SRF Cavity Processing and Cleanroom Facility Upgrades at Michigan State University

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PRODUCTION PROCESSING

➢ The MSU SRF cavity processing and coldmass assembly infrastructure is being upgraded to meet the production needs of multiple SRF projects, including the driver linac for the FRIB and the MSU Reaccelerator.

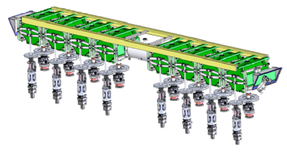
➢ The objective is to modify the current infrastructure to increase throughput and optimize the process workflow. The cavity processing facility is being optimized for one cavity per day throughput.

➢ Preproduction cavity processing is planned to begin in middle of 2012, with full production beginning late 2013.

➢ The upgrade to the facility assumes the baseline SRF cavity processing plan (Table 2). Baseline procedures may be modified from results of preproduction cavity testing and research.

Table 1: Cavity Quantities for FRIB

Description	Proposed Baseline
Certified cavities required for FRIB	341
Certified cavities for spare modules	26
Non-performing cavities	10%
Total fabricated cavities for production	400
Reprocess fraction	20%
Number of processes	480
Total number of coldmasses	55



FRIB β=0.53 HWR coldmass assembly

Table 2: Baseline SRF Cavity Processing Plan

Process Step	
Degrease cavity	Vendor
Bulk chemical polish	Vendor
Pure water rinse	Vendor
Hydrogen degas	MSU
Degrease cavity & components	MSU
High pressure rinse (HPR) with UPW	MSU
Assemble to test insert (RF certification)	MSU
Purge & remove from insert	MSU
Install to coldmass string	MSU

