Project BOXER Info Session

PSA Plant Site Readiness

6 February 2023

Project BOXER: TA for C19RM bulk O2

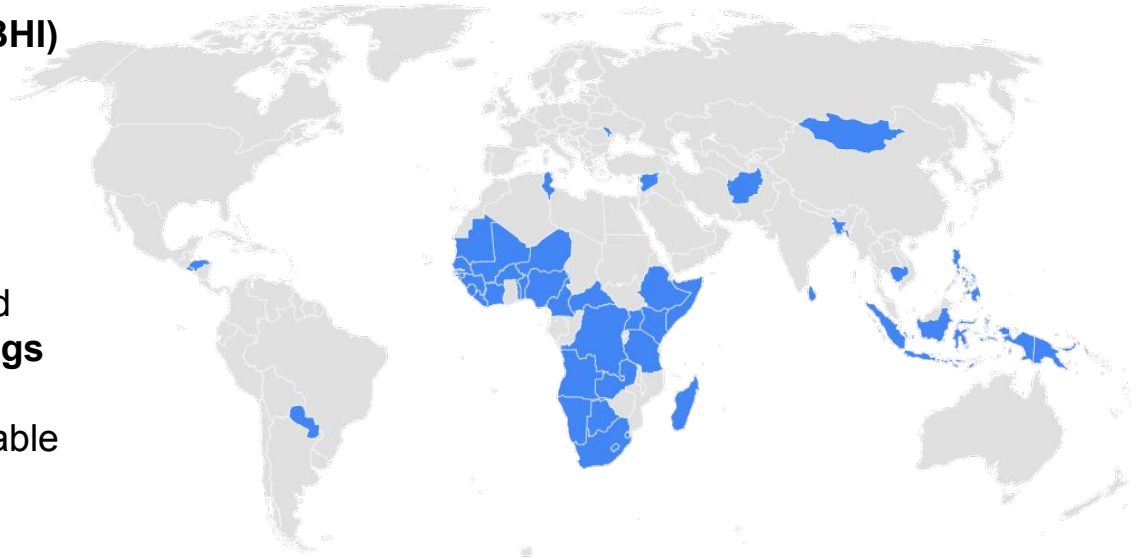
Project Scope/Objective: To provide technical assistance that will support the implementation, monitoring and oversight of Pressure Swing Adsorption (PSA) plants and relevant Global Fund oxygen investments **to ensure sustainability and maximized impact of increased global oxygen capacity**

TA Provider: Build Health International (BHI)

Who is BHI?

A team of **technical experts** focused on a commonsense approach to physical infrastructure to allow for the **delivery of high-quality care**, that can be operated and maintained in **resource-constrained settings**

BHI's mission is to enable dignified, affordable and high-quality healthcare for all



Project BOXER is providing technical assistance to 46 out of 57 countries procuring PSA plants via C19RM

Project BOXER Info Session

Topic: PSA Plant Site Readiness

Presenter: Eric Buckley, Director of Oxygen Engineering, Build Health International

As Director of Oxygen Engineering, Eric leads the BHI team focused on improving access to lifesaving medical oxygen through infrastructure improvements, oxygen plant repair and maintenance, design of new oxygen plants and hands-on training in low-resource areas throughout the world. Eric also oversees collaborative efforts among global partners and organizations, funders, ministries of health, and other stakeholders who share a common goal of strengthening health systems through improved oxygen delivery and access.

Your PSA Plant is Ordered - What's Next?

Order PSA Plant*	Select PSA Plant Location	Develop Construction Documents	Site Work	Installation & Commissioning
PSA Plant Manufacturer/Supplier shares technical requirements for infrastructure Supplier provides suggested layout drawings	Finalize plant layout with PSA Plant Manufacturer/Supplier*, considering hospital operational needs**	Considering other infrastructure upgrades required Must ensure they match supplier requirements	Initiate tender Select contractor Start construction Schedule site inspection with PSA Plant Manufacturer/Supplier*	PSA Plant Manufacturer/Supplier to unload, install, test, and commission the PSA plant Plant technicians to participate in a supplier-led training

***For countries procuring plants through UN agencies, contact them for more information on this process**
***For PPM/wambo procurements, countries will need to coordinate closely with i+solutions.**
****Operational Needs:** What the hospital will need in place to operate the PSA plant in a way that works for them. Examples: Storage for cylinders, office or toilet attached to the plant house, upgrading the transformer or adding a generator house, improving road access to the plant location, etc.

