

# Overview: PSA Plant Site Readiness Process and Responsibilities

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This document outlines the process of preparing sites to receive and install pressure swing adsorption (PSA) plants. Each step is broken down by scope of responsibility for each stakeholder. The site readiness process will differ based on the type of plant being received (containerized plant versus skid-mounted plant) and where it will be installed (into an existing building or a newly constructed building). Principal Recipients (PRs) who use PSA plants should use this document to stay on schedule and to clarify roles and responsibilities between themselves, the supplier, and i+solutions. Each supplier has specific and varying prerequisites for site readiness, which the PRs must verify. The below outlined recommendations may not be applicable to every PSA site. The PR must confirm specific responsibilities with their final selected supplier.

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# 1. Containerized PSA Plants

## Initial Requisition

1.	Supplier
After plant specifications are finalized, potential PSA plant suppliers submit bids. <i>When PSA plants are purchased through Central Procurement (via wambo.org), the process is managed by i+solutions and all bids are received from pre-approved suppliers with known local capacity to deliver the project in each individual location.</i>	
2.	i+ solutions / BHI
Bids are reviewed to ensure compliance with specifications. <i>When purchased through Central Procurement, this technical review is completed by both the i+solutions team, as well as the Build Health International (BHI) team.</i>	
3.	Supplier
Fabrication of the unit begins by the manufacturer.	

## Site Planning

4.	Supplier
PSA plant supplier shares technical requirements for infrastructure that must be in place for the equipment to be installed; this is typically provided as a chart or itemized list. In addition, the PSA plant supplier provides layout drawings of the container and schematic level drawings of the recommended concrete pad and canopy structure. Once the specifications have been shared, the site readiness process begins.	
5.	PR
<p>Hospital administrative staff, Ministry of Health (MoH) officials, Principal Recipient (PR) or other relevant parties will determine supplemental programmatic instructions that must be incorporated into the documentation of the necessary construction works. In addition, there should be discussion about additional scope items, not relevant to the PSA plant supplier, regarding the programmatic/operational needs of the hospital. Key discussion points include:</p> <ul style="list-style-type: none"> <li>• How many technical staff are available to operate the plant?</li> <li>• Does the hospital need to hire any additional technical staff?</li> <li>• Will the hospital carry sufficient maintenance and operating budget for the PSA plant?</li> <li>• Where will the cylinders, spare parts, and consumables be stored and how will this inventory be managed?</li> <li>• The construction documents must be prepared by a design team. The party selected to develop the documents will depend on local practices and the capacity of various potential collaborators. These documents are typically developed by: <ul style="list-style-type: none"> <li>◦ External architects and engineers hired by the MoH.</li> <li>◦ In-house MoH (or other governmental agency) engineering professionals.</li> <li>◦ A design team employed by the general contractor responsible for construction. This practice is commonly referred to as design-build.</li> </ul> </li> <li>• 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.</li> <li>• What are the energy requirements for the PSA plant? <ul style="list-style-type: none"> <li>◦ Does the hospital need to upgrade a transformer or purchase another generator or perform any other additional infrastructure work outside of the supplier's scope?</li> <li>◦ Will funding for fuel be made available for backup generators?</li> </ul> </li> <li>• When moving between buildings, will the oxygen piping run in trenches or along above ground infrastructure?</li> <li>• When/how will plant housing layout, considering space constraints and operational needs (e.g., office space, road access, cylinder storage, toilet, etc), and ramp space be finalized?</li> <li>• Cylinder storage: If the PSA plant will be filling cylinders, there needs to be space dedicated to cylinder storage for both empty and full cylinders. This space needs to be appropriately secured and accessible only to trained staff, accessible for transporting cylinders (particularly if they will be loaded/unloaded to be transported outside of the facility), and appropriately stored, away from flammable objects.</li> </ul>	

## Site Selection & Construction Documents

6.	PR
<p>Hospital administrative staff, ministry of health (MoH) officials, or other relevant parties must identify the precise location of where the PSA plant container will be permanently located.</p> <ul style="list-style-type: none"> <li>The area and the concrete platform provided for the installation of the on-site oxygen production container unit should be dedicated to only the use of the PSA plant container. It must be wide and open enough to allow easy access for a truck and easy installation of the container by a crane. It must contain no storage or warehousing of any product whatsoever within its surroundings. In particular, the presence of flammable materials (cardboard box, grease, diesel, oil, etc.) are strictly prohibited near the container.</li> <li>Air pollutants (e.g., generator exhausts, idling cars, waste incinerators), must be a minimum of 10m away from the PSA plant.</li> <li>The location must be cleared, excavated, level and compact the ground at the location selected for the PSA plant container. The site must meet the minimum dimension requirements of the supplier, including space for a ramp.</li> <li>The container area needs to be well lit and in a secure location that is not prone to flooding.</li> <li>It is strongly recommended to fence and lock the container area to limit access to authorized personnel only. The fence door must accommodate a forklift and be at least 1.8m (3.5 ft) wide.</li> </ul>	
7.	PR
<p>Layout drawings and specifications from the supplier, in conjunction with any additional programmatic requirements by hospital officials (as outlined in step 5), are used to develop a comprehensive set of construction documents. These documents should demonstrate the infrastructure work that the general contractor is required to perform. Construction documents will include architectural and engineering drawings, any relevant written specifications (if required), and an itemized bill of quantities.</p> <ul style="list-style-type: none"> <li>Prior to developing the construction documents, the design professionals responsible for this scope of work must complete an assessment of the existing hospital to identify any improvements required to the existing infrastructure to allow the PSA plant to be installed.</li> <li>Infrastructure improvements that are not typically part of the PSA plant supplier's scope of work, or included in their package of site readiness requirements, may include items such as increasing the size of the existing transformer that serves the hospital, expanding road or truck access within the facility to allow access to the PSA plant location, identifying tie-in points to the existing piping network, etc.</li> </ul>	
8.	PR
<p>For a containerized PSA plant application, the minimum infrastructure works typically include civil, electrical and architectural components, including:</p> <ul style="list-style-type: none"> <li>A concrete pad to provide a level setting surface for the container. The size of the pad will depend on the size of the container used (6.06m / 20ft or 12.2m / 40ft), as well as any specific manufacturer requirements. The pad should be provided with a ramp to allow access for moving equipment and efficient cylinder movement.</li> <li>A canopy structure to provide protection from direct weather exposure to the container. The minimum canopy dimensions will vary based on supplier recommendations and must provide additional coverage beyond the limits of the container if cylinders will be stored outside of the container walls. The canopy is typically constructed of tube steel columns and steel roof trusses, with timber purlins and sheet metal roofing. The structure will vary depending on local practices.</li> <li>Electrical feeders connecting the PSA plant container to the main distribution panel of the hospital must be provided, as well as any necessary upgrades to the existing infrastructure. This scope should also include any necessary connections to new or existing back-up power sources, such as generators, and the accompanying transfer switches.</li> <li>A chain-link fence around the perimeter of the canopy and concrete pad is recommended for safety and security purposes.</li> </ul>	
9.	PR
<p>The design team works collaboratively with the PR or hospital officials to develop the construction documents with necessary feedback and approval from the MoH or governing body, incorporating any additional programmatic requirements beyond the needs of the PSA plant supplier (i.e. office space, storage closets, etc.).</p> <ul style="list-style-type: none"> <li>One key consideration is cylinder storage. If the PSA plant will be filling cylinders, there needs to be space dedicated to cylinder storage for both empty and full cylinders. This space needs to be appropriately secured and accessible only to trained staff. Additionally, the space should be accessible for transporting</li> </ul>	

cylinders (particularly if they will be loaded/unloaded to be transported outside of the facility), and appropriately stored, away from flammable objects.

