Panels with all required IOs to control the two Ruston Generators.
- Each PLC System Control Panels shall have its own 24VDC Supply system to supply both New MCC and Control PLC Panel.

Scope includes the supply of;

- Replacement of Faulty Engine Thermocouples, RTDs, Speed Probes, Temperature and Pressure switches.
- Replacement of Instrument faulty cables
- Four sets of installation, operation and maintenance manuals, as well as all relevant drawings, plus one electronic copy of the manual and drawings;

The requirements for the installation and commissioning are covered under Section 3 of the technical specification for the MCC Technical Specification in Scope of work

Technical System Information

Generator System Specification

Current Control Panel Specification

G6 Engine Details			G1 Engine Details		
Name:		Ruston 16RK270	Name:		Ruston 12RK270
Engine Number:		1H10424	Engine Number:		1H1271
Continuous Service Output:		3.59MW	Continuous Service Output:		2.7MW
<u>Alternator</u>			<u>Alternator</u>		
Name:		Leroy Somer	Name:	ABB INDUSTRY	Leroy Somer
Type:		LSA 56 BZ11-8P	Type:	AMG 710MR8S	LSA 56 BZ11-8P
Serial Number:		600158-1	Serial Number:		4558392
IP Number:			IP Number:		IP23
Output:		3600KW (4500KVA)	Output:		3400KVA
<u>G6 PLC Details</u>			<u>G1 PLC Details</u>		
Items	Model	Components	Items	Model	Components
PLC Unit	Allen-Bradley	Modular Processors	PLC Unit	SIEMENS	Modular Processors
	SLC 500 series	Thermocouple/mV Input Module		SMATTIC S5-100U CPU 100	Thermocouple/mV Input Module
		RTD/ Resistance Input Module			RTD/ Resistance Input Module
		High Speed Counter Module			High Speed Counter Module
		Discrete I/O Modules			Discrete I/O Modules
User Interface	Paneview 600		User Interface		
G6 Governor Details			G1 Governor Details		
Items	Model	Components	Items	Model	Components
	ALSTOM	Type: 1102v-4g 15R		gec alsthom	
		serial no: 0020666		regulayeurs	
		rpm 1350-1500		europa	
		motor 24v		type 1102v-49 15R	
		stop 24v		serial no :9719707	
	droop 4%				
	cus no-rg 13089				
User Interface			User Interface		

Setup and Terminal arrangement is shown in the Appendix 1

General Information

The following information applies to the PLC Control System for both Ruston Engines mentioned in the above details.

The upgraded PLC should have the same capability and features of the existing PLC or have more advance Digital instrument that will maintain the safety of the Generator when in operation.

The PLC handles all control and alarm function. It also measures the Engine & Turbocharger speeds and operates a series of relays as a temperature scanner. It also incorporates the protection system for both the Engine and Alternator units.

The control panel must incorporate the following items to be mounted inside the panel are:

- PLC Unit (Modular system mounted in rack)
- Control fuses
- Temperature Scanner unit to read existing thermocouples and provide protection
- Control relays
- Speed signal convector
- Audible alarm
- Terminal Blocks

Items mounted on the panel door:

- PLC User Interface Panel
- Engine Hours runs Indicators
- Governor solenoid latched indicator lamp
- Panel ON lamp
- Air System Indicator
- Air System ON/OFF switch
- Metal Detector Indicator & Reset
- Engine Stop and Start buttons
- Engine Speed lower and raise buttons
- Reset Button
- Local-Remote control switch
- Hand-Auto control switch
- Emergency Stop Button

The emergency Stop button must be connected directly to the shutdown relay and cuts off the engine without requiring any action from the PLC.

User Interface Panel

The User Interface Panel should contain a colour touch screen together with a set of buttons for data entry and function keys. This unit should indicate all status and alarms conditions. It also should give limited access to system setup.

On Power Up, the unit should run a self-test routine and then display a default screen which shows current status of the system.

Default Screen

The screen should display;

- Set unavailable/ Hand/ Auto Status
- Engine Speed (When Running)
- Turbo Speed (When Running)
- Various Indicator and warning message prompt

This screen must carry the software vision/revision number which would be used to track or enquire about the software or operation of the equipment.

The sub displays of following variable must be inclusive but not limit to;

- Alternator
 - Temperature
 - Winding
 - Air
 - Terminal Output
 - Voltage
 - Current
 - Frequency
- Engine
 - Temperature
 - Cylinders
 - Exhaust
 - Turbine Inlet (Turbocharger)
 - Turbine Outlet (Turbocharger)
 - Charge Air
 - Bearing
 - Jack Water
 - Raw Water
 - Lube Oil
 - Pressure
 - Start Air
 - Fuel
 - Jacket Water
 - Crankcase
 - Lube Oil
 - Charge Air

The Alarm & Shutdown System – Protection System

Alarms & Shutdowns are to be indicate by a special alarm window which indicates the cause of the alarm with a fault code.

An Acknowledge/reset button is to be provided which removes the alarm window and if possible mute audible alarm. If several alarms are present, the alarm will not be muted.

All current alarms are to be automatically added to the fault list

The Fault List

Include a running log of all system faults & warning. In each case, the following data is to be stored and displayed;

- Alarm Date (DD/MM/YY)
- Alarm Time (HH:MM: SS)
- Fault Code & Description
- Engine Reading
- Alternator Reading

Include provisions for this data to be export via MODBUS or serial ports.

Alarms & Trip Setting

Independent relay OFF and ON points must be definable for the following analogue signals;

- High Charge Air Temperature – Shutdown
- High Charge Air Temperature – Alarm
- High Exhaust Temperature – Alarm
- High Jacket Water Temperature – Alarm
- High Jacket Water Temperature – Shutdown
- Low Lube Oil Pressure – Alarm
- Low Lube Oil Pressure – Shutdown
- High Crankcase Pressure – Alarm
- High Alternator Winding – Alarm
- High Alternator Bearing Temperature – Alarm
- High Alternator Air Temperature – Alarm

This allows fully variable hysteresis for every alarm channel.

System Diagnostic Tool – Built In

The user interface panel should support a System Diagnostics Screen. This may be accessible either in the setup menu or by a pre-defined button on the default screen.

This screen should contain many inputs, outputs and control flags used in the engine control system. These are generally labelled as on a (Ruston) standard engine control drawing and have similar functions:

- Main control relays
- Restart lockout from speed switch
- Air start lockout from speed switch
- Alarm On/ engine running from speed switch
- Secondary over speed protection from speed switch

Engine Speed

The engine speed is measured using a magnetic pickup. The signal from this is processed to produce a 24 VDC square wave. This should feed into a high speed counter on the PLC.

Independent relay OFF and ON points are definable for each of the following speed signals. This allows fully variable hysteresis for every speed channel.

- Restart Lockout
- Start Air Cut-off
- Running / Alarms On
- Overspeed

Communication

Communications protocol

Using MODBUS interface or similar product to connect to the PLC processor via D9 or similar upgraded connection. Note the inclusion of a RTS-CTS jumper at the PLC end of the cable for device to communicate.

The PLC must be a slave unit on the MODBUS

SCADA Integration

Ensure the PLC is capable of communicating to /able to be integrated in EFL internal SCADA system for remote Control and monitoring of the generator unit from our national control centre in the Main Island Viti Levu.

SEL Integration

Ensure the PLC is capable of communicating to /able to be integrated in EFL protection system for the remote status of the generator unit at our control room HMI and National Control Centre. Currently SEL unit are used for CB control and protection.

Scope of Work B

2 General Requirements

1.1 Location

These two new MCC switchboards are to be installed at the Cawaira Power Station at Labasa, owned by Energy Fiji Ltd (EFL) one for generator G1 and the second is for generator G6

Cawaira Power Station is located on the second largest Island of Fiji, Vanua Levu and operates 1 x 3.6MW and 1 x 3.0MW Ruston Generator Engine.

1.2 Scope

The scope of the works shall comprise the Design, Manufacture, Factory Testing (witnessed by the EFL representative), Delivery to site, Installation and Commissioning of the following equipment to replace the existing G1 and G6 Motor Control Centre (MCC) in accordance with the Contract and manufacturing requirements of AS, NZS and IEC standards.

- 2 x new MCC Panel to supply all the auxiliaries for the two Ruston Engine Generator.
- Each MCC shall have its own 24DC Supply system to supply both New MCC and Control PLC Panel. For the Ruston Generators

Scope includes the supply of;

- One set of spare parts;
- Four sets of installation, operation and maintenance manuals, as well as all relevant drawings, plus one electronic copy of the manual and drawings;

The requirements for the installation and commissioning are covered under Section 3 of this technical specification.

The new MCC switchboards shall be located in the same location as the existing boards/panels.

The Contractor/Bidder shall replace all the outgoing existing motor cables from the MCC Board as these are old and may be short to be connected to the new MCC.

The new MCC 415V switchboards may be manufactured into two or three sections to ease the logistic of installing the new board.

The Contractor shall be responsible for the following requirements:

Motor Control Centre (MCC) Panels x 2

1. The redesign and providing calculations for the busbar rating and short circuit current ratings using the existing ratings as shown on the annexed schematic drawing No. 1OE 31004 (FEA Drg No. 10-E31-004)
2. Existing Motor Starters are DOL but Bidders should consider Soft Starters for the high ampere motor circuit.
3. The determination of current rating and protection for all outgoing circuit from the MCC should use existing as reference.
4. Provide provision for remote start and stop of all Motors Starters should be also provided.

5. Provision for remote status/indication and faults/trips for the all auxiliary motors are to be provided as these MCC which will be integrated to a new PLC control system been also on Tender.,
6. Provision of a more advance control system will be an advantage.
7. The Bidder shall provide details for the Supply of;
 - a) Two complete 415V MCC switchgear indoor switchboard equipped with withdrawal circuit Breakers and DOL motor starter controls for isolation of circuits during maintenance.
8. Provide a work schedule for this project which includes the installation and commissioning.
9. Existing MCC Panel Dimension is W-700mm, L-3400mm, H-2400.
10. Provide
 - Power, control and instrumentation cables and cable support system;
 - Provide replacement of existing cables for all auxiliary motors
 - All necessary accessories.

1.3 Delivery

The new 415V MCC switchboards shall be delivered to Cawaira Power Station in Labasa, installed and commissioned according to Standard mentioned in this document.

1.4 Existing Drawings Supply Characteristics

The information on the existing MCC Panels, instrument electrical diagram, is included in Annex A of this document.

MCC Panel Drawings;

1. Circuit Drawing and Motor Rating Schedule for G1
2. Circuit Drawing and Motor Rating Schedule for G6
3. Control Procedure

1.5 Climate

The following service conditions will apply

- Ambient temperature 10°C to + 40°C;
- 100 % humidity with rapid temperature drop can occur;
- The altitude is less than 100m asl;
- Earthquakes can be expected.
- Rainy season is over the October-March period.

1.6 Standards

The equipment shall comply with the requirement of the latest revisions of the following standards, as applicable and the equivalent AS/NZS where available. In case of deviation between the IEC, ANSI and IEEE standards and the AS/NZS standards, the latter will take precedence.

IEC 60044	Instrument transformers;
IEC 60144	Degrees of protection of enclosures for low voltage switchgear and control gear;
IEC 60185	Current Transformers;
IEC 60664	Insulation co-ordination
AS/NZS 3439	LV Switchgear and control gear assemblies, including metal-enclosed bus;

1.7 Drawings

Specification drawings

The sample drawings shall be of the attached specimen in Annex B

Contract drawings

Contract drawings shall be provided by the Contractor to the Engineer/EFL by the Contract not later than four weeks after the contract award and shall include:

- a. Fully dimensioned outline and layout drawings of the equipment.
- b. Construction and assembly drawings showing details of the equipment including complete panel mounting details, electrical wiring, terminal blocks, electrical power connections and instrumentation.
- c. Diagrams of all electronic and electrical circuits contained in the equipment.
- d. Design calculations.

