

NuMI Shutdown Summary

PMG Meeting

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7 January 2021

Conditions & Plan for 2020 Shutdown

- In June 2019 a cooling water (RAW) leak was identified on PH2-02. The rate was about 5 L/day and the decision was to not replace PH2-02.
- PH2-02 continued to leak water and its rate was about 12 L/day by summer 2020.
- The original plan was:
 - Install a new HVAC cooling duct the length of the Target Hall and into the Chase.
 - Rebuild the motor drives for the H1-module.
 - Replace PH1-03 with PH1-05 (1MW horn).
 - Replace leaky PH2-02 if time allowed.
 - Transfer used components to C0.
 - Complete many smaller scope jobs and annual maintenance activities.
- Impact of COVID-19 added significant uncertainty to the plan.

Given the Uncertainty We Made Two Shutdown Plans

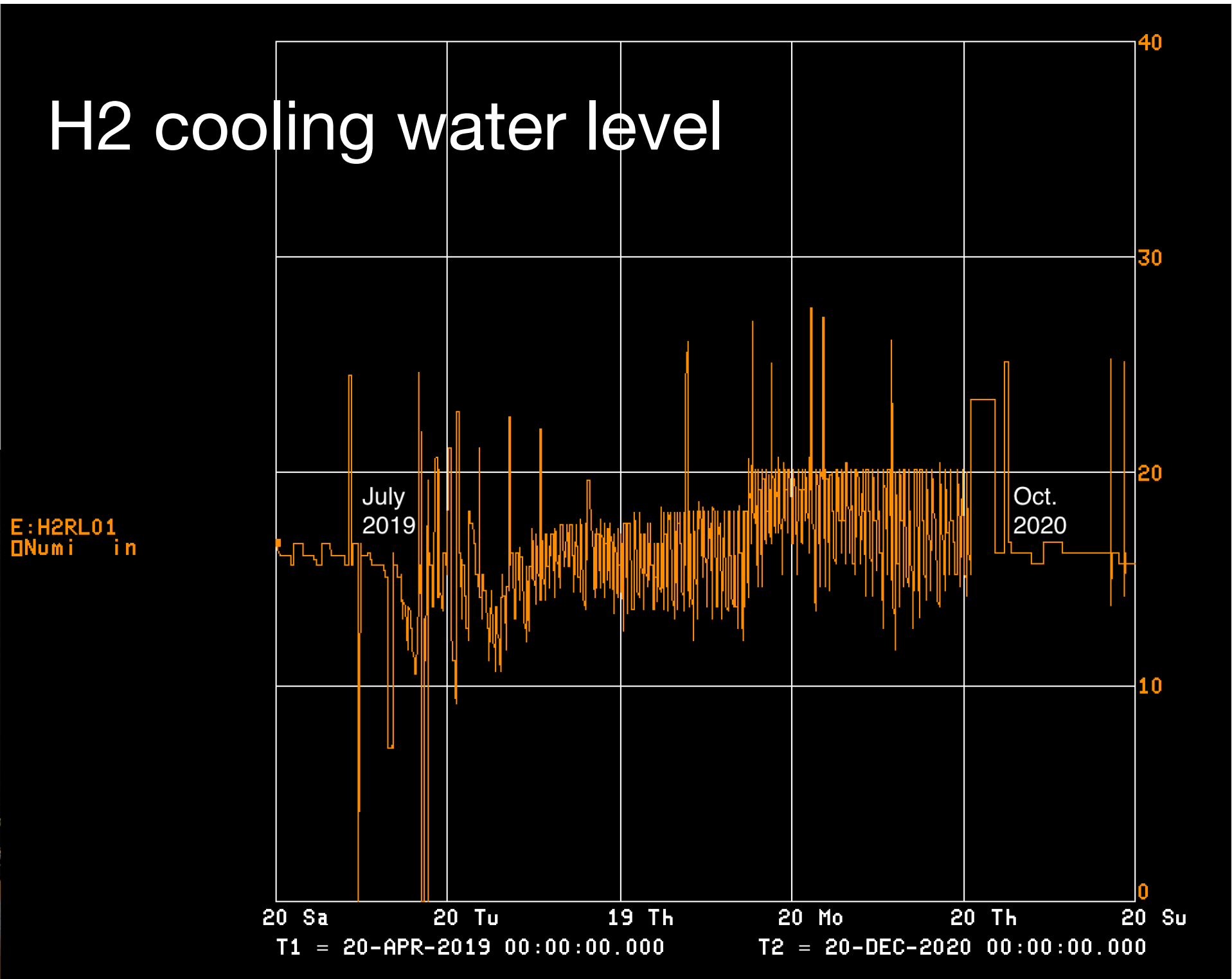
- **Plan A:**

- Complete H1 module renovation (much uncertainty: 2-8 weeks)
- Replace PH1-03 with PH1-05
- Install HVAC system
- Leave PH2-02 in place