Site Readiness Steps

1. Coordination
2. Site Planning
   Location, Layout, Plant Housing & Construction Documents
3. Site Work
4. Installation and Commissioning
5. Training
6. Operation and Maintenance

1. Coordination

PRs need to coordinate with each hospital receiving the plant to:

- **Identify key admin and technical staff** to support the plant coordination, commissioning, and operations.
- **Identify space available** for the plant, considering operational needs (e.g., office space, road access, cylinder storage, toilet, etc), and ramp space
- Work with the supplier to **finalize plant layout**, considering space constraints and operational needs

Topics for PRs to discuss with each site

- How many technical staff are available to operate the plant?
- **Does the hospital need to hire any additional technical staff?**
- What maintenance and operating budget does the hospital have for the PSA plant?
- **Where will the cylinders, spare parts, and consumables be stored?**
- Is there sufficient road access to the PSA plant? *This is particularly important when there are plans to send cylinders to facilities outside of the hospital.*
- Is the infrastructure around the future plant house conducive to delivering cylinders to supply manifolds?
- What are the energy requirements for the PSA plant?
    - **Does the hospital need to upgrade a transformer or purchase another generator?**
    - Will funding for fuel be made available for backup generators?
- Are you going to run oxygen piping in trenches or along above ground infrastructure?
- Review the service and warranty contract with the procurement agencies or department.
- When do you expect to have the site work completed and ready to receive the plant? This should be communicated to the supplier to coordinate the delivery date.
- **Finalize plant housing layout, considering space constraints and operational needs (e.g., office space, road access, cylinder storage, toilet, etc), and ramp space**

1. Coordination: Support from BHI

BHI Can:

- Guide conversations about technical considerations for site preparations with PR and the hospital
- Provide budget tools to develop allowances for generalized budget
- Identify general infrastructure requirements
- Work with the supplier/i+solutions to finalize plant layout, considering space constraints and operational needs

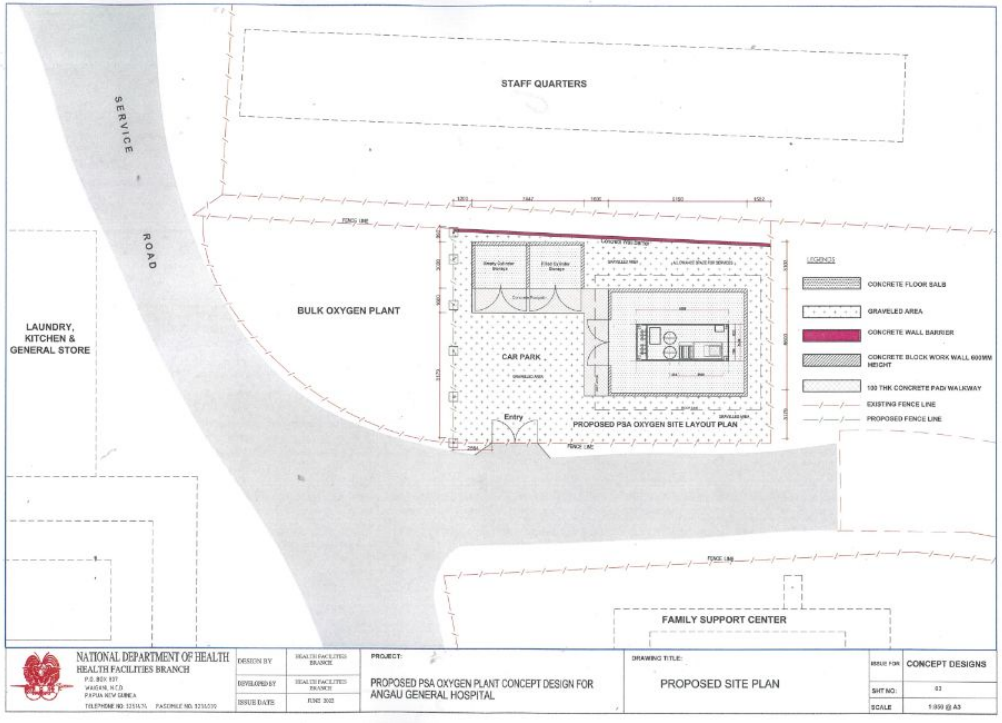
BHI Cannot:

