Sample Preparation Laboratory (SPL) Overview-Feb. 2024

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What is SPL and Why is it Needed?

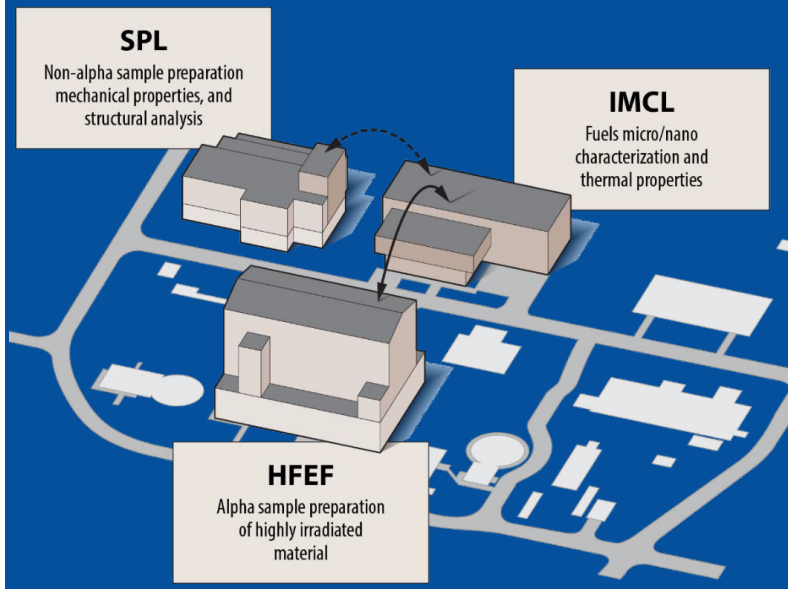
- SPL's mission will be ***to support characterization of engineering and microstructural scale reactor structural materials***
- Post-irradiation examination
- ***Hazcat 3 facility***
- ***Sample preparation***
- ***Mechanical properties testing***
- ***Microstructural analysis***
- ***No loose alpha bearing materials***
- Office space
- Machine shop (Future)

SPL-August 2023

SPL Location and other Primary PIE Capabilities at MFC

- HFEF handles full sized fueled experiments (Engineering Scale)
- IMCL provides high end microscopy, thermal testing, and small-scale mechanical testing of irradiated materials including sample preparation of commercial fuel pellet sized experiments
  - Micro to atomic scale
- **SPL handles alpha clean structural experiments for microstructural characterization**
  - **Engineering through sub-micron level**
- HFEF, IMCL, and SPL are broadly available to the nuclear research community through the Nuclear Science User Facilities, University partnerships, DOE programs, and Strategic Partnership programs

MFC



IDAHO NATIONAL LABORATORY

SPL Design Parameters and Cost

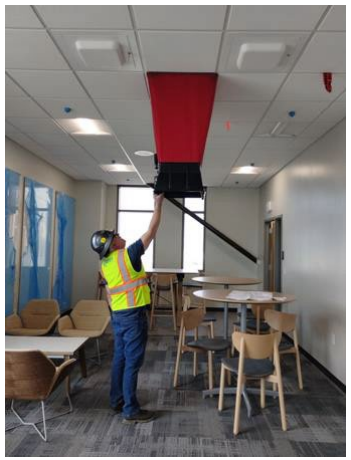
- Approx. 4088 sq. meters. (3 stories)
  - Braced frame structural steel with 0.3 meter. solid, grouted, reinforced concrete masonry unit (CMU) exterior walls
  - Seismic Design Category 2, Limit State B
- Divided into office space and laboratory space
  - User facility building designed for easy access by visiting researchers
  - 762 sq. m office space, 3100 sq. m laboratory space
  - Office space provided on all three floors
- 1st floor: Shielded sample preparation line and instrument enclosures
- 2nd floor: Hoods, gloveboxes, transfer cell of the shielded sample preparation line
- 3rd floor: Manipulator repair area, personnel decontamination room, and ventilation
- $166 Million US Dollars

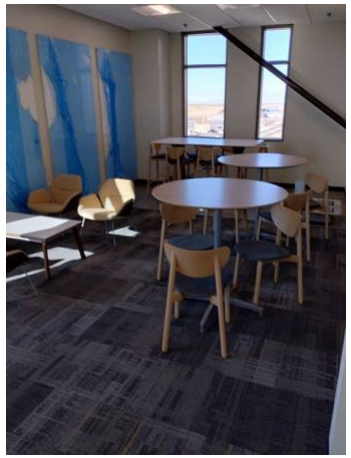
Time Frame

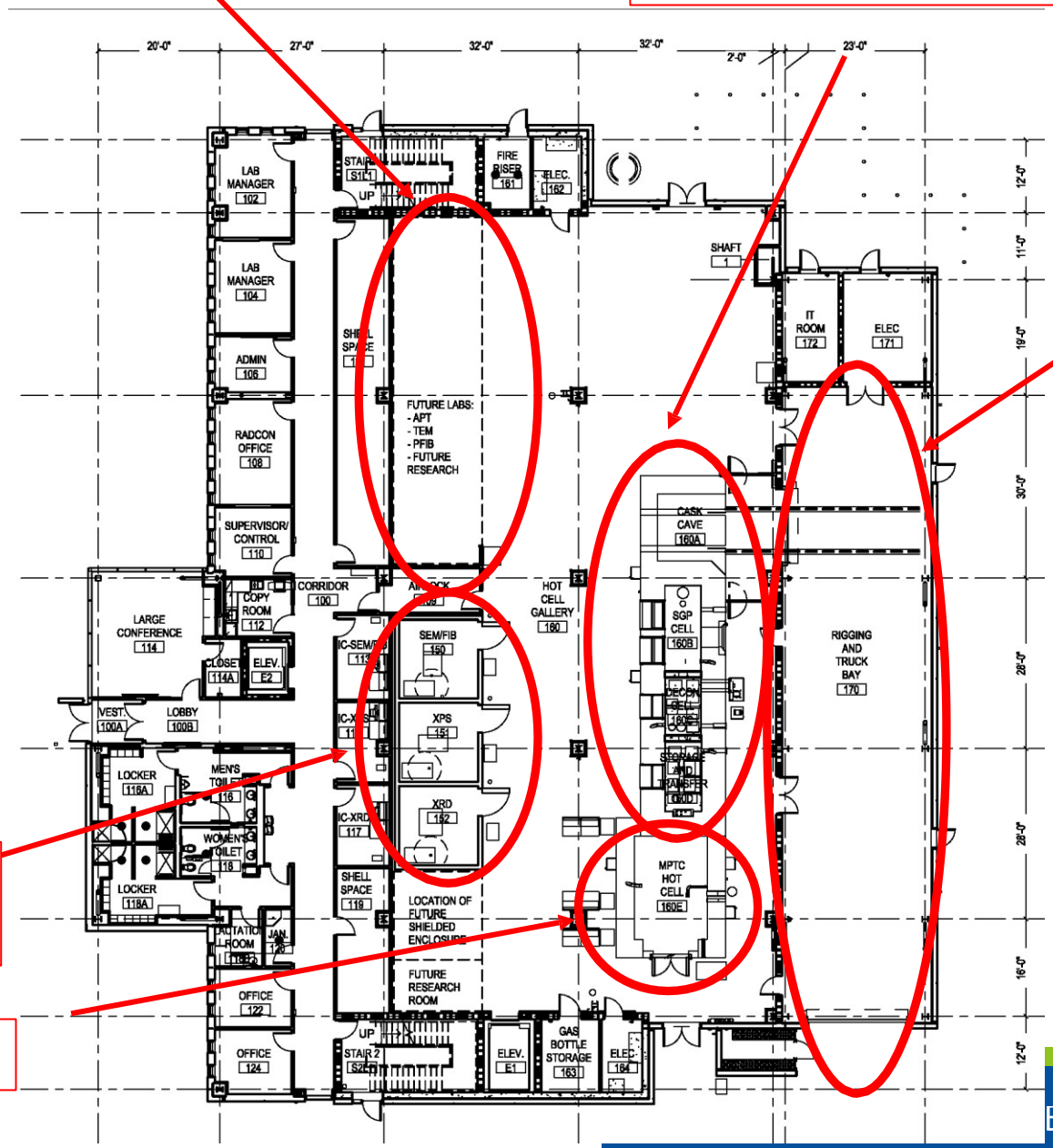
- Currently under construction
  - Started in FY2020
- Status of Feb. 2024
  - Main shell of building in place
  - Hot cell is poured
  - Shielded enclosure walls in place
  - Office spaces completed
  - Working on HVAC system and finishing aspects of the facility
- Expected completion of construction in Oct. 2024
- Perform MSA/ORR demonstrations through FY2025
  - MSA-Management Safety Assessment
  - ORR-Operational Readiness Review
- Fully operation at some point in FY2026