All the drawings prepared by the Contractor must comply with the EFL Drafting Specification for New Plant (see Annex B).

All drawings shall be A2, A3 and A4 standard sizes and in addition to the drawing title an information block shall be shown near the lower right hand corner to contain the following entries:

- Specification No.
- Contract No.
- Drawing approved
- Drawing approved subject to statutory approval
- Approval not required
- Provisional approval as noted. Design/Manufacture may proceed
- Not approved
- Date
- Space for Project Manager signature

1.8 Design Suitability

It shall be the Contractor's responsibility to implement the design requirements and objectives of the specification. Where the specification does not cover an aspect of the equipment design, the Contractor, in consultation with EFL, shall use a design that ensures correct and reliable operation.

The contractor shall assume full responsibility for the correct operation of the equipment.

Design work shall include, but is not limited to:

- a) Provision of an overall programme.
- b) A detailed Commissioning Plan to coordinate all required tests and inspections with the commissioning programme.
- c) Layout drawings for the cubicles, cables routes, etc
- d) Cable schedules
- e) I/O list
- f) Updating EFL drawing files and as built station drawings
- g) Liaison with EFL representative for protection, control, and instrumentation.

Upon completing the draft design the Contractor shall submit the relevant documentation to the Engineer to the Contract who will convene a design review and Hazop meeting to verify that the design meets the objectives of the upgrading project. The Contractor shall address any deviation, or requirement identified through the design review meeting.

1.9 Manufacturing Programme and Progress Reporting

The Contractor shall supply to the EFL, not later than two weeks after contract award date, a manufacturing programme showing the proposed progress of drawings, manufacture, delivery of equipment and installation/commissioning.

The contractor shall submit two copies of a brief and concise monthly progress report covering:

- (i) The state of progress in manufacture and installation as measured against the approved Manufacturing and Installation Programme.
- (ii) A statement of any delays and reasons why they have occurred.
- (iii) An assessment of the effect of such delays on the attainment of the approved Manufacturing and Installation Programme (not necessarily solely contractual key dates).
- (iv) A statement of the measure, which has been taken or is proposed to eliminate or at least minimize the effect of the delay.

1.10 Inspection and Test Plan

The Contractor shall submit for approval not later than 2 weeks from acceptance date of the tender, two copies of an inspection and test plan (and every subsequent changes).

If at any time during the execution of the Contract, it is found necessary to modify the inspections and test plan, then the Contractor shall submit a revised plan to EFL for approval.

1.11 Instruction Manuals

The contractor shall supply four copies of an installation, operation and maintenance manual at, or prior to, the time of the delivery. These manuals shall contain all the information necessary for the erection, installation, commissioning, operation and maintenance of the equipment and shall include copies of the technical descriptions of all other manufacture's items used.

The manuals shall be as simple and as clear as possible, fully illustrated with drawings and diagrams as necessary and detailed with part numbers for ordering replacements.

The manuals shall be submitted as an electronic copy as well.

In addition the manual shall contain the data sheets of all the parts used, suitable for identification and ordering purposes.

2.0 Technical Requirements for New MCC Switchboards

2.1 General Requirements – Motor Control Center (MCC)

2.1.1 Scope of Contract

The equipment required to be supplied under this part of the contract consists of:

- a) 2 x Motor Control Center (MCC) 415V switchboard
- b) Recommended spare parts.
- c) Special erection and maintenance tools.
- d) Installation, operation and maintenance manuals.
- e) Replacement of all existing auxiliaries motor power cables
- f) Provide Tool Box Laptop loaded with software

2.1.2 Service

The MCC switchboards is to be located inside the Cawaira power house and will provide power supply to all auxiliary motors for G1 and G6. These two generators are Ruston Generator Engines.

The following are the listed auxiliaries connected to the two required MCC Panels and the Bidders are required to provide the protection to cater for the normal and starting currents;

G1 MCC CIRCUIT RATING SCHEDULE

Cawaira Power Station G1 MCC Details													
	Motor Description	Motor Rating	Motor Amps	MCCB Rating	TOL Rating	DOL Starter						Ammeter Local & Remote	Comments
						Control Mode			Local				
						OFF	Manual	Auto	Run	OFF	Fault		
1	Jacket Water Cooling Water Pump Motor	7.5KW	13.04293	32	13-20A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. Thermistor Protection. 24V DC Control
2	Oil Priming Pump Motor –	21kW	36.52021	63	30-42A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. Thermistor Protection. 24V DC Control
3	Baring Gear Motor	2,6kW	4.52155	16	3.5-4.8A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. Forward & Reverse Operation. 24V DC Control
4	Crankcase Extractor Fan Motor -	0.830KW	1.443418	6	1.0-2A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. . 24V DC Control
5	Radiator Fan Motor 1	5.5kW	9.564818	16	9-15A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. Thermistor Protection. 24V DC Control
6	Radiator Fan Motor 2	5.5kW	9.564818	16	9-15A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. Thermistor Protection. 24V DC Control
7	Radiator Fan Motor 3	5.5kW	9.564818	16	9-15A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. Thermistor Protection. 24V DC Control
8	Radiator Fan Motor 4	5.5kW	9.564818	16	9-15A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. Thermistor Protection. 24V DC Control
9	Radiator Fan Motor 5	5.5kW	9.564818	16	9-15A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. Thermistor Protection. 24V DC Control
10	Radiator Fan Motor 6	5.5kW	9.564818	16	9-15A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. Thermistor Protection. 24V DC Control
11	Lub Oil Heater 1	1.5KW	2.608587	32	20-32A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. Thermistor Protection. 24V DC Control
12	Lub Oil Heater 2	1.5KW	2.608587	32	20-32A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. Thermistor Protection. 24V DC Control
13	Jacket Water Immersion Heater	4kW	6.956231	32	16-32A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Manual Operation
14	Lub Oil Centrifuge Unit		125	125		Yes	Yes	No	Yes	Yes	Yes	Yes	Manual Operation
15	Low Current Distribution Cct		180	180		Yes	Yes	No	Yes	Yes	No	Yes	Manual Operation
16	Main Incomer			800		Yes	Yes	No	Yes	Yes	No	Yes	Manual Operation - NEMO HD+ Multifunction Energy Meter
			430.0904										

G6 MCC CIRCUIT RATING SCHEDULE

Cawaira Power Station G6 MCC Details														
	Motor Description	Motor Rating	Motor Amps	MCCB Rating	TOL Rating	DOL Starter						Ammeter	Comments	
						Control Mode Positions			Local Indications					Local & Remote
						OFF	Manual	Auto	Run	OFF	Fault			
1	Jacket Water Cooling Water Pump Motor	4KW	5.5649851	16	5-10A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. Thermistor Protection. 24V DC Control	
2	Oil Priming Pump Motor –	22kW	3.0607418	63	30-42A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. Thermistor Protection. 24V DC Control	
3	Baring Gear Motor	2.2kW	3.0607418	16	2-7A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. Forward & Reverse Operation. 24V DC Control	
4	Crankcase Extractor Fan	0.830KW	1.1547344	6	1.0-2A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. . 24V DC Control	
5	Radiator Fan Motor 1	7.5kW	10.434347	20	9-15A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. Thermistor Protection. 24V DC Control	
6	Radiator Fan Motor 2	7.5kW	10.434347	20	9-15A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. Thermistor Protection. 24V DC Control	
7	Radiator Fan Motor 3	7.5kW	10.434347	20	9-15A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. Thermistor Protection. 24V DC Control	
8	Radiator Fan Motor 4	7.5kW	10.434347	20	9-15A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. Thermistor Protection. 24V DC Control	
9	Radiator Fan Motor 5	7.5kW	10.434347	20	9-15A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. Thermistor Protection. 24V DC Control	
10	Radiator Fan Motor 6	7.5kW	10.434347	20	9-15A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. Thermistor Protection. 24V DC Control	
	Radiator Fan Motor 7	7.5kW	10.434347	20	9-15A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. Thermistor Protection. 24V DC Control	
	Radiator Fan Motor 8	7.5kW	10.434347	20	9-15A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. Thermistor Protection. 24V DC Control	
11	Lub Oil Heater 1	1.5KW	2.0868694	10	4-10A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop. . 24V DC Control	
12	Lub Oil Heater 2	1.5KW	2.0868694	10	4-10A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop.. 24V DC Control	
13	Jacket Water Immersion	4kW	5.5649851	32	16-32A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Remote Automatic Start and Stop	
14	Lub Oil Centrifuge Unit		32	32		Yes	Yes	No	Yes	Yes	Yes	Yes	Manual Operation	
15	Low Current Distribution Cct		180	180		Yes	Yes	No	Yes	Yes	No	Yes	Manual Operation	
16	Main Incomer			800		Yes	Yes	No	Yes	Yes	No	Yes	HD+ Multifunction Energy Meter	

The exact single drawings for the existing MCC is not available because this Power Station has been in operation for the last 30+ years and documentation of some equipment cannot be located. The design of the new MCC panel should be of standard mentioned in this document.

The Auxiliaries are programmed to start one at a time if the control mode is in Automatic. Remote modes of control should be also provided. Manual modes of starting and stopping are also to be provided on each aux panel. Any over current trip should lockout the controls and can only be restarted once the trip lockout is manually reset.

The control for each Auxiliary Motor should have their respective protection as per ASNZ or IEEC standard mentioned in this document.

The switchboard is to be located inside the Cawaira Powerhouse will provide power supply to all auxiliary motors for G1 and G6. These two generators are Ruston's Generators.

2.1.3 Seismic Strength

The equipment will be installed in an area subject to earthquakes and shall withstand without damage or malfunction the most adverse combination of the following forces:

- Forced produced by the equipment own weight.
- Earthquake induced forces giving rise to horizontal and vertical accelerations of 0.75g acting through the centre of mass of the equipment. Both horizontal and vertical motions shall be combined to provide the most adverse effect unless it can be shown that there is insignificant interaction between the horizontal and the vertical motions of the equipment response.
- Electromagnetic and mechanical forces produced over the full range of the equipment operating capability.

Individual vibration sensitive components forming part of the equipment must be able to withstand induced loads resulting from periodic vibration having an acceleration of 0.75g over the frequency range of 1Hz to 15Hz.

All components shall be securely fastened into place. Provision shall be made to mechanically restraining all plug-in, or withdrawable devices and modular elements.

2.1.4 Drawings

Specification drawings

Sample drawings are attached for design references.

Contract drawings

Contract drawings shall be provided by the Contractor to the Engineer to the Contract not later than four weeks from the contract award and shall include:

- a. Fully dimensioned outline and layout drawings of the equipment
- b. Busbar general arrangement, Layout and footprint drawings
- c. Construction and assembly drawings showing details of the equipment including complete panel mounting details, electrical wiring, terminal blocks, power connections and instrumentation
- d. Diagrams of all electric and electronic circuits contained in the equipment.
- e. Design calculations (fault calculations, cable sizing, load list, load analysis, etc.)
- f. Protective device coordination and protection relay settings.

All the drawings prepared by the Contractor must comply with the EFL Drafting Specification for New Plant (see Annex B).

All drawings shall be, A3 standard sizes and in addition to the drawing title an information block shall be shown near the lower right hand corner to contain the following entries:

- Specification No.
- Contract No.
- Drawing approved
- Drawing approved subject to statutory approval

- Approval not required
- Provisional approval as noted. Design/Manufacture may proceed
- Not approved
- Date
- Space for Project Manager signature

2.1.5 Design Suitability

It shall be the Contractor's responsibility to implement the design requirements and objectives of the specification. Where the specification does not cover an aspect of the equipment design, the Contractor shall use a design that ensures correct and reliable operation.

The contractor shall assume full responsibility for the reliable operation of the equipment.

2.1.6 Manufacturing Programme

The Contractor shall supply to the Engineer to the Contract, not later than two weeks from contract award date, a manufacturing programme showing the proposed progress of drawings, manufacture and delivery of equipment.

