



Terms of Reference (ToR)

Solarization of PSA Oxygen Plants at Tellewoyan and Rally Time Hospitals – Liberia

Project Title	Provision and Installation of Solar Power Systems for PSA Oxygen Plants at Tellewoyan and Rally Time Hospitals in Liberia
Implementing Agency	Plan International Liberia, Principal Recipient under GFTAM Grant
Partner Institution	Emergency Medical Services (EMS)
Duration	Four Months
Start Date	June 2025

1. Background

The Ministry of Health (MoH), in collaboration with the Global Fund through the COVID-19 Response Mechanism (C19RM), is working to strengthen the country's integrated health system, with a particular focus on enhancing medical oxygen supply across health facilities. The COVID-19 pandemic exposed significant gaps in healthcare infrastructure, especially in the availability and reliability of oxygen systems, which are critical for the treatment of severe respiratory illnesses.

As part of the Global Fund's Grant Cycle 7 (GC7), Plan International Liberia, serving as the Principal Recipient, supported the installation of four Pressure Swing Adsorption (PSA) oxygen plants across key regions in the country. While these installations have greatly improved access to medical oxygen, the functionality of the PSA plants is highly dependent on consistent power supply.

Two of the PSA plant sites Tellewoyan Memorial Hospital in Lofa County and Rally Time Hospital in Grand Kru County continue to face serious power supply challenges due to unreliable electricity and the high operating costs associated with diesel generators. These limitations threaten the sustainability and uninterrupted operation of the oxygen plants.

To ensure continuous functionality and reduce dependency on fossil fuels, Plan International Liberia is initiating the solarization of the PSA plants at the two aforementioned hospitals. This intervention aims to provide a reliable, cost-effective, and environmentally sustainable energy solution.

The Terms of Reference outline the scope and technical requirements for the design, supply, installation, and commissioning of hybrid solar photovoltaic (PV) systems at the selected sites. The goal is to engage a qualified contractor to implement this intervention in alignment with national health priorities and Global Fund investment objectives.

2. Objectives

- Provide sustainable and reliable solar energy to operate the PSA oxygen plants with reduced reliance on diesel.
- Ensure continuous oxygen production during both dry and rainy seasons.
- Enhance the operational resilience of health facilities.
- Build local technical capacity for system operation, monitoring, and maintenance.

3. Scope of Work

The selected service provider will be responsible for:

- Assessment of sites to provide the drawing and BOQs for mounting structures and battery storage
- Designing, supplying, and installing solar PV systems at 2 sites
- Integrating systems with existing power infrastructure (grid/generators)
- Training local staff on operations and maintenance
- Providing documentation, warranty, and remote monitoring tools

4. Technical Specifications

Component	Specification	Warranty
PV Panels	Monocrystalline solar PV panels (225 kW total; ~563 x 400W modules),	≥12-year product warranty, 25-year performance warranty (≥82%)
PCS (Inverter)	90 kVA continuous, 150 kW peak, 400/230V, 50 Hz; Grid-forming;	Minimum 5 years full replacement warranty
Battery Storage	LiFePO4 (preferred), modular, ≥4–5 hours autonomy, multi-source chargeable (solar, generator, grid)	Minimum of 10 years
ATS	Integrate an ATS to enable seamless switching between solar, battery, generator, and future grid power.	
Mounting Structure	Ground-mount fixed system, corrosion and wind resistant	10-year warranty
Cabling	IEC 60227 & 60502; voltage drop ≤2% on AC/DC sides	
Monitoring System	Real-time analytics, alerts, data logging, remote access	
Enclosures	IP65 or higher, climate-controlled if required	
Protection Devices	Surge and lightning protection (DC and AC sides)	

4.1 Solar Panels

Type: Monocrystalline, 225 kW total; ~563 x 400W modules

Product warranty: Minimum 12 years

Performance warranty: By the end of the 25th year, 82% of nominal output must be achievable.

Installation: The prospective contractor shall provide layout drawings and array connection diagrams to specify the installation details of the solar PV modules and the support structures.

4.2 Main Power Conversion System (PCS)

The microgrid system's grid-forming PCS must provide at least 90 kVA of continuous output and 150 kW of peak power at any time, even without solar generation. The power supply must be 400/230V, 50Hz.

The PSA plant to be powered by the microgrid system has a total installed power of 55 kW with an estimated peak demand of 70 kVA. The load includes a 30 kW VFD compressor and a 7.5 kW booster compressor. The maximum demand at starting is approximately 70 kVA. The plant operates 6 hours/day with an average demand of 45 kW.

The solar PV system must be designed and arranged to provide power primarily to the oxygen PSA plant while also having enough capacity and flexibility to accommodate smaller secondary loads, like lighting or auxiliary equipment up to 20 kW, when the PSA plant is inactive. The system should incorporate suitable load management or switching features to redirect power effectively without affecting performance.