SPL 1st Floor Layout

- Office Space
- ***Shielded Instrument Enclosures with separate control rooms***
- ***Sample Preparation Cells***
  - Sizing, polishing, and grinding
  - Decontamination
  - Sample storage
- ***Mechanical Properties Test Cell (MPTC)***
- Truck Bay – Cask Receiving
- Future space

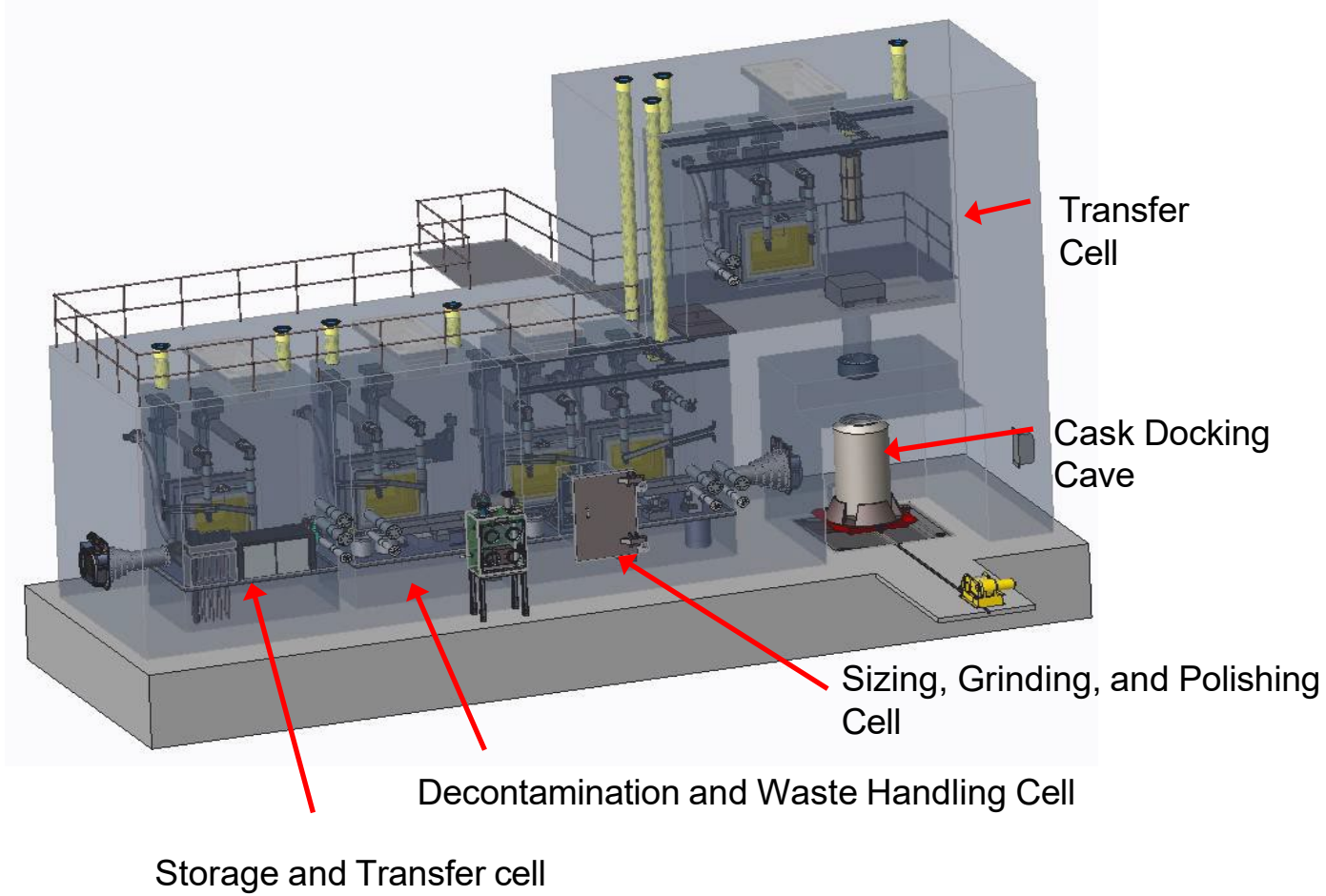






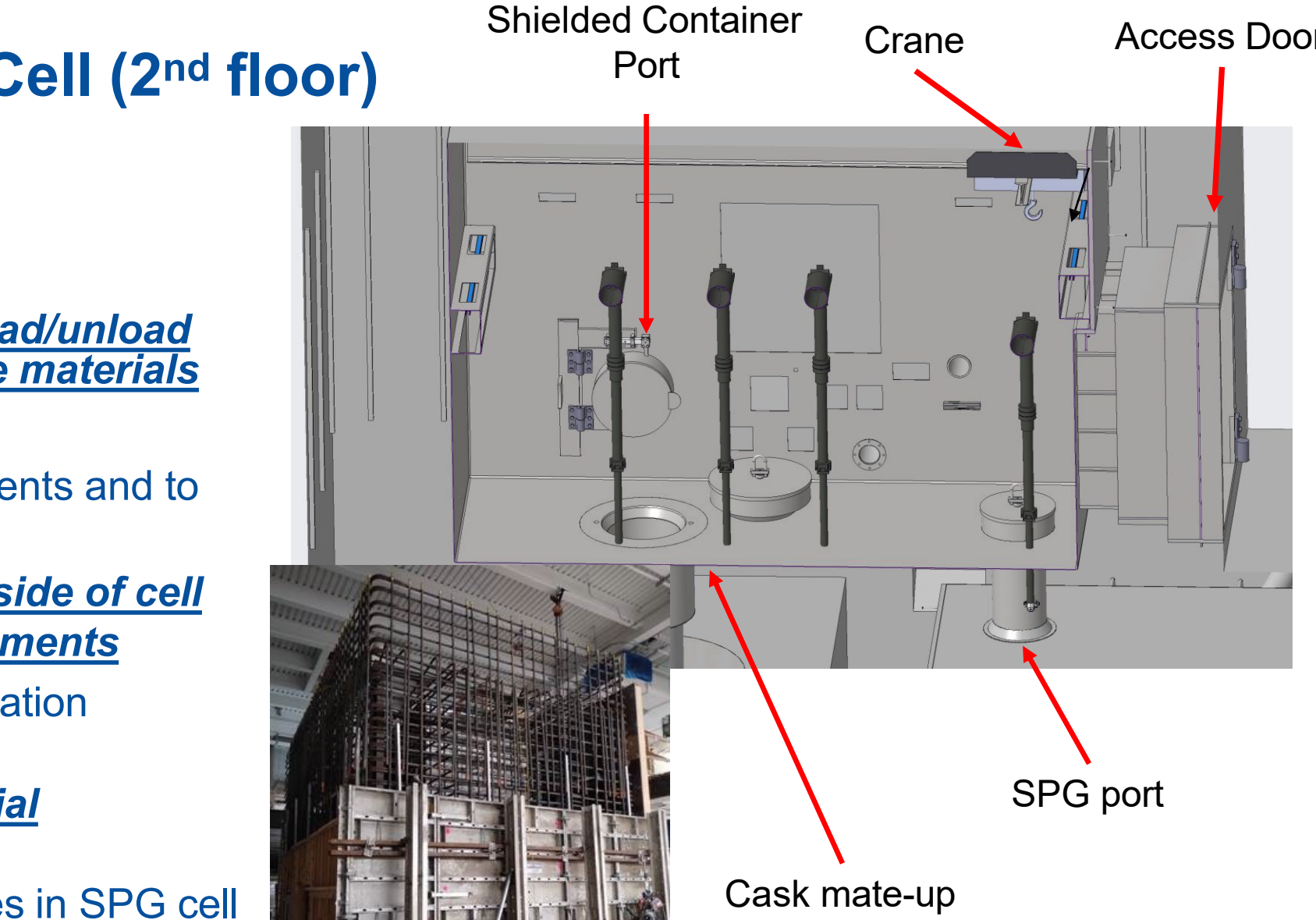
Hot Cell Layout and Properties

- Multi-room cell for various activities
  - **Cask docking cave**
  - **Transfer cell**
  - **Sizing, grinding, and polishing cell**
  - **Decontamination cell**
  - **Storage cell**
  - **Mechanical properties test cell (Not Shown) (MPTC)**
- Cell has 1.2 m. thick concrete wall
  - 0.91 m high density concrete ceilings



Material Transfer Cell (2nd floor)

- 2 sets of manipulators
