



National Power Corporation

SUPPLEMENTAL/BID BULLETIN NO. 1
DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF BATAN
ISLAND SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS) UNDER
PR NO.HO-PIG22-019 / REF. NO. PB22109-JL00413

07 November 2022

All prospective bidders and authorized copy holders of the Bid Documents of the above-mentioned project are hereby advised of the changes in the provision of the Bid Documents, to wit:

A. BID SUBMISSION OPENING

FROM	TO
09 November 2022 9:30 AM Kaňao Room	16 November 2022 9:30 AM Kaňao Room

B. SECTION VI - TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS PART I

REFERENCE SECTION	PREVIOUS VERSION	REVISED VERSION
GW – 8.0 Tools and Appliances	• One (1) set – Earthing Resistor (0 – 1000 ohms)	• One (1) set – Load Resistor (0 – 1000 ohms)
	• One (1) set – Voltmeter (with a minimum rated voltage of 600VAC and 1.1kVDC)	• One (1) set – Voltmeter (with a minimum rated voltage of 600VAC and 1kVDC)
	• One (1) set – Clamp Meter (with minimum rated current of 500A)	• One (1) set – Clamp Meter (with minimum rated current of 1000A)
EW – 2.0 Energy Storage System		• Replace the whole section with the attached revised EW-2.0 Energy Storage System

TECHNICAL SPECIFICATIONS PART II

REFERENCE SECTION	PREVIOUS VERSION	REVISED VERSION
TDS – Technical Requirements	• Insert the provision between item nos. 2 and 3.	• Deviation from the requirements indicated in the technical data sheets and

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		non-submission of the required drawings and documents listed as Annexes A to E and F-1.0 to F-9.0 shall be ground for disqualification.
TDS – Annex A	• ANNEX A -LETTER OF AUTHORIZATION AND GUARANTEE STATEMENT	• ANNEX A - LETTERS OF AUTHORIZATION AND GUARANTEE STATEMENTS.
TDS – Annex F-1.0	F-1.0 Total Capacity of Solar PVat AC Side	F-1.0 Total Capacity of Solar PV Plant at AC Side
TDS – Annex F-6.11	F-1.0 Technical and Functional Requirements for the Battery Management System, Power Conversion System, ESS Control System and Housing as stated in EW-2.4 ESS	F-1.0 Technical and Functional Requirements for the Battery Management System, Power Conversion System, ESS Control System and ESS Enclosure/Cabinet as stated in EW-2.4 ESS
TDS – Annex F-7.3	Chemistry NMC, LMO or Blended LMO / NMC	Chemistry NMC, LMO, Blended LMO / NMC, LFP
TDS – Post Qualifications		• Revise the metric prefixes and subscriptofthe unit of power, voltage and weight.
TDS – Annex G-7.8	G-7.8 Housing	G-7.8 ESS Enclosure/Cabinet
	Gross Weight, Installed with batteries (kg) By Supplier	Gross Weight, Installed with batteries (kg) ≤60kg



	<table border="1"> <tr> <td>Maximum Housing Dimension, Length x Width x Height (m)</td> <td>By Supplier</td> </tr> </table>	Maximum Housing Dimension, Length x Width x Height (m)	By Supplier	<table border="1"> <tr> <td>Dimension, Length x Width x Height (m)</td> <td>By Supplier</td> </tr> </table>	Dimension, Length x Width x Height (m)	By Supplier
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TDS – Annex G-8.3	<table border="1"> <tr> <td>Chemistry</td> <td>Refer to EW-2.4.2(c)</td> </tr> </table>	Chemistry	Refer to EW-2.4.2(c)	<table border="1"> <tr> <td>Chemistry</td> <td>NMC, LMO, Blended LMO / NMC, LFP</td> </tr> </table>	Chemistry	NMC, LMO, Blended LMO / NMC, LFP
Chemistry	Refer to EW-2.4.2(c)					
Chemistry	NMC, LMO, Blended LMO / NMC, LFP					
TDS – Annex G-8.6	<table border="1"> <tr> <td>• Cycle Lifetime (Full Cycle)</td> <td>At least 4000</td> </tr> </table>	• Cycle Lifetime (Full Cycle)	At least 4000	<table border="1"> <tr> <td>• Cycle Lifetime</td> <td>At least 5000</td> </tr> </table>	• Cycle Lifetime	At least 5000
• Cycle Lifetime (Full Cycle)	At least 4000					
• Cycle Lifetime	At least 5000					
TDS – Annex G-14.0	G-14.0 AUTOMATIC CIRCUIT BREAKER	G-14.0 AUTOMATIC CIRCUIT RECLOSER				
TDS – Annex G-19.0	G-19.0 SPARE PARTS FOR SOLAR PV SYSTEM AND AUXILIARIES (Minimum Requirements as Specified in the Technical Specifications and Manufacturer's Standard and Recommended Spare Parts)	G-19.0 SPARE PARTS FOR SOLAR PV SYSTEM, ENERGY STORAGE SYSTEM(ESS), POWER AND ENERGY MANAGEMENT SYSTEM(PEMS) AUXILIARIES (Minimum Requirements as Specified in the Technical Specifications and Manufacturer's Standard and Recommended Spare Parts)				
TDS – Annex G-19.7	List of other spare parts recommended by Manufacturer (For Automatic Circuit Recloser and etc.)	Other spare parts recommended by the Equipment (SPP, ESS, PEMS and Automatic Circuit Recloser) Manufacturer (Specify)				
TDS – Annex G-20.3	Earthing Resistor (0-1000 ohms)	Load Resistor (0-1000 ohms)				
TDS – Annex G-21.0	<ul style="list-style-type: none"> • Include this provision in Other Requirement 	<ul style="list-style-type: none"> • Certificate of Site Inspection duly signed by the Batan DPP Plant-in-Charge and/or its duly authorized NPC personnel. 				

C. CONTACT PERSON


<p>CARLO LLORCA PLANT HEAD – BATAN DPP 0908-181-8802</p>



All other terms and conditions shall remain the same.

For the information and guidance of all authorized copy holders of the Bid Documents and prospective bidders.

For the Bids and Awards Committee:


RENE B. BARRUELA
Vice President, CAG and Chairman,
Bids and Awards Committee



wrenches shall be mounted on a suitable shadow board arranged for wall mounting.

Every special tool and instrument shall be accompanied or furnished with maintenance or instruction manuals in English language.

All tools and appliances supplied shall be handed over to NPC in perfect condition at the time of taking over.

All bidders are required to submit in their proposal the detailed list of special tools to be supplied. This list is preliminary and subject to changes in order to conform with the final design without any additional cost. The final list with the corresponding brochures/catalogues shall be submitted to NPC for approval not later than one (1) month prior to the delivery of the equipment.

All brochures/catalogues shall be written in English. If in foreign language other than English, it must be accompanied by a translation of the documents in English. The documents shall be translated by the relevant foreign government agency, the foreign government agency authorized to translate documents, or a registered translator in the foreign bidder's country; and shall be authenticated by the appropriate Philippine foreign service establishment/post or the equivalent office having jurisdiction over the foreign bidder's affairs in the Philippines.

Tools for Solar PV System

Tools for Solar PV System shall be supplied by the Supplier which shall consist of the following:

1. One (1) unit – Toolbox
2. One (1) set – Insulation Resistance Tester (with rated voltage at 250V/500V/1000V)
3. One (1) set – Load Resistor (0 – 1000 ohms)
4. One (1) set – Voltmeter (with a minimum rated voltage of 600VAC and 1kVDC)
5. One (1) set – Clamp Meter (with minimum rated current of 1000A)
6. One (1) unit – PVC hose, flexible and robust, 20mm Ø, at least 30m length with drum or reel assembly.
7. One (1) unit – Extendable/telescopic panel cleaning pole with squeegee and sponge, at least 12ft (fully extended) length with hose attachment (20mm Ø hose)

Tools for Power and Energy Management System (PEMS) and Energy Storage System (ESS)

Tools for PEMS and ESS shall be supplied by the Supplier which shall consist of the following:

- a) One (1) Desktop computer (Minimum of Intel I7 Processor, 16 GB RAM, 1-TB HDD, 2Ghz, 32" screen size and with the latest pre-installed windows operating system compatible with manufacturer's or supplier's software) needed in programming the PEMS and ESS control setting complete with licensed CD-ROM drive dongles including other digital components that require exclusive programs from the manufacturer with free update throughout the operating life of the equipment. The desktop shall also have an uninterruptable power supply (UPS).

PART I – TECHNICAL SPECIFICATIONS

EW – ELECTRICAL WORKS

EW – 2.0 – ENERGY STORAGE SYSTEM

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PART I – TECHNICAL SPECIFICATIONS

EW – ELECTRICAL WORKS

EW-2.0 ENERGY STORAGE SYSTEM

This section provides the definition, scope of works, functional/ performance requirements, technical specifications, and standards for the Energy Storage System (ESS).

EW-2.1 Definition of Terms

- a) **State of Charge (SoC)** is the level of charge of a battery system/ module measured from 0%. 0% SoC refers to a fully discharged battery and 100% SoC refers to a fully charged battery.
- b) **Depth of Discharge (DoD)** is the level of charge of the battery system/ module measured from 100% SoC. 100% DoD refers to a fully discharged battery and 0% DoD refers to a fully charged battery.
- c) **Maximum Normal State of Charge (MaxNSoC)** is the SoC at which the ESS can be charged at maximum rate (i.e. prior to taper/trickle charge).
- d) **Minimum Normal State of Charge (MinNSoC)** is the SoC specified by the ESS/battery manufacturer at which the ESS can inject power to the interconnection point at full rated power. At MinSoC, the ESS must be able to inject full power for at least 5 seconds.
- e) **Usable Range of SoC** is the range between MaxNSoC and MinNSoC.
- f) **Usable Energy** is the kWh capacity available of the Usable Range of SoC.
- g) **State of Health (SoH)** is an indicator of the remaining capacity of the battery system/module to deliver the required Usable Energy. It shall reflect remaining life, in equivalent full cycles of the battery, and indicate if the battery system/ module need replacement.
- h) **Beginning of Life (BoL)** is the instance that ESS begins operation during conduct of Commissioning Tests.
- i) **End of Life (EoL)** is defined as the instance where the Usable Energy falls below the required value as determined by the SoH indicator and/or a performance test.
- j) **Cycle Lifetime** is the number of full charge and discharge cycles between the EoL and BoL at nominal C rating @25°C.
- k) **Power Conversion System (PCS)** refers to the subsystem of the ESS that contains inverter(s), power electronics, circuit breakers, transformers, switchgears and safety systems required for the ESS to



inject and absorb electricity between the interconnection point (e.g. busbar) and the battery system.

