Lawrence Berkeley National Laboratory (LBNL)

ALS-U Accumulator Ring Installation

Challenges & Lessons Learned

Tobias Griesemer
ALS-U Shutdown Manager & AR Installation Lead

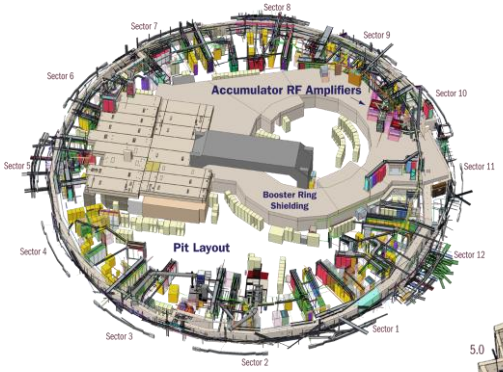
5th PAU Workshop - Removal and Installation
May 4 - 7, 2026
PSI, Switzerland

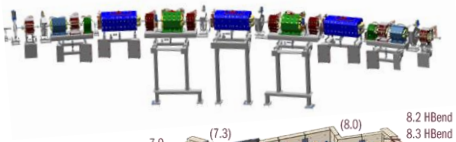
U.S. DEPARTMENT of ENERGY
Office of Science
BERKELEY LAB
ALS
ALS-U

Outline

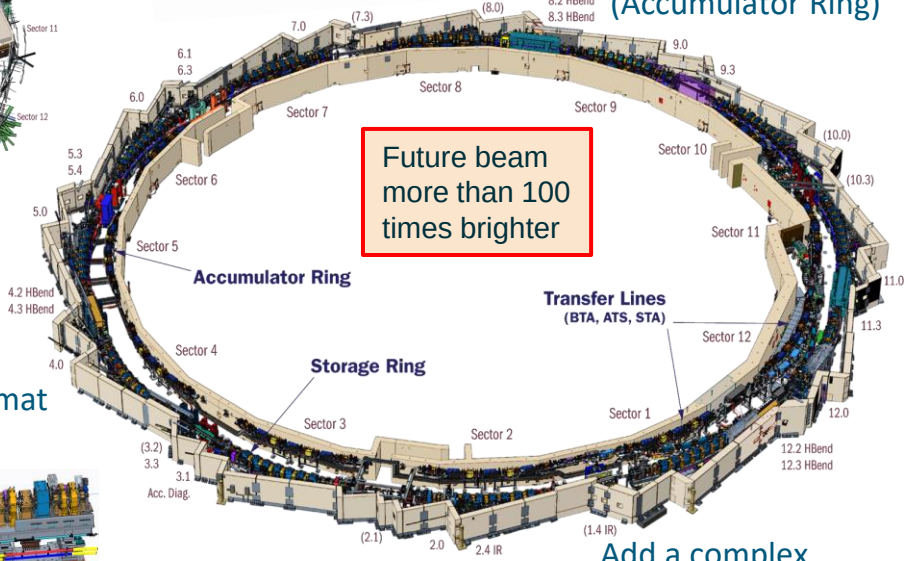
- ALS-U project introduction
  - Advanced Light Source
  - Accumulator Ring and Storage Ring
- AR installation methods
  - Overhead crane installation
  - Ground based installation
- Key Challenges
- Lessons Learned
- Summary

ALS-U - Replace one accelerator with two new ones*





Add 3-bend achromat to the injector complex (Accumulator Ring)