- Provide detailed design documentation information **prior** to selecting a supplier, and receiving their detailed infrastructure requirements.
  - Can only be performed once the manufacturer's specific system requirements are known. Each supplier has different site requirements for their systems which must be adhered to.
- Provide pricing or cost feedback for local infrastructure works

2. Site Planning: Location

Key considerations for selecting **plant house location**:

- Meets the minimum space requirements provided by the supplier
- Distance from air pollutants (e.g., idling cars, incinerators, generator exhaust, etc) or flammable materials (cardboard boxes, grease, oil, etc)
- Location in relation to power source and buildings the oxygen will be piped to
- Location should be secure and not prone to flooding
- Road access for plant installation and cylinder distribution (where applicable)
- Space for other plant house needs: gen house, toilet/office, cylinder storage, etc.



2. Site Planning: Risk Mitigation

Common Challenge: Poorly maintained or selected site location

Examples:

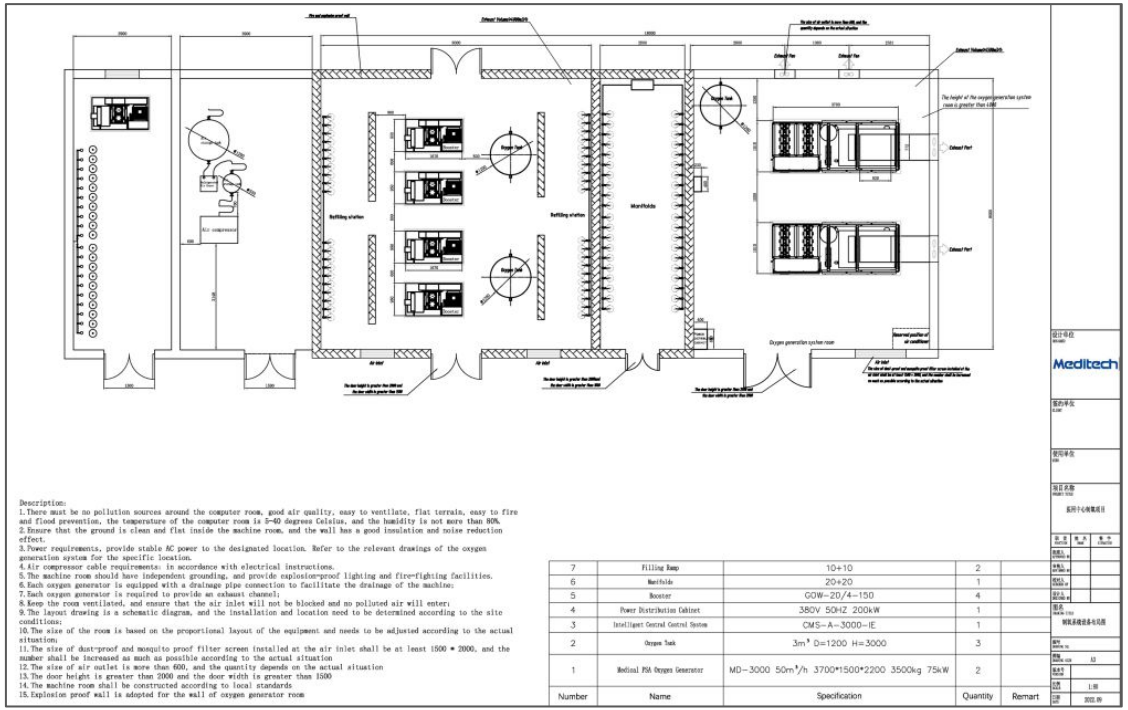
- PSA plant is located in an area prone to flooding or other environmental issues
- Site selected does not allow for efficient access to patient delivery or cylinder inventory management

Risk Mitigation:

- **Carefully evaluate the location** selected and incorporation risk mitigation into building design if environmental issues cannot be avoided in location selection.
- **Coordinate with hospital administration** to determine operational needs and consider those in selecting the plant house location.
- When determining site work, **consider construction needs** outside of the plant house building, to ensure smooth operation of the plant and delivery of oxygen to patients.