- ***Main purpose of cell is to load/unload casks and to decontaminate materials***
- Tooldrop system
- Crane to help unload experiments and to transfer experiments
- ***Glovebox attached on backside of cell***
  - ***Contamination measurements***
- Shielded container mate up station
- ***Access door to the cell for decontamination and material introduction/removal***
- Plug to shield cell from sources in SPG cell



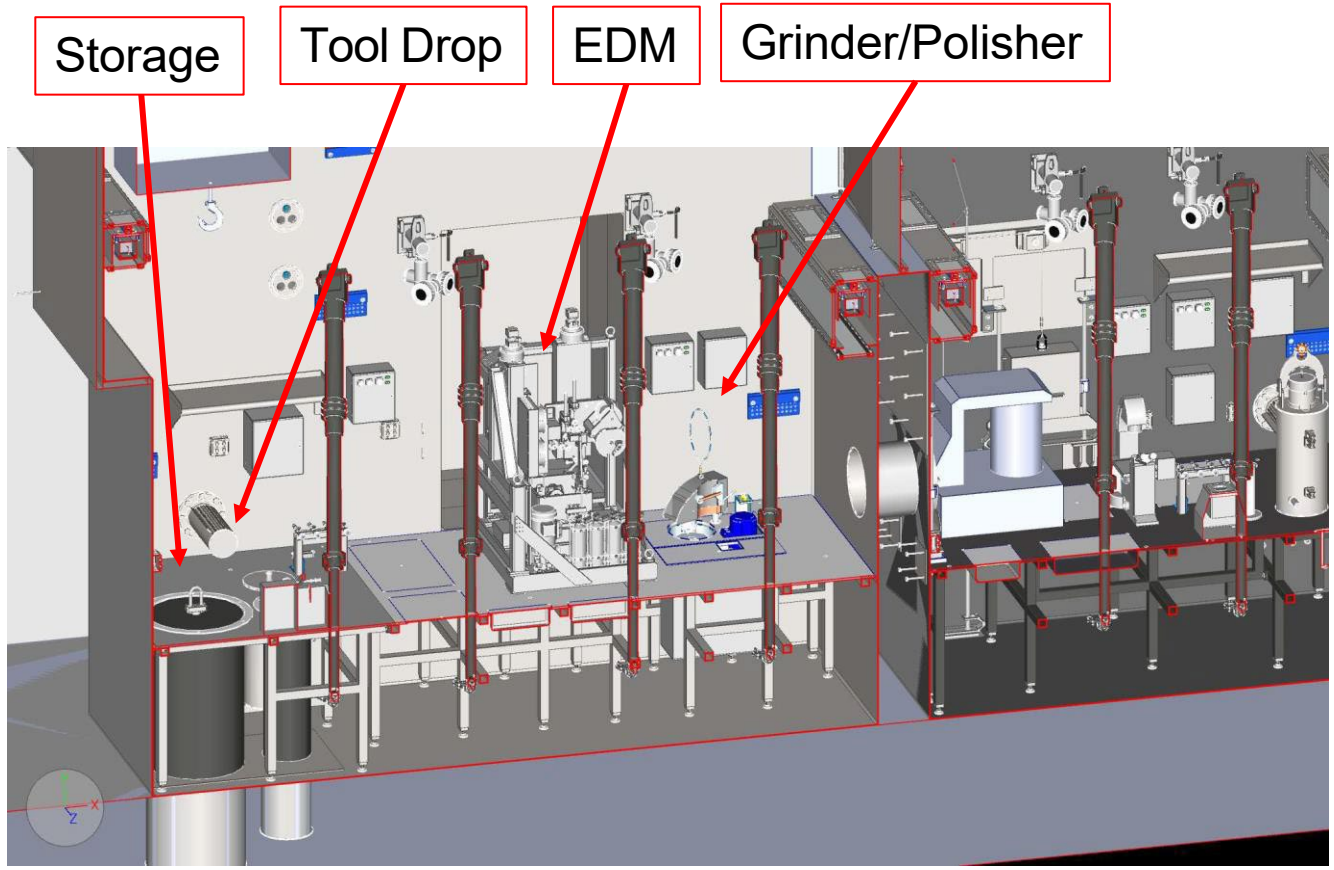
Cask Docking Cave

- Truck lock to unload casks using a rail system and cask cart
- Accept a variety of casks using adapter plates
  - BEA Research Reactor (BRR) Cask, primary cask for transfer between ATR and SPL
  - HFEF-5 waste cask
  - Shielded 55-gal drum (208 liter)
  - GE-100
  - Others with correct mate up systems