- l) **ESS Control System (ECS) / ESS controller** refers to the control system of the ESS.
- m) **Battery Management System (BMS)** refers to the sub-system of the ESS that monitors and controls the battery units and ensures proper charge and discharge of the battery modules.
- n) **Battery modules** are the smallest modules/ unit of energy storage that is user replaceable without the use of specialized tools and equipment. They are made of individual battery cells connected in series/parallel or combination thereof.
- o) **Energy Storage System (ESS)** refers to the system responsible for the storage and discharge of electricity depending on the power system requirements. It is composed of the following sub systems:
- Battery Management System
 - Battery Modules/ Batteries
 - Power Conversion Systems/ Battery Inverter
 - ESS Control System/ESS Controller
 - ESS Transformer

EW-2.2 Scope of Works

The general scopes of work are enumerated below. Additional details are provided in the relevant sections of the tender.

- a) All services, materials, and equipment necessary for the proper installation, maintenance, and operation of the ESS. (e.g. ESS enclosure/cabinet, ESS transformer, communication, control and power cabling, cable trays, conduits, connection hardware, safety, and protection equipment, etc.).
- b) The ESS shall be supplied and integrated as a complete operational equipment/system consisting of its appurtenances, tools, sub-systems, firmware, and software; including all items not specifically mentioned but are essential to the proper operation of the ESS as required herein. **The BMS, batteries and its racks shall be supplied together under one brand/manufacturer.**
- c) Back-to-back guarantee/warranty with equipment manufacturer(s). Supplier shall provide/extend all warranties provided by the manufacturer to NPC. In case the supplier is unable to rectify/remedy defects in the product, they shall shoulder all expenses that the manufacturer may levy to remedy/rectify the defects.
- d) Complete documentation:
- Design and as-built drawings.
 - Installation, Operation and Maintenance Manuals
 - Electrical circuit diagrams
 - Performance Monitoring Test, Factory and Site Acceptance Test procedures.

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- Back-up copies of control programs (firmware and other configuration software)
 - Other relevant documents (if any).
- e) Training of plant and technical services personnel regarding ESS as part of the plant as specified in *GW-14.0 Training of NPC Personnel*.

EW-2.3 Site Conditions

- a) Environmental Conditions (refer to Section VI – GW 5.0, Design & Duty Conditions)
- b) The ESS enclosure/cabinet shall have a footprint/area adequate to house all the major and appurtenant equipment of ESS (considering clearance requirements from adjoining equipment and structures). Refer to Section IX – Reference Drawings, Proposed Equipment Layout for the allocated space for the ESS.

EW-2.4 Energy Storage System (ESS)

The ESS shall mainly function as **grid stabilization equipment** by providing ancillary services. It shall support the operation of the whole power plant by providing buffer power in the event there is power and/or frequency fluctuations (e.g. Power output of the solar plant suddenly drops due to shading caused by cloud formation).

It shall have a power rating of (refer to Section VI – GW 6.0 *Supplier's scope of works*) (continuous) and a usable energy of at least (refer to Section VI – GW 6.0 *Supplier's Scope of Works*).

Bi-directional (Import and Export) Digital Energy Meter shall be provided to account for energy import and export to and from the ESS. It shall be connected to the 3-phase, 60Hz system between the ESS and the ESS transformer.

The operating voltage of the ESS and the output voltage of the PCS respectively shall depend on the equipment manufacturer's specifications. However, the high voltage side of the ESS transformer shall be 13.8kV (line to line).

Roundtrip efficiency of the ESS must be at least 80%. Efficiency shall include/account the energy utilized by the cooling system, lighting, BMS, PCS and ECS/ESS Controller.

Detailed specifications of its components are provided in the succeeding sections.

EW-2.4.1 Battery Management System (BMS)

The BMS shall control and monitor all battery module parameters. e.g. SoC/DoD, string/module voltage, current, temperature, impedance (or equivalent parameter to indicate the "health" of the battery modules).

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SoH data shall be available while the ESS is in operation and shall be revalidated by a performance test to be conducted at least once a year (or as the need arises).

The BMS shall automatically control the charge/discharge of all batteries including cell balancing, equalization and other maintenance and safety functions/procedures to ensure proper operation of the battery system. The same function can be triggered manually if necessary.

- a) The BMS must be capable of keeping the operational history of individual battery modules. Operation of the battery module shall be managed individually to account for different module characteristics. Minimum parameters to be logged are as following:
- Module voltage
 - Module current
 - Replacement history of battery module
 - Module faults/alarms
 - Module temperature
 - State of Charge (SoC) / Depth of Discharge (DoD)
 - State of Health
- b) The bidder/manufacturer shall specify the MinNSoC and MaxNSoC as defined in EW-2.1 of this section.

EW-2.4.2 Battery Modules/Batteries

- a) Usable Energy of the batteries shall be at least (*refer to Section VI – GW-6.0 Supplier's scope of works*) within the warranty period. Testing shall be performed during factory acceptance, commissioning and at least once a year, or as the need arises (i.e. performance test) to ascertain the amount of usable energy. Bidder/manufacturer shall provide all test procedures subject to review and approval of the National Power Corporation.
- b) Batteries shall have a minimum cycle lifetime of at least 5000 cycles @ nominal C-rate @25°C. The nominal C-rate of the battery to be supplied shall be 1C or higher. Batteries that have lower nominal C-rate shall be acceptable if these are configured in parallel to meet the equivalent rated power as the batteries with 1C rating. For example, 0.5C rated batteries with 120kWh energy capacity shall be connected in parallel with another identical module to meet the equivalent 1C rated batteries with 120kWh energy capacity. **It shall self-discharge for not more than 10% of its capacity per month.** The remaining cycles shall be translated into the SoH indicator parameter. This model shall be implemented in the BMS and shall be validated and adjusted (if necessary) during the conduct of annual performance tests.
- c) Battery cell shall be prismatic format with an acceptable battery chemistries such as Lithium Manganese Oxide (LiMn2O4-LMO), Lithium Nickel Manganese Cobalt Oxide (LiNiMnCoO2-NMC), blended NMC/LMO and Lithium Ferrous Phosphate (LiFePO4-LFP).
- d) Battery Modules shall be self-contained, modular and user replaceable without the need for specialized equipment. For purposes of transport and installation, gross weight of each battery module shall not exceed 60kgs.



- e) Each battery module (if possible, each cell) shall be equipped with overcharge, short circuit, and thermal runaway protection. Each battery rack shall be protected by fuse and/or by DC circuit breaker against electrical fault, this also serves as the main disconnecting means for repair and maintenance.
- f) Batteries must be compliant to IEC 62619 or UL 1642. Test certificate of the batteries shall be submitted during post-qualification.

EW-2.4.3 Power Conversion System (PCS) / Battery Inverter

- a) The PCS shall have the following functionalities:
- Parallel operation;
 - Capable to provide ancillary services;
 - Provide Short Circuit Current sufficient to trigger circuit breakers and other protection devices for duration of not less than 50ms;
 - Provision of reactive power;
 - Frequency Control. The nominal system frequency shall be 60Hz and shall be maintained within the limits of 59.7Hz and 60.3Hz during normal conditions based from **Philippine Distribution Code 2017**;
 - Voltage Control; and
 - Fault ride through with programmable voltage and duration.
- b) The PCS shall have a nominal power rating (net of ESS auxiliary power requirements) with 110% overload capability of at least ten (10) minutes.
- c) PCS must be able to perform Power Swing necessary to compensate for sudden loss of generation from either the diesel generators or the solar PV plant.
- d) The PCS shall have the capability to support the changes in power direction of the battery (from charge to discharge and vice versa) within 200ms.

EW-2.4.4 ESS Control System (ECS) / ESS controller

- a) The ECS / ESS controller shall serve as the interface between the Hybrid controller and the ESS. It shall ensure that the ESS is able to respond to the commands of the Hybrid controller in performing all its functional requirements as specified herein.
- b) The ECS / ESS controller shall be equipped with its own control interface that can display the status of the ESS and its components. The interface must be capable of monitoring operational and maintenance history of the ESS (of the SoC and "health" of each battery module).

EW-2.4.5 ESS Digital Energy Meter

This specification covers the technical and associated requirements for the ESS digital energy meter including instrument transformer and accessories required for the electric generating plants.

