OAK RIDGE National Laboratory

Material Plasma Exposure Experiment (MPEX) Enhancements

Expression of Interest Overview

February 18, 2021

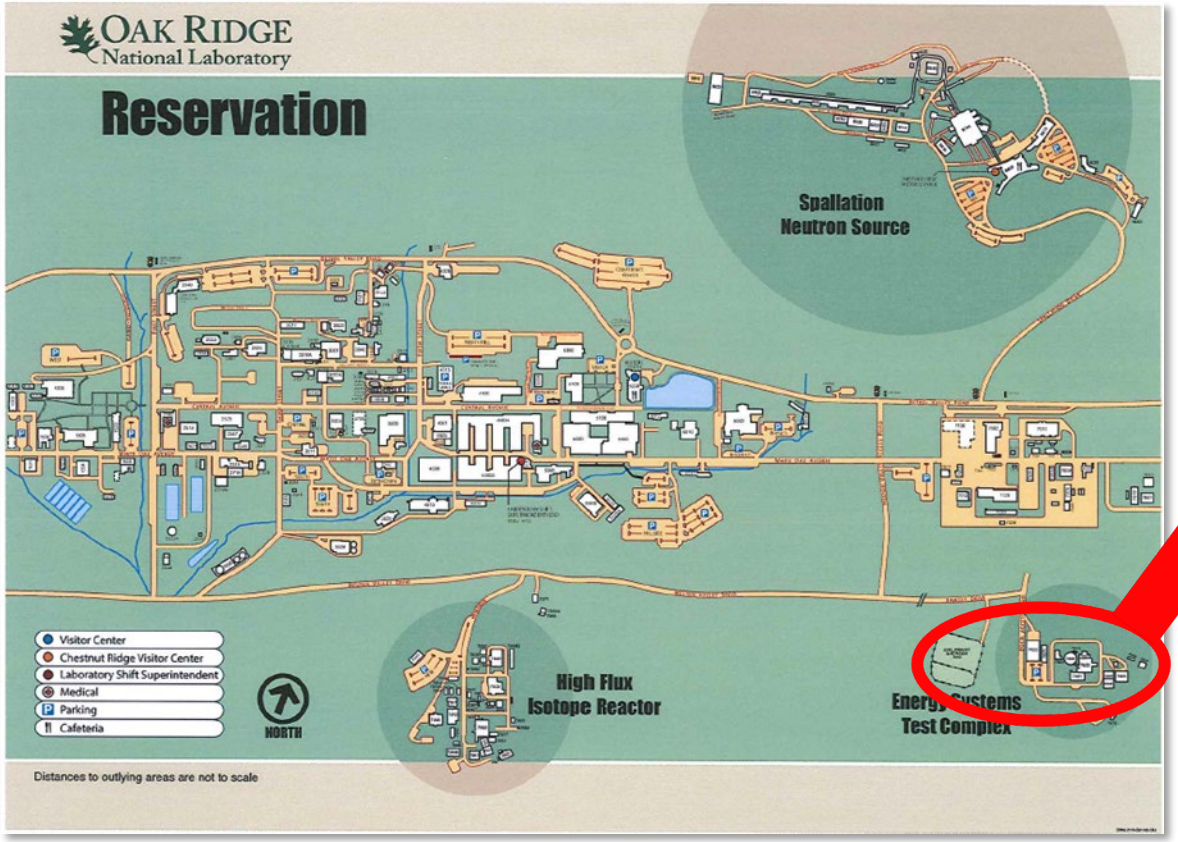
U.S. DEPARTMENT OF ENERGY

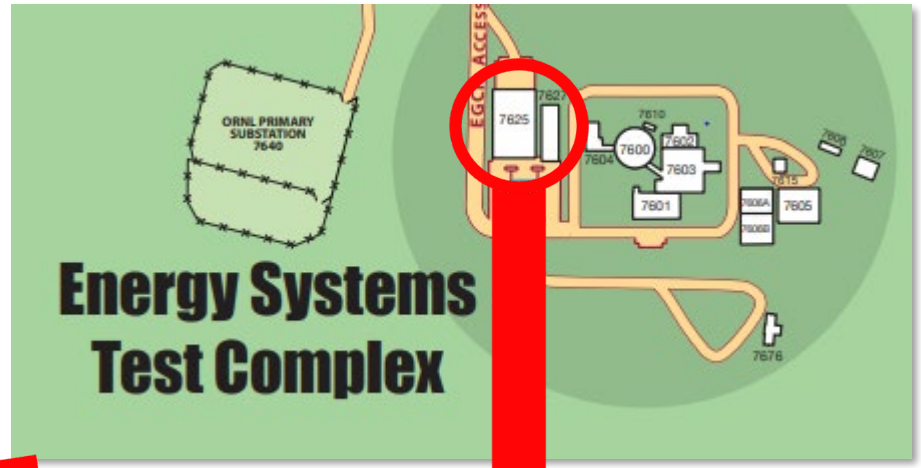
MPEX Facilities Enhancements Construction Scope

- The scope of MPEX Facilities Enhancement construction includes installation of:
  - supporting features and systems for MPEX operations at existing Buildings 7625 and 7627 at Oak Ridge National Laboratory (ORNL).
  - extensions of plant utilities and services to MPEX.
- Installation shall be performed in accordance with the Certified-for-Construction package.