Cask Docking Cave Minus Cart

Sizing, Grinding, and Polishing Cell-SPG Cell

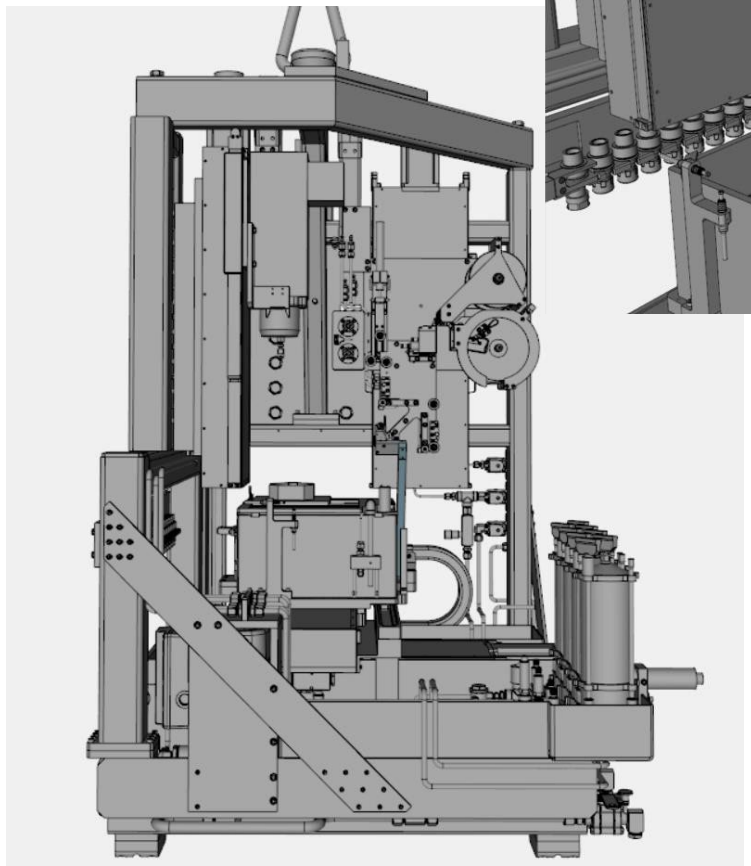
- 2 sets of manipulators
- Receive material from the Material Transfer Cell (2nd Floor)
- Storage locations for material
- ***Polisher/grinder***
- ***Sectioning by saws and other methods***
- ***Electro Discharge Machine (EDM)***
  - Access door to the EDM if needed
- Tooldrop system
  - Introduction of tools and supplies
- Crain to support lifting samples and equipment
  - Shared with the decontamination cell via sliding door

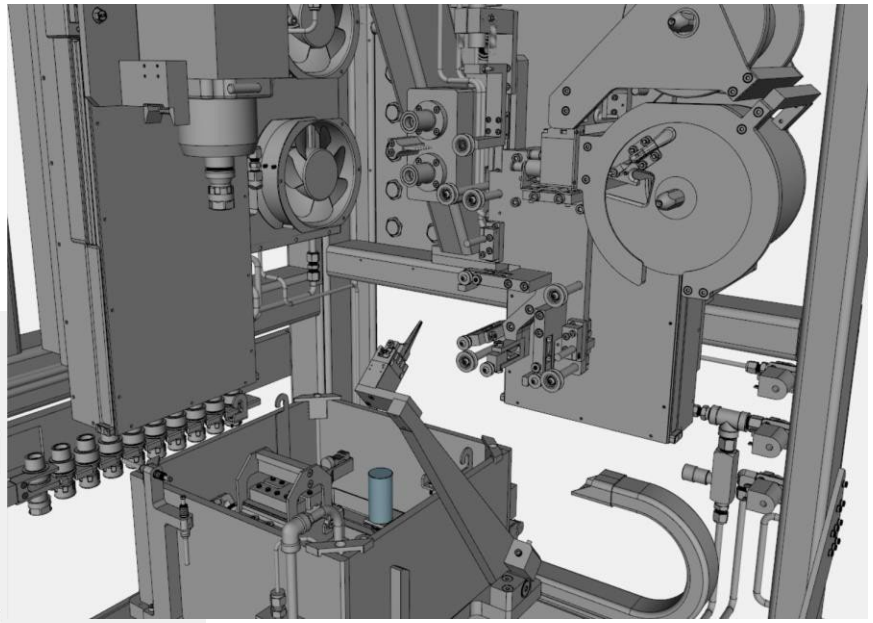


Conceptual design of the SPG Cell

Electro Discharge Machining (EDM)

- 4 Axis machine EDM thru Viteris
- Self spoiling
- Mill capabilities
- Multiple tooling capabilities
- Will be remotized as much as possible
- Removable from cell for complex maintenance via rail system and adjacent access door



