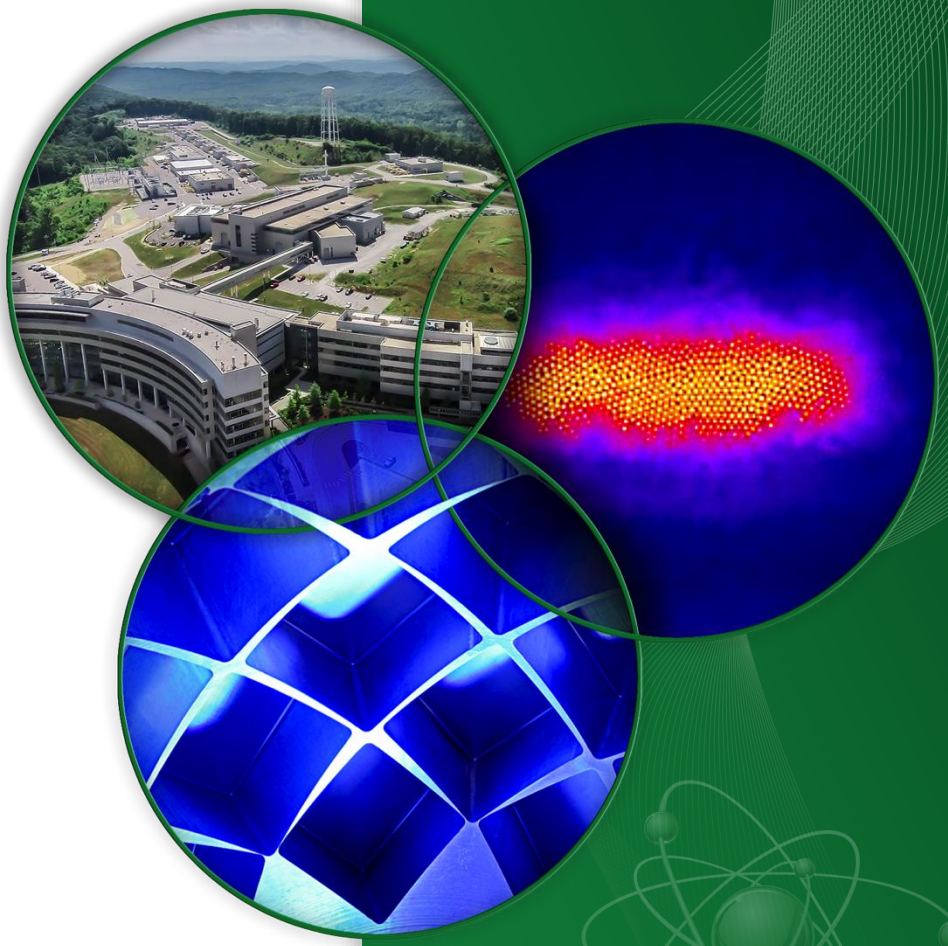
SRF Activities



Presented at the

Accelerator Advisory Committee Review

John Mammosser
SCL Systems Group
Research Accelerator Division

March 24-26, 2015

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Superconducting RF Activities at SNS

- **SRF activities at SNS are focused in three primary areas**

1. Support of Superconducting Linac (SCL) operations, maintenance and improving operational performance

2. Support of SRF and Plasma Processing R&D aimed at improving installed operational gradients

3. Operating and improving SRF facilities to carryout the above activities

SCL Support Activities - Since last Review

- **Highlights of support activities for reliable LINAC operation:**
  - Removal of one Medium Beta (MB) and one High Beta (HB) cryomodule for replacement of a RF coupler in each module
    - Standard servicing of these cryomodules was conducted
    - Tested in test cave to verify performance
    - Installation of these two cryomodules back into service
    - **No MB spare is still a concern**
  - Removal of a low performing HB cryomodule (now the spare HB), this CM will be serviced and part of Plasma R&D development efforts in the next few months
  - Warmup of three cryomodules for warm section repair