- Installation of the MPEX technical system itself is NOT included in the scope. This effort is being conducted by ORNL Fusion Energy Division (FED) staff

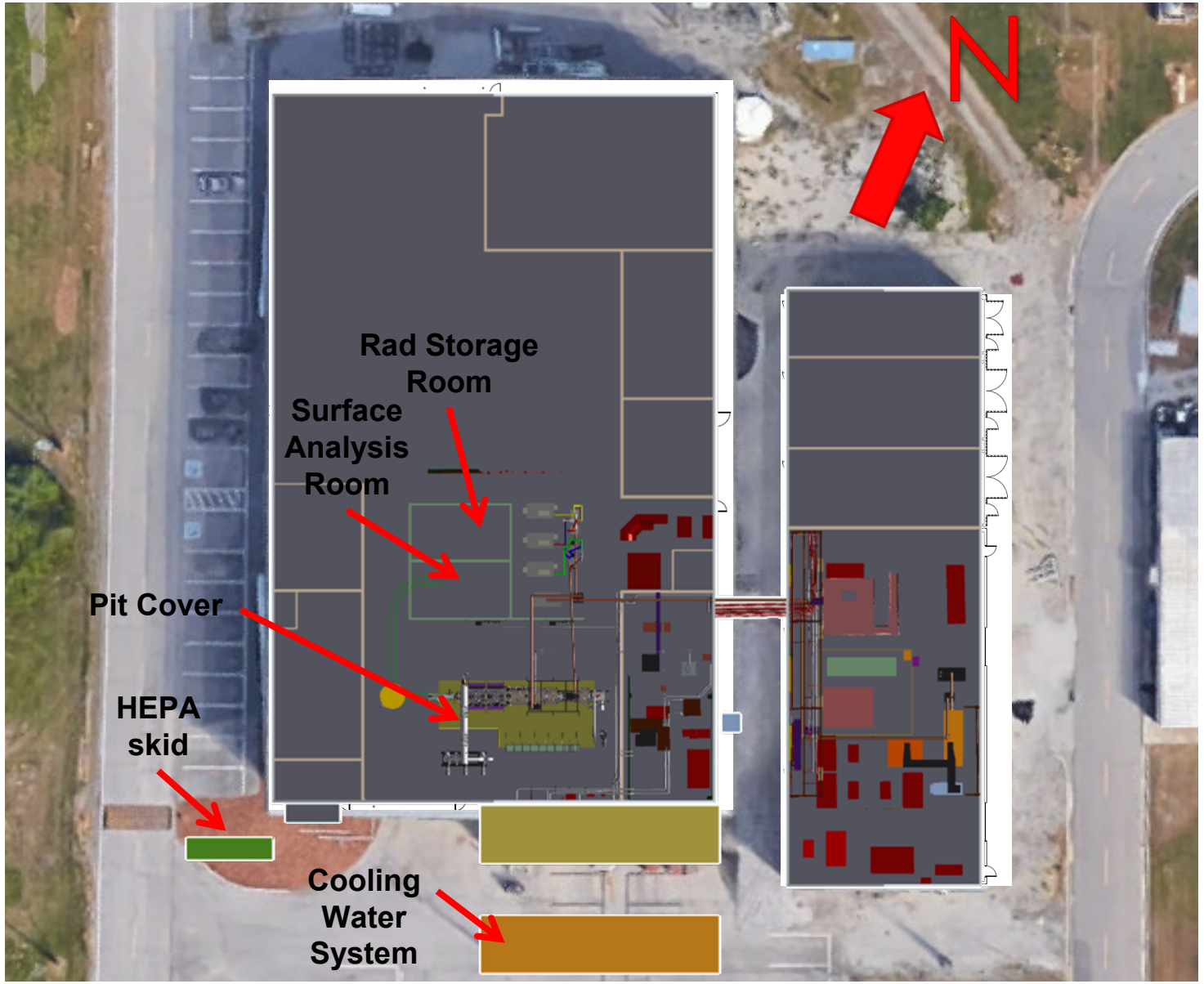
Facilities Overview





OAK RIDGE National Laboratory

MPEX in 7625 and 7627

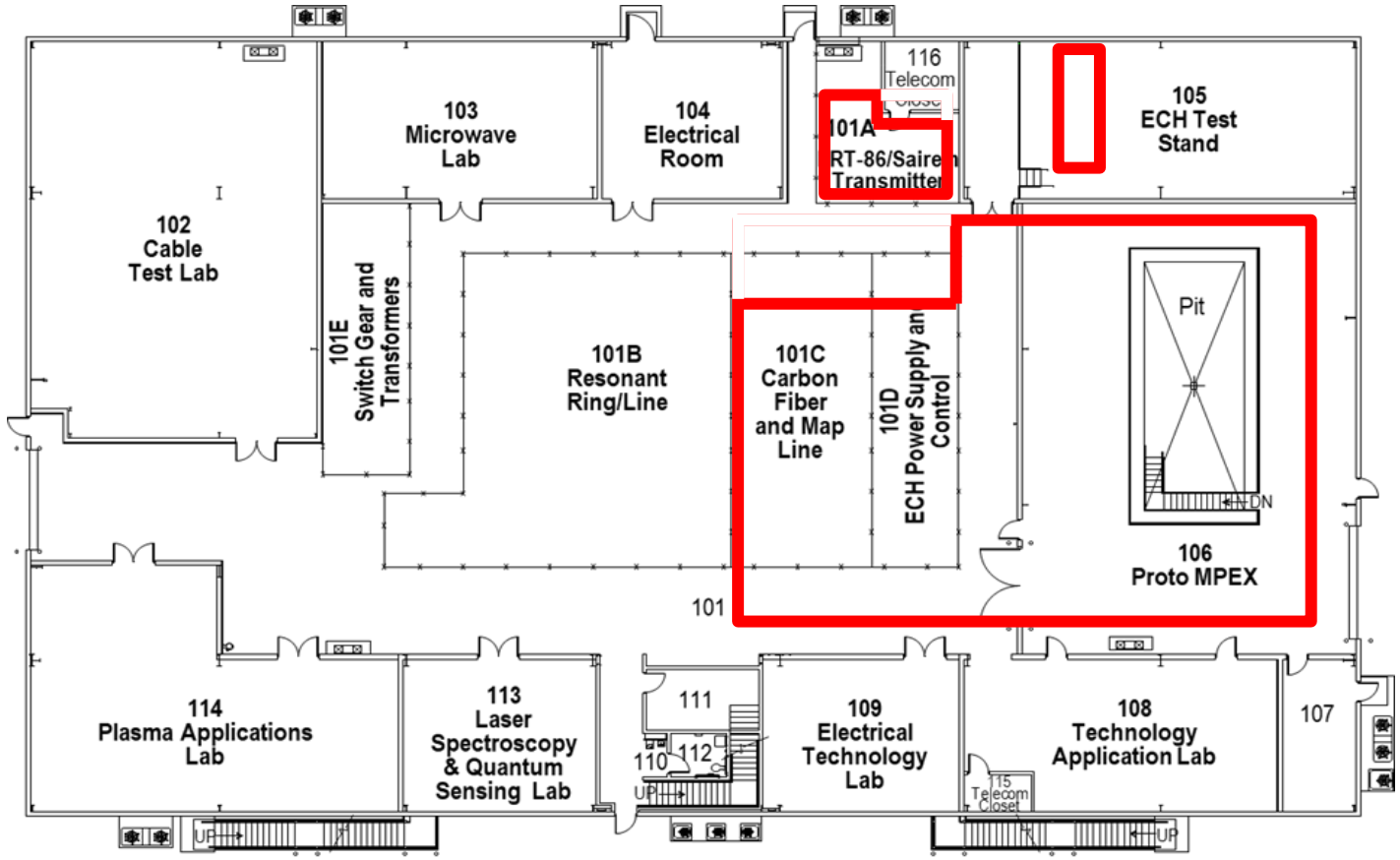


Building 7625

Building 7625

- Two story building constructed in 2004 with approximately 27,000 ft^2 of useable space that includes conditioned laboratories, offices, and common space
- Clear-span high bay with two overhead cranes (20T and 5T), and two roll-up doors (18’ wide x 20’ tall)
- Existing services include electrical power (medium and low voltage); water (potable, sanitary, process, demin); HVAC; fire protection; compressed air; nitrogen; network.
- Typically occupied by ~5 residents, but personnel load fluctuates in response to research and maintenance operations
- Currently a “Standard Industrial” facility with no radiological operations
- Research work primarily associated with plasma technology

