OSD Mantech P 2
Automated Repair Cell - ARC

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Office managed by ARL under contract Cooperative Agreement Number W911NF-10-2-0094 with UTRC.

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- CS Equipment Supplier
- Production Facilities
- Qualification Operations

Presentation Overview

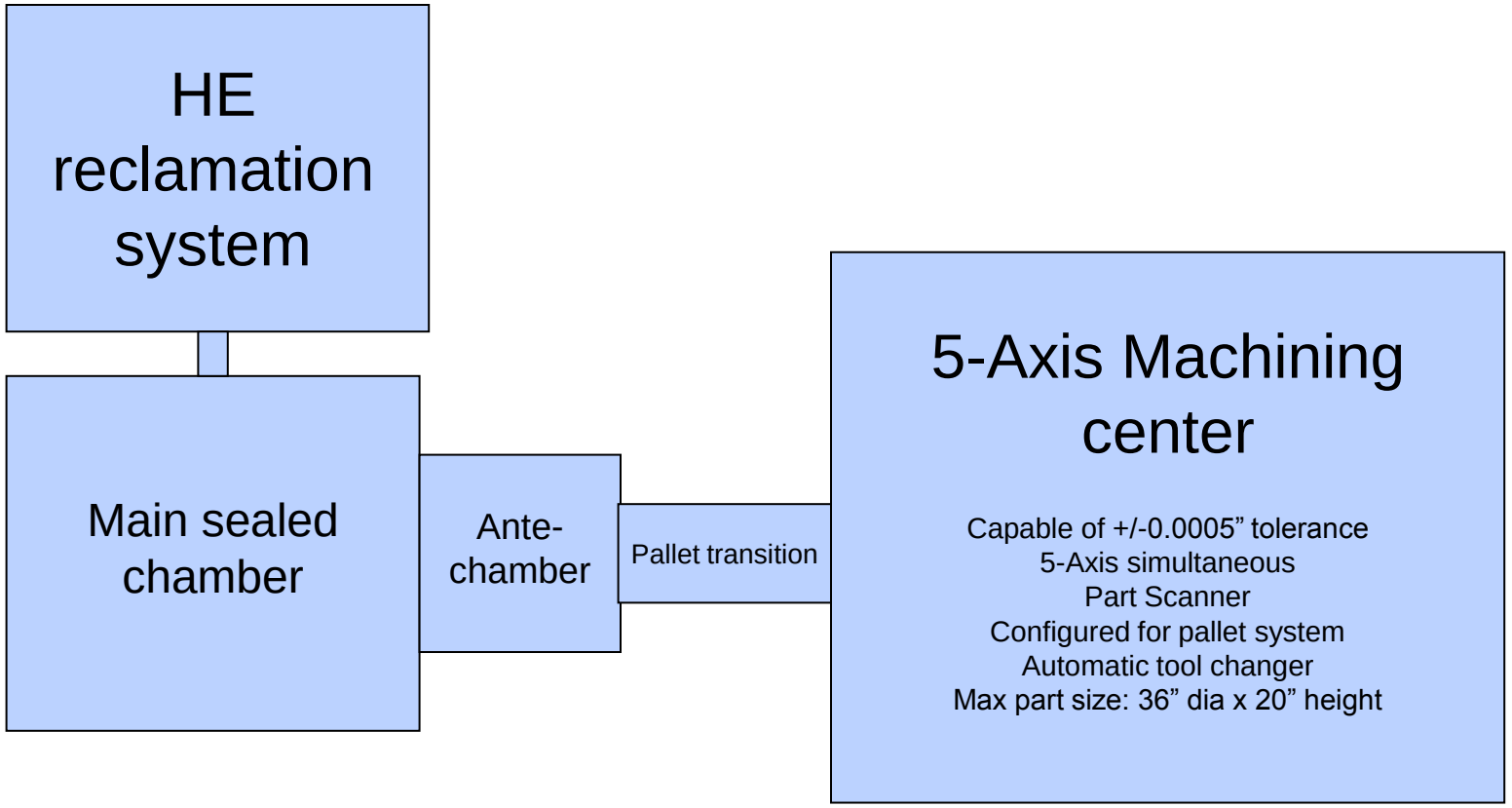
- Automated Repair Cell process overview
- Current design status
  - Alternate configurations
- Sub-component selection
  - 5-Axis machining center
  - Main sealed chamber
  - Helium Reclamation system
  - Automation