2.1.7 Instruction Manuals

The contractor shall supply four copies of an installation, operation and maintenance manual at, or prior to, the time of the delivery. These manuals shall contain all the information necessary for the erection, installation, commissioning, operation and maintenance of the equipment supplied by the Contractor and shall include copies of the technical descriptions of all other manufacture's items used.

In addition the manual shall contain the data sheets of all the parts used, suitable for identification and ordering purposes

2.1.8 Training

The Contractor is required to provide training to 10 FEA personnel on;

1. the operation of the switchboard with related interlocks
2. switchgear operation
3. PLC reloading of software and work file
- 4.

2.1.9 Spares

The following should be included in the scope of equipment supply;

1. All ratings of thermal Protection and contactor used
2. All types of indications used
3. All types of switches used

2.2 Technical Requirements

2.2.1 Standards

The equipment supplied shall meet the following standards.

AS/NZS 3439 – Low voltage switchgear and control gear assemblies

AS/NZS 3497 – Low voltage switchgear and control gear

AS 1939 – Classification of degree of enclosure protection

IEC 6044-1, 2 – Instrument transformers

All electrical apparatus, materials and wiring shall comply with the AS/NZS 3439.1 Electrical Wiring Regulations as applicable. Equipment built to other standards will be accepted providing that in the opinion of the Engineer to the

Contract they meet or surpass the above standards. Full details of the standard used shall be provided in the tender submitted.

2.2.3 MCC Switchboard

The location of the MCC 415V station switchboard is on the main generator floor corridor beside Ruston Generators. The switchboard shall have a neat and uniform appearance and the layout of the equipment mounted on the panel fronts shall follow the logical pattern for ease of identification and maintenance.

The available space dimensions of the existing 415V main switchboard are: W-700mm, L-3400mm, H-2400 if it is shifted preassembled into place.

The switchboard shall be equipped with explosion vents through the top and shall be capable of preventing any internal arcing fault being propagated beyond the compartment in which it occurs. The switchboard shall be designed to ensure the safety of personnel standing in front of the switchboards during an internal arcing fault. The incomer to the MCC 415V Board shall be a Circuit Breaker rated to replace as per existing isolating switch.

The switchboard shall be manufactured to a design successfully tested to the standard requirement of internal arcing fault test to AS/NZS 3439.1.

The switchboard shall have a form of segregation Form 3b, or Form 4 to AS/NZS 3439.1 Annex ZD. The switchgear shall conform to Type 2 coordination as per AS/NZS 3947.

The Switchboard shall be mounted on Anti Vibration devices

The switchboard and equipment must be fully type tested in accordance with the relevant standards.

The existing MCC switchboard is rated for 415V, 3-phase, 4 wire, 50Hz and 1200A continuous, with a short-time withstand capability of 51kA for 1 seconds. However the Contractor shall submit, as a part of the design, the calculation for determining the 415V busbar maximum short circuit current under the worst case scenario. Existing rating is listed

Provisions shall be made for connecting temporary earthing leads to the incoming cable terminations.

The Contractor shall design the switchboard for maximum continuity of supply so as to ensure that it is capable of a very high level of availability and reliability, given its vital function for the operation and safety of the power station.

Specific technical requirements in accordance with AS/NZS 3439.1 are included in Annex C.

The contractor shall include in his proposal an arcing detector in the busbar compartment.

2.2.3.1 Remote Provision

The new MCC panels will be later incorporated into a PLC control system to control the associated Generator. All circuit breakers are to have provision for remote control and also to have provision for remote indication for status and faults.

2.2.4 New MCC Panel Maintainability

It shall be possible to fully service, remove and replace existing functional units safely while the switchboard is in service and energized.

It shall also be possible to install additional functional units in spare positions on the switchboard and their associated cabling while the switchboard is in service and energized.

Visual inspection of the following equipment shall also be possible while the switchboard is in service and energized:

- Switching devices
- Conductor connections and markings
- Relay settings and indicators
- Fuse links

All circuit breakers, isolators, etc. shall have provision for padlocking in the open (Off) position.

2.2.5 Auxiliary Power Supply

Two new dc power supply system shall be part of this contract to supply control voltage to each New MCC.

The equipment supplied by the Contractor shall have standard protection for any DC Control System.

The dc supply at the switchboard incomers shall be monitored and alarmed for under voltage/loss of supply conditions. Auxiliary contact shall be provided for remote alarming.

The existing DC Supply is a very old and the Contractor is required to review the existing supply. FEA is looking at having a separate DC Supply system (24 – 48V) and the Contractor is required to design this option.

2.2.6 - 415V Switchboard Components

2.2.6.1 MCC Busbars

The busbar assembly shall be a Type Tested assembly rated 1200A.

The preferred material is hard-drawn rectangular section copper, which shall be rigidly supported and fully insulated (Rated insulation voltage 1,500V; Rated impulse insulation voltage 12kV) throughout their length with heat-shrinking material appropriately coloured for identification purposes. Tee-offs and bolted joints shall be provided with removable boots to allow inspection and Ductor testing. The neutral busbar shall be sized as the phase busbars.

The busbar system shall be completely enclosed in earthed metal chambers with removable panel fitted to give access to them. The removal of these panels shall not give access to other incoming or outgoing circuits which may be energized from their remote ends. The bus sections shall be fully segregated from each other.

Circuit phase busbars and connections shall be rated at not less than the associated switchgear.

As-built drawings showing details of the busbar general arrangement, joints, take-off points and other connections on the busbars shall be provided. All torque settings for the bolted connections shall be clearly indicated on the drawings.

Neutral and earth busbars shall be completely isolated from each other. The current carrying capacity of the neutral bars shall not be less than the current carrying capacity of the associated phase busbars. The main earth bar shall be copper with a minimum cross section as per design and shall run the full length of the switchboard. The main earth bar shall be capable of carrying the short time withstand current specified for a period of one seconds. Full height earth bars in cable compartments shall be provided. The earth bars shall be drilled at regular spacing for the connection of external cabling earth conductors. Likewise full height neutral busbars in cable compartments shall be provided.

All busbar assemblies, including main horizontal and vertical runs and connections to incomer shall be fully accessible for inspection and available with the necessary safeguards for thermal imaging. Thermal imaging is preferred to be conducted via inspection windows mounted at strategic locations on the switchboard enclosure. The inspection windows shall be type tested for arc faults within the switchboards.

2.2.6.2 Anti-condensation Heaters

Thermostatically controlled anti-condensation heaters shall be provided in all cable wireways, incoming feeder compartments and busbar chambers. The heaters shall be supplied from a power supply external to the switchboard. MCBs shall be used to feed the heater circuits, which shall be protected against earth leakage. Heater status indication LEDs shall be provided.

2.2.6.3 Factory Testing Requirements

Routine test in accordance with AS/NZS 3439 shall be carried out at the switchboard manufacturer's premises. These tests shall include the following as a minimum:

- All type test
- Ductor (micro ohm meter) test of all busbar joints, tee-offs and connections. The tests shall be complete with a detailed busbar general arrangement diagram showing all joints/connections.
- Dielectric tests
- Insulation resistance test (power and control circuits)
- Contact resistance on circuit breakers
- Functional tests on all circuit breakers
- Ratio and impedance test on all current transformers

- Earth continuity
- Functional sequence, interlocking and primary injection testing of all protective relays and devices
- Phase sequence/orientation for all busbars and feeders.

Prior to commencement of tests at the manufacturer's works the Contractor shall submit for approval of the Engineer to the contract an inspection and test plan

2.2.6.4 Withdrawal Air Circuit Breakers

The incoming main feeder shall be equipped with withdrawable air circuit breaker of the triple pole unit, which shall be of the four pole type. The incoming feeder circuit breaker shall be housed in a separate metal compartment.

The circuit breakers shall have the following current ratings:

Rated voltage	415Vac
Rated current	Incomers 600A,
Rated frequency	50Hz
Short circuit breaking capacity	21kA (depending on Bidder design)
Short circuit making capacity	30kA (depending on Bidder design)
Short time withstand current	15kA for 1sec (depending on Bidder design)

The withdrawable circuit breakers shall have the following features:

- Automatic safety shutters to cover the busbar circuit connections when the circuit breaker is withdrawn. The shutters shall be provided with facility to be locked for isolation purposes. Integral earthing facilities shall be provided to effectively earth the circuit breaker frame when it is in the service position.
- A stored energy operation mechanism capable of being electrically and manually charged with both remote and electrical and manual control. The circuit breaker auxiliary power shall be from the 110Vdc system referred to in Section 2.2.5 of this specification. The status of the stored energy shall be indicated.
- Interlocks to inhibit circuit breaker closing operation until the stored energy system is sufficiently charged to close and trip the circuit breaker.
- Anti-pumping device to prevent re-closing of the circuit breaker after it tripped subsequent to closing and tripping on fault.
- Mechanical interlock to prevent disconnection of the circuit breaker from the busbars unless the circuit breaker is in the open position.
- Mechanical interlocks to prevent connection of the circuit breaker to the busbar unless the circuit breaker is in the open position.
- A clearly visible mechanical indicator to show the circuit breaker closed or open position.
- A circuit breaker operation counter.
- Auxiliary contacts as follows:
 - Four contacts that close when the circuit breaker is open
 - Four contacts that close when the circuit breaker is closed
 - Two contacts that close when the circuit breaker is in service position
 - Two contacts that open when the circuit breaker is in service position
 - Two contacts that close when the circuit breaker trip operates.

The status of the first two sets of contacts above shall remain unchanged when the circuit breaker is withdrawn. The last set of contacts above shall be provided with a reset facility. The spare circuit breaker auxiliary contacts shall be pre-wired to terminals for future use.

- Be interchangeable for units of the same rating.
- Service, test and isolated position with relevant position indicators.
- Lockable covers on the local manual controls
- Manual resetting of the circuit breaker before it can be manually re-closed.
- Overcurrent and earth fault protection devices. All protection relays shall be provided with test terminal blocks to facilitate secondary injection tests. The same tests terminal blocks are also required for the Energy Meters.

o) Switchgear local/remote control selector switch.

Motor Controls

The DOL starter controls and main circuit for each aux motor shall have provision for complete isolation during maintenance of the motors. It shall be a withdrawal type of design.

Instrument and metering

Instruments supplied with the switchboard shall comply with the requirements of IEC 60051-2. The instrument frames shall be dimensioned 96mmx96mm and have non-reflective glass and stud terminals.

Voltmeters for the incoming circuit and busbars shall be equipped with switches to be used for selecting the voltage between any two phases for indication on the voltmeter. Each voltmeter shall be of class 1.5 accuracy and shall be scaled 0 to 500V, with the 415V value marked in red.

The ammeters shall be supplied for each incoming circuit and shall have accuracy class 1.5 and suitably scaled to match the nominal maximum current from the relevant circuit. Ammeter phase test links shall be provided in a readily accessible location.

Current transformers

The current transformers shall comply with the requirements of BS 3938. They may be of either the bar primary, or wound primary type. All current transformers are required for operation at the rated frequency and shall have an insulation level of 2.5kV.

All current transformer secondary windings shall be terminated into separate terminal blocks with means of shorting the secondary windings at the terminal blocks. All current transformers shall be Class I, Class SP10, 5/10/15VA or according to Design requirement and shall have a rated secondary current of 1A.

Overcurrent and Earth Fault protection

The main incomer circuit breaker shall be supplied with new separately mounted current transformers and overcurrent, under voltage and earth fault protection relays to provide adequate protection for the switchgear. Option is to use the inbuilt circuit breaker protection if it is available. The Contractor is required to include any additional/proposed protection schemes that will add more safety to the switchboard and equipment.

Power Energy meters

The incomers to the switchboard shall each be metered by a **Nemo HD+** capable of giving out remote metering on the switchboard. The meters shall comply with IEC 62053-11 and shall be of accuracy class 0.1 or better.

