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Item No.	Unit	Item Description	Qty	Unit Cost	Amount
	lumpsum	<p>* Supply, delivery, installation, testing and commissioning of 18.15kWp Solar Panels and 1x 15 kVA Grid Tie Inverter Rooftop Solar Photovoltaic System for Balanga Water District</p> <p>*See the attached documents for other details and specifications.</p>	1		

TOTAL AMOUNT IN WORDS:	
<p>Quoted by:</p> <p style="text-align: center;">_____</p> <p style="text-align: center;">Supplier</p> <p>Terms & Conditions:</p> <ol style="list-style-type: none"> 1. As a government agency, BLWD shall deal only with a legitimate supplier / contractor which issue BIR-registered official receipt; 2. All quoted prices must be inclusive of 5% tax for materials & supplies; 6% for labor and 1% expanded withholding tax 	<p>Requested by:</p> <p style="text-align: center;"></p> <p style="text-align: center;"><u>LORETO Q. PALAD</u> BAC CHAIRMAN</p> <p>Noted by:</p> <p style="text-align: center;"></p> <p style="text-align: center;"><u>Engr. Charlito G. Rodriguez</u> General Manager</p>

A. System Design

System size (kWp)	18.15
No. of PV Modules based on Max kWp	33
Required roof area on (m ²)	72.93
Total weight of the solar panels in the rooftop (kgs)	821.70
Inverter quantity	1
Aggregate capacity (kVA)	15.00

B. General Requirements

The scope of works includes and not limited to the requirements.

- Complete electrical engineering and design with electrical plans and system performance.
- Aluminum made mounting system for modules will be mounted on flat roof section.
- All DC cabling, protection devices and mounting hardware between the PV module and all AC cabling, protection devices and accessories between the inverters and main grounding lugs and clips are to be use to ground the panel to attain a possible lowest resistance. Grounding the panels prevents overvoltage caused by lightning surge.
- Technical documentations required for the application of building permits and net metering.
- System and specifications of materials to be designed by a licensed Professional Electrical Engineer in accordance with;
 - CEC (Clean Energy Council) Standard of Australia
 - Australian Standards of PV Installations (AS)
 - PEC (Philippine Electrical Code)
 - PDC (Philippine Distribution Code)
 - Local Distribution Utility Interconnection Requirements
 - Manufacturer's Standard and other local and international standards that is acceptable
- Online monitoring portal for online monitoring of system performance and energy yield (via internet web portal)
- All equipment and installation costs

C. Project inclusions

- 18.15kWp Solar panels + 1x 15kVA Grid Tie Inverter roof top Solar Photovoltaic
- Comprehensive electrical engineering design, inspection, technical consultation, and shop drawings
- Supply of materials, delivery, and installation of the solar PV system
- Testing, commissioning, and energization
- Training for the operation and maintenance of the system
- Technical documents for building official electrical permit, barangay construction clearance, fire safety permit and net-metering applications
- Maintenance and inspection twice a year and remote online monitoring for fault notifications and system performance – FREE for the first year. Succeeding years maintenance will be based on the service warranty agreement issued after the installation
- **Utility net-metering applications and manual transfer switch for pump electricity meter are included**

D. Technical Specifications

1. Solar Photo Voltaic (SPV) Array

Solar module shall be minimum of **33 pcs. Tier 1 Mono Crystalline Type**, rated at minimum **550 Watts per Solar PV module**, suitable for grid connectivity. The cells shall lay embedded in transparent EVA behind tempered glass. The glass is inset deep in an aluminum frame, there by offering maximum protection. The back of the module is sealed with a high-quality back sheet. The wiring shall be terminated in a box at the backside of panel and shall have no cavities and completely watertight and is resistant to temperature and UV radiation. The efficiency of PV panels at standard irradiance shall be minimum of 85%. The mechanical structure shall withstand gusts of wind up to 150km/hr. from back side of the panel. The offered modules must conform to the latest edition of any of the following IEC/ equivalent BIS Standards of PV module design qualification and type approval:

Crystalline Silicon Terrestrial PV Modules: IEC 61215 / IEC 61730

Module junction box (weatherproof), where the module terminals shall be interconnected and output taken, shall be designed for long life outdoor operation in harsh environment as per the relevant BIS specifications and protected against surges. It should be a provision for replacing the cable, if required.

Protective devices against surges at the PV module shall be provided. Low voltage drop bypass diodes shall be provided. PV modules used in solar power plants must be warranted for output wattage, which should not be less than 90% at the end of 10 years and 80% at the end of 2 years.

2. Mounting Structures

The PV modules will be mounted on fixed metallic structures of adequate strength and appropriate design, which can withstand load of modules and high wind velocities up to 150 km per hour. The support structure used in the power plants will be hot dip galvanized iron (G.I) for anodized aluminum.