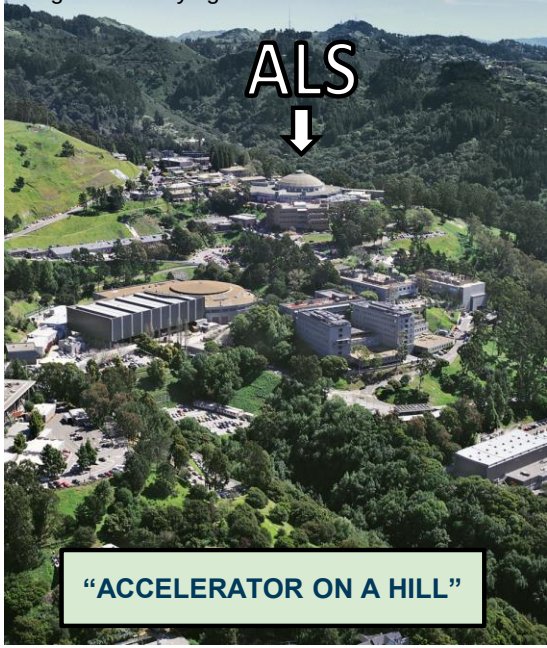


Future beam more than 100 times brighter

Add a complex transfer line region

Replace the existing storage ring with a multibend achromat
36 bends -> 108 bends

Storage Ring at the ALS commissioned 1993. Synchrotron light source providing extremely bright soft x-ray light.

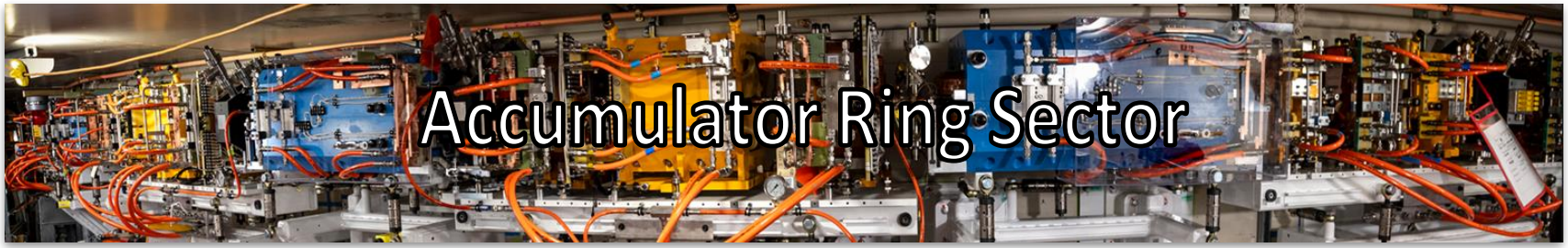


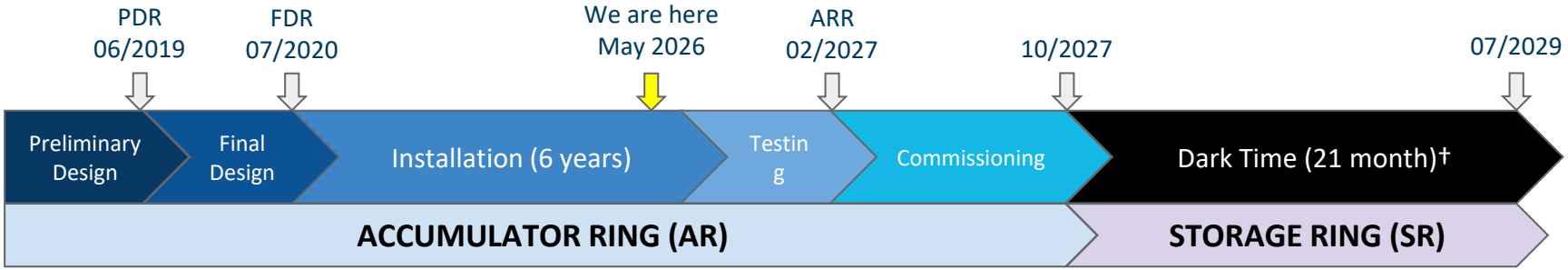
U.S. DEPARTMENT of ENERGY
Office of Science
BERKELEY LAB
ALS
ALS-U

*P. Gupta - Poster session
†A. Stewart - Session 6

Timeline - AR Installation nearing completion

- All 48 raft and 36 dipole in-tunnel assemblies are installed and aligned.
- Electrical infrastructure pit installation is in full progress right now.*

