Employer's Requirements

Monitoring & Control

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

Location: Pulau Tiga, Maluku, Indonesia

1 Intended Purpose

The control and communications system of the proposed hybrid PV-Diesel-BESS power plant is to provide overall operational control of the power plant. It is required to monitor and control all system inverters, charge controllers (if any), BESS and back-up diesel generator and give a visual presentation of system status and operational information to local system operators. This is to be done on an on-going basis (24/7) for the entire expected lifetime of the power plant.

The high-level requirements from the control and communications system are as follows:

- Enable local/remote Supervisory Control And Data Acquisition (SCADA)
    - Monitoring the system operational status' and displaying the status' in an organised fashion for the operational staff.
    - Operational control of generation and transmission equipment as well as the distribution system elements.
    - Logging system parameters including meteorological data, system status', alarms/alerts and metering data.
- Provide a flexible communication infrastructure which allows communications between IEDs, RTUs, PLCS and other devices; wired or wireless.
- Provide storage for historical data which may be used to assess system performance; locally or remote.
- System shall be built using standard equipment and protocols to enable future expansion/modification.
- Remote control is not necessary for safety reasons, but remote monitoring is a mandatory requirement

2 Control philosophy

In very simplistic terms, the system is based around the battery inverters, BESS. The system functions by periodically charging and discharging the batteries. The BESS discharges into the load and local generation system (PV and DG) recharges the batteries.

The system shall be setup to ensure PV energy is maximised. The BESS shall form the grid and thus will control how much energy can be drawn from the PV without making the grid unstable. The BESS will also govern when the DG is required based on State of Charge.

This means that the control system needs to be setup to allow for seamless operation of the system. This can be achieved via distributed or centralised control as long as:

- The whole system or individual components are operable locally.
- Faults are quickly indicated and easily diagnosed by local staff.

This can only be done by creating a robust modular system which gathers and displays enough data.

3 General requirements for works

The system shall be engineered and installed to a very high standard. The general requirements include but are not limited to:

- All works must be undertaken by experienced designers, programmers and installation staff with appropriate certification. Relevant certificates shall be supplied with the Tender submission.
- The contractor shall install products which are reliable with a demonstrable history of being installed in similar situations over long periods without maintenance issues.
- All logic controllers shall be rated for the environment with conformal coating to ensure maximum reliability. All hardware should be accompanied by warranty documentation supporting installation in this environment.
- All network switches need to be industrial type (ruggedised); rated for the environment they are to be installed in.
- All ethernet cables shall be shielded (STP) CAT6. All fibre cables shall be multimode OM2, OM3 or OM4.
- All external control cables shall be multicore type.
- All control cable terminations shall be done using appropriate termination type (ferrules, lugs etc.).
- All cables buried underground shall be buried in rigid conduit or be gel impregnated to minimise water ingress.
- All spare conduits shall have a draw wire.
- Computers shall all be in the form of laptops with internal battery backup.

4 Training and Documentation

The contractor shall provide adequate training for local operators; more details on training requirements is covered in Section 10. As part of the handover, additional documentation that supports the training shall also be provided for local operators.

Requirement for training and documentation are as follows:

- The contractor shall utilise and train local nominated staff. Training shall include but not be limited to the following systems and services:
    - System overview
    - HMI operation
    - Device configuration
    - System Software
    - Hardware Maintenance
    - Other details are covered in Section 10
- Training costs to be included in the tender offer shall be all inclusive in terms of cost of training personnel, travel, accommodation and training materials.
- Training shall be provided both on site and in a classroom setting.
- The system shall be accompanied with detailed operating instructions in both hard copy and electronic format. A copy of the electronic copy has to be provided to PLN MMU and NZMATES. The minimum documentation required is as follows:
    - System Functional Description and design documentation
    - OEM Hardware Documentation
    - Hardware operations and maintenance documentation
    - Software operations and maintenance documentation
    - HMI User Guide
- The System Functional Description shall provide a basic description of the system, the relationship between the functions supported by the system, and the communications network used by the system and include all system drawings. it shall cover:
    - Description of the system architecture.
    - Description of all functions
    - Interfaces and data flow diagrams.
    - Description of the SCADA communications network

5 Control system

The overall control system shall be setup to provide autonomous power plant operations allowing for seamless energy transfer between PV inverters, BESS, Diesel Generators and distribution loads. A distributed control system is acceptable for this project; however, a site system controller may also be used to provide overall inter-device coordination.

The requirements for the control elements are as follows:

- The PV controller shall enabling the PV system to manage
    - Output power
    - Synchronisation
    - Fault response
    - Automated grid connection
- The BESS controller shall enabling the BESS to manage
    - Network parameters (Voltage and Frequency)
    - Output power
    - PV loading
    - DG loading
    - Synchronisation
    - Fault response
    - Automated grid connection
- The DG controller shall enabling the DG system to manage
    - Network parameters (Voltage and Frequency)
    - Output power
    - Synchronisation
    - Fault response
    - Automated grid connection
- The control system shall comprise of intuitive Human Machine Interface/s (HMI) that allows the operator to monitor each system.
- The local controller shall allow the operators to configure operational settings and provide device level control.
- The control system must have basic capability including by not limited to:
    - PV curtailment
    - Automatic Start/Stop Genset based on BESS State of Charge
    - Manual Start/Stop control of all inverters and the diesel generator
        - Operate the main circuit breakers
    - Changing the main parameters of each of the main system components including all inverters, the BESS and diesel generator
- The system shall allow access to data stored locally on each device controller.
- The monitoring data must be accessible remotely via an online portal.
- The monitoring and control system must incorporate a meteorological station including sensors:
- Pyranometer
- Back of panel temperature sensor
- Wind Speed
- Ambient Temperature

