

SNS Operational Experience

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Groups

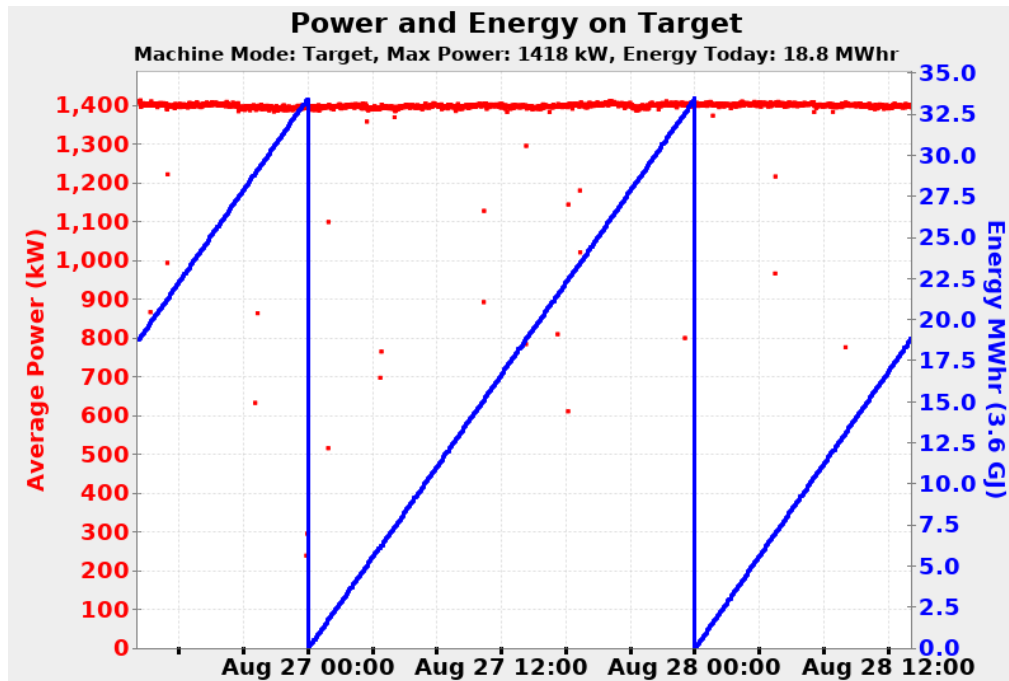
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SNS Operational Performance is Excellent