EW-2.4.5.1 Technical Characteristics and Requirements

The ESS digital energy meter shall be furnished and installed by the Supplier as shown on the bid drawings complete with stainless steel housing, test block and associated metering instrument transformers (current transformers) of appropriate burden and accuracy and other accessories for indoor metering purposes. It shall be capable to measure the power generated and received by the ESS. It shall be designed to operate continuously for the normal life of the meter. The digital energy meter shall meet the following minimum requirements:

ITEM	DESCRIPTION	REQUIREMENTS
1	Number of Wires	3 or 4
2	Voltage, V	120-480
3	Accuracy class	0.2s
4	Current Range	Class 10
5	Frequency, Hz	60
6	Register Type	LCD
7	Soft Switches	Available
8	LCD Display	Programmable
9	The Kilowatt-hour meter to be provided is certified and approved by ERC	Yes
10	Communication Port for Kilowatt-hour meter	To be Provided
11	Meter Test Block	
	No. of Poles	10 (4 Voltage & 6 Current Terminals)
	Rated Voltage, V	600V
	Equipment Standard	ANSI C12.9
	Test Block Cover	Required
11	Metering Current Transformer	
	a. Application (Indoor/Outdoor)	Indoor
	b. Insulation type	Full cast epoxy resin
	c. Primary rated current, A	By Supplier
	d. Secondary rated current for all windings, A	5
	e. No. of cores	One (1) core Secondary CT
	f. CT ratio	By Supplier
	g. Burden, VA	2.5
	h. BIL, kV	10

In extreme cases, the Supplier shall furnish, if necessary, indoor type potential transformer with the same BIL rating. The transformer shall have appropriate voltage ratio which is suitable for ESS digital energy meter and ESS AC voltage system. All costs associated with the supply and installation of such transformer shall be to the account of the Supplier.



The ESS digital energy meter shall have but not limited to the following features:

1. Pilferage proof
2. Tamper Proof
3. Wrong Wiring Alarm
4. Current Flow display
5. Can withstand the temperature of -20°C to $+70^{\circ}\text{C}$ and Humidity of up to 95% non-condensing
6. With back light display
7. With built-in battery for LCD display and back-up battery
8. TOU Programmable Ready
9. Measure display (Energy, RMS voltage & current per phase, Reactive & Apparent Power, Power factor, Frequency, Calendar, Time and etc.)

The ESS digital energy meter with the required metering instruments shall be enclosed by a separate enclosure for proper protection and safety against water droplets, dust, exposure of energized conducting material and the like without additional cost to NPC.

For ESS digital energy meter, communication ports shall be provided or available in the energy meter exclusively intended for electronic reading, hence reading the data determined from the computer remotely from the meter. Electronically gathering of data can logged parameters to the computer such as instantaneous parameters, billing information, load survey, events or tampers, transactions, etc.

EW-2.4.6 ESS Enclosure/Cabinet

- a) The ESS shall be self-contained in its own free-standing enclosure/cabinet. It shall be supported with a suitable foundation. The ESS enclosure/cabinet shall have a footprint/area adequate to house all the major and appurtenant equipment of ESS (considering clearance requirements from adjoining equipment and structures).

For enclosure integrated by the ESS manufacture to package the system into a single compact or multiple containerized housing shall be permitted provided that it is rated for outdoor operation with a minimum required IP rating and shall comply all applicable provisions thereon.

- b) The ESS shall be equipped with a built-in redundant cooling system to control and maintain the temperature required inside the battery compartment. It shall be tropicalized and can operate automatically. It shall be configurable and programmable to be able to reboot and operate itself with automatic switchover, whenever there is a fault on the first cooling equipment, without human intervention (e.g. manual switching).
- c) ESS enclosure/cabinet shall be rated of at least IP55 and 2-hour fire rating.

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- d) The ESS shall have adequate protection to prevent unauthorized access to the ESS.
- e) ESS shall be equipped with emergency stop buttons outside the enclosure/cabinet.
- f) ESS enclosure/cabinet together with its enclosed non-current carrying metal frame shall be connected to ground and protected from any unexpected electricity leakage.

EW-2.4.7 ESS Transformer

EW-2.4.7.1 General

This specification covers the technical and associated requirements for the ESS transformer and accessories for use in electric generating plants. The rating of this transformer is specified in the **Technical Data Sheets** and in **GW -6.0 Supplier's Scope of Works**. The supplied transformer shall be in accordance with the latest revision of IEEE Std. C57.12.00.

EW-2.4.7.2 Technical Requirements

The supplied ESS transformer for Batan Energy Storage System shall meet the following minimum requirements:

ITEM	DESCRIPTION	REQUIREMENTS
1	Type of Cooling	ONAN
2	Insulation	Mineral Oil with its electrical and chemical characteristics is compliant with IEC and is Polychlorinated Biphenyls (PCB) free
3	Type	Two-winding Transformer
4	Audible Sound Level	Refer to Table specified under EW-2.4.7.3.8
5	Vector Group	YNd11
6	Temperature	
	a. Ambient Temperature	40°C
	b. Temperature Rise	65 °C
7	Winding Connection	
	• H-Winding	Wye with Neutral Grounded
	• X-Winding	Delta
8	Insulation Level	
	a. Nominal Voltage Level, kV	
	▪ H-winding	13.8
	▪ X-winding	By Supplier
	b. Highest Voltage Level, kV	
	▪ H-winding	15



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	▪ X-winding	By Supplier
	c. Basic insulation level, kV	
	▪ H-winding	95
	▪ X-winding	By Supplier
9	Winding Material	100% Copper
10	Bushing Material	Porcelain
11	% Impedance at Rated kVA	Manufacturer's Data
12	Efficiency	
	a. At 100% load	By Supplier
	b. At 75% load	By Supplier
13	Tap Changer	No-Load
14	Taps	
	a. H-Winding	13.8 kV ± 2 x 2.5%
	b. X-Winding	N/A
15	Transformer Losses	
	a. No-Load Loss, W	By Supplier
	b. Load Loss, W	By Supplier
16	Tolerances	
	a. No-Load & Load Loss	Not more than 10% of the manufacturer's specified value
	b. Total Loss	Not more than 6% of the manufacturer's specified value
	c. Impedance	± 10% of the manufacturer's specified value
17	Ground Terminal Connection	Suitable for 100 mm ² copper conductor
18	Weight of oil, kg	By Supplier
19	Total Weight, kg	By Supplier
20	Test and Experience Requirements	
20.1	Test Requirements ¹	
	a. Routine Test to be performed	Yes
	b. Certified Design and Routine Test Reports to be submitted	Yes

EW-2.4.7.3 Design Requirements

EW-2.4.7.3.1 Rating

The transformer rating specified in the Technical Data Sheets shall be the basis of the Supplier's guarantee as to performance and temperature rise.

¹ Test Report of a licenser instead of the Supplier's Manufacturer shall not be accepted.



The ratings indicated are based on actual load requirements at the service and operating conditions specified herein.

EW-2.4.7.3.2 Voltage

The transformer to be supplied shall be designed to withstand the over voltages for the duration of voltage excursions which may be expected as a result of full load rejection of the inverters.

EW-2.4.7.3.3 Frequency

Frequency for operation shall be 60 Hz.

EW-2.4.7.3.4 Overload Requirement

The overload rating and operation shall be in accordance with all cyclic loading duties as specified in IEC 60076-7. The overload capability of any auxiliary equipment such as bushings, LTC's, CT's, oil expansion tanks, leads, etc. shall not be less than the transformer overload rating. If other considerations will limit the overload capability of the transformer, the Supplier shall specify these limitations in his proposal.

EW-2.4.7.3.5 Short Circuit Withstand Capability

The transformer shall withstand the mechanical and thermal stresses produced by external short-circuit currents specified in IEEE Std. 57.12.00 (latest revision).

EW-2.4.7.3.6 Transformer Loss Evaluation

Depending on the requirement stated in the Technical Data Sheets, the Supplier is required to fill-in all the information for the transformer losses in the Technical Data Sheets for the ESS transformer and station service/dry-type transformer in order for the NPC to fully determine the most cost effective of the proposed transformer(s) to be supplied considering both cost of losses and first cost.

The transformer shall be designed for the most economical loss ratio (copper loss/iron loss) for the application as specified in the Technical Data Sheets for the transformer.

EW-2.4.7.3.7 Impedance and Reactance

The impedance and reactance shall be stated in the Proposal.

EW-2.4.7.3.8 Audible Sound Level

Sound levels decibels (dB) at rated voltage and frequency for liquid immersed ESS transformer shall be as below. The average sound level of the transformer shall not exceed these values when measured in accordance with the conditions outlined in the latest ANSI/IEEE C57.12.90 or IEC 60076-10 for oil-immersed transformers or ANSI/IEEE C57.12.91 or IEC 60726 for dry-type transformers.



Equivalent Two-winding, kVA	Average Sound Level, dB
1-50	48
51-100	51
101-300	55
301-500	56
750	57
1000	58
1500	60
2000	61
2500	62

EW-2.4.7.3.9 Tolerances

The transformer shall be designed and manufactured with tolerances in accordance with applicable ANSI/IEC/IEEE standards.

EW-2.4.7.3.10 Electrical Insulating Oil

The Supplier shall furnish oil with quality suitable as an insulant and coolant for transformers. The oil shall be new naphthenic based mineral oil meeting the requirements of the latest ASTM D3487 (Specification of Mineral Insulating Oil Used in Electrical Apparatus).

Insulating liquid must not contain more than 2PPM of Polychlorinated Biphenyl (PCB), classified as "PCB free". The Supplier shall submit a certification from the manufacturer of the transformer that the transformer oil does not contain PCB and the laboratory analysis shall be conducted by a DENR-Accredited Laboratory.

The Supplier shall state the commercial name and specifications of the oil to be furnished. NPC reserves the right in the future to use any oil which meets the above specifications and the use of such oil shall not affect the Supplier's guarantee.

EW-2.4.7.4 Design and Construction Features

EW-2.4.7.4.1 General

The transformer design, manufacture and assembly shall minimize vibration and shall prevent damage by inherent vibration and stress during operation, transportation and short circuits.

EW-2.4.7.4.2 Cores

Cores for the transformers shall be constructed of the highest quality, non-aging high permeability grain oriented silicon steel. The steel shall be in thin



laminations, annealed after cutting and rolled to ensure smooth surface at the edges.

The laminations must be free from impurities and must receive stress relief treatment after punching. The laminations shall be accurately flattened, especially at the edges and insulated by suitable procedures with long life heat resistant insulating coat.

