

# **Noble Liquid Test Facility (PAB) & Edwards Warm/Cold Labs status**

Flor de María Blaszczyk  
ND All hands meeting – Feb. 7<sup>th</sup> 2023

# Cleaning up NLTF

- Thanks to the cleaning day operation in 2022, most of the parts have been transferred to their new location: either the closed bin shelves, or the storage containers outside of NLTF.
- Working on cleaning up the flammable and chemical cabinets throughout the facility.
- Mezzanine continues being re-organized with the left side being a tool storage space, and the right side storage for diverse parts.



# Cleaning up NLTF

- Moved all non-weather sensitive parts to external storage containers.
- A 2<sup>nd</sup> date for cleaning/re-organizing PAB will probably be needed.



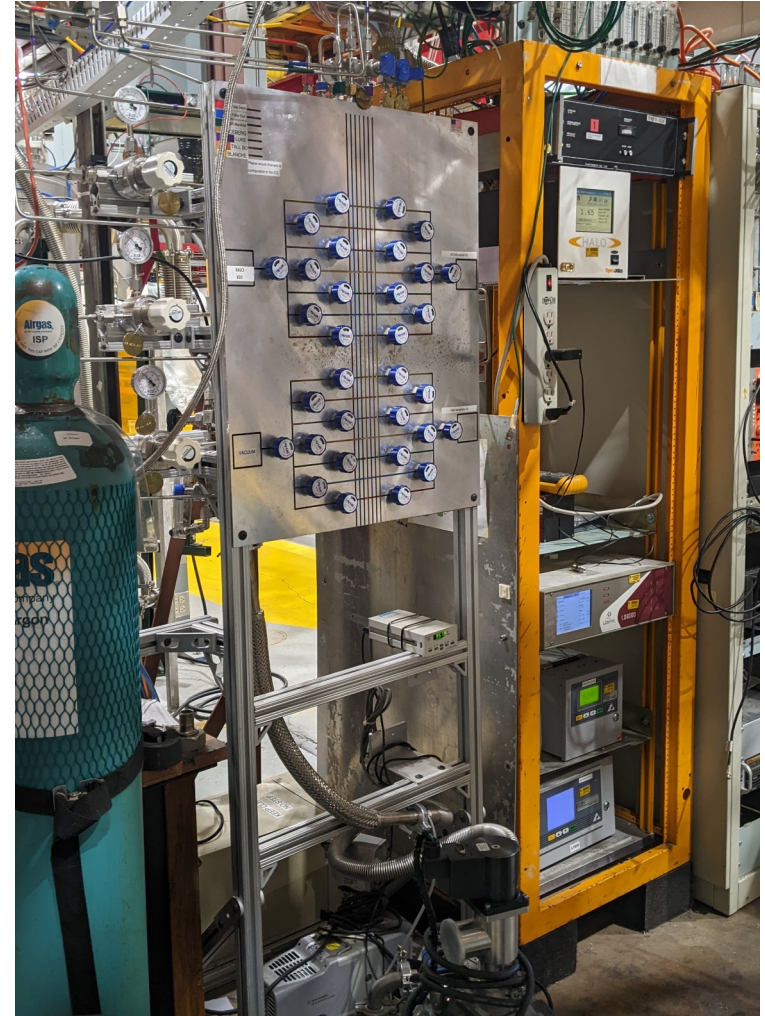
# Upgrades – LAr and LN2 transfer

- The addition of ICEBERG to our facilities has shown that we are at the limit of our capacity: outer dewar needed to be refilled at least 2-3 times per fill, purity drops every time fill is interrupted and restarted
  - a new 3000L dewar was installed back in late 2022, still waiting to connect our readout system to its instrumentation (pending vendor response)
- The main fill line is having more and more issues, and fill rates not understood
  - studies on-going about the fill rates
  - design on-going for the first part of the transfer line upgrade which will include having remote controllable valves, a simpler layout which allows for expansion of the facility, homogeneous piping sizes across the whole facility
- Documentation of the facility has significantly increased and has been centralized
  - P&IDs, procedures, parts inventory, etc. can now be found through the Noble R&D wiki.