**10. PR**

Once final documents are approved, the PR will use the complete construction document package to initiate a tender process to source a local contractor to complete the works as described in the construction documents. This step is not necessary if a design-build process is used, and the construction documents are developed as part of the General Contractor's scope of work.

**11. PR**

The PR receives bids from local contractors as part of their standard tender process and selects a contractor to perform the works.

## Site Work

**12. PR**

Once a contractor is selected and the work begins, the design team is typically available to answer contractor questions and monitor general progress on site to ensure the development conforms to the intent of the construction documents.

**13. PR**

The PR, in collaboration with the design team, will monitor the contractor's progress and ensure that deadlines and deliverables are met per the agreement, and any support required by the contractor to complete their work is provided. These responsibilities are typically spelled out in the tender agreement.

**14. PR**

Install a Concrete Slab for the Container

- A level concrete pad must be installed to support the PSA plant container. Exact concrete pad dimensions will depend on the selected supplier and their specific requirements. As an example, the dimensions recommended by one supplier are shown below. These dimensions will be different for other suppliers. Do not use these dimensions for any official drawings or construction work.
  - 20' container minimum dimensions of 12m x 7m (40 ft x 25 ft)
  - 40' container minimum dimensions of 18m x 7m (60 x 25 ft)
- An entry ramp must be built to accommodate a forklift to access the container doors and needs to be a minimum of 2.5m (7 ft) wide, with a slope not to exceed 12:1.
- The platform floor must be pitched to prevent water accumulation, or drains shall be provided at one or more locations within the slab to drain surface water
- Water is condensed and collected inside the PSA plant machinery. There should be a drain cast into the concrete floor to evacuate water out of the container. This drain should be linked to a wastewater network, or managed in a controlled manner (e.g., a soak away pit) to avoid flooding, standing water, erosion, or run-off issues.

**15. PR**

Install Canopy Roof

- Install a roof canopy structure to provide weather protection to the containerized PSA plant. This canopy is typically constructed from welded tube steel framing members and sheet metal roof but can be adjusted to best align with local construction practices.
- Clear height to underside of roof structure needs to be at least 4m (15ft) high. This requirement must be coordinated with the specific requirements of the manufacturer.

**16. PR**

Prepare the existing oxygen piping network for connection to the new PSA plant

- This scope of work must be coordinated closely with the supplier and the responsibilities outlined in the contract or purchase agreement. The PSA plant supplier will often only include very small amounts of piping (as little as 1 meter) in their quote for the purpose of connecting the new PSA plant to an existing network.
- For containers that will pipe oxygen directly to a medical oxygen piping network, the starting point of this existing network must be extended to be within close proximity to the container.
- To connect the PSA plant to the existing medical oxygen piping network, one of the two options presented below should occur to ensure a correct connection:

	<ul style="list-style-type: none"> <li>• Main trunking pipe can be run underground from the plant to the hospital. This piping is typically run in trenching that is 30 to 60 cm deep, and the copper pipe is fed through 50 to 75 mm PVC conduit for protection.</li> <li>• Main trunking pipe can be run overhead, supported by external walkway structures or other supplemental framing to the hospital. As an alternative to mounting the pipe on existing framing, newly installed miscellaneous steel frames can be used to support the pipe as it spans between structures.</li> </ul>
17.	PR
<p>Install a new oxygen piping network that will be fed by the new PSA plant</p> <ul style="list-style-type: none"> <li>• This scope of work must be coordinated closely with the supplier and the responsibilities outlined in the contract or purchase agreement. The PSA plant supplier is often capable of installing the hospital's new oxygen piping network and can be the best positioned to do so. However, this must be negotiated as part of the agreement with the supplier and is often contracted separately from the PSA plant installation.</li> <li>• Identify the services and locations to receive new piping and outlets. This must be coordinated with the final size and configuration selected for the new PSA plant.</li> <li>• Hire a contractor or service provider to design the piping layout and complete the installation per the required local standards. This work must be completed prior to the PSA plant being installed.</li> </ul>	
18.	PR
<p>Complete the necessary electrical infrastructure installations to power the PSA Plant</p> <ul style="list-style-type: none"> <li>• Complete an electrical infrastructure assessment by engaging with a qualified professional to evaluate the existing hospital infrastructure to ensure it can provide power to the PSA plant. This provider will identify any aspects of the existing electrical infrastructure that must be upgraded, improved or modified to address any safety concerns or quality issues.</li> <li>• Liaise with the relevant authority or utility company for the provision of a stable and sufficiently sized electricity connection, such as transformer upgrades, when required.</li> <li>• Engage with a local electrician to carry out all infrastructure upgrades or remediation efforts identified in the electrical infrastructure assessment.</li> <li>• Prepare electrical connections for the PSA plant. Dig trenches for electrical feeder cables from the metering panel to the PSA plant location. Trenches will be approximately 20cm x 60cm.</li> <li>• Install the new electrical feeder to bring service to the PSA plant container location from the main distribution panel. The final feeder location must be coordinated with the location requirements provided by the PSA plant supplier.</li> <li>• If required, install the new back-up generator and transfer switch that will power the PSA plant at times of power loss.</li> <li>• Ensure an adequate supply of fuel for any generators supporting the PSA plant.</li> </ul>	
19.	PR
<p>Once the work on site reaches substantial completion, the supplier will be alerted that the site readiness work has been completed and the PSA plant is ready to be received.</p>	
20.	Supplier
<p><b>For Central Procurement:</b> The supplier will work to schedule a site visit for their local partner to independently verify in-person that the site work has been completed per the supplier's specifications, and the site is now able to operate the PSA plant.</p> <p><b>For Local Procurement:</b> It is recommended that the PR negotiate the contract to include an arrangement for the supplier to visit and approve the site for PSA plant installation. This is to ensure that the site and plant house meets supplier specifications prior to the plant being shipped to the site.</p>	
21.	Supplier
<p>The supplier will either approve the site ready for delivery or will provide a punch list of items that must be addressed by the hospital before the PSA plant arrives.</p>	
22.	PR
<p>The hospital will then work with their own staff or the general contractor responsible for infrastructure development to rectify any remaining issues identified by the supplier.</p>	
23.	Supplier

Once the site has been (1) approved by the supplier as “ready to receive the plant”; and (2) any final items identified by the supplier have been addressed, the container will be scheduled for delivery to the site. The supplier will be present to receive the equipment. Potential risks and key recommendations for selecting and managing contractors are outlined below:

- a) Beware of supplier's overstating their experience in planning, executing and commissioning the necessary site readiness works to install the PSA plant.
  - Request the suppliers to provide examples of design work/engineer drawings that were similar in scale and complexity to the works being requested under the tender.
  - Request the suppliers to provide examples of construction work, and contact information for references, of completed work that is of similar scale and complexity. Ideally these example projects would be within the local market and context of the work being proposed.
- b) Supplier's may rely on local subcontractors that lack the necessary expertise and experience to perform key aspects of the site readiness works.
  - Require all bidders to note which elements of the scope of work will be subcontracted out to others, and which scope of work will be self-performed.
  - Require all bidders to submit the qualifications of all subcontractors to be used for the project.
- c) Ensure that the supplier is completing a sufficiently detailed site visit or assessment prior to quoting the works, leading to cost and schedule implications once work begins.
  - Require the suppliers to include detailed site visits and existing conditions surveys as part of their bid. A brief field report should be issued upon completion of each site visit to document the findings of the assessment.
- d) Ensure that the supplier's engineers have the requisite experience designing work in the specific country or context, leading to inappropriate systems or materials being used and specified.
  - The suppliers should specify in their qualification documents their past experience working in the local market and the local standards the engineering/designs will follow (i.e. metric versus imperial dimensioning, fitting thread type for plumbing or oxygen piping, electrical voltages and frequency, governing building code, etc.)
  - If the supplier has not demonstrated sufficient experience working in a given location, the above noted standards proposed by the supplier, as well as all construction drawings, shall be reviewed and verified by a local contractor/professional to validate the appropriateness of the proposed works based on local standards and common construction practices.
- e) Ensure suppliers are sufficiently designing/engineering/planning the works prior to the start of construction.
  - All final design documents must be reviewed and approved for construction prior to the supplier beginning work on site.
- f) Ensure suppliers do not move forward without quality assurance (QA) or quality control (QC) procedures on site to ensure the construction works comply with the approved design documents.
  - Each supplier should be required to submit their own internal QA/QC procedures for all work they are performing and overseeing on site for review and approval.
  - The supplier should be required to submit field reports with high resolution photographs of work in-progress at regular intervals throughout construction, or at major milestones of completion.
  - Third-party review and sign-off of the completed works for the previously reviewed and approved construction documents should be required for the contractor's work to be considered complete.

## Installation & Commissioning

24.	PR
<p>Clear access must be provided by the hospital to allow for the truck to deliver the plant and for the crane being used to unload the plant.</p> <ul style="list-style-type: none"> <li>• The delivery of the equipment is required to be carefully coordinated with the supplier and the hospital. PSA plant containers are typically shipped by sea freight from the manufacturer's location, and often have delivery lead times between 8-12 weeks. This time frame does not include time needed for local ground transportation or any time needed for customs clearance.</li> <li>• Due to the noted lead time, a decision will need to be made regarding the delivery of the equipment while the site infrastructure work is still ongoing. If it is decided that the supplier should ship the container prior to the work being completed, the hospital will need to ensure the work is completed before the scheduled arrival date of the container.</li> <li>• If the plant arrives at the hospital prior to the infrastructure work being completed, a temporary storage location will need to be identified for the container. Additionally, if the plant container is stored in a temporary location while infrastructure work is being completed, a crane will need to be mobilized to unload the container from the initial delivery, as well as when the container is moved to its final location.</li> </ul>	



<b>25.</b>	<b>Supplier</b>
The supplier will receive the PSA plant delivery and be responsible for unloading the truck and setting the container in its final position. The delivery of the equipment will need to be carefully coordinated with the supplier and the hospital.	
<b>26.</b>	<b>Supplier</b>
The supplier will deliver the container in its final location on site and will begin the process of making all necessary connections to the existing infrastructure. These connection points include bringing power to the plant from the new feeder installed at the container location, as well as connecting the PSA plant to the existing piping network at the predetermined tie-in point, if the plant is configured to feed piping.	
<b>27.</b>	<b>Supplier</b>
Once the plant is connected to the electrical infrastructure, as well as the piping network, the PSA plant supplier will test and commission the plant per the supplier agreement and specifications.	
<b>28.</b>	<b>Supplier/PR</b>
Once the plant is successfully commissioned and the requisite purity is achieved, the supplier will deliver a training program for the onsite technicians responsible for day-to-day maintenance of the plant. Each training program will vary, but the program typically lasts for at least two days at each location. Any specific details or requirements of the training program must be discussed and negotiated with the supplier in advance.	
<b>29.</b>	<b>PR</b>
After the plant is delivered, the hospital staff must organize and inventory the spare parts and consumables provided by the supplier as part of the initial delivery and contract. These parts should be stored near the PSA plant in an organized manner, and hospital staff should take responsibility for tracking and managing the inventory of the equipment. Hospital staff should make sure to understand which of these parts they are allowed to implement independently when needed, and which are only to be performed by the supplier as part of the service agreement. The hospital should have a clear protocol in place in case of fire. This includes fire extinguishing equipment and staff trained on how to use it.	
<b>30.</b>	<b>PR</b>
Once the PSA plant is commissioned and training is complete, the day-to-day operation of the equipment will be handed over to the hospital. At this point, the hospital will be running the plan on their own and should be clear on how to escalate issues with the plant and have clear direction on the contact information of the supplier should issues arise that require service.	

## 2. Skid Mounted (or Individual Parts) Plants - New Building

### Initial Requisition

1.	Supplier
<p>After plant specifications are finalized, potential PSA plant suppliers submit bids.</p> <ul style="list-style-type: none"> <li>When PSA plants are purchased through Central Procurement (WAMBO) this process is managed by i+solutions and all bids are received from pre-approved suppliers with known local capacity to deliver the project in each individual location.</li> </ul>	
2.	i+ solutions / BHI
<p>Bids are reviewed to ensure compliance with specifications.</p> <ul style="list-style-type: none"> <li>When purchased through Central Procurement, this technical review is completed by both the i+solutions team, as well as the Build Health International (BHI) team.</li> </ul>	
3.	Supplier
<p>Fabrication of the unit begins by the manufacturer.</p>	

### Site Planning

4.	Supplier
<p>The PSA plant supplier shares technical requirements for infrastructure that must be in place for the equipment to be installed. This is typically provided as a chart or itemized list.</p> <p>PSA plant supplier provides a suggested layout drawing of the plant room and schematic level drawings indicating additional requirements of the space, such as minimum headroom, wall fan locations, louver sizes, duct sizes, etc. Once the specifications have been shared, the site readiness process begins.</p>	
5.	PR
<p>Hospital administrative staff, MoH officials, PRs or other relevant parties will determine supplemental programmatic instructions that must be incorporated into the documentation of the necessary construction works. In addition, there should be discussion about additional scope items, not relevant to the PSA plant supplier, regarding the programmatic/operational needs of the hospital. Key discussion points include:</p> <ul style="list-style-type: none"> <li>How many technical staff are available to operate the plant?</li> <li>Does the hospital need to hire any additional technical staff?</li> <li>Will the hospital carry sufficient maintenance and operating budget for the PSA plant?</li> <li>Where will the cylinders, spare parts and consumables be stored and how will this inventory be managed?</li> <li>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.</li> <li>What are the energy requirements for the PSA plant? <ul style="list-style-type: none"> <li>Does the hospital need to upgrade a transformer or purchase another generator?</li> <li>Will funding for fuel be made available for backup generators?</li> </ul> </li> <li>Are you going to run oxygen piping in trenches or along above ground infrastructure?</li> <li>When/how will plant housing layout, considering space constraints and operational needs (e.g., office space, road access, cylinder storage, toilet, etc), and ramp space be finalized?</li> <li>Cylinder storage: If the PSA plant will be filling cylinders, where will the dedicated space for cylinder storage for both empty and full cylinders be located? This space needs to be appropriately secured and accessible only to trained staff, accessible for transporting cylinders (particularly if they will be loaded/unloaded to be transported outside of the facility), and appropriately stored, away from flammable objects.</li> </ul>	

### Site Selection & Construction Documents

6.	PR
<p>Hospital administrative staff, MoH officials, or other relevant parties must identify the precise location of where the PSA plant building will be permanently located.</p> <ul style="list-style-type: none"> <li>There must be sufficient access to the PSA plant house for the truck delivering the PSA plant to get close</li> </ul>	



enough to unload and for the plant to be transported into the building. The building access door must be wide enough for the PSA plant to be loaded in through. It must not contain storage or warehousing of any product whatsoever within its surroundings that would impact the travel path, storage or installation of the equipment. In particular, the presence of flammable materials (cardboard box, grease, diesel, oil, etc) are strictly prohibited near the PSA plant building prior to or after plant installation.