SCL Current Support Activities

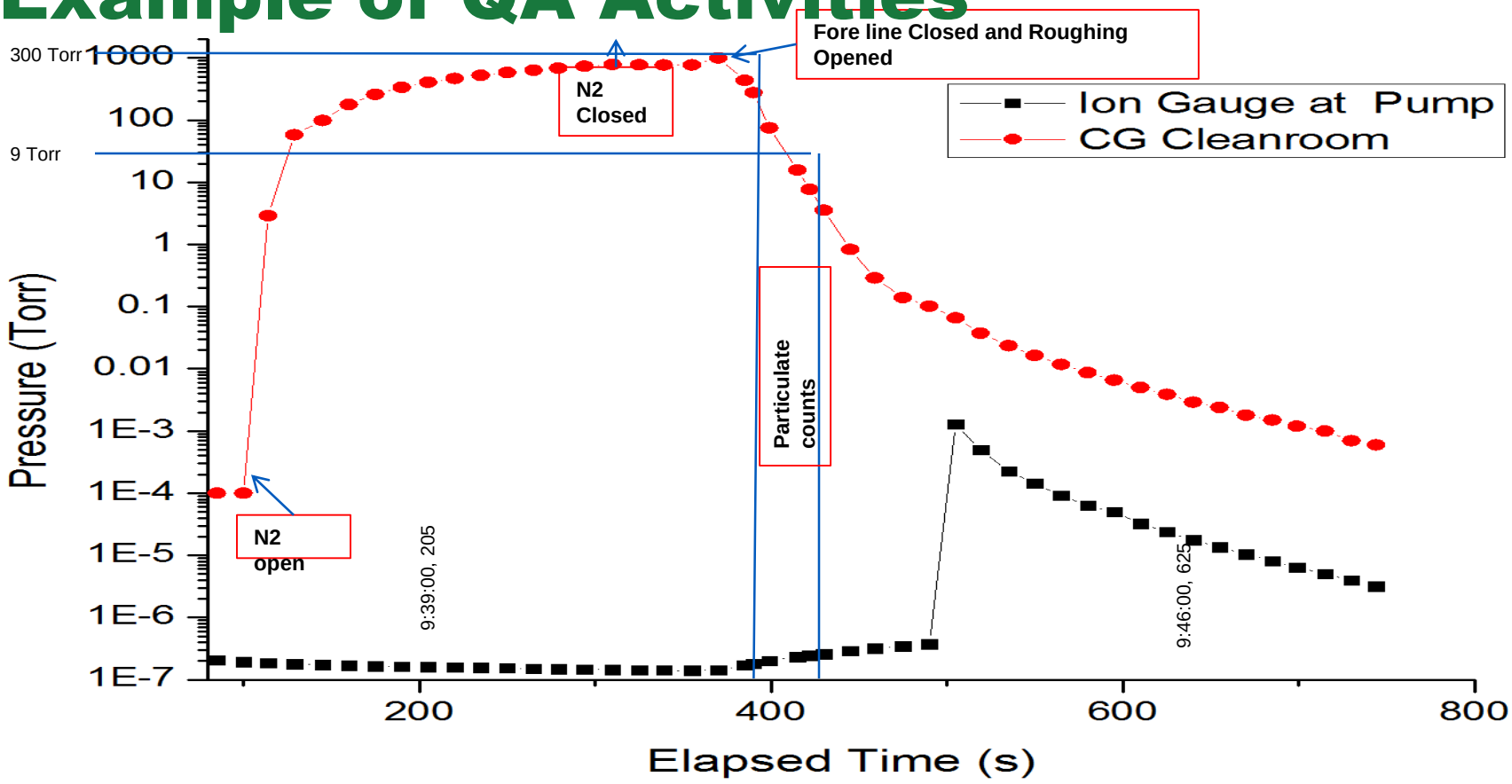
- **Typical Cryomodule Servicing**
  - Removal of HOM probes and piezo fast tuners
  - Repair of CM components (reliefs, diodes, tuners, etc.)
- **In-situ thermal cycling of CM's to recover performance**
- **Quality Assurance Team Activities**
  - Focus on development of repeatable repair procedures and capturing of critical data
  - Reducing particulate contamination during repairs and R&D activities
    - Particulate contamination leads to reduced gradients due to field emission effects