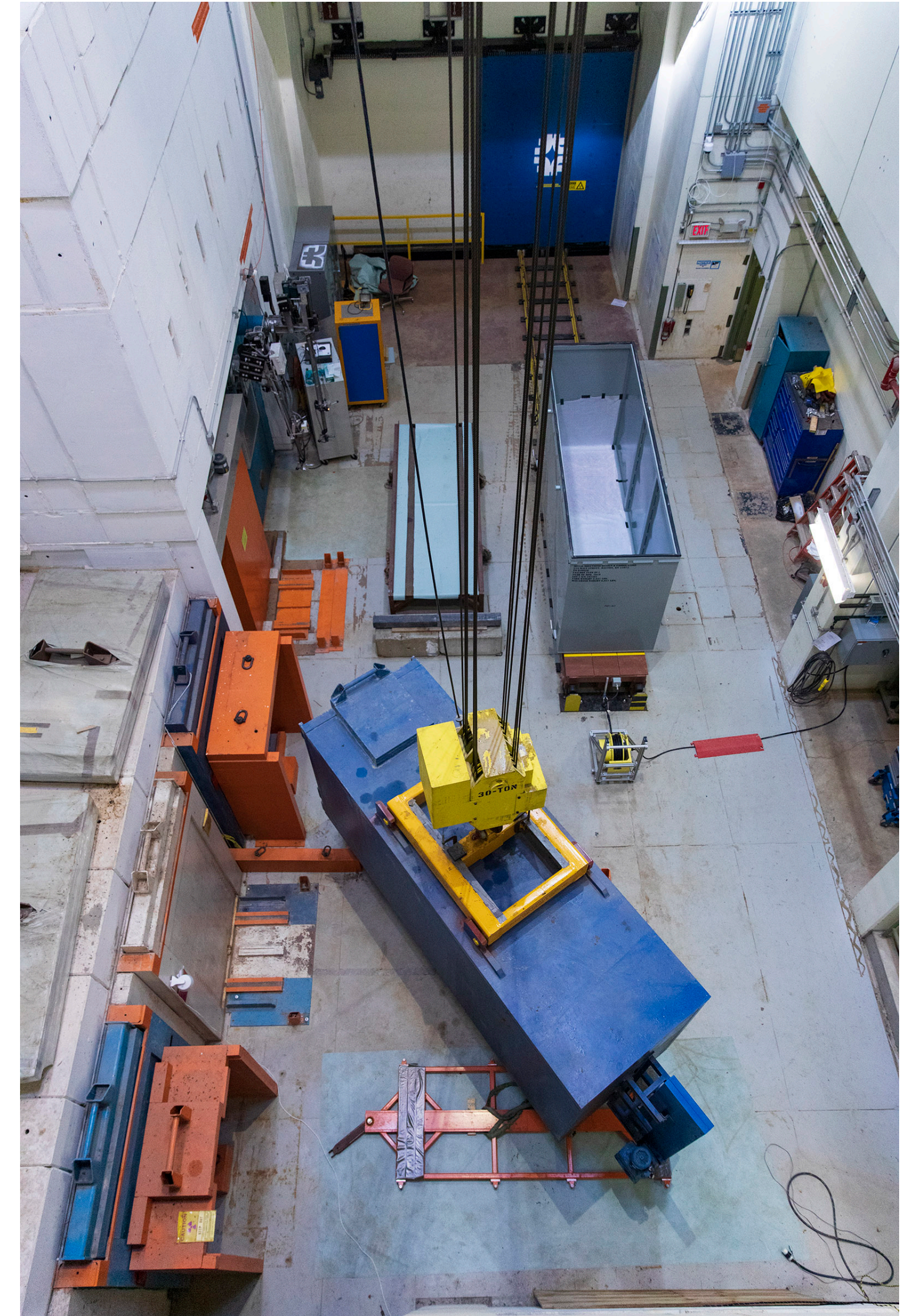
- **Plan B:**

- Install HVAC system
- Replace PH2-02

By end of May the likelihood of completing Plan-A was 50/50.
Given the uncertainty we decided to replace PH2-02 while H1 module
drive components were being fabricated.
RAW leak was on B-dot detector on the beam-right side of PH2-02.