Building 7625 – First Floor



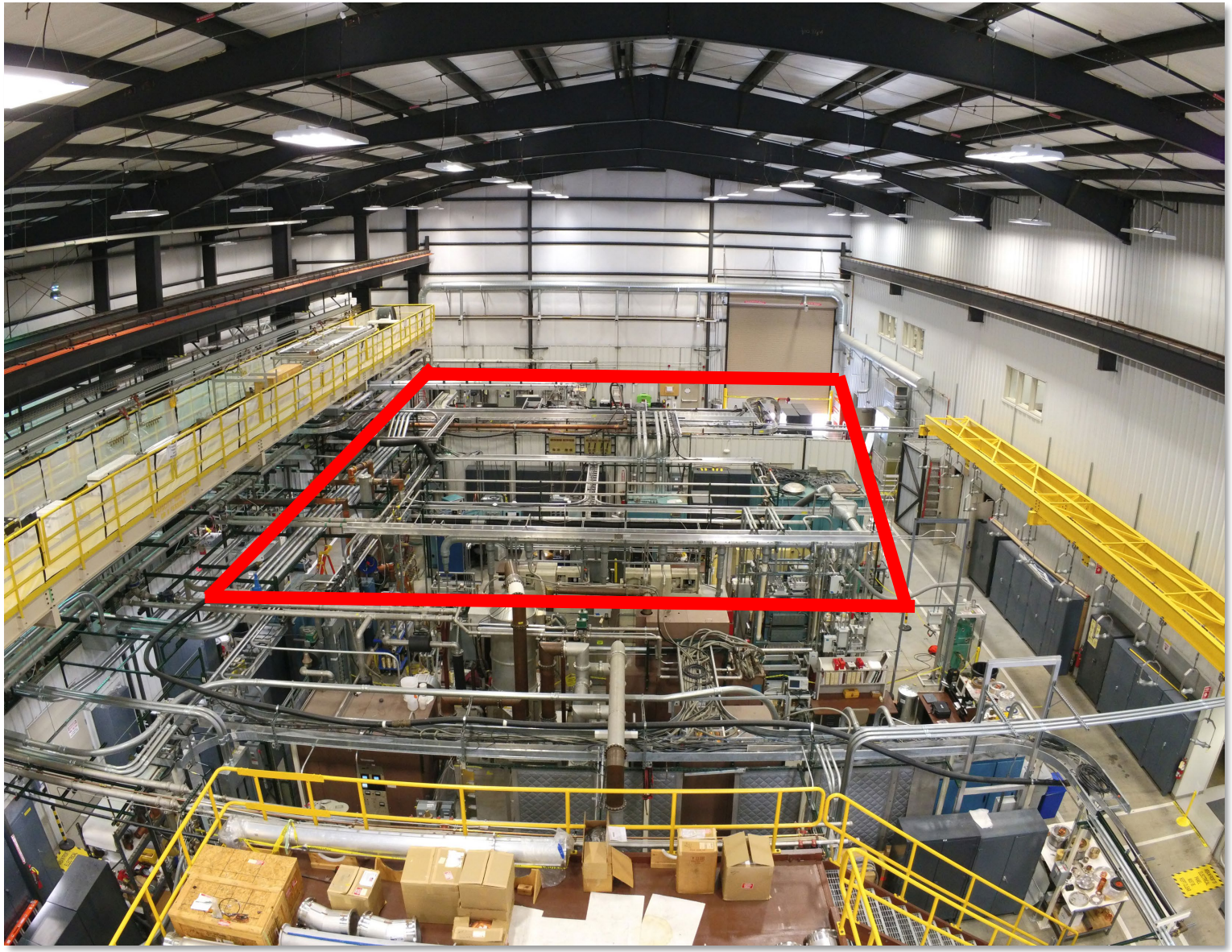
Building 7625 First Floor

Building 7625 – Second Floor

Building 7625 Second Floor

General MPEX Area, Looking South

This is a current view of the facility. Equipment, experiments, and items in the MPEX construction area (outlined in red) will be removed by others prior to construction

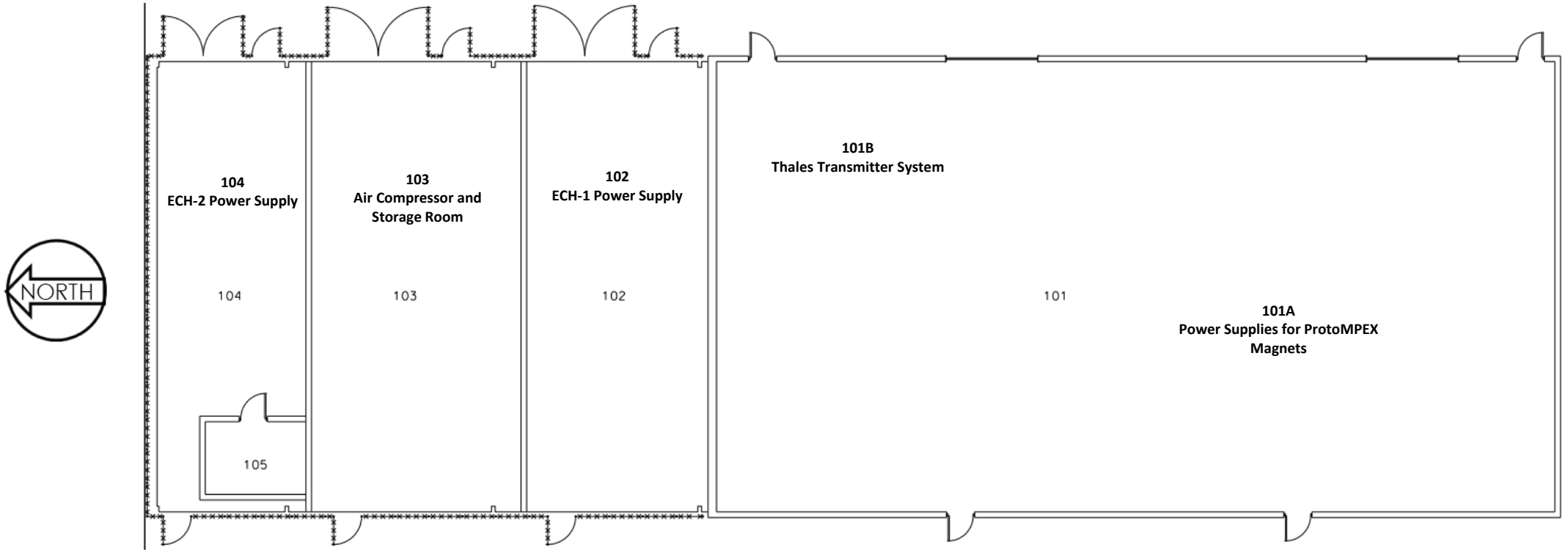


Building 7627

Building 7627

- Single story building constructed in 2008 with approximately 8900 ft^2 of useable space
- Facility consists of one partially conditioned (Room 101) and three unconditioned bays
- Available services include electrical power (medium and low voltage); demin water; compressed air; fire protection (Room 101 only). Limited HVAC in Room 101.
- Not routinely occupied
- Currently a "Standard Industrial" facility with no radiological operations
- Space is used primarily for housing power supplies for research equipment in Building 7625. Also contains compressed air supply system for both 7625 and 7627.