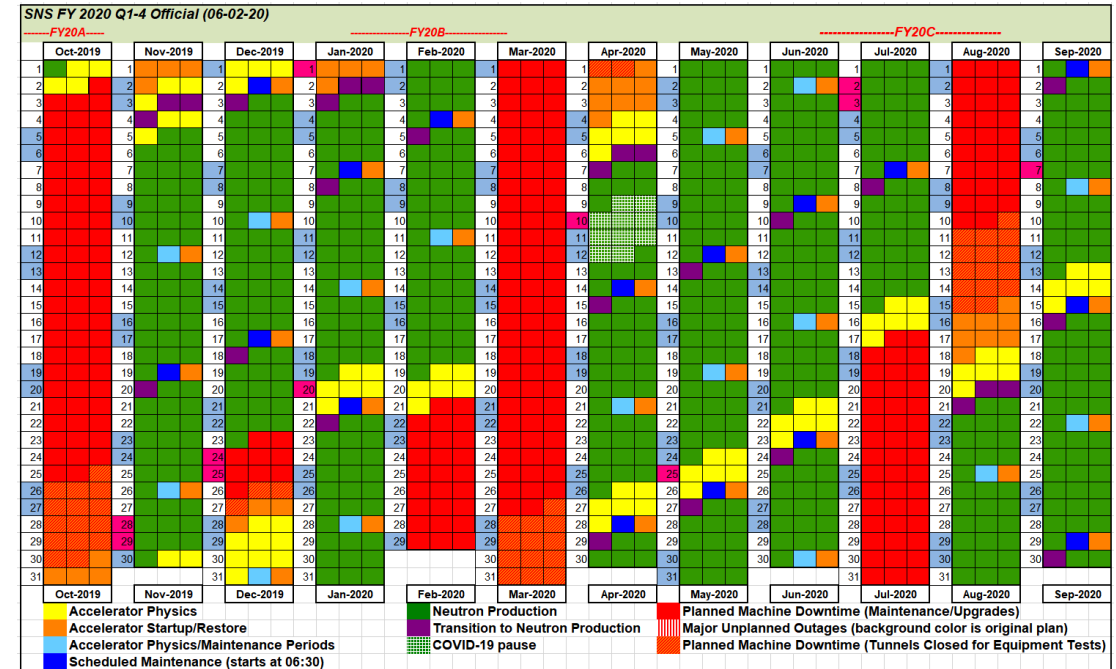
- FY2020 operational statistics

NP hours	5080.5
NP delivered hours	4828.9
NP availability (%)	95.1

Availability=uptime/NP hours



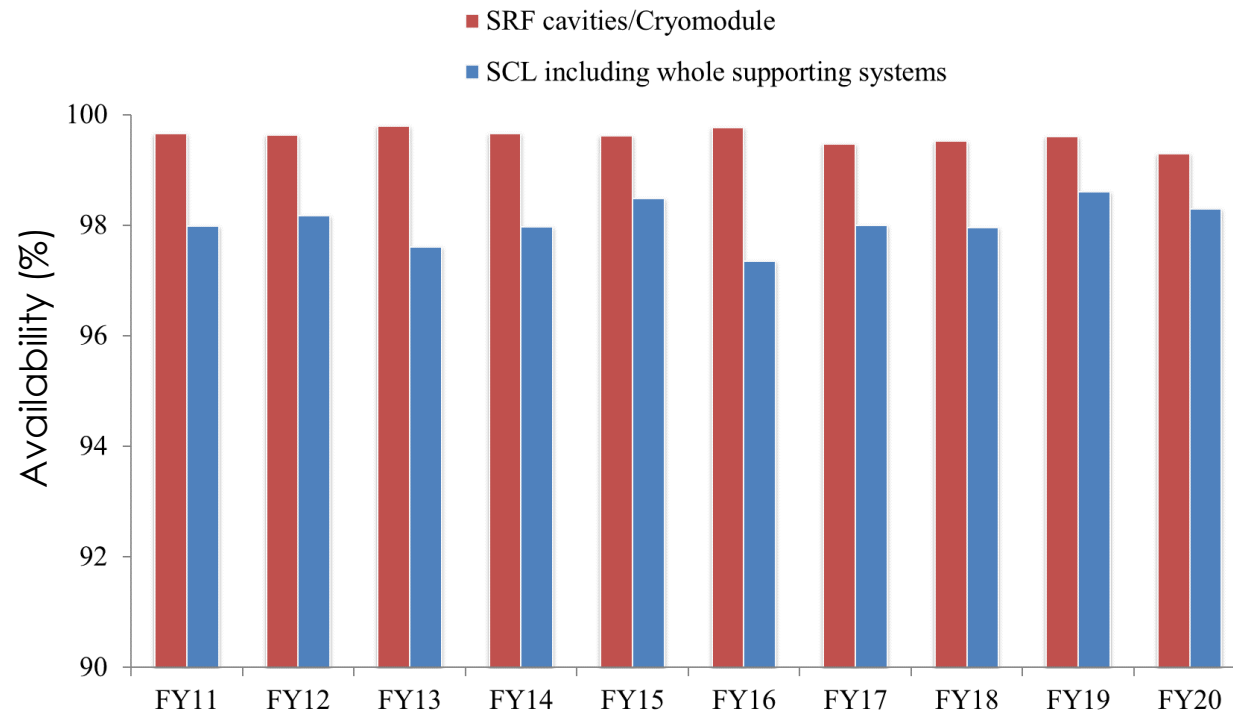
FY2020 schedule



Example:
Operational performance of 2-day period

SNS SCL performance

- SCL continues providing highly reliable operation
 - SRF cavities/Cryomodule: 99.6%
 - Whole SCL system including all supporting sub-systems: 98%



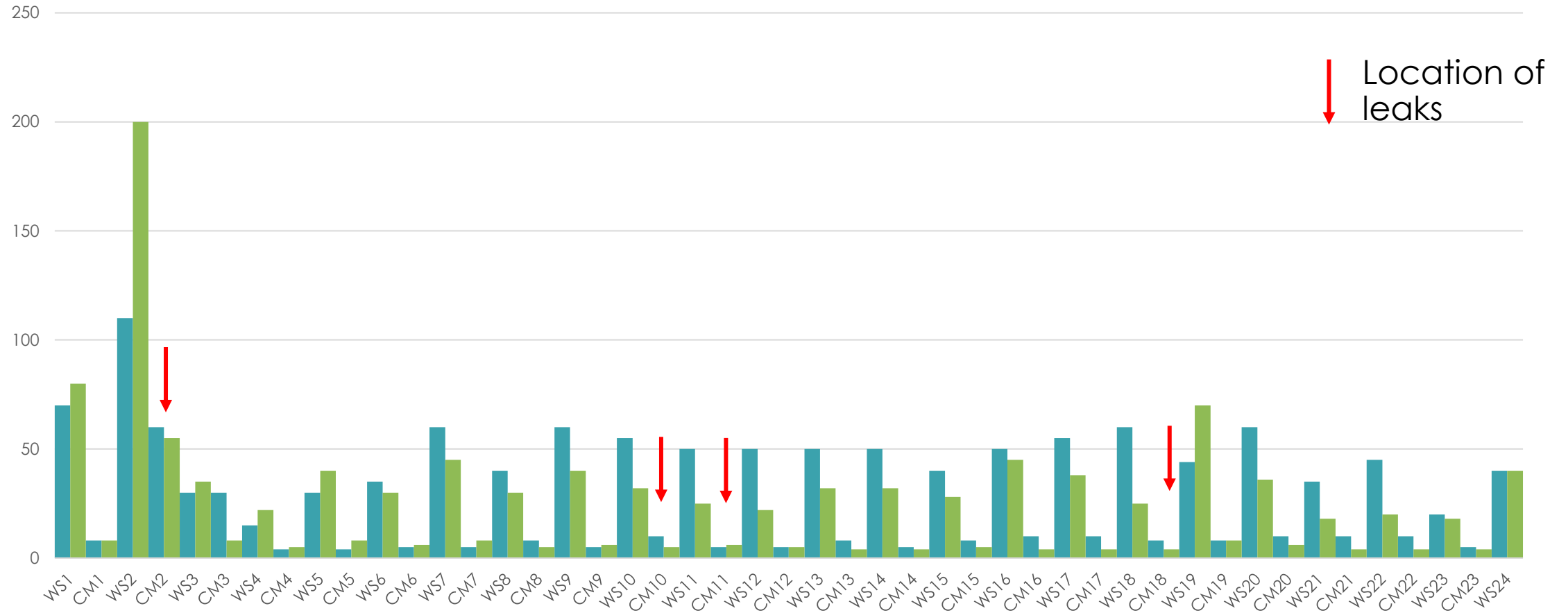
- Achieving highly reliable operation requires meticulous planning and execution of maintenance

