WHO technical consultation on oxygen scale-up

Session 2

30 October 2020

Agenda

Friday 30 October 2020		
16:00–16:10	**Welcome remarks** • Review of agenda and meeting objectives • Participant attendance • Summary of Session 1	**Janet Diaz** Lead, Clinical Management for COVID-19 WHO Health Emergency Programme
16:10–16:30	**PSA technical and operational overview** • Oxygen source overview • PSA plant value chain • PSA configuration overview • Discussion framework	**Alejandra Velez** Focal point, oxygen scale-up WHO Health Emergency Programme
16:30–17:25	**Structured discussion** 1. "Round robin" technical considerations, 7 common queries 2. Open floor	**Fetnah Ramirez** (co-chair) **Edgardo Diaz** (co-chair)
17:25–17:30	**Wrap-up and next steps**	**Janet Diaz**

Summary of main findings from Session 1

- ✓ **Discussion point:** Estimating oxygen need-gap based on COVID-19 ESFT, whose outputs are epi-informed oxygen need projections
  - ❖ Suggestion to consider other hypoxaemia-causing illness and to address this need-gap first, and then to consider for surges such as those needed for advanced care in the case of COVID-19.
  - ❖ Focus should be on longer term, continuous oxygen demand across all levels of the health system.

- ✓ **Discussion point:** Assumptions on existing capacity (availability and accessibility in LMICs)
  - ❖ No consensus reached on methodology, but common theme emphasized the lack of baseline data.
  - ❖ Suggestion to pull data, country by country, in order to propose a range of existing capacity.
  - ❖ Suggestion that assessments be done in a holistic and comprehensive manner.
  - ❖ Pre-existing gaps exist beyond oxygen sources, such as lack of availability of other related equipment, ancillary devices and reliable power supply – all needed for continuous oxygen delivery.
  - ❖ Barrier to scaling-up has resulted from lack of knowledge on oxygen therapy.

- ✓ **Discussion point:** Assumptions of oxygen supply mix solution
  - ❖ No consensus on the methodology, common point that oxygen supply mixes are context specific.
  - ❖ Noted clarifications: cylinders are not a “source”, but where no plant onsite, cylinders come from plant (either PSA or liquid); and PSA onsite could be interchangeable with bulk tank, if feasible option.
  - ❖ Piped systems may be a significant factor to improving oxygen therapy.

The aim of this technical consultation is to achieve the following core objectives across four teleworking sessions:

Needs assessment: taking stock of existing guidance to forecast oxygen needs; identification of shared challenges; formalizing baseline assumptions and framework methodologies that apply for a **high-level oxygen needs estimation for LMICs.**

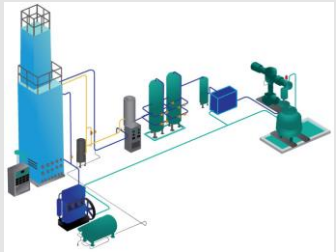
Today

Technical guidance: finalizing operational elements and inputs for WHO consideration in producing interim guidance documents for oxygen production from PSA oxygen generator plants and subsequent distribution (e.g. cylinder manifolds, oxygen piping) at the facility level. (1 of 2 sessions)

Global scale-up mapping: establishing live mapping updates and/or networking resources to leverage previous accomplishments, to foster collaborations, and to avoid duplication of activities.

Identification of other work areas could result in the addition of further working sessions.

Solutions for oxygen supply will often be a mix of available sources: PSA oxygen generation plants are a suitable option for surge, and there is a need for operational guidance

	PSA bedside concentrators	PSA O_2 generator plants	Cryogenic liquid
Description	 Different flow rates, typical: 5, 8 or 10 L/min – medical use	 Different sizes and configurations: single and duplex 2–200+ Nm^3/hr	 Produced mainly for heavy industry; serves medical sector where GMP allows
Requirements	• Situated onsite, bedside. • Continuous and reliable electrical source. • Device-specific spares needed. • Timely technical maintenance (preventive every 6 months). • Need for IPC measures as is situated bedside.	• Various own/operate models. • Often situated onsite. • Continuous and reliable electrical source during plant and booster operations. • Detailed technical and financial planning for long-term operations and maintenance (~20 years). • Need > 4 technicians for 24/7 operation.	• Third party responsible for production and supply chain. • Plants must be offsite. Bulk liquid tanks with passive vaporization for onsite storage (specialized materials). • *CAPEX and OPEX are very high, borne by third party.* • Scaling-up medical needs.
Additional considerations	• Difficult to optimize for at-scale needs. • Not suitable for high-flow or higher pressure needs (e.g. patient ventilators). • Depending on the capacity and oxygen therapy, flow could be split among patients.	• Scaling-up medical needs. • Continuous supply at all atmospheric pressures. • Supply can be piped bedside and/or plant can fill cylinders to be used bedside or transported elsewhere.	• Goods and service contract. • Product can be used via high-pressure gas cylinders or piped bedside from bulk tank.