Both sides of each sheet shall be insulated with a durable, heat resistant insulation. The cores shall be held firmly by core clamp and brace to ensure adequate mechanical strength to support the winding and to withstand without damage or deformation, the forces, caused by short circuit stresses, transportation or handling to prevent shifting of the core laminations.

The core shall be solidly grounded to the tank and shall be provided with approved lifting devices or lifting lugs at suitable points of the core assembly for core lifting.

EW-2.4.7.4.3 Windings

Windings for transformer shall be of the best modern design of conductor having constant cross-section and uniform insulation or graded insulation as required. The coils shall be wound and supported in a manner to provide sufficient oil ducts which will be maintained without constriction.

End coils shall have extra insulation. Coils shall be made up, shaped and braced to provide for expansion and contraction due to temperature changes in order to avoid abrasion of insulation and provide rigidity to resist movement and distortion caused by abnormal operating conditions.

Adequate barriers shall be provided between windings and core and between high and low voltage windings. End coils shall have extra protection against abnormal line disturbances. Permanent current-carrying joint for splices shall be welded or brazed, properly formed and finished, and insulated to conform to the basic insulation.

Winding conductor shall be free from scars, burrs and splinters and shall be uniformly insulated.

The completed assembly of core and coils shall be vacuum dried, immediately impregnated and immersed in dry oil. They shall be adequately braced to withstand ocean shipment, short-circuit forces and earthquakes.

EW-2.4.7.4.4 Bushing

All porcelains used in bushing shall be wet process, homogenous, and free from cavities or other flaws. The glazing shall be uniform in color and free from blisters, burrs and other defects. All porcelain parts shall be one piece. The bushings of the same rating shall be interchangeable.

Bushing up to 110 kV BIL shall be porcelain bulk type whereas bushings above 110 kV BIL shall be condenser-type. In the latter case, the bushing shall be provided with capacitance test tap.

SECTION VI – TECHNICAL SPECIFICATIONS

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Bushings shall have the continuous current-carrying capacity necessary to carry the full 65°C temperature rise. The bushings shall also be capable of carrying overload currents as required by EW-2.4.7.3.4

The terminal pads shall be of high conductivity bronze or copper and shall be plated with hot flowed electro silver or electro-tin. Whenever a larger terminal pad is required for higher current rating, the mounting holes shall conform to NEMA Standards.

The HV and LV terminations of the ESS transformer shall be fitted with suitable insulating shroud. The insulating shrouds shall be manufactured through dip moulding process and shall be made from flexible polyvinyl chloride (PVC) material, suitable for low voltage to high voltage applications. The insulating shroud shall be flame retardant, conforming with the UL 94 Standards. They shall be type tested for electric strength in accordance with IEC 60243-1 or approved equivalent standards.

EW-2.4.7.4.5 Gasket

Gaskets shall be unaffected by hot insulating oil, retain their resiliency during the life of the associated equipment, and be unaffected by weather while maintaining oil and gas tightness. Nitrile rubber gaskets are acceptable. Gaskets of neoprene and/or any kind of impregnated/bonded cork or cork only are not acceptable. Gasket flanges shall have grooves or metal stops to prevent over compression of gaskets. All bolted transformer tank or accessory openings shall be gasketed.

EW-2.4.7.4.6 Tank

The transformers shall be housed in a steel tank with all permanent joints molded, backed up by a sturdy steel structure as required to obtain the desired rigidity and strength. The material shall be of high grade steel plate having good welding qualities. All seams, flanges, lifting and jacking lugs, braces and other parts attached to the tank shall be welded. No rivets shall be used. The cover shall be bolted type. The tank shall be able to withstand an internal pressure with oil at operating level.

All openings such as joint between the case and cover, bushings insulation mountings, etc., shall have welded on flanges to provide gaskets surfaces and allow for bolt holes. No bolts shall pass to the inside of the case and cover. Flanges shall have gaskets which will remain oil-tight and will not deteriorate under severe conditions. The tank with radiator fitted shall be tested for leaks before painting.

EW-2.4.7.4.7 Radiators

Radiators, if to be provided, shall be bolted to the main transformer tank and readily detachable. Isolation valves shall be fitted to the tank to permit radiator removal without draining the main tank. Separate filling plugs, air bleed plugs and drain plugs shall be fitted to each radiator section. Radiators shall be galvanized externally prior to etching and painting. Particular attention shall be given to their internal cleaning and painting to ensure that the radiators arrive in a serviceable condition. All radiators shall be

completely sealed with blanking plates and neoprene seals for transport. They shall be thoroughly dried before shipment.

EW-2.4.7.4.3 Hardware

All energized hardware, i.e., bolts, nuts and washers shall be made of tinned copper alloy material such as silicon bronze or equivalent. All other hardware shall be hot-dip galvanized.

EW-2.4.7.5 Fittings and Accessories

The following transformer accessories shall be included:

- a) HV Bushing
- b) Oil Level Indicator
- c) Oil Sampling Plug
- d) Oil Drain Valve
- e) Oil Temperature Indicator
- f) Pressure Relief Valve
- g) Lifting Lugs
- h) Anchor Bolts
- i) Earthing Terminals
- j) HV/LV Insulating Shroud

EW-2.4.7.6 Equipment and Marking

The transformer shall be provided with a stainless steel nameplate in accordance with the latest standard of IEC60076-1, fitted in a visible position showing the information indicated below. The entries on the plate shall be indelibly marked.

- a) Kind of transformer
- b) Number of this standard
- c) Manufacturer's name
- d) Manufacturer's serial number
- e) Year of manufacture
- f) Number of phases
- g) Rated power (in kVA or MVA)
- h) Rated frequency (in Hz)
- i) Rated voltages (in V or kV) and tapping range
- j) Rated currents (in A or kA)
- k) Connection symbol
- l) Short circuit impedance (in %Z)
- m) Type of cooling (i.e. OA, ONAN, etc.)
- n) Insulation voltage (withstand voltages)
- o) Insulating liquid
- p) Temperature rise (in °C)
- q) Total mass, kg
- r) Mass of insulating oil

The minimum recommended dielectric strength of oil filling the transformer shall also be engraved on this plate. The rating plate and any other instructions or designations shall be in the English language.

EW-2.4.7.7 Standard and Common Tools

The Manufacturer of transformer shall provide standard/common tools for use in the installation/maintenance of transformer.

EW-2.4.7.8 Tests

All tests shall be performed as per latest revision of ANSI C57.12.90 Factory Test shall include, but not limited to the following:

EW-2.4.7.8.1 Routine Test

1. Ratio, Polarity and Phase Relation Test
2. No Load Losses and Excitation Current at rated Voltage and Frequency
3. Induced Potential Test (Low-frequency Dielectric Test)
4. Mechanical (Leak Test)

EW-2.4.7.8.2 Design Test

1. Winding Resistance Measurement Test
2. Impedance Voltage and Load Loss Measurement
3. Temperature Rise
4. Lightning Impulse
5. Audible Sound Level
6. Mechanical (Lifting & Moving Devices, Pressure Test)

EW-2.4.7.8.3 Miscellaneous Test

1. Insulation Power Factor
2. Insulation Resistance
3. Short Circuit Capability

EW-2.4.7.8.4 Site Test

The Supplier shall perform all tests specified by the equipment Manufacturer, applicable standards and as necessary to verify the proper operation of the equipment in the presence of NPC representatives.

1. Check level and alignment of the installed transformer;
2. Check tightness of connections and fastenings;
3. Check proper grounding;
4. Check oil level monitors, nameplate, vent plugs;
5. Check wire and cable connections;
6. Check cable glands and entrance; and
7. Check on the proper installation of transformer accessories.
8. Winding resistance
9. Insulation Resistance
10. Transformer Turns Ratio
11. Dielectric Test

EW-2.4.7.9 Failure to Meet Guarantees

Depending on the requirement stated in the Technical Data Sheets, the transformer will be tested for compliance with the Manufacturer’s guaranteed losses. If the transformer losses, as determined by test, at rated voltage, frequency and 100% rated kVA exceed the guaranteed total losses, the excess in losses shall be evaluated at the following rated cost and the resulting amount shall be deducted from the contract price.

$$S = 2 [(N_{L-L}) (N_{LM} - N_{LG}) + (L_L) (L_{LM} - L_{LG})]$$

Where:

- S = Amount to be deducted from the Contract Price
- N_{L-L} = Price in Php/Watt for the no-load losses as stated in the Technical Data Sheets
- N_{LM} = Measured no-load losses expressed in Watt
- N_{LG} = Guaranteed no-load losses as stated on the Technical Data Sheets
- L_L = Price in Php/Watt for the load losses as stated in the Technical Data Sheets
- L_{LM} = Measured load losses expressed in Watt
- L_{LG} = Guaranteed load losses as stated on the Technical Data Sheets

When the excess of the total losses reaches five percent (5%), NPC shall have the right to reject the transformer for which such excess is verified during the factory acceptance test.

Successful Bidder shall promptly provide NPC one (1) original and three (3) certified copies of all test data and reports on the transformer.

EW-2.4.7.10 Data and Documentation Requirements

The following documents shall be submitted after award of contract for NPC’s review and approval prior to procurement and installation of the supplied equipment and materials:

1. Outline drawings of transformer and accessories showing the following:
 - a) General Dimensional Drawing
 - b) Sectional Drawing
 - c) Nameplate Drawing
 - d) Marshaling box with connection diagram
2. Description and instructions covering the installation, operation and maintenance of the transformer and accessories;
3. Duly signed Routine Test Results; and



4. Field Test to be Performed and Certified Test and Inspection Reports duly signed and witnessed by NPC representative

EW-2.5 Warranty

The ESS including but not limited to the Battery Management System, Battery Modules/Batteries, Power Conversion System(s)/Battery Inverter, ESS Control System/ESS controller, and ESS transformer shall have a minimum warranty of five (5) years. This warranty shall be covered by a back-to-back warranty arrangement with the manufacturer. The supplier shall submit its warranty agreement with the manufacturer that stipulates the scope and responsibilities of each party. Both parties (bidder and manufacturer) shall be equally and severally liable for failure of either party to perform warranty obligations.