Issue with warm valve leaks

- During the last two maintenance periods, warm sector gate valve through leaks have been identified.
 - The first valve leak was discovered last August on CM2 when removing CM1 for repairs.
 - During the current winter down, we identified 3 more leaky valves
 - During the current winter down, six cryomodules were warmed up for
 - CM1 for repairs upstream vacuum system
 - CM**18**, 19 for repairs on CM18
 - CM**10**, **11**, 12 for removal and replacement of CM11
- Sector gate valves are the pneumatic valves on each end of cryomodule.
- These valves are closed for cryomodules that requires maintenance.

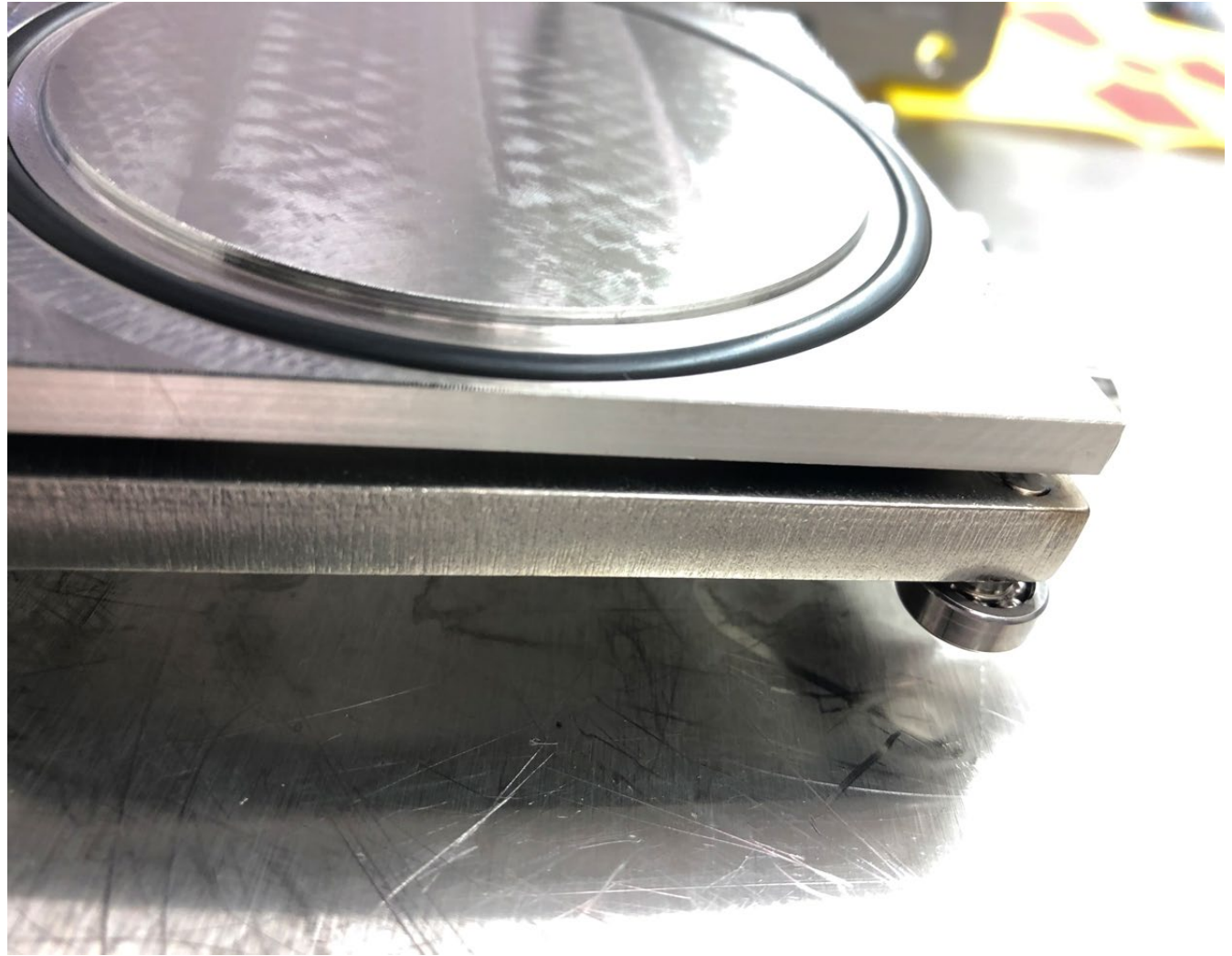
Residual Activation and Locations of Valve Leaks