ARC – Automated Repair Cell Process review

- Repair damaged hardware
  - Advanced machining capability
  - Cold Spray additive deposition
- Incorporate scanning technologies
  - Compare damaged hardware to nominal solid mode
- Multi-phase automated cycle from hardware insertion to removal

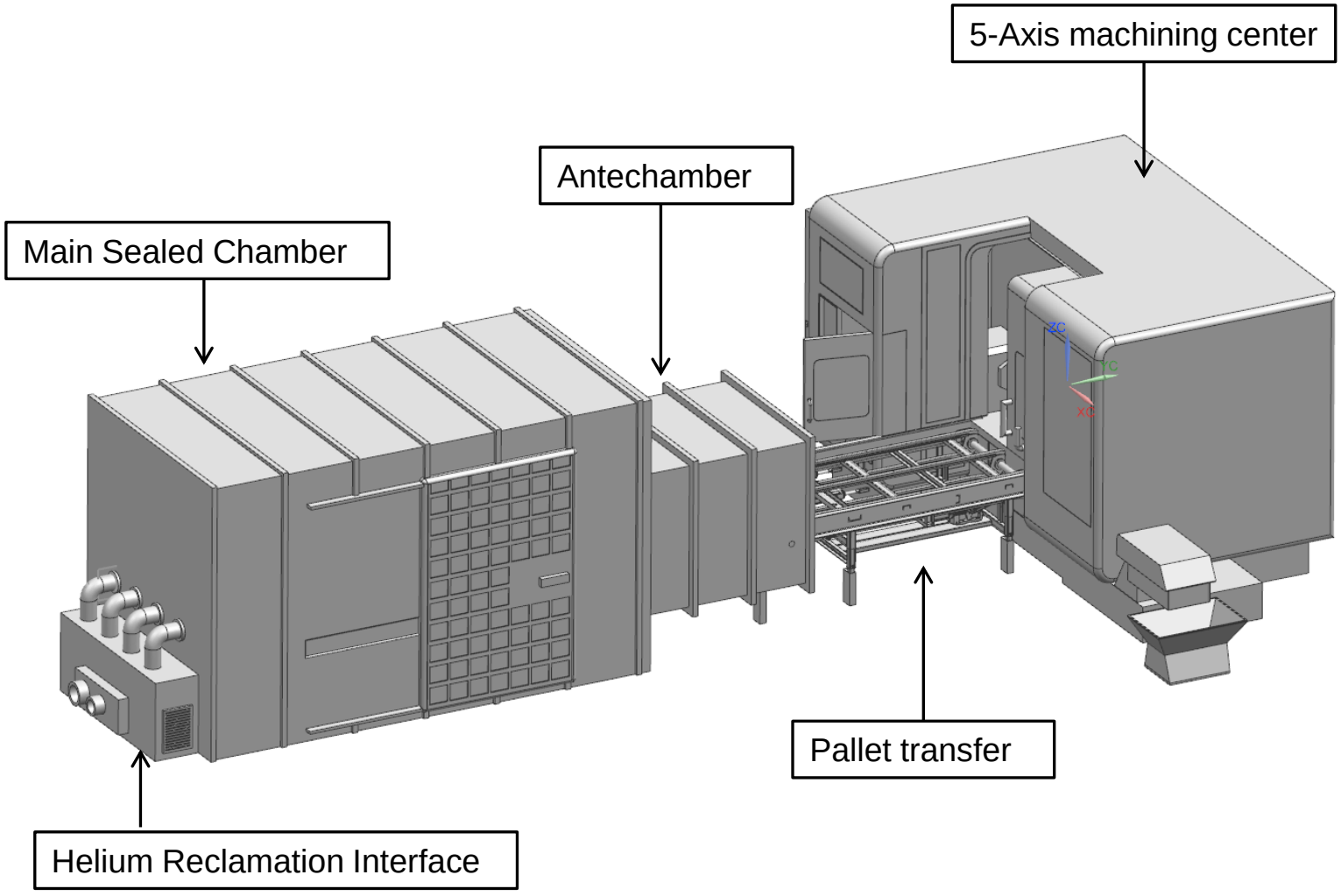
ARC – Current Design status

System level overview



ARC – Current Design status

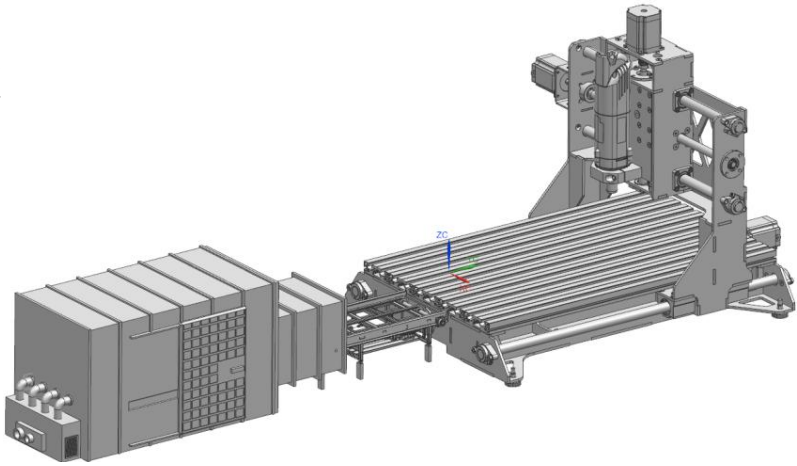
