

## Employer's Requirements

### Diesel Generator

**Project:** Engineering, Procurement and Construction of Hybrid PV-Diesel-Battery Energy Storage System

**Location:** Pulau Tiga, Maluku, Indonesia

## 1 Intended Purpose

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The hybrid PV-Diesel-BESS will prioritise renewable energy generation and energy discharge from the BESS.

The purpose of the diesel generator is to provide backup support to the hybrid PV-Diesel-BESS, in case the BESS is running low after unusually high demand, several days of low solar gain and/or failure of the PV/BESS.

During daytime, conditions permitting, all power will be supplied from solar PV generation. The surplus of energy will be used to charge the BESS. In this mode, the diesel generator will be started automatically when the battery state of charge is low. It is expected that the diesel generator will be required to run for short periods of time, until the BESS is charged to its set-point state of charge value.

### 1.1 Topology and specifications

- A single diesel generator shall be AC coupled to the PV and BESS
- The specified maximum continuous power rating must be at least 20kW, with an overload capability of 110% of rated apparent power.
- Generators running from biofuels shall be considered a great advantage although this is non-essential.



**Figure 1: Existing Diesel Generator in P. Tiga site**

## 2 Specific Equipment Requirements

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### 2.1 Diesel Engine

- The engine must be of standard design and of original manufacture.
- The engine must be four-stroke.
- The cooling system shall be water cooled (radiator).
- The average load factor of the engine over a period of 24 hours shall be 0.85 (85%) for prime power output. The engine shall conform to ISO 3046.
- The engine shall be fitted with standard accessories including an air cleaner, electronic governor, fuel tank with inlet and outlet connections, automatic start capability, battery charging alternator unit and voltage regulator, fuel injection, and fuel pump with engine speed adjustment.
- The diesel generator must be integrated into the hybrid power plant in such a way that in case of a major fault in the solar PV system (e.g., inverter failure) it can bypass the PV system and directly feed into the island electrical distribution system.
- The engine shall have a control panel with a start/stop button and displaying lube oil pressure indication, water temperature indication, RPM indication, engine cumulative runtime indications, low lube oil trip indication, over and under speed indication.
- The electric governor shall be Class A1, as per ISO 3046/BS 5514 with actuator as per standard design of manufacturer.
- The engine speed shall adjust itself automatically so that the frequency at no or constant load shall remain within a band of  $\pm 1\%$  of the rated/nominal frequency.
- A fuel tank with a minimum capacity of 500 litres (to provide a 5-6 months storage capacity) shall be installed and have fill, vent and drain openings as well as fuel level indication. The fuel system shall be fed through an engine driven fuel pump.
- A 24Vdc battery starter (as per manufacturer standard) shall have sufficient capacity for the needs of the engine starting system, control panel and auxiliaries.
- The battery charger shall be suitable to charge 24Vdc batteries with transformer and rectifier and charging rate selector switch. The connection charger and batteries shall be copper lead with lugs and other accessories.
- All pipelines, fittings and accessories requirement shall be provided by Bidder. And the piping work shall include all fittings and accessories required such as elbow, bends, reducer, flanges, flexible connection etc.
- Engine area shall be concrete based, bunded for oil-spill containment

**Table 1: Component PLN Requirements**

No	Description	PLN Requirements	Notes
1	Type	Diesel Engine	Open type
2	Configuration	Inline	
3	Cooling system	Water Cooling (Radiator)	Radiator must use Manufacturer design/specifications
4	System start	Battery	
5	Coupling Generator	Direct coupling	
6	Rated speed	1500 rpm	
7	Governor	Electro mechanic	
8	Fuel Support	Up to B.30	
9	Engine Country	OECD Country	
10	Fuel Tank capacity	500 litres	Bunded or double skin
11	Surrounding Noise level	<103 dB	5-meter distance
12	Protection Engine	By default Engine	
13	Starting Panel and Engine Monitoring	By Bidder	

## 2.2 Alternator

The alternator requirements are as follows:

- The excitation shall be brushless type and self-excited. The exciter unit should be mounted on the control panel or alternator assembly.
- Automatic voltage regulator shall be provided as per standard practice of manufacturer.
- In the event of fault, AVR shall remove voltage to the alternator.
- Voltage dip shall not exceed 20% of rated voltage for any step load as per standard ISO:8528.

The alternator parameters are summarised below.