Residual Radiation at 30cm (mRem/hr)
dark green - 06/2020, light green- 11/2020



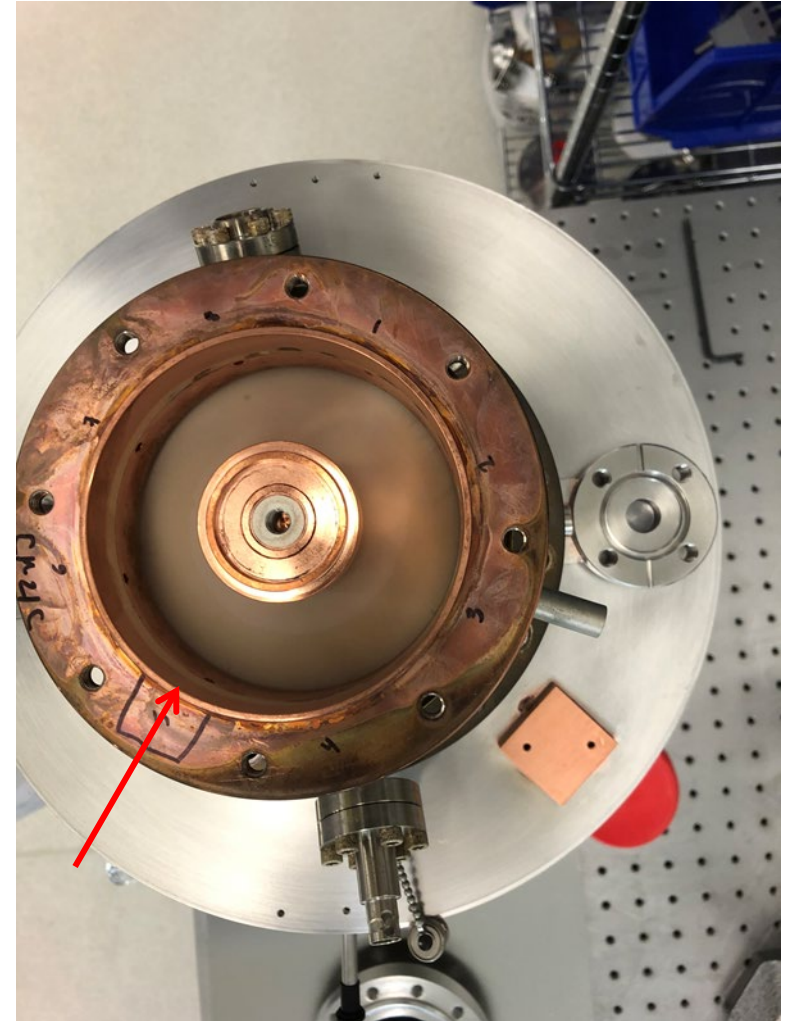
CM02 Sector Gate Valve Seal

- O-ring has lost its elasticity and was flat at the seal surface
- No signs of embrittlement or cracking