Each Auxiliary motor control is to be have a meter to meter Amps and Volts

Terminal blocks

Terminal blocks shall comply with ESI 12-1. The preferred terminal blocks are:

Type	Application
Klippon SAK2.5	Remote control and remote indication
Klippon SAK4	General
Klippon SAK 6N	General and 240Vac circuits
Klippon SAK10	General (high current)
Klippon SAKA10	VT and CT earth links
Klippon EG32/1	Mounting of diodes in circuit breaker controls/protection
Klippon DK4	Mounting of diodes in alarm circuits.

The minimum thickness of terminal blocks shall be 6.5mm.

The trip connection shall be shielded at their terminal block by means of insulated covers.

Cabinets shall have at least 10 spare terminals and enough extra space on mounting bars for 20% more terminals.

2.2.7 MCC Switchboard Construction

Cabinets

The equipment shall be constructed in free standing sheet metal cabinets suitable for top and bottom cable entry. The cabinet sheet metal work shall not be less than 2mm thick and gland mounting plates shall not be less than 3.5mm thick. Gland mounting plates shall be undrilled unpainted galvanized steel or brass for 3-phase cables, and brass or aluminium for single core cables.

The cabinets shall be provided with a base plinth being 100mm high as a minimum height.

The cabinets shall be suitable for mounting on Uni strut framework.

The switchboard panels shall be accessible on the front and on rear.

The cabinets shall comply with AS 1939. The degree of protections with the doors or covers of functional units or ducts open or removed shall not be less than IP21.

Panel wiring, ferrules and cableways

All panel wires shall be multi-stranded copper of at least seven strands and shall have radial thickness of PVC insulation to IEC 60502-1 standard.

The minimum conductor cross sectional area shall be 1.5mm²

The wiring insulation shall be coloured in accordance with the following table.

Colour of wire	Circuit Particular
Red White Blue	AC Phase connections in current and voltage transformer circuits Connections to earth.
Green with yellow stripes	Color code used for earthing of the system and connection to ground
Black	AC neutral connections, earthed or unearthed, connected to the secondary circuits of current and voltage transformers and all the other neutral points.
Light grey	Connections in dc circuits

Inter panel connections shall be made in such a way that does not reduce the ability of the switchgear to contain an arcing fault.

The wiring shall be executed in a neat and orderly manner and the arrangement of wiring and the positioning of any cableways within each cabinet shall not obstruct access to equipment terminals and mounting devices.

Vertical cabling ducts extending the full height of each tier shall be provided for cabling access to each module. Vertical ducts shall be provided with internal full-length perforated metal supports for fixing cables by means of cable ties and shall be no less than 400mm in clear width. Each cable compartment shall be fitted with a lift-off hinged door. Extra low voltage equipment, control wiring and busbars shall be grouped and separated from low voltage equipment.

Labels and engravings

All controls, instruments and indications shall be labelled with appropriate inscriptions describing their function. All switchboard equipment shall be numbered from left to right when viewed from the front of the switchboard unless noted otherwise.

All labels shall be submitted to the Engineer to the Contract for approval.

Labels shall have black background with white letters and shall be made of engrave able phenolic material engraved with suitably sized vertical characters. The label shall be fixed in place with suitable adhesive.

Nameplates reading "DANGER – LIVE BUSBARS" shall be affixed on each removable cover of busbar chambers of incoming supply connections. Each shroud over terminals of normally live bare metal shall be labelled "DANGER – LIVE TERMINALS" warning label shall have white lettering on red background.

Anticorrosion treatment

Equipment offered shall be constructed of materials and be finished in such a way that corrosion is minimized. Materials and combination of materials used in the construction of the equipment shall be selected and arranged to prevent bimetallic corrosion.

Ferrous parts shall be either:

Hot dip galvanized

Zinc-plated and passivated

Painted over zinc coating, or phosphate treated

Surfaces to be hot dip galvanized shall be sound, clean and free from harmful scale, rust, moisture or any foreign matter. Inspection of the completed surface preparation may be required by the Engineer to the Contract before galvanizing or painting begins.

Painting

If steel parts are not zinc coated, a suitable phosphate treatment or approved equivalent shall be applied. Where blast cleaning is necessary to remove rust or scales, it shall be prepared by the dry method of sandblasting.

The application of the first coat of paint shall follow immediately after inspection of the cleaned surfaces and in the case a surface becoming contaminated between cleaning and applying the protective coating, then it shall re-cleaned. Primer (of the rust-inhibiting type) and undercoat paint shall be applied as soon as possible thereafter, each to a minimum thickness of 0.05mm. Finishing coats of baking enamel shall then be applied so that the complete paint system shall have a minimum thickness of 0.13mm with no porosity.

The colour of finishing coats of the internal surfaces shall be grey, whereas the colour of the external surfaces shall be advised by the Engineer to the Contract on contract award. All internal gear trays shall be painted white.

Quality control

The Contractor shall ensure that effective quality control procedures are instituted at his works and details of any quality assurance standards adhered to should be provided in the tender.

It will be expected that the quality control procedures will include at least the following:

- a) Ensuring that materials/parts used in the manufacture of the specified work are free from defects and meet their specification. This must include checking against tolerances, and obtaining manufacturer's test and, where applicable, analysis certificates.
- b) Inspection at the critical stages of all phases of the specified works
- c) Verifying the accuracies of gauges and test instruments used for checking and commissioning the specified works.
- d) Ensuring that the components, materials and processes are fitted, used and applied in accordance with their manufacturer's instructions.
- e) Ensuring that the qualification and training of personnel used in the design, production, testing, erection and inspection processes are adequate for their respective functions.

The Purchaser may appoint an independent inspecting authority to certify that the Contractor's design, production, testing and quality assurance resources, procedures and facilities are appropriate to the specified work.

Anti-Vibration Mountings

The Bidder should provide adequate designed ant vibration mounting for the panels to be mounted on.

2.2.8 Power, Control, Signal Cabling and Earthing

2.2.8.1 Power cables

Single core power cables

Single core power cables shall be fixed at intervals not exceeding 2,400mm for vertical runs and horizontal runs on cable ladders, and 600mm horizontal runs on Unistrut channel, and at either side of bends, or risers and before terminations.

Single cores forming part of a 3-phase circuit shall, unless otherwise specified, be held in trefoil touching formation by cable clamps with band of neoprene lining between clamps and cable surface at interval not exceeding 600mm for straight runs and not exceeding 300mm in curves.

Cable clamps for single core in trefoil formation shall be fixed directly to supporting steelwork. All the other cables shall be installed on Aluminium cable ladders; alternatively the existing cable support can be used subject to Engineer's approval. The distance between the wall and the surface of the nearest cable shall not be less than 20mm. The supports shall be capable of withstanding the extreme forces when the cables are carrying the maximum possible short-circuit current. Cable ladders shall not form part of the supporting steelwork or the purpose of fixing cleats.

Auxiliary Motor Circuit Cables

The Bidder is required to quote for the replacement of all existing Auxiliary Motor cables from the new MCC to the existing locations. Attached in Annex A is the list of cables to be replaced. The Bidder is also required to provide a Cable Cutter and Cable Crimp Tool with all required cable glands.

Multicore power cables

Multicore power cables shall be installed in one basic layer, spaced at least one cable diameter apart and fixed as follows:

- a. On horizontal ladders at intervals not exceeding 2400mm
- b. On vertical ladders or clamped to Unistrut channels at intervals not exceeding 600mm, or 20 times the outside diameter of the cable, whichever is the least.

2.2.8.2 Control Cables

In this specification the term 'control cables' shall mean any cables or cabling used for control, indication, protection and alarm purposes.

Control cable shall have copper conductors with PVC insulation rated for 600V and PVC overall jacket unless otherwise specified.

Control, indication, protection and alarm cables shall be installed as follows:

- On horizontal ladders, fixing is required for take-off points and elsewhere as necessary to ensure a neat secure formation;
- On vertical cable ladders, cables may be bunched in groups and fixed to the Unistrut channel with clamps at intervals not exceeding 300mm. The overall height of the bunch shall not exceed 75mm.
- Where clamped to Unistrut channels, cables may be bunched in groups and fixed to the Unistrut channel with clamps at intervals not exceeding 300mm. The overall height of the bunch shall not exceed 75mm.

2.2.8.3 Cable Installation

A combination of cable ladder systems, ducts and conduits shall be provided to the cabling, taking into account aesthetics, maintenance access to other equipment, and environmental considerations. Where possible, existing cable ladder systems, ducts and conduits shall be used.

In locations where available space restricts the installation of cable ladders, cables may be clamped to perforated cable trays or to horizontal Unistrut channels, fixed directly to the wall. For vertical runs three methods shall be employed for the principal cable routes as follows:

1. Open cable ladders with cable strapped to the ladder with ties;
2. Cables clamped to Unistrut channels with Unistrut cable clamps or trefoil cable clamps;
3. Perforated cable trays. This method is limited to short, complicated runs with many directional changes and tee offs.

Power cables shall be spaced at least 20mm from the walls.

Cables may be supported by running in aluminium or PVC conduits or pipes fixed directly to the surface. These conduits or pipes shall be purely for the provision of mechanical support to the cable; sheath shall not be removed

from cables within such conduits. Conduits shall be fixed in position with saddles at spacing of not more than 1,200mm.

Cable installation facilities shall be fixed to concrete with expanding type masonry anchors. Explosion driven fasteners shall not be used.

Control and power cables on one ladder

Where the number of power and control cables installed in the area does not warrant the installation of separate cable ladders, both types of cables may be installed on the one cable ladder side by side on the one set of Unistrut channels. In such cases control indication and alarm cables may be bunched as above, but power cables shall be spaced at least 300mm away from the control, indication, protection and alarm cables and from other power cables and be installed in one basic layer only.

Support of cables

All cables shall be provided with supports located as close as possible to the point of termination of the cables. Cables run on perforated cable trays shall be fixed with profile shaped saddles at spacing between 150mm and 300mm as required to ensure a neat installation without sagging between saddles. Cables leaving cable ladders over the side rail shall be fixed to the ladder at the point from where they start to lift. Where cables drop over the ladder rung, the sharp edge shall be fitted with a smooth radius drop-out fitting.

Cable protection

In all locations within 200mm of the floor and in any other locations where cables may be exposed to mechanical damage, the Contractor shall provide and install guards to protect the cables, or alternatively shall enclose the cables in aluminium, or PVC pipes or conduits. Where cables on ladders pass under or adjacent to pipes containing fluids they shall be provided with covers to divert any leaking fluid.

Conductors of different systems in raceway

Cables of different usage, voltage and classification shall as far as possible be physically separated in accordance with IEEE 422, however the following requirements must be complied with unless otherwise approved by the Engineer to the Contract.

Where cableway consists of two or more levels of cable ladder, power cables are to run on the higher level and control and instrumentation cables on the lower levels.

Control and instrumentation cables are to be physically segregated into two groups as follows:

- Control cables used for intermittent operation of devices, indication and alarms.
- Low level analogue signal typically 4-20mA and low level digital signals.

A minimum distance of 300mm shall be kept between all sound or telephone cables and any other cables except when cables paths cross at right angles, and where run with low level analogue or digital control cables.

Earthing cables shall be segregated from all other cables such that should an earth conductor be damaged by a high earth fault current, no damage will result to other cables.

Control and instrumentation cables are not to be run in the same cable ladder with high voltage cables under any circumstances.

Control cables may be run with power cables over short distances, such as entrances to motor control centres, provided that:

- The control wiring is insulated for the full power circuit voltage and is used to control only the equipment supplied by the adjacent power cables.
- Cables are installed in an order which will prevent any cable being damaged by the weight of the others.

Conductors of different systems in the same cables

Conductor used for ac and dc circuits shall not be carried in the same multi conductor cable. Low level process signal conductors shall not be carried with other signal conductors in the same multi conductor cable.

Separate cables shall be provided for control and instrumentation and power circuit.