Preliminary concept

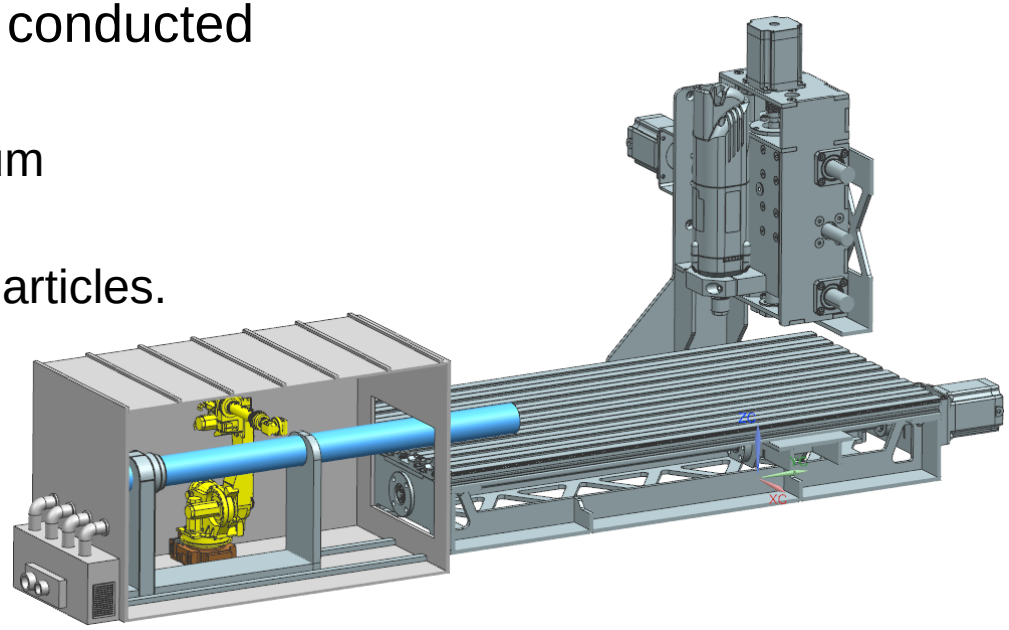


Alternate configurations

Task dependent functionality

- ARC machining capability scaled for work function.
  - Bridge mill can facilitate oversized components.
  - Main sealed chamber can be used as a “stand-alone” section with cold spray and light machining conducted by robot.
    - Periscope repair w/ Helium reclamation.
    - Facilitate long tube work articles.