Batteries shall be tested at least once a year (or as the need arises) to ascertain the usable energy of the ESS within the warranty period. If at any time during the warranty period the ESS fails to deliver the required usable energy, the supplier/manufacturer shall repair or replace the defective components to ensure the required performance standards are met. All costs associated with the warranty shall be to the account of the supplier/manufacturer.

EW-2.6 Track Record

EW-2.6.1 ESS Manufacturer

Manufacturer of the ESS should have current (working) install base of more than 1MW. Bidder shall provide a list of reference project(s) with contact details for verification purposes. (fill-out form in Section VI – Technical Specifications – Part II Technical Data Sheet – Annex C).

EW-2.6.2 Battery Manufacturer

Manufacturer of the batteries should be ISO 9001/14001 certified and have at least five years of experience in production of Li-ion cells as given by EW-2.4.2 (c). Offered battery model must have a current (working) install base of at least 1MWh. Bidder shall provide a list of reference project(s) with contact details for verification purposes. (fill-out form in Section VI – Technical Specifications – Part II Technical Data Sheet – Annex D)

EW-2.7 Measurement of Payment

Measurement of payment for all electrical works shall be based on the bid price of each item as shown in the Schedule of Requirements – Electrical Works, Section VII of the Bid Document. The cost of each item shall cover all works required and described in the pertinent provisions of the specifications.

PART II – TECHNICAL DATA SHEETS**EW – ELECTRICAL WORKS****Drawings and Documents to be Submitted during the Bid****TABLE OF CONTENTS**

SECTION	DESCRIPTION	PAGE
Annex A	Letter of Authorization and Guarantee Statement	VI-TDS (EW)-Bid-2
Annex B	Schematic Diagram	VI-TDS (EW)-Bid-3
Annex C	ESS Manufacturer's Track Record Data Sheet	VI-TDS (EW)-Bid-4
Annex D	Battery Module Manufacturer's Track Record Data Sheet	VI-TDS (EW)-Bid-5
Annex E	PEMS Manufacturer's Track Record Data Sheet	VI-TDS (EW)-Bid-6
F-1.0	Solar PV Plant	VI-TDS (EW)-Bid-7
F-2.0	Solar PV Modules	VI-TDS (EW)-Bid-7
F-3.0	String Inverter	VI-TDS (EW)-Bid-7
F-4.0	Solar PV Plant (SPP) Transformer	VI-TDS (EW)-Bid-8
F-5.0	Energy Storage System (ESS) Transformer	VI-TDS (EW)-Bid-8
F-6.0	Energy Storage System	VI-TDS (EW)-Bid-9
F-7.0	Battery Modules	VI-TDS (EW)-Bid-9
F-8.0	Power and Energy Management System	VI-TDS (EW)-Bid-10
F-9.0	Automatic Circuit Recloser	VI-TDS (EW)-Bid-11

PART II - TECHNICAL DATA SHEETS

EW – Electrical Works

Technical Requirements

1. The Bidder is required to provide all the information required under the column "Supplier's Data". Although not given by NPC, the Supplier's Data shall be based on the International Standard.
2. NPC's requirements are indicated below. The Supplier shall indicate their data corresponding to the said NPC requirements to facilitate evaluation of Supplier's compliance to the specifications.
3. Deviation from the requirements indicated in the technical data sheets and non-submission of the required drawings and documents listed as Annexes A to E and F-1.0 to F-9.0 shall be ground for disqualification.
4. All data and information specified in the requirements shall be in English language.

ANNEX A - LETTER OF AUTHORIZATION AND GUARANTEE STATEMENT

The following *Drawings* and *Documents* shall be submitted by the Supplier in **sequential order** as listed hereunder and shall be attached in the bid documents as **Annexes**. All data and information shall be in English language.

Letter of Authorization and Guarantee Statement for the Following Equipment:

- a. Solar PV (SPV) Module
- b. String Inverter
- c. Energy Storage System (ESS)
- d. Power and Energy Management System (PEMS)

either from the following:

- Original Equipment Manufacturer (OEM); or
- Licensee of the OEM accompanied by a Certification from OEM as a Licensee or the Licensee Agreement; or
- Authorized Distributor (accompanied by a Certificate of Authorized Distributorship from the OEM/Licensee of the OEM. If from the Licensee, a Certification from the OEM as a Licensee or the Licensee Agreement must also be submitted).

Note: *Documents or brochures submitted must be in English language as stated in Section II-ITB Clause 11.0.*

ANNEX B - SCHEMATIC DIAGRAM

The following *Drawings* and *Documents* shall be submitted by the Supplier in **sequential order** as listed hereunder as **Annexes** during the bid process. All data and information shall be in English language and shall be drawn using the metric system as unit of measurement.

Annex B.	Schematic Diagram of the Proposed Solar PV-Diesel Hybrid Power Plant (with ESS) showing all equipment/components to be furnished including interfacing and communication system of the Solar PV with the Existing Power Plant
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Note: *Failure to submit drawings and documents listed hereunder Annex B shall be ground for disqualification.*



ANNEX C - ESS Manufacturer's Track Record Data Sheet

Brand and Model	Capacity Installed (MW)	Date Installed	Client's Name	Location	Client's Contact Details

 Name of Firm Name & Signature of Representative Designation



ANNEX D - Battery Module Manufacturer's Track Record Data Sheet

Brand and Model	Capacity Installed (MWh)	Date Installed	Client's Name	Location	Client's Contact Details

Name of Firm

Name & Signature of Representative

Designation



ANNEX E - PEMS Manufacturer's Track Record Data Sheet

Brand and Model	No. of Units Installed	Date Installed	Client's Name	Location	Client's Contact Details

_____ Name of Firm Name & Signature of Representative Designation



F-1.0 SOLAR PV PLANT

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
F-1.1	Total Capacity of Solar PV Plant at AC Side	At least 300 kW	
F-1.2	Total Number of Inverters connected in parallel	By Supplier	

F-2.0 SOLAR PV MODULES

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
F-2.1	Manufacturer	By Supplier	
F-2.2	Model	By Supplier	
F-2.3	Place of Manufacture	By Supplier	
F-2.4	Cell Type	Monocrystalline Silicon	
F-2.5	Rated Power (Wp) at STC	By Supplier	
F-2.6	Efficiency	At least 21%	

F-3.0 STRING INVERTER

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
F-3.1	Manufacturer	By Supplier	
F-3.2	Model	By Supplier	
F-3.3	Place of Manufacture	By Supplier	
F-3.4	Rating	By Supplier	
F-3.5	Efficiency	≥95%	
F-3.6	Output Voltage (V _{AC})	480 V (nominal voltage adjustable by ±5% via system set points)	
F-3.7	Output Frequency (Hz)	60 Hz, ±0.5%	

Name of Firm

Name & Signature of Representative

Designation



ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
F-3.8	Data Interface	Modbus	
F-3.9	Topology	Transformerless	

F-4.0 SOLAR PV PLANT (SPP) TRANSFORMER

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
F-4.1	Manufacturer / Brand	By Supplier	
F-4.2	Place of Manufacture	By Supplier	
F-4.3	Rated Capacity	400 KVA	
F-4.4	No. of unit/s	1 set	
F-4.5	Number of phase	Three (3)	
F-4.6	Frequency, Hz	60	

F-5.0 ENERGY STORAGE SYSTEM (ESS) TRANSFORMER

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
F-5.1	Manufacturer / Brand	By Supplier	
F-5.2	Place of Manufacture	By Supplier	
F-5.3	Rated Capacity	150 kVA	
F-5.4	No. of unit/s	1 set	
F-5.5	Number of phase	Three (3)	
F-5.6	Rated operating frequency, Hz	60	

Name of Firm

Name & Signature of Representative

Designation



F-6.0 ENERGY STORAGE SYSTEM

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
F-6.1	Manufacturer	By Supplier	
F-6.2	Model	By Supplier	
F-6.3	Place of Manufacture	By Supplier	
F-6.4	Nominal Rating (kW)	120+10% overload	
F-6.5	Usable Energy	≥120 kWh	
F-6.6	Power Swing (kW)	120	
F-6.7	Reverse Power Swing (kW)	120	
F-6.8	Power Swing and Reverse Power Swing Response time (milliseconds)	≤200	
F-6.9	Power Factor	-1 to +1	
F-6.10	Operating Frequency (Hz)	60 Hz	
F-6.11	Technical and Functional Requirements for the Battery Management System, Power Conversion System, ESS Control System and ESS Enclosure/Cabinet as stated in EW-2.4 ESS	Required	
F-6.12	Manufacturer's Track Record	> 5 years	
F-6.13	List of Reference Projects with contact details ¹	Required	

F-7.0 BATTERY MODULES

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
F-7.1	Model	By Supplier	

¹ Use Annex C

Name of Firm

Name & Signature of Representative

Designation



ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
F-7.2	Manufacturer	By Supplier	
F-7.3	Chemistry	NMC, LMO, Blended LMO / NMC, LFP	
F-7.4	Gross weight of one Battery Module	≤60 kg	
F-7.5	Nominal Capacity (Ah)	By Supplier	
F-7.6	Current Operational Install Base	At least 1MWh	
F-7.7	List of Reference Projects with contact details ²	Required	

F-8.0 POWER AND ENERGY MANAGEMENT SYSTEM

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
F-8.1	Technical and Functional Requirements as stated in EW-3.0 PEMS	Required	
F-8.2	List of Reference Projects with contact details ³	Required	
Hybrid Controller			
F-8.3	Manufacturer	By Supplier	
F-8.4	Model	By Supplier	
F-8.5	Place of Manufacture	By Supplier	
Genset Controller			
F-8.6	Manufacturer	By Supplier	
F-8.7	Model	By Supplier	
F-8.8	Place of Manufacture	By Supplier	

² Use Annex D

³ Use Annex E

Name of Firm

Name & Signature of Representative

Designation



ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
Solar/PV Controller⁴			
F-8.9	Manufacturer	By Supplier	
F-8.10	Model	By Supplier	
F-8.11	Place of Manufacture	By Supplier	
ESS Controller/ESS Control System⁵			
F-8.12	Manufacturer	By Supplier	
F-8.13	Model	By Supplier	
F-8.14	Place of Manufacture	By Supplier	

F-9.0 AUTOMATIC CIRCUIT RECLOSER

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
F-9.1	Manufacturer	By Supplier	
F-9.2	Place of Manufacture	By Supplier	
F-9.3	Brand/Model	By Supplier	
F-9.4	Type	Solid Dielectric Vacuum Interrupter	
F-9.5	Phase	Three	
F-9.6	Rated Frequency	60 Hz	
F-9.7	Nominal Rated Voltage	13.8 kV	

⁴ If the Solar/PV controller and the ESS Control System/ESS controller is built-in the String Inverter(s) and ESS respectively, the supplier shall indicate the brand and model of the said controllers.