ReA3 β=0.041 QWR coldmass

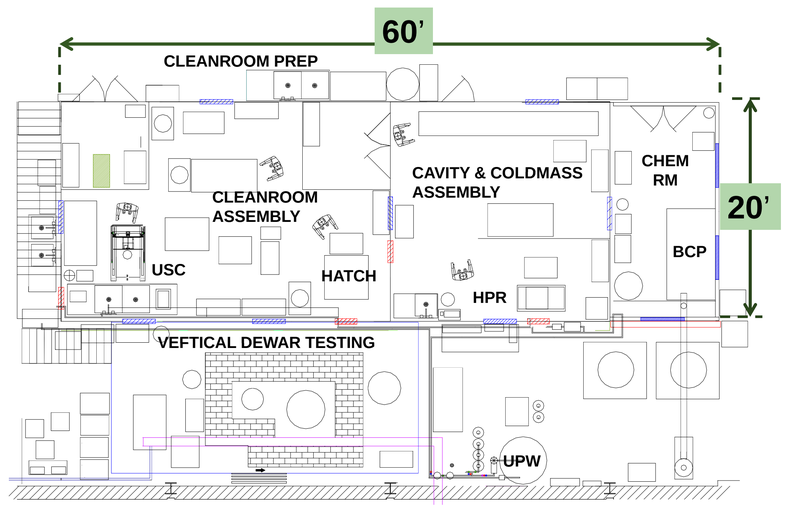


Figure 1. Current SRF Facility at Michigan State University

SRF FACILITY UPGRADE

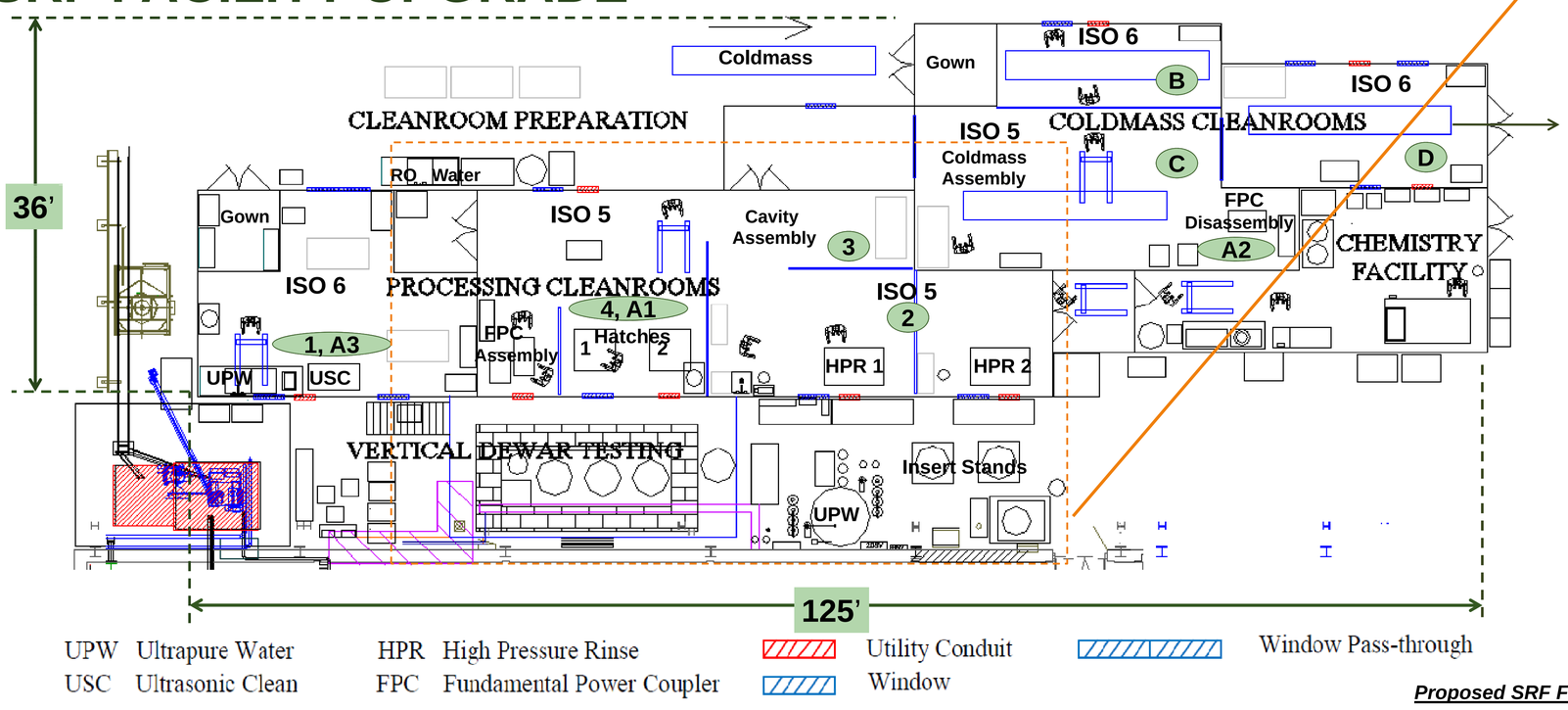


Figure 2. Proposed SRF Facility Upgrade

Table 3. Cleanroom Process Steps for Cavities

	Process Description
1	Ultrasonic cleaning of components (ISO 6)
2	Cavity high pressure rinse (ISO 5)
3	Cavity & component assembly (ISO 5)
4	Cavity assembly to vertical test insert (ISO 5)

Table 4. Cleanroom Process Steps for Coldmass Assembly

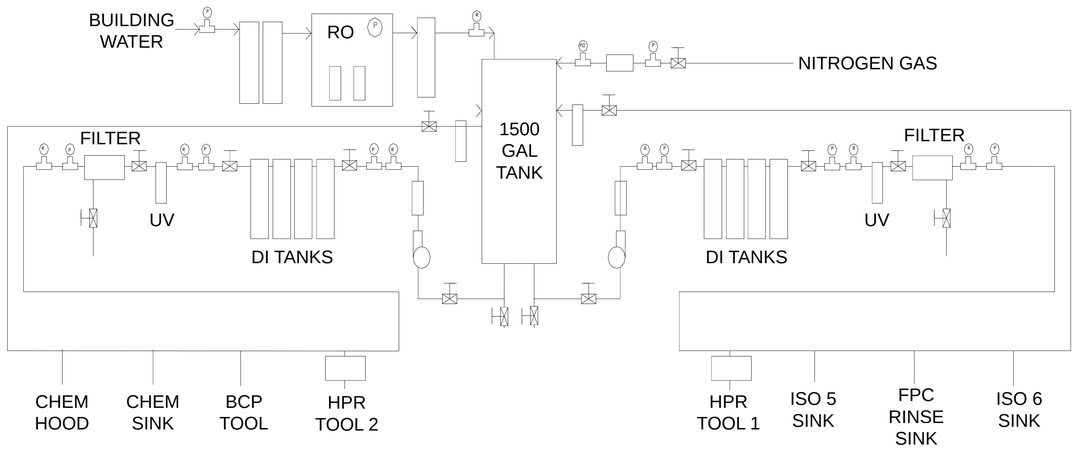
	Process Description
A1	Purge certified cavity after dewar test & disassemble (ISO 5)
A2	Disassemble fundamental power coupler (ISO 5)
A3	Assemble lifting fixtures to solenoid & ultrasonic clean(ISO 6)
B	Coldmass rails received/prepared (ISO 6)
C	Assemble certified cavity/FPC/ solenoid to rail system (ISO 5)
D	Pump down & leak check coldmass (low temperature bake out "under investigation") (ISO 6)

➢ Tables 3 & 4 list process steps for cleanroom tasks in preparation for vertical dewar testing & coldmass assembly labeled in Figure 2.
➢ Critical processes are performed in an ISO 5 cleanroom environment

Proposed SRF Facility Upgrade Summary

➢ **Cleanroom preparation** → area with dedicated 0.5 GPM RO/DI water system make up rate & 210 gallon storage tank
➢ **Ultra pure water system** → 5.2 GPM RO system (7400 GPD) - 1500 gallon storage tank – 2 polishing loops
➢ **Cleanroom addition** → 1,700 SF addition to existing 1000 SF cleanroom to accommodate coldmass assembly, second insert hatch, second high pressure rinse, dedicated FPC assembly space
➢ **Chemistry facility** → doubled to 400 SF to house a new BCP tool, a batch etching hood, a neutralization system & a storage for chemistry consumables
➢ **Lean Manufacturing Workouts** → being conducted across all cleanroom processes to reduce waste, identify critical product paths & bottleneck operations, improve visual controls and enhance safety. Takt time-based, standard operations & workflow are being created to minimize cavity processing time, keep inventories low, & optimize consumption rates & storage capacities.

ULTRA PURE WATER SYSTEM



