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1. Glossary of Terms & Abbreviations

The “contractor” refers to the prime contractor responding to this request for proposals.

AC	alternating current
ATS	automatic transfer switch
BESS	battery energy storage system
BYD	(lithium ion battery manufacturer)
CB	Circuit Breaker
CCU	Critical Care Unit (L'Unité de Surveillance Continue (USC) - French)
CDV	Medical building (Le conseil et le dépistage Volontaire)
DAS	data acquisition system
DC	direct current
DER	Distributed Energy Resource
DOD	depth of discharge
EdH	Electricite du Haiti
HTOC	UNOPS Haiti Operations Centre
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
kWh	kilowatt-hour
kW	kilowatt
kV	kilovolts
kVA	kilovolt-ampere
LCOE	levelized cost of energy
MPPT	maximum power point tracking
MSPP	Ministry of Public Health and Population (Haiti)
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
O&M	operations and maintenance
PV	photovoltaic

PVC	poly vinyl chloride
RFP	request for proposals
SCADA	supervisory control and data acquisition
SoC	state of charge
SOH	state of health
STC	standard test conditions
UL	Underwriters Laboratories
UPVC	Unplasticized Polyvinyl Chloride
V	volts
VIH	Medical building (HIV)

2. Introduction

2.1 Project Summary

The combination of a poorly developed health system in addition to the centralised and precarious electricity supply system has accentuated the difficulties in the country, particularly amidst the ongoing diesel crisis. Considering UNOPS experience in implementing similar projects in the health sector and the energy sector, the MSPP and World Bank requested UNOPS support for the implementation of the project consisting in two major activities:

1) **Generation (GEN)**: Acquisition, delivery, installation and commissioning of electric power systems for grid-connected facilities at Hopital Saint Antoine de Jérémie.
2) **Distribution (DIS)**: Upgrade of the existing electrical plan at Saint Antoine Hospital in Jérémie (HSAJ). This intervention will involve replacing the existing energy distribution systems with new systems according to the provided basic electrical schematics.

Therefore, as part of the project, the United Nations Office for Project Services (UNOPS) issued this Request for Proposals (RFP) to obtain firm fixed price proposals for full-scope design-build services for a hybrid solar + storage + diesel generators system + retrofit of the distribution system. The proposed work will provide resilient electricity service for Hospital Saint Antoine de Jeremie. Additional project scope includes training technicians capable of maintaining the microgrids and controlling their operation.

2.2 Project Goals

The project is intended to support four primary goals:

1. Ensure the availability of resilient electricity supplies for the healthcare facility
2. Provide solar generation which would optimally match energy consumption at the site
3. Reduce the lifetime levelized costs of energy (LCOE)
4. Reduce the environmental impacts, including greenhouse gas emissions
5. Reduce energy losses in the energy distribution system/network and ensure the availability of a resilient electricity distribution system for the healthcare facility.

Secondary project goals include:

6. Provide PV installation training and experience for local technicians
7. Increase healthcare sector experience and knowledge of DERs and advanced energy solutions
8. Provide accurate electrical installation plans (as built) based on architectural surveys of the hospital.
9. Ensure the presence of electrical protections in the hospital's electrical distribution network. Guarantee the safety of staff, patients, and visitors against electrical issues.

2.3 Background

The combination of a poorly developed health system in addition to the centralized and precarious electricity supply system has accentuated the difficulties in the country's response to the progress of COVID-19. As part of the national response to the consequences of the Covid pandemic, the government has defined a strategy that aims to maximize access to early treatment in order to avoid the rapid deterioration of cases to a critical state, for which the treatment will be much more difficult, expensive and with less chance of survival. Several hospital institutions have benefited from a strengthening of the technical platform. The project supplied oxygen concentrators, pulse oximeters and masks to 96 medical facilities in the country. Hospital St Antoine de Jeremie (HSAJ), which is the reference hospital for the Grand'Anse Department received 32 oxygen concentrators which are underused because of the lack of electrical energy.

Additionally, other problems in the distribution system have been identified, including:

- EDH: The main problems are the lack of supply and inadequate power supply (voltage too high or too low), which is detrimental to the operation of electromedical equipment.

- Generators: Generators with unbalanced phases due to non-compliant distribution networks. This causes a reduction in the generator's lifespan.

- Photovoltaic installations: Low power supplied compared to needs, inadequate inverters because they do not allow direct power supply to services by solar panels in the absence of batteries.

- Absence of electrical network diagram, lack of circuit identification, and crossover between lighting circuit and socket circuit. This makes it extremely difficult or even impossible to trace the origin of electrical problems in care delivery services and hospital annex buildings (administration, hospitality...).

- Undersized or absent central safety devices: the hospital is exposed to significant risks of fire and electrocution of employees in technical rooms.

- Undersized cables compared to potential energy consumption in services, exposing the infrastructure to significant risks of fire in case of circuit overload.

- Undersized circuit breakers. This causes the observed impossibility during our missions to use more than 2 or 3 oxygen concentrators (650w) in care delivery services.

- Oversizing or absence of certain safety devices such as circuit breakers exposing the infrastructure to significant risks of fire in case of circuit overload.

- Defective sockets causing a significantly high risk of fire, electrification, and electrocution of individuals in care services.

- Insufficient general lighting in care rooms.

- Lighting circuits also require upgrading; however, the level of risk and impact on care is lower than that of intervention on energy production and distribution via sockets.

The project is developed in terms of Request for Proposals (RFP), where the Bidder is responsible for

- Activity 1: the final design of a renewable system matching specific site conditions, installation, commissioning, warranty, operation and maintenance
- Activity 2: the retrofit of the distribution system

Table 1 Hospital Saint Antoine Jeremie Data

Parameter	Unit	GRAND'ANSE - Jeremie
Facility Name	Text	Hôpital Saint Antoine de Jérémie
Facility Type	Text	University Hospital and Laboratory
Opening hours	Text	24/7. Clinique 8am – 4pm
Latitude	Lat	18.64561° or 18° 38' 44" north
Longitude	Lng	-74.11801° or 74° 7' 5" west
Existing PV panels	Number	Total: 142 PV 66 PV 325 W 36 PV 450 W 16 PV 385 W 12 PV 315 W 12 PV 400 W
Existing PV capacity	kWp	48 Kwp
Existing PV inverters	Text	58.2kW (7 systems)
Battery	unit	108 (Lead Acid)
Battery capacity	Ah	435 (Lead Acid)
Battery inverter	Text	2 x MagnaSine MS4024, Not connected to Solar Panels
Generator	Text	350kVA Genset is out of service
Transformer	Text	37.5*3 kW
Electrical plan	Text	In appendix
Issues	Text	Imbalance of load on the electrical system, Insufficient energy in term of quantity Total absence of city grid electricity Lack of inverters and several out of sync power sources

Peak consumption hours	Text	Between 11h am and 3h pm
EDH connection	Text	Yes, but there **NO** electricity supply from city grid for more than 2 years
Estimated PV capacity based on rooftop available area for Solar PV installation	kWp	108 kWp
Estimated area available for Solar PV installation	m2	775

Table 2 Hospital Saint Antoine Jeremie Existing Solar system Data

INSTALLED ON	Inverters	Panels	Batteries	Services supplied
Dec 2022	2*4kVA Outback	qty 12, 325W	qty 16; Trojan 435Ah, 6V	**Medecine Interne**
Dec 2022	2*8kVA Outback	qty 24, 325W	qty 16; Trojan 435Ah, 6V	**Urgences / ICU urgences**
Dec 2022	1*8kVA OutBack	qty 12, 325W	qty 16; Trojan 435Ah, 6V	**Hospitalisation Chirurgie**
2018	6.4kW Schneider Connext	qty 66, 250W	qty 48; Trojan 435Ah, 6V	**4 Air conditioners (Theaters, Neonatology,)**
2018	3*3.6kW Outback			**Theaters, Neonatology, Pediatrics**
2019	3kW Gowatt	qty 6, 200 W	qty 4; Trojan 435Ah, 6V	**Casher**
2016	6KVA Outback	qty 10, 200W	qty 8; Rolls 435Ah, 6V	**Laboratory**

2.4 Key RFP dates

Table 1 below summarizes the key RFP milestones and dates.

