



Lunar Surface Environment Test Capabilities – JSC B351

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Outline



- ESTA
- General Facility information
- Test capabilities
 - Lunar Simulant handling areas
 - Settling dust chamber
 - Component dirty thermal vacuum chamber - 3ft
 - System level dirty thermal vacuum chamber - 15ft
 - Experience & previous testing

<https://www.youtube.com/watch?v=VbK8GR7vWcl>

<https://www.youtube.com/watch?v=CRao0yq1LE4>

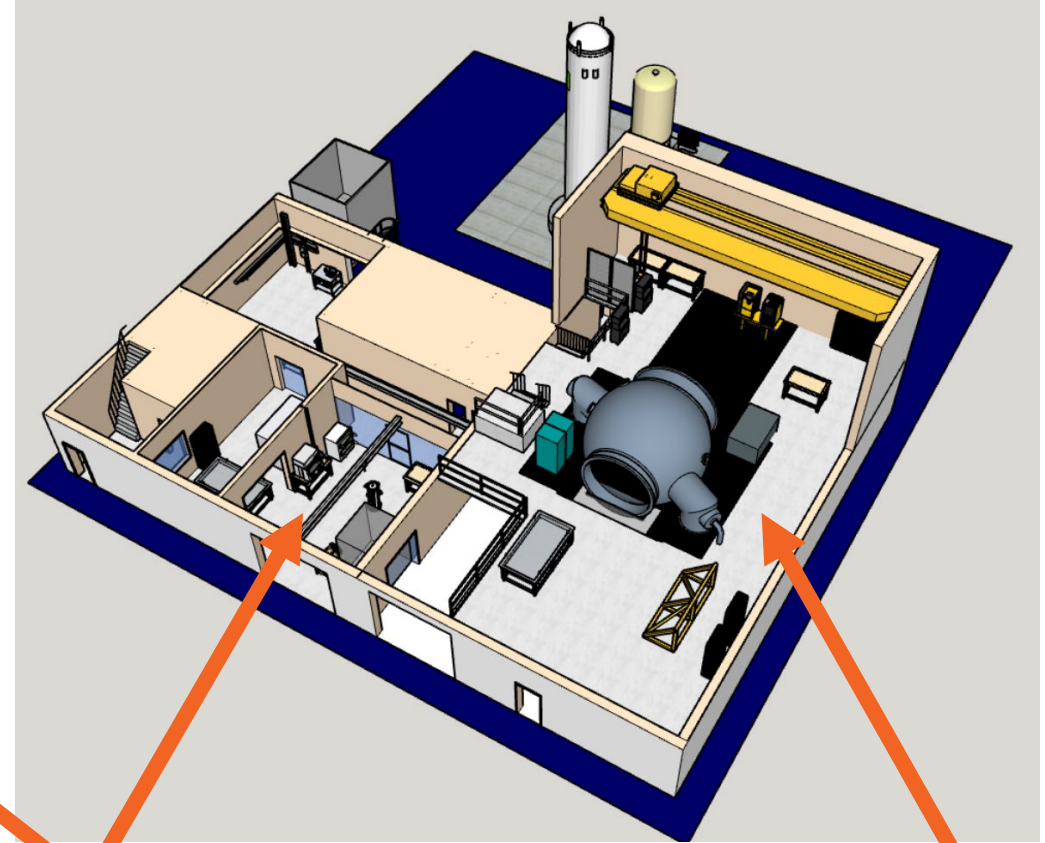


B351: Thermal Vacuum Test Facility





Dust Containment and Preparation Room



Dust containment & preparation room

15' chamber



Dust Containment and Preparation Room



Enclosed 750 ft² room sealed and equipped with HEPA fan filtration unit for dust containment and negative pressure maintenance.

Particulate monitoring and audible alarm to ensure air quality is maintained.

Provides room for regolith bin loading and preparation.

Provides room for test article preparation and pre-conditioning prior to transfer to the 15' chamber.

Houses desktop ambient dust box and small vacuum bell jar.

Settling Dust Chamber

- Meets some industry standards for dust exposure
- 72"x36"x30" interior
- Timed dusting allows for repeated application of dust to moving test articles
- Initial validation testing with Lunar simulants underway
- Located in B351 Dust Preparation Room
- Status: Online and available for use



Component Level Dusty Vacuum Chamber

- Thermal Vacuum capability with dust mitigation for pumping system
- 36"x36"x36" Box shape
- Rough or High vacuum (10-5 torr range quickly, 10-7 demonstrated)
- Shroud temperature range of -300F to +300F
- Shroud walls independently controlled for zone temperature conditioning if needed
- Status: Online and available for use





15ft Chamber Capability



- Description
 - 15ft Φ Spherical Chamber with ~78in Φ clear entry
- Environment Capability
 - **Vacuum:** 1×10^{-6} torr (ultimate),
 - Pumping, rotary piston pumps, roots blowers & two 36in diameter diffusion pumps
 - **Atmosphere:** Air or GN_2 Repressurization
 - **Thermal Range:** -185°C to $+120^\circ\text{C}$ Thermal shroud temperatures
 - High channel count data feedthroughs
 - High power feedthroughs available
 - Max platform load: 4,000 lb
 - Test article operation on 48" x 96" regolith bed in chamber with surface interactions with regolith to depths down to ~3 ft
- Previous tests: used for fuel cell, electric APU during Shuttle, Cryogenic propellant storage, Apollo lunar rover tire, CaRD (ISRU)



Simulant Drill Tube

- Tube jacket to be flooded with LN2 for cooling and heated GN2 for return to ambient temperature
- 13.5" (.342 m) ID and 42" (1.06 m) drill depth with 4" clearance above soil height
- Designed to be filled with compacted lunar regolith simulant with a target water content of 5% water by weight
- Holds ~370 lb. (168 kg) of simulant for a combined weight of ~984 lb. (446 kg)