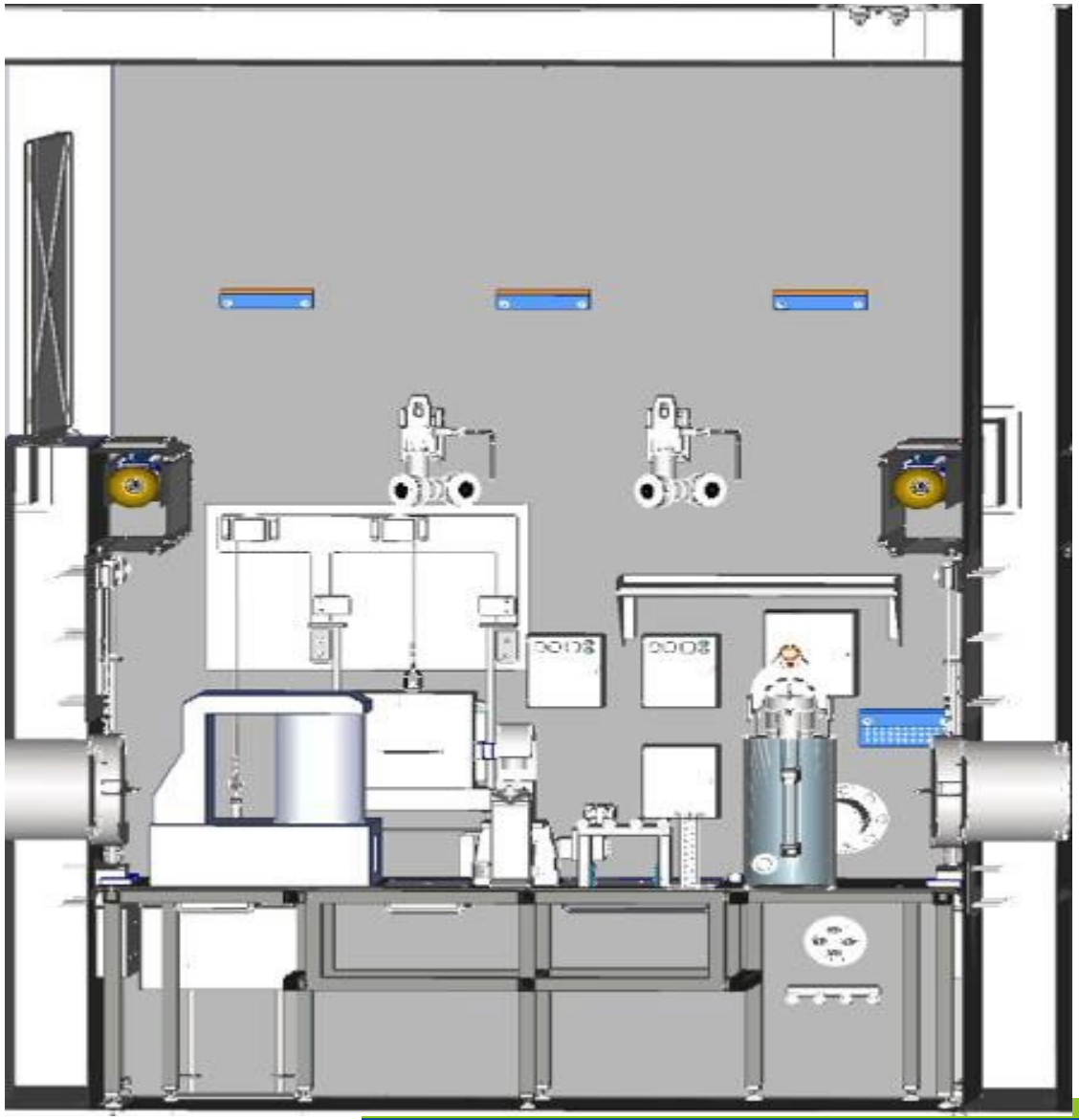


Conceptual Designs of the EDM

Decontamination Cell

- 1 set of manipulators
- ***Primary purpose is to decontaminate samples***
  - Ultrasonic cleaners
- ***Optical microscopy***
  - Sample identification and polish conditions
- ~~***Sputter coater (Moved to Enclosure)***~~
  - ~~Electrically grounding of samples~~
- Hatch above for access to the cell
  - Removed by crane on second floor
- Tooldrop system
- ***Transfer capability to glovebox on backside of cell***

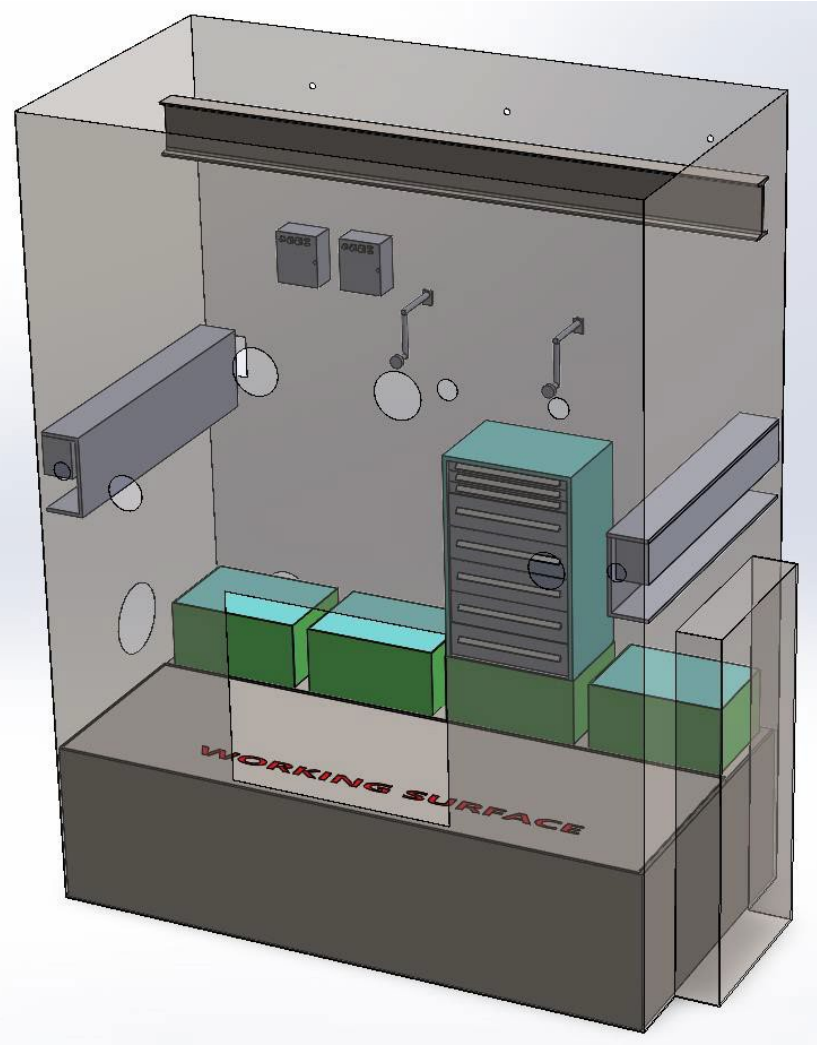
Decontamination Cell



Sample Storage Cell

- 1 set of manipulators
- ***Capability to store 1,800 standard samples with 100 mechanical property test samples in below table storage***
- Crain to help lift sample storage containers from floor storage
- Tooldrop system
- ***Pneumatic rabbit system for transfer to various locations in laboratory***
  - 3 shielded enclosures
  - MPTC
  - 2nd floor glovebox line
- Ceiling shielded plug that is removal by 2nd floor crane for access to cell