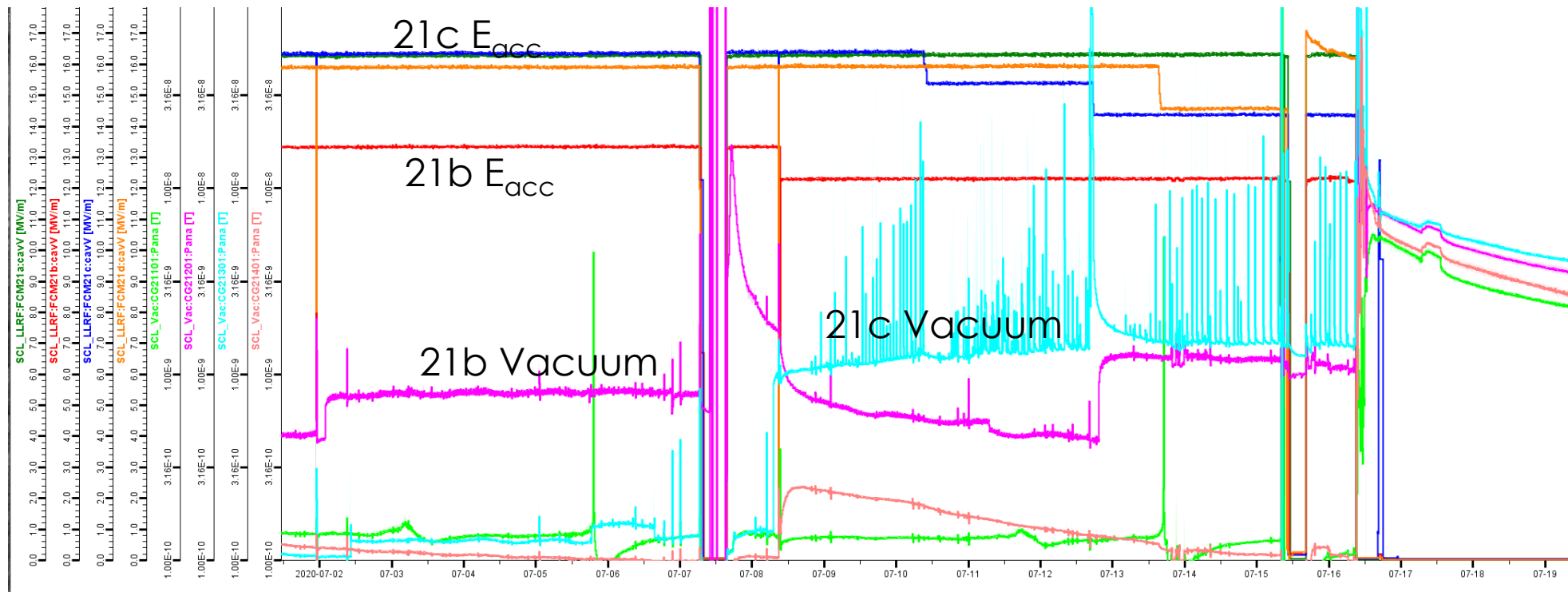


Current Operational Issues- Fundamental Power Coupler (FPC) vacuum leaks

- Over the last few years FPC leaks through the ceramic window have increased
- To date 9 FPCs have been removed from cryomodules
 - 8 out of these have identified leaks of 10^{-7} Torr L/s,
 - 1 was removed due to severe oxidation (D)
- Leak locations were identified around choke joint brazing to ceramic



Indication during operation



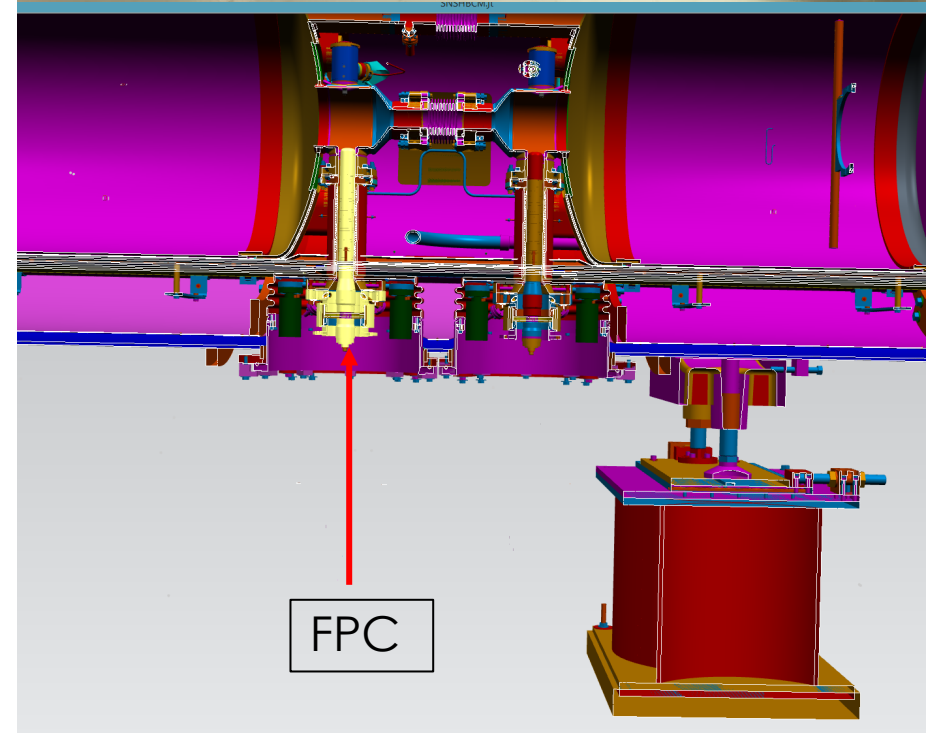
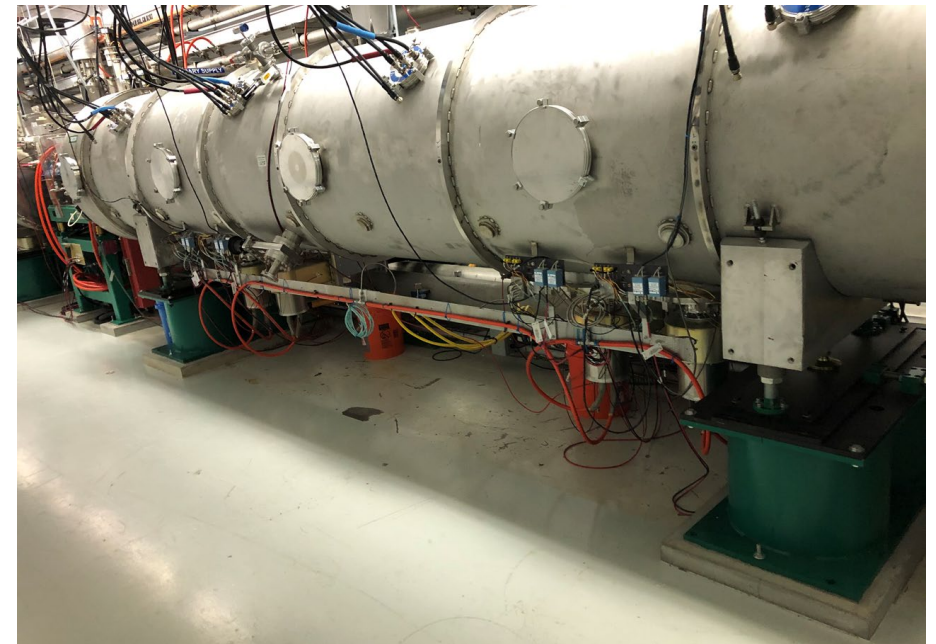
- Typically vacuum pressure becomes less stable with spikes (increase up to 10^{-9} torr range)
- Run those cavities at a reduced E_{acc} or turn-off using an energy margin