Table 1 RFP Milestones and Dates

Milestone	Date
RFP released	15 March
Information Meeting for all bidders	20 March
Site visit for all bidders	25 - 26 March
Q&A questions due	28 March

Q&A response posted	30 March
Submission Deadline	01 April
Evaluation & Interviews & Negotiations & Clarifications	15 April
Notification of finalists	19 April
Final Contractor selection	19 April

3. Objectives

Project objectives are summarised as follows:

Activity 1

A. Install solar photovoltaic (PV) system
B. Install battery energy storage system (BESS)
C. Install the new generator
D. Integrate the new generators into the new microgrid
E. Integrate the existing renewable energy systems into the new microgrid if required/appropriate.
F. Install and integrate microgrid controls, DER controls, and load controls
G. Complete electrical infrastructure reconfiguration and upgrades, including utility 3-phase power upgrade if required, and utility interconnection and protection
H. Interconnect, test, and commission microgrid
I. Train local technicians to maintain and control microgrid
J. Operation and Maintenance

Activity 2

K. Réalisation du plan de distribution électrique tel que mis à niveau par le projet.
L. La securisation du reseau electrique: éliminer les risques d'incendie, d'électrocution et électrocution.
M. La capacité pour chaque service d'utiliser des équipements électromédicaux et 6 concentrateurs d'oxygène simultanément.
N. La stabilité du réseau électrique: qui permettra une plus grande durabilité des équipements électromédicaux
O. La disponibilité de prises électriques sécuritaires suffisantes pour tous les lits dans les services à fortes densité humaines (patients et accompagnateurs) tels que la maternité.
P. Éclairage sécuritaire et suffisant dans les services remis à niveau
Q. Réduction importante des pertes d'énergie due au éléments défectueux ou inappropriés du réseaux de transport de l'énergie depuis la source de production jusqu'au point d'utilisation

R. Production de diagrammes électriques mis à jour
S. Formation des électriciens de l'hôpital

4. Gender objective

UNOPS works with its various partners to tackle inequalities between men and women around the world, in order to have a lasting impact in fighting poverty and promoting sustainable economic growth that benefits everyone. UNOPS management has made gender parity one of its priorities. To reaffirm the organisational commitment to achieve these ambitious goals, the RFP contemplates the actions below that need to be considered by the companies that will participate in the process:

Activity 1: The contractor must ensure that a 20% quota of women recruited among the workers is respected

Activity 2: The contractor and UNOPS must ensure that any team that will undergo training is composed of at least 30% women

5. Scope of Works

The session will delve into the comprehensive scope of works encompassing:
Activity 1 which focuses on the intricate stages of designing, procuring, and installing a hybrid system generation. This activity forms the foundational pillar of the project, outlining the strategic approach towards integrating sustainable energy solutions within the existing infrastructure.

Activity 2 will be thoroughly examined, centering on the retrofit of the distribution network as per the detailed design annexed. This phase underscores the meticulous process of upgrading and optimising the distribution channels to ensure seamless energy flow and efficiency throughout the facility.

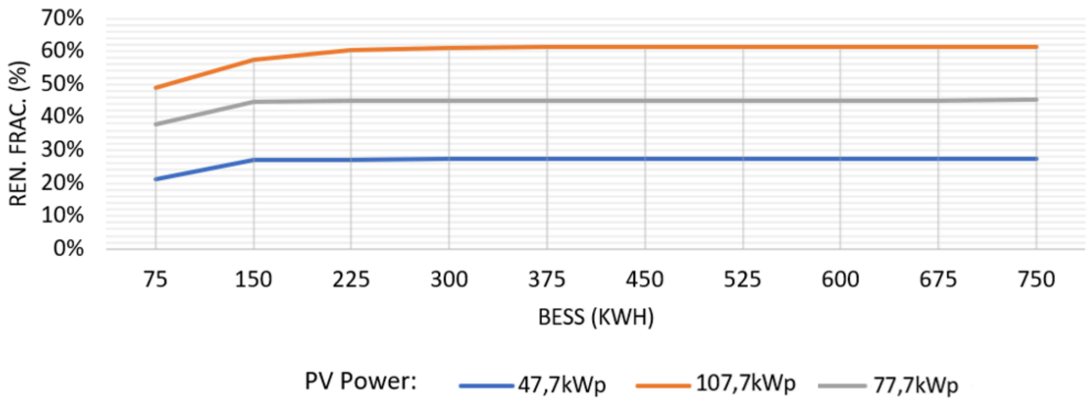
Furthermore, the session will delve into the supplementary works involving the replacement of the existing solar panel metallic structure and the installation of a 120 KVA generator, highlighting the strategic enhancements aimed at bolstering the energy infrastructure's resilience and capacity.

5.1.1 Activities

Activity 1

After assessing the current structure of the solar panels and the available space for new installations, it has been determined that implementing a 108 kWp solar configuration, which includes an additional 60 kWp to augment the existing 48 kWp installation, along with 10 sets of batteries totaling 150 kWh, is feasible. This configuration aims to achieve an approximate penetration of 65% of renewable energy, aligning with the hospital's current energy consumption pattern.

Impact of photovoltaic generation on renewable fractions



Considering this analysis, the hybrid system to be installed must consider the following structure:

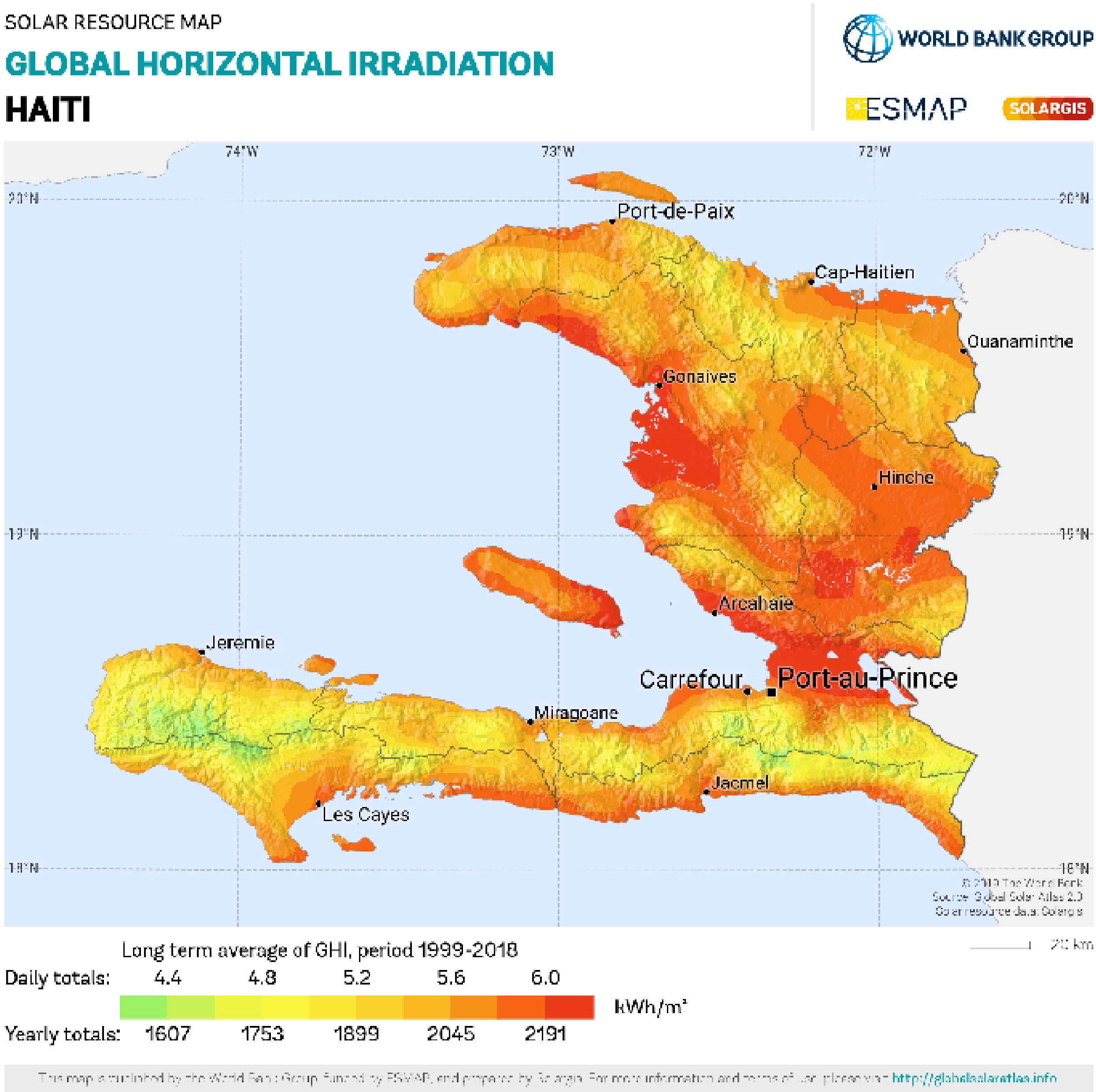
Name	Hôpital Saint Antoine de Jérémie
Quantity BYD packs	10 packs of 15.1 Kwh or 150 kWh
Quantity of Inverter	2 inverter of 50KVA
Quantity of PV	Additional 60 kWp to be integrated with the existed 48 kWP already installed
Additional system price:	30% of the total amount of investment
Additional system price:	20% of the total amount of investment
Additional IOT price:	5% of the total amount of investment
Additional design price:	5% of the total amount of investment