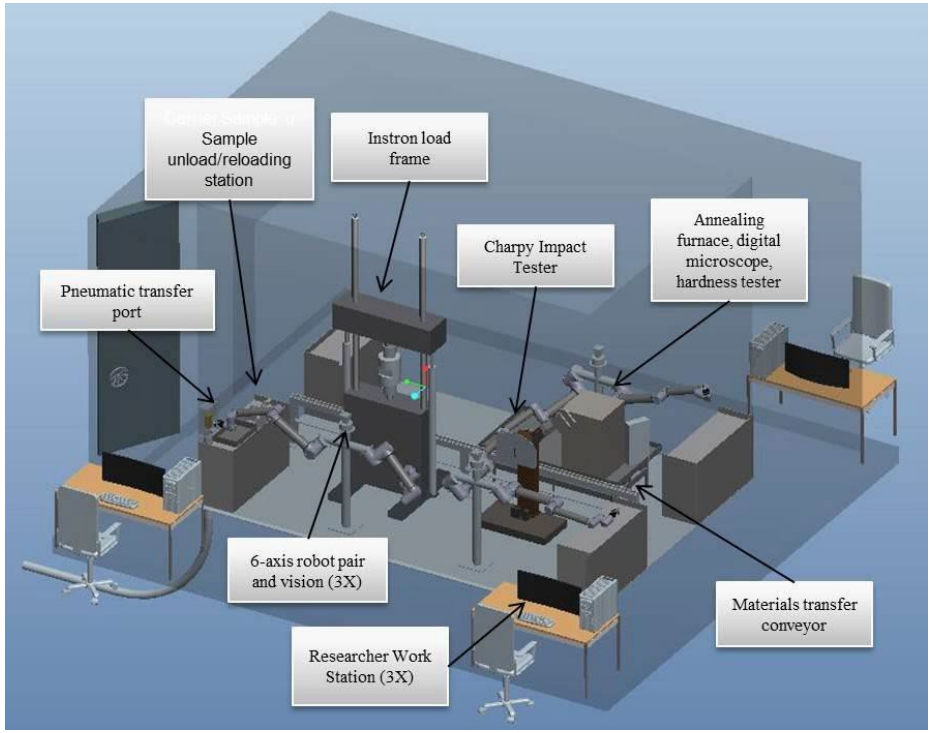
Pneumatic Transfer Station



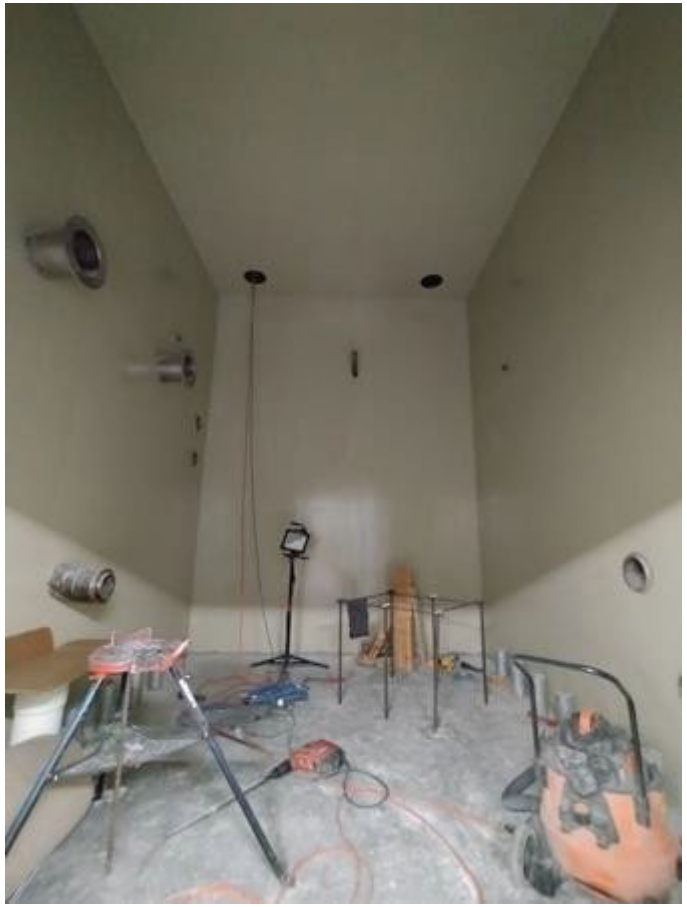
Sample storge cell

Mechanical Properties Testing Cell (MPTC)

- 0.91m thick concrete side walls with 0.6m high density concrete ceiling
  - Rated for 10 Ci of Co^{60} (370 billion Bq)
- Tooldrop system
- Rabbit system from sample storage cell
- ***Four UR10E robots to support instrument loading activities***
- U tubes for instrument connections into the floor
- Instruments:
  - ***Instron load frame***
  - ***Charpy impact tester***
  - ***Hardness tester***
  - ***Annealing furnace***
  - ***Optical microscopy***
  - ***Welder***
- ***Access Door for entry into cell***