In-situ Cryomodule Repair Development

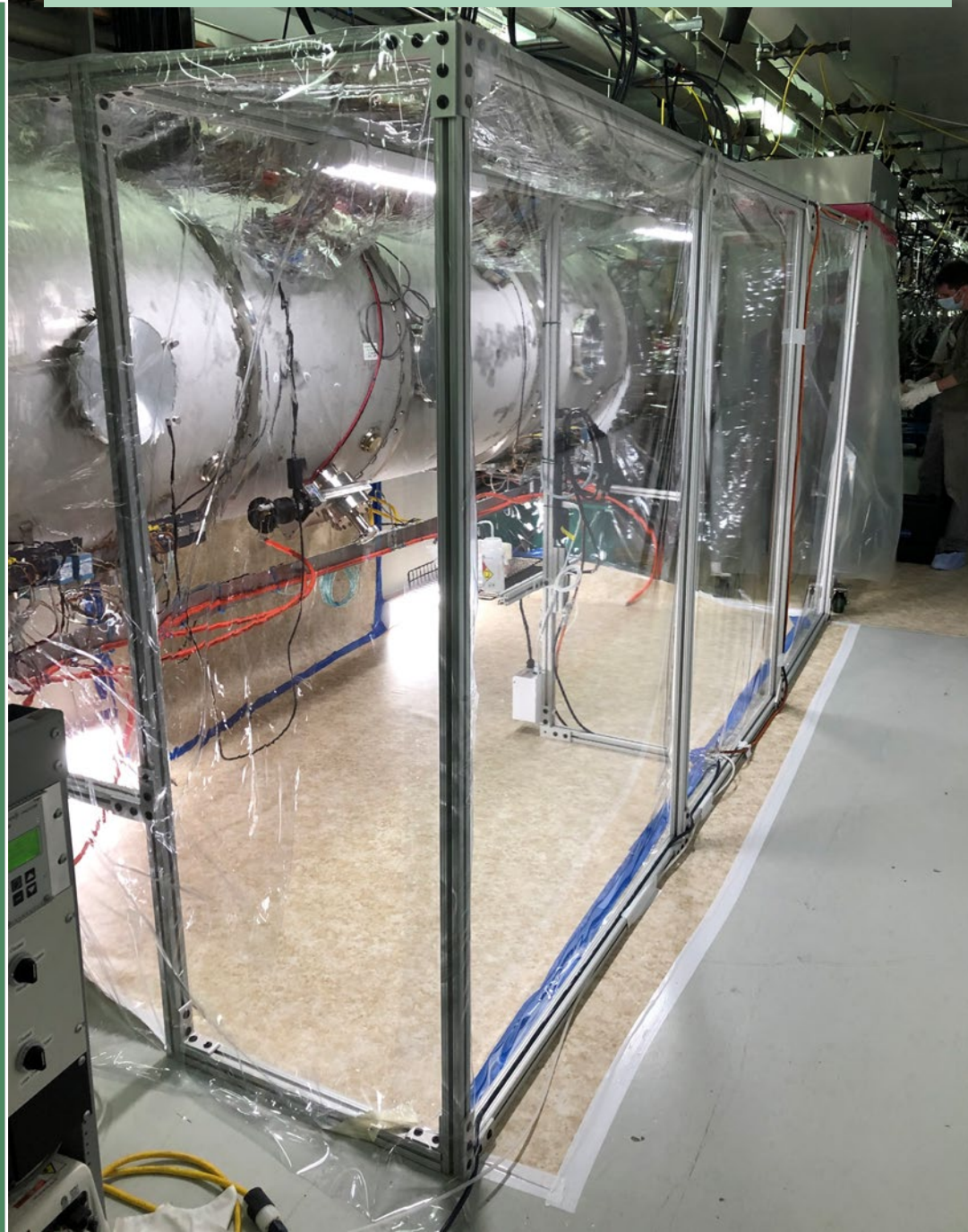
- Due to the recent increase of beamline maintenance activities, SNS developed methods for making beamline in-situ repairs in the tunnel
- During the August 2020 maintenance down we attempted replacing two FPC on CM21
 - A portable cleanroom was fabricated in-place and established ISO 4 conditions
 - Tooling was developed to remove and insert couplers
 - The process was successful and now has been applied during the December 2020 down on CM18