<https://cdcv.sfnal.gov/redmine/projects/noble-detector-r-d/wiki>

# Upgrades – LAr purity and monitoring

- Typical purity needed for physics:  $\sim$ ppb  $O_2$  (electron lifetime),  $<1$  ppm  $N_2$  (light),  $\sim 10$  ppb  $H_2O$ 
  - vendor purity:  $< 1$  ppm  $O_2$ ,  $\sim$ ppm  $N_2$ ,  $\sim$ ppm  $H_2O$
- Single pass inline filters (+ internal filters in some cryostats)
  - currently too small (frequent regeneration)
  - swap to LArIAT filter (combined and larger), renamed DROGO
  - integration of DROGO has started, and will include a filter regeneration station for all NLTF filters
- A new sampling point was added to sample directly from the outside dewar to prevent bad argon fills.
- Relief valves are a frequent source of leaks...
  - cannot be rebuilt on site but certifying the lab to repair/rebuild code stamped valves is too complicated
  - relief valves will be replaced with burst disks, upgraded system will automatically use burst disks instead
- The gas analyzer panel will be upgraded to be remote controllable in the future.

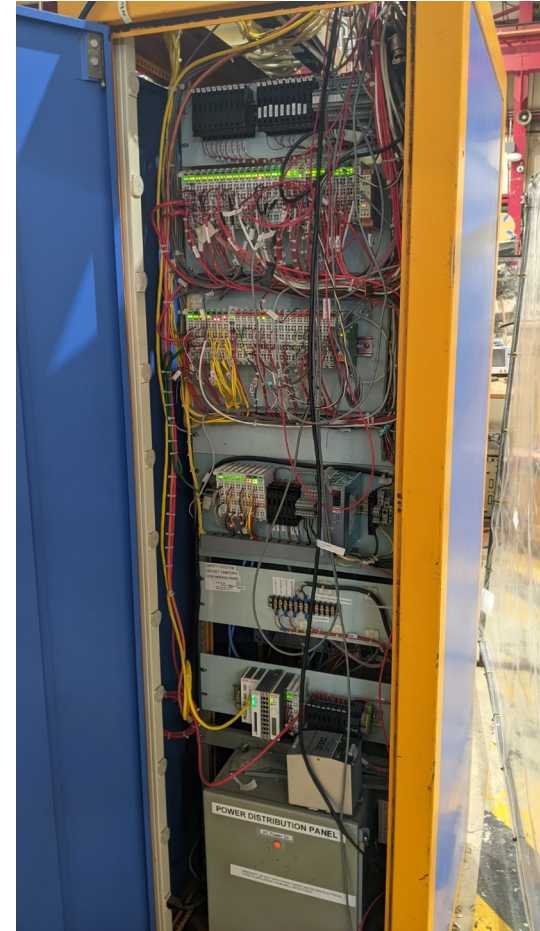


# Upgrades – LAr purity and monitoring

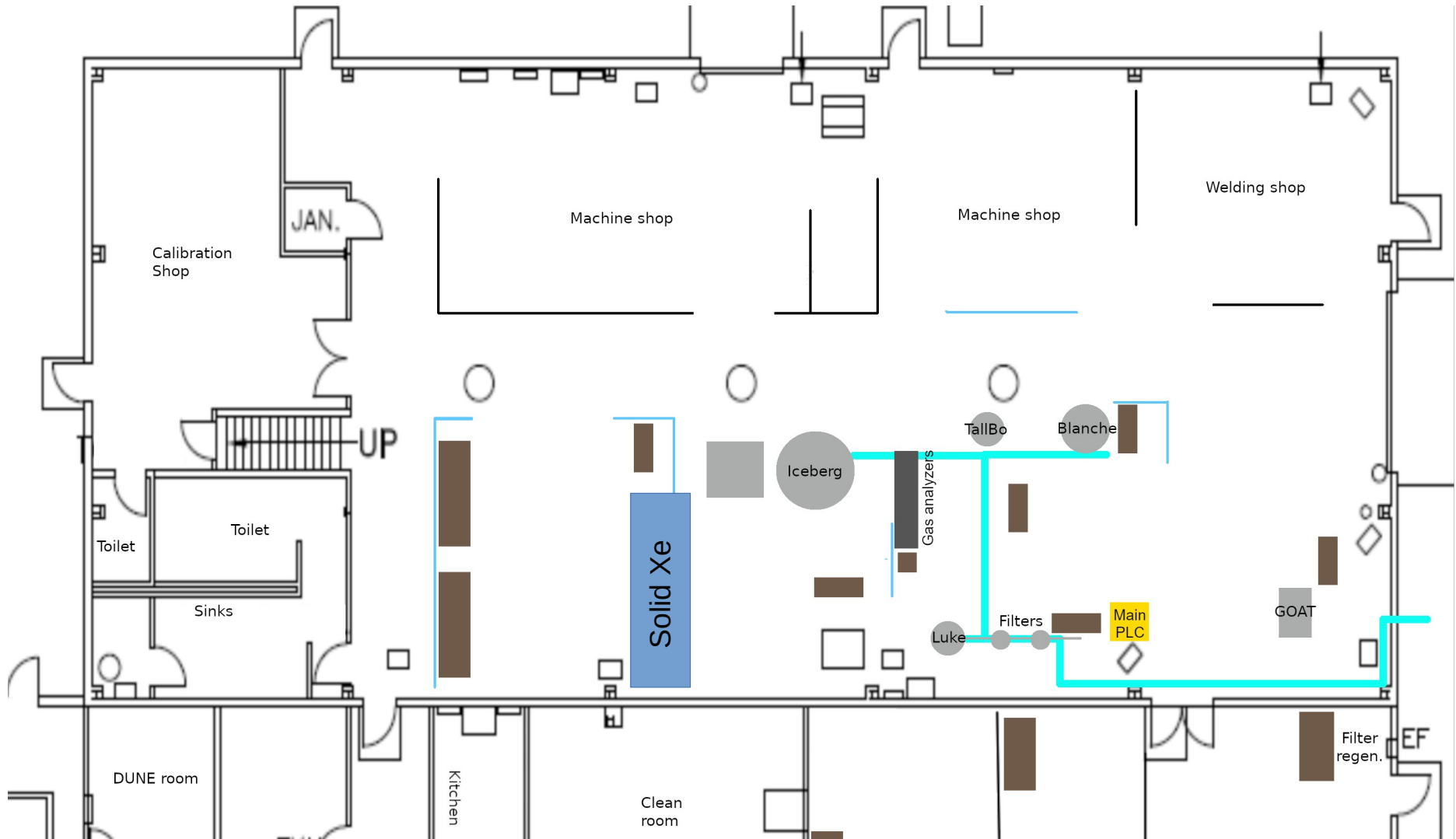


# Upgrades – Cryogenic controls

- Currently everything, except for Iceberg, is controlled via a single legacy PLC
  - old components, crowded, hard to maintain, cannot upgrade or expand
  - have had problems after power outages
- Cryo-controls will move from IFIX to Ignition
- Architecture will be split into new PLCs for each permanent test-stand + 1 coordinator PLC for shared utilities and temporary setups
- All components have arrived and new PLC cabinets are being built at the NOvA building
- Installation at NLTF currently on stand-by until inner window between high bay and annex gets boarded up, work order placed over 6 months ago
  - need more wall space to mount the main PLC cabinet