- As a minimum requirement, the following data should be monitored, logged and displayed online at minimum 5 min intervals and retained for at least 5 years in the logging system:
    - PV System
        - DC voltages & currents at MPPT level
        - DC power on each MPPT
    - Grid supply
        - Grid voltage on each phase
        - Frequency
        - Power supplied on each feeder
    - Battery
        - BESS State of charge
        - Battery cell temperature
        - Battery room ambient temperature (if powerhouse is used)
        - HVAC system status (for each HVAC unit)
    - Generator
        - Generator state
        - Generator Voltage on all phases
        - Generator Frequency
        - Generator power on all phases
        - Generator Yield, Running hours & Fuel consumption
        - Fuel level indication
    - System performance
        - PV Yield
        - BESS state of health
    - Meteorological data:
        - Solar Irradiance
        - Temperature of Sensor Cell
        - Back of panel temperature for a single panel
        - Wind Speed
        - Ambient Temperature
    - Switch position
        - OPEN/CLOSE indication
        - TRIPPED indication
- It should identify all fault events and communicate these to local operators in an accessible and easy to interpret/understand format, with relevant troubleshooting and fault rectification processes clearly laid out in system operation and maintenance manuals.
- It should be possible to set up different warning and alarm levels on the monitoring system which should trigger the sending of emails and SMS messages to relevant operators. All warnings and alarms should be logged for future reference. for example;
    - Distribution network fault
    - BESS fault
    - PV fault
    - DG fault
    - Communication system faults
- All key control equipment shall have at least 8hours of battery backup in case of power outages. This shall be in the form of 24Vdc uninterruptible power. 240Vac UPS is not required.

6 Communications system

Requirements for the communication networks are primarily driven by the requirements of the applications and application data flows that need to be supported over the network and the constraints imposed physical location of the hardware where those applications need to be supported.

However, the minimum requirements are:

- Standard communications protocols are used.
- System components are easily sourced and replaced as and when required.
- System is secure from cyber attacks

6.1 Local network

The local network shall be primarily built around the TCP/IP network protocol; commonly known as EtherNET. the communications network will be required to support IP routable protocols such as ModBUS o TCP/IP or DNP3 o TCP/IP.

- All primary control hardware shall have at least 1 RJ45 port for data transfer over TCP.
- Serial protocols are to be avoided as much as possible; it may be used on a subsystem level.
- All switches and routers shall be industrial type with spare ports available for future expansion.
- Backbone hardware (switches/routers/fibre to copper media converters) shall be capable of a minimum of 100Mbit/s
- A hardware firewall and VPN server will be considered more favourably.
- A local NTP server shall be established to synchronise the timing of events.
- IP address shall be displayed on each device.

6.2 Internet and cloud services

- All monitored system data will have to be relayed via the available 4G mobile network to a remote online internet portal and logged and stored there for remote observation and future reference. All data should be presented in logical, easy-to-read graphs and/or bar charts and be able to generate customized reports.
- The monitoring & control system must operate with full functionality without continuous internet connection or cloud based data services. It should be able to store data locally for at least 30 consecutive days, and once the internet connection is restored, upload these monitoring data to the portal.
- A dedicated internet connection shall be provided with a static IP address or permanent DNS resolution for remote access. Wireless internet connection (e.g. 3G or Satellite) is acceptable for the internet uplink. For example, use an outdoor routerboard using a Simcard that allows 4g signal. Solutions must be simple, low-cost, and reliable.
- The internet portal shall support remote access from any internet connected computer via a web browser or smartphone devices via an Android or iOS application.

- Internet for personal use on site shall be restricted by applying firewall rules or QOS rules to prevent access to common sites such as facebook, youtube, linkedin etc.

6.3 Public reporting

- The Employer may choose to make public any system performance data acquired through the Monitoring and Control system. Data that the Contractor requires to be held confidential must be listed in the Tender response.

7 Scope of Works

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

- Design, construction, testing and commissioning of the monitoring and control system including all required accessories.
- The first year of connection/data charges in their contract price and allow for handover of the internet contract at the close of the Defects Liability Period.
- Training and capacity building for local staff for operation and maintenance.

8 Optional Items

The following optional items may be offered by Bidders. Inclusion of these items will strengthen any Proposal.

8.1 Optional: Independent Monitoring Platform

Bidders can offer optionally an Independent Monitoring Platform (IMP) and components additional to the proprietary ones embedded into inverters. Bidders should detail the outreach of the platform, compatibility with brands and equipment, reliability, and functionalities. Some options in the market that are encouraged to be offered are Ferntech, ComAp, Elum, Hornbill, and other controllers with monitoring platforms

8.2 Optional: Independent Operation and Maintenance Platform

A platform/tool/app that can ease the operation and maintenance activities and asset management is also an allowed optional offer. Bidders can propose solutions available in the market for consideration and that are compatible with e monitoring platform. Bidders must detail outreach of platform, benefits, and justification.