2. Site Planning: Plant Layout

Example: Suggested layout provided by Supplier



Description:
1. There must be no pollution sources around the computer room, good air quality, easy to ventilate, flat terrain, easy to fire and flood prevention, the temperature of the computer room is 5-40 degrees Celsius, and the humidity is not more than 80%.
2. Ensure that the ground is clean and flat inside the machine room, and the wall has a good insulation and noise reduction effect.
3. Power requirements, provide stable AC power to the designated location. Refer to the relevant drawings of the oxygen generation system for the specific location.
4. Air compressor cable requirements: in accordance with electrical instructions.
5. The machine room should have independent grounding, and provide explosion-proof lighting and fire-fighting facilities.
6. Each oxygen generator is equipped with a drainage pipe connection to facilitate the drainage of the machine;
7. Each oxygen generator is required to provide an exhaust channel;
8. Keep the room ventilated, and ensure that the air inlet will not be blocked and no polluted air will enter;
9. The layout drawing is a schematic diagram, and the installation and location need to be determined according to the site conditions;
10. The size of the room is based on the proportional layout of the equipment and needs to be adjusted according to the actual situation;
11. The size of dust-proof and mosquito proof filter screen installed at the air inlet shall be at least 1500 * 2000, and the number shall be increased as much as possible according to the actual situation
12. The size of air outlet is more than 600, and the quantity depends on the actual situation
13. The door height is greater than 2000 and the door width is greater than 1500
14. The machine room shall be constructed according to local standards
15. Explosion proof wall is adopted for the wall of oxygen generator room

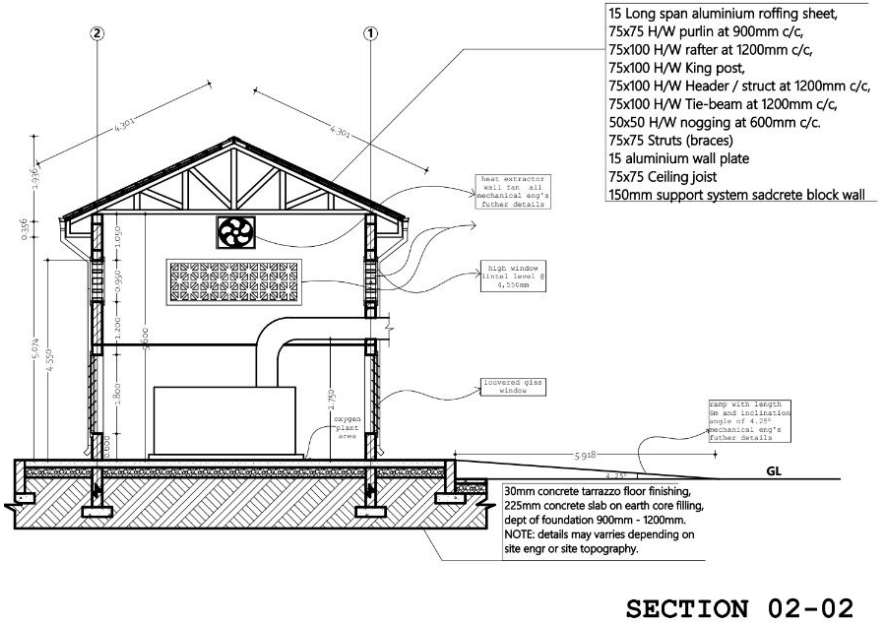
Number	Name	Specification	Quantity	Remart
7	Filling Ramp	10+10	2	
6	Manifolds	20+20	1	
5	Booster	GOW-20/4-150	4	
4	Power Distribution Cabinet	380V 50HZ 200kW	1	
3	Intelligent Central Control System	CMS-A-3000-IE	1	
2	Oxygen Tank	3m³ D=1200 H=3000	3	
1	Medical PSA Oxygen Generator	MD-3000 50m³/h 3700*1500*2200 3500kg 75kW	2	

Meditech

- Work with supplier/i+solutions to adjust the **plant layout** to fit space available, operational needs, hospital preference.
- **Identify improvements to existing facility** (outside of the supplier scope) required and **customize plant layout** and infrastructure work accordingly. This might include increasing the size of the transformer, expanding road access, or identifying tie-in points to a existing piping network.