2.2.8.4 Cable Ladders

Cable ladders shall be made of aluminium in all areas. The ladders shall not have deflections of more than 3.5cm when simply supported over a 6m span and carrying an evenly distributed load of 40kg per metre, noting however that the ladder shall be supported at ≤ 3 m intervals. The cable ladders shall be complete with all necessary non-combustible, corrosion resistant supports, hanger rods and brackets and the like.

Aluminium cable ladders shall not be placed in direct contact with unpainted or uncoated dissimilar metals other than zinc, tin or cadmium except when making conductive connections by an approved method.

2.2.8.5 Cable Identification

The Contractor shall identify the ends of all power, control, and instrument circuits in accordance to IEC 391 and/or FEA practice.

2.2.8.6 Termination and Ferrules

The end of every wire and every cable core shall be fitted with an appropriate crimp or cable lug and shall be fitted with a ferrule to provide a permanent method of identifying the wire or cable core.

Wire ends terminated in screw terminals must be crimped in boot lace ferrules.

The identification system used to mark each cable, core, or wire shall be manufactured from moisture and oil resistant insulating material and offer long life in the environment, which they are installed without fading or deterioration. The marker shall be of the interlocking type and shall grip the insulation firmly.

Where possible, phase identification of multicore power cables shall be self-coloured cores. For cables where the cables cores are not self-coloured, the phase identification shall be provided by insulated, non-flammable, heat-shrinkable tubing, coloured appropriately.

Unless otherwise specified, the screens of screened cables shall be earthed at one end only. This shall generally be the end at which the signal originates.

Earthing of copper screens shall be by means of wrapping three or more turns of 1.0mm² stranded tinned copper earthing conductors over the exposed screen and making an effective soldered joint with the screen. The earth conductor shall be terminated at the equipment by means of crimp-on terminal lugs. All earthing conductor must be insulated.

2.2.8.7 Trefoil Cable Cleats

Trefoil cleats shall be of nonmagnetic material, fitting the contours of the single core cables and securely anchoring the cable into position. The cleats shall be capable of withstanding bursting forces of 4kN due to fault current in the cable.

2.2.8.8 Conduits

Conduit and conduit fittings shall comply with the requirements of, and be installed in accordance with the NZ Electricity Regulations Act.

Metallic conduits and fittings shall be aluminium. PVC conduit shall be of the heavy duty grade.

Where wiring is to be concealed from view, the conduit shall be installed above suspended ceilings, embedded in concrete, or chased in masonry walls. The chasing of concrete walls and floors is not acceptable.

Conduit shall be installed to allow easy and safe drawing of cables. Where conduits are bent, the inside radius of the bend shall be not less than six times the nominal size of the conduit. No more than two consecutive 90degrees bends or multiple number of bends adding up to a total of 180degrees shall be installed between two conduit ends. Where more than the above number of bends is required an intermediate flush draw-in box shall be provided. Conduit runs in excess of 10m shall also be provided with draw-in boxes.

Conduits exposed to view shall run parallel to the structural lines.

Where surface mounted conduit crosses an expansion joint, then expansion fittings must be provided.

All joint in PVC conduits shall be made waterproof by using suitable adhesive compounds. Suitable moulded threaded attachments shall be used for entry into equipment.

All surface mounted conduits shall be fixed in position with stand-off saddles and screws, spacing the conduits approximately 5mm off the surface, at spacing no more than 1.2m, for metallic conduits and 0.8m for PVC conduits.

2.2.8.9 Earthing

Cable ladders shall be bonded together to form a continuous electrical circuit and shall be provided with an electrical connection to the main station earthing busbar comprising of an aluminium conductor of not less than 70mm² in cross sectional area at each end and at the intermediate positions spaced not more than 10 metres apart.

All the electrical equipment must be earthed. The contractor shall ensure that all metal work encasing electrical items is bonded to earth.

Busbars and grounding conductors shall be rated to carry currents equal in magnitude and duration to that associated with the short circuit rating of the equipment.

The earthing terminals on the frames of control cubicles and other such enclosures shall be a M8 stud. The metal cases of all the instruments, relays and the like mounted within such enclosures shall be connected to this earthing stud by conductors of not less than 6mm².

Earthing connections between this stud and the existing station earth grid shall be via an aluminium strap not less than 90mm².

2.2.9 Tests

The equipment shall be thoroughly tested at the manufacturer's works. Should failure to comply with the guaranteed or specified standards occur, the EFL reserves the right to reject the item of equipment concerned

Routine tests

Works tests shall include electrical and mechanical routine tests as appropriate as specified in the relevant standards.

Test Certificates

Certificates recording the test results shall be supplied in the form of separate documents for:

- Type tests
- Routine tests
- Performance tests

2.2.10 Spares and Accessories

All special lifting and handling devices and tools required for the installation and maintenance of the equipment offered shall be supplied with the equipment.

The Contractor shall as a minimum supply spares as detailed in the relevant schedule. The Contractor shall also offer any spare parts considered necessary. The Purchaser reserves the right to vary the number of spares ordered when the contract is awarded.

Spares shall be supplied preserved against deterioration in storage. Packages shall be clearly marked so that the contents may be identified without opening.

2.3 Civil Work Requirements

2.3.1 Mounting of new switchboard

The new switchboard shall be mounted on the same position as the old board.

All new cubicles shall be bolted down to the floor with chem.-set bolts all around the base. The cubicle/panel design should be done to allow cable entry from the existing cable trench or overhead cable ladders/trays as if required. The Contractor shall be responsible for resealing the floor or any similar requirement after the new switchboard is installed and any other Civil Works required if their switchboard design layout differs from existing cable trenching layout.

After completing the design, the Contractor shall provide the drawings showing the dimensions and location for bolting the switchboard base to the concrete floor with the calculation of their seismic strength. Note the panels will be installed beside the Diesel Ruston Engines and will encounter a lot of vibration.

2.3.2 Ducts

Where ducts or trenches are required through existing walls or floors the Contractor shall submit a methodology for the duct installation to the Engineer to the Contract for approval.

2. New MCC Installation and Commissioning

3.1 General Requirements

This installation specification stipulates the requirements for the upgrading of the existing MCC 415Vac switchboard that supplies the generator auxiliaries for the Ruston Generator G1 and G6 of Cawaira power station.

The contractor is required to notify the EFL Project Manager and the Engineer to the Contract at least two weeks prior to the commencement of work.

The Bidder/Contractor shall be responsible for the installation and commissioning of the new 415V Board and shall bid accordingly. EFL shall provide manpower to assist as part of on the job training.

To ensure a good communication and a full understanding of the responsibilities of the parties, the Contractor is responsible for ensuring that Contractor's personnel is appraised of these requirements.

The following requirements for work at site shall be met by the Contractor:

- Site induction – All Contractor staff shall have current First Aid/CPR and PHC certificates, and shall undergo site induction before commencing any work at Cawaira power station. The Contractor must ensure that any addition to the work team undergo this induction on their first arrival to site. Induction is to be arranged by the Contractor through the EFL Project Manager.
- A Contractor AHC holder must be present all times work is performed on site.
- The tendering company must hold and maintain an Employer License, applicable to all staff who are proposed to be used on this contract.

Standards and Regulations

The installation of the 415V switchboard, shall comply with the following standards.

Safety Rules, Fiji, or NZ Electricity Industry
General Safety Handbook, Fiji, or NZ Electricity Industry
AS/NZS 3000:2007 Australian/New Zealand wiring rules
AS/NZS 4325 Power cables
AS/NZS 2650 PVC-insulated cables for switchgear/control gear wiring
AS/NZS 5000.3 Multicore control cables
AS/NZS 4417 Cable markings
IEC 60702-2 Cable termination

3.2 Scope of Work

The contract works include providing supervision, administration and management, and supplying all construction equipment, materials supplies and services necessary for the installation, testing and commissioning of the new MCC 415V switchboard, as specified under Section 2 of this specification.

The Contractor shall manage the disconnection and removal of existing cable circuits and removal of the old 415V MCC Board and how to shift the new switchboard to site and how to effect the installation of and the connection of the various feeders and outgoing circuits to the new switchboard. The Contractor shall provide, a works program schedule with the minimum interruption to the Cawaira Power Station power generation capability for EFL approval.

3.3 General Installation Requirements

Access and work shall be governed by the Safety Rules, Electricity Industry, April 1995. The Contractor is responsible for meeting all safety requirements as directed by the Engineer to the contract.

Standards of workmanship and materials referred to under Section 2 and 4 must be adhered to.

All work of the Contractor shall comply with the following regulations and standards:

General safety Handbook of the Electricity Industry SM-EI Parts 1, 2 and 3.
Electricity regulations and Electricity Safety book
AS/NZS 2017 Electrical installations – testing and inspection guidelines

Any work that the Engineer/FEA to the Contract will deem unsatisfactory in terms of compliance with the above standards shall be reworked at the Contractor's expense to the satisfaction and approval of the Engineer to the Contract.

The technical requirements regarding cabling, terminations and wiring are those specified under Section 2 of this specification.

3.4 Installation Procedures

The succession of work stages shall be such that, for minimizing the duration of the relevant outages of the main machines, it will be necessary to complete beforehand all the installation work that can be effected with the main units in service.

The principal areas of work associated with the installation and commissioning of the new MCC 415V switchboards are:

- Setting in place the new 415V MCC switchboard and test it prior to connecting to it incoming circuit, by using the local 415V supply;
- Connecting and testing progressively the incoming and outgoing new cables to the motors, endeavouring to have the one generator outage at any time;
- Testing the new cables to all the aux motors and load test of the MCC panel.
- Test of the new Control panels with associated new replaced field devices
- Interfacing with the unit and station PLC if available at the time.

Before commencing any such work the Contractor shall ensure that the following prerequisite have been met:

- Inform the Engineer to the contract and complete the site induction procedures
- Electrical, mechanical and hydraulic isolation of equipment as applicable
- Receive authorization documentation.

Remote Provision

The new MCC panels will be incorporated into a PLC control system also in the Scope of Works A in this Tender to control the associated Generator. All circuit breakers are to have provision for remote control, metering and also to have provision for remote indication for status and faults.

Cabling

The contractor shall supply all the following cable requirements:

- Replace the existing power cable from the MCC 415V terminals to all the Aux Motors.
- Replace the existing cables to the new field devices
- Provide new cables for the new Scada in the Station Control room.
- Any other accessories required for termination of cables to the new MCC switchboard or new Control Panel.

The Contractor shall submit a detailed procedure for effecting the progressive connections of feeders and loads to the new switchboard with minimal impact on the availability of the unit still in service and with reliable power supply for the station essential services.

OPTION- the Bidders shall provide circuit Terminations at the bottom level of the cable chambers to allow existing cables to reach their new Termination points.

3.5 Equipment and Materials

The Contractor shall procure and supply the materials and equipment necessary to complete the installation of the 415V MCC switchboards and its connections to the controls and auxiliary services. The equipment and materials to be supplied shall include, but not limited to, the following items:

- Power and control cables
- Cable accessories, racks, termination kits
- Holding down bolts
- Terminals for I/O connection
- All consumables
- Replacement of existing cables to all existing auxiliary motors

3.6 Testing and Commissioning

The Contractor shall be responsible for ensuring that all equipment and systems covered and altered by this contract are tested and commissioned successfully in accordance with manufacturer requirements and relevant standards.

The Contractor shall provide all equipment necessary for testing and commissioning and shall also submit to the Engineer to the contract a programme of the commissioning tests, with relevant estimated duration.

The pre-commissioning tests shall include but not limited to the following:

- a) inspection of all the equipment for correct installation, functioning, labelling and wiring;
- b) Insulation resistance tests of all circuits to earth and between phases.

In particular the following tests shall be performed as a minimum:

- LV switchboard: IR, Phase rotation and functional tests
- Cables: IR and loop tests
- Protection relays: Secondary injection, calibration, continuity, polarity tests.