- Air pollutants (e.g. generator exhausts, idling cars, waste incinerators), must be a minimum of 10m away from the PSA plant.
- The location must be cleared, excavated, level and compact the ground at the location selected for the PSA plant building. The site must meet the minimum dimension requirements of the supplier, including space for a ramp.
- The PSA plant building area needs to be well lit and in a secure location that is not prone to flooding.
- It is strongly recommended to fence and lock the building area to limit access to authorized personnel only. The fence door must accommodate a forklift and be at least 1.8m (3.5 ft) wide.

## 7. PR

Layout drawings and specifications from the supplier, in conjunction with any additional programmatic requirements by hospital officials (as outlined in step 5), are used to develop a comprehensive set of construction documents that demonstrate the infrastructure work that the general contractor is required to perform. Construction documents will include architectural and engineering drawings, any relevant written specifications (if required) and an itemized bill of quantities.

- Prior to developing the construction documents, the design professionals responsible for this scope of work must complete an assessment of the existing hospital to identify any improvements required to the existing infrastructure to allow the PSA plant to be installed.
- Infrastructure improvements that are not typically part of the PSA plant supplier's scope of work, or included in their package of site readiness requirements, may include items such as increasing the size of the existing transformer that serves the hospital, expanding road or truck access within the facility to allow access to the PSA plant location, identifying tie-in points to the existing piping network, etc.
- The construction documents must be prepared by a design team. The party selected to develop the documents will depend on local practices and the capacity of various potential collaborators. These documents are typically developed by:
  - External architects and engineers hired by the MoH.
  - In-house MoH (or other governmental agency) engineering professionals.
  - A design team employed by the general contractor responsible for construction. This practice is commonly referred to as design-build.

## 8. PR

For a skid mounted or individual parts PSA plant, where the equipment will be located in a new stand-alone building, the minimum infrastructure works typically include civil, electrical and architectural components, including:

- Civil works necessary to provide a well-graded site, with proper drainage and flood protection, as well as siting of the new building relative to the existing hospital campus. Civil drawings will also document any necessary underground utilities, as well as any connections into existing sewer lines, if required.
- Architectural drawings will include all necessary details and information to document the dimensions and materials necessary to build the plant house 'shell'. This includes floor plans identifying room layouts, wall types and locations, door and window types, and generic equipment layouts. These drawings will also include building elevations and sections that show opening dimensions required for doors and windows, wall heights, and roof slopes. Doors must be provided that are wide enough to install and remove any of the PSA plant components, and the ceiling height should be coordinated with the supplier's requirements for access above the equipment.
- In simple buildings, structural information can be shown as part of the architectural drawings, otherwise a detailed package of structural documents will be required. Structural documents will include wall and column foundation types and dimensions, concrete slab on grade details, any concrete or masonry reinforcing details, roof truss member size and configuration, roof purlin size and minimum thickness and type of metal deck. The most common configuration of new plant house buildings consists of cast-in-place concrete foundations, reinforced masonry bearing wall structures with reinforced concrete ring beams at the wall top and bottom, a reinforced concrete slab on grade, steel or timber roof trusses, timber roof purlins, and metal roof deck. However, the structure may vary greatly depending on local practices.
- Electrical feeders connecting the PSA plant building to the main distribution panel of the hospital must be provided. In addition, the scope of work will include all electrical work within the plant house building necessary for the individual components, including a new electrical panel for all PSA plant and miscellaneous components (lighting and any outlets for support spaces). This scope of work will also

include any necessary upgrades to the existing infrastructure as identified by the design team. This scope should also include any necessary connections to new or existing back-up power sources, such as generators, and the accompanying transfer switches.

- Mechanical scope for the new plant house building will include specifying louver types within the wall construction, exhaust fans for each of the spaces to ensure proper air circulation, duct sizes for all equipment that requires direct venting (such as the air compressors) and any active cooling required in the space for very hot climates. Active cooling typically consists of mini-split air conditioning systems. Mechanical scope also includes a final dimensioned layout and plan drawing of all equipment being provided by the PSA plant supplier, that conforms to the manufacturer's requirements for access and spacing.
- Plumbing scope is typically limited to incoming water and wastewater to serve any restroom or sink facilities installed as part of the plant house buildings but can also include drainage and sewer system tie-ins for equipment that produces water that must be removed from the building.

## 9. PR

The design team works collaboratively with the PR or hospital officials to develop the construction documents with necessary feedback and approval from the MoH or governing body, incorporating any additional programmatic requirements beyond the needs of the PSA plant supplier (i.e. office space, storage closets, etc.).

- One key consideration is cylinder storage. If the PSA plant will be filling cylinders, there needs to be space dedicated to cylinder storage for both empty and full cylinders. This space needs to be appropriately secured and accessible only to trained staff, accessible for transporting cylinders (particularly if they will be loaded/unloaded to be transported outside of the facility), and appropriately stored, away from flammable objects.

## 10. PR

Once final documents are approved, the PR will use the complete Construction Documents package to initiate a tender process to source a local contractor to complete the works. This step is not necessary if a design-build process is used, and the construction documents are developed with the General Contractor's scope of work.

## 11. PR

The PR receives bids from local contractors, as part of their standard tender process, and selects a contractor to perform the work. Potential risks and key recommendations for selecting and managing contractors are outlined below:

- Beware of supplier's overstating their experience in planning, executing and commissioning the necessary site readiness works to install the PSA plant.
  - Request the suppliers to provide examples of design work/engineer drawings similar in scale and complexity to the works being requested under the tender.
  - Request the suppliers to provide examples of construction work and contact information for references from previous developments that are of similar scale and complexity. Ideally these example projects would be within the local market and context of the work being proposed.
- Supplier's may rely on local subcontractors that lack the necessary expertise and experience to perform key aspects of the site readiness works.
  - Require all bidders to note which elements of the scope of work will be subcontracted out to others, and which scope of work will be self-performed.
  - Require all bidders to submit the qualifications of all subcontractors to be used for the project.
- Ensure that the supplier is completing a sufficiently detailed site visit or assessment prior to quoting the works, leading to cost and schedule implications once work begins.
  - Require the suppliers to include detailed site visits and existing conditions surveys as part of their bid. A brief field report should be issued upon completion of each site visit to document the findings of the assessment.
- Ensure that the supplier's engineers have the requisite experience to design work in the specific country or context, leading to inappropriate systems or materials being used and specified.
  - The suppliers should specify in their qualification documents their past experience working in the local market and the local standards the engineering/designs will follow (i.e. metric v imperial dimensioning, fitting thread type for plumbing or oxygen piping, electrical voltages and frequency, governing building code, etc.).
  - If the supplier has not demonstrated sufficient experience working in a given location, the above noted standards proposed by the supplier, as well as all construction drawings, shall be reviewed and verified by a local contractor/professional to validate the appropriateness of the proposed works based on local standards and common construction practices.
- Ensure suppliers are sufficiently designing/engineering/planning the works prior to the start of construction.

- All final design documents must be reviewed and approved for construction prior to the supplier starts to work on site.
- f) Ensure suppliers do not move forward without Quality Assurance (QA)/Quality Control (QA) procedures on site to ensure the construction works comply with the approved design documents.
- Each supplier should be required to submit their own internal QA/QC procedures for all work they are performing and overseeing on-site for review and approval.
  - The supplier should be required to submit field reports with high resolution photographs of work in-progress at regular intervals throughout construction, or at major milestones of completion.
  - Third-party review and sign-off of the completed works for the previously reviewed and approved construction documents should be required for the contractor's work to be considered complete.