Drill Tube in Dust Prep Room

Simulant Bin

➤ Description

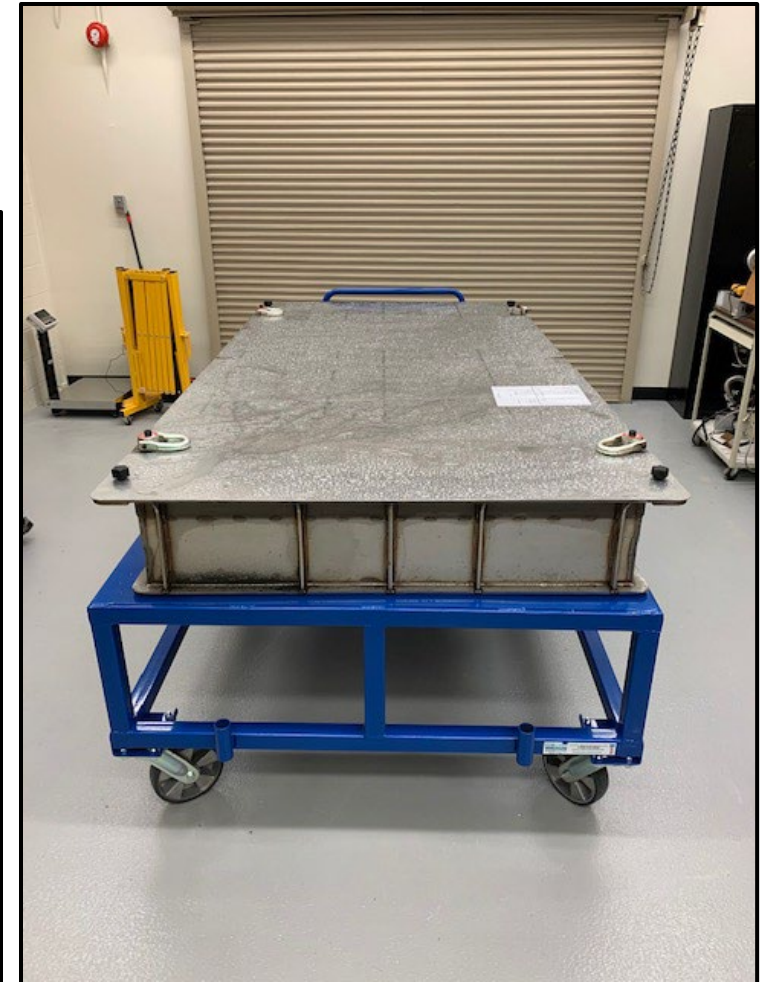
- For use in 15' Chamber
- Basic bin, designed to be filled with simulant in dust containment room and transported into chamber after preparation.

➤ Soil Bin Specifications

- Dimensions: 48" x 96"
- Empty weight: 650 lb
- Max level fill: 8"
- Max level fill weight: 2,880 lb
- Max test article weight at max fill: 520 lb*

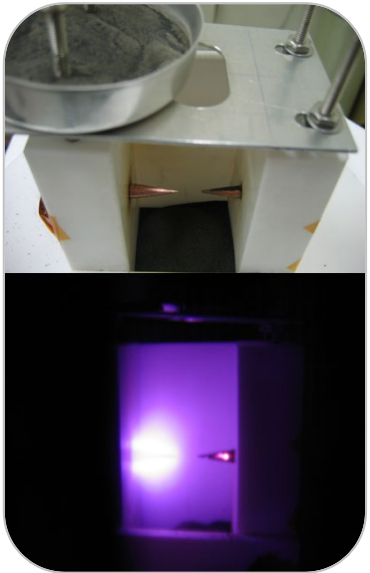
* Based on max platform load of 4,000 lb and assuming two techs (200 – 300 lb each) are needed to install into chamber.

Movable partitions provide customization for a lower fill percentage to minimize unnecessary simulant and maximize test article weight budget



Experience with Regolith Simulants/Dust

Lunar dust effects on electrical components



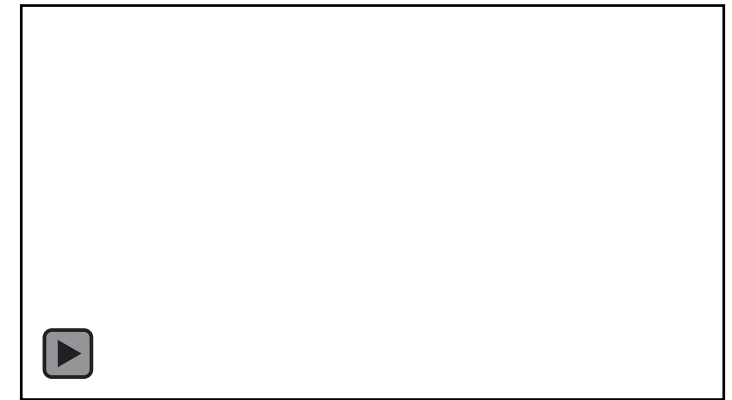
**OVEN in Dust Box
(ISRU/Resource
Prospector)**



**O2 Extraction via H2
Reduction (ISRU)**



**Planetary Surface Simulation-
Dust mitigation**



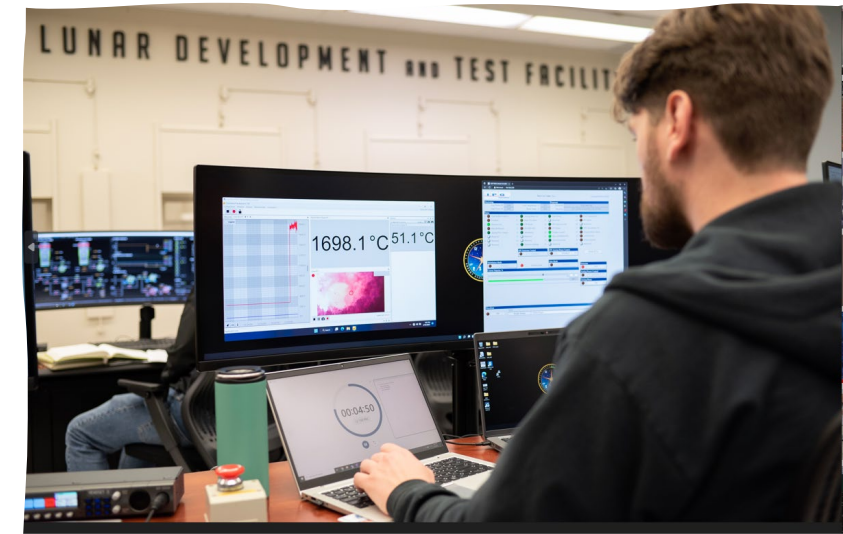
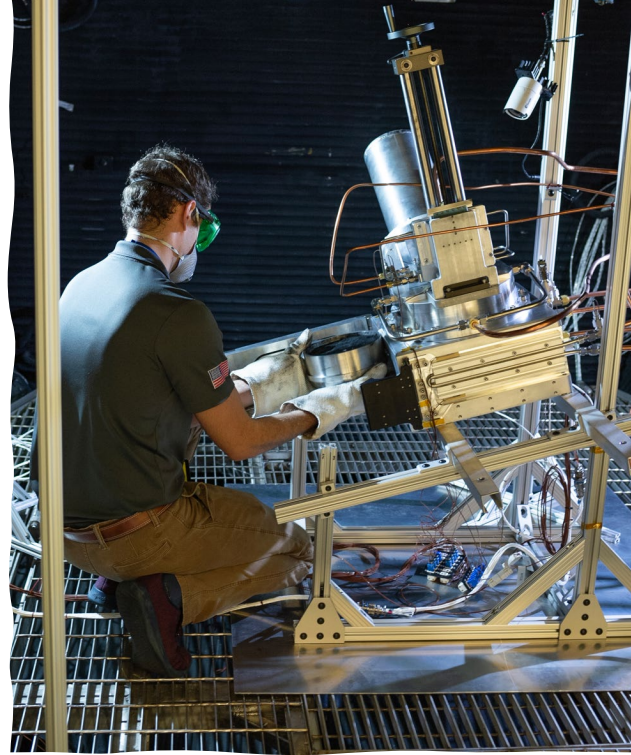
**VIPER Wheel Assy Dust
Exposure Test**