In order to complete component replacements we used components to C0. We completed two such moves: TA-03 and PH2-02 in July and August, respectively.



Horn-1 Strip-line Flag Cooling Installation

200 feet of 12" duct installed in Target Hall and Chase.

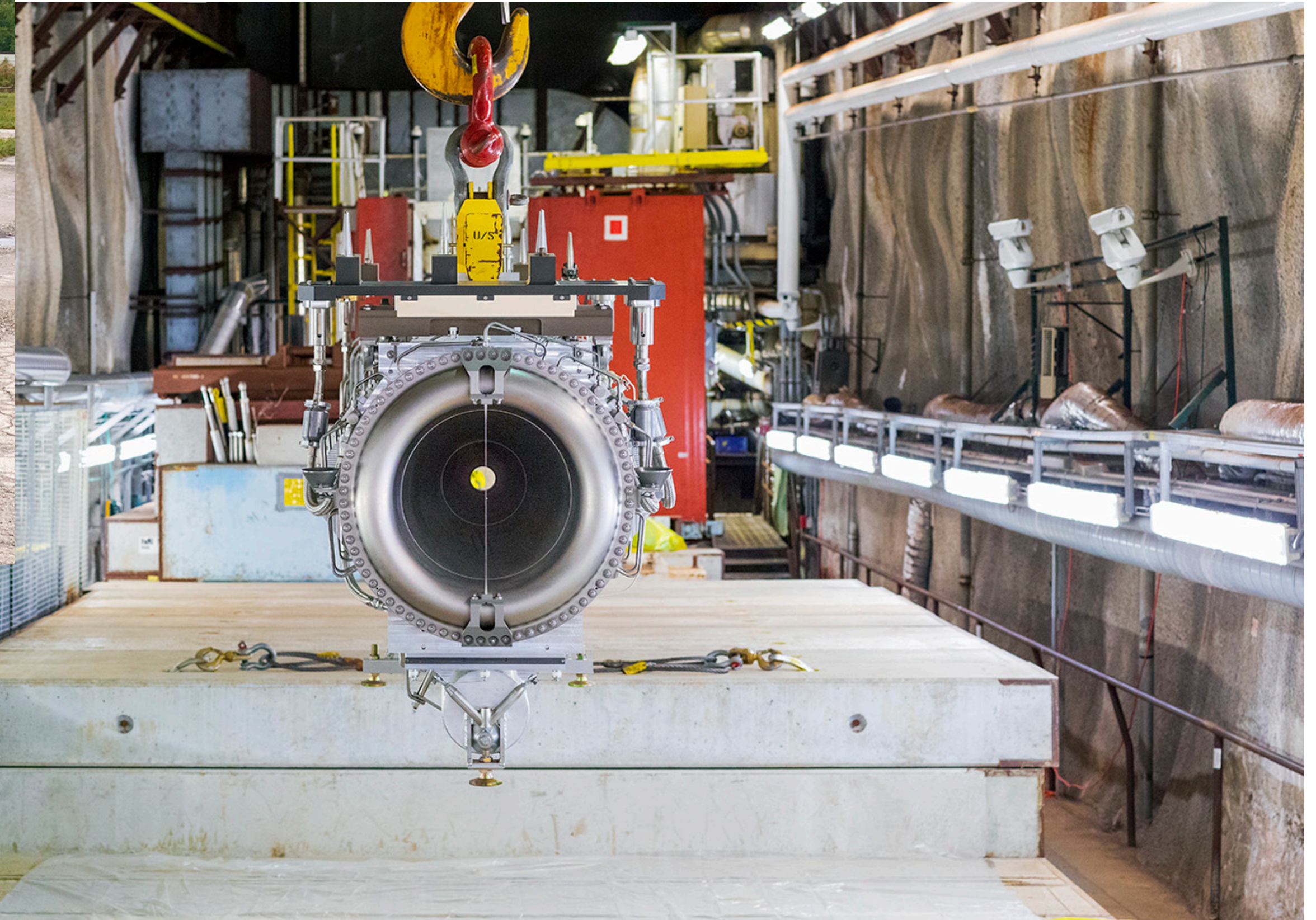
Installation was 80% complete by September 3.