Building 7627



Building 7627

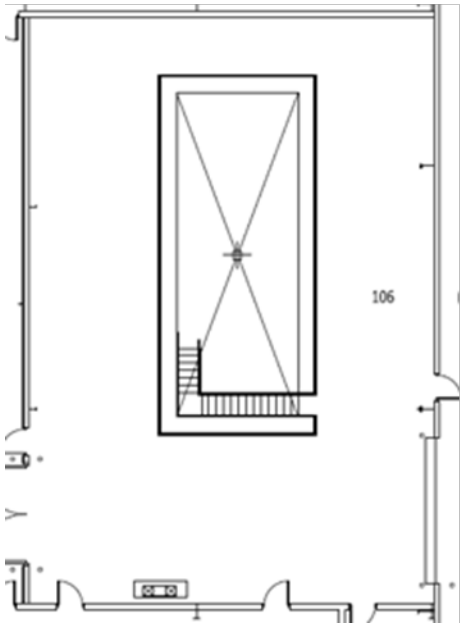
Facility Enhancements

- Facility enhancements refer to the design, procurement, **construction, and installation** of equipment necessary to support MPEX installation and operation, and includes

  - Pit Modifications
  - Magnetic Shielding Wall
  - Personnel Boundary
  - Confinement Ventilation
  - Control Room
  - Hydrogen Safety
  - Cooling Water
  - Surface Analysis Room
  - Helium Quench Vent Syste
  - Utilities

Pit Modifications Subsystem

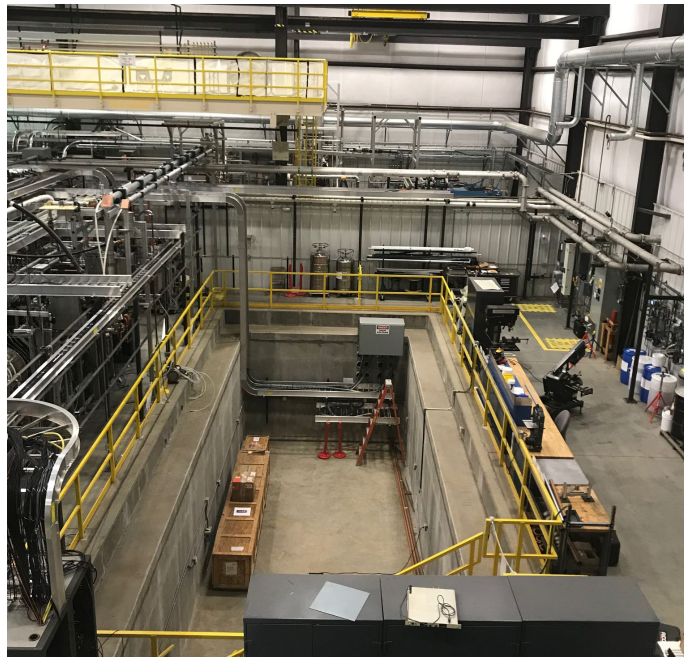
- Install structural cover over pit to support MPEX device [PM-1, PM-2]
- Rework stairs; install lighting, blowers, O2 deficiency instrumentation; and extend sprinkler system to pit [PM-3, PM-4, PM-5]
- Install water collection/containment for potentially rad-contaminated water leaks [PM-10, PM-11]
- Upgrade existing sump system [PM-6, PM-7, PM-8, PM-9]



MPEX Pit:

44' L x 19' W x 12' D

2' Ledge 18" Below High Bay Floor Elevation



MPEX Pit

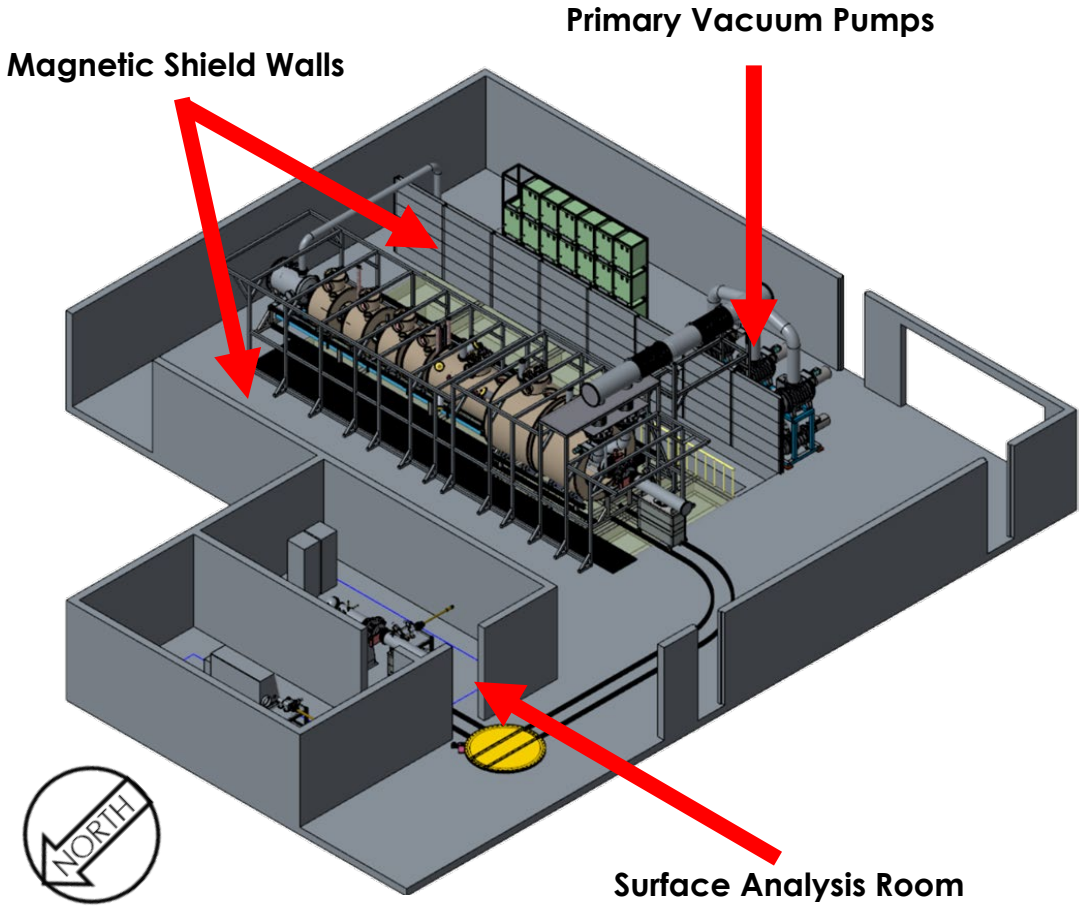
Hydrogen Safety Subsystem

- Monitoring instrumentation located at MPEX gas manifold and MPEX device area [HS-1, HS-2, HS-3, HS-4]
- Detect 10% of Lower Explosive Limit (LEL) of hydrogen and deuterium [HS-1, HS-2, HS-3, HS-4]
- Alarms displayed locally and sent to Control Room [HS-1, HS-2, HS-3, HS-4]
- Shutdown and inhibit flow of flammable gas from supply cylinders [HS-1, HS-2, HS-3, HS-4]

MPEX I&C

Magnetic Shield Wall Subsystem

- Steel barrier walls (50’ long x 8’ tall) to reduce magnetic field affect on equipment and general field magnitude in MPEX area [MSW-1, MSW-2, MSW-4]