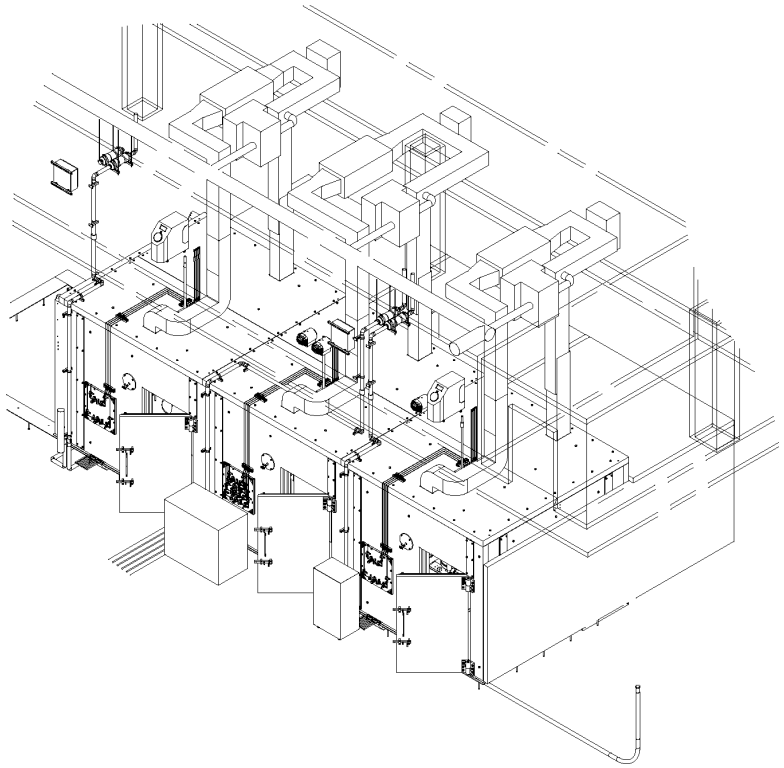
Planned Layout of MPTC



View of inside the MPTC

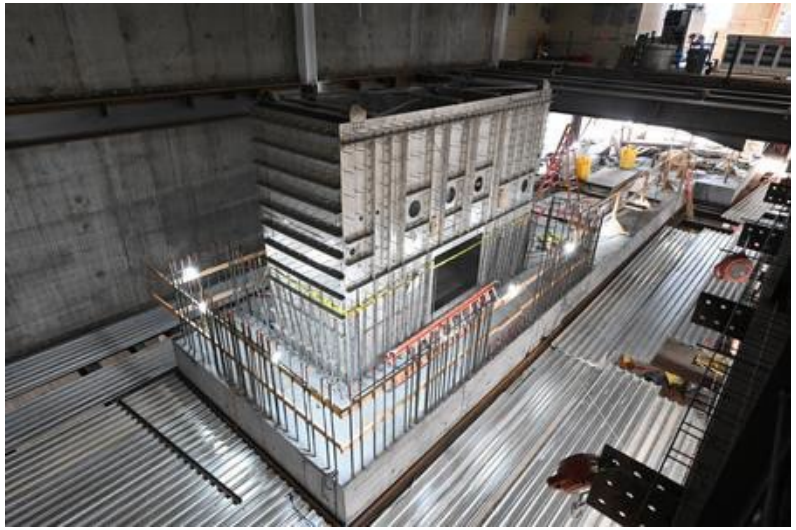
Shielded Instrument Cells

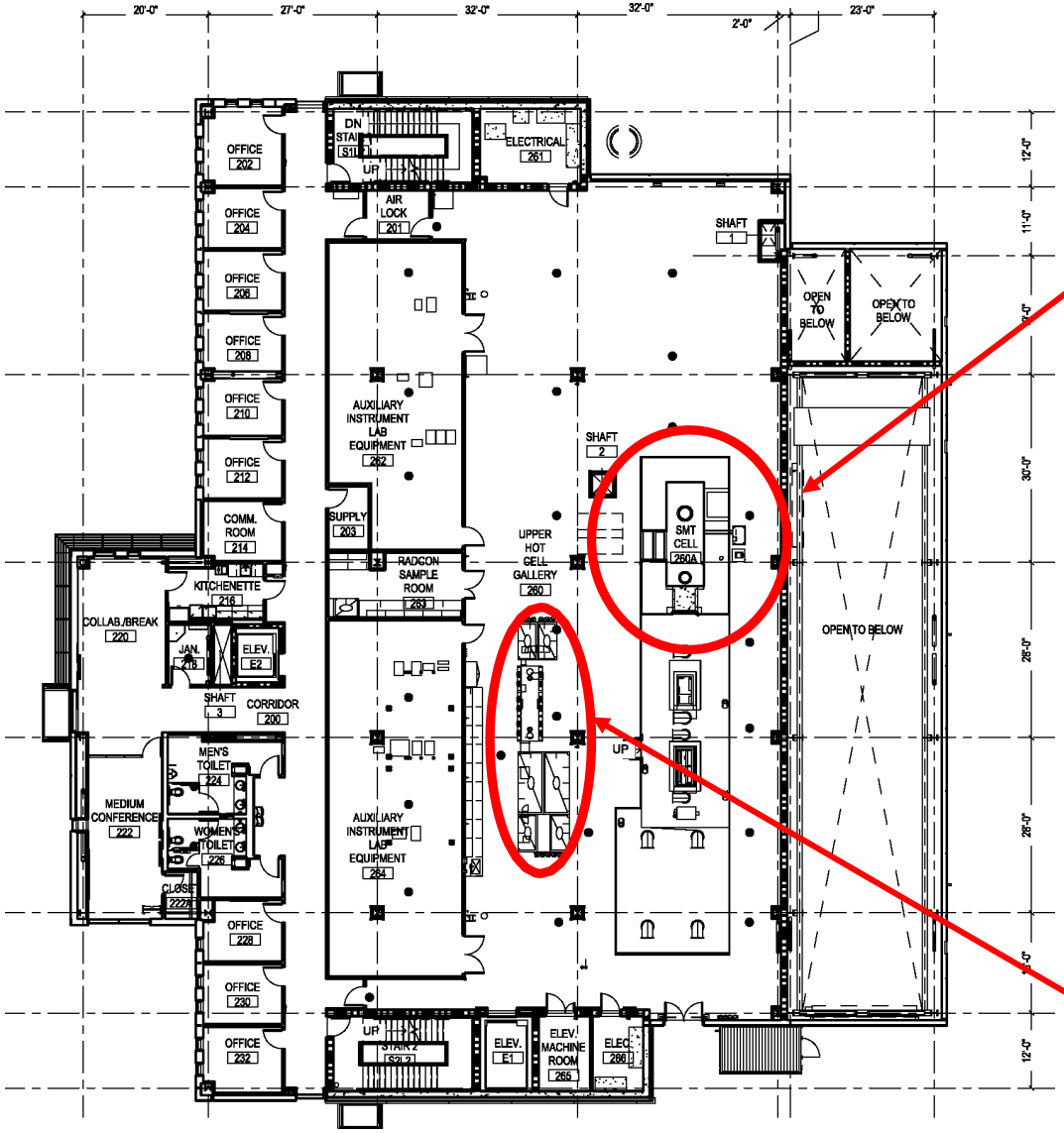
- **3 shielded enclosures for instruments**
- 21 cm thick steel walls
  - Rated for 0.25 Ci of Co^{60} (9.25 billion Bq)
- One future pad/area designated for future shielded enclosure
- All 4 pads serviced by rabbit system
- Planned instruments for cells
  - ***X-ray diffraction***
  - ***X-ray photoelectron spectroscopy***
  - ***Focused Ion Beam Spectroscopy***
- ***Instruments operated in outside room via U-tube connection***
- ***All instruments will have capability to be loaded with robots***
- All support equipment for instruments will be on 2nd floor
- Access doors to perform low level work, instrument setup, and maintenance



SPL 2nd Floor Layout

- Office Space
- Instrument Support Equipment
- ***Material Transfer Cell***
- ***Glovebox/Fume Hoods Line***
- Support equipment rooms for instrument rooms on 1st floor
- ***Space for expansion***
  - Robotics development area
  - Machine shop (future)

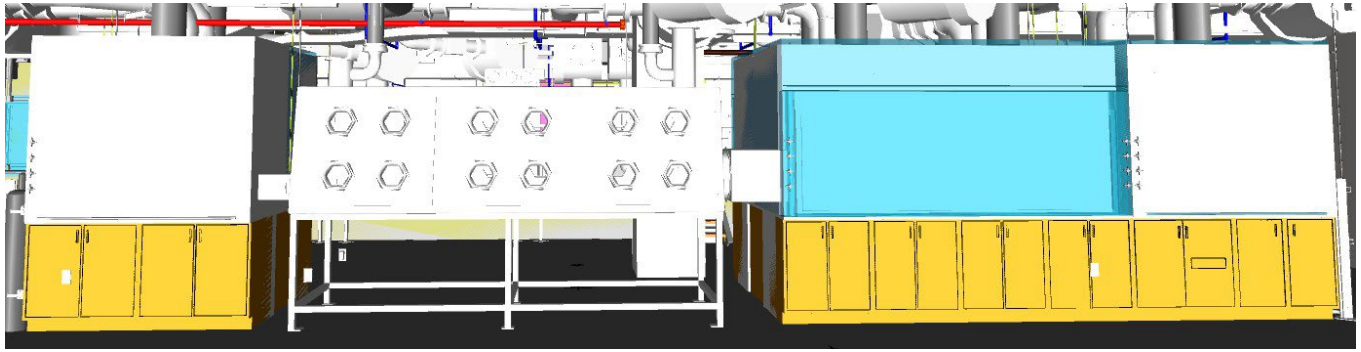




Glovebox/Hood Line

- ***Large glovebox for highly contaminated materials***
  - Glovebox has shielded storage locations
- ***6 fume hoods with connection to the glovebox to two of the hoods***
  - 5 contaminated hoods for various activities
  - 1 larger non-radiological hood for chemical work