## Site Work

12.	PR
Once a contractor is selected and the work begins, the design team is typically available to answer contractor questions and monitor general progress on site to ensure the works are conforming to the intent of the construction documents.	
13.	PR
The PR, in collaboration with the design team, will monitor the contractor's progress and ensure that deadlines and deliverables are met per the agreement. Additionally, the PR will confirm any support required by the contractor to complete their work is provided. These responsibilities are typically spelled out in the tender agreement.	
14.	PR
<p>Build the PSA plant house as designed in the final and approved set of construction documents. The plant house shall incorporate all size, spacing and configuration requirements as established by the PSA plant supplier. At a minimum, the new plant house structure shall:</p> <ul style="list-style-type: none"> <li>○ Be configured to suit the mechanical layout of the PSA plant, along with any programmatic needs of the hospital.</li> <li>○ Provide sufficient access around all equipment for future service, maintenance, and replacement.</li> <li>○ Provide sufficient headroom to install all oxygen equipment in its final position, considering any minimum access needed above the units for service.</li> <li>○ The entry must be built to accommodate a forklift to access the PSA plant room, which generally requires a doorway width that is a minimum of 2.5m (7 ft).</li> <li>○ Provide concrete ramps to access any raised floor or slab elevations. The slope should not exceed 12:1.</li> <li>○ The plant house slab shall include drains to remove surface water and condensate collected inside the PSA plant at one or more locations within the slab. This drain should be linked to a wastewater network, or managed in a controlled manner (e.g., a soak away pit) to avoid flooding, standing water, erosion, or run-off issues.</li> <li>○ Install all ductwork, exhaust fans, and louvers as required to achieve the necessary airflow within the plant room.</li> <li>○ All foundations and primary structural elements shall be designed and installed to meet the minimum requirements of the governing local building code (or international standards if a local code does not exist).</li> </ul>	
15.	PR
<p>Prepare the existing oxygen piping network for connection to the new PSA plant.</p> <ul style="list-style-type: none"> <li>• This scope of work should be coordinated closely with the supplier and the responsibilities outlined in the contract or purchase agreement. The PSA plant supplier will often only include very small amounts of piping (as little as 1m) in their quote for the purpose of connecting the new PSA plant to an existing network.</li> <li>• For PSA plants that will pipe oxygen directly to a medical oxygen piping network, the starting point of this existing network should be extended and be within close proximity to the PSA plant building.</li> <li>• To connect the PSA plant to the existing medical oxygen piping network, one of the two options presented below will need to occur to be able to make this connection: <ul style="list-style-type: none"> <li>i. Main trunking pipe can be run underground from the plant to the hospital. This piping is typically run in trenching that is 30 to 60 cm deep, and the copper pipe is fed through 50 to 75 mm PVC conduit for protection.</li> <li>ii. Main trunking pipe can be run overhead, supported by external walkway structures or other supplemental framing to the hospital. As an alternative to mounting the pipe on existing framing, newly installed miscellaneous steel frames can be used to support the pipe as it spans between structures.</li> </ul> </li> </ul>	
16.	PR
<p>Install a new oxygen piping network that will be fed by the new PSA plant.</p> <ul style="list-style-type: none"> <li>• This scope of work must be coordinated closely with the supplier and the responsibilities outlined in the contract or purchase agreement. The PSA plant supplier is often capable of installing the hospital's new oxygen piping network and can be the best positioned to do so. However, this must be negotiated as part of the agreement with the supplier and is often contracted separately from the PSA plant installation.</li> <li>• Identify the services and locations to receive new piping and outlets. This must be coordinated with the final size and configuration selected for the new PSA plant.</li> </ul>	

	<ul style="list-style-type: none"> <li>Hire a contractor or service provider to design the piping layout and complete the installation per the required local standards. This work must be completed prior to the PSA plant being installed.</li> </ul>
17.	PR
<p>Complete the necessary electrical infrastructure installations to power the PSA Plant</p> <ul style="list-style-type: none"> <li>Complete an electrical infrastructure assessment by engaging with a qualified professional to evaluate the existing hospital infrastructure to ensure it can power the PSA plant. This provider will identify any aspects of the existing electrical infrastructure that must be upgraded, improved or modified to address any safety concerns or quality issues.</li> <li>Liaise with the relevant authority or utility company for the provision of a stable and sufficiently sized electricity connection, such as transformer upgrades, when required.</li> <li>Engage with a local electrician to carry out all infrastructure upgrades or remediation efforts identified in the electrical infrastructure assessment.</li> <li>Prepare electrical connections for the PSA plant. Dig trenches for electrical feeder cables from the metering panel to the PSA plant location. Trenches will be approximately 20cm x 60cm.</li> <li>Install the new electrical feeder to bring service to the PSA plant building location from the main distribution panel. The final feeder location must be coordinated with the location requirements provided by the PSA plant supplier.</li> <li>If required, install the new back-up generator and transfer switch that will power the PSA plant at times of power loss.</li> <li>Ensure an adequate supply of fuel for any generators supporting the PSA plant.</li> </ul>	
18.	PR
<p>Once the work on site reaches substantial completion, the supplier will be alerted that the site readiness work has been completed and the PSA plant is ready to be received.</p>	
19.	Supplier
<p><b>For Central Procurement:</b> The supplier will work to schedule a site visit for their local partner to independently verify in-person that the site work has been completed per the supplier's specifications, and the site is now able to operate the PSA plant.</p> <p><b>For Local Procurement:</b> It is recommended that the PR negotiate the contract to include an arrangement for the supplier to visit and approve the site for PSA plant installation. This is to ensure that the site and plant house meets supplier specifications prior to the plant being shipped.</p>	
20.	Supplier
<p>The supplier will either approve the site ready for delivery or will provide a list of items that must be addressed by the hospital before the PSA plant arrives.</p>	
21.	PR
<p>The hospital will then work with their own staff, or the general contractor responsible for the infrastructure works to rectify any remaining issues identified by the supplier.</p>	
22.	Supplier
<p>Once the site has been approved by the supplier as ready to receive the plant, and any final items identified by the supplier have been addressed, the PSA plant will be scheduled for delivery to the site, and the supplier will be present to receive the equipment.</p>	

## Installation & Commissioning

23.	PR
<p>Clear access must be provided by the hospital to allow for the truck to deliver the plant and for the crane being used to unload the plant.</p> <ul style="list-style-type: none"> <li>It should be noted that the delivery of the equipment will need to be carefully coordinated with the supplier and the hospital. PSA plant equipment is typically shipped by sea freight from the manufacturer's location, and often have delivery lead times between 8-12 weeks. This time frame does not include time needed for local ground transportation or any time needed for customs clearance.</li> <li>Due to the noted lead time, a decision will need to be made regarding the delivery of the equipment while the site infrastructure work is ongoing. If it is decided that the supplier should ship the equipment prior to</li> </ul>	