In-situ Repair Hardware

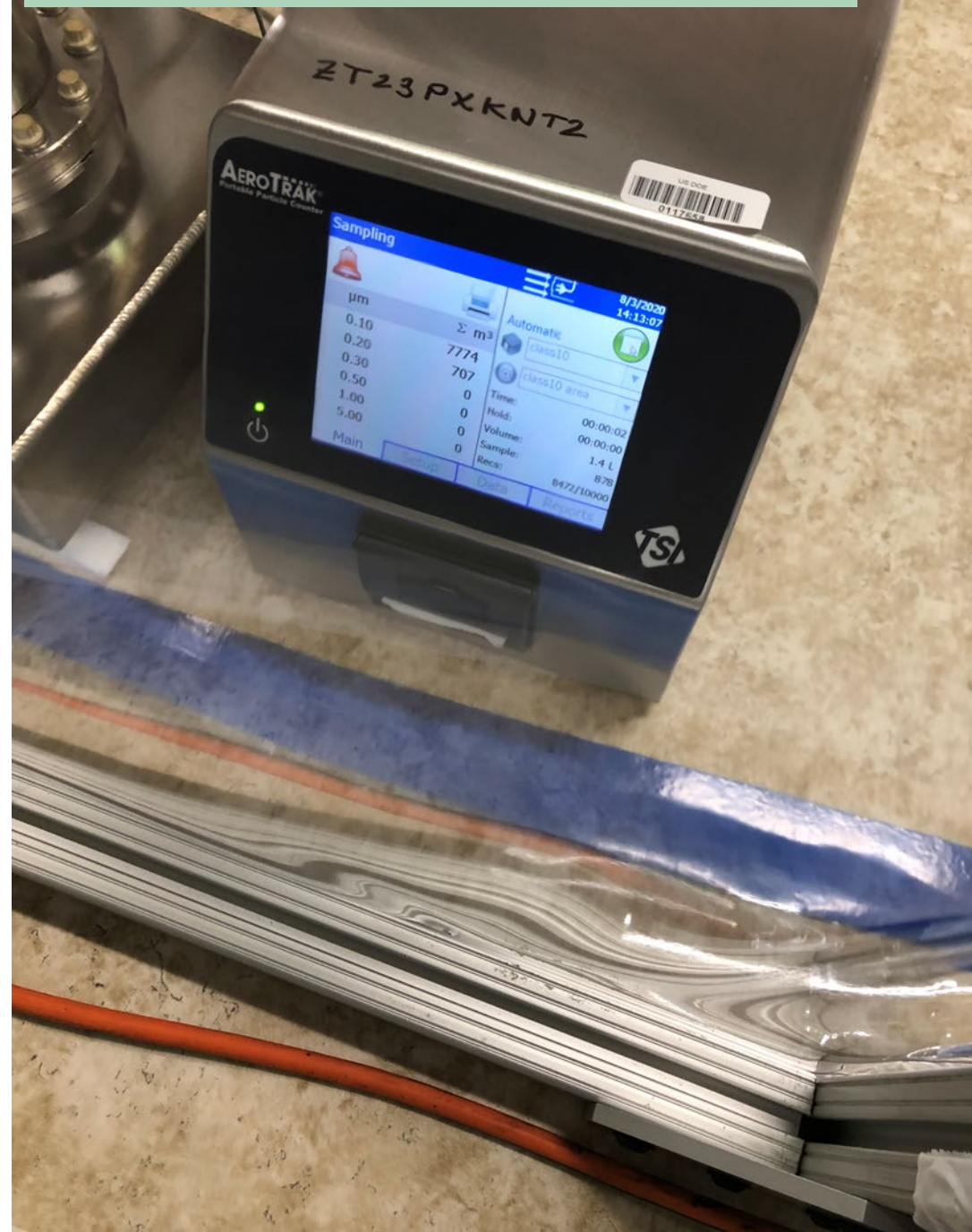
- Removal of FPC is in a difficult location
- A lifting cart was modified to connect to an FPC (high lighted in yellow)
- Remove the FPC with no contact
- Then insert the new FPC