**Auger Dryer for Water extraction
Mars soil (ISRU)**

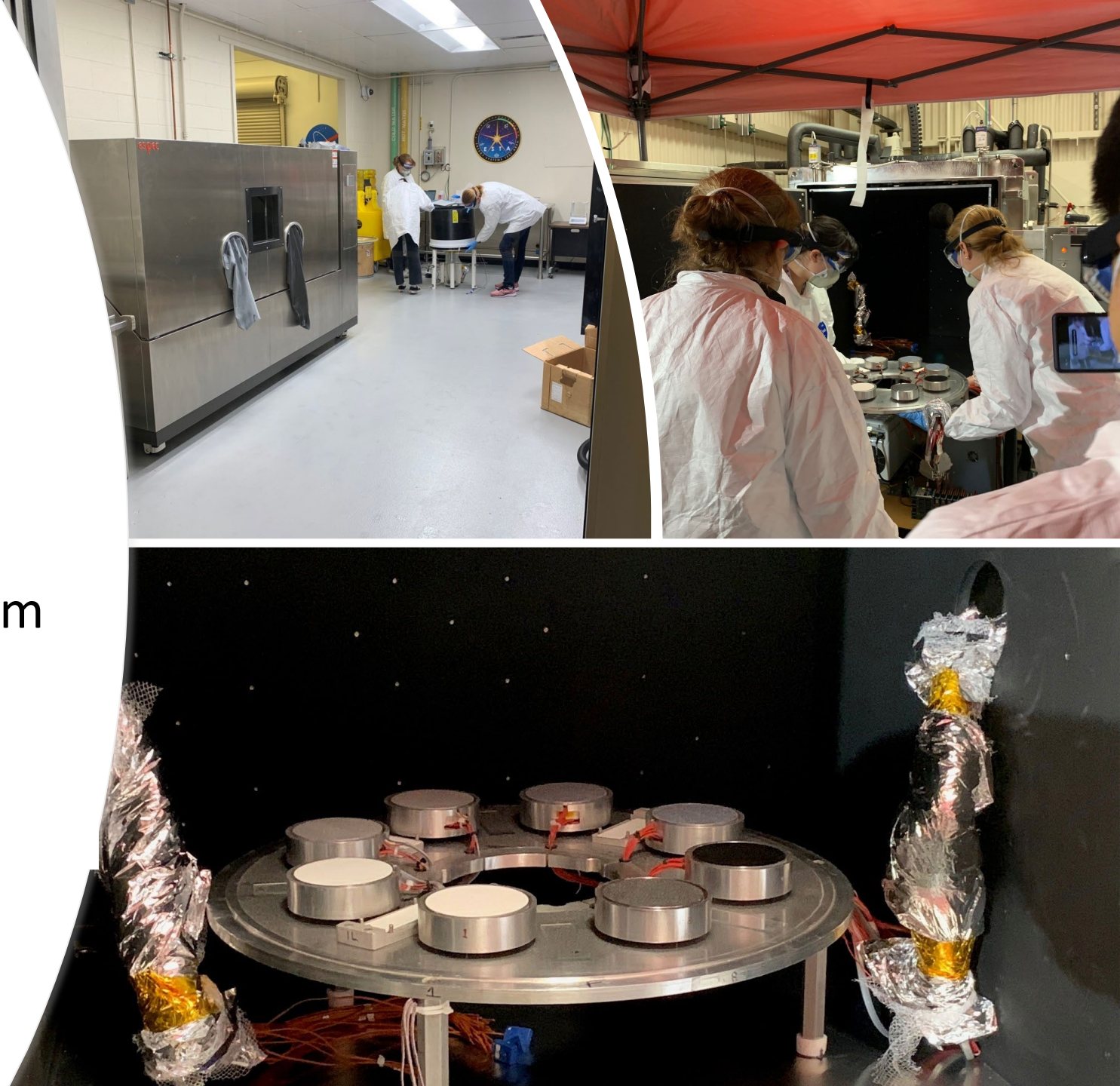
Experience with Lunar Simulant – CaRD (ISRU)

- Lunar Simulant Prep (bottom left)
- Simulant installation in CaRD reactor – top left
- CaRD in 15ft thermal vacuum chamber – top right
- CaRD under test – bottom right



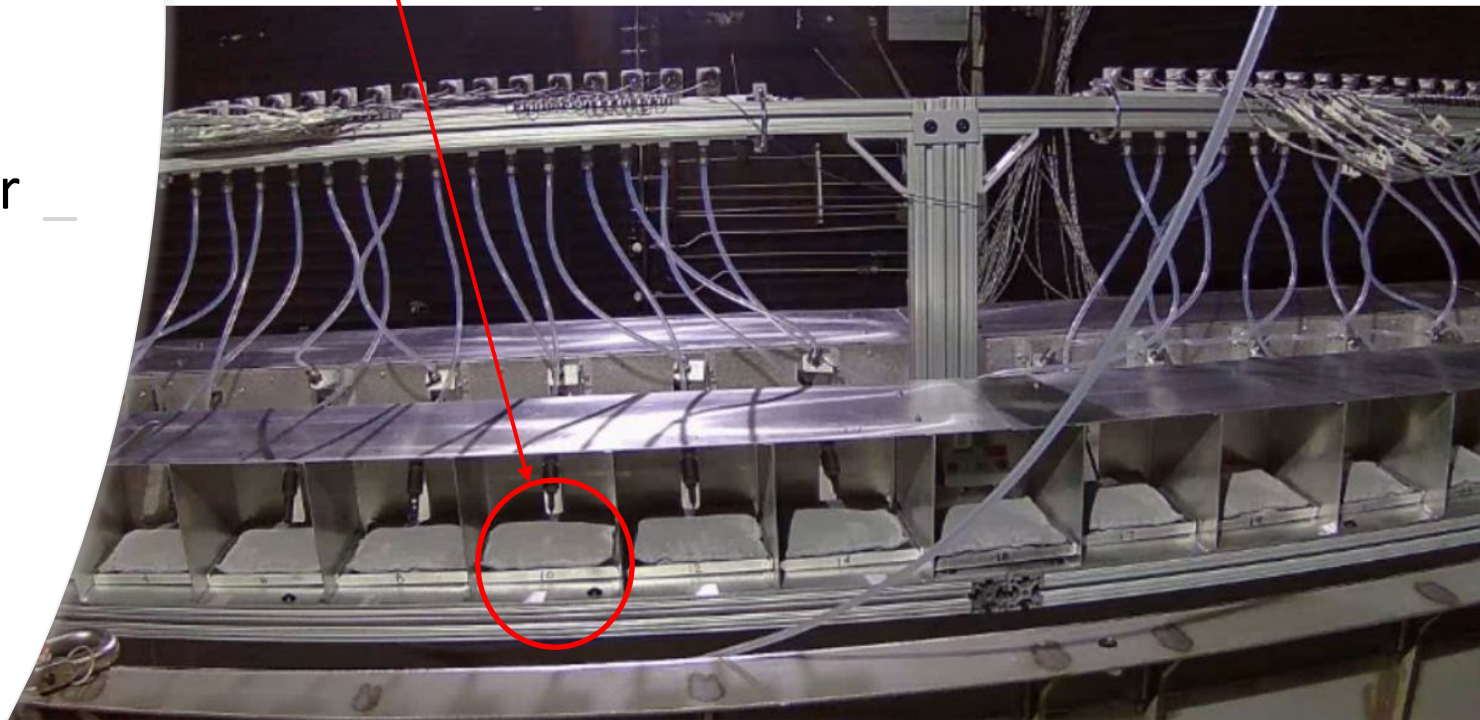
Experience with Lunar Simulant – LDES

- Test article dusting in simulant prep & handling area – top left
- Loading test article in 3ft vacuum chamber – top right
- LDES test setup in 3ft vacuum chamber - bottom