<p>the work being completed, the hospital will need to ensure the work is completed before the scheduled arrival date of the shipment.</p> <ul style="list-style-type: none"> <li>• If the plant arrives at the hospital prior to the infrastructure work being completed, a temporary storage location will need to be identified for the PSA equipment. This location should be secure and well-protected from the environment.</li> <li>• If the plant equipment is stored in a temporary location while infrastructure work is being completed, a forklift or crane will need to be mobilized to unload the equipment from the initial delivery, as well as when the units are moved to their final location.</li> </ul>	
<b>24.</b>	<b>Supplier</b>
<p>The supplier will receive the PSA plant delivery and be responsible for unloading the truck and setting up the equipment in the building. The delivery of the equipment will need to be carefully coordinated with the supplier and the hospital.</p>	
<b>25.</b>	<b>Supplier</b>
<p>The supplier will land the complete PSA plant skid in its final location within the building or will locate each of the individual components in the specific locations identified in the design documents. The supplier will begin the process of making all necessary connections within the PSA plant components, as well as all connections to the existing infrastructure. These connection points include bringing power to the plant components from the new electrical panel installed within the plant house building, as well as connecting the PSA plant to the existing piping network at the predetermined tie-in point (if the plant is configured to feed piping).</p>	
<b>26.</b>	<b>Supplier</b>
<p>Once the plant is connected to the electrical infrastructure, as well as the piping network, the PSA plant supplier will test and commission the plant per the supplier agreement and specifications.</p>	
<b>27.</b>	<b>Supplier/PR</b>
<p>Once the plant is successfully commissioned, and the requisite purity is achieved, the supplier will begin a training program for the onsite technicians responsible for day-to-day maintenance of the plant. Each training program will vary, but the program typically lasts for at least two days at each location. Any specific details or requirements of the training program must be discussed and negotiated with the supplier in advance.</p>	
<b>28.</b>	<b>PR</b>
<p>After the plant is delivered, the hospital staff must organize and inventory the spare parts and consumables provided by the supplier as part of the initial delivery and contract. These parts should be stored near the PSA plant in an organized manner, and hospital staff should take responsibility for tracking and managing the inventory of the equipment. Hospital staff should make sure to understand which of these parts they are allowed to implement independently when needed, and which are only to be performed by the supplier as part of the service agreement. The hospital should have a clear protocol in place in case of fire. This includes fire extinguishing equipment and staff trained on how to use it.</p>	
<b>29.</b>	<b>PR</b>
<p>Once the PSA plant is commissioned and training is complete, the day-to-day operation of the equipment will be handed over to the hospital. At this point, the hospital will be running the plan on their own and should be clear on how to escalate issues with the plant and have clear direction on the contact information of the supplier should issues arise that require service.</p>	

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### 3. Skid Mounted (or Individual Parts) Plants - Existing Building Initial Requisition

1.	Supplier
<p>After plant specifications are finalized, potential PSA plant suppliers submit bids.</p> <ul style="list-style-type: none"> <li>When PSA plants are purchased through Central Procurement (via wambo.org) this process is managed by i+solutions and all bids are received from pre-approved suppliers with known local capacity to deliver the project in each individual location.</li> </ul>	
2.	i+ solutions / BHI
<p>Bids are reviewed to ensure compliance with specifications.</p> <ul style="list-style-type: none"> <li>When purchased through Central Procurement, this technical review is completed by both the i+solutions team, as well as the Build Health International (BHI) team.</li> </ul>	
3.	Supplier
<p>Fabrication of the unit begins by the manufacturer.</p>	

### Site Planning

4.	Supplier
<p>PSA plant supplier shares technical requirements for infrastructure that must be in place for the equipment to be installed. This is typically provided as a chart or itemized list. In addition, the PSA plant supplier provides a suggested layout drawing of the plant room, and schematic level drawings indicating additional requirements of the space, such as minimum headroom, wall fan locations, louver sizes, duct sizes, etc. This is the point where the site readiness process must begin.</p>	
5.	PR
<p>Hospital administrative staff, MoH officials, PRs or other relevant parties must identify the precise location of where the PSA plant will be permanently located within the existing structure.</p>	
6.	Supplier
<p>PSA plant supplier provides a suggested layout drawing of the plant room, and schematic level drawings indicating additional requirements of the space, such as minimum headroom, wall fan locations, louver sizes, duct sizes, etc.</p>	
7.	PR
<p>Hospital administrative staff, MoH officials, PRs or other relevant parties will coordinate all requirements as specified by the supplier, such as head room, door openings, power, ventilation, etc. with the characteristics of the existing space selected for the PSA plant equipment. In addition, there should be discussion about additional scope items, not relevant to the PSA plant supplier, regarding the programmatic/operational needs of the hospital. Key discussion points include:</p> <ul style="list-style-type: none"> <li>How many technical staff are available to operate the plant?</li> <li>Does the hospital need to hire any additional technical staff?</li> <li>Will the hospital carry sufficient maintenance and operating budget for the PSA plant?</li> <li>Where will the cylinders, spare parts, and consumables be stored and how will this inventory be managed?</li> <li>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.</li> <li>What are the energy requirements for the PSA plant? <ul style="list-style-type: none"> <li>Does the hospital need to upgrade a transformer or purchase another generator?</li> <li>Will funding for fuel be made available for backup generators?</li> </ul> </li> <li>Are you going to run oxygen piping in trenches or along above ground infrastructure?</li> <li>When/how will plant housing layout, considering space constraints and operational needs (e.g., office space, road access, cylinder storage, toilet, etc), and ramp space be finalized?</li> <li>Cylinder storage: If the PSA plant will be filling cylinders, there needs to be space dedicated to cylinder storage for both empty and full cylinders. This space needs to be appropriately secured and accessible only to trained staff, accessible for transporting cylinders (particularly if they will be loaded/unloaded to be transported outside of the facility), and appropriately stored, away from flammable objects.</li> </ul>	

## Site Selection & Construction Documents

8.	PR
<p>Hospital administrative staff, MoH officials, or other relevant parties must identify the precise location of where the PSA plant will be permanently located.</p> <ul style="list-style-type: none"> <li>The area provided for the installation of the on-site PSA plant must be dedicated to this use. Access to the existing building must be wide and open enough to allow easy access for a truck and easy installation of the PSA plant. It must contain no storage or warehousing of any product whatsoever within its surroundings. In particular, the presence of flammable materials (cardboard box, grease, diesel, oil, etc) are strictly prohibited near the PSA plant.</li> <li>Air pollutants (e.g., generator exhausts, idling cars, waste incinerators), must be a minimum of 10 meters away from the PSA plant.</li> <li>The floor area available must meet the minimum dimension requirements of the supplier, as well as the minimum headroom requirements for the equipment.</li> <li>The existing building area needs to be well lit and in a secure location that is not prone to flooding.</li> <li>It is strongly recommended to lock the space to limit access to authorized personnel only. The fence door must accommodate a forklift and be at least 1.8m (3.5 ft) wide.</li> <li>The existing space must be able to receive adequate power to operate the plant, and must be able to be modified to allow for adequate air flow and ventilation provided by exhaust duct, fans and intake louvers.</li> </ul>	
9.	PR
<p>Layout drawings and specifications from the supplier, in conjunction with any additional programmatic requirements by hospital officials (as outlined in step 7), are used to develop a comprehensive set of construction documents, that demonstrates any infrastructure upgrade work that will be needed to be performed by the general contractor. Construction documents will include architectural and engineering drawings, any relevant written specifications (if required), an itemized bill of quantities.</p> <ul style="list-style-type: none"> <li>Prior to developing the construction documents, the design professionals responsible for this scope of work must complete an assessment of the existing hospital to identify any improvements required to the existing infrastructure to allow the PSA plant to be installed.</li> <li>Infrastructure improvements that are not typically part of the PSA plant supplier's scope of work, or included in their package of site readiness requirements, may include items such as increasing the size of the existing transformer that serves the hospital, expanding road or truck access within the facility to allow access to the PSA plant location, identifying tie-in points to the existing piping network, etc.</li> <li>The construction documents must be prepared by a design team. The party selected to develop the documents will depend on local practices and the capacity of various potential collaborators. These documents are typically developed by: <ul style="list-style-type: none"> <li>External architects and engineers hired by the MoH.</li> <li>In-house MoH (or other governmental agency) engineering professionals.</li> <li>A design team employed by the general contractor responsible for construction. This practice is commonly referred to as design-build.</li> </ul> </li> </ul>	
10.	PR
<p>For a skid mounted or individual parts PSA plant application, where the equipment is located in a new stand-alone building, the minimum infrastructure works typically include civil, electrical and architectural components, including:</p> <ul style="list-style-type: none"> <li>Civil works necessary to provide a well graded site include information on proper drainage and flood protection, as well as siting of the new building relative to the existing hospital campus. Civil drawings will also document any necessary underground utilities, as well as any connections into existing sewer lines, if required.</li> <li>Architectural drawings will include all necessary details and information to document the dimensions and materials necessary to build the plant house 'shell'. This includes floor plans identifying room layouts, wall types and locations, door and window types, and generic equipment layouts. These drawings will also include building elevations and sections that show opening dimensions required for doors and windows, wall heights, and roof slopes. Doors must be provided that are wide enough to install and remove any of the PSA plant components, and the ceiling height should be coordinated with the supplier's requirements for access above the equipment.</li> <li>In simple buildings, structural information can be shown as part of the architectural drawings, otherwise a detailed package of structural documents will be required. Structural documents will include wall and column foundation types and dimensions, concrete slab on grade details, any concrete or masonry reinforcing details, roof truss member size and configuration, roof purlin size and minimum thickness and type of metal deck. The most common configuration of new plant house buildings consists of cast-in-place concrete foundations, reinforced masonry bearing wall structures with reinforced concrete ring beams at</li> </ul>	