The purpose of the cooling is to reject heat generated by beam interaction with Horn-1.



PH2-04 Installation

PH2-04 was identified as the preferred replacement H2. PH2-02 was prepared and installed in the chase on 10 September.

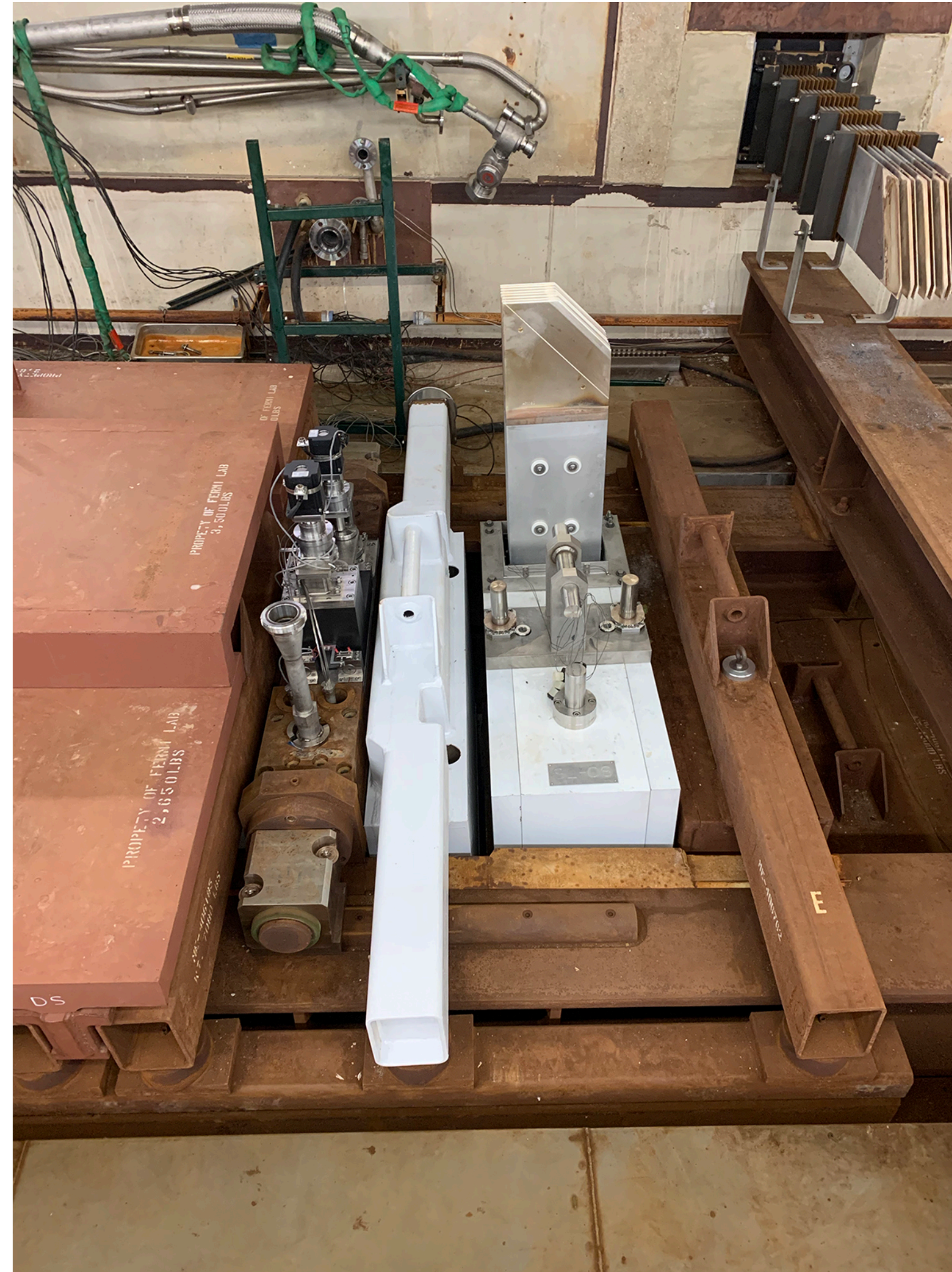


Horn-1 Module Drive Re-build.

Accelerator Improvement Project

- Ambient module dose rate $> 10\text{Rad/hour}$.
- Much remote handling and eight moves of the module between Chase and Hot Cell.