Experience with Lunar Simulant – Dust Mitigation Study on Suit material

- Close-up of suit material coupon covered in dust– top left
- Test articles in 15ft vacuum chamber – top right
- View of test assembly with dusty coupons -Bottom





Backup



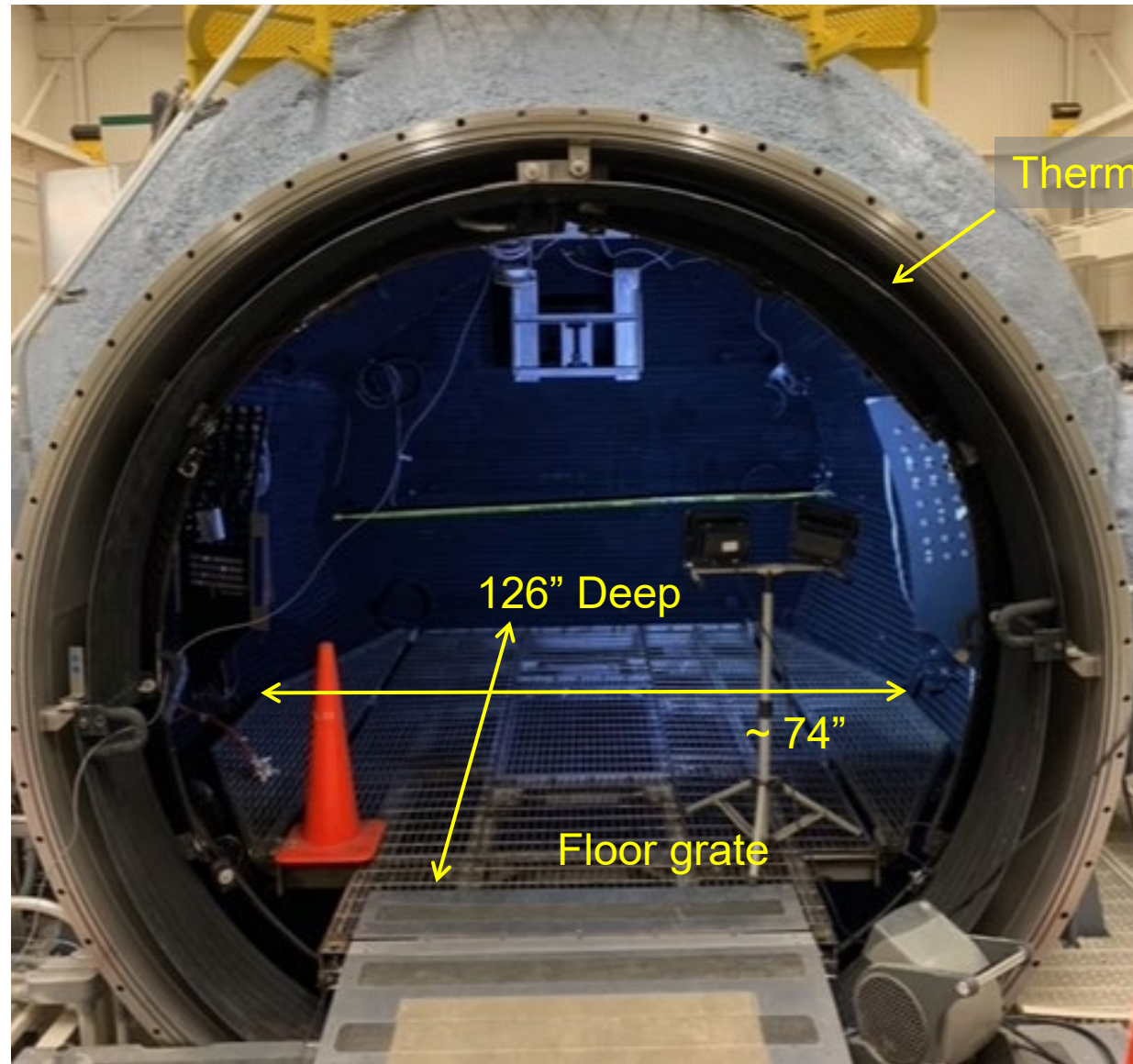
Detailed Chamber & Facility Interface Information