the wall top and bottom, a reinforced concrete slab on grade, steel or timber roof trusses, timber roof purlins, and metal roof deck. However, the structure may vary greatly depending on local practices.

- Electrical feeders connecting the PSA plant building to the main distribution panel of the hospital must be provided. In addition, the scope of work will include all electrical work within the plant house building necessary for the individual components, including a new electrical panel for all PSA plant and miscellaneous components (lighting and any outlets for support spaces). This scope of work will also include any necessary upgrades to the existing infrastructure as identified by the design team. This scope should also include any necessary connections to new or existing back-up power sources, such as generators, and the accompanying transfer switches.
- Mechanical scope for the new plant house building will include specifying louver types within the wall construction, exhaust fans for each of the spaces to ensure proper air circulation, duct sizes for all equipment that requires direct venting (such as the air compressors) and any active cooling required in the space for very hot climates. Active cooling typically consists of mini-split air conditioning systems. Mechanical scope also includes a final dimensioned layout and plan drawing of all equipment being provided by the PSA plant supplier, that conforms to the manufacturer's requirements for access and spacing.
- Plumbing scope is typically limited to incoming water and wastewater to serve any restroom or sink facilities installed as part of the plant house buildings but can also include drainage and sewer system tie-ins for equipment that produces water that must be removed from the building.

#### 11. PR

The design team works collaboratively with the PR or hospital officials to develop the construction documents with necessary feedback and approval from the MoH or governing body, incorporating any additional programmatic requirements beyond the needs of the PSA plant supplier.

#### 12. PR

Once final documents are approved, the PR will use the complete construction documents package to initiate a tender process to source a local contractor to complete the works as described in the construction documents. This step is not necessary if a design-build process is used, and the construction documents are developed as part of the General Contractor's scope of work.

#### 13. PR

The PR receives bids from local contractors as part of their standard tender process, and selects a contractor to perform the works. Potential risks and key recommendations for selecting and managing contractors are outlined below:

- Beware of supplier's overstating their experience in planning, executing and commissioning the necessary site readiness works to install the PSA plant.
  - Request the suppliers provide examples of design work/engineer drawings similar in scale and complexity to the works being requested under the tender.
  - Request the suppliers provide examples of construction work and contact information for references of completed work that are of similar scale and complexity. Ideally these example projects would be within the local market and context of the work being proposed.
- Supplier's may rely on local subcontractors that lack the necessary expertise and experience to perform key aspects of the site readiness works.
  - Require all bidders to note which elements of the scope of work will be subcontracted out to others, and which scope of work will be self-performed.
  - Require all bidders to submit the qualifications of all subcontractors to be used for the project.
- Ensure that the supplier is completing a sufficiently detailed site visit or assessment prior to quoting the works, leading to cost and schedule implications once work begins.
  - Require the suppliers to include detailed site visits and existing conditions surveys as part of their bid; a brief field report should be issued upon completion of each site visit to document the findings of the assessment
- Ensure that the supplier's engineers have the requisite experience designing work in the specific country or context, leading to inappropriate systems or materials being used and specified.
  - The suppliers should specify in their qualification documents their past experience working in the local market and the local standards the engineering / designs will follow (i.e. metric v imperial dimensioning, fitting thread type for plumbing or oxygen piping, electrical voltages and frequency, governing building code, etc.)
  - If the supplier has not demonstrated sufficient experience working in a given location, the above noted standards proposed by the supplier as well as all construction drawings, shall be reviewed and verified by a local contractor/professional to validate the appropriateness of the proposed works based on local

- standards and common construction practices
- e) Ensure suppliers are sufficiently designing / engineering / planning the works prior to beginning construction.
  - All final design documents must be reviewed and approved for construction prior to the supplier beginning work on site
- f) Ensure suppliers do not move forward without Quality Assurance (QA)/Quality Control (QC) procedures on-site to ensure the construction works comply with the approved design documents.
  - Each supplier should be required to submit their own internal QA/QC procedures for all work they are performing and overseeing on-site for review and approval
  - The supplier should be required to submit field reports with high resolution photographs of work in-progress at regular intervals throughout construction, or at major milestones of completion
  - A third party review and sign-off of the completed works against the previously reviewed and approved construction documents should be required for the contractor's work to be considered complete

## Site Work

14.	PR
Once a contractor is selected and the work begins, the design team is typically available to answer contractor questions and monitor general progress on site to ensure the works are conforming to the intent of the construction documents.	
15.	PR
The PR, in collaboration with the design team, will monitor the contractor's progress and ensure that deadlines and deliverables are met per the agreement. The PR will confirm any support required by the contractor to complete their work is provided. These responsibilities are typically spelled out in the tender agreement.	
16.	PR
<p>Prepare the existing space to receive a PSA plant, along with preparing it for any other programmatic needs of the hospital.</p> <ul style="list-style-type: none"> <li>• The flooring within the existing space must be a dust free and durable surface capable of supporting heavy equipment.</li> <li>• The space must be adequately ventilated per the requirements of the manufacturer while considering the local and environmental factors.</li> <li>• An entry ramp must be built to accommodate a forklift to access the PSA plant room and needs to be a minimum of 2.5m (7 ft) wide, with a slope not to exceed 12:1.</li> <li>• The existing slab shall include drains to remove surface water and condensate collected inside the PSA plant at one or more locations within the slab. This drain should be linked to a wastewater network, or managed in a controlled manner (e.g., a soak away pit) to avoid flooding, standing water, erosion, or run-off issues.</li> <li>• All existing primary structural elements shall be evaluated to ensure they are able to adequately support the PSA plant equipment per the requirements of the governing local building code (or international standards if a local code does not exist).</li> </ul>	
17.	PR
<p>Prepare the existing oxygen piping network for connection to the new PSA plant.</p> <ul style="list-style-type: none"> <li>• This scope of work must be coordinated closely with the supplier and the responsibilities outlined in the contract or purchase agreement. The PSA plant supplier will often only include very small amounts of piping (as little as 1m) in their quote for the purpose of connecting the new PSA plant to an existing network.</li> <li>• For PSA plants that will pipe oxygen directly to a medical oxygen piping network, the starting point of this existing network must be within close proximity to the PSA plant room.</li> <li>• To connect the PSA plant to the existing medical oxygen piping network, one of the two options presented below will need to occur to be able to make this connection:               <ol style="list-style-type: none"> <li>i. Main trunking pipe can be run underground from the plant to the hospital. This piping is typically run in trenching that is 30 to 60 cm deep, and the copper pipe is fed through 50 to 75 mm PVC conduit for protection.</li> <li>ii. Main trunking pipe can be run overhead, supported by external walkway structures or other supplemental framing to the hospital. As an alternative to mounting the pipe on existing framing, newly installed miscellaneous steel frames can be used to support the pipe as it spans between structures.</li> </ol> </li> </ul>	