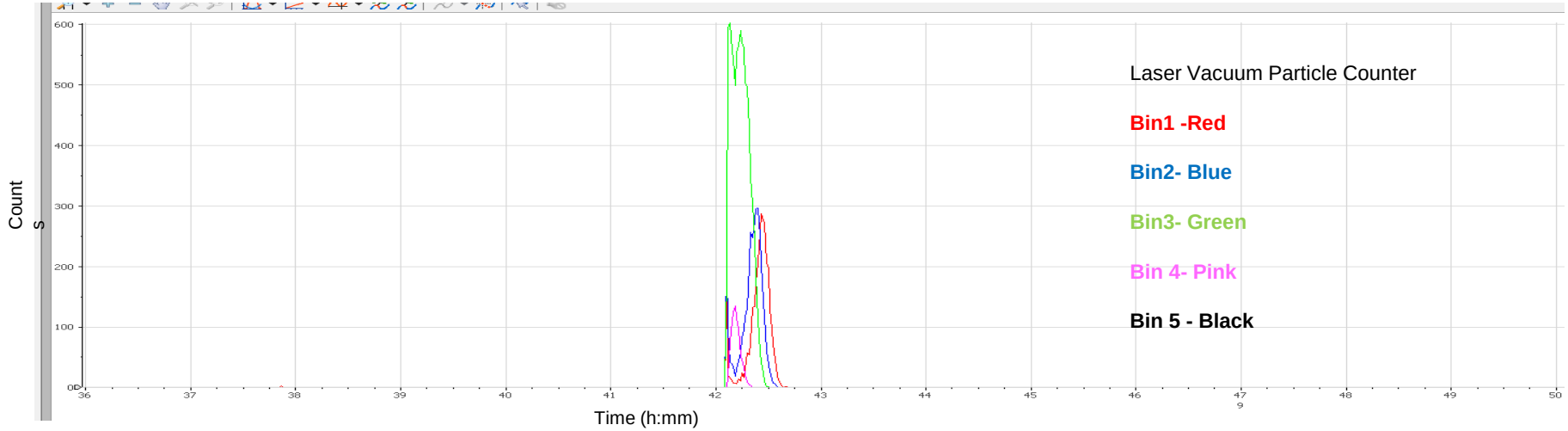
Quality Assurance Team Activities

- Reducing particulate generation and migration is a priority

- Topical areas visited by the QA team
  - Particulate control during venting and purging (example next)
  - Particulate control during cryomodule beam line component removal and replacement
  - Cleaning step effectiveness and improvements (just started)

Example of QA Activities



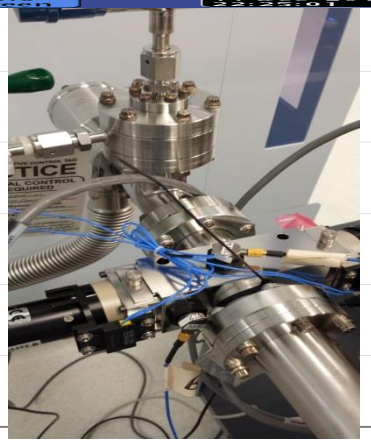


Normal Pumpdown

580 particle counts

Normal Pumpdown

Time = 10 min



Bypass Pumpdown

1 particle counts

Bypass Pumpdown

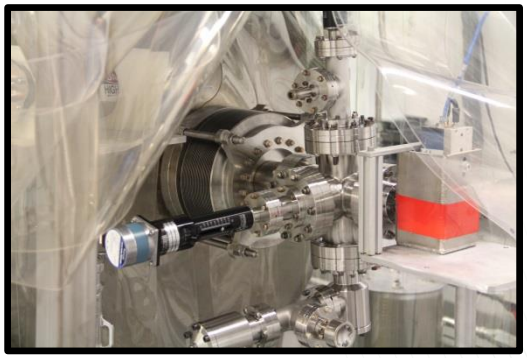
Time = 19 min

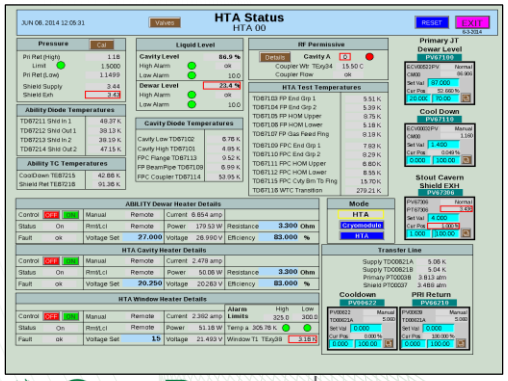
Development of in-house MB spare

- **There is a strong need for a spare MB Cryomodule!!**
  - In-house cavity prototyping effort is underway with MB cavity, procedures developed and tooling verified
    - Developing local vendor capabilities
    - Shorten long lead procurements activity (Response to AAC2012 recommendation)
  - Next step is to verify trimming procedure and then fabricate first MB cavity spare in niobium
  - The spare MB CM effort is awaiting funding