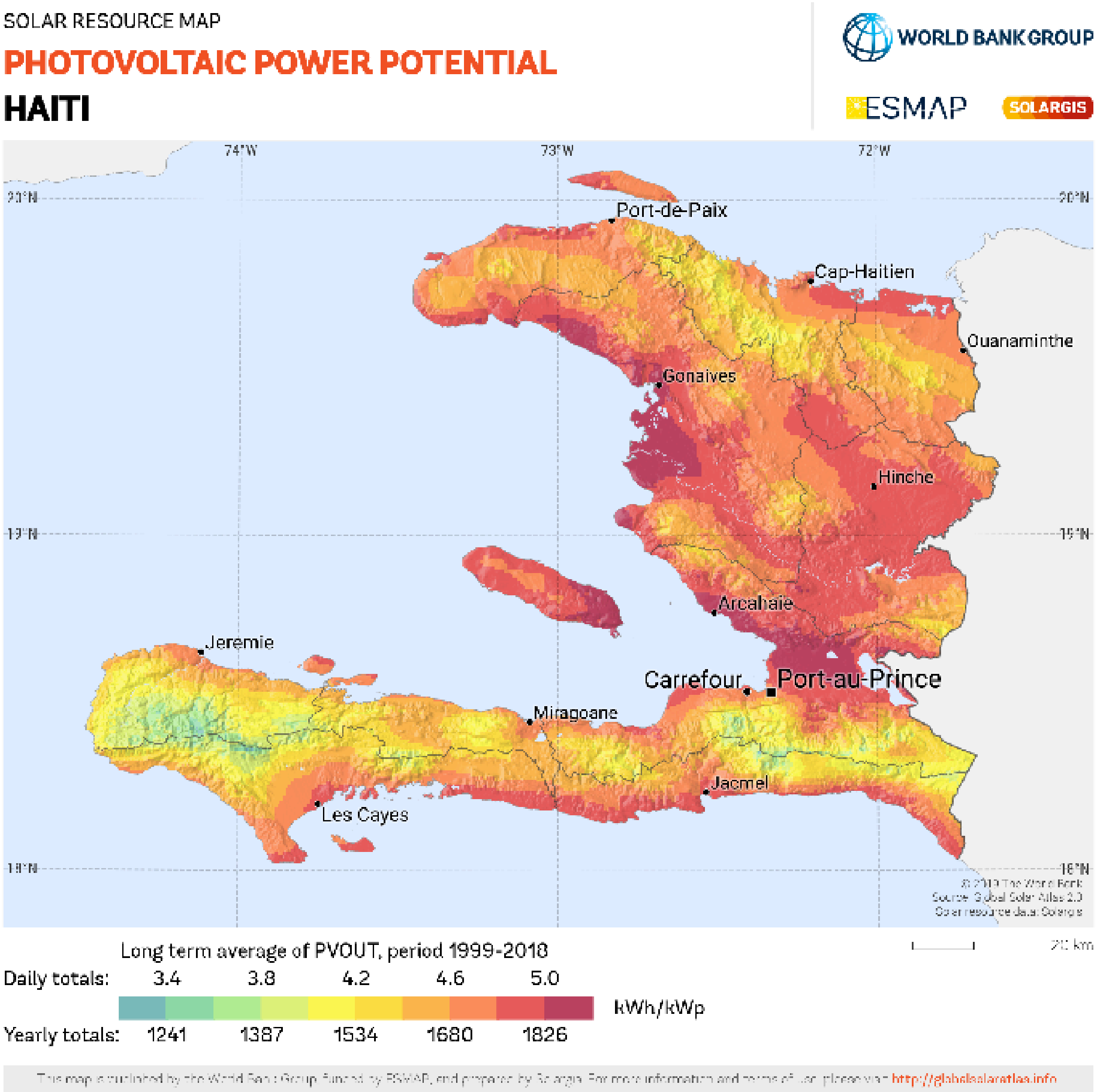
Activity 2

Name	**Hôpital Saint Antoine de Jérémie**
Main Power Circuits to Replace	All (Transformers/Genset/Inverters - Main Panels - Secondary Panels)
Services Requiring Complete Electrical Circuit Refurbishment	Operating rooms, delivery rooms, neonatology, internal medicine, surgeries, covid, emergencies, Maternity, pediatrics, Post Op
Services to Connect to Corresponding Secondary Panel	Administration, outpatient clinics, secondary buildings

5.1.2 Climatological conditions and solar irradiation availability for PV generator sizing considerations

The system and associated equipment shall be able to operate under the high temperatures in Haiti and must, therefore, be constructed to work in difficult conditions in ambient temperatures varying between 10°C to 50°C, in relative humidity conditions, and in sea, dusty and/or heavy windy environments. All PV sizing and PV energy generation estimates should be carried out based on the ESMAP Global Solar Atlas available at https://globalsolaratlas.info/download/haiti and shown below





5.2 Detailed Scope

Activity 1

The power system, and all the associated equipment, must be capable of producing electricity at 120 Volt +/- 5%, at 60 Hz +/-5%.

The power system shall be able to operate in the following conditions:

1. Design Temperature Range: 10-45°C
2. Relative Ambient Humidity 5-95%
3. Pressure 101325 Pa (1atm)
4. Peak Wind Gust: Category 3 hurricane in Saffir–Simpson scale or equivalent

5. Seismic Zone: Strong seismic activity

It is the responsibility of the Vendor to design all components to operate at safe rated sustainable operating temperatures over the required ambient temperature range. Any outdoor component shall be weather-proofed or fully contained in weatherproof, environmentally conditioned enclosures with minimum NEMA 3R (or equivalent) protection. The outdoor components shall be able to withstand the design conditions including the maximum wind speed and local seismic activity.

Install solar photovoltaic (PV) system

- The contractor shall complete all tasks necessary to design, engineer, install, and deploy a new solar PV system that is sized to the available area of each site and optimized to site energy demand. The contractor shall be responsible for all aspects of design, engineering, permitting, interconnection, procurement, installation, commissioning, deployment, etc. for this PV system. The contractor will procure all construction supplies required for the complete construction, including steel framing, concrete footings, and all installation hardware and materials.
- The contractor is required to make sure that all required materials, equipment's subsystem is included in his offer to deliver a completed and functional system, includes but not limited the following components:
    - Solar PV modules;
    - Fixed Mounting structures suitable for a number of PV panels;
    - PV combiner box;
    - Solar PV inverter;
    - System Cables (DC & AC);
    - UPVC Riser Pipes / conduits and Joints;
    - PVC pipe/ PVC conduit for cable holding.
    - Earthing, short-circuit, surge and lightning protection;
    - Chain Link Fences to protect the system;
    - DC breaker with enclosure;
- The contractor should consider the site condition in terms of obstacles and shadings.
- This scope of works is not meant to be a comprehensive definition of works, but merely a guide for the items of work contained within this tender package.
- The Contractor shall generate a site and electrical plan, which indicates the design parameters and electrical works that are required for the successful completion of the project that has to be approved by UNOPS.
- The contractor shall clear from all areas planned for the work, materials, debris, etc, prior to the commencing of work.

Install battery energy storage system (BESS)

Battery energy storage capacity shall be the primary grid-forming resource, with diesel-fuelled generation as a secondary grid-forming resource for use when BESS resources are unavailable or excessively depleted. Assuming optimal BESS state of charge (SoC) at the outset of microgrid islanding, as well as application of appropriate load-control protocols, storage resources shall be specified to provide power and energy capacity sufficient to support at least 6 hours of microgrid service in “normal resiliency” mode, without start-up of diesel generation. The contractor's design and engineering scope include optimizing resource sizing and performance as described below in the section Technical Specifications and Performance Requirements.