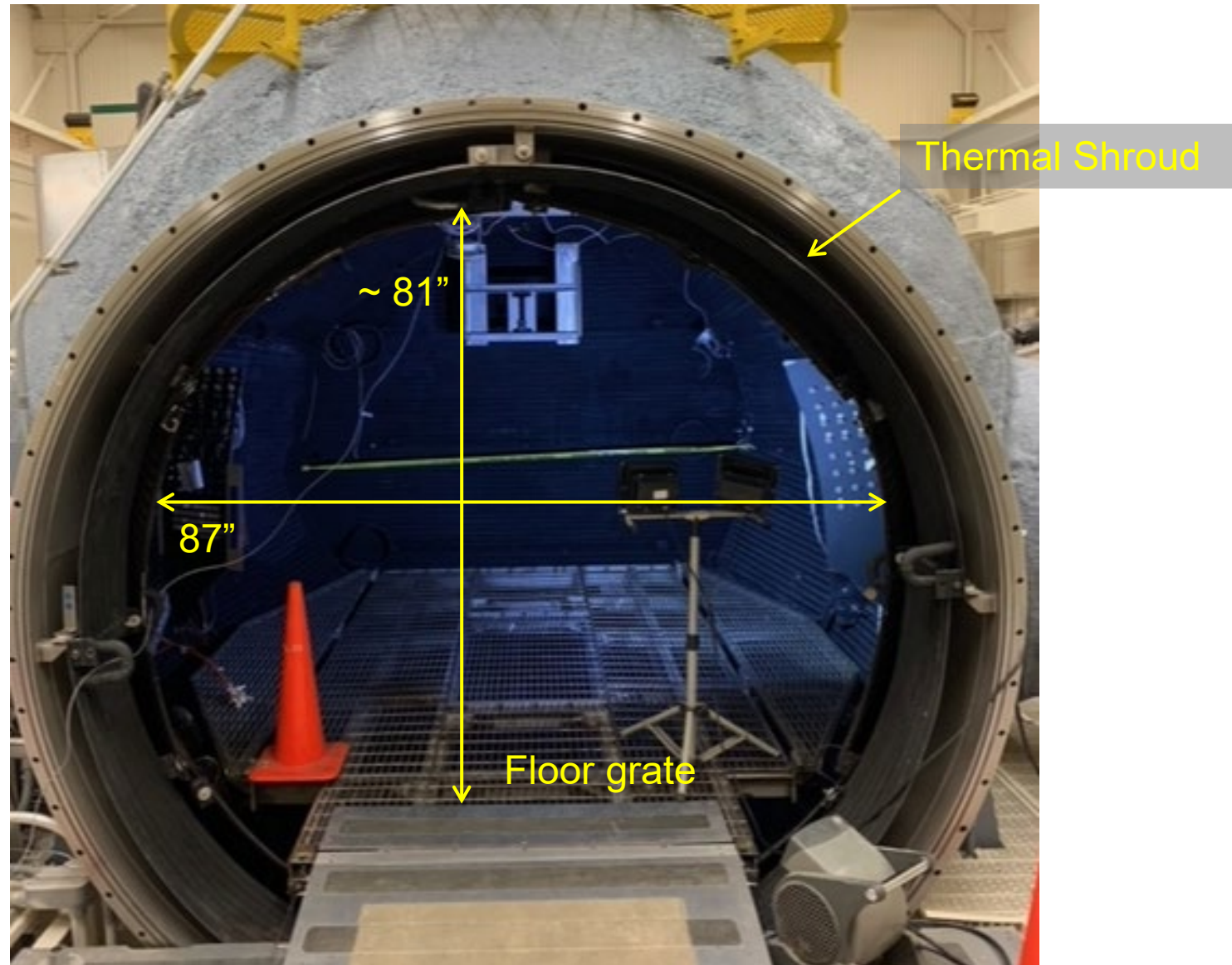
Control Room



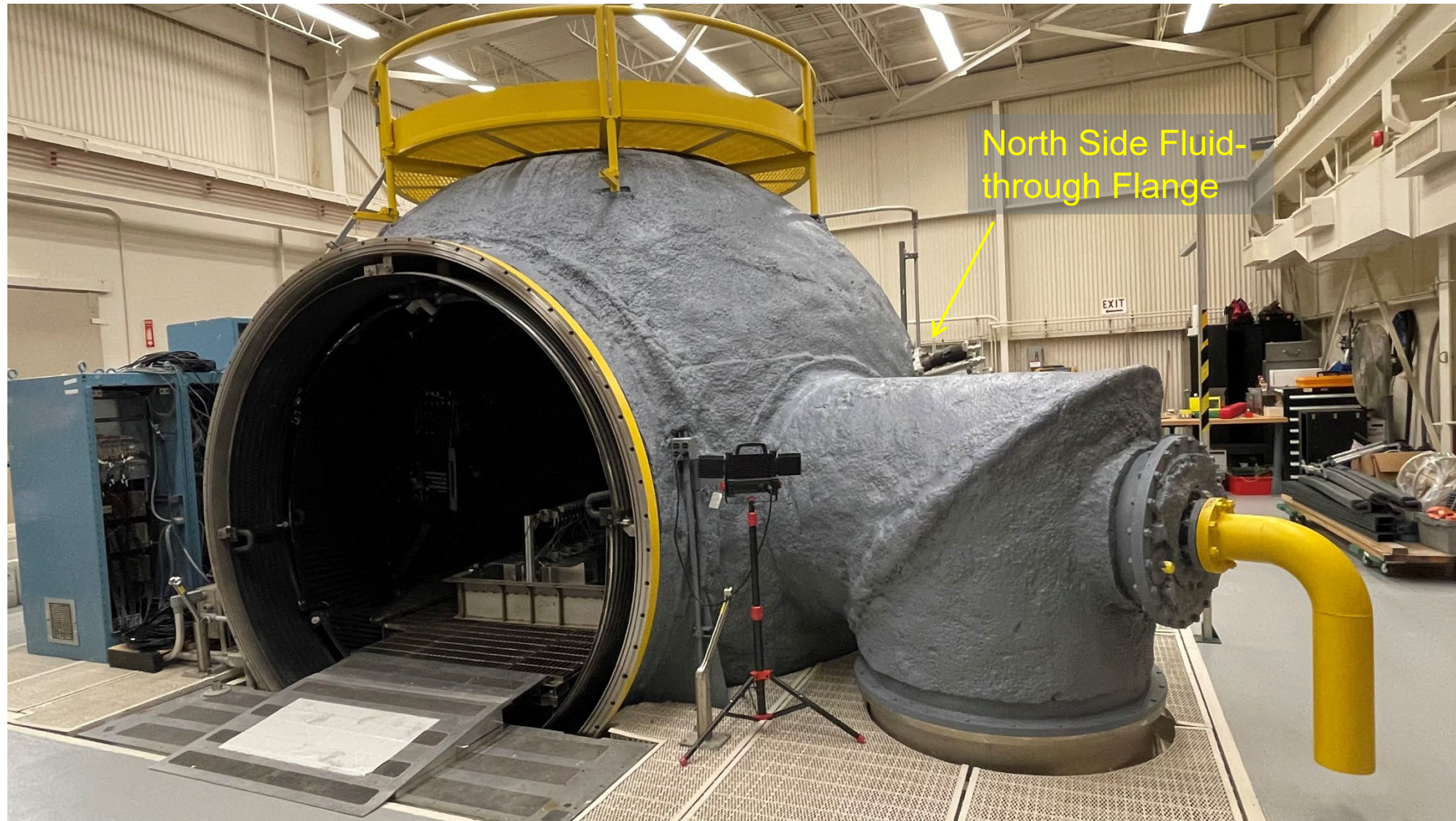
15ft Chamber Platform



15ft Chamber Opening



15ft Chamber Facing West



15ft Chamber Facing North

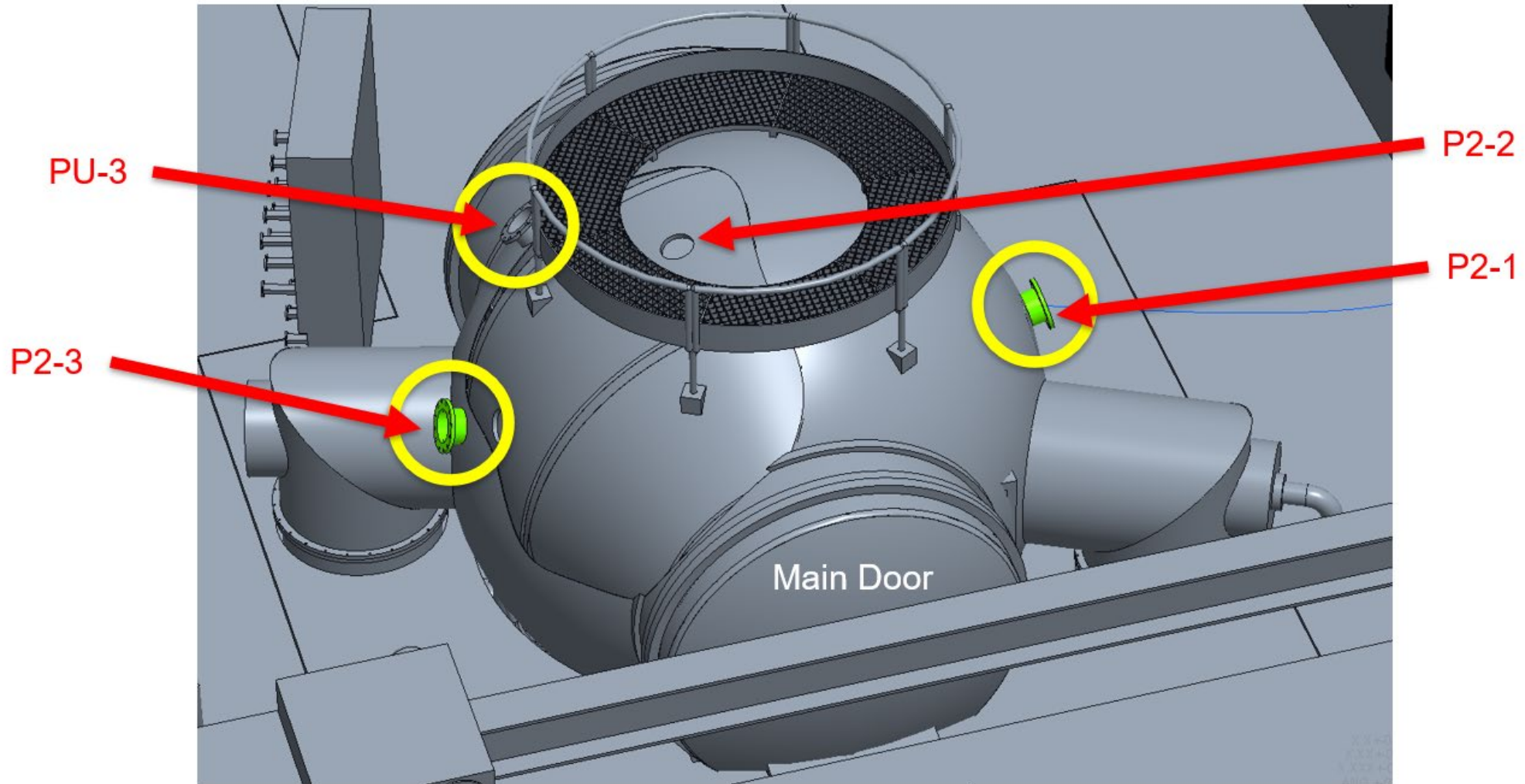