Horizontal Test Apparatus Developed, Integrated and Commissioned

- **Qualifies Cavity in a Similar Way to Accelerator Operations**
- **HPRF and Diagnostics**
  - Using 5MW klystron in the RFTF
  - 8 radiation detectors, camera system for imaging inside of cavity, 20 temperature sensors, etc
- **Horizontal Testing**
  - Used first to support plasma processing R&D with HB cavities fully dressed





SRF Support of plasma processing R&D

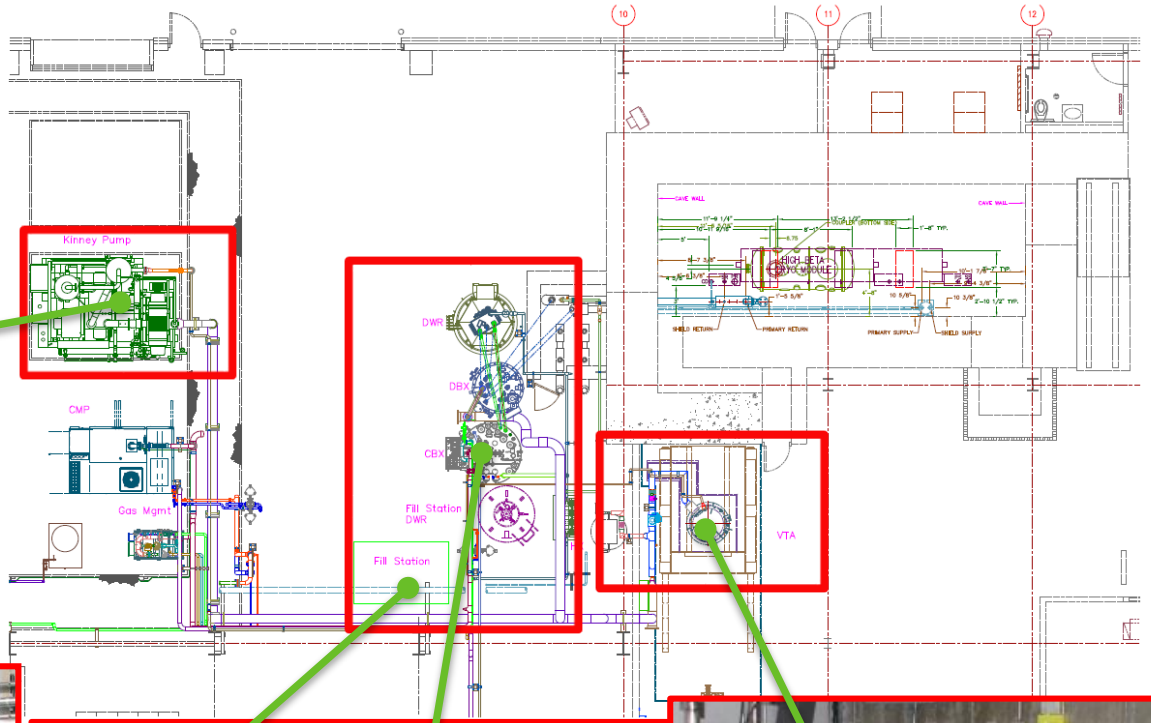
- Preparation for HTA test
  - High beta cavities dressed with helium vessel
  - Preparation of cavities in clean room
  - Installation of cavity in HTA
  - Integration of HTA in the SNS test cave
  - Support activities during test