The contractor shall be responsible for all aspects of design, engineering, permitting, interconnection, procurement, installation, commissioning, deployment, etc. for this BESS. The contractor must protect BESS from any damage by placing protections against short circuits, overcharging, disconnection, etc.

The contractor shall be responsible for installing exclusionary chain-link fences with gates and visual screens to protect the BESS and the diesel generator wherever it is required. The contractor shall be responsible for installing any required firebreaks and vegetation control systems around the BESS and diesel generator and using materials supplied by the contractor. All fencing, firebreak, and vegetation control systems shall be designed and installed in compliance with applicable building codes, fire codes, and manufacturer recommendations.

Install and integrate microgrid controls, DER controls, load controls, monitoring, and interfaces

The contractor shall complete all tasks necessary to design, engineer, install, and configure all communications, telemetry, controls, and human-machine interfaces required to manage and execute all microgrid functions.

The contractor is obliged to:

- Ensure the supply of electricity in the quantity and quality established.
- Ensure the performance of the supervision provided for in the Project to the entire facility. The bidder must prepare a protocol for the supervision of its facilities indicating the main activities to be carried out on each of the installed equipment.
- Ensure that the frequency of forced and programmed interruptions of the photovoltaic system is less than 5 times during a semester.
- Ensure that the maximum time for forced interruptions and programs of the photovoltaic system is less than 600 minutes during a semester.

The microgrid controls and resources shall be integrated to support automatic islanding of the microgrid during grid outages, including integration of onsite DERs (both electric supply and controllable loads).

Preferred control solutions will be capable of automatically managing a seamless transition between grid-connected and island states, assuming sufficient onsite power at the time of an outage, with no loss of electricity at any of the facilities served by the microgrid.

The microgrid shall include electric load-management systems designed and integrated to perform a range of functions, including adjusting or curtailing various electric loads to manage inrush currents, prevent coincident peaks, and manage continuous loads during both grid-connected and islanded operations. New energy management systems are expected to control existing medical equipment, heating, ventilation, and air conditioning (HVAC) systems; and other load controls to be identified by the contractor.

The proposed microgrid shall include telemetry and monitoring systems and processes (the "Data Acquisition System" or DAS) that support all objectives for allocating energy consumption and costs to each facility in the microgrid; tracking and analyzing energy usage as well as the performance of each component in the microgrid; producing data sets for compliance with applicable regulations as well as grant agreement periodic reporting requirements, and providing public information and education about resilient and renewable energy system performance.

The system should allow a report to be evaluated considering the following data:

- Voltage measured every 15 minute or less
- Frequency measured every 15 minute or less
- Power supplied measured every 15 minutes or less
- kWh supplied per hour.
- Report on the frequency of interruptions and the time of each interruption.
- Cause of interruption

The project objectives include public outreach and education to inform healthcare facility team members about the performance and benefits of the microgrid. The contractor's scope shall support these objectives by, at a minimum, developing and integrating a system that produces a real-time or near real-time visualization of the microgrid in operation, presenting status and lifetime production information, for example, with data provided by the DAS. The visualization system will post information publicly on screens of the buildings of healthcare facilities.

The contractor's scope shall include developing secure communication and control protocols and human operator interface systems for monitoring and managing all microgrid subsystems. The contractor's scope shall include producing a Microgrid System Integration and Control Manual (the "Microgrid Control Manual"), describing the microgrid control systems, subsystems (e.g., DER and load management controls), and human interface systems, how they are integrated for interoperation, and all onsite user control and data retrieval processes.

It has to be shown how all these protocols and procedures can be realistically handled by the hospital staff (i) during the O&M period and (ii) afterwards - for example, if and when separate generators may still be in use on site that are not integrated and/or handled or fueled by existing hospital or third party technical staff.

Activity 2

The scope of this intervention concerns the internal distribution network of the hospital from the transformer station to the electrical outlets or lighting devices in the hospital services.

The distribution system and all associated equipment or devices must be capable of supplying electricity at 208 Volts +/- 5%, at 60 Hz +/- 5% Three-phase and 120 Volts +/- 5%, at 60 Hz +/- 5% Single-phase. In all secondary electrical panels at the various healthcare service levels.

The electrical system must be able to operate under the following conditions:

- Design temperature range: 10 - 75 °C
- Relative ambient humidity 5-95%
- Pressure 101325 Pa (1atm)
- Category 3 hurricane on the Saffir-Simpson scale or equivalent
- Seismic zone: High seismic activity

It is the responsibility of the supplier to design all components to operate at sustainable and safe operating temperatures within the required temperature range above, especially for electrical cables contained in metal conduits. Any component installed outdoors must be weatherproof, wind-resistant, seismic activity-resistant, or entirely contained in weatherproof and air-conditioned enclosures with a minimum NEMA 3R (or equivalent) protection. Outdoor components must withstand design conditions, including maximum wind speed and local seismic activity.

Each circuit must be clearly identified, as well as the elements powered in the post-intervention electrical diagrams.

Project intervention scope in response to the observations described in section 2.3, the project aims to upgrade electrical distribution systems and networks by performing the following activities depending on the realities and priorities of each site:

1) Purchase and installation of new central panels, double throw, safety switches, and other safety devices.
2) Establishment of new distribution circuits for outlets in services benefiting from oxygen therapy such as: Maternity, Neonatology, Post Op, Emergencies, Covid Center, Pediatrics.
3) Replacement of defective outlets in services where outlet circuits do not require complete reinstallation.
4) Implementation of the electrical distribution plan as upgraded by the project.
5) Technical staff training and provision of professional inspection and maintenance kits (Toolbox, measuring instruments).

Central Distribution (from Transformers to Service Electrical Panels)

The service provider must study the central electrical distribution network to be implemented (electrical diagrams provided for each site) and propose improvements if necessary.

Electrical distribution systems are an essential part of the power supply system. Two types of distribution are important for this project:

1) **Internal Wiring / Hospital Internal Distribution Network** (which is composed of several independent circuits as the base case, and connects several buildings within the hospital premises) and
2) **The existing distribution network of the EDH** - generally "upstream" of the hospital's meter from the EdH, which serves not only the hospital but also many customers in the city.

Bidders will evaluate the tender documents (design diagrams of the new hospital internal distribution system, diagrams of the existing system, technical specifications of the work, minimum technical specifications of the equipment, on-site safety requirements, etc.) and assess the existing hospital distribution system to provide recommendations and better size their bids (Technical, Financial, Execution Team, activity schedule…)

The existing central distribution system inside the hospital premises must:

- be balanced and meet the following requirements:
- Appropriate Voltage and Frequency: Single-phase 120 V +/- 5%, at 60 Hz +/- 5% at all consumption points; Three-phase 208V +/- 5%, at 60 Hz +/- 5% at all service electrical panels.
- Availability of electricity on demand
- Reliability and safety
- Sized correctly for consumer load (at least 1 oxygen concentrator 700W for every 2 beds simultaneously in care services and adequate lighting in the rooms).

Electrical cables must not be accessible to users and will either be buried or exposed via overhead conduits made of suitable metal.

All safety devices (Circuit breakers, Surge protectors, Grounding mesh, Ground detector, Disconnect switch) must be installed in an open or covered environment according to the applicable standards for hospital facilities.

Distribution in care rooms or services

The existing central distribution system inside the hospital premises must:

- be balanced and meet the following requirements:
- Appropriate Voltage and Frequency: Single-phase 120 V +/- 5%, at 60 Hz +/- 5% at all consumption points; Three-phase 208V +/- 5%, at 60 Hz +/- 5% at all service electrical panels.
- Availability of electricity on demand
- Reliability and safety
- Sized correctly for consumer load (at least 1 oxygen concentrator 700W for every 2 beds simultaneously in care services and adequate lighting in the rooms).

The electrical cables of the outlet circuits must not be accessible to users and will be mounted exposed on the walls using suitable metal conduits according to the following guidelines:

- 3 duplex outlet positions per 20A circuit breaker
- 1 duplex outlet position every 2m in medical care services

All safety devices (Circuit breakers, Surge protectors, Grounding mesh, Ground detector, Disconnect switch...) must be installed in a covered environment according to the applicable standards for care rooms. The luminaires in quality and quantity must provide a minimum of 200 lux of lighting according to the applicable standards for general care rooms.