- The novelty of the job and high radiation area meant much uncertainty in scope. If all went well it would take two weeks, at worst eight weeks.
- Mostly the job went well. There were some minor problems, but in total it took three weeks to complete.
- Rebuild complete by 9 October.

PH1-05 Installation



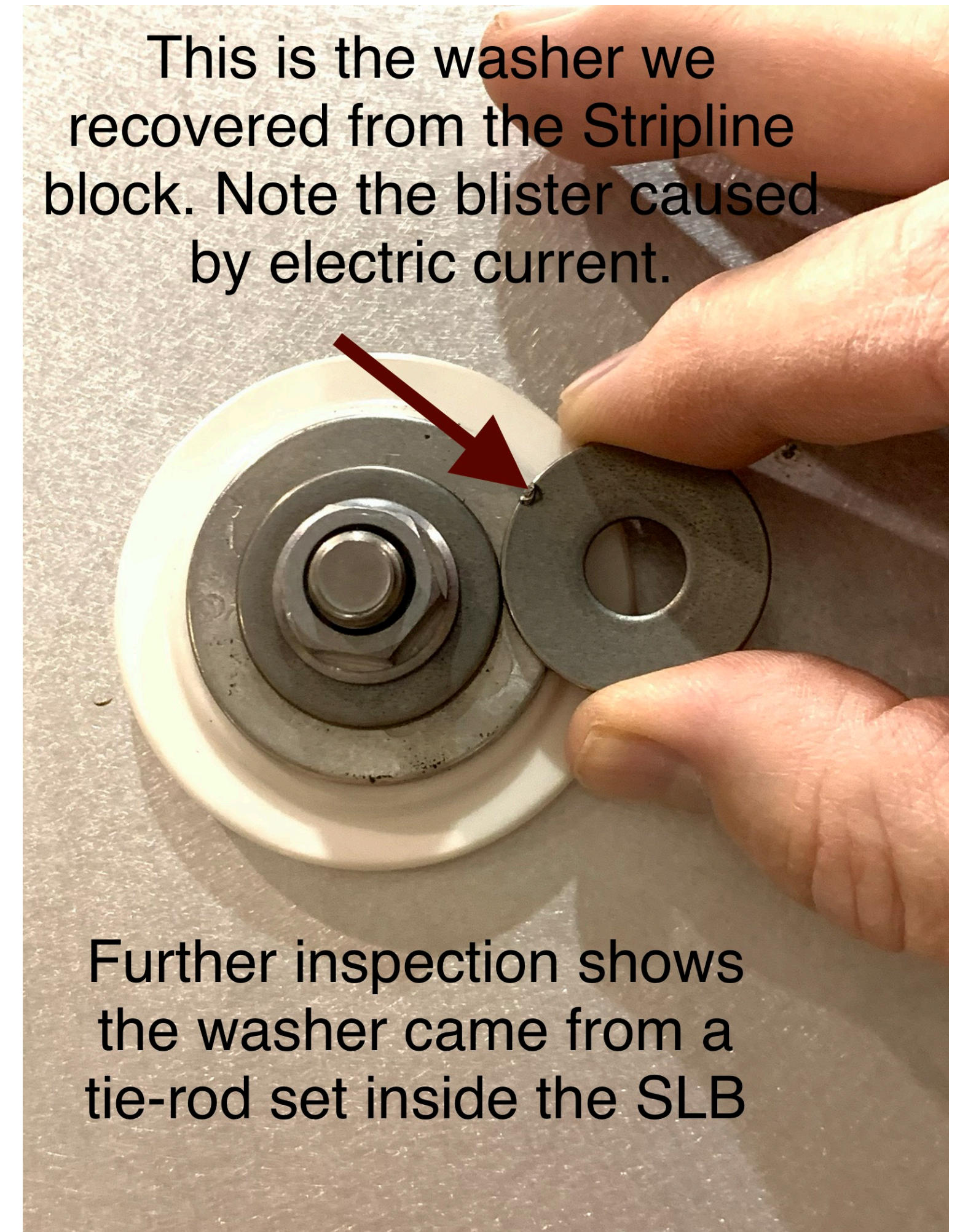
In order to get the air cooling to the horn strip-line flag a new T-block was fabricated and installed.