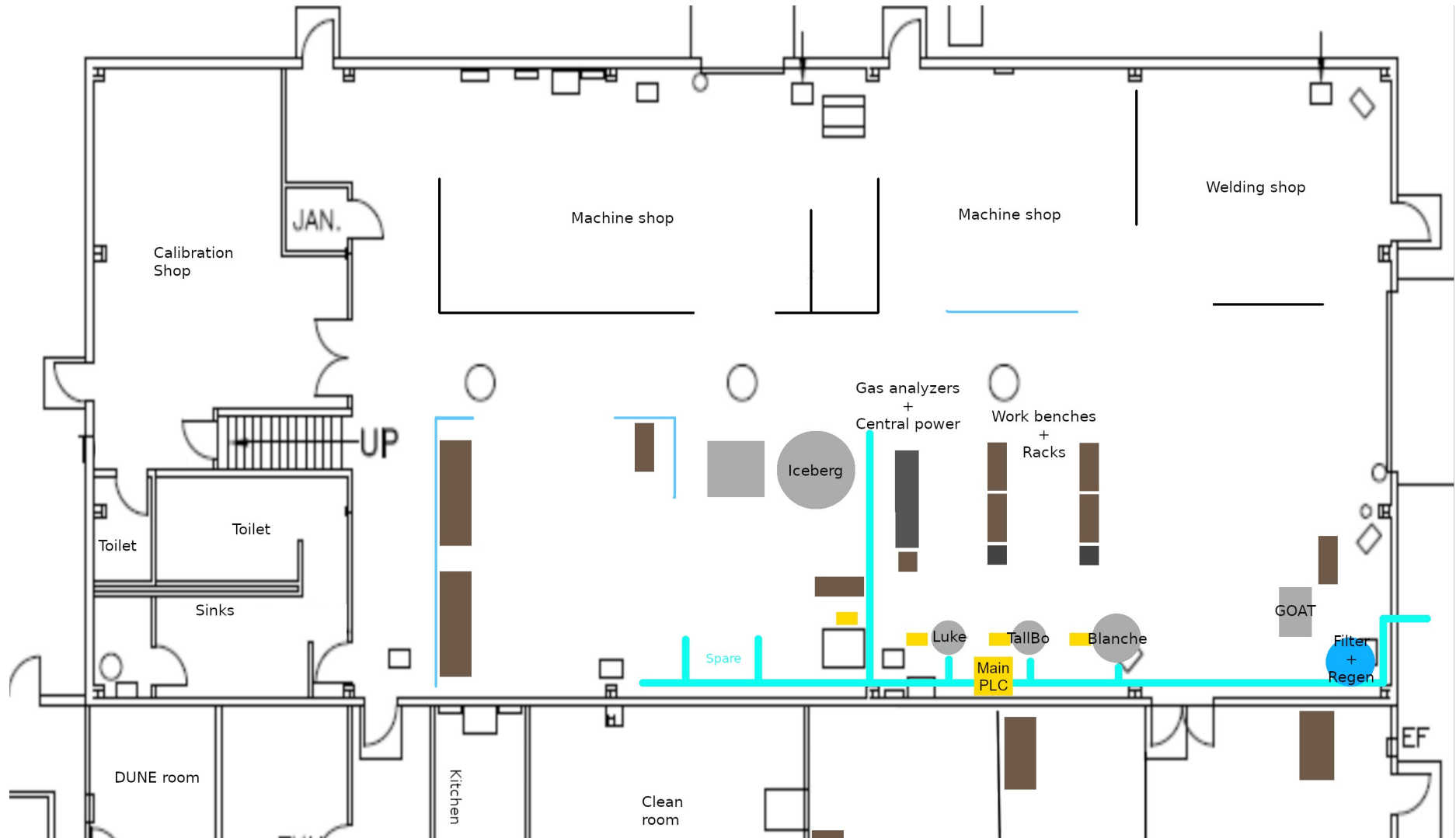


# Upgrades – current layout





# Upgrades – New layout

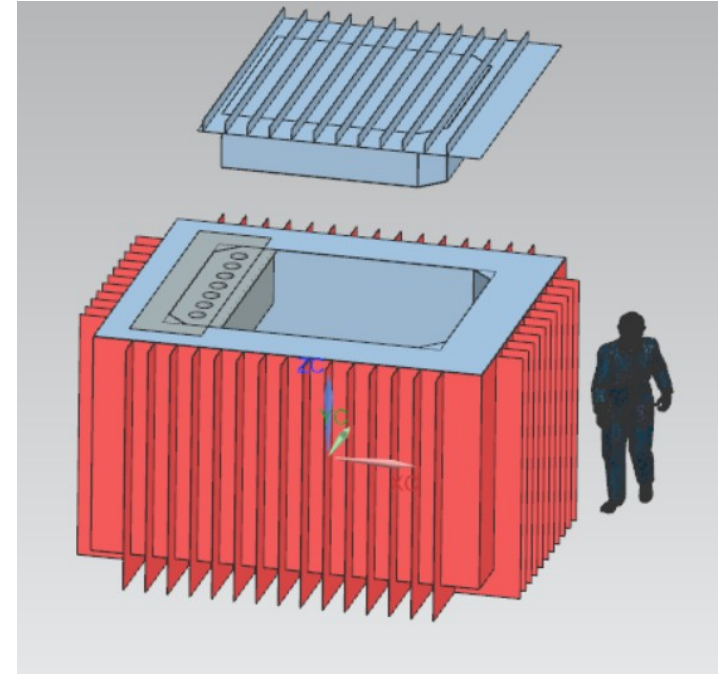


# Edwards building Cold and Warm labs

- The labs should be available for use mid- February (TBC).
- The new labs coordinator is Monica Nunes.
- Initial occupants of both labs have been decided:
  - GOAT, the high pressure gas TPC test-stand, will be moving from NLTF to the warm lab.
    - the system is mostly stand alone, an alternative has been found to read out its dew point meter, only missing power supplies to replace those NLTF is loaning
    - doesn't require ODH system
    - GEM-TPC prototype (T. Mohayai New Initiatives award) will also be tested in GOAT but needs clean room space to work on chamber when open
  - DUNE VD PoF/SoF test-stand will move to the cold lab (until MATF starts).
    - completely stand alone test-stand, mostly bench equipment, LAr and LN2 can be obtained through 180L portable dewars until external dewars are installed (no filtering)
    - ODH analysis shows that ODH protection system is not required (but will be installed at a later date)