Clearroom Developed for Tunnel Repairs



Particle counting to Class 10



Tunnel Cleanroom and FPC Lift Cart

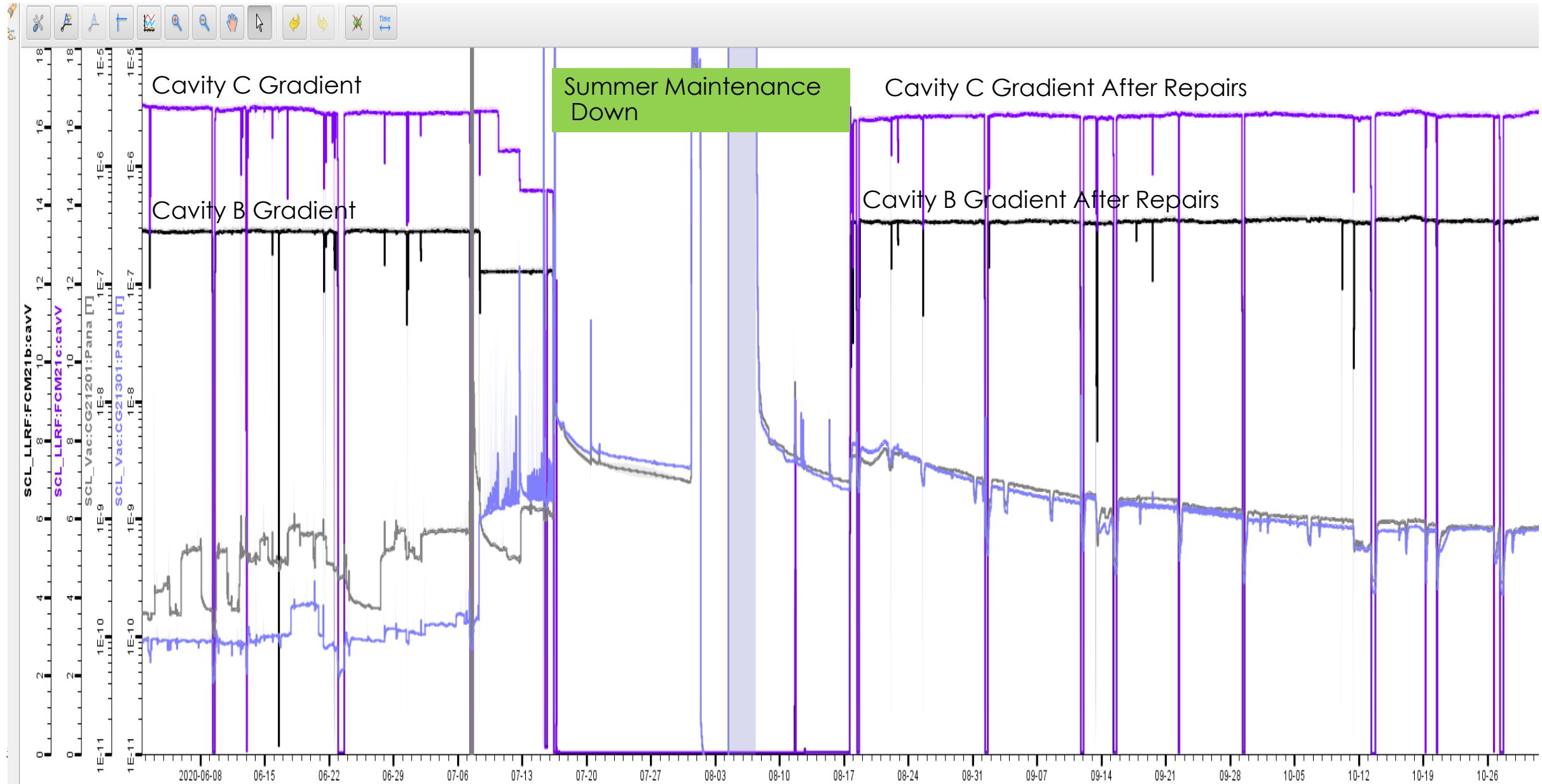


Performing the Repairs

- Images of the FPC being removed and new FPC being inserted
- ULPA filter is located directly behind the FPC



Cryomodule 21 Cavity B and C - before and after repair



Summary

- SNS Superconducting Linac Performance continues to be outstanding, 98% availability
- Warm Sector Gate Valves and FPC Power Couplers Failure Rates Have Increased recently (maybe end of life)
- SNS is developing and utilizing in-situ beamline repairs to address current issues with good success so far