The **“Mounting Structure”** should have the following features:

The modules support structure shall be hot dipped galvanized (at least 120 micron) iron for holding the PV modules. The supplier/contractor shall specify installation details of the PV modules and the support structures with appropriate diagrams and drawings. The work shall be carried out as per the designs approved by owner.

The structure should be designed to allow easy replacement of any module. The array structure shall be so designed that it will occupy minimum space without sacrificing the output from the SPV panels. The minimum clearance required from the parapet wall of the roof and in between row of panels is minimum of 2 feet for cleaning the panels and servicing. The bidder shall specify installation details of the PV modules and the support structures with appropriate diagrams and drawings. The work shall be carried out as per the designs approved by the procuring entity.

3. Junction Boxes

The junction boxes shall be dust proof, vermin and waterproof and made of FRP / Thermo Plastic. The terminals shall be connected to copper bus bar arrangement of proper sizes. The junction boxes shall have suitable cable entry points fitted with cable glands of appropriate sizes for both incoming and outgoing cables. Suitable markings shall be provided on the bus bar easy identification and cable

ferrules shall be fitted at the cable termination points for identification. Each main junction box shall be fitted with appropriate rating blocking diode.

4. Power Conditioning Unit (PCU) / Solar Inverter

As SPV array produce direct current electricity, it is necessary to convert this current into alternating current and adjust the voltage levels to match the grid voltage. Conversion shall be achieved using an electronic inverter and the associated control and protection devices. All these components of the system are termed the "Power Conditioning Unit (PCU)". In addition, the PCU shall also house MPPT (Maximum Power Point Tracker), an interface between Solar PV array and the inverter, to maximize Solar PV array energy input into the system. PCU including MPPT and protection must conform to IEC 61683/IS 61683, IEC 60068-2 (1,2,14,30) / Equivalent BIS Std.

The contractor shall be a duly qualified and accredited by the PCU/Inverter manufacturer to install, maintain, monitor and provide technical support for the PCU/Inverter.

5. DC and AC Switches

a. DC Side

MCB of suitable rating shall be provided for connection and disconnection of array and PCU for maintenance purpose. Switches and circuit breakers on DC side shall be DC rated or they shall be sufficiently de-rated, if AC rated switches are used.

b. AC Side

MCB of suitable rating shall be provided for connection and disconnection of PCU and load.

6. Cables and accessories

All the cables shall be supplied conforming to IEC 60227/IS 694 & IEC60502/IS 1554 shall be 1.1 kV grade as per requirement. Only PVC copper cables shall be used. The size of the cables between array and interconnections, array to junction boxes, junction box to PCU, PCU to AC distribution box etc. shall be so selected to keep the voltage drop and losses to the minimum.

Permissible Wire Drop on DC side shall be $\leq 1\%$. The bidder shall supply installation accessories, which are required to install and successfully commission the power plant.

7. Earthing and Lightning Protection

Earthing: The array structure of the PV yard shall be grounded properly using adequate number of earthing kits. All metal casing or shielding of the power plants shall be thoroughly grounded to ensure safety of the solar power plants.

Lightning: The SPV power plants shall be provided with the lightning and over voltage protection. The main aim in this protection shall to reduce the over voltage to a tolerable value before it reaches the PV or other sub system components. The source of over voltage can be lightning, atmosphere disturbances, etc.

E. Technical data of Power Conditioning Unit (PCU) / Solar Inverter (1 unit)

1. General Data

Width:	511 mm
Height:	724 mm
Depth:	226 mm
Dimension (width):	511 mm
Dimension (height):	724 mm
Dimension (depth):	226 mm
Weight:	35.52 kg
Protection class:	NEMA 4X
Night time consumption:	< 1 W
Inverter topology:	Transformerless
Cooling:	Variable speed fan
Elevation:	2000 m (6560 ft) with a max. input voltage of 1000 V / 3400 m (11160 ft) with a max. input voltage of 850 V
Certificates and compliance with standards:	UL 1741-2010, UL1998 (for functions: AFCI and isolation monitoring), IEEE 1547-2003, IEEE 1547.1-2008, ANSI/IEEE C62.41, FCC Part 15 A & B, NEC Article 690, C22. 2 No. 107.1-01 (September 2001), UL1699B Issue 2 -2013, CSA TIL M-07 Issue 1 -2013
DC connection terminals:	x DC+ and 6x DC- screw terminals for copper (solid / stranded / fine stranded) or aluminum (solid / stranded)
AC connection terminals:	Screw terminals 14 - 6 AWG
UL safety standards & network regulations:	UL 1741-2015, UL 1998, UL 1699B Issue 2-2013