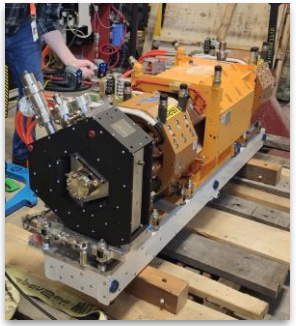


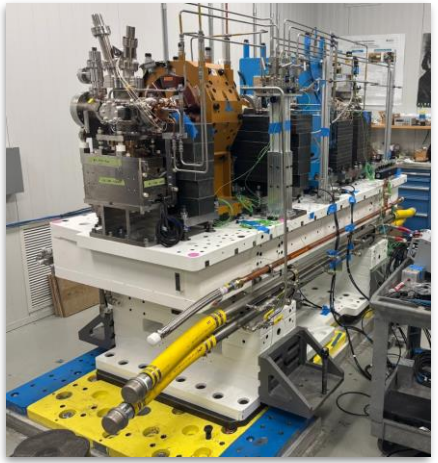


AR as a learning ground for the upcoming SR

- AR is being installed while the machine is running.
- Lots of pauses and time to fine tune our plans.
- Majority of SR work will be performed by the contractor in a relatively short period of time.
- We are already guiding that contractor through the AR process and our lessons learned.

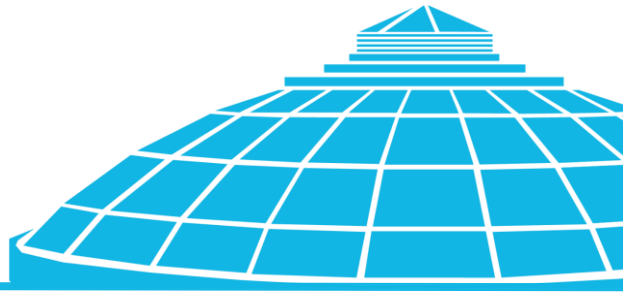
STRATEGY
Develop processes and lessons learned before the start of Dark Time.





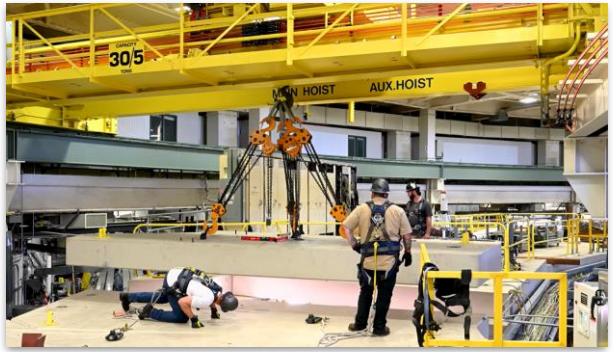
AR raft	SR raft
1000 kg 2 m length 0.5 m width 1m height	**14000 kg** 3.5 m length 1.5 m width 2m height