<b>18.</b>	<b>PR</b>
<p>Install a new oxygen piping network that will be fed by the new PSA plant.</p> <ul style="list-style-type: none"> <li>• This scope of work must be coordinated closely with the supplier and the responsibilities outlined in the contract or purchase agreement. The PSA plant supplier is often capable of installing the hospital's new oxygen piping network and can be the best positioned to do so. However, this must be negotiated as part of the agreement with the supplier and is often contracted separately from the PSA plant installation.</li> <li>• Identify the services and locations to receive new piping and outlets. This must be coordinated with the final size and configuration selected for the new PSA plant.</li> <li>• Hire a contractor or service provider to design the piping layout and complete the installation per the required local standards. This work must be completed prior to the PSA plant being installed.</li> </ul>	
<b>19.</b>	<b>PR</b>
<p>Complete the necessary electrical infrastructure installations to power the PSA plant.</p> <ul style="list-style-type: none"> <li>• Complete an electrical infrastructure assessment by engaging with a qualified professional to evaluate the existing hospital infrastructure to ensure it can power the PSA plant. This provider will identify any aspects of the existing electrical infrastructure that must be upgraded, improved or modified to address any safety concerns or quality issues.</li> <li>• Liaise with the relevant authority or utility company for the provision of a stable and sufficiently sized electricity connection, such as transformer upgrades, when required.</li> <li>• Engage with a local electrician to carry out all infrastructure upgrades or remediation efforts identified in the electrical infrastructure assessment.</li> <li>• Prepare electrical connections for the PSA plant. Dig trenches for electrical feeder cables from the metering panel to the PSA plant location. Trenches will be approximately 20cm x 60cm.</li> <li>• Install the new electrical feeder to bring service to the PSA plant room from the main distribution panel. The final feeder location must be coordinated with the location requirements provided by the PSA plant supplier.</li> <li>• If required, install the new back-up generator and transfer switch that will power the PSA plant at times of power loss.</li> <li>• Ensure an adequate supply of fuel for any generators supporting the PSA plant.</li> </ul>	
<b>20.</b>	<b>PR</b>
<p>Once the work on site reaches substantial completion, the supplier will be alerted that the site readiness work has been completed and the PSA plant is ready to be received.</p>	
<b>21.</b>	<b>Supplier</b>
<p>For Central Procurement: The supplier will work to schedule a site visit for their local partner to independently verify in-person that the site work has been completed per the supplier's specifications, and the site is now able to operate the PSA plant.</p> <p>For Local Procurement: It is recommended that the PR negotiate the contract to include an arrangement for the supplier to visit and approve the site for PSA plant installation. This is to ensure that the site and plant house meets supplier specifications prior to the plant being shipped from the supplier.</p>	
<b>22.</b>	<b>Supplier</b>
<p>The supplier will either approve the site ready for delivery or will provide a list of items that must be addressed by the hospital before the PSA plant arrives.</p>	
<b>23.</b>	<b>PR</b>
<p>The hospital will then work with their own staff, or the general contractor responsible for the infrastructure works to rectify any remaining issues identified by the supplier.</p>	
<b>24.</b>	<b>Supplier</b>
<p>The supplier must conduct a site visit to validate the list of remaining issues that have been addressed by the PR and validate that the site is ready to receive the PSA plant. Once the plant room has been approved by the supplier as ready to receive the plant, and any final items identified by the supplier have been addressed, the PSA plant will be scheduled for delivery to the site, and the supplier will be present to receive the equipment.</p>	



## Installation & Commissioning

25.	PR
<p>Clear access must be provided by the hospital to allow for the truck to deliver the plant and for the crane being used to unload the plant.</p> <ul style="list-style-type: none"> <li>It should be noted that the delivery of the equipment will need to be carefully coordinated with the supplier and the hospital. PSA plant equipment is typically shipped by sea freight from the manufacturer's location, and often have delivery lead times between 8-12 weeks. This time frame does not include time needed for local ground transportation or any time needed for customs clearance.</li> <li>Due to the noted lead time, a decision will need to be made regarding the delivery of the equipment while the site infrastructure work is ongoing. If it is decided that the supplier should ship the equipment prior to the work being completed, the hospital will need to ensure the work is completed before the scheduled arrival date of the shipment.</li> <li>If the plant arrives at the hospital prior to the infrastructure work being completed, a temporary storage location will need to be identified for the PSA equipment. This location should be secure and well protected from the environment.</li> <li>If the plant equipment is stored in a temporary location while infrastructure work is being completed, a forklift or crane will need to be mobilized to unload the equipment from the initial delivery, as well as when the units are moved to their final location.</li> </ul>	
26.	Supplier
<p>The supplier will receive the PSA plant delivery and be responsible for unloading the truck and setting the container in its final position. The delivery of the equipment will need to be carefully coordinated with the supplier and the hospital.</p>	
27.	Supplier/PR
<p>The supplier will land the complete PSA plant skid in its final location within the building or will locate each of the individual components in the specific locations identified in the design documents. The supplier will begin the process of making all necessary connections within the PSA plant components, as well as all connections to the existing infrastructure. These connection points include bringing power to the plant components from the new electrical panel installed within the plant house building, as well as connecting the PSA plant to the existing piping network at the predetermined tie-in point (if the plant is configured to feed piping). This scope of work must be carefully coordinated with the responsibilities of the supplier and the responsibilities of the building contractor to ensure there are no gaps in responsibility that would prevent the plant from being installed.</p>	
28.	Supplier
<p>Once the plant is connected to the electrical infrastructure, as well as the piping network, the PSA plant supplier will test and commission the plant per the supplier agreement and specifications.</p>	
29.	Supplier/PR
<p>Once the plant is successfully commissioned and the requisite purity is achieved, the supplier will begin a training program for the onsite technicians responsible for day-to-day maintenance of the plant. Each supplier's training program will vary, but the program typically lasts for at least two days at each location. Any specific details or requirements of the training program must be discussed and negotiated with the supplier in advance.</p>	
30.	PR
<p>After the plant is delivered, the hospital staff must organize and inventory the spare parts and consumables provided by the supplier as part of the initial delivery and contract. These parts should be stored near the PSA plant in an organized manner, and hospital staff should take responsibility for tracking and managing the inventory of the equipment. Hospital staff should make sure to understand which of these parts they are allowed to implement independently when needed, and which are only to be performed by the supplier as part of the service agreement. The hospital should have a clear protocol in place in case of fire. This includes fire extinguishing equipment and staff trained on how to use it.</p>	
31.	PR
<p>Once the PSA plant is commissioned and training is complete, the day-to-day operation of the equipment will be handed over to the hospital. At this point, the hospital will be running the plant on their own and should be clear on how to escalate issues with the plant and have clear direction on the contact information of the supplier should issues arise that require service.</p>	