Pictured are PH1-05 (far left) and T-block and strip-line block.

Installation complete by 20 November.

PH1-05 Commissioning: Ground Fault!

- Successful power-on access for thermal imaging.
- Horn scans & subsequent move complete before TG holiday.
- Horn PS tripped during pulsing exercise.
- Thorough investigation with AD EE-support and TSD departments pointed to the newly installed Strip-line block.
- A bolt assembly worked loose internally and a washer faulted to ground between the strip-line and the block.
- New SLB installed and another round of horn-scans/alignment were done. Target installation followed and **HEP beam was started by 12 December.**



This is the washer we recovered from the Stripline block. Note the blister caused by electric current.

Further inspection shows the washer came from a tie-rod set inside the SLB

Down stream end
of NuMI beam line



Looking down
stream inside
the beam-ready
NuMI Target Hall
on 12 December



- NuMI-AIP has **reached its goal of One Megawatt** capability.
- The **2020 shutdown has been challenging yet successful** – the team was ambitious in taking on multiple large scale changeout / installation tasks in a pandemic. It was indeed an outstanding achievement!
- This **project is 90% complete**, and the remaining ~\$1.2 ML fund should be enough to cover a few activities for reliability improvements through next shutdown.
- Sincere **thanks** to everyone for your support and contributions in the past two years, especially those who had been on site for the NuMI installation and troubleshooting from mid-June to mid-December.
- **Wishing you a very safe and happy holiday season.**

Directive Milestones	Baseline Date	Actual Date	% Complete
Start Project	NOV-18	DEC-18	100
Horn 1 Final Design	APR-19	APR-19	100
Target Fabrication	MAY-19	AUG-19	100
Horn 1 Fabrication	FEB-20	JUN-20	100
Horn Stripline, Testing	MAR-20	AUG-20	100
Horn 1 Stripline Installation	AUG-20	DEC-20	100
RAW, Target Chase Cooling, Shielding	OCT-19	OCT-19	100
Tritium Mitigation	OCT-19		80
Project Completion	JAN-21		90

Financials as of 11/30/20	
Budget	5,600,000
Balance	1,245,725

Activities remaining

Target Autopsy A1901.02.03	Target Module Rebuild A1901.03.03	MINOS Dry Cooler A1901.04.02	Decay Pipe US Window A1901.05.01	Hadron Monitor A1901.06.01
Team: George Lolov, Meredith Lee, Keith Anderson , et al.	Team: Vladimir Sidorov, Clay Leonard, Kris Anderson , et al.	Team: Adam Taylor, Lee Hammond , et al.	Team: Mike Campbell, Dirk Hurd , et al.	Team: Katsuya Yonehara, Nnamdi Agbo, Joe Beleski , et al.
Remove target TA-02 downstream flange for inspection	Fabricate, preassemble and test the Target module drive mechanism	Install a dry cooler to provide free cooling to the MINOS CHW loop for eliminating cold weather operations impact	Generate drawing package of the US window changeout system for future reference	Test the Hadron Monitor once they are delivered from U. of Texas at Austin