2. Site Planning: Plant Housing

- Develop set of **construction documents** with sufficient detail for a contractor to understand the work. Documents should include:
  - Architectural Drawings
  - Structural Drawings
  - Site Plan & Civil Drawings
  - Mechanical Drawings (ventilation, cooling, etc)
  - Equipment Layout: *Already finalized by the supplier*
  - Electrical drawings (to include single line diagram)
- Develop a **Bill of Quantities (BoQ)**
- Initiate **call for tender** to source contractors
- **Review tender bids** and qualifications of bidders
- **Select a contractor** to perform site work



SECTION 02-02

2. Site Planning: Risk Mitigation

Common Challenge: Inadequate infrastructure to allow for the operation of the PSA plant

Examples:

- Insufficient electrical capacity of existing system (transformer, generator, feeders, distribution panels, etc.)
- No civil works completed for preparing site, or providing shelter for containerized PSA plants

Risk Mitigation:

- Conduct an electrical assessment of the hospital and determine where and how to upgrade electrical infrastructure to support the PSA plant.
- Detailed electrical drawings should be created and checked by qualified professionals before construction begins

2. Site Planning: Support from BHI

BHI Can:

- Identify areas where existing infrastructure is inadequate or requires upgrades to support the plant based on photos and information provided by the PR.
  - Level 4 Countries: Conduct a site assessment and produce a report with recommendations
- Provide site specific, detailed design drawings for contractors to bid on the works.
  - Only after a site visit is done for this purpose, however there may be situations where we can provide drawings with adequate information and photos
  - All drawings and documentation will be designed to international standards
- Review contractor bid documents and/or detailed design drawings or documents
  - BHI can provide feedback regarding the completeness of the bids and contractor questions about the scope of work / construction documents
  - Evaluate skills and qualifications of contractors based on documentation provided for past completed work
- Review Bills Of Quantities (BoQ) for completeness and accuracy in material quantities

2. Site Planning: Support from BHI

BHI Cannot:

- Issue signed or stamped permit drawings for any international jurisdictions
  - Any permitting submissions must be done by local designers
  - BHI holds no professional registrations in any plant installation location
- Identify local contractors to complete infrastructure works, including managing the tendering process

3. Site Work

- Monitor contractor progress
- Alert supplier* of site prep completion and schedule inspection for verification
- Schedule delivery* of PSA plant

*For countries going through Central Procurement, this will be done through i+solutions

NOTE: If site work is not completed before delivery of plant: temporary storage will need to be arranged by the PR, as well as a crane for later delivery.

3. Site Work: Civil & Architectural

- Site must be properly **leveled and graded** and any **drainage** or storm water issues at the site must be addressed
- Any roadwork or **truck access** must be provided to allow plant to be installed and serviced
- **Width of door and ceiling height** must meet manufacturer requirements to allow for installation
- Must have a **ramp** to transport cylinders in/out of the container or plant house building
- Must have **sufficient space** around the plant to maneuver cylinders and service the equipment

3. Site Work: Electrical

- Any required **upgrades to the existing primary electrical infrastructure** must be made - this includes fixing unsafe conditions (such as improper or missing grounding or oversized breakers) or upgrading existing elements (such as undersized transformers or generators)
- Install **appropriately sized primary feeder cable** to bring power from the main distribution panel to the PSA plant room or site for the container
- Install the **back-up power system**, such as a diesel generator, and the associated automatic transfer switch to ensure uninterrupted plant operation during loss of power




3. Site Work: Oxygen Piping

- Piping designs must follow governing local codes or accepted international standards, such as ISO 7396
- All piping used in the installation must be copper, and cleaned for oxygen service
- All piping diameters must be sized by a qualified professional based on flow rates and piping lengths to limit pressure loss within the piping runs
- Oxygen outlet types must be coordinated with local standards to ensure they are compatible with the hospital's oxygen delivery devices

3. Site Work: Risk Mitigation

Common Challenge: Inadequate plant house buildings.