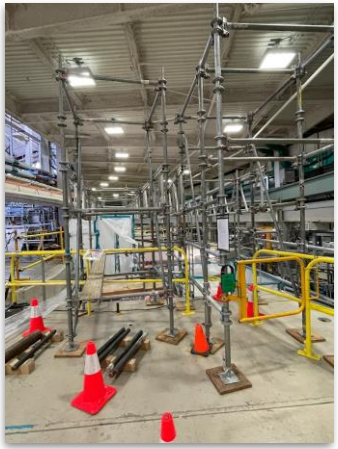
Accumulator Ring Installation Methods

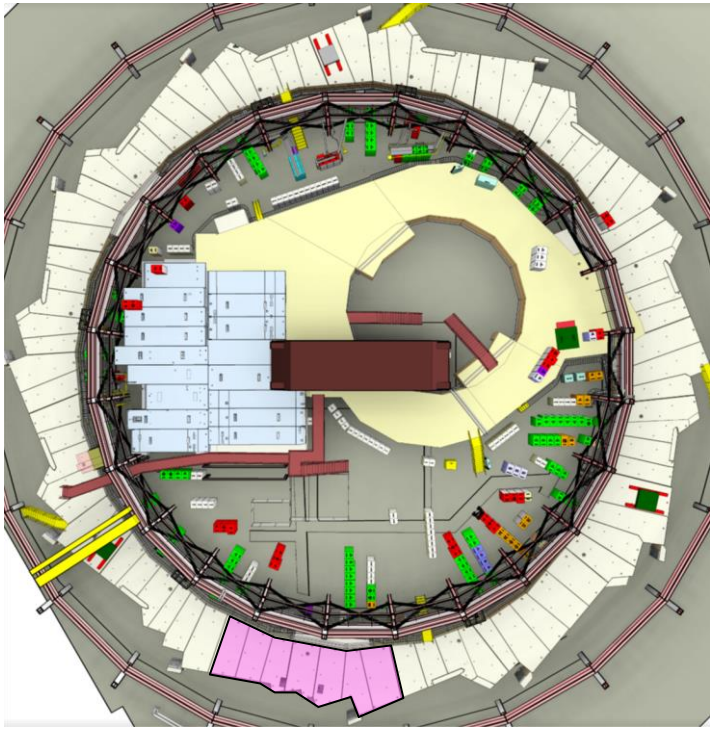


Installation methods are roof block driven

- The ALS tunnel is covered by 82 roof blocks.
  - Average weight is 11000 kg (max. 24750 kg).
  - Most of them are removable; 8 h process.
- Ground based installation mandatory (and preferred).
- Overhead crane installation for hard to reach locations.
- Seismic upgrades in the facility require constant work-around*



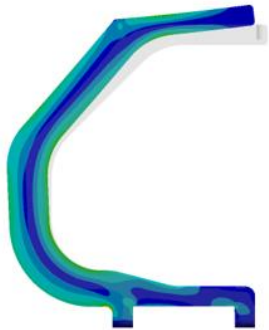




Custom crane lifting fixtures for AR installation

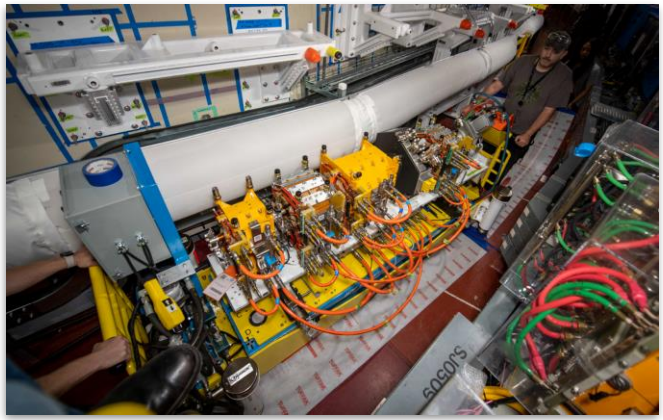
- AR raft crane installation required custom C-shaped lifting fixtures to deal with remaining infrastructure.
  - Designed and manufactured in-house.
  - Engineering note + critical lift plan required.
- Pit rack installation with custom adjustable lifting fixture.
  - Low profile for max. clearance.

Fire sprinkler system.
AR installed 5-20 cm
under roof blocks.