⁵ If the Solar/PV controller and the ESS Control System/ESS controller is built-in the String Inverter(s) and ESS respectively, the supplier shall indicate the brand and model of the said controllers.

Name of Firm

Name & Signature of Representative

Designation



PART II – TECHNICAL DATA SHEETS**EW – ELECTRICAL WORKS****Documents to be Submitted during Post-Qualification****TABLE OF CONTENTS**

SECTION	DESCRIPTION	PAGE
G-1.0	Solar PV Plant	VI-TDS (EW)-PQ-1
G-2.0	Solar PV Modules	VI-TDS (EW)-PQ-1
G-3.0	String Inverter	VI-TDS (EW)-PQ-2
G-4.0	Solar PV Plant (SPP) Transformer	VI-TDS (EW)-PQ-3
G-5.0	DC Box	VI-TDS (EW)-PQ-5
G-6.0	AC Combiner Box	VI-TDS (EW)-PQ-5
G-7.0	Energy Storage System	VI-TDS (EW)-PQ-5
G-8.0	Battery Modules	VI-TDS (EW)-PQ-6
G-9.0	Energy Storage System (ESS) Transformer	VI-TDS (EW)-PQ-7
G-10.0	Power and Energy Management System	VI-TDS (EW)-PQ-9
G-11.0	Power Cables	VI-TDS (EW)-PQ-9
G-12.0	Fuse Disconnect Switch with Lightning Arrester Combination	VI-TDS (EW)-PQ-10
G-13.0	13.8kV Three-Phase Kilowatt-Hour Meter	VI-TDS (EW)-PQ-10
G-14.0	Automatic Circuit Recloser	VI-TDS (EW)-PQ-11
G-15.0	13.8kV Tie Line Primary Conductor	VI-TDS (EW)-PQ-16
G-16.0	Steel Pole	VI-TDS (EW)-PQ-17
G-17.0	Bus Conductor and Hardware	VI-TDS (EW)-PQ-17
G-18.0	Job Site Cameras	VI-TDS (EW)-PQ-18
G-19.0	Spare Parts for Solar PV System and Auxiliaries	VI-TDS (EW)-PQ-19

SECTION VI – TECHNICAL SPECIFICATION

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G-20.0	Standard/Special Tools for Solar PV System	VI-TDS (EW)-PQ-19
G-21.0	List of Other Documents To Be Submitted in Addition To The Technical Data Sheets	VI-TDS (EW)-PQ-20



PART II - TECHNICAL DATA SHEETS

EW – Electrical Works

Technical Requirements

1. The Bidder shall complete and submit this document during the post-qualification which shall serve as reference for the review and approval of brochure/drawings during implementation stage. The Bidder shall use additional sheets as necessary for any other additional information following the format shown herein or by reproducing the same.
2. The Bidder is required to provide all the information required under the Column "Supplier's Data". Although not given by NPC, the Supplier's Data shall be based on the International Standard.
3. NPC's requirements are indicated below. The Supplier shall indicate their data corresponding to the said NPC requirements to facilitate evaluation of Supplier's compliance to the specifications. The data required are technical features and characteristics of the Equipment to be provided by the bidder which shall at least be equal or superior to NPC's requirements.
4. The bidder shall provide copies of the manufacture's and equipment certifications as listed in this document
5. Non submission of the required documents shall be a ground for disqualification.

G-1.0 SOLAR PV PLANT

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-1.1	Total Number of Modules	By Supplier	
G-1.2	No. of Modules in Series (Array)	By Supplier	
G-1.3	Number of Parallel Combination	By Supplier	
G-1.4	Number of Inverters	By Supplier	

G-2.0 SOLAR PV MODULES

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-2.1	Manufacturer	By Supplier	
G-2.2	Model	By Supplier	
G-2.3	Cell Type	Monocrystalline Silicon	
G-2.4	Rated Power (Wp) at STC	By Supplier	
G-2.5	Module Efficiency	At least 21%	
G-2.6	Solar PV Module Service Life	By Supplier	
G-2.7	Rated Voltage (V) at STC	By Supplier	
G-2.8	Rated Current (A) at STC	By Supplier	
G-2.9	Open Circuit Voltage (V _{oc}) at STC	By Supplier	
G-2.10	Short Circuit Current (I _{sc}) at STC	By Supplier	
G-2.11	Power Tolerance	± 3%	
G-2.12	Dimension (L x W)	By Supplier	
G-2.13	Weight (kg)	By Supplier	
G-2.14	Junction Box IP Rating	IP65	

Name of Firm

Name & Signature of Representative

Designation



G-3.0 STRING INVERTER

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-3.1	Manufacturer	By Supplier	
G-3.2	Model	By Supplier	
G-3.3	Inverter Power Rating (kW)	By Supplier	
G-3.4	Efficiency at Rated Power	≥95%	
G-3.5	Input DC Power (kW _P)	By Supplier	
G-3.6	No. of MPPT	At least One (1)	
G-3.7	Input Voltage Range per MPPT (V)	By Supplier	
G-3.8	Maximum Open Circuit Voltage per MPPT (V)	By Supplier	
G-3.9	Maximum Input Current per MPPT (A)	By Supplier	
G-3.10	Maximum Short Circuit Current per MPPT (A)	By Supplier	
G-3.11	Nominal Output Voltage (V)	480 V (adjustable by ±5% via system set points)	
G-3.12	Maximum Output Current (A)	By Supplier	
G-3.13	Number of Phase	Three (3)	
G-3.14	Nominal Output Frequency (Hz)	60 Hz, ±0.5%	
G-3.15	Power Factor at Rated Power Rating	By Supplier	
G-3.16	Total Harmonic Distortion	5%	
G-3.17	Operating Temperature Range (°C)	By Supplier	
G-3.18	Data Interface	Modbus	
G-3.19	Topology	Transformerless	
G-3.20	Ingress Protection Rating	IP65	
G-3.21	Over current Protection	Required	
G-3.22	Overvoltage Protection	Required	
G-3.23	Anti-Islanding Protection	Required	

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ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-3.24	DC Reverse Polarity Protection	Required	
G-3.25	Ground Fault Monitoring	Required	
G-3.26	Grid Monitoring	Required	
G-3.27	PV Array Fault Monitoring	Required	
G-3.28	Residual Current Monitoring	Required	

G-4.0 SOLAR PV PLANT (SPP) TRANSFORMER

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-4.1	Manufacturer/Brand	By Supplier	
G-4.2	Model	By Supplier	
G-4.3	Rated Capacity (kVA)	400	
G-4.4	Number of Phase	Three (3)	
G-4.5	Type of Cooling	ONAN	
G-4.6	Insulation	Mineral Oil with its electrical and chemical characteristics is compliant with IEC and is Polychlorinated Biphenyls (PCB) free	
G-4.7	Type	Two-winding Transformer	
G-4.8	Audible Sound Level	Refer to Table specified under EW-1.10.3.8	
G-4.9	Vector Group	YNd11	
G-4.10	Temperature		
	<ul style="list-style-type: none"> Ambient Temperature (°C) 	40	
	<ul style="list-style-type: none"> Temperature Rise (C°) 	65	
G-4.11	Winding Connection		
	<ul style="list-style-type: none"> H-Winding 	Wye with Neutral Grounded	
	<ul style="list-style-type: none"> X-Winding 	Delta	

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ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-4.12	Insulation Level		
	a. Nominal Voltage Level (kV)		
	• H-Winding	13.8	
	• X-Winding	0.48	
	b. Highest Voltage Level (kV)		
	• H-Winding	15	
	• X-Winding	1.2	
	c. Basic Insulation Level (kV)		
	• H-Winding	95	
	• X-Winding	30	
G-4.13	Winding Material	100% Copper	
G-4.14	Bushing Material	Porcelain	
G-4.15	No. of Bushing	Three (3)	
G-4.16	Impedance at Rated Capacity (%)	Manufacturer's Data	
G-4.17	Efficiency	By Supplier	
G-4.18	Tap Changer	No-Load	
G-4.19	Taps		
	• H-Winding	13.8 kV ± 2 x 2.5%	
	• X-Winding	N/A	
G-4.20	Transformer Losses	By Supplier	
G-4.21	Tolerances		
	• No-Load & Load Loss	Not more than 10% of the manufacturer's specified value	
	• Total Loss	Not more than 6% of the manufacturer's specified value	
	• Impedance	± 10% of the manufacturer's specified value	
G-4.22	Ground Terminal Connection	Suitable for 100 mm ² copper conductor	

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ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-4.23	Weight of Oil (kg)	By Supplier	
G-4.24	Total Weight (kg)	By Supplier	