All control, protection, alarm and indication circuits shall be tested to ensure correct operation and shall include, but not limited to the following:

- a) local and remote opening and closing of the main circuit breakers ;
- b) local and remote start stop of all auxiliary motors
- c) circuit breaker open/closed and racked-in indication
- d) point of control switch operation
- e) Remote alarms and indications.

Any defect or inadequacy identified through the tests shall immediately fixed, or listed in a Commissioning Defect sheet if it cannot be fixed immediately.

Two weeks after commissioning, the Contractor shall carry out post commissioning checks on the equipment. All items noted on the Commissioning Defect sheet must have been fixed at this time and written confirmation of their completion produced during these checks.

Following the completion of the commissioning tests, the Contractor shall check spares against list and put them into stores.

At this time the Contractor shall deliver all outstanding documentation including compliance certificates, as-built drawings, O&M manual, commissioning test report as well as the close out report to the satisfaction of the Engineer to the Contract.

4. Post Award Documentation Requirements

In addition to the supply of the equipment called upon in this Specification, the Contractor shall comply with the requirements set out in the following clauses.

4.1 Information to be supplied by the Contractor

In addition to the supplied of the plant called for in this specification the Contractor shall comply with the requirements set out in the following clauses.

All drawings and other information, including technical manuals, instructions and plant and equipment markings and labels shall be submitted in English.

4.2 Manufacturing Programme

The Contractor shall submit for approval, not later than two weeks from acceptance of the tender, two copies of the Manufacturing Programme of the 415V switchboard, which shall contain:

- (i) The list of activities and sub-activities with relevant time durations
- (ii) The order in which the Contractor proposes to carry out completion of supply of the plant, including design, manufacture, factory test and delivery
- (iii) The times when submission and approval of all the Contractor drawings and documentation are required.

If at any time during the execution of the Contract it is found necessary to modify the Manufacturing Programme, the Contractor shall submit for approval a revised Manufacturing Programme. No alteration to the Manufacturing Programme shall be made without written approval of the Engineer to the Contract.

4.3 Progress Reports

The supplier shall submit two copies of a brief and concise monthly progress report indicating:

- (i) The state of progress in manufacture as measured against the approved Manufacturing Programme
- (ii) A statement of any delays and reasons
- (iii) An assessment of the effect of such delay on the attainment of the approved Manufacturing Programme
- (iv) A statement of the measures that have been taken, or are proposed to eliminate or at least minimize the effect of the delay.

4.4 Inspection and Test Plan

The Contractor shall submit, not later than 3 weeks from acceptance of the tender, two copies of an inspection and test plan for approval of the Engineer to the contract.

If at any time during the execution of the Contract it is found necessary to modify the inspection and test plan, the Contractor shall submit for approval a revised plan.

4.5 Contract Drawings

The Contractor shall submit for approval not later than 3 weeks from acceptance date of the tender a list of proposed drawings required under this contract. The list shall include a brief drawing title.

4.6 Instruction Manual

The Contractor shall supply installation, commissioning, operation and maintenance manuals. The manuals shall contain all the information necessary for erection, installation, commissioning, operation and maintenance of the 415V MCC switchboard and shall include technical descriptions of all other sub-supplier's item used.

The manuals shall be as simple and clear as possible, fully illustrated with drawings and diagrams and detailed with data sheets and part numbers for ordering replacement.

Two draft copies of the manuals (marked as draft) shall be submitted for approval not later than 16weeks from acceptance of tender.

No later than two weeks after final approval, four copies of the approved manual shall be supplied for use during the installation work.

Four copies of any subsequent approved revisions shall be supplied for inclusion in the manuals.

The Contractor shall supply all final copies of the manuals in durable A4 size, four hole, D-ring binders. The binders shall be inscribed on the front cover and the spine with:

Energy Fiji Limited
Cawaira Power Station
PLC Control System and MCC Switchboards
For Ruston G1 and G6 Ruston Engine
Contract No.....
Installation, O&M Manual

The contents of the manual shall be written specifically for the plant being supplied, shall be fully indexed and shall generally follow the format and include the information as outlined in the following clauses.

General Information

The following general information shall be included in the manuals:

- (i) Title page containing the following information:
 - a. Base data,
 - b. Type and model.
 - c. Name of station it is to be installed in.
 - d. Contract number.
 - e. Serial numbers.
 - f. Standards the MCC 415V switchboards and New Control Panels were built to.
 - g. Manufacturer's address.
- (ii) A general description (including any special features) referring to photographs and figures where appropriate.
- (iii) A technical schedule giving the following information:
 - a. All the information required by the Specification's technical schedule.
 - b. A full schedule of weights and dimensions.
 - c. Current and voltage rating of all components, i.e. maximum continuous, emergency, overload capability, and fault current withstand capability.
- (iv) The serial numbers and manufacturer's address for all items supplied by other manufacturers.
- (v) Details and drawings of any special tools required for installation, operation or maintenance.
- (vi) Colour photographs showing external views and views inside the cabinets.

Description of the equipment

The detailed description of the equipment covering the technical characteristics shall be followed by the headings that specifically illustrate the installation, commissioning, operation and maintenance procedures, as well as the spares requirements.

- **Installation Instructions**

Detailed instructions shall be included for the handling, installation and storage of the equipment including the following:

- (i) A brief description on the method of dispatch (including precautions taken on shipping specifications if applicable) shall be supplied.
- (ii) A detailed list of the checks required on arrival at site shall be given in the manual.
- (iii) Detailed instructions on precautions and maintenance requirements to be taken for both long-term (greater than 3 months) and short-term (up to 3 months) storage.
- (iv) Detailed instruction procedures.
- (v) All drawings used in manufacture or assembly of the equipment shall be listed and referred to on the installation drawings. Where components are proprietary manufactured items they shall be identified on the drawings and manufacturer's name, model number and size stated.

- **Commissioning**

Detailed instructions for pre-commissioning and commissioning tests (procedure and expected results) and checks shall be supplied. Results of factory acceptance tests shall be included for comparison with acceptance tests.

- **Operating Guide**

A detailed operating guide shall be supplied.

- **Maintenance**

Detailed inspection, maintenance and test procedures shall be included and shall comprise:

- (i) Instructions for routine tests
- (ii) All necessary information for the correct setting, or other adjustment and testing of all items including proprietary manufactured items.
- (iii) Lists and details of recommended inspection, assessment repair and test procedures. Areas subject to high stress or corrosion during operation shall be identified.

- **Spares**

A complete list of spares shall be provided in the manual. The spare parts list shall contain the following information:

- (i) Part description and identification number to sufficient detail to facilitate Purchaser's orders.
- (ii) Quantities of like parts on each piece of equipment.

4.7 Test Report and Calculations

The Supplier shall supply reports detailing test methods and recording test results in the form of separate documents for:

- (i) Routine tests.
- (ii) Special tests.
- (iii) Commissioning tests.
- (iv) Performance tests.
- (v) PLC/Software configuration and parameter settings.

The Supplier shall supply four copies of all test reports within two weeks of completion of the FAT. Prints and oscillography photographs of such quality that all lines and inscriptions are clearly legible shall be included in each test report.

The test reports and calculations supplied by the Supplier shall include:

- (i) Contract number and name.
- (ii) Equipment description and serial numbers.
- (iii) Report number and date.

4.8 Shipping Documents

The Supplier shall forward shipping documents to the FEA prior to the time of delivery of the Plant in accordance with the General Conditions of Purchase.

5. Summary of Information Required after Contract Award

The number of prints/copies of the following data and drawings as indicated below shall be forwarded to the Engineer to the Contract for approval by the required dates.

Item No.	Description	No. Copies	Date required by
1.1	Confirmed Manufacturing Programme	2	2 weeks after Signing of Contract
1.2	Progress Reports	2	Monthly
1.3	Inspection and Test Plan	3	4 weeks after Signing of Contract
1.5	Drawing List	1	4 weeks after Signing of Contract
1.6	All Contract Drawings	3	4 weeks after Signing of Contract
1.7	Instruction Manuals	5	16 weeks after Signing of Contract

6. Information Required after Contract Award as Final Versions

The final versions of prints/copies of the following data and drawings as indicated below shall be forwarded to the Engineer to the Contract by the required dates after approval.

Item No.	Description	No. Copies	Date required by
1.9	Updated Manufacturing Programme	2	3 week after approval
1.10	Inspection and Test Plan	3	3 week after approval
1.11	Drawing List	1	16 weeks after approval
1.12	Contract Drawings	3	18 weeks after approval
1.13	Instruction Manuals	5	2 weeks after FAT
1.14	Test Reports	4	2 weeks after FAT
1.15	Shipping Documents	1	Prior to shipment
1.16	Software licenses (registered in the name of FEA)	2	2 weeks after Site Acceptance Test

B. Schedules

Schedule 1 Price schedule

Bidders are expected to use this format for their Pricing Schedule

Description		\$ Amount Currency: _____
1	Price for the Control System, New Control Panel, PLC and Scada Software and Hardware	
2	Price for the new 415V Board and Control System - New 415V Board	
4	Price for the new DC System – Batteries and Charger	
5	Price for the Replaced cables	
7	Price for the Balance of Equipment required for the upgrade	
8	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	
9	Three Copies of Software with a laptop Toolbox loaded with required software for Operation, Troubleshooting and Maintenance	
10	Commissioning works Freight, transportation cost, Delivered Duty	
11	Training for: <ul style="list-style-type: none"> • Operation & Maintenance of the Generator • Software 	
	TOTAL , Off-Shore cost of Equipment Supply – exclusive of Fiji Import Custom Duty, taxes or other Fiji Government related charges	
12	Local Tax Components	
13		
	TOTAL ,	

PAYMENT SCHEDULE

Description		Percentage Payment	\$ Amount Currency:
1	Design Manufacture of 2 x MCC Panels & FAT		
2	Design Manufacture of 2 x PLC System Panels & FAT		
3	Supply of other Accessories as required in Tender Specification		
4	Delivery of items 1, 2 & 3 to site		
5	Installation and Commissioning SAT		
6	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		
7	Three Copies of Software with a laptop Toolbox loaded with required software for Operation, Troubleshooting and Maintenance		
8	Training for: <ul style="list-style-type: none"> • Operation & Maintenance of the Generator • Software 		
12	Local Tax With Holding Tax WHT Components		
13			
TOTAL,			

Below are formats of price schedules that Bidders may use or may submit similar formats.

Schedule 1A – Prices

Item	Quantity	Description	Unit price	Total price
1	2	Control panel main switchboard		
2	1	Set of contractual spares		
3	1	Set of special tools		
4	2	Installation/commissioning of MCC switchboard		
5	2	Materials/Cables etc		

Schedule 1B – Packing and Shipping

Item	Quantity	Description	Unit price	Total price
1	2	Control panel main switchboard		
2	2	MCC panel switchboard		
3	1	Set of contractual spares		
4	1	Set of special tools		

Schedule 1C – Schedule of Essential Spare Parts

Item	Quantity	Description	Unit price	Total price
1	1	DOL Starters		
2	1	Each type of contactor starter used		
3	1	Fuses and breakers		

Schedule 1D – Labour, plant and materials for variation work

Item	Description	Unit	Rate	
			With Op.	Without Op.
1	Labour (*)			
	a. Supervisor	Hr		
	b. Test Technician	Hr		
	c. Electrical Fitter	Hr		
	d. Welder	Hr		
	e. Labourer	Hr		
2	Plant			
	a. Mileage (state vehicle)	km		
	b. Mileage (state vehicle)	km		
	c. Compressor (state data)	hr		
3	Material			
	a. 415V cable (state data)	m		
	b. Control cable (state data)	m		

(*) The hourly rate shall be inclusive of any on/off site overhead

Schedule 2 Manufacturing Programme

The Tenderer shall submit with the tender a proposed manufacturing Programme in the form of Gantt chart using Microsoft Project or similar project management software.