- South wall (1” thick low-carbon steel) protects MPEX primary vacuum pumps [MSW-2]
- North wall (0.5” thick Alloy 49 steel) protects sensitive diagnostics in Surface Analysis Room [MSW-3]

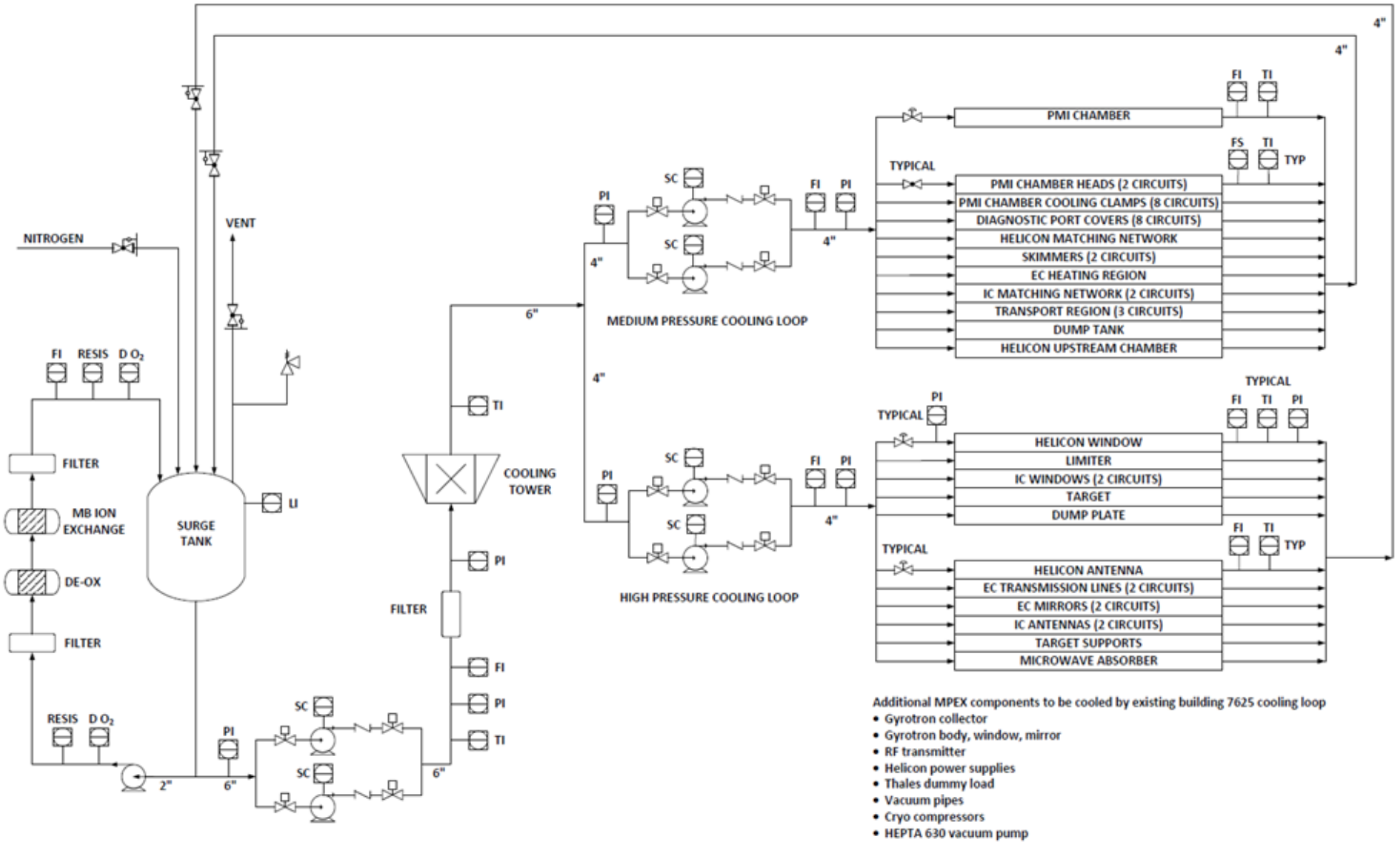


Cooling Water Subsystem

- New closed-loop cooling water system dedicated to MPEX on-vessel components only
  - Separate from other water-cooled components due to potential for water to become slightly rad contaminated [ONVWC-1]
  - Provides nominal 400 GPM flow and removes approx. 1.1 MW heat [ONVCW-1, ONVCW-4]
  - Meets water quality requirements of on-vessel components (pH, conductivity, dissolved oxygen, copper concentration) [ONVCW-2]
  - To be located outside Building 7625 south of existing cooling water system equipment [PR117-R]