G-5.0 DC BOX

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-5.1	DC Circuit Breakers		
	Continuous Current Rating	By Supplier	

G-6.0 AC COMBINER BOX

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-6.1	Circuit Breakers		
	Continuous Current Rating	By Supplier	

G-7.0 ENERGY STORAGE SYSTEM

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-7.1	Manufacturer	By Supplier	
G-7.2	Model	By Supplier	
G-7.3	Nominal Power Rating (kW)	At least 120	
G-7.4	Usable Energy (kWh)	At least 120	
G-7.5	Frequency (Hz)	60	
G-7.6	Battery Management System	By Supplier	
	Charge / Discharge		
	1. Nominal Charge / Discharge Current (A)	By Supplier	

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ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
	2. Maximum Charging Current (A)	By Supplier	
	3. Maximum Discharge Current (A)	By Supplier	
G-7.7	Number of Battery Modules	By Supplier	
G-7.8	ESS Enclosure/Cabinet		
	Gross Weight, Installed with batteries (kg)	≤60kg	
	Dimension, Length x Width x Height (m)	By Supplier	

G-8.0 BATTERY MODULES

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-8.1	Manufacturer	By Supplier	
G-8.2	Model	By Supplier	
G-8.3	Chemistry	NMC, LMO, Blended LMO / NMC, LFP	
G-8.4	Nominal Capacity	By Supplier	
G-8.5	No. of Cells per Module	By Supplier	
G-8.6	Electrical Characteristics		
	• Nominal Terminal Voltage (V _{DC})	By Supplier	
	• Minimum Operating Voltage (V _{DC})	By Supplier	
	• Maximum Operating Voltage (V _{DC})	By Supplier	
	• Maximum Normal State of Charge (MaxNSoC) ¹ (%)	By Supplier	

¹ As defined under Section VI – Technical Specifications Clause EW-2.1

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ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
	<ul style="list-style-type: none"> Minimum Normal State of Charge (MinNSoC) (%) 	By Supplier	
	<ul style="list-style-type: none"> Nominal C-rate @ 25°C 	1 or higher	
	<ul style="list-style-type: none"> Self-discharge Rate per Month (% of its capacity) 	≤10%	
	<ul style="list-style-type: none"> Cycle Lifetime 	At least 5000	
G-8.7	Physical Characteristics		
	<ul style="list-style-type: none"> Dimension, Length x Width x Height (m) 	By Supplier	
	<ul style="list-style-type: none"> Maximum Gross Weight (Kg) 	60	
G-8.8	Overcharge Protection	Required	
G-8.9	Short Circuit Protection	Required	
G-8.10	Thermal Runaway Protection	Required	

G-9.0 ENERGY STORAGE SYSTEM (ESS) TRANSFORMER

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-9.1	Manufacturer/Brand	By Supplier	
G-9.2	Model	By Supplier	
G-9.3	Rated Capacity (kVA)	150	
G-9.4	Number of Phase	Three (3)	
G-9.5	Type of Cooling	ONAN	
G-9.6	Insulation	Mineral Oil with its electrical and chemical characteristics is compliant with IEC and is Polychlorinated Biphenyls (PCB) free	
G-9.7	Type	Two-winding Transformer	
G-9.8	Audible Sound Level	Refer to Table specified under EW-2.4.7.3.8	

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ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-9.9	Vector Group	YNd11	
G-9.10	Temperature		
	• Ambient Temperature (°C)	40	
	• Temperature Rise (C°)	65	
G-9.11	Winding Connection		
	• H-Winding	Wye with Neutral Grounded	
	• X-Winding	Delta	
G-9.12	Insulation Level		
	d. Nominal Voltage Level (kV)		
	• H-Winding	13.8	
	• X-Winding	By Supplier	
	e. Highest Voltage Level (kV)		
	• H-Winding	15	
	• X-Winding	By Supplier	
	f. Basic Insulation Level (kV)		
	• H-Winding	95	
	• X-Winding	By Supplier	
G-9.13	Winding Material	100% Copper	
G-9.14	Bushing Material	Porcelain	
G-9.15	No. of Bushing	Three (3)	
G-9.16	Impedance at Rated Capacity (%)	Manufacturer's Data	
G-9.17	Efficiency	By Supplier	
G-9.18	Tap Changer	No-Load	
G-9.19	Taps		
	• H-Winding	13.8 kV ± 2 x 2.5%	
	• X-Winding	N/A	
G-9.20	Transformer Losses	By Supplier	

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ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-9.21	Tolerances		
	<ul style="list-style-type: none"> No-Load & Load Loss 	Not more than 10% of the manufacturer's specified value	
	<ul style="list-style-type: none"> Total Loss 	Not more than 6% of the manufacturer's specified value	
	<ul style="list-style-type: none"> Impedance 	+ 10% of the manufacturer's specified value	
G-9.22	Ground Terminal Connection	Suitable for 100 mm ² copper conductor	
G-9.23	Weight of Oil (kg)	By Supplier	
G-9.24	Total Weight (kg)	By Supplier	

G-10.0 POWER AND ENERGY MANAGEMENT SYSTEM

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-10.1	Manufacturer	By Supplier	
G-10.2	Model	By Supplier	
G-10.3	Communication	By Supplier	

G-11.0 POWER CABLES²

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
15 kV Power Cable			
G-11.1	Manufacturer	By Supplier	
G-11.2	Brand	By Supplier	
G-11.3	Max. continuous current carrying capacity of conductor at 90°C	Manufacturer's Data	
G-11.4	Conductor Cross-Section, mm ²	Refer to Single Line Diagram	

²Refer to EW-1.8 and EW-6.4 specifications

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ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-11.5	Conductor Material	Annealed Copper	
G-11.6	Insulation Material	Cross-linked polyethylene (XLPE)	
1.5kV DC Power Cable			
G-11.7	Manufacturer	By Supplier	
G-11.8	Brand	By Supplier	
G-11.9	Conductor Size	By Supplier	
G-11.10	Conductor Metal	Tin Annealed Copper Stranded Wire	
G-11.11	Type of Insulation	Refer to EW-1.8(b)	

G-12.0 FUSE DISCONNECT SWITCH WITH LIGHTNING ARRESTER COMBINATION³

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-12.1	Manufacturer	By Supplier	

G-13.0 13.8KV THREE-PHASE KILOWATT-HOUR METER⁴

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-13.1	Manufacturer	By Supplier	
G-13.2	Brand and Model	By Supplier	

³Refer to EW-6.0 specifications

⁴Refer to EW-6.0 specifications

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G-14.0 AUTOMATIC CIRCUIT RECLOSER⁵

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-14.1	Manufacturer	By Supplier	
G-14.2	Place of Manufacture	By Supplier	
G-14.3	No. of Units	1	
G-14.4	Brand/Model	By Supplier	
G-14.5	Type	Solid Dielectric Vacuum Interrupter	
G-14.6	Phase	Three	
G-14.7	Rated Frequency	60 Hz	
G-14.8	Nominal Rated Voltage	13.8 kV	
G-14.9	Maximum Rated Voltage	By Supplier	
G-14.10	Rated Normal Current (Min.)	800 A	
G-14.11	Rated Symmetrical Interrupting Current at rated Voltage	≥2 kA	
G-14.12	Rated Short Time Current for 3 secs.	≥2 kA	
G-14.13	Rated Making Current (RMS)	>12 kA	
G-14.14	Rated 1 min. power frequency withstand between phase and earth (min.)	50 kV	
G-14.15	Interrupting Medium	Vacuum	
G-14.16	Insulation Medium	Cycloaliphatic epoxy or equivalent	
G-14.17	Rated Operating Sequence (total number of trips/counts to lock out)	4	
G-14.18	Current Sensing	By Supplier	

⁵ Refer to EW-6.0 specifications

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ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-14.19	Voltage Sensing	By Supplier	
G-14.20	Mechanical Life – minimum number of close/open operations – without inspection	30000	
G-14.21	HV Bushing Creepage Distance	≥65 mm	
G-14.22	Min. length of umbilical (multi-core) cable to be provided	At least 20 m	
G-14.23	AC Supply	230 Volts single-phase	
G-14.24	DC Supply		
	a. Voltage	By Supplier	
	b. Make of Batteries	By Supplier	
	c. Type	Re-chargeable sealed lead-acid battery	
	d. Capacity	By Supplier	
	e. Battery Operating Time after Loss of AC supply	At least 72 hours	
	f. No. of reclose sequences possible within 72 hours after the loss of ac supply	By Supplier	
G-14.25	Spare Battery	Re-chargeable sealed lead-acid battery	
	Capacity : 26Ah Voltage : 12Vdc Dimensions (LxWxH): same as original	To be provided	
G-14.26	Manual "Open-Close" Functionality with Operator Hook Stick	To be provided	
G-14.27	Controller		
	a. Type	Electronic type equipped with advance protection, metering, control and communication in an individual module arranged within the compartment	

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ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-14.28	Protection Features		
	a. Directional Overcurrent and Earth Fault Protection	Yes	
	b. Instantaneous/Time Overcurrent	Yes	
	c. Sensitive Earth Fault (Current Setting Range 1 – 80 Ampere)	Yes	
	d. Under and Over Voltage	Yes	
	e. Under and Over Frequency (pick-up setting range of 45 – 65 Hz)	Yes	
	f. Cold Load Pick-up Element	Yes	
	g. Inrush Restraint Element	Yes	
	h. Auto Reclosing Element	Yes	
	i. Harmonics Protection Element (up to 15 th Harmonics)	Yes	
	j. Negative Phase Sequence Element	Yes	
	k. Auto Change Over Protection Scheme	Yes	
	l. Four (4) Independent Protection Groups - Each Group must contain independent protection settings for each direction	Yes	
G-14.29	Remote control communication of existing Recloser Controller with integrated free software application and can be installed in a desktop, laptop and cellular phone devices. Effective WIFI signal range minimum of 100ft line of sight	Yes	
G-14.30	Monitoring/Metering Functions	Yes	
G-14.31	Data Records		