Heights & Clearances for 15ft Chamber

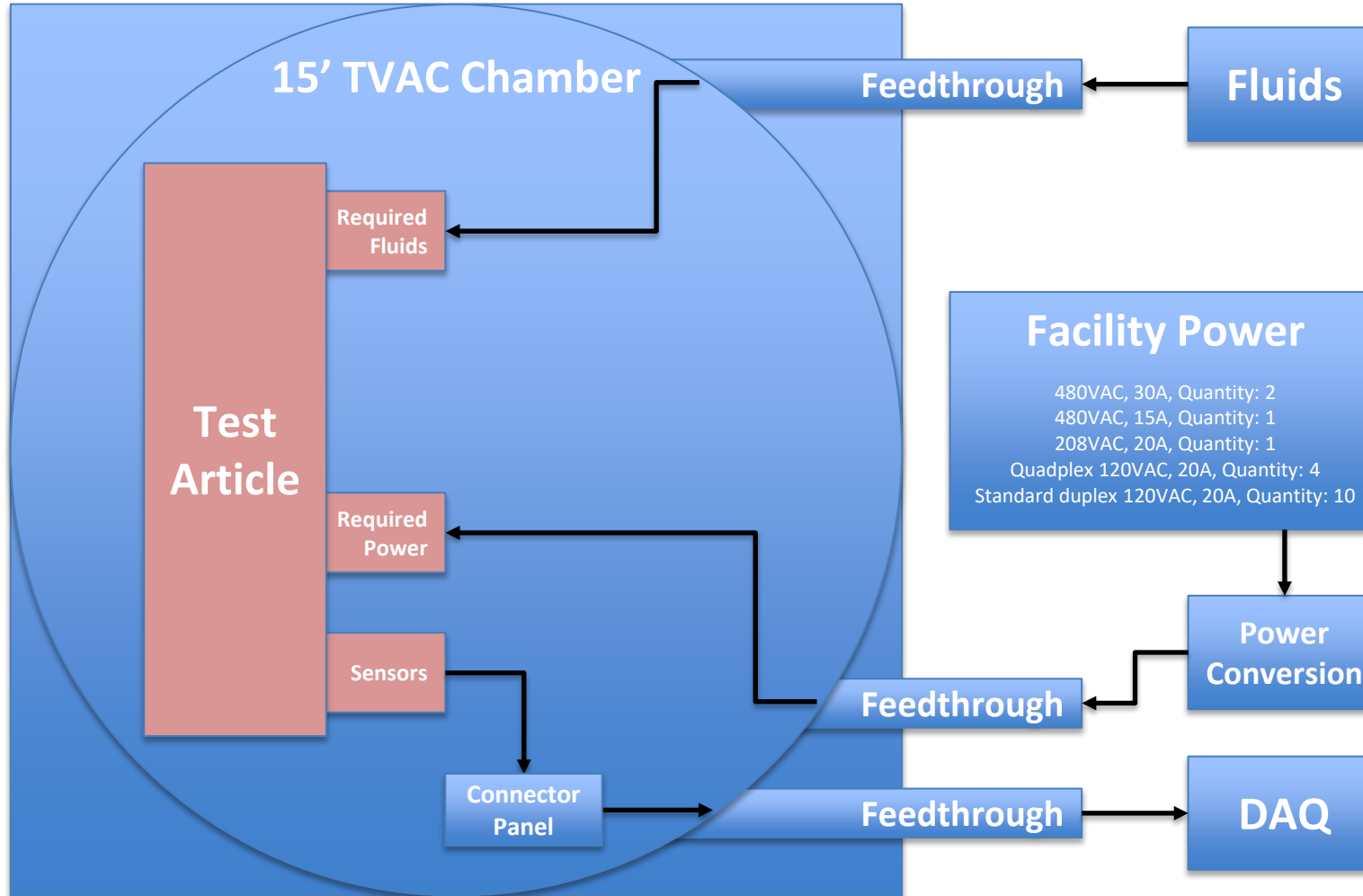
- The height of the crane hook over the 2nd floor is 14 ft.
- Hardware brought into facility via 12 ft roll-up door
- Lifted up over the 3.5 ft railing- railing is removable