- Cold-box inspired from CERN cold box for NASA/Fermilab collaboration and DUNE VD PoF/SoF

# Edwards building Cold labs “cold box”

- All NLTF test-stands have a turn around time of at least 1 week from pumping down to warming up, and the largest test stand is at 2+ weeks.
  - PoF/SoF needs a faster turn around time when they enter production stage
  - initial idea was to build a cold box à la CERN
- B. Pellico in collaboration with NASA is working on building a robotic arm that could work in space, and needs a large enough volume to test it, has funds to build a box.
- D. Pushka has drafted a preliminary design of a shallow membrane LN<sub>2</sub>/LAr cryostat which would meet the needs of both projects and also could be used as a generic test-stand in the future.
  - procurement process has been started



## Specifications:

ID: 2m width x 2.5m length x 1m liquid depth

OD: <3.5m x <4m x < 2.5m

Operates at atmospheric pressure

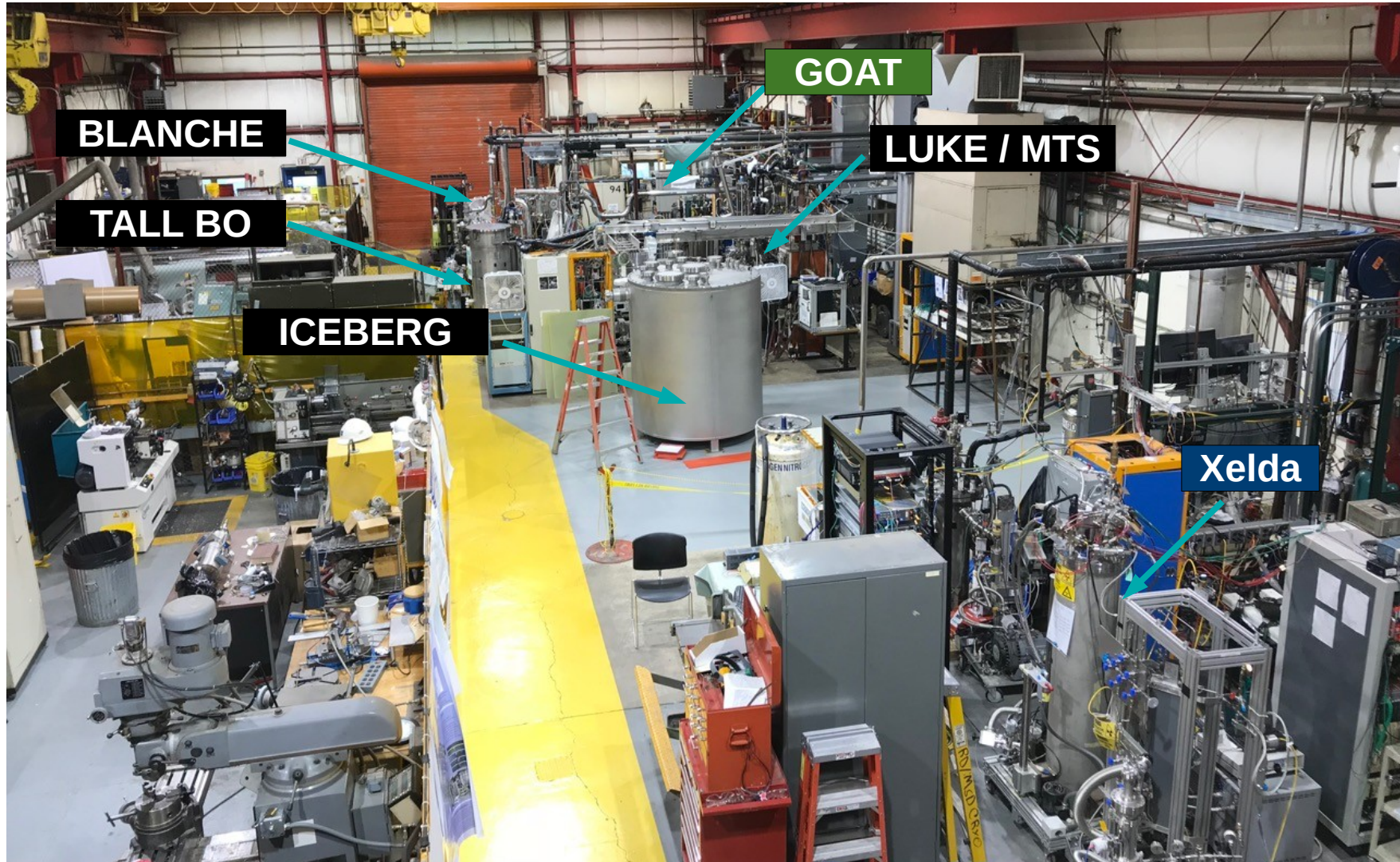
Removable lid with fixtures to attach experiments