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ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
	a. Sequence of Event (Up to 5000 events can be stored)	Yes	
	b. Fault and Disturbance Records	Yes	
	c. Load Profile	Yes	
G-14.32	Communication Interface	RS 232/RS 485	
G-14.33	Rated Duty Cycle	O-0.1s CO-1s-CO-1s-CO	
G-14.34	Controller Cubicle Degree of protection	At least IP 65	
G-14.35	Fault Indicator for overhead lines to be integrated with the control cubicle	To be provided	
G-14.36	Buzzer Alarm Trip, Open/Close Alarm Indications	To be provided	
G-14.37	Bird Guard for insulation protection between the load side and line side, Units	6	
G-14.38	Total Weight, kg	By Supplier	
G-14.39	Programming (Configuration) and Maintenance Human-Machine Interface equipped w/ Operating and Configuration Editor Software Program to be provided	Yes	
	a. Type	Laptop Computer	
	1. No. of Units to be supplied	1	
	b. Hardware		
	1. Processor	I7/equivalent or higher	
	2. Clock Frequency, GHz	2.0 (min.)	
	3. RAM Capacity, GB	16	
	4. SSD Drive, GB	512	

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ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
	5. Hard Disk Capacity, TB	1	
	6. Video	Dedicated 4 GB min.	
	7. Optical Drive	Built-in/USB DVD ±RW	
	8. Display	15" LCD Color Monitor	
	9. Audio System	Built-in Stereo Speakers	
	c. Software		
	1. Operating System	Licensed Windows 10Pro, pre-installed with back-up CDROM bundled with latest version of MS Office and reference manuals	
	2. Communication Stack	OSI-TCP / IP	
	3. Configuration Tools	Provided with back-up copy	
	4. Testing, Maintenance and Diagnostic Software	Provided with back-up copy	
	d. Peripheral Connectivity		
	1. Communication Interface (I/O)	USB to Serial Port (RS 232/RS 485) Converter, 2 USB Port, VGA/HDMI/Display/Bizlink Ports, Headphone & Microphone ports and DC jack for power adapter	
	e. Keyboard	84/85 key with embedded numeric key pad	
	f. Mouse	Built-in touch pad pointing device	
	g. Power Adaptor	100 - 240V full range 50 – 60Hz	
	h. Battery	Li-ion battery pack 4-5hrs rundown battery life with APM	
G-14.40	Operating and Configuration Editor Software Program		

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ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
	a. All system software and configuration editor software program including licenses and instruction manuals	To be provided	
G-14.41	Training		
	Manufacturer-supervised Hands-on Technical Training including configuration, setting and parameterization for minimum of three (3) Plant personnel	Yes	
G-14.42	Test Requirement		
	1. Design and Routine Tests Reports required	Yes	
G-14.43	Equipment and Manufacturer's Experience		
	1. The Manufacturer should have been in the business of manufacturing the equipment for not less than: years	10	
	2. The same type of equipment being offered should have been in the actual service for not less than: years	5	
G-14.44	Warranty	One (1) year minimum	

G-15.0 13.8KV TIE LINE PRIMARY CONDUCTOR⁶

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-15.1	Manufacturer	By Supplier	
G-15.2	Type	1/0 AWG ACSR	
G-15.3	Ampacity	230 A	

⁶Refer to EW-6.0 and EW-7.0 specifications

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G-16.0 STEEL POLE⁷

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-15.1	Manufacturer	By Supplier	
G-15.2	Place of Manufacture	By Supplier	
G-15.3	Structural grade of steel used	ASTM A572 grade 345MPa (50ksi) (minimum)	
G-15.4	Pole Shape	Octagonal	

G-17.0 BUS CONDUCTOR AND HARDWARES⁸

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
Stranded Conductor Requirements			
G-17.1	Manufacturer	By Supplier	
G-17.2	Type designation	Aluminum Conductor Steel Reinforced (ACSR)	
G-17.3	Conductor size	1/0	
G-17.4	Ampacity, A	230	
Conductor Hardware			
G-17.5	Tension Clamp		
	a. Type	Bolted, U-Bolt	
	b. Material of Body	Aluminum Alloy	
G-17.6	Connectors		
	a. Type	wedge pressure clamp for stranded conductor connection	

⁷Refer to EW-7.0 specifications

⁸Refer to EW-6.0 specifications

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ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
	b. Angle and T-connectors type	wedge pressure clamp for stranded conductor connection	

G-18.0 JOB SITE CAMERAS⁹

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-18.1	Manufacturer	By Supplier	
G-18.2	Type	Time-Lapse Camera	
G-18.3	Quantity	At least 2 sets	
G-18.4	Control Display	Thin-Film-Transistor (TFT) Liquid Crystal Display (LCD)	
G-18.5	Image Sensor Resolution	At least 1.3 Megapixel CMOS	
G-18.6	View Angle	At least 110 degrees viewing angle	
G-18.7	Still Image Resolution	1280 x 720	
G-18.8	Time Lapse Interval	15 minutes/ User-programmable	
G-18.9	Battery Type	Standard AA or AAA Size Alkaline Batteries	
G-18.10	Battery Life	At least 120 days of image recording	
G-18.11	Additional Battery (Spare)	To Be Provided	
G-18.12	Enclosure	IPX4 compliant	
G-18.13	Storage Memory	SDHC	
G-18.14	Storage Capacity	32GB	
G-18.15	Additional Storage per camera (Spare)	At least One (1)	

⁹Refer to EW-1.11

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G-19.0 SPARE PARTS FOR SOLAR PV SYSTEM, ENERGY STORAGE SYSTEM(ESS), POWER AND ENERGY MANAGEMENT SYSTEM(PEMS) AUXILIARIES¹⁰ (Minimum Requirements as Specified in the Technical Specifications and Manufacturer’s Standard and Recommended Spare Parts)

ITEM	DESCRIPTION	QTY.	SHELF LIFE	INTERVAL OF REPLACEMENT
G-19.1	Memory Cards/ Data Storage	2 units		
G-19.2	Spare Wind Anemometers	3 pcs		
G-19.3	Spare Solar Pyranometer	1 pc		
G-19.4	Spare Thermocouple for solar module temperature	1 set		
G-19.5	Spare Thermocouple for ambient air	1 pc		
G-19.6	Battery Modules ¹²	1 pc		
G-19.7	Other spare parts recommended by the Equipment (SPP, ESS, PEMS and Automatic Circuit Recloser) Manufacturer (Specify)	1 lot		
	1.			
	2.			

G-20.0 STANDARD / SPECIAL TOOLS FOR SOLAR PV SYSTEM¹³

ITEM	DESCRIPTION	QTY.
G-20.1	Tool Box	1 unit
G-20.2	Insulation Resistance Tester (with rated voltage at 250V / 500V / 1000V)	1 set

¹⁰ Refer to GW-7.0

¹²Not to be supplied

Notes: Minimum requirements but the Supplier may increase the specified quantity if found not sufficient during Warranty Period.

¹³Refer to GW-8.0

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G-20.3	Load Resistor (0-1000 ohms)	1 set
G-20.4	Voltmeter (with a minimum rated voltage of 600VAC and 1kVDC)	1 set
G-20.5	Clamp Meter (with minimum rated current of 1000A)	1 set
G-20.6	PVC hose, flexible and robust, 20mm diameter, at least 30m length with drum and reel assembly	1 unit
G-20.7	Extendable/telescopic panel cleaning pole with squeegee and sponge, at least 12ft length with hose attachment (20mm diameter hose)	1 unit

G-21.0 LIST OF OTHER DOCUMENTS TO BE SUBMITTED IN ADDITION TO THE TECHNICAL DATA SHEETS

Manufacturer’s Certification Requirements

1. **ISO 9001 Certificate of the Manufacturer** for the following equipment:
 - a. Solar PV (SPV) Modules
 - b. String Inverters
 - c. Energy Storage System
 - d. Battery Modules/Batteries

2. **ISO 14001 Certificate of the Manufacturer or equivalent** for the following equipment:
 - a. Solar PV (SPV) Modules
 - b. Battery Modules/ Batteries

Equipment Certification Requirements

1. Test Certificates/Certificates of Conformance of the **SPV modules** to be supplied that comply with the following standards:
 - a. **IEC 61215** – Crystalline Silicon Terrestrial Photovoltaic (PV) Modules- Design Qualification and Type Approval
 - b. **IEC 61730-1** – Photovoltaic (PV) module safety qualification – Part 1: Requirements for construction
 - c. **IEC 61730- 2** – Photovoltaic (PV) module safety qualification- Part 2: Requirements for testing
 - d. **IEC 61701** – Salt mist corrosion testing of photovoltaic (PV) modules

2. Test Certificates/ Certificates of Conformance of the **String Inverters** to be supplied that comply with the following standards:
 - a. **IEC 62109-1** – Safety of power converters for use in photovoltaic power systems- Part 1: General requirements
 - b. **IEC 62109-2** – Safety of power converters for use in photovoltaic power systems- Part 2: Particular requirements for inverters
 - c. **IEC 62116** – Utility-interconnected photovoltaic inverters – Test procedure of islanding prevention measures

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3. Test Certificates/ Certificates of Conformance of the **Battery Modules** to be supplied that comply with the following standards:

- a. **IEC 62619** – Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications; or
- b. **UL 1642** – UL Standard for Safety of Lithium Batteries

Other Requirement

- 1. Latest Copy of **Bloomberg New Energy Finance List of Tier 1 Manufactures** reckoned from the bid opening date.
- 2. **Certificate of Site Inspection** duly signed by the Batan DPP Plant-in-Charge and/or its duly authorized NPC personnel.

Name of Firm

Name & Signature of Representative

Designation