- Existing demin cooling water system to cool MPEX auxiliary equipment (gyrotron, RF generator, cryo compressors, power supplies, vacuum pumps)
  - Adds nominal 1100 GPM of flow and 3.9 MW heat load [OFFVCW-1, OFFVCW-3]
  - The existing system has recently been determined to lack capacity to fully support new MPEX loads
  - An option for design effort to upgrade the existing system is included in the A-E Scope of Work

Cooling Water Subsystem



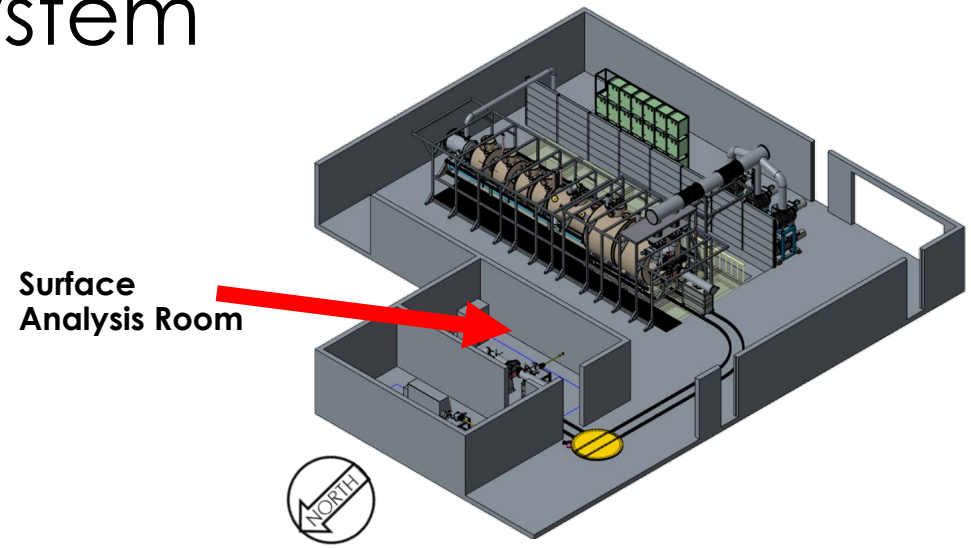
On-Vessel Cooling Water System

Personnel Boundary Subsystem

- Non-ferrous personnel barrier around MPEX device [PB-1]
- Access gate(s) interlocked with potentially hazardous MPEX operations [PB-2, PB-3]
- Captured key or equivalent system will prevent hazardous operations from being initiated if personnel are in the exclusion area; and will shut down on-going hazardous operations if personnel attempt to enter the exclusion area [PB-2, PB-3]