Rails on sides and bottom to attach instrumentation

7x 6"ID feedthroughs, conflat

# Back up

# Test stands at NLTF



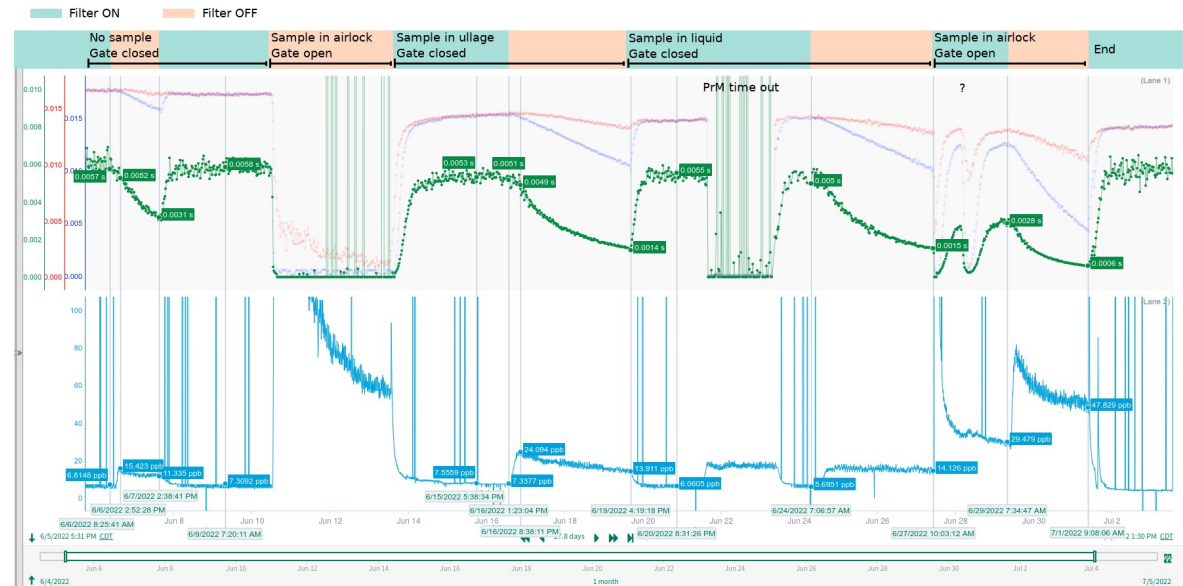
# Luke / MTS (250L)

- Features: Purity monitor, internal filter, airlock mechanism to insert materials into the cryostat, elevator to lower the materials into the gas and liquid space, ~10 cables that can be used to provide power or readout to devices inserted through the airlock.
- Purpose: Mainly for testing materials in GAr or LAr (impact on electron lifetime). Can be used to test small setups (they must fit in the airlock basket).



- Current status: thanks to everyone's efforts, Luke was rebuilt earlier this year and has been working very well.

→ 2 material tests completed successfully and a 3<sup>rd</sup> one will take place in September.