ARC – Current Design status

Order of operations

1. Work article is introduced to 5-Axis Machining cell for preliminary inspection and pre-machining.
2. Work article translates to Antechamber.
3. Ante-chamber purges Oxygen.
4. Work article translates to Main seal chamber.
5. Cold spray operation begins on work article.
6. Work article translates back to 5-Axis Machining cell through Antechamber.
7. 5-Axis Machining cell conducts machining operations required on work article.
8. Work article is inspected and ready for removal.

ARC – Subcomponent selection

5-Axis Machining center

- Use and application of 5-Axis Machining center is heavily driven by product requirements.

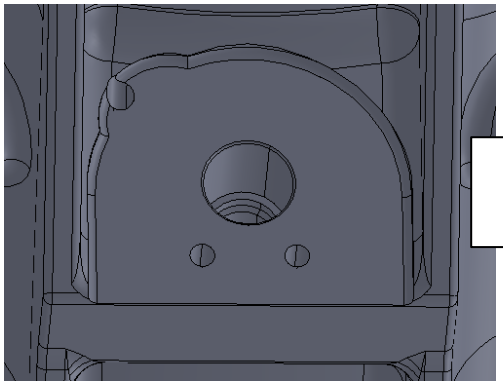
- For current ARC concept, 5-Axis Machining center must have the following capabilities:
  - Positional tolerance of +/-0.0005”
  - Simultaneous axis synchronization
  - Work envelope of 36” Ø x 20” height
  - Part scanning capability
  - Work article automation
  - Automatic tool changer