2. Input Data

Number of MPPT:	1
Recommended PV Power (kWp):	12.0 – 19.5 kW
Max. usable input current:	50.0 A
Max. usable input current total (MPPT1 + MPPT2):	50 A
Max. array short circuit current (1.5 * I _{max}):	75.0 A
Nominal input voltage:	325 V
Operating voltage range:	325 - 1000 V
MPP Voltage Range:	325 - 850 V
Max. input voltage (U _{dc max}):	1000 V
Integrated DC string fuse holders:	6- and 6+

3. Output Data

Max. output power 480 V:	NA
Max. output power 240 V:	NA
Max. output power 208 V:	15000 VA
Output configuration:	3~ NPE 208/220 V
Frequency range:	45 - 65 Hz
Nominal operating frequency:	60 Hz

Total harmonic distortion:	< 3,5 %
Power factor range:	0 - 1 ind,/cap
Max continuous output current 480 V:	NA
Max. continuous output current 240 V:	NA
Max. continuous output current 208 V	41.6 A
OCPD/AC breaker size 480 V:	NA
OCPD/AC breaker size 208 V:	60 A
Max. efficiency:	97.3 %
CEC efficiency 480 V:	NA
CEC efficiency 240 V:	NA
CEC efficiency 208 V:	96.5 %

4. Protection Devices

DC reverse polarity protection:	Yes
Anti islanding:	Internal; in accordance with UL 1741-2005, IEEE 1547-2003 and NEC
Over temperature protection:	Output power derating / Active cooling
AFCI:	Yes
Rapid shutdown compliant:	Yes (according to NEC 2014)
Ground fault protection with isolation monitor interrupter:	Yes
DC disconnect:	Yes

5. Interfaces

USB (A socket):	Datalogging and inverter update possible via USB
2x RS422 (RJ45 socket):	Solar Net
Wi-Fi / Ethernet / Serial / Datalogger and webserver (optional):	Wireless standard 802.11 b/g/n / Fronius Solar.web, SunSpec Modbus TCP, JSON / SunSpec Modbus RTU - Available with the Fronius Datamanager 2.0 Card only
6 inputs or 4 digital inputs/outputs (optional):	Load management; signaling, multipurpose I/O - Available with the Fronius Datamanager 2.0 Card only

F. Technical data of Solar Photo Voltaic Crystalline Silicon Terrestrial PV Modules (33 pieces)

1. Electrical Data (Standard Test Conditions)

Nominal Max. Power (Pmax):	550 W
Opt. Operating Voltage (Vmp):	42.57 V
Opt. Operating Current (Imp):	12.92 A
Open Circuit Voltage (Voc):	51.44 V
Short Circuit Current (Isc):	13.67 A
Module Efficiency:	21.31 %

2. Electrical Data (Nominal Module Operating Temperature)

Nominal Max. Power (Pmax):	414 W
Opt. Operating Voltage (Vmp):	40.10 V
Opt. Operating Current (Imp):	10.34 A
Open Circuit Voltage (Voc):	47.80 V
Short Circuit Current (Isc):	10.94 A

** Under Nominal Module Operating Temperature (NMOT), irradiance of 800 W/m², spectrum AM 1.5, ambient temperature 20°C, wind speed 1 m/s.*

3. Mechanical Data

Cell Type:	Gallium-doped Mono c-Si PERC, Half-cut cells, 182 mm
Number of Cells:	144
Front Cover:	3.2 mm glass, high transmission, AR coated, tempered
Encapsulation:	EVA
Back Cover:	White backsheet
Junction Box:	IP68 rated, 3 Bypass Diodes
Frame:	30 mm anodized Aluminium alloy
Cable:	1 x 4 mm ² , 350 mm length or customized
Connectors:	MC 4 / MC 4 compatible
Dimension:	2278 mm x 1133 mm x 30 mm
Weight:	26.5 kg
Wind Load:	2400 Pa or 244 kg/m ²

4. Temperature Characteristics

Operating temperature (°C):	-40 to +85
Temperature Coefficient of Pmax (%/°C):	-0.35
Temperature Coefficient Voc (%/°C):	-0.275
Temperature Coefficient Isc (%/°C):	0.045
Nominal Module Operating Temperature NOCT (°C):	45 ± 2

G. Warranty

- 1. Solar PV Modules** – Must be twenty-five (25) years or more on linear performance warranty and ten (10) years or more on product warranty on materials
- 2. Inverters** – Must be ten (10) years or more on product warranty
- 3. Workmanship** – Must be one (1) year workmanship guarantee or more against faults and defects in relation to installing the system or the operation and performance of the system. Repair or replacement of any defect within the warranty period including replacement of all part of the system where necessary within a reasonable time frame.