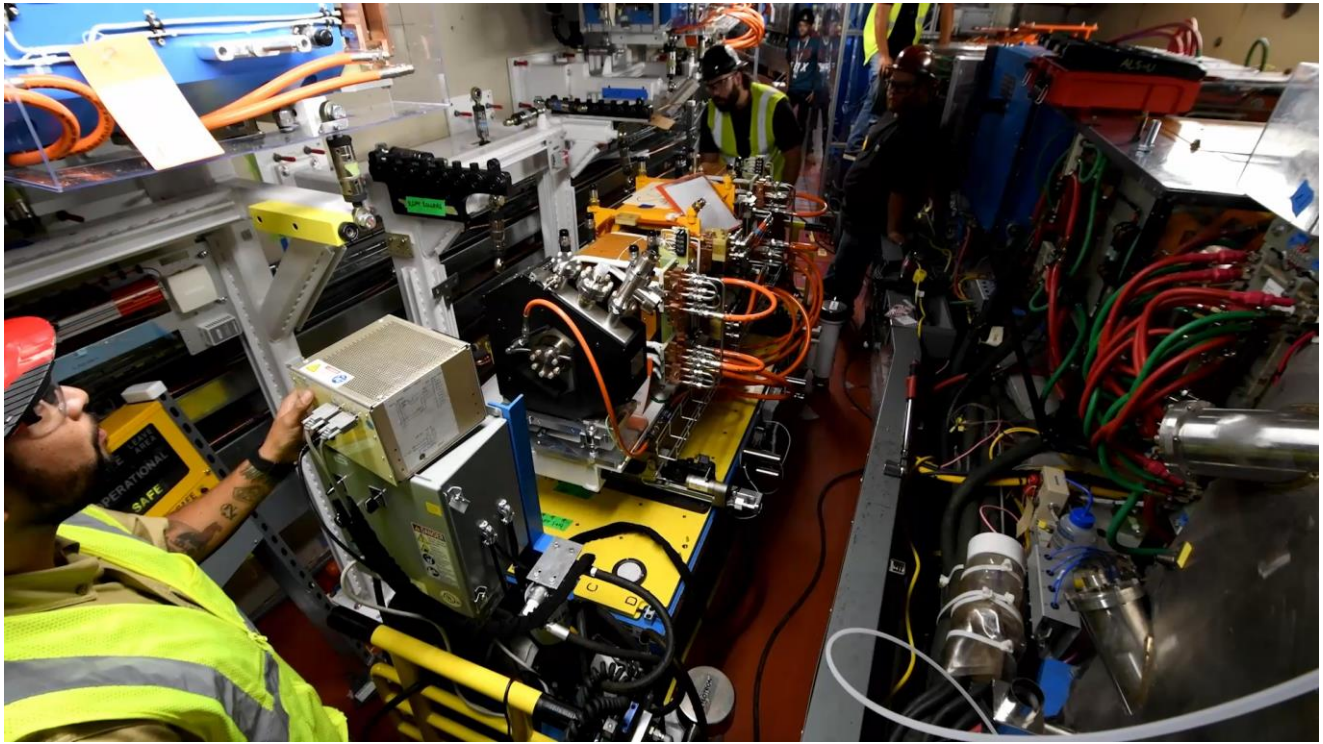
Ground based ‘Lifting Cart’ installation

- Custom built scissor lift cart.
- Vertical lift with off-the-shelf scissor lift.
- Horizontal translation with rollers and electrical actuators.
- Air casters and wheel casters for tunnel maneuvering.
- Levelling jacks as outriggers for stability and fine adjustment.
- Compatible with over 80% of all tunnel locations.
- Stationed in the tunnel.
- Utilized as future maintenance tool.
- Most efficient and preferred installation method.