4.3 Battery Storage

The storage system must provide enough capacity to run the PSA plant for at least 3 hours without solar generation or external power sources. The solar battery system shall be designed for easy scalability, allowing seamless storage capacity expansion through modular components or additional units, with minimal reconfiguration or downtime. Lithium iron phosphate is the preferred battery technology, but the bidding contractor could consider other technologies.

4.4 Mounting Structures

The structure will be a ground-mounted, fixed system.

Product warranty: The warranty must be for at least 10 years. The contractor must justify that the racking system can withstand local wind loads and environmental corrosion.

4.5 Cables

All cables shall conform to IEC 60227 & IEC 60502—voltage rating: 1,100V AC, 1,500V DC. The total voltage drop on the cable segments from the solar PV modules to the inverter shall not

exceed 2.0%. The total voltage drop on the cable segments from the inverter to the PSA distribution board shall not exceed 2.0%

4.6 COMMs and Monitoring

The system must provide a monitoring system that offers remote access to real-time operation and performance parameters and historic operating parameter logs.

4.7 System Enclosure

All system components shall be housed within an outdoor enclosure rated IP54 or higher. For systems not utilising a prefabricated container, the contractor shall construct a dedicated, weatherproof building as part of this project. This building must include a climate control system that maintains operational temperatures within the manufacturer's specified range.

4.8 Surge Protection

Surge protection shall be provided on the DC and AC sides of the solar system.

4.9 System Integration

To ensure its adaptability and reliability, the microgrid system must be able to seamlessly manage two external power sources—a diesel generator and utility power—and automatically manage them based on energy requirements. The utility power supply will not be integrated initially, but the system must be ready to take it on without any additional changes.

The PSA plants in both facilities are rated 55 kW, and the projected peak demand is 70 kVA.

The backup generator specified for the PSA plant on Rallytime Hospital is 150 kVA and standby-rated. The backup generator in Tellewoyan Hospital is 165 kVA and standby-rated.

4.10 Available Area

The ground array should not exceed 500 m².

5. System Standards

The PV system must be compliant with the following international standards:

- PV system design and installation must comply with IEC 62548
- The system must be tested and commissioned to IEC 62446
- Solar PV system components should comply with standards and codes IEC 61215, IEC 61730 Part 1 and 2, Salt Mist Corrosion Testing As per IEC 61701.
- Operation grid interconnection standards like IEC 62116 (anti-islanding) and IEC 61727 (PV grid compliance). Especially when there is possible future grid interconnection.
- All electrical enclosures to meet IP65+ standards for dust and water resistance.



6. Site-Specific Information

- Tellewoyan Hospital
 - GPS Coordinates: 8.425782, -9.746566
- Rallytime Hospital
 - GPS Coordinates: 4.575126, -8.221610

The proposed site layout for the system is shown below in Figures 1 and 2:



Figure 1: Tellewoyan Hospital - Proposed Site Layout



Figure 2: Rallytime Hospital - Proposed Site Layout

Energy Consumption Pattern: The daily energy usage trend is shown below in Figure 3:

Daily Profile

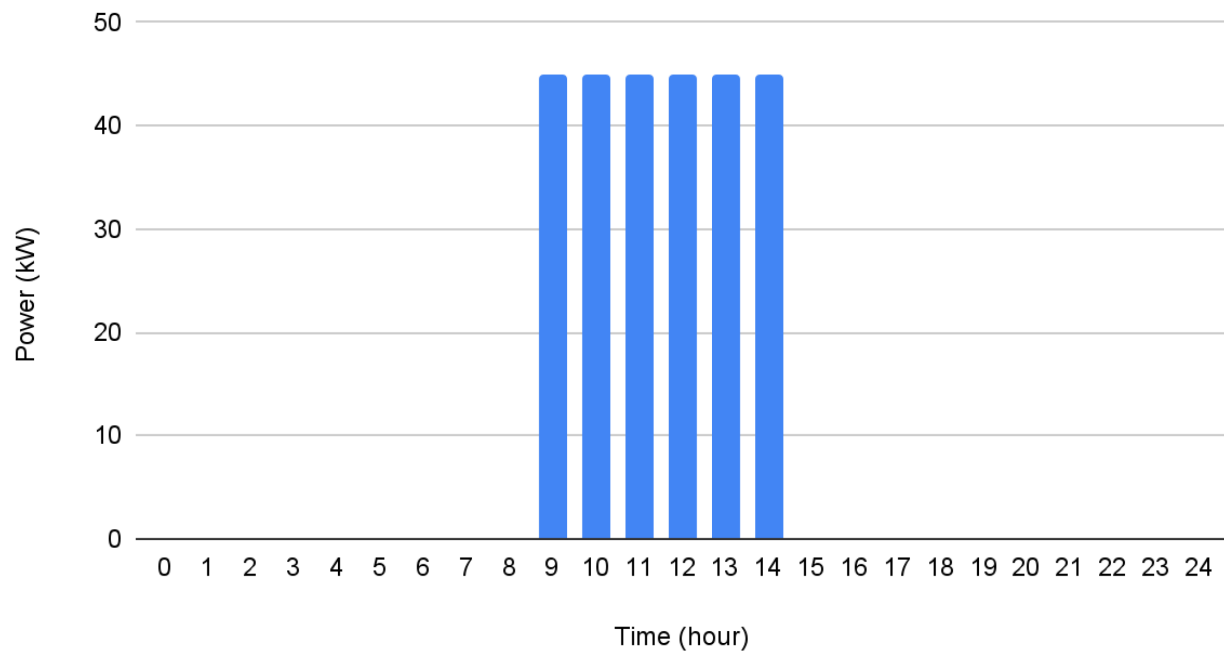


Figure 3: Daily energy usage

7. Key Deliverables

Deliverable 1:

- a. Detailed Planned Schedule of works.
- b. Detailed site assessment report, including:
 - i. Identification for components' location(s)
 - ii. Photo documentation and assessment of any shading objects
 - iii. Selection of a suitable mounting system
- c. Design sizing and documentation, including (where applicable):
 - i. Site plan showing PV array layout, underground cable, duct routing, etc.
 - ii. Appropriate sizing in piping lengths and sections for the entire installation
 - iii. Shop Drawings (e.g., Single-line electrical diagram showing PV array configuration and system interconnection, wiring layout including distances; protections; components etc.)
- d. A description of the proposed performance and acceptance testing procedure that will be undertaken during commissioning phase.
- e. A letter certifying the compliance with requirements on warranties, spare parts for 2-3 years and standards, etc.
- f. The PV modules will be ground-mounted, supplier will take responsibility for construction of mounting structure ensuring its structural integrity.

Deliverable 2:

- a. Complete solar system installation (PV array, inverter, batteries, controllers)
- b. Performance testing and acceptance
- c. Commissioning reports signed by health facilities or EMS/PIL official

Deliverable 3:

- a. Formal signed User Acceptance Test (UAT) and Commissioning of the Solar PV system, etc. Report shall be approved by the Health Facilities and EMS officials
- b. Submission of final Technical Report, inclusive of:
 - i. As-built drawings
 - ii. Technical description of the final solution
 - iii. Testing/Commissioning report (inclusive of final testing and values)
 - iv. Datasheets
 - v. Static verification of mounting structure (if applicable)
 - vi. Warranty certification/documentation for the main components
 - vii. Submission of photos, videos and visual material of the final system installed
- c. Training on Operation and Maintenance (O&M) of the installed equipment for the beneficiaries' representatives (end users and beneficiaries' staff maintenance crews) and provision of training materials and O&M manuals. Inclusive of:

- i. Basics on the Solar PV system commissioned (components and operation)
- ii. Basic shutting-down procedures (in case it is necessary)
- iii. Operation and Maintenance of the solar PV system (for future hand-over after maintenance period)
- iv. Integration with gensets (where applicable)
- v. All basic issues that might occur and the relevant troubleshooting.
- vi. A special focus should be on using the online monitoring system and troubleshooting of basic errors and problems that occur frequently.
- d. Signaling labelling:
 - i. All components shall be labelled in English.
 - ii. Signs or labelling warning about safety hazards, e.g. smoking, water contact, etc.
 - iii. Emergency shutdown procedures (visual information) shall be provided.
 - iv. Panel with up keeping and operating instructions for the beneficiary shall be installed.

Deliverable 4:

- a. Integration of remote monitoring tools
- b. Defect liability and post-installation support (12 months)
- c. Final report for commissioning and installation of solarization system at both sites with pictures

8. Implementation Timeline

Milestone	Timeline
Contract Signing and Preparation for site	Week 1
Site Assessment & Final Design	Week 2
Procurement & Delivery	Weeks 3–7
Mobilization of equipment	Week – 8
Installation & Commissioning	Weeks 9–12
Training & Handover	Weeks 13–14
Final Documentation Submission	Week 15

9. Reporting and Oversight

The contractor will report to:

- Plan International – Liberia and Ministry of Health
- With oversight from Emergency Medical Services (EMS) Team
- Weekly progress reports during installation
- Monthly post-installation performance monitoring (first 3 months)

10. Payment Terms

Payment will be performance-based, linked to the completion of deliverables:

- 30% on contract signing and mobilization against the Bank Guarantee
- 30% on delivery and installation of equipment
- 30% upon successful commissioning and training
- 10% upon submission of final documentation and performance verification (after 60 days of operation)