ARC – Subcomponent selection

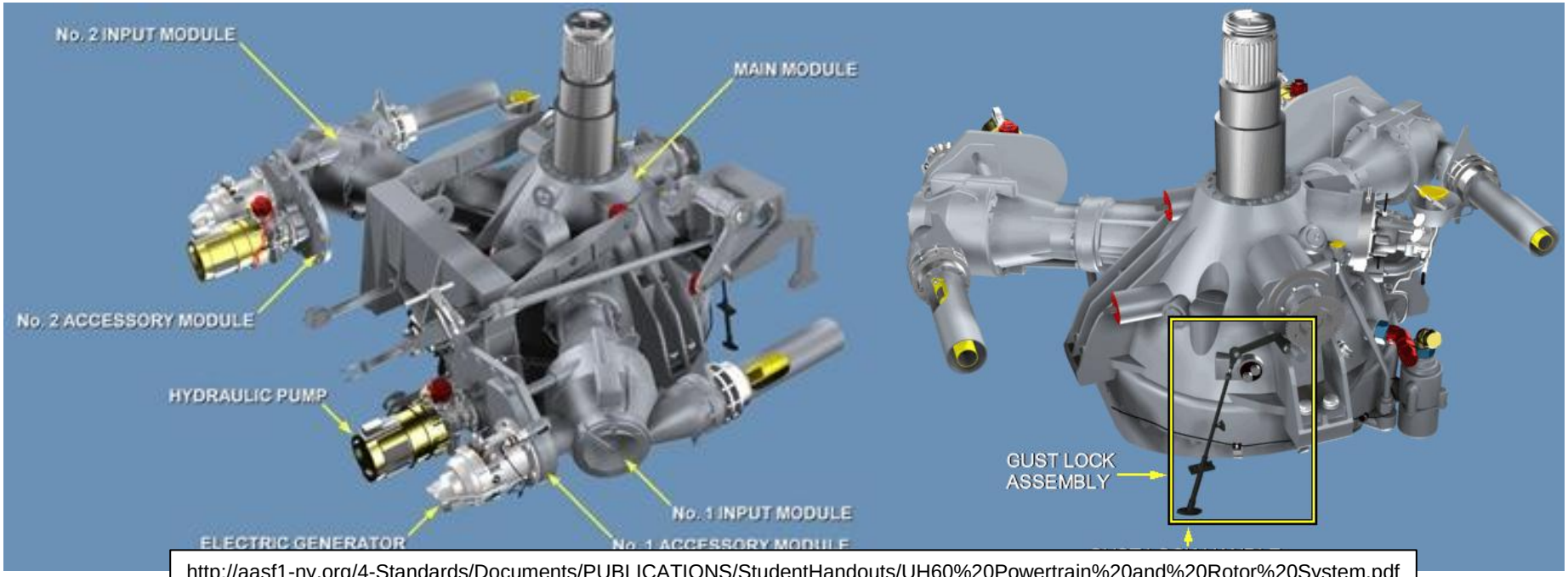
5-Axis Machining center scanning

Work article scanned

http://jteg.ncms.org/wp-content/gallery/ColdSpray/ColdSpray_SlideDeck.pdf



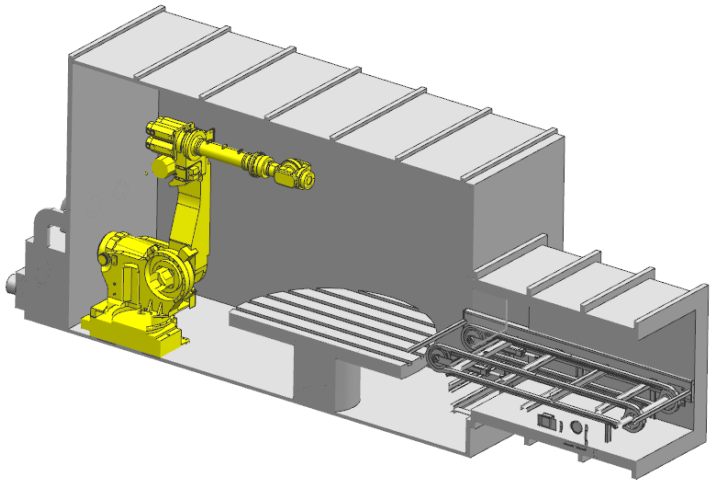
Compared to nominal geometry



http://aasf1-ny.org/4-Standards/Documents/PUBLICATIONS/StudentHandouts/UH60%20Powertrain%20and%20Rotor%20System.pdf