The Gantt chart shall incorporate the key dates and show the activities necessary throughout the contract period to indicate the Tenderer's programme for manufacturing and delivery of the goods. The programme shall include as minimum:

1. The scheduled start and finish date for each activity
2. The float associated with the scheduled dates
3. The duration of each activity
4. The identification of all milestone dates
5. The critical clearly shown.
6. The key dates, as follows:
 - Commencement of design

- Completion of design
- Award of sub-supplier purchase orders
- Shipment of critical materials/items
- Receipt of critical materials/items
- Commencement of fabrication of major items
- Completion of fabrication of major items
- Commencement of assembly
- Completion of assembly
- Commencement of testing
- Completion of testing
- Packing
- Shipping
- Arrival at Cawaira power station

Schedule 3 Tenderer's Experience

The Tenderer shall supply the following information with the tender:

1. A statement setting out the experience, resources and facilities at the Tenderer's disposal, and that of their sub-contractors, in the supply, maintenance, testing, delivery of items to be supplied under the contract.
2. Details of the Tenderer's previous experience in the supply of similar type of goods and equipment to that offered. The information to be supplied shall include:
 - Model/type number
 - General description
 - Number installed
 - Date installed
 - Country
 - Customer name and address

Schedule 4 Information on goods offered

The Tenderer shall supply a full description of the goods offered showing suitability for its intended application.

If equipment is offered complying with a standard equivalent to any standard mentioned in this specification, then the Tenderer shall state the name of the standard, issuing authority, number, issue and full title of such standards and include an English language copy of the standard or relevant part thereof with the tender.

Schedule 5 Shipping Plan

The Tenderer shall provide with the tender, the details of how it proposes to ship of the completed goods to the delivery point, to include, but not limited to:

- Details and contents of the shipment
 - type of packaging, e.g. containerized, or crated
 - type of container
 - number of crates
 - weight and dimensions of each container or crate
 - storage, e.g. below deck or on deck
 - any proposed above deck cargo, or soft top containers, hazardous cargo information, special requirements, handling methods
- Value of shipment
- Name and location of factory
- Expected time of departure (ex factory)
- Name of port

- Expected time of departure ex port
- Road transport details
- Expected time of arrival at the delivery point, i.e. Cawaira Power Station

Schedule 6 Quality Assurance Programme

The Tenderer shall submit a draft Quality Assurance manual in accordance with the NZ Standard NZS 9901:2000. Where the Tenderer is already working to an equivalent or higher category of any internationally recognized Quality Assurance Standard then the standard may be proposed for the Work.

If a standard is offered as equivalent to or exceeding the specified NX Standard NZS9002:1990 category, the Tenderer shall state the issuing authority, number issue and full title of the Standard.

The tenderer shall provide evidence of Certification to NZS 9002: 1990 or equivalent or higher standard by a recognized authority.

The tenderer shall provide full details of the methods of traceability. Tenderers may propose any part or component of the goods for which it considers traceability inappropriate.

If the Tenderer is not certified to an internationally recognized Quality System the Purchaser may, during evaluation of tenders, call for further information and may require to audit the supplier quality system.

Schedule 7 Proposed Subcontractors and Sub-suppliers

Tenderers shall submit with the tender a list of Sub-Contractors and Sub-Suppliers that they propose to employ together with a brief description of the Plant or Work they propose to sublet.

Description of Sub-suppliers/contractors	Name/address of Sub-supplier/contract

Schedule 8 Deviation from / Exceptions to Tender Documents

The Tenderer shall specify below, in detail, all deviation from, exception to and alternatives offered to the tender document, including reference to the appropriate clauses or sub-clauses. Any entry shall be referenced to the Tender Document Clause No. to which they refer. A complete copy of this schedule should be supplied with the tender.

The Tender shall be deemed to be compliant with the content and intent of the tender document except in respect of deviation or exceptions listed in this schedule. If no deviations or alternatives are proposed by the Tenderer, enter “None” below.

No deviations from or exception to or alternative to the Tender Document shall be made subsequently to the contract without the written approval of the Purchaser.

Clause No.	Details of Deviation/Exception	Reason for Deviation/Exception

Schedule 9 Technical Data Schedules

The Tenderer shall complete the following schedules and shall guarantee the particulars and performance set out therein. The Tenderer shall supply a copy of the completed schedule with the tender.

Schedule 9.1 Recommended Additional Spare Parts

The Tenderer shall complete the following table with the spare parts they recommend for:

- The duration of the warranty period
- 15years of operation

Such spare parts shall be in addition to the mandatory spare parts already listed in the tender document. The price for these recommended additional spare parts shall not be included into the bid price.

It shall be understood that:

- The Purchaser may at their sole discretion choose to purchase any one or combination and any quantity of these spare parts
- The price of such a purchase will be added to the contract price
- The delivery of such additional spare parts shall be subject to same terms and conditions as those applicable to the mandatory spare parts.

Description	Qty for DLP duration	Qty for 15yrs	Unit price \$
PLC CPU	1		
Analogue Input Module – Thermocouple,RTD	2		
Analogue Output	2		
Digital Input	2		
Digital Output Module	2		
Power Supply Unit	2		
Control Interphase output relay	6		

Schedule 9.2 Special Tools

Item	Description	Use	Number	Weight
1	Cable Cutter Hydraulic or Hand			
1	Cable Crimp Tool			

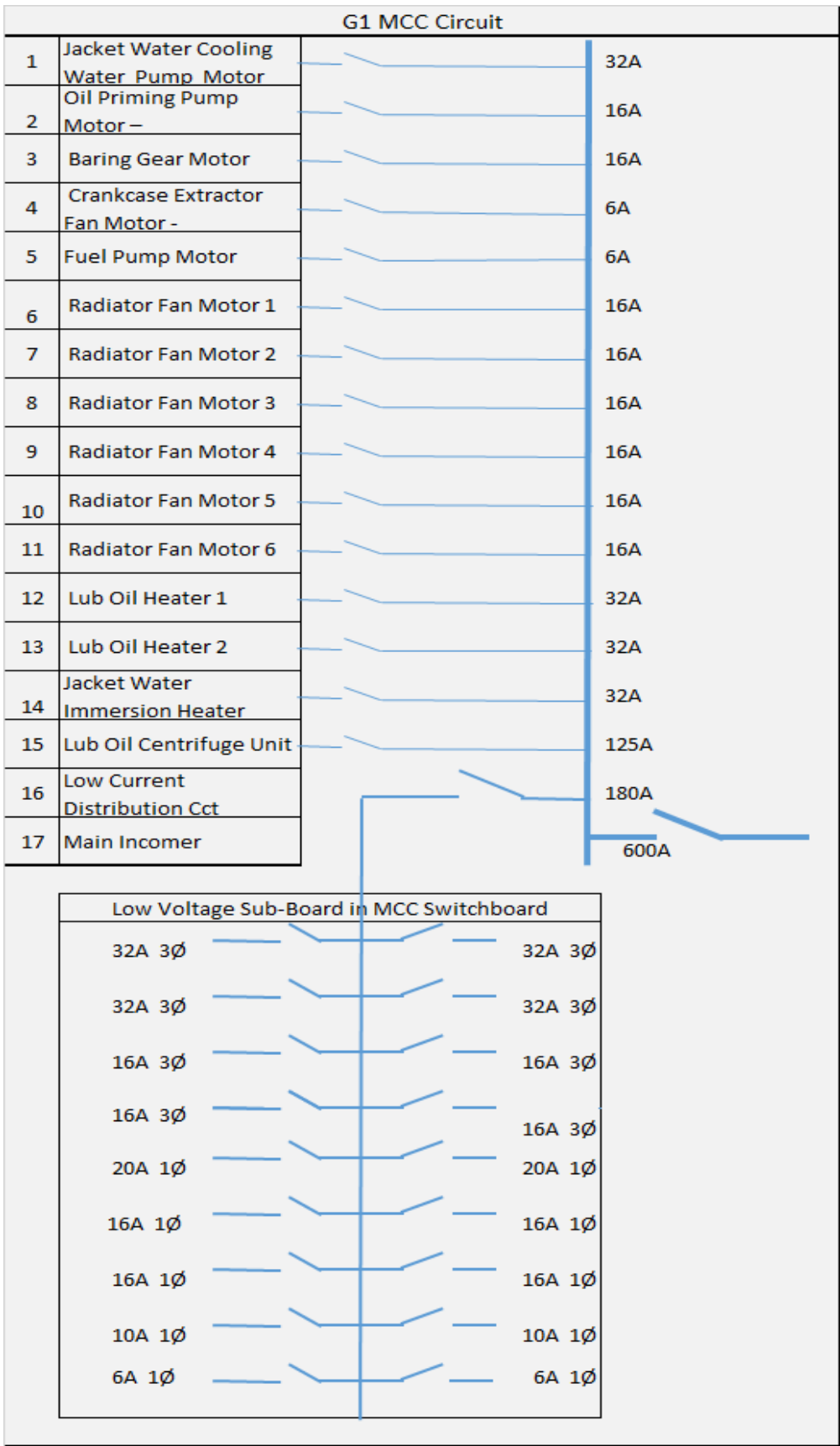
Schedule 9.3 Consumables

Item	Unit quantity	Quantity for 1yr	Supplier 1	Supplier 2

Schedule 9.4 Technical Support

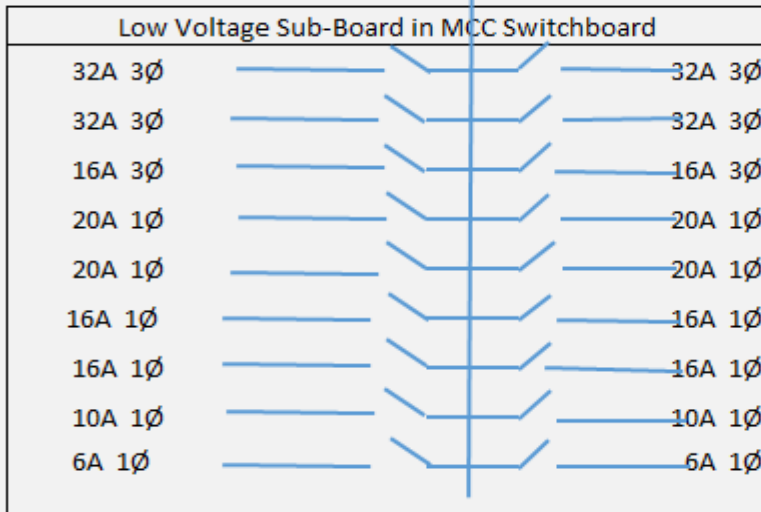
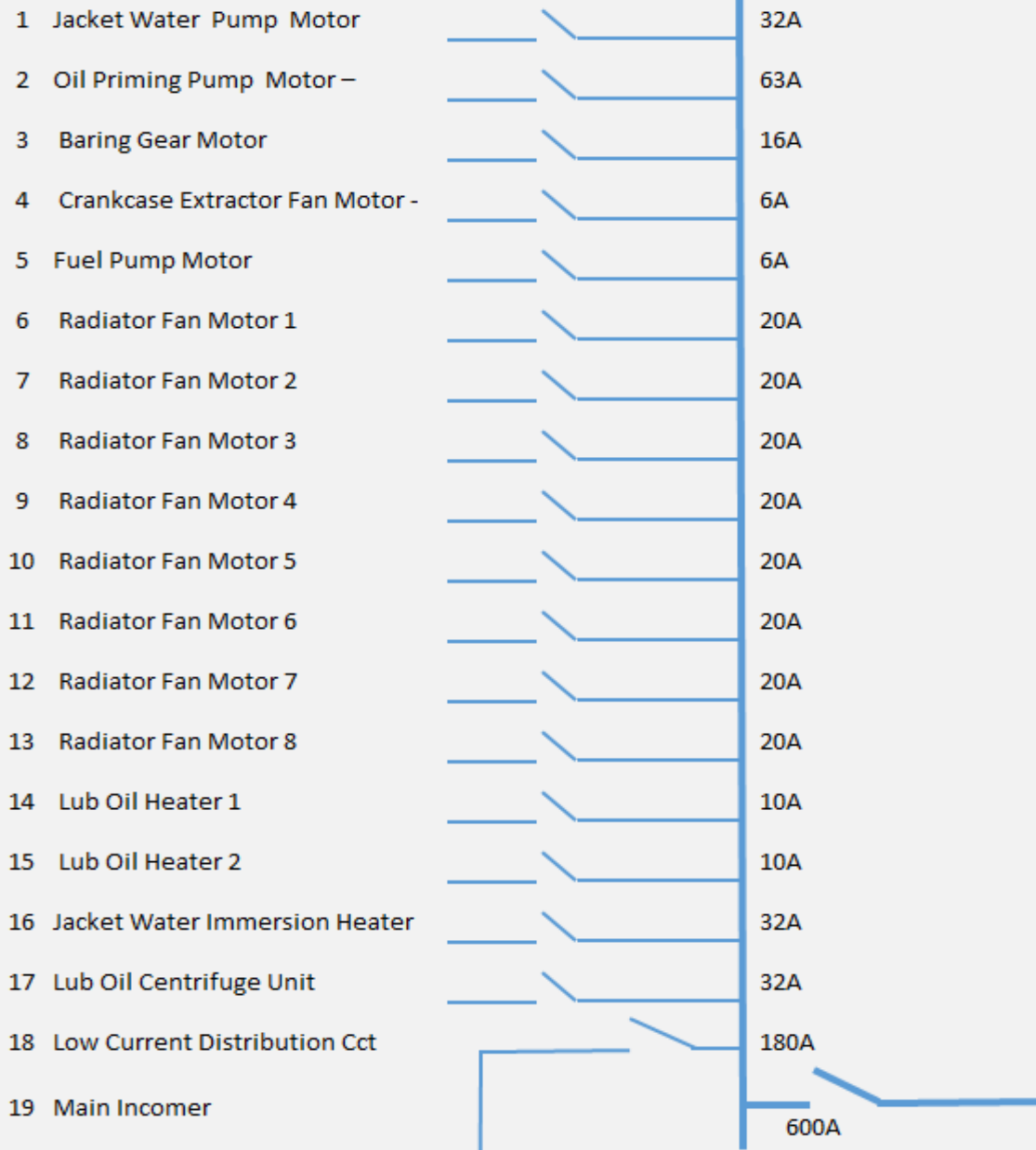
Description of Technical Support	Details of Personnel and Support Centres