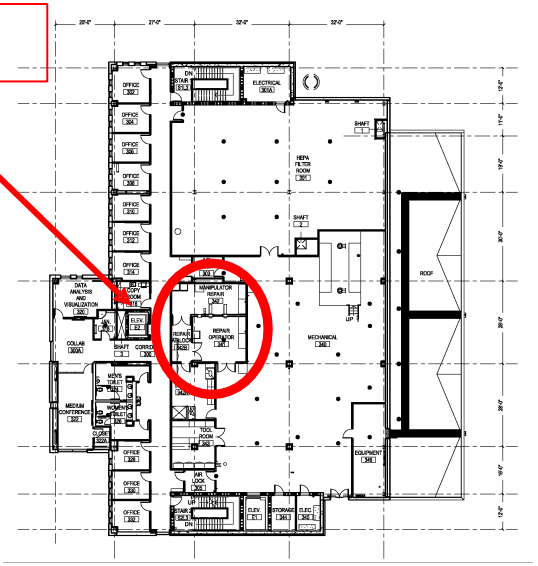
Glovebox design



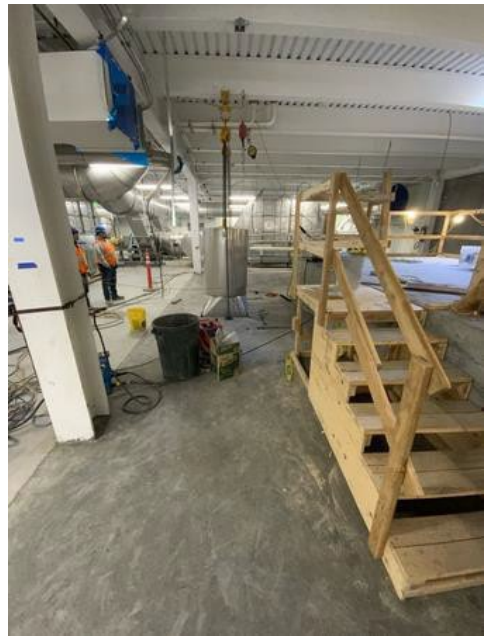
Side view of glovebox line

SPL 3rd Floor Layout

- Office Space
- ***Air Cleaning Equipment (HEPA)***
- ***Manipulator Repair Area (MRA)***
- ***Mechanical Equipment***
- Tool Room
- Personnel Decontamination Room
- Limited extra space for future expansion

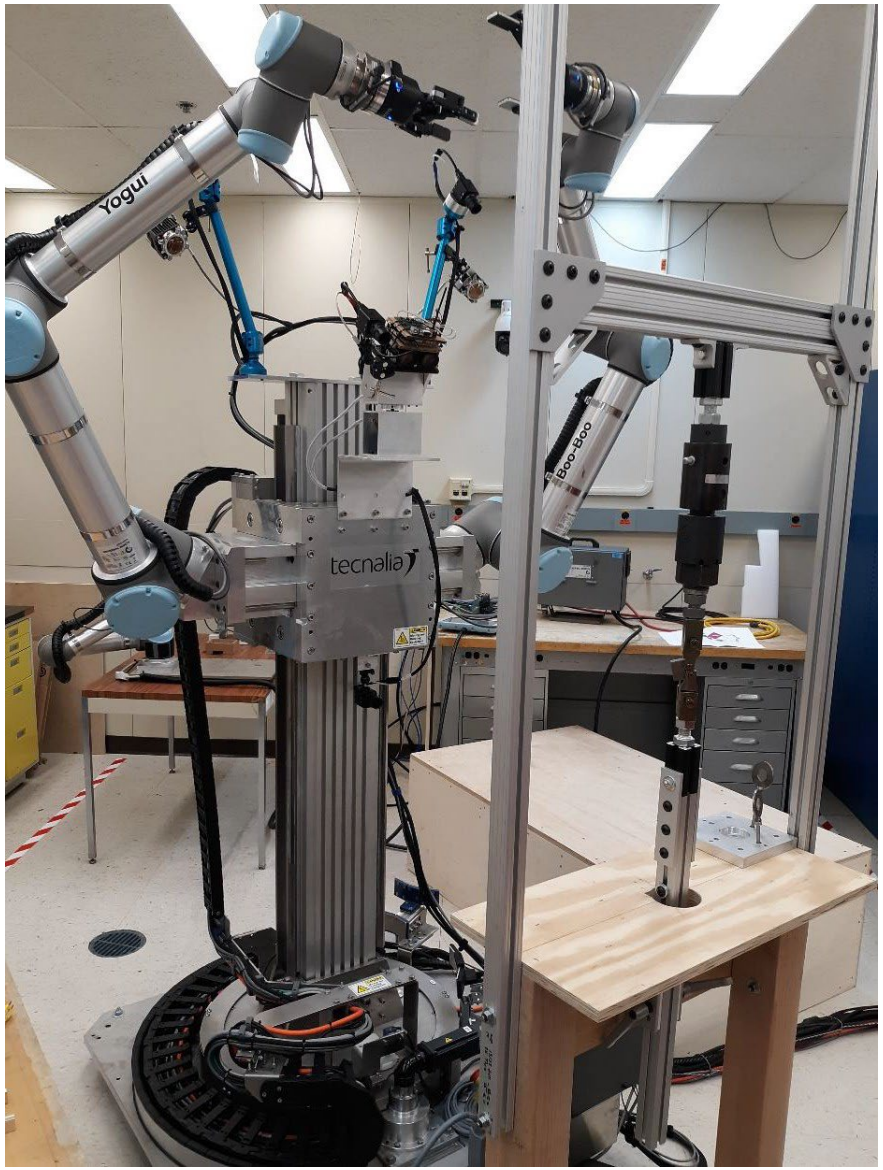


MRA



Application of Robotic Technology in SPL

- Robots will be utilized in various locations in SPL for activates
- MPTC-Four UR10E Robots
- Instrument cells will utilize a UR5E arm to perform loading activities
- All robots will be programable for repetitive actions and can be operated freely with the use of cameras attached to the robot
- Multiple cameras in areas to support use of the robots



Dual Arm Robot Teleoperated System

Application of Robotic Technology in SPL

UR5E robot and instrument set up

Loading ½ compact tension specimen in Instron mockup via two UR10E robots

Questions!