“Value chain” of PSA oxygen generator plants: using a holistic approach to Increasing access to medical oxygen in LMICs

Manufacturing/ design/ innovative solutions

- Appropriate technology or solutions for medical application
- Solutions considerate of challenging environments

Planning

A contextually appropriate solution proposition includes:

- Needs assessment
- Demand quantification
- Absorptive capacity (power/housing incl. or excl.)

Procurement

Steps include:

- Tender process
- Payment
- Shipment

And should cover product validation, INCOTERMS, installation/training, SLA, etc.

Installation & commissioning

Microplanning for installation and commissioning

Including:

- Training
- Final testing
- Setting up operations team with tools and resources for success

Operations & maintenance

Adequate staffing for:

- Operations
- Tech Support

Assurance of adequate consumables and spares where needed, when needed

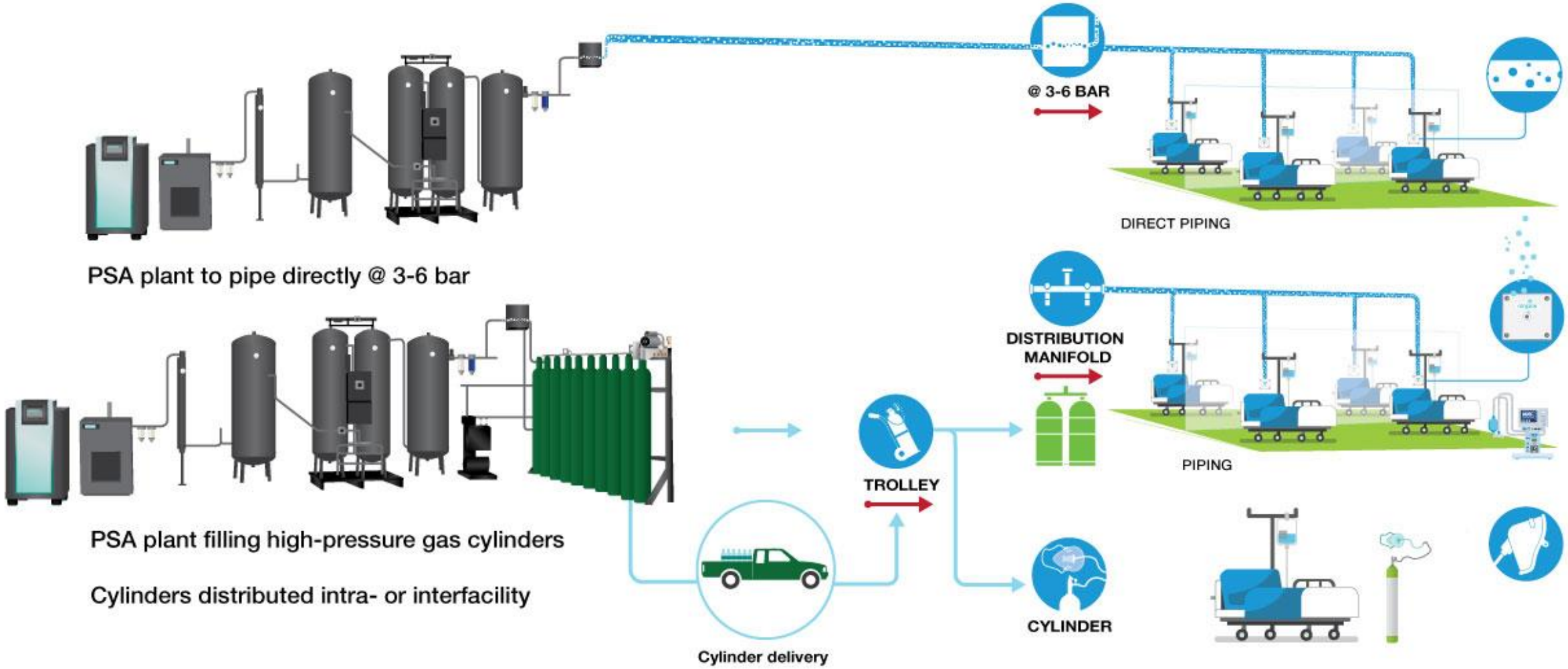
Integration into health care continuum

All in place for holistic system operations:

- Facility management integration
- Devices and services requiring oxygen are all “online”
- Training in oxygen therapy is conducted and refreshed

Longer term sustainability will require assessment of and planning for each step. Thinking ahead, especially during COVID-19 surge, means giving consideration to possibility of decommissioning and/or reallocation.

PSA oxygen generation plants system overview: supply (production and reserve) + distribution (piped network or trolleys) + delivery (regulation and conditioning)



Details of PSA oxygen generation plants for medical application

Overview

Different components: PSA, power generation, booster/filling, etc.
Different configurations: single, duplex, multiplex
Different sizes: 2–200+ Nm^3/hr
Option of skid-mounted or containerized systems

Technical requirements

- Plants typically situated onsite.
- Site-specific environmental considerations in planning stage (elevation, humidity, dust…).
- Plant size based on facility and catchment need.
- Planning for redundancy: secondary and emergency supply via parallel plant, booster/filling and cylinder stocking…
- Continuous and reliable electrical source during plant and booster operations.
- Rigorous PPM schedule to be defined, modified for context, and followed judiciously.