Distribution in rooms not included in the intervention.

Services or rooms not involved in the production of medical care will be:

- Connected to the secondary electrical panel of the area (see general electrical power diagram of each site)
- Outlet circuits and lighting circuits will be differentiated during this connection.

5.2.1 Interconnect

Based on the document for commissioning the contractor shall coordinate and perform all tasks required to obtain interconnection approval from healthcare facilities, install and test interconnection protection and control systems, verify the safety and code compliance of installed systems, test and validate the system's performance, and commission the system for ongoing operations.

The commissioning documentation is in the appendix.

5.2.2 Protect the area of installation

The areas of installation should be protected from unauthorised access with fences and lockable doors. The protection measures should be strong enough and adequate to the local conditions. The theft of solar panels and battery equipment is common. The power cables should not be exposed and easily accessible by thieves and should be covered with a protection tube. Special care will be required (i) for the flammable batteries and (ii) regarding resilience against Haiti's frequent natural disasters and how this overlaps with the other protection measures.

5.2.3 Operation and Maintenance

The maintenance program will be implemented by the contractor for twelve (12) months after the installation of the hybrid photovoltaic system.

The bidder must deliver a maintenance plan for the system, based on the recommendations of the manufacturer and suppliers, projections of equipment use and working conditions, taking into account the realities of the health and energy sectors in general and the day to day operational situation of the specific hospital. The plan needs to consider:

Activities O&M	Frequency per month	Duration (weeks)	Responsible	Spares and other materials

The bidder must include a list of spare parts that are necessary for the operation of the equipment at their (unit) prices, including the cost of replacement (at current prices). At a minimum, the following should be considered in the list:

- PV modules
- PV inverters
- Battery cells
- Battery inverters
- Circuit breakers
- Surge protectors
- Ground detector
- Central wiring junctions
- Switch
- Disconnect switch
- Phase load balancing
- Voltage measurements

The operator must have insurance:

- Material damage to the property of third parties due to the contractor's action.
- Against accidents to third parties and their own personnel.

It is the responsibility of the contractor to adapt the activities to the conditions established in the Hospital in relation to behaviour measures, security, free access spaces, determinations in relation to COVID-19 or infectious diseases and others that considerations the Hospital Management may issue.

5.3 Project Execution

- Once the project is awarded, the contractor **must** carry out a detailed site visit, site survey to identify component's locations, cabling routing, and any other necessary works;
- During this site visit – which may require technical staff to remain on-site for several days, install data loggers etc. the winners must assess in detail, amongst others:
  (i) how the health process works and how it interacts with the base case energy services (consider that all lighting appliances will be ON inverter 24h/7jrs);
  (ii) which appliances are critical; (iii) what suppressed demand may exist (many equipment are in warehouses waiting to be used when energy provision will be adequate…);

(iv) how current energy dispatch works and who owns/pays/operates which generator; etc.
(v) how the future energy dispatch plan will work (Hospital electrical distribution)

- A regular status meeting (weekly basis) with UNOPS representatives shall be carried out to discuss current and planned activities and significant issues.
- The contractor is required to submit the Design Brief, Concept Design, and Final Design Design for verification, review, and approval by UNOPS (Design Review) prior to installation as a condition of this request. The contractor will be responsible for supporting the UNOPS local project team during the Design Review /verification process by the UNOPS third party expert team prior to.
- The Contractor must provide a work installation plan and implementation period such as having to be approved by UNOPS and has to consider the main steps below:

Weekly series - Generation	1	2	3	4-6	7-8	9	10-11	12-13	14 -15	16 -20	21-34	35 -39	40
1. Launch of the RFP and invitation to companies to participate in the competitive process.	X												
2. Site visits and clearance		X											
3. Proposals submission			X										
4. Evaluation of the proposals				X									
5. Approval and signature of the contract					X								
6. Site visit by contractor to for a more detailed assessment of the electrical system at the hospitals and discussion of findings with UNOPS						X							
7. Submit the 60% drawing and design for review							X						
8. Comments from UNOPS / Contractor design review								X					
9. Submit the final stamped drawing and design to be verified by UNOPS.									X				
10. Design Review (UNOPS) / Contractor provide requested information and clarification										X			

11. Delivery										X	X		
12. Supply installation											X	X	
13. Training, Commissioning													X

- The contractor is responsible for any defect or damage in any components of the New solar PV system until the completion of commissioning of the central integrated system.
- The contractor is responsible for any defect or damage in any components of the existing PV system he will work on until the completion of commissioning of the central integrated system.

5.4 Design Parameters

- The contractor should take into account the site condition in terms of obstacles and shadings.
- The contractor must perform a structural assessment of the building on whose roofs the PV panels will be installed. A detailed report including structural calculations, assumptions, test performed, pictures will be submitted by the contractor. Attention must be paid on demonstrating how the building's performance can support the panels to be installed in the normal circumstances and in case of dynamic load on the building (seismic activities or hurricanes…)
- The contractor must provide a stamped drawing and design to be reviewed and approved by UNOPS.
- The contractor must include in the design and later implement a plan to ensure the security of the place (fences, gates, and other structures).
- During the design phase the contractor must support the UNOPS local team during the design review process performed by a UNOPS third party expert team (providing clarifications to the questions of the reviewers, modify the documents to fit international standards when required…).

Site investigations

- Site assessment and layout
- Hospitals structure description
- Local for the PV installation
- Local structure for the control room / stock of batteries
- Environmental and social impact assessment
- Structural calculation of the buildings where the panels will be installed and proof that the structure can support the additional weight of the panels/metallique structure

For more details please refer to those questions/ remarks below (if applicable)**:**

- Prepare complete design packages with the full information (design layout for each building structure including drawings and/or other visual designs)
- If reinforcing steel is needed to support the weight of the PV , give the details, and properties of the reinforcing steel:type of Reinforcing Steel, Steel Bars (The specific size and diameter), Yield Strength, Corrosion Resistance, Size and Spacing, Design Considerations. ect….
- Give the structural capacity of the existing structure including material properties.
- If an additional concrete frame made of blocks would be added, give details of the materials, sections, etcetera. How are these concrete blocks going to resist the seismic event, which is critical in Haiti. Please provide full information in terms of calculations and an elaborated set of drawings. "
- If additional retrofitting works would be added, give details of the materials, sections, etcetera. How are the new structural elements going to resist the seismic event, which is critical in Haiti. Please provide full information in terms of calculations and an elaborated set of drawings.

5.5 Electrical Work

- All grounding and protection equipment throughout the system shall be sized and specified to reduce damage on all components; such systems shall be approved by UNOPS.
- All electrical works shall comply with the manufacturer's instructions and regulations.
- System configuration, testing and commissioning should be carried out.

5.6 Procurement

- Procurement and expediting tasks for all equipment and materials are the responsibility of the Contractor.
- The equipment and materials shall be purchased by the contractor, and the contractor is responsible for the equipment and materials shipping and transportation, storage, etc.
- All of the procured material shall be brand new with valid warranty certificates.

5.7 Safety and damage

The contractor must also have insurances:

- Material damage to the property of third parties due to the contractor's action.
- Against accidents to third parties and own personnel caused by the contractor.
- The bidder is required to comply with HSSE standards of UNOPS to ensure the safety and security of its personnel and any other person on site.
- The contractor must keep the site clean and orderly throughout the duration of the works;

- The contractor must provide permanent marking, labelling, and signage of the equipment for the project;
- The contractor must fully comply with all applicable rules regarding notification, safety, and labor when working.
- It is the responsibility of the contractor to clean up all once the construction works are completed.

5.8 Manuals, Catalogues and Electrical & Design Parameters

- Bidders shall submit catalogues and data sheets of all the offered PV and battery systems equipment with detailed technical specifications for the proposed systems and components. In addition, the contractor shall submit all required documents such as Shop Drawings, catalogues, factory acceptance tests, and test reports by other accredited parties. The offered PV and battery systems shall be capable of operating in the climatic site conditions, ensuring the system sustainability and durability.