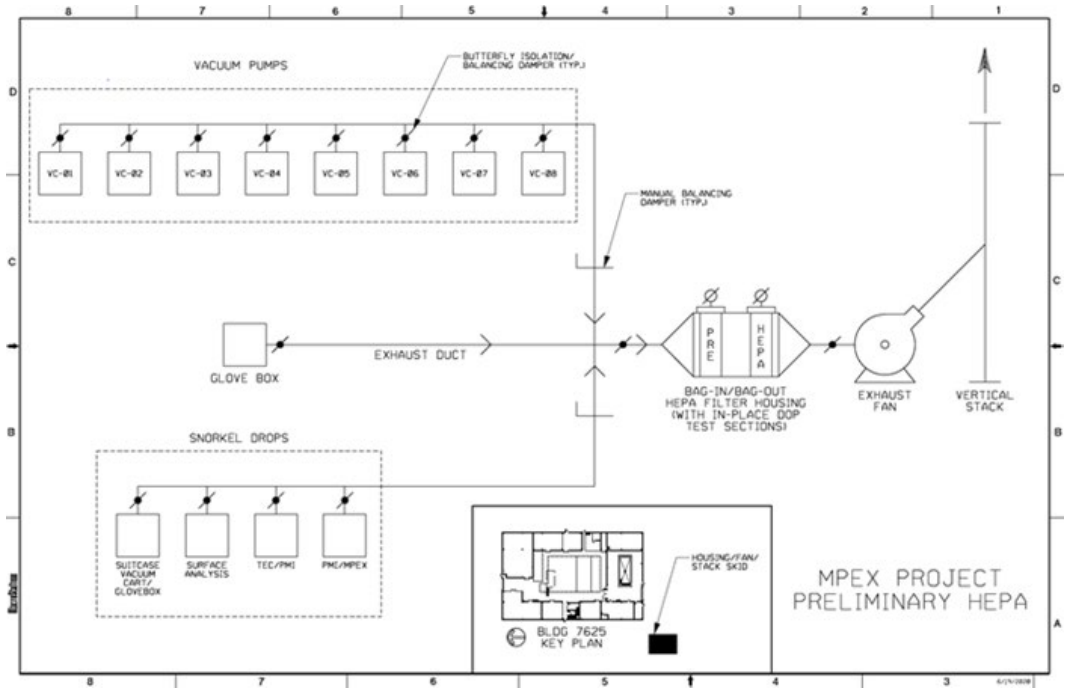
Surface Analysis Room Subsystem

- Delineates space for performing post-plasma exposure examination of targets [SAR-1]
- Nominal 16’ x 28’ x 8’ tall 80/20 framework or equivalent
- Panel walls open to high bay (cubicle style)
- Includes service drops for compressed air; nitrogen; off-device demineralized water; HEPA snorkel [SAR-2, SAR-5]
- Includes electrical power and communication jacks [SAR-5]
- Houses the Surface Analysis Chamber (not in A-E scope)



Confinement Ventilation Subsystem

- Required due to work with irradiated targets [CV-1]
- HEPA-filtered nuclear-grade bag-in/bag-out housing with fan, motor, and discharge stack [CV-1]
- Hard-piped to provide continuous ventilation to vacuum pumps, glovebox [CV-2]
- Snorkel drops to selected MPEX device locations [CV-3]

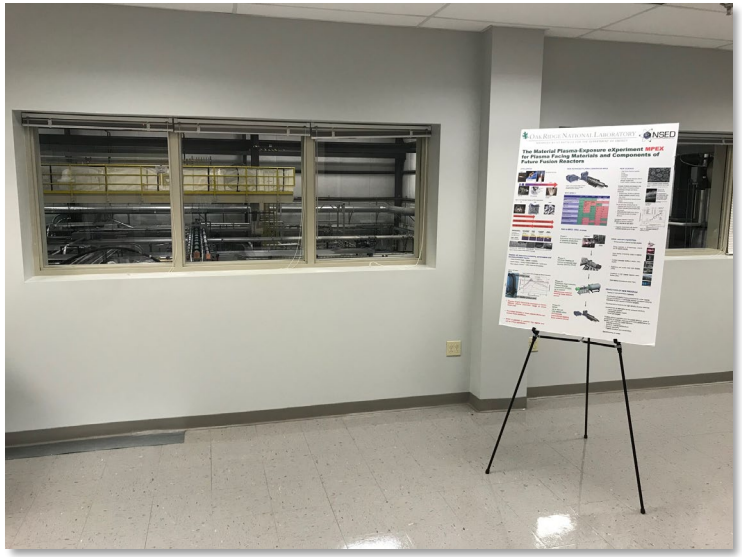


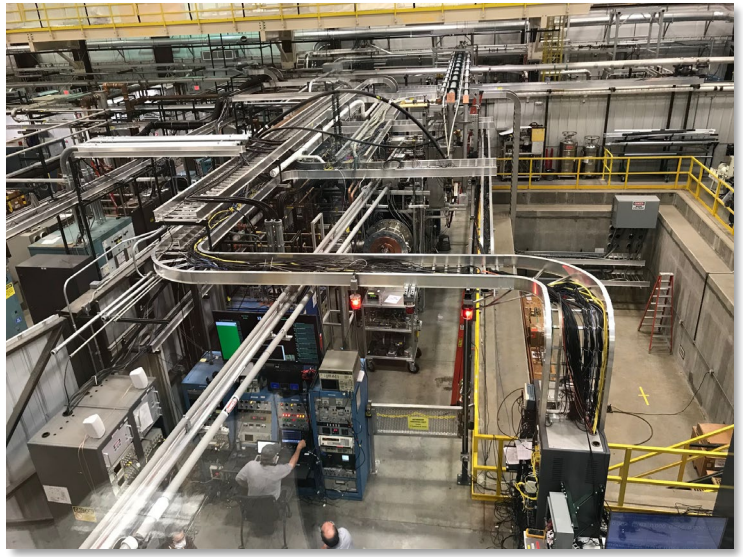
Helium Quench Vent Subsystem

- Welded stainless steel piping system [HQV-1]
- Channels helium gas from super-conducting magnet cryostat relief valves to building exterior in the event of a magnet quench [HQV-1]
- Configured to minimize resistance to helium gas flow [HQV-3]
- Interfaces with six superconducting magnet cryostats with liquid helium volumes from 200 L to 800 L, with a total combined liquid helium volume of 2500 L [HQV-2]

Control Room Subsystem

- Multiple workstations (5) and related control equipment installed in Room 210 to function as central control and monitoring location for MPEX device and supporting systems [CR-1, CR-5, CR-6]
- Second floor space has windows overlooking the MPEX device [CR-2]
- Existing 6" PVC conduit (6 each) provides for cable routing from MPEX area to control room [CR-3]





Utilities Subsystem

- Provide sufficient utility services for MPEX operations as delineated in the MPEX Equipment List (attachment to A-E design service RFP)
  - Electrical Power [UTIL-1, UTIL-2, UTIL-3, UTIL-4]
  - Short-term Emergency Power to ensure safe shutdown in a loss-of-power event [UTIL-5]
  - Water (potable and process) [UTIL-6, UTIL-7, UTIL-8]
  - Nitrogen [UTIL-9, UTIL-10]
  - Compressed Air [UTIL-11, UTIL-12]
  - HVAC [UNA-1, UNA-2]
  - Fire Protection [UNA-2]