# Tall Bo (450L)

- Features: Manual elevator platform
- Purpose: Mainly used for photon detector studies.
- Current status: 4 experiments using it currently, 1 more in the past
  - Proportional scintillation study, thresholds established
  - NIR: Typically light in LAr is UV, but studies show there's also emissions in IR. 1<sup>st</sup> physics run was successful so now taking more data with improved setup.
  - LILAr: pixel detector coated with ASe to develop detector that can collect both charge and light or for very large surface area photon detection
  - Xe/CH<sub>4</sub> doping: neutron capture and low energy event detection
  - LAr scattering: study light properties in LAr



# Blanche (450L)

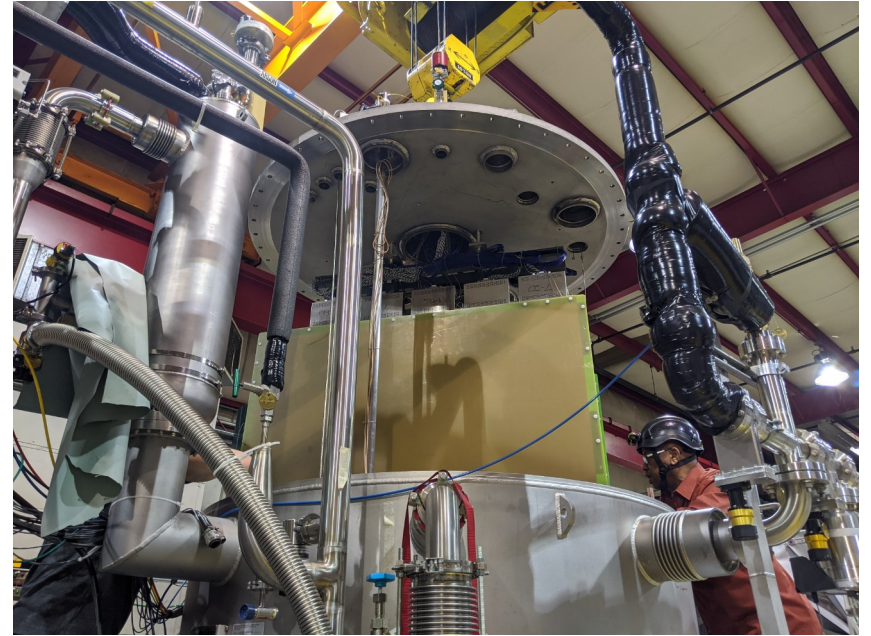
- Features: Purity monitor (depending on setup), internal filter (future upgrade)
- Purpose: Originally designed for HV tests but multipurpose cryostat.
- Current status: Works fine but improvement on purity would be welcome.
- Run plan:
  - LArCADE: charge amplification in LAr will continue taking data, just completed a run
  - Pixel TPC for low energy event detection





# Iceberg (3000 L)

- Features: Purity monitor, internal filter, full TPC (2 cathodes, central anode)
- Max Dimensions: 3000 L (4.2 ton LAr), 152 cm diameter x 183 cm height
- Purpose: Dedicated to DUNE tests for the time being



- Current status:
  - New nested stand to support TPC is being designed for easier installation of setups that do not need the TPC
  - Investigating if possible to operate cryostat independently from CE test stand to maximize usage of the cryostat
- Run plan:
  - Recently complete HV test run and DUNE VD POF test run.
  - On stand by until new cold electronics arrive.

# Other setups present at PAB

- GOAT: High pressure TPC R&D
  - will move to IERC's Warm Lab
- Xelda / Scene: Vessel used for dark matter studies
  - will be used for hydrogen bubble chamber (B. Ramson LDRD) and likely moved to the MiniBooNE building.
- SBND purity monitor refurbishment station in the annex and 2x2 purity monitor station in high-bay
- DUNE VD photon detector power-over-fiber and signal-over-fiber testing area
- Open dewars available but not a lot of work space:
  - clean up in progress
  - re-organization of our parts stock and inventory tracking
  - create new work spaces in the annex

# Electrical upgrades

- A lot of the equipment is outdated and needs upgrading
  - replace existing power supplies with modern units
  - centralize the power needs and distribute via patch panels
  - develop central slow control system (power supplies and purity monitors) integrated to the cryo control system
- Experiments are looking for small signals, any electrical noise can drown it
  - except Iceberg, all other tests stands are not electrically isolated from the rest of the building
  - pumps, machines, A/C, air compressor, etc. generate large amounts of electrical noise
- Goal: separate building ground from “detector” ground in a similar way Iceberg has done it (transformer + power conditioners)