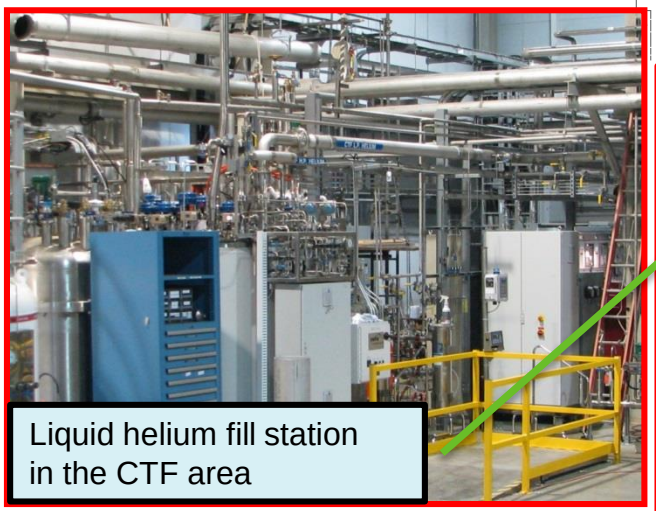
Vertical Test Area

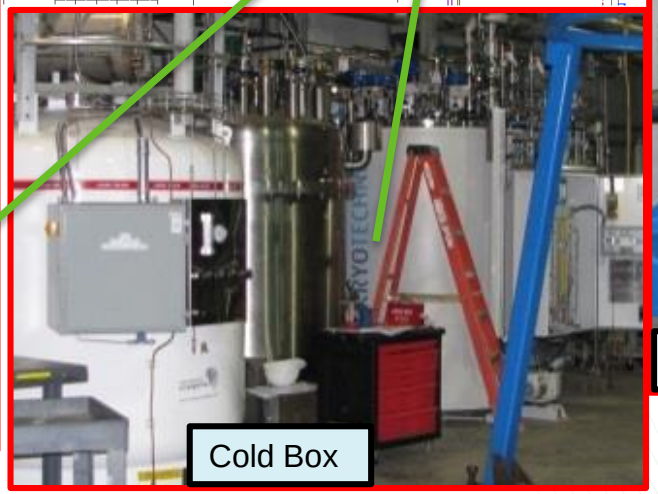
- Commissioned at 4.2K 9/2013
- Started commissioning at 2K with Kinney skid 1/2015
- Current focus is on qualifying the two HB cavities with modified end-groups
  - Cavities had end groups changed to remove HOM cans and improve thermal stability
  - Verify vertical performance at 2K

CTF System Installed and Commissioned


Kinney Pump Skid




Liquid helium fill station in the CTF area


Cold Box


Vertical Dewar Shielding Lid

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CTF Refrigeration System Specifications

Description	Specification
Refrigeration	650W @ 4.4K
Liquefaction	240 L/hr
He High Header Pressure	13 atm
Helium Mass Flow	81 g/s
Oil Content	< 0.1 ppmv
He Low Header Pressure	1.05 atm
Start Up Time	< 6 hours

CTF Liquid Helium Fill Station

- **The CTF Fill Station now commissioned and ready for use**
  - Needed to mitigate supply chain issues during helium shortages
  - Allows for responding to emergency needs of liquid helium supply
  - Supports sample environment and instrument operations
- **The CTF Fill Station is also integrated with the VTA**
  - Supplies liquid helium to VTA
  - Potentially allows operation of the VTA without running the CTF
  - Liquid helium can be transferred from the VTA back to the Fill Station
    - Power is conserved with this feature

Additional SRF Facilities

- **Cavity Inspection Station**
  - Internal cavity inspection system construction complete, currently developing tooling and capture hardware
- **Centrifugal Barrel Polishing**
  - Installed but not commissioned, procedure be developed for a cavity repair
- **Niobium Heat Treatment Furnace**
  - Furnace installed, commissioned and R&D activities started
- **Cleanroom assembly facilities continued operations and improvements**
  - Degreasing of cavity and new component cleaning station (on site but not installed)
  - HPR commissioned and studies for performance identified
  - New entry way and larger doors installed for easier installation of cryomodules for repair

Facility Plans

- **There is a Need for a Chemistry Facility**
  - The facility will aid in the repair and maintenance activities addressing damaged cavities, and the reprocessing of cavities used in the linac
  - This facility is necessary for the cleaning and processing of SRF structures for R&D to improve machine performance
  - The facility is also necessary for process development for new cavities
    - **STS can benefit from this effort**