5.9 Construction

- The contractor shall implement its standard Quality Assurance / Quality Control plan for construction activities on the Project Site;
- The contractor shall supply all labour, tools, machinery, equipment and equipment transportation for all work;
- The contractor shall keep the site clean and orderly throughout the duration of construction;
- The contractor shall provide permanent equipment marking, labelling and signage for the project;
- The contractor shall fully comply with all applicable notification, safety and work rules when working
- It is the contractor responsibility to clean the modules once the construction work is completed

5.10 Commissioning

Commissioning shall include providing a complete operations and maintenance (O&M) manual in French and training to enable SPBMI staff to perform required operational tasks and routine maintenance. The training will be focusing on system operation, maintenance and troubleshooting, the training scope shall be approved by UNOPS, the activities shall include but not limited to the following:

- The contractor shall provide a time plan and test procedure for the process of commissioning;
- The contractor shall offer all goods and materials for inspection and witness testing. He shall inform the UNOPS or his authorised representative of the date when the goods and

materials will be ready for inspection and witness testing. If the tests are beyond the resources of the supplier, he shall make arrangements for these to be carried out elsewhere.

- Such testing should include the following tests as a minimum:
    - Cable insulation and continuity test: such tests should be carried before commending installation;
    - System earthing test: The earth resistance should be measured to ensure operator safety;
    - Module testing includes the following:
        - Checking the cleanliness of the surface (glass) area of the module as it should be free of any dirt and dust;
        - PV modules Visual Inspection: A visual inspection of the modules should be done to check for defects in the modules such as cracks, chips, delamination, fogged glazing, and discolouration, this should be done for the front glass and back sheet or back glass in the case of double-glass modules;
        - PV modules connector and cable Inspection: Check the sealing gels of the junction box to ensure it has no crack or crevice;
        - Ensure that all modules have been tested before shipping by double-checking the flash reports;
        - DC voltage measurement: This can be done either on the modules level or on combiner box level;
    - Inverter
        - Ensuring that all components are free of dust if not, a dry cloth should be used to wipe away any accumulated dirt/dust;
        - A visual inspection for any damages in the device enclosure also inspects the nameplate of the inverter and compares it with the tender required rating.
    - PV Combiner box panels
        - Inspect the enclosure material, outer insulation layer, panel door lock, cable glands and gas jacket
        - Visual inspection of the rating of all internal components (fuses, DC CB, Blocking diodes of panels and compare with required ratings and ensure that all required(tender) components of panels are available
        - Inspect the availability of guide/instruction and warning labels inside
        - Inspect the clearness between all panel components if adequate.

- not especially if the panels are collected locally

The training work is complementary to the operational guarantees already contemplated and the guarantee of good execution of the infrastructure works (Defect Notification Period / DNP) valid for 12 months after the completion of the work. The contract covers the durability of the systems during the 12 months of O&M and the warranty periods for equipment and all systems as established for the photovoltaic sector globally (“good practices”) as described in the section about warranties. In case of malfunction, the contractor must repair or change the equipment and systems for which the malfunction has been established and will provide the followings:

- Solar Inverter operation
- Battery SOC and SOH
- System isolation
- System monitoring
- Fault diagnosis
- Safety and emergency shutdown procedure
- User manuals, operation manuals and drawings must be provided in French and Creole

The commissioning documentation is in appendix

5.11 System Warranty and After Sales

The contractor shall distinguish between the product expected lifetime, limited product and product performance warranties offered by the manufacturer and the 1-year free maintenance service with extended responsibility of the Contractor to ensure safe and continuous operation of the system and quick replacement of failed components. The expected lifetime, warranties and responsibilities of the Contractor in regard to 1-year free maintenance service are summarized in the table below and described in detail in Annex I. The project lifetime is 25 years.

Components	**Minimum Expected lifetime**	**Minimum Product warranty by Manufacturer**	**Minimum Performance Warranty by Manufacturer**	**1-year free maintenance service by Contractor**
PV Modules	25 years	15 years	90% power @10 years 80% power @20 years	During the 1-year period the Contractor should enhance the product warranty of all supplied components and
PV Modules Mounting	25 years	10 years	N/A	
Power Electronics	10 years	5 years	N/A	

Battery	10 years and 6000 cycles	5 years	60% of initial capacity or max output energy as specified by the manufacturer after 10 years or 6000 cycles what comes first	have all spare parts and components for replacement in stock and should guarantee the resolving of any issues and failure within 2 calendar weeks. All associated costs are covered by the Contractor.
Online Monitoring System	10 years	3 years	N/A	
Generator	10 years	3 years	N/A	
Smart Power Management	10 years	3 years	N/A	
Electrical distribution network	25 years	10 years	N/A	

The Contractor should provide at least one (1) year free operation & maintenance service from the commissioning date of the entire system (any other warranty will not be accepted) and ensure a quick failure diagnosis, repair and if necessary replacement of each supplied item as per its initial description and specification. During this period the Contractor should have all spare parts and components for replacement in stock in Haiti and should guarantee the resolving of any issues and failure within 2 calendar weeks. All associated costs, e.g. purchase, storage, transportation, etc., are covered by the Contractor.

During this period the Contractor is responsible for any damage to the existing generators, electrical distribution network components or consumer equipment caused by any failure of the supplied components or due to the mistakes in the design of the power system, e.g. not replacing the cables of the electrical distribution network so that they match the power supply from new power system or not introducing the protection devices where it is necessary according to the electrical standards described in Annex I. All associated costs to repair and bring back into operation the damaged equipment of the hospital are covered by the Contractor.

The contractor shall quote all equipment expected lifetime, product and product performance warranties and confirm the 1-year free maintenance service and provide details as per Chapter 5.3.7 Operation & Maintenance.

5.12 Final Completion

- The Contractor shall complete any required document or list, clean up the construction site and remove any temporary structures, equipment or services, and construction debris;
- Copies of all final approvals and certifications shall be provided to UNOPS.

- The Contractor shall provide three (3) hard copy sets and one soft copy of the final Project as-built documentation.

6. Evaluation Criteria

Projects will be scored based on the cumulative analysis of technical (up to 70 points) and financial (up to 30 points).

The technical evaluation will analyze the degree to which the proposal meets the technical requirements described below in Annex I. Proposals must meet a minimum technical score in order to proceed to financial evaluation.

Among the cross-check of the proposed system design supplied by the Contractor, the quality of the supplied documentation will be assessed by the fact if the following items are included and described in detail:

- Integration of the existing solar system and in combination with their batteries into the new integrated system,
- How does the system design deals with different priorities of appliances in the hospital, and health services which may not be optimal, and both may change over time
- How does the system design address different generators dispatch strategies and different payment flows for energy
- What is the strategy to operate and maintain the renewable system after the 1 year free maintenance period
- How is the system protected against disasters
- How is the system protected against the theft or fires
- How does the system design covers the case of the increased COVID patients and required O2 concentrators (700w per concentrator; qty 40 available and only 6 in use because of lack of energy for now)
- How will the system be dispatched
- What exactly will be measured and assessed after the award
- Which other risks and important system design issues does the Bidder sees
- What are the ways to optimize the system design if the Bidder would have 20% more total budget

Annex I. Technical requirements

Compliance with or deviation from the specification shall be clearly stated by the bidder in the below sections and submitted as part of the offer. The bidder shall apply good engineering practice and follow the applicable standards in the Solar PV system design. In addition, the bidder shall include technical and performance specifications of the equipment that will be used for the project.

1. PV Modules

	PV Capacity	Total PV capacity is optimized for the available area for Solar PV installation and match the energy demand of the healthcare facility
	Module specifications	Solar PV panels shall follow these technical and performance specifications: 1. Mono- or polycrystalline silicon 2. PV Panels with enough number of cells and energy efficiency ensuring the system offered has the requested capacity 3. Tolerance better than -0 / +5% 4. Maximum weight per module with packaging is 30 kg, e.g. the gross weight of a pallet with 30 modules should not exceed 900 kg. 5. Frameless modules are not allowed 6. Double insulation modules with cables and MC4 connectors 7. Junction box with accessible bypass diodes 8. Anti-reflective glass cover 9. Modules must be PID (potential induced degradation) proof
	Standards	1. certificate IEC 61215 (edition 2) 2. certificate IEC 61730: 2016 series (or newer)
	Module efficiency	Minimum shall be 17%
	Limited Power Warranty	The modules shall be subject to a 15-year limited product warranty or more. The performance warranty shall ensure that the modules will produce at least 90% of their nominal power after 10 years and 80% of the nominal power after 20 years