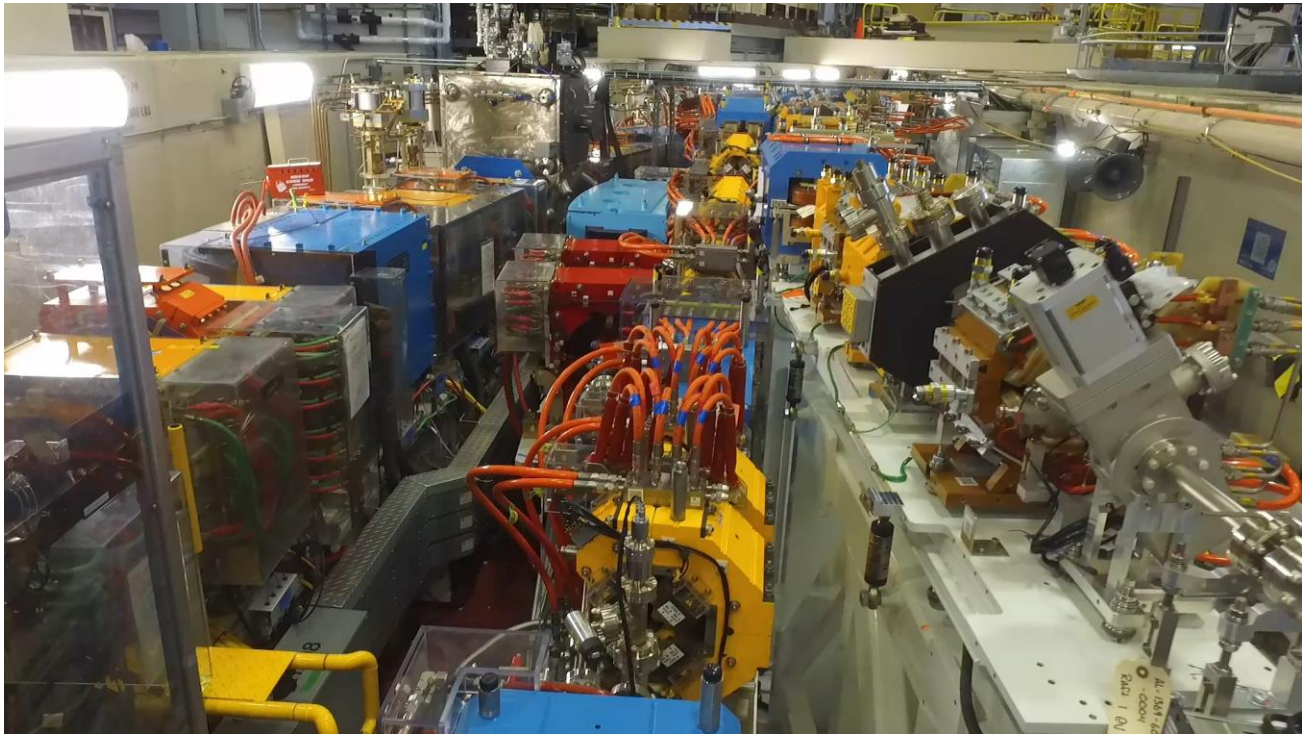


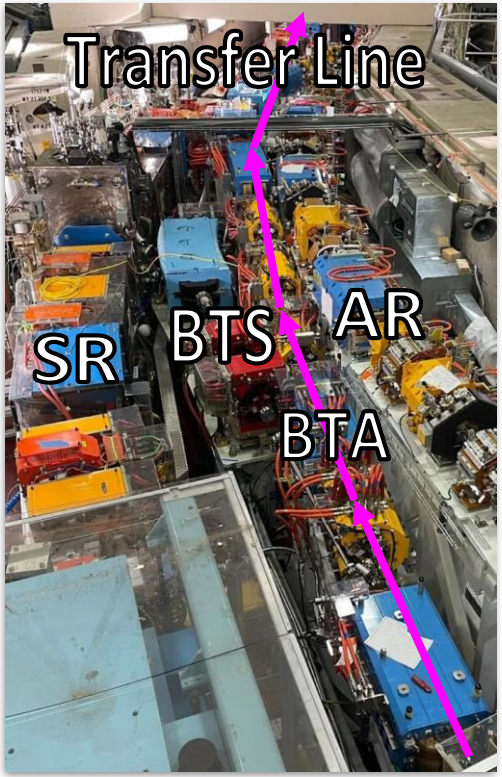
Ground conveyance is our introduction and learning ground for future SR moves*

Ground based ‘Lifting Cart’ installation process



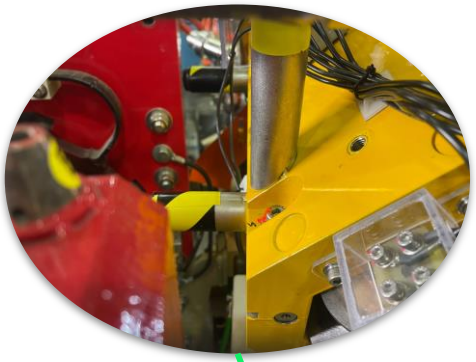
Transfer Line as the last big piece of the puzzle





Custom crane lifting fixtures for the Transfer Line

- Transfer line consists of many unique assemblies.
- Custom U-shaped fixtures for heaviest 2200 kg raft.
- ‘Inclined raft’ installation as highlight of the transfer line.



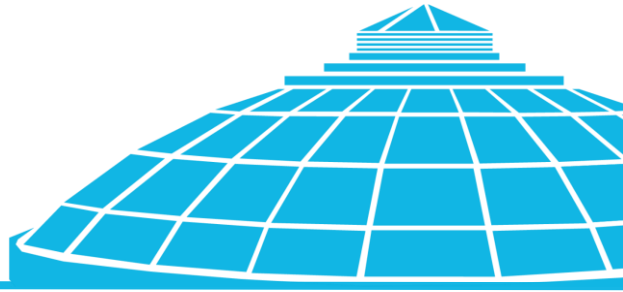
BTA 03 Lifted @ 8.72 degrees

BTA 03 Transported @ 8.72 degrees

BTA 03 Installed @ 8.72 degrees

Very Tight!