ARC – Subcomponent selection

Main Sealed Chamber



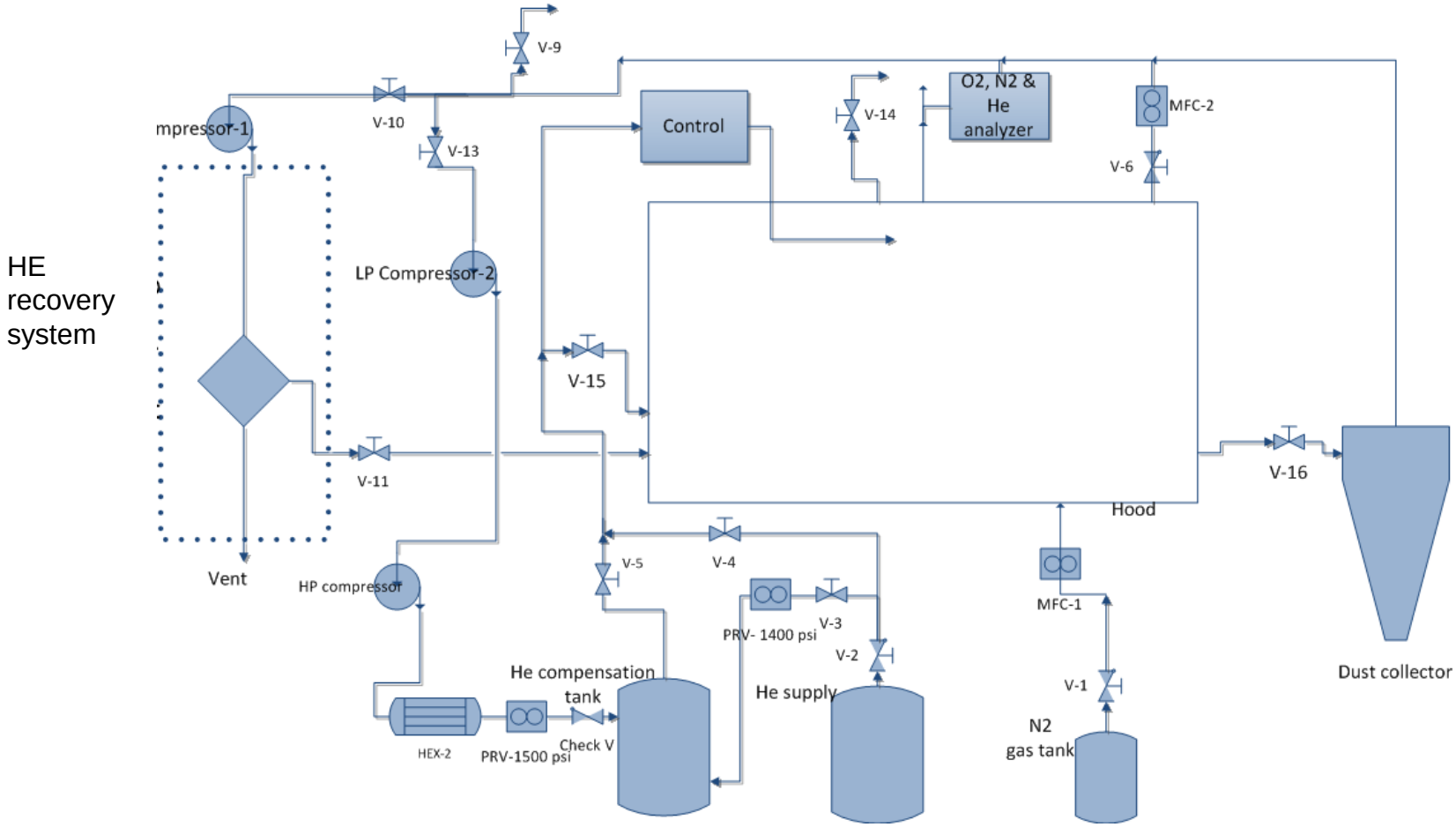
- Purpose to contain Helium used as propellant as work article undergoes coldspray operation.

- For current ARC concept, the Main Sealed Chamber must have the following features:
  - Internal volume of < 1000ft³
  - Vacuum rated door
  - Hermetic feedthroughs for robot and electrical wiring
  - Rotary table
  - Servo controlled pallet system
  - Operator glove box

ARC – Subcomponent selection

Helium Reclamation System

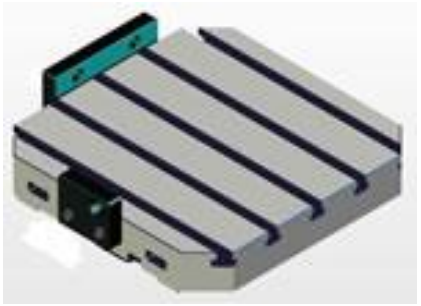
- Purpose to contain Helium used as propellant as work article undergoes cold spray operation.



ARC – Subcomponent selection

Automation Solutions

- Automation maintains a high efficiency workflow and repeatability. Degree of automation can be tailored to system requirements.
- Work article fixtured to pallet.
- Pallet maintains work article positioning.
- Pallet system requires integration with Antechamber/Main sealed chamber.
- Pallet system is highly configurable.
- Automation solutions include the use of robots.



Thank you.