Sample Drawing for G1 MCC



Sample Drawing for G6 MCC

G6 MCC Circuit



MCC Cable Replacement

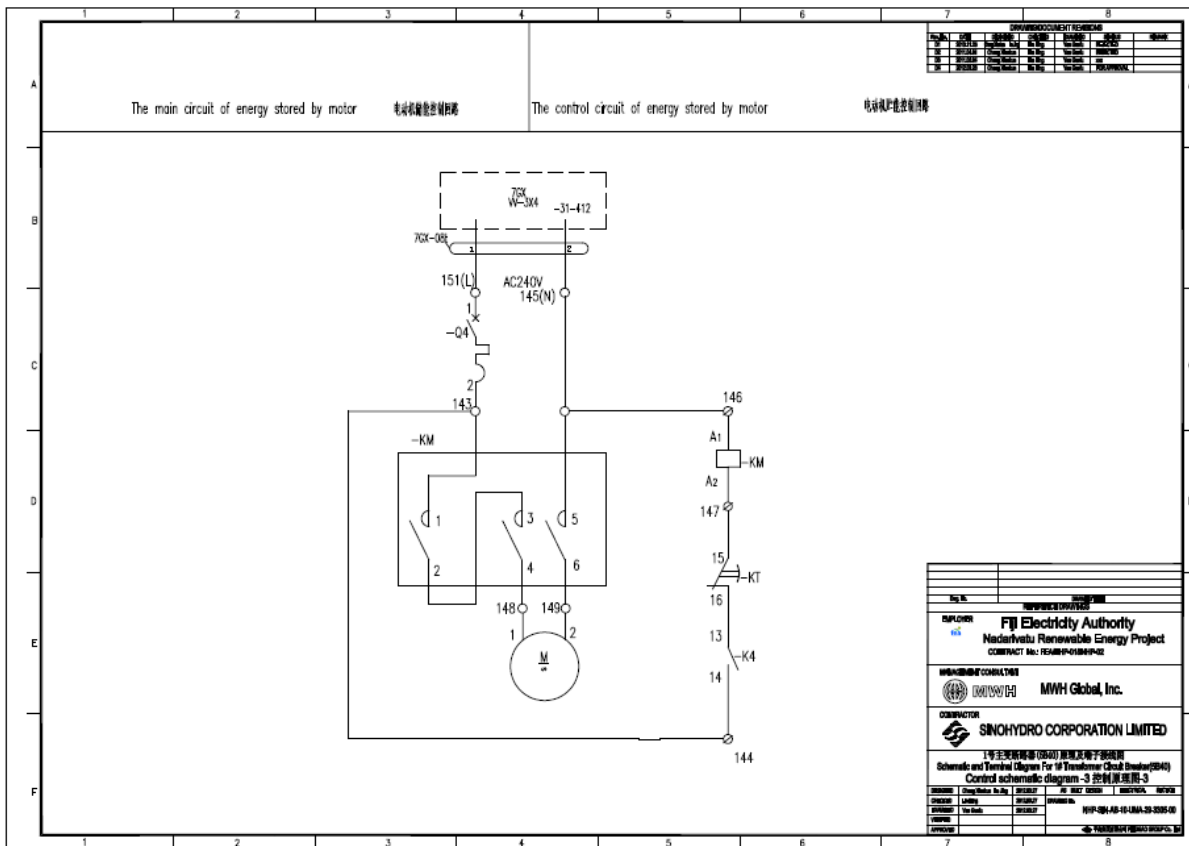
G1 Cable Replacement

Cable Description	From	To	Distance in Meters	No.of runs	Total Cable Length	Cable Size mm2	Circuit Rating A	Required Cable Type
Motor Cable	Jacket Water Cooling Water Pump Motor	G1 MCC	10	1	10	6	32	4Core+E XLPE cable
Motor Cable	Oil Priming Pump Motor –	G1 MCC	12	1	12	4	63	4Core+E XLPE cable
Motor Cable	Baring Gear Motor	G1 MCC	17	1	17	4	16	4Core+E XLPE cable
Motor Cable	Crankcase Extractor Fan Motor -	G1 MCC	18	1	18	4	6	4Core+E XLPE cable
Motor Cable	Radiator Fan Motor 1	G1 MCC	25	1	25	6	16	4Core+E XLPE cable
Motor Cable	Radiator Fan Motor 2	G1 MCC	25	1	25	6	16	4Core+E XLPE cable
Motor Cable	Radiator Fan Motor 3	G1 MCC	25	1	25	6	16	4Core+E XLPE cable
Motor Cable	Radiator Fan Motor 4	G1 MCC	25	1	25	6	16	4Core+E XLPE cable
Motor Cable	Radiator Fan Motor 5	G1 MCC	25	1	25	6	16	4Core+E XLPE cable
Motor Cable	Radiator Fan Motor 6	G1 MCC	25	1	25	6	16	4Core+E XLPE cable
Motor Cable	Lub Oil Heater 1	G1 MCC	15	1	15	6	32	4Core+E XLPE cable
Motor Cable	Lub Oil Heater 2	G1 MCC	15	1	15	6	32	4Core+E XLPE cable
Motor Cable	Jacket Water Immersion Heater	G1 MCC	8	1	8	6	32	4Core+E XLPE cable
Motor Cable	Lub Oil Centrifuge Unit	G1 MCC	10	1	10	10	125	4Core+E XLPE cable
	Low Current Distribution Cct	G1 MCC	50			2.5	180	Internal
							614	

G6 Cable Replacement

Cable Description	From	To	Distance in Meters	No.of runs	Total Cable Length	Cable Size mm2	Circuit Rating A	Required Cable Type
Motor Cable	Jacket Water Cooling Water Pump Motor	G6 MCC	5	1	5	6	16	4Core+E XLPE cable
Motor Cable	Oil Priming Pump Motor –	G6 MCC	14	1	14	6	63	4Core+E XLPE cable
Motor Cable	Baring Gear Motor	G6 MCC	17	1	17	4	16	4Core+E XLPE cable
Motor Cable	Crankcase Extractor Fan Motor -	G6 MCC	11	1	11	4	6	4Core+E XLPE cable
Motor Cable	Radiator Fan Motor 1	G6 MCC	30	1	30	6	20	4Core+E XLPE cable
Motor Cable	Radiator Fan Motor 2	G6 MCC	30	1	30	6	20	4Core+E XLPE cable
Motor Cable	Radiator Fan Motor 3	G6 MCC	30	1	30	6	20	4Core+E XLPE cable
Motor Cable	Radiator Fan Motor 4	G6 MCC	30	1	30	6	20	4Core+E XLPE cable
Motor Cable	Radiator Fan Motor 5	G6 MCC	30	1	30	6	20	4Core+E XLPE cable
Motor Cable	Radiator Fan Motor 6	G6 MCC	30	1	30	6	20	4Core+E XLPE cable
Motor Cable	Radiator Fan Motor 7	G6 MCC	30	1	30	6	20	4Core+E XLPE cable
Motor Cable	Radiator Fan Motor 8	G6 MCC	30	1	30	6	20	4Core+E XLPE cable
Motor Cable	Lub Oil Heater 1	G6 MCC	17	1	17	6	10	4Core+E XLPE cable
Motor Cable	Lub Oil Heater 2	G6 MCC	17	1	17	6	10	4Core+E XLPE cable
Motor Cable	Jacket Water Immersion Heater	G6 MCC	6	1	6	6	32	4Core+E XLPE cable
Motor Cable	Lub Oil Centrifuge Unit	G6 MCC	8	1	8	10	32	4Core+E XLPE cable
	Low Current Distribution Cct	G6 MCC	50			2.5	180	Internal
							525	

EFL DRAUGHTING SPECIFICATION FOR NEW PLANT



Annex C

Technical requirements to AS/NZS 3439.1

Item	Detail/Value	Notes
Service Condition	Indoors where the switchboard is in a well ventilated area	
Cable Entry (Incoming supply cables)	Top and Bottom Entry	
Cable Entry (Outgoing cables)	Top and Bottom Entry	
Access	Front access. Rear access for busbar inspection	
Supply Voltage (V)	415V, 3 phase, 4 wire	Classification in AS/NZS3439.1
Supply Frequency (Hz)	50Hz	Classification in AS/NZS3439.1
Connected Load (A)	Refer Single Line Diagrams	Classification in AS/NZS3439.1
Fault Level (kA)	30kA	Classification in AS/NZS3439.1
Fault duration (sec)	1 second	Classification in AS/NZS3439.1
Diversity	0.9	Classification in AS/NZS3439.1
Ambient Temperature (°C)	10-40°C	
Relative Humidity (%)	Up to 90%	Damp conditions

Chemical Present	Nil	
Pollution Degree	Degree 3	Classification in AS/NZS3439.1
Segregation	Form 3b or 4	<ol style="list-style-type: none"> 1. Separation of busbars from the functional units and separation of all functional units from one another. 2. Separation of terminals for external conductors from the functional units, but not from each other. Terminals to be shrouded with removable boots. 3. Terminals for external conductors separated from busbars
Degree of Protection	IP43 or better	Live parts, ingress of foreign bodies and liquid
Spare Space	10% minimum	
Module Style	Fully withdrawable	
Main Circuit Breaker	Withdrawable ACB	
Power Monitors	Separate unit or integral with circuit breaker	
Motor Starters	Withdrawal Type	
Motor Starter Communication		
Soft-starters		
Soft-starter Communication		

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: _____

Tender submission

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

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

This tender closes at 4.00pm (1600hrs) on Wednesday 15th February, 2023.

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.