Challenges & Lessons Learned



Prototype testing pays off

- Full installation test setup outside of the tunnel with mock-up stand and dummy magnet for the custom ground based installation.
- Tunnel installation went smoothly because there was a lot of practice.
- We still had surprises…
  - Wall conditions (bowing, that required wall shaving).
  - Infrastructure that required adjustment.
- Thorough preparations and shutdown breaks mitigated any big delays.
- Dark Time will require even more thorough planning.

Vacuum connection testing in clean lab

Lessons Learned

Extra effort for prototype testing was totally worth it!

AR tunnel wall shaving to resolve interference

- Inner tunnel wall has irregularities/bowing.
- Potential interferences with ion pumps were discovered.
- Wall shaving at four different locations.
  - Shield wall is highly process controlled.
  - 7 mm deep.
  - Custom tooling, tested outside of tunnel beforehand.
  - Full dust control.
- Support stand shimming as a related challenge.

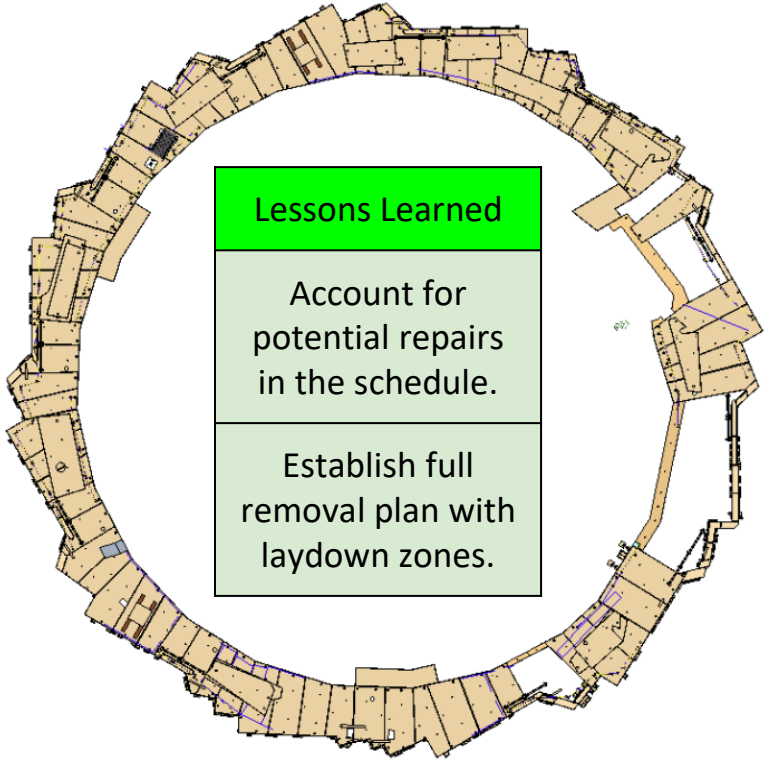
Lessons Learned

Analyze as-built conditions early and thoroughly to avoid future interferences

Roof block stacking and unexpected repairs

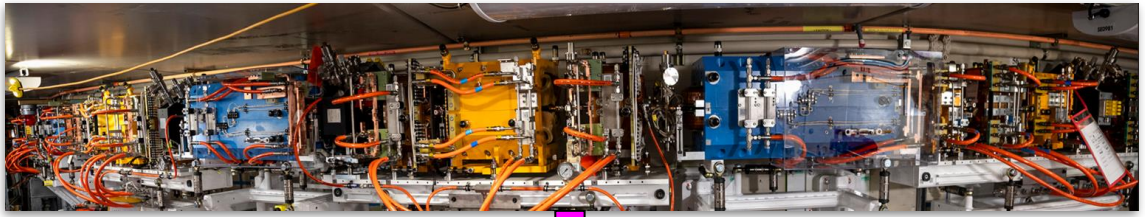
- 13 roof block removed at once.
- Double stacking required.
- Repairs required before replacing the blocks.