Main Penetration Flange Locations



15' Chamber Interfaces



Fluid Penetrations

- Three 15" OD (10.5" feedthrough real estate) available to test article
- Multiple flanges on hand to accommodate a variety of fluid line feedthroughs
- 2 flanges currently installed, each with the following cryogenic feedthroughs:
 - Four 1" lines with AN818-16J nut
 - One 2" line with AN818-16J nut
- 1 flange currently installed with the following feedthroughs for water transmission:
 - Six ¼" AN lines
 - Three ½" AN lines

Power:

- Power delivery is flexible
- Facility power can be converted from AC to DC as needed using power supplies
- Currently known high end power need is 8 kW

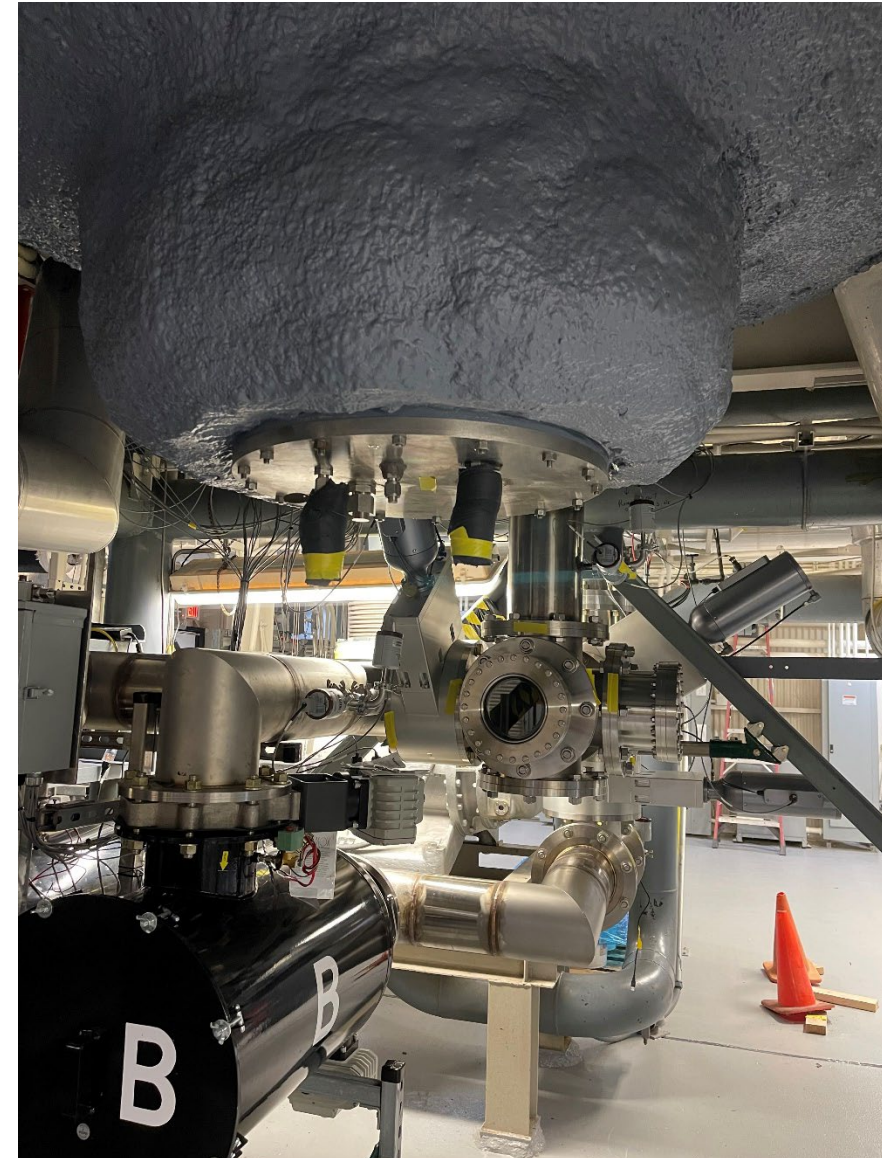
Data Interfaces:

- 72 Type-T TC connectors
- 32 Circular MIL Spec Connectors (3#16 pin Jam nut receptacle)
- 25 Circular MIL Spec Connectors (8#20, 4#16 pin Jam nut receptacle)

[Click here for a full list of flanges and connector interfaces for the chamber](#)

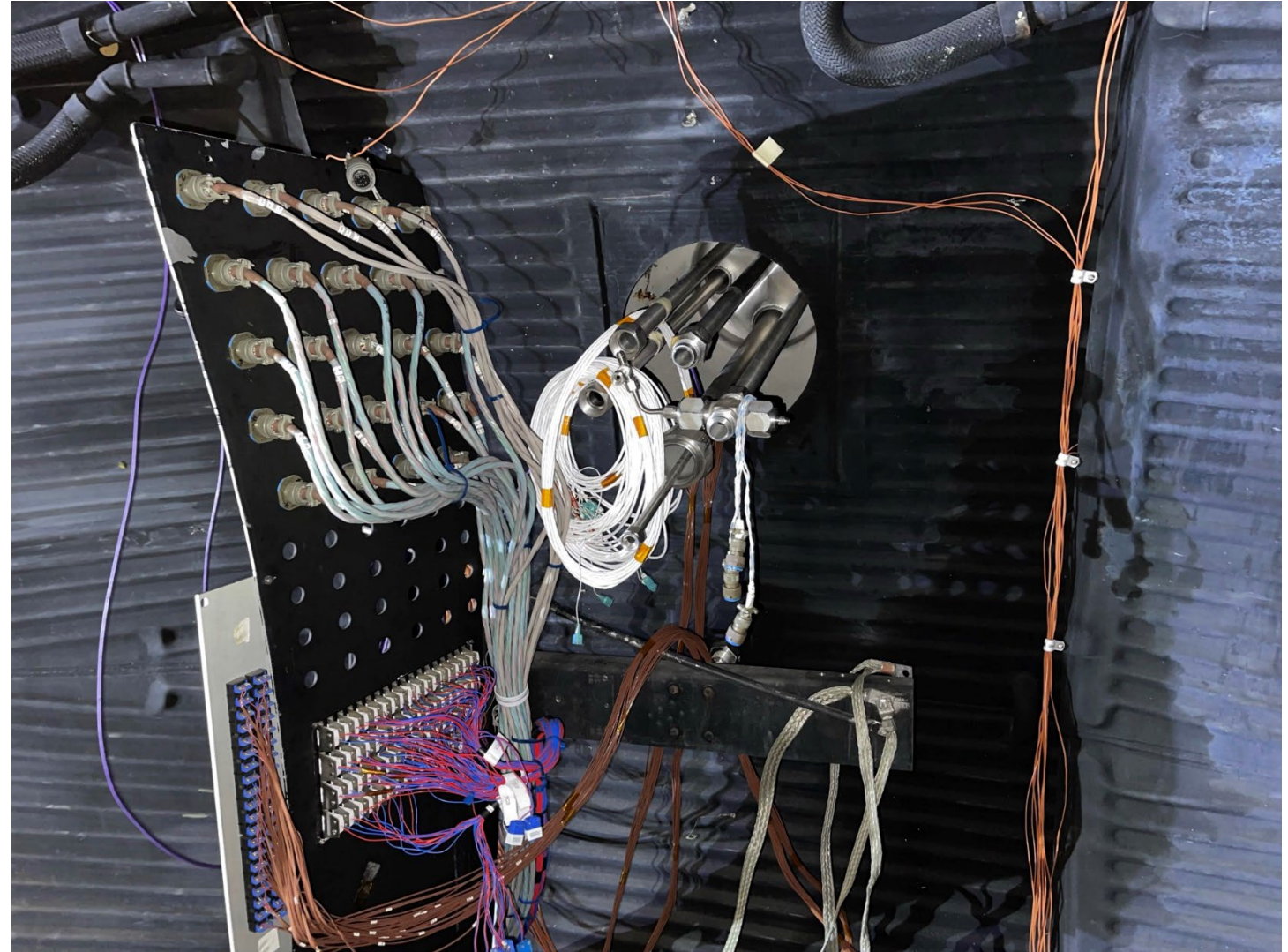
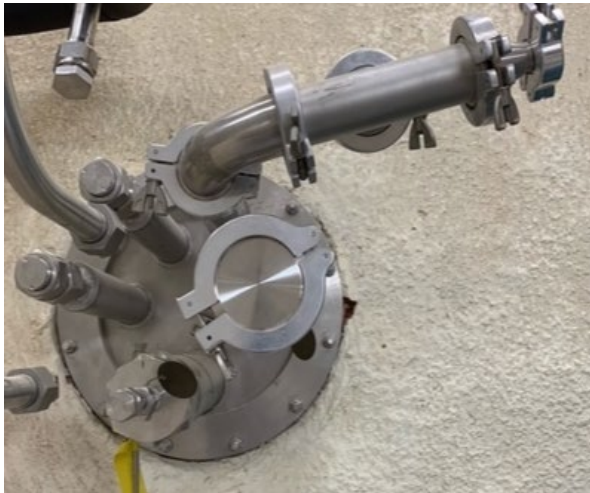
15ft Chamber Bottom