Operational requirements

- Multiple own/operate models: BOO, BOOT, PPP, user owned/operated.
- HR requirements: day-to-day operations, trained and skilled BME/T.
- Plant operations built into facility operational strategy.
- Detailed financial planning for long term operations and maintenance (~20 years); covering:
  - Power (approx. 80% of lifetime costs)
  - Technical components
  - HR, etc.

WHO Technical Specifications: https://www.who.int/publications/i/item/technical-specifications-for-pressure-swing-adsorption(psa)-oxygen-plants

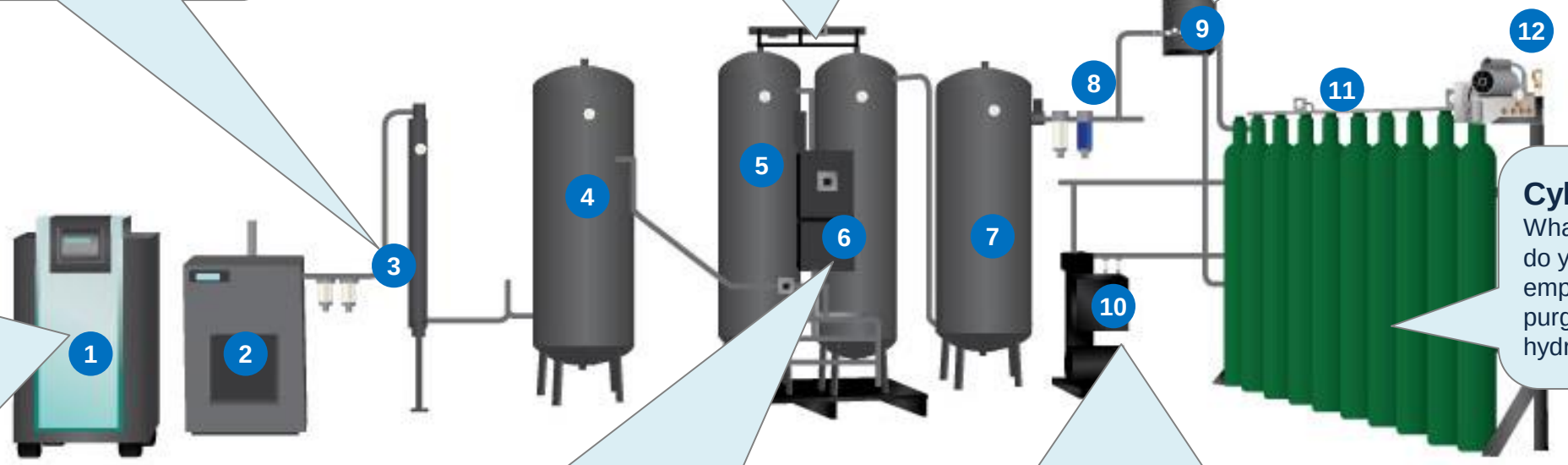
PSA oxygen generation plants: common equipment-related technical queries

Filtration assembly
- What are critical components to ensure quality outcomes?
- Do coal towers warrant extra spend?

PSA sizing (total Nm³/hr) and configuration
- What are critical technical criteria for decision-making?

Oxygen purity monitoring
- How can we manage to ensure continuity of quality product?
- At what frequency should we seek re-certification (third party)?

Air compressors
Elevation is important when sizing this component.
- Any “rules of thumb” to ensure that offers match contextual need?
- What flexibility do we have, +/- m, if a plant is relocated?



Cylinder filling
What QA/QC process do you employ on empty cylinders (e.g. purge/vacuum, hydrostatic testing)?

Control panel
- How can we ensure end-user gets soft- and firmware updates from third-party components?
- Is remote monitoring advantageous?

Booster compressors
- What are the advantages and challenges of having booster compressors in the configuration?
- What would be the “ask” to the market to improve the challenges?

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1 Air compressor
2 Refrigeration/air dryer
3 Filtration assembly
4 Compressed air tank
5 PSA – O_2 generator
6 Control panel
7 Product/buffer tank
8 Bacteria filter
9 Oxygen sensor
10 Booster compressor
11 Cylinder filling ramp
12 Vacuum pump

PSA oxygen generation plants: common operational challenges – closing remarks and next steps

PSA plant

High-pressure gas cylinder filling

Cylinder delivery

- Poorly sized, poorly configured plants resulting in unnecessary operational overhead or altogether abandonment
- Operating environment challenges
- Lack technical guidance for system operations
- Lack of technical guidance for preventive and curative maintenance
- Lack of guidance for what is needed in a service-level agreement
- No comprehensive quality assurance, no post-commissioning third-party testing guidelines
- General safety of oxygen production and distribution

ACTION: Entities are encouraged to participate in the development of a PSA plant operational guidance. The discussed and outlined challenges all frame what will be a tremendously helpful global good.

Thank you!

Next session:

November 13

Oxygen distribution

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