1. Chips/cracks
2. Loose aggregate around pin sleeves
3. Loose/spinning lifting inserts

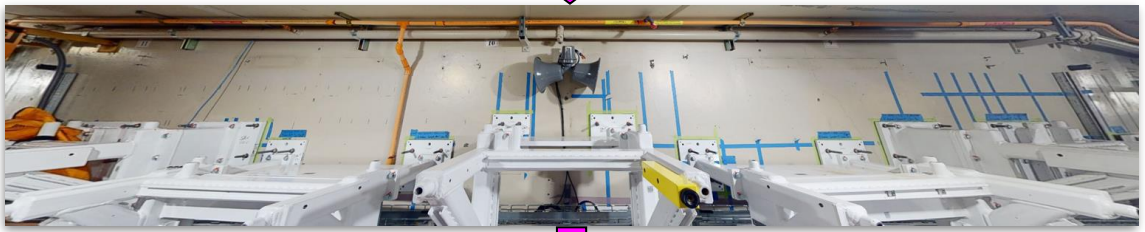


Removing entire AR sector for rework due to QA vendor issue of a magnet and insufficient acceptance testing before assembly

1. Initial installation



2. Removal for rework



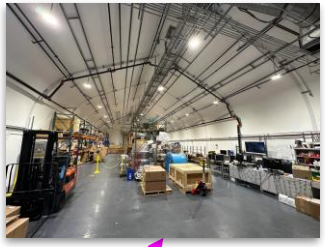
3. Second installation

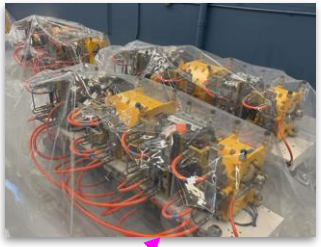
Lessons Learned
Strict hand-off requirements.
No open non-conformance reports or known issues accepted during hand-off

Staging areas are overcrowded due to space limitations

Off-site Storage

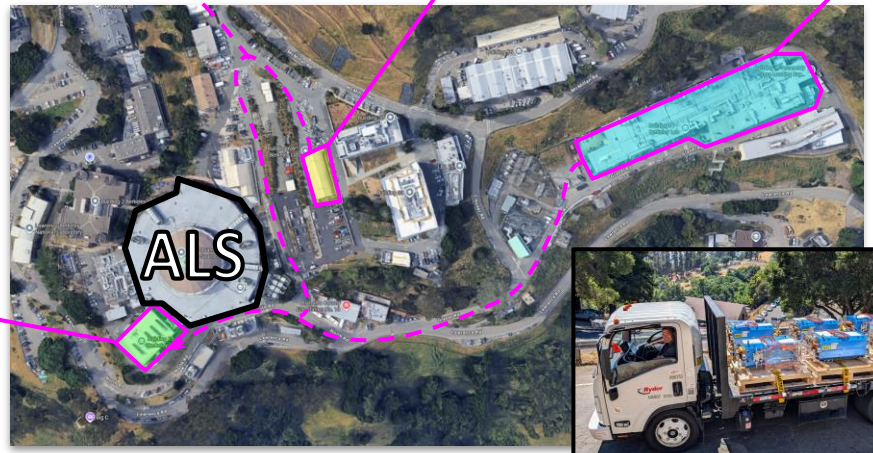
B6W Material storage





B77 Assembly shop Prestaging

B15 High Bay Staging area



Lessons Learned
Building additional storage space allowed for good material flow
Transportation plans and testing to avoid delays and damage

Summary

- Fully integrated ALS/ALS-U and contractor installation team is key to success.
  - Close long term collaboration between the Mech Tech and R&I teams during prototype development and tunnel installation led to success.
- AR in-tunnel raft and dipole hardware installation is completed.
  - Major milestone of the ALS-U project; over 5 years in the making.
  - Installation methods are complex, but work excellently in our facility.
- AR experience and lessons learned are de-risking Dark Time planning and execution.

Thank you