Examples:

- Door openings, or ceiling heights are insufficiently sized for equipment
- Inadequate ventilation is provided to prevent overheating
- Not enough space to maneuver cylinders around the plant

Risk Mitigation:

- Detailed drawings are created and checked by qualified professionals against the supplier layout before construction begins

- This plant has been designed with stairs, instead of ramps. Ramps are needed for ease of loading and unload cylinders and for forklift access for non-containerized plants.
- The concrete pillars are constructed in a way that the container cannot be moved in the future.

3. Site Work: Support from BHI

BHI Can:

- Visit the site to verify upgrade work meets specification requirements (level 4 countries).
  - Not a formal site inspection – only to validate work completed. The supplier must do the final inspection before the plant is delivered and there still may be a required inspection by the authority having jurisdiction.

BHI Cannot:

- Serve as a project manager or hospital representative to overseeing construction work for site readiness
- Performing any construction works or installations related to PSA plant site readiness, including provide supervision of subcontractors performing the work or purchase of any equipment/materials

4. Installation & Commissioning

- Provide clear access to allow for plant delivery and crane use by the supplier
- Supplier to unload, install, test, and commission the PSA plant.
- Hospital technical staff must participate in training program held by the supplier
- Spare parts and consumables must be organized and inventoried
- Manage day-to-day operation of the equipment, including preventative and corrective maintenance.

Mbarara, Uganda

4. Installation & Commissioning

Mbarara, Uganda

Note: A section of the truss had to be removed to install this plant equipment. It is very important that manufacturer requirements are checked against construction documents to ensure there is enough clearance for the equipment.

4. Installation & Commissioning

Lesotho

Mirebalais, Haiti

5. Training

Supplier Training

- Each plant comes with a supplier-led training. This specific content of this training will vary by each supplier, but should provide a general overview of PSA plant operations to the users. Typically, this training is geared toward technicians that will be managing the day to day plant operations.
- It is important for the PR and hospital staff to identify, and make available, the staff who will be responsible for maintaining and operating the plant. BHI recommends at least one dedicated person who can monitor the plant on a daily basis. This does not have to be someone with any formal or specific technical training.

BHI Training

As part of Project BOXER, BHI is available to provide additional training to supplement the manufacturer provided in-person training. This training can be developed to cover specific needs within each country context.

BHI training can be developed to provide additional education to several different stakeholders, such as:

- PSA Plant Technicians
- PSA Plant Experts (e.g., Regional Technical Referent supporting multiple plants)
- Administrators

6. Operation and Maintenance: Technical

- Technicians must conduct daily monitoring checks, preventative maintenance, and corrective maintenance.
- Provide a clean environment for the PSA plant to operate.
- Ensure continuous access to reliable power
- Understand the maintenance schedule and warranty terms of the equipment.
    - Including supplier support responsibilities and warranty voiding activities that the hospital should not engage in related to plant service.
- Work with admin to schedule preventive maintenance visits with the supplier, per the service agreement.
- Good stock management practices in place to ensure regular supply and availability of spare parts and consumables.

6. Operation and Maintenance: Admin

- Actively engage in PSA plant budget management to ensure adequate funds for the the long term operation of the plant. Budget considerations to include:
  - Fuel
  - Electricity
  - Human Resources
  - Plant maintenance: to include tools, spare parts, consumables, cylinders, and stock management
  - Trainings
- With the technical team, create and be an active participant in an escalation plan to respond to PSA plant issues.
- Work with the technical team to schedule preventive maintenance visits with the supplier, per the service agreement.

Key Documents / Resources

- **Skid-Mounted and Containerized Plant Site Prep Checklist**
- **Detailed Electrical Assessment Form**
- **Site Readiness Process and Responsibilities**
- **Budget Allowance Tool**

Questions

Future Information Sessions

What types of information sessions are you interested in participating in?

Please fill out this survey!

Potential Information Sessions

- PSA plant common failures & maintenance recommendations
- Energy management & electrical infrastructure challenges
- Management for spare parts and consumables
- Daily maintenance routines & checklists

Build Health International

www.buildhealthinternational.org