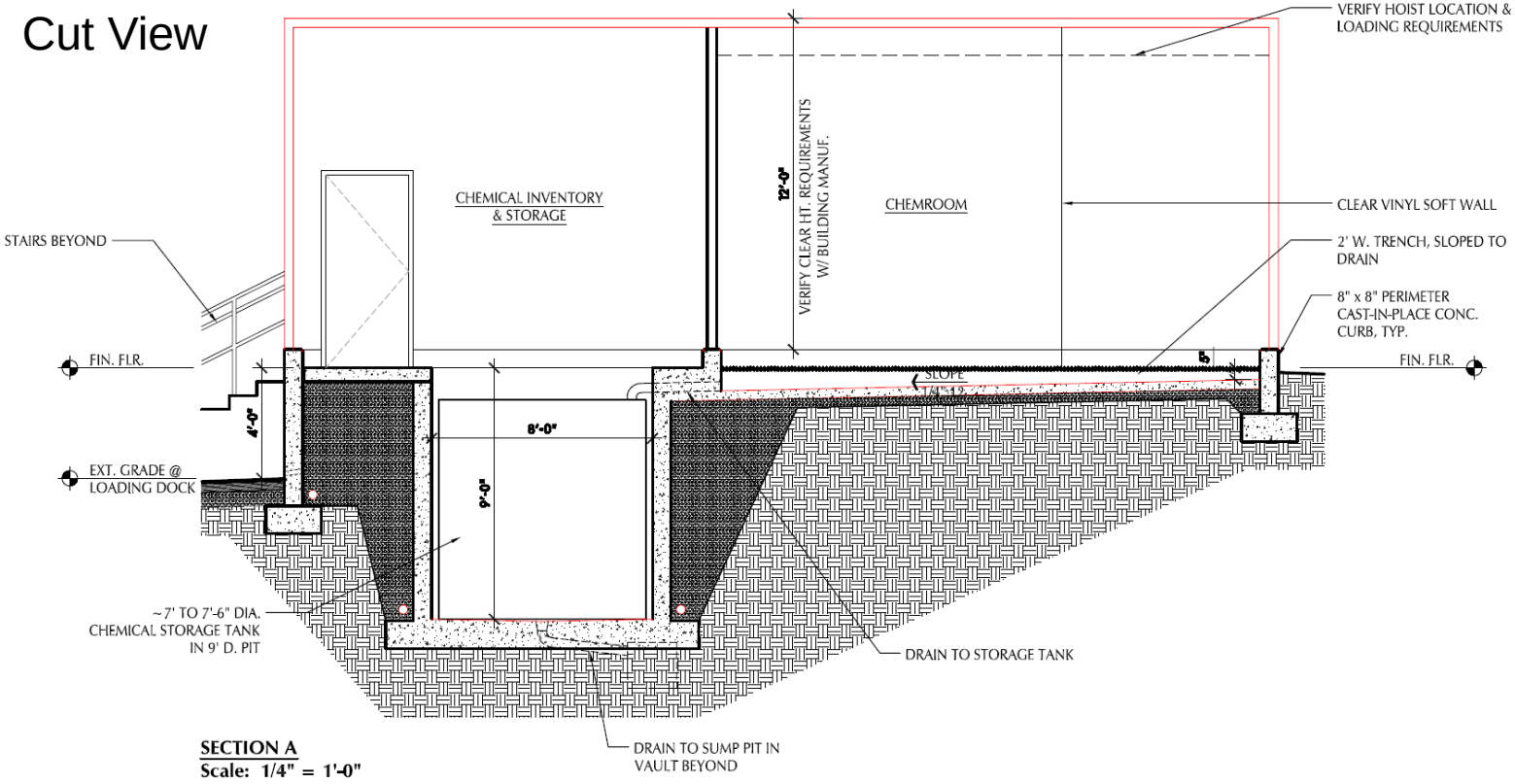
A Small Scale Chemistry Facility Concept Was Developed

The chemistry facility concept is designed as a low through put cavity and component processing facility

Plan submitted, reviewed and awaiting funding

Small Scale Chemistry Facility Concept

Cut View



Small Scale Chemistry Facility Capabilities:

- Electropolish Chemistry
  - Full cavities (low through put)
  - Small samples and cavity components

- Degreasing
  - Full cavities (moved from cleanroom)
  - Small samples and cavity components

HF free chemistry will be pursued to reduce risks and cost

Summary of SRF Activities

1. Large part of our effort is supporting linac operations
   - Developing and implementing repairs and improvements
   - Preparing for a spare MB cryomodule with cavity development
2. Supporting Plasma Processing R&D for future linac performance improvements
3. Developing, operating and maintaining SRF facilities to support above activities