	Voltage rating	Shall be compatible with the inverter voltage. Mismatch losses to be considered
	Disconnecting means	Shall be provided for the PV generator to isolate it for the grid safely when needed
	Tilt	Shall be optimized for local conditions and used technology
	Labelling	The bidder shall provide the following information at the project completion: 1. Manufacturer, brand, model and serial number 2. Rated power and efficiency 3. A clear indication of the connecting inlets and outlets 4. Warranty and Safety warning

2. PV modules mounting

	Features	Bidders are requested to provide complete appropriate solutions, including supply of materials, civil works etc., as part of the project. The tilt angle and azimuth of the modules are optimized for production concerning the needs and the local conditions. Therefore, shadowing of the PV modules from trees, buildings, or any other obstacles should be minimized over the whole day, and there shall be no shadows in +/-4 hours around solar noon. Bidders are requested to provide the solar field layout drawings of their solution coupled to a calculation of the required area (size) for Solar PV Modules in the offered system as well as provide energy production forecasts based on the orientation, tilt and shadowing effects for Solar PV Modules in the provided system. The PV modules mounting should withstand Peak Wind Gust: Category 3 hurricane in Saffir–Simpson scale or equivalent as well as have adequate performance for the region seismic protection. The roof areas must be inspected for their structural characteristics and a conclusion should be made if the existing constructions (roofs) are suitable for the solar pv installation and additional weight and wind loads which is caused by the installation. A stress analysis or testable statistical calculation of all elements used, including anchors in the building and clamps for module mounting must be provided. The base for the mechanical loads

		must be national standards (or applicable US standards) for wind load and the design loads must consider typical hurricanes. Metal surfaces and joints must provide corrosion protection through coating, anodization of separation with separation elements. The total mounting structure on the building must be connected to a lightning-protection system (if available) or grounded by connections (of sufficient dimension) outside the building. Equipotential bonding of all modules fixed must be assured by the mounting rack (pure contact on aluminium racks is deemed sufficient, even if anodized).
	Standards	The design of the PV mounting structure should follow the guidelines specified in IEC 62548.
	Warranty	The PV modules mounting shall be subject to a 10-year limited product warranty or more.

3. Power electronics

	Features	The system must include an intelligent inverter and controller to control the solar PV output, charging and discharging of the Battery and the switching on and off of generator output in tandem. Additionally, the power electronic devices should include protection and power quality devices that counter problems like power backflow to the generator due to solar production. The generators must be protected from reverse current. When connecting a number of battery inverters together in a cluster, a multicluster box must be included, and when the system is connected to the public utility grid, a grid connect box must also become an integral part of the system.
	Firefighter's switch	Solar arrays mounted on roofs of public buildings shall be equipped with an accessible lockable manual DC disconnect switch.
	Inverter specifications	Solar PV inverters and battery inverters or integrated hybrid inverters are acceptable. The solution should be integrated with diesel generators and must control the switching on and off of the generators. When connecting a number of battery inverters together in a cluster, a multicluster box must be included, and when the

		system is connected to the public utility grid, a grid connect box must also become an integral part of the system Their design should be based on the requirements specified below. Solar inverters with: 1. Inclusive of at least 2 maximum power point trackers (MPPT) compatible with the PV modules layout and maximizing the PV production 2. Inverter EU efficiency min 95% (on-grid) Battery inverters with: 1. Three-phase with output voltage 208V, 60hz and single phase 120V and 60Hz 2. Compatible with BYD LiFePO4 Li-Ion battery system Please note that we expect the battery system to be used daily, and therefore, the charging and discharging cycle will also happen daily.
	General specifications	1. Operating temperature from 0 degC to 50 degC 2. Qty 3 independent inverters synchronised to have the 3-phase output. However, other suitable configurations are also acceptable.
	Standards	Regarding quality assurance, they must follow these certifications. Proof of compliance should be presented along with the technical offer, as previously specified 1. Design IEC 62093 (follow its guidelines) or equivalent 2. Overvoltage category as per IEC 62477 or equivalent 3. Protection Class as per IEC 60664-1 or equivalent 4. Climatic category as per IEC 60721 or equivalent 5. Protection class (according to IEC 62109-1) / overvoltage category (according to IEC 62109-1) or equivalent 6. Safety: EN 60335-1, EN 60335-2 (if the system has a battery) or equivalent 7. Emission: EN 55014-1; Electromagnetic compatibility EN 55014-2; Limits EN 61000-3-3 or equivalent 8. CE-conformity LVD 2014/35/EC and EMC 2014/30/EU or equivalent 9. Safety for converters: EN 62109-1 and EN 62109-2 or equivalent 10. EMC: EN 61000-2, EN 61000-3 or equivalent Note: For all equivalent standards please specify.

	Safety	1. Protection against overload and reverse polarity 2. IP protection class 54 or better
	Warranty	The expected operating lifetime of the battery charge controller and inverter should be more than 10 years and the warranty period is minimum 5 years.

4. Battery

	Battery capacity	Rated capacity is optimized for the available area for Solar PV installation and matches the energy demand of the healthcare facility. It should integrate the predefined amount of pre-purchased battery packs of BYD B-Box Premium LVL 15.4 (15.36kWh), that are currently stored at UNOPS premises in Haiti
	Battery type	Lithium-ion batteries (LiFePO4)
	Features	The set of batteries in the Hybrid Energy System shall include these technical and performance specifications: 1. Number of guaranteed cycles at 80% DOD > 5000 cycles 2. Individual cell monitoring 3. Operating temperature from 0 degC to 40 degC 4. Protection against deep discharge, overcharge 5. Charge balancing between cells 6. Batteries should be installed in a climate-controlled environment. The temperature should be kept at optimum operating condition. Note: Factory assembled standard modules are preferred above the single unit assembled on-site.
	Standards	Regarding the quality and safety assurance, they must follow these certifications, showing proof of compliance along with the technical offer as structure previously specified: 1. UL 1973 und UN38.3 (or equivalent) 2. IEC 62619, 3. UL 1642
	Labelling	The bidder shall provide the following information for each Battery at the project completion: 1. Manufacturer 2. Serial number

		3. Number of series and parallels 4. Rated capacity (Ah @C10 and @C100) 5. Rated voltage 6. Manufacturing date 7. A clear indication of the connecting inlets and outlets 8. Charge strategy 9. Safety warning
	Warranty	The expected lifetime of the Battery shall be ten (10) years and at least 6000 cycles or more, and the warranty period shall be a minimum of five (5) years.
	Maintenance	Maintenance requirements shall be as low as possible

Unops team will perform a quality control over all the materials used as part of the integrated system provided by the contractor.

5. Technical room

	Specifications	A containerized solution based on a weatherproofed container (or several), preassembled, and tested in a controlled environment before shipment, to serve as technical room hosting inverters, charge controllers, battery bank inclusive of intelligent battery charge, protection, lighting protection, temperature control, current/voltage fluctuation protection and any other elements that make-up Balance of Systems (BOS) is acceptable. The solution built-in a hospital room (or several) with the same protection and control requirement as above is acceptable. This solution is to include an optimal and controlled environment (temperature, humidity, access etc.) to enhance the lifespan and functionality of the offered PV components, inclusive of appropriate safety features, cooling system etc. System design should consider and incorporate energy requirements for container/hospital room(s) internal environment control systems and ensure that its specific energy requirements do not reduce the requested PV solution capacity. Equipment should be protected with the corresponding IP rating according to where they are installed.
	Features	The technical room shall include these features: 1. Smoke detection and alarm 2. Fire extinguisher

		3. Climate control and protective device 4. Conditions: Tropical Environment 5. Operating Temperatures (outside the room): Tropical (0/+50 degC) 6. Internal temperature shall be regulated for optimal performance of equipment 7. If applicable, concrete base: provide specifications and/or requirements for the cement/concrete base for placement of the container. Related civil works to be undertaken by the bidder. 8. Ensure that the product conforms to appropriate and applicable European, American, Japanese and Australian standards regarding Safety for Electrical Appliance, Electrical Standards, Building Standards, Container Internal Environment, General Ventilation and Cooling standards for such facilities. Offer to reflect the cost of this element (technical room), including overall system cost improvement and/or increment related to this option.