**Table 2: Alternator parameters**

No	Description	PLN Requirements	Notes
1	Output	Minimum 20 kW Continuous	Capable with 110% load
2	Voltage	400 ± 5% V	
3	Frequency	50 Hz	
4	Operation Mode	Continuous	
5	Output Phase	3 Phase 4 wire	
6	Excitation	Self-excited	
7	Protection system	By generator	Installed on synchronizing panel
8	Country origin	OECD Country	
9	Degree of protection	IP-23	
10	Frequency variation	± 1%	As defined by the engine governor
11	Type of AVR	Electronic	

## 2.3 General Electrical System and Control panels

- The control panel shall be free standing on the floor or wall mounted with a minimum protection rating of IP42. The minimum steel enclosure thickness is 1.6 mm.
- The control panel must include:
  - A genset controller from a reputable supplier, such as Woodward, Deepsea, or ComAp.
    - The genset controller must have basic capability including automatic synchronizing and control breaker, active and reactive power control, TCP/Modbus communications with the hybrid controller and an electric generator performance log.
  - A digital meter or meters to display:
    - Voltage
    - Current
    - Power factor
    - Frequency
    - Total energy
    - Hours of runtime
    - Oil pressure
    - Water temperature
    - Battery voltage
    - Fuel level
  - A digital display showing all manufacturer alarms and faults
  - Fuses and MCBs with suitable ratings
  - A push button for ON/OFF operation
  - A selector switch for AUTO/Manual/Test mode
  - Pilot lamps for each 3-phases
  - A battery charger for the generator starter battery with voltage regulator, voltmeter and ammeter.
  - Control system equipment and components such as relays, contactors, etc.
  - An Emergency shutdown switch.
- The remote monitoring and control system should be able to display all of the parameters shown on the control panel
- Voltage control and regulating.
- Terminal blocks shall have a capacity of no less than 15A, and a rated voltage of up to 1000V.
- All small wiring inside the panel shall be no less than 2.5 mm<sup>2</sup> copper conductor PVC insulated and up to 1000V rated voltage.
- All internal components and wiring shall be provided with identifications labels.
- The neutral of diesel generator, fuel tank, electrical panel and all exposed materials shall be solidly earthed to the earthing pit. The resistance of the earthing grid shall not exceed 5 ohm.

## 2.4 Operating modes

- The diesel generator shall have the following modes of operation
  - Auto mode
    - The diesel generator shall start automatically when the BESS has depleted and the controller has sent a command signal to automatic ON.
    - Once the alternator voltage and frequency have synchronized, the circuit breaker shall close connecting the load to the diesel generator.
    - The diesel generator should automatically shut down once the BESS signals that it has reached a predetermined state of charge.
  - Manual Mode: the diesel generator shall start/stop when the operator presses the start/stop push button
- The diesel generator shall shutdown when the following conditions occur:
  - Overload
  - Short circuit
  - Under speed
  - Under voltage
  - Over winding temperature
  - Over voltage tripping
  - Low voltage tripping
  - Phase sequence tripping
  - Phase failure tripping

## 2.5 Engineering design and documentation

- For the current tender, Bidders must submit detailed technical datasheets of diesel generator, genset controller, generator control panel, generator circuit breaker, contactor, fuses, etc.
- Bidders should also submit
  - A general arrangement drawing of the diesel generator, control panel, fuel tank, piping layout and etc.
  - An electrical single line and schematic diagram along with cable schedule, fuel oil system with instrumentation and control, governor system and voltage regulator.
  - Detailed test report from the vendor/manufacturer.
- For the actual works, Bidders shall submit:
  - A detailed civil foundation report for the generator and fuel tank.
  - Fuel piping diagram with storage tank.
  - An Operation & Maintenance manual containing, but not limited to, information such as operational instructions and safety, maintenance details with time schedules, fault diagnosis and rectification, parts list, contact details of nearest distributor.

## 2.6 Fuel Tank

- Single or multiple fuel tanks may be provided.
- The fuel tank or tanks must have a total combined capacity of 500 litres
- Fuel tank must be installed on a concrete pad next to the powerhouse, see Section 4.



- Protections should be in-place against accidental spilling
- Fuel storage tanks need to be concrete based, banded to prevent oil-spill. Environmental hazards.



### 3 Scope of Works

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The scope of works shall include but not be limited to the following:

- Design, construction, testing and commissioning of the diesel generator including foundations and all required fixing accessories.
- Fuel tanks with support, all accessories, filters, valves, fittings level indicators.
- Piping with support for fuel, generator-cooling system include all valves accessories fitting.
- A generator control panel complete with controller and switchboard.
- Training and capacity building for local staff for operation and maintenance.