- Located directly below the middle of the chamber
- 20" flange



15ft Chamber Fluid Feedthroughs (South)

- South Side Fluid Pass-through & Electrical Patch panel
- 15" Flange, 10.5" Through



15ft Chamber Fluid Feedthroughs (North)

- North Side Fluid Pass-through
- 15" Flange, 10.5" Through





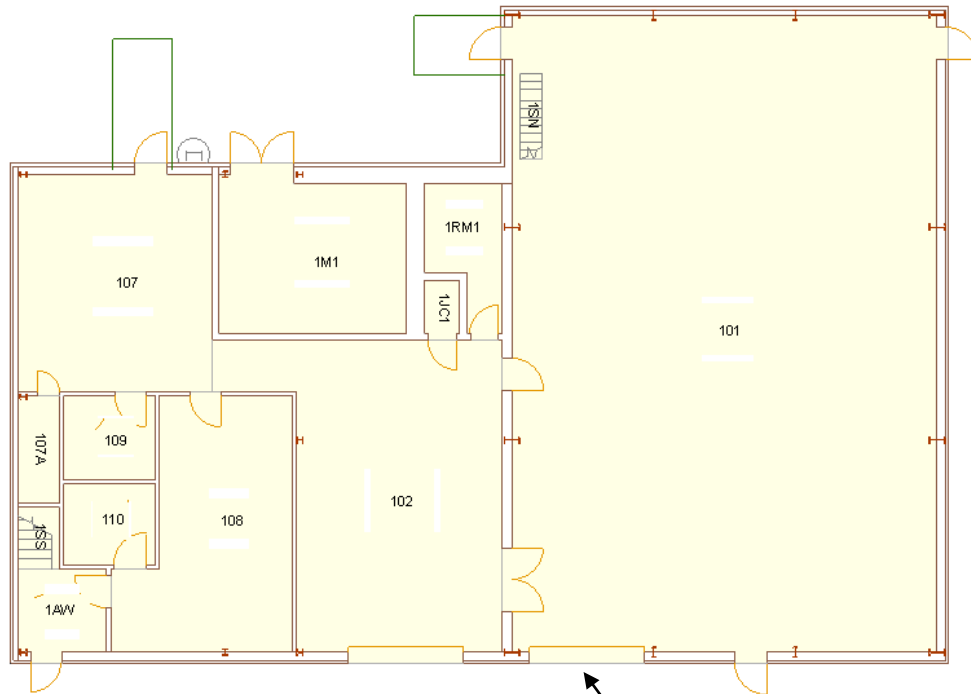
B351: Floor Plan

North



1st Floor

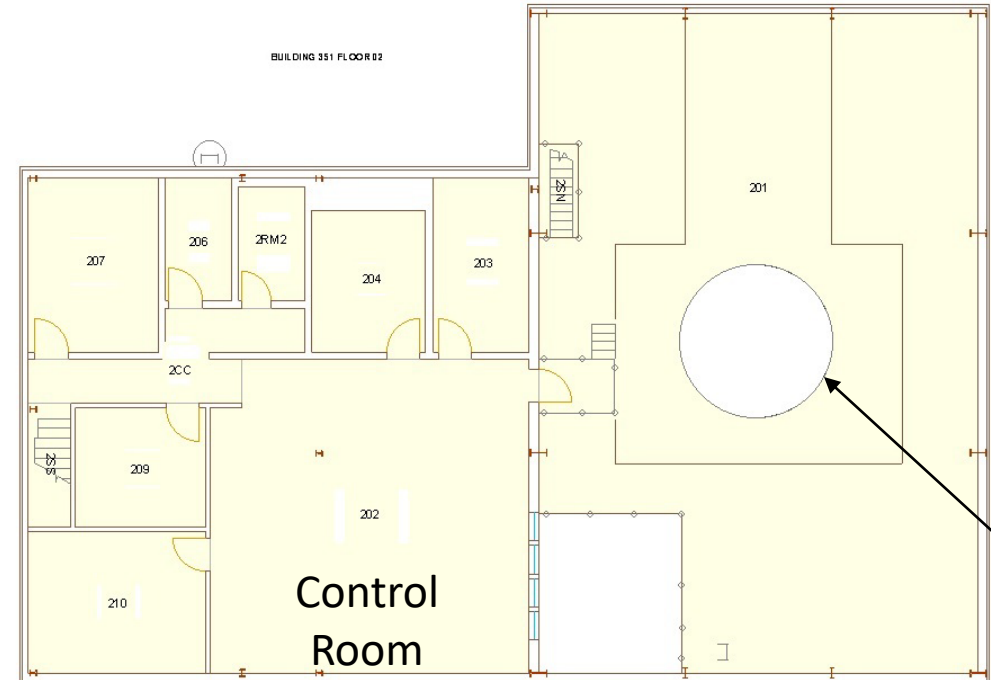
BUILDING 351 FLOOR 01



12ft Rollup
Door

2nd Floor

BUILDING 351 FLOOR 02



15'
Chamber



Flange Feedthrough Example