6. Online monitoring system

	Monitoring and Management overview	Internet connectivity will be available at the site. The online monitoring system shall be a user-friendly dashboard that shows real-time power consumption, indicating which sources are used to provide the required power (grid, generator, solar PV or battery bank). 1. Overview list of installed equipment (Solar PV modules, inverter, solar charger, battery bank, generator etc.) 2. Battery bank properties (SOC and SOH) 3. Generation Overview indicating the production of each device in the system (Solar PV, Batteries etc. and Fault Diagnostics 4. Earnings/Saving in terms of energy (kWh), money ($), and emissions (kgCO2eq) from the solar system.
	List of hourly based parameters	Local and remote monitoring shall be provided to track the system's operation with real-time & historical data for at least 1 year with 15 Minutes resolution and 3 years with 1 hour

		resolution of data storage capacity. It must include at least the following parameters: 1. Total Electricity consumption (from the loads) 2. Total Electricity PV Production 3. Battery State of Charge 4. Battery Discharge Power 5. Alarms and configuration records 6. Generator/grid status and energy production
	Standards	It is an advantage for the monitoring system to follow the guidelines specified by IEC 61724-1
	Warranty	The components of an online monitoring system shall be subject to a 3-year limited product warranty or more.

7. Smart power management

	Systems operation logic	The hybrid energy solution shall include Smart Power Management that allows the working system to supply electricity according to the following logic/priorities 1. Solar PV 2. Grid 3. Battery 4. Generator
	Details	Smart Power Management should be able to provide: 1. Interconnection with local building electrical distribution panel 2. Interconnection with generators 3. Integration of all power sources and load to work as one system 4. Intelligent monitoring and control of all power sources, including batteries and/or generators and including auto-start and shutdown of generators. 5. Dynamic intelligent management for overall PV system/batteries/generators (energy supply solution). 6. Setup and activation of Internet-based (online) monitoring of Solar PV systems for Performance / Availability / Status etc.

		7. Integration of Solar PV – Batteries – Generators to operate in an integrated, intelligent and automated manner with regards to energy supply
	Non-critical loads management	Since the premises may contain segregated distribution circuits, with most loads that are considered critical connected accordingly, some power-hungry non critical loads as air conditioners – are connected to the non-critical load circuits. During grid outages, while the building should be running only on battery, the smart system must disconnect the non-critical load circuits as soon as the battery SOC falls below 80%.
	ATS for generators	Currently, the switching between generators is done manually. As a part of this project, an ATS needs to be installed in order to make switching between diesel generators automatically and controlled by the operator of the SCADA system. A Plan B needs to exit in case this is faulty.
	Changeover switch	A changeover switch shall be included to be able to bypass PV.
	Power requirements	The system should not vary the power factor of the load.
	Warranty	The components of a smart power management system shall be subject to a 3-year limited product warranty or more.

8. Electrical distribution network

	Systems operation logic	Electrical distribution systems are an essential part of the electrical power system. In order to transfer electrical power from an alternating current (AC) source to the place where it will be used.
	Details	The existing distribution system and the drawings of the future distribution system should be examined and indication for replacement given so that it can provide the following requirements: ● Proper voltage and frequency: 120V +/-5%, at 60Hz +/-5% at all consumer points ● Availability of power on demand ● Reliability and Safety ● Properly sized for the consumer load (it is necessary to establish the electrical plans for the complete hospital

		with the identifying feeders characteristics, cable size, and consumer loads at each socket)
	Warranty	The expected lifetime of the electrical distribution network is at least 25 years. The components of an electrical distribution network shall be subject to a 10-year limited product warranty or more.

9. Generator

	Capacity	120 KVA
	Frequency	60 Hz
	Phase	3
	Mian Voltage	400/230 v
	Rated Speed (R.P.M)	1500
	Rated at Power Factor (cos Phi)	0,8
	Fuel	Diesel
	Warranty	2 years

10. Penalties during the Contract & O&M

10.1 Penalties during contract execution

Unops reserves the right to apply the following penalties in case of delay imputed to the contractor.

The days are intended as calendar days.

Milestones	LIMIT ADMITTED	PENALTIES
Contract signature	**X**	
Site visit by contractor for a more detailed assessment of the electrical system at the hospital	X + 9 days	100 usd per additional day

Submission of report of findings with UNOPS for discussion.		
Submit the 60% drawing and design for review + detailed Infrastructure assessment report	X + 23 days	100 usd per additional day
Submit the final stamped drawing and design to be verified by UNOPS.	X + 45 days	100 usd per additional day
Delivery of goods	X + 180 days	100 usd per additional day
Supply installation	X + 215 days	200 usd per additional day
testing, Commissioning, training	X + 220 days	200 usd per additional day

The accumulated amount of the financial penalties for the delays will not be more than 10% of the contract value.

10.2 Penalties during O&M

PARAMETER	LIMIT ADMITTED PER SEMESTER	PENALTIES
The frequency of forced and programmed interruptions of the photovoltaic system is less than:	5 times	6 or more times: 1%
Total time in hours of interruptions (forced or programmed) during a semester:	216 hours	216,1 hours or more: 1%
Ensure that the maximum time for each forced interruption of the photovoltaic system is less than:	600 minutes	601 or more: 2%
Ensure that the supply voltage must not exceed the limits:	Upper limit: 126V Lower limit: 114V (for 120 V)	Outside of the limit more than 60 minutes: 0,1%
Ensure that the supply frequency of the photovoltaic system must not exceed the limits:	Upper limit: 63Hz Lower limit: 57 Hz	Outside of the limit of more than 60 minutes: 0,1%
Hours of forced or programmed Interruption of DAS (data missing):	300 minutes	301 or more: 2%

Note: % is based on the total **amount of the Contract** for Operation and Maintenance. The source of information for monitoring O&M will be: Data Acquisition System (DAS).

11. Contractor Project team (key personnel required)

The bidders should include in their offer the technical team that will implement the project activities. The minimum requirement expected for the contractor team structure are :

N*	Position	Required qualification	Area of expertise	Year of relevant experience
1	Electrical Engineer	Diploma in Electrical engineering	Electrical power plants Solar systems	5 years minimum in the design and implementation of electrical solution for multi-storey buildings, Hybrid electrical system in Haiti. -Design and Implemented at least 4 similar projects
2	Structure Engineer	Diploma in civil engineering	Structural/Civil Engineer	5 years minimum in the design , assessment of multi-storey buildings, Metallic Structure for solar panel in Haiti -Design and Implemented at least 4 similar project
3	Site Team Manager	Bachelor in Electrical Engineering	Electrical power plants Solar systems	-3 years minimum in the design and implementation of electrical solution for multi-storey buildings, Hybrid electrical system in Haiti. -Implemented at least 3 similar project

Annex II. Site locations and Pictures

1. Jeremie, Grand'Anse

1.1 Available areas

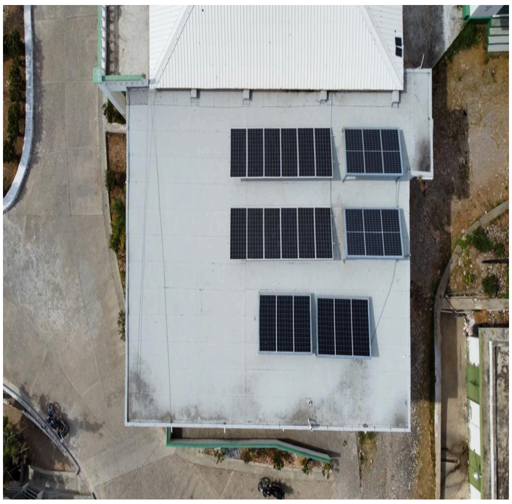
Hospital Saint Antoine de Jeremie, HSAJ areas available for Solar PV installation and the aerial view are shown below. PV energy conversion potential map for Haiti with an expected 4.2 kWh/kWp.day PV electricity generation output for Jeremie according to the ESMAP energy yield estimation

Table 2 HSAJ area available for Solar PV installation

Area	Name	Area, m2
Area 1	Toit médecine interne Hommes	115
Area 2	Toit médecine interne Femmes	75
Area 3	Toit de l'Urgence	77
Area 4	Toit de SOP	350
Area 5	Toit de la Maternité	250

Toit médecine interne Hommes: 115 m2

Toit de l'Urgence: 77m2



Toit médecine interne Femmes: 75 m2

Toit de SOP: 350 m2

Toit de la Maternité: 250 m2

Figure 1 St Antoine de Jeremie Hospital areas available for Solar PV installation

Picture: Available area for solar panels installation Area 2 (left) and Area 1 (right)

1.1 Generators, Distribution, Battery Inverters

Photo: Génératrice @ UNOPS

1.2 Solar PV

Photo: Onduleur et accumulateurs du système photovoltaïque du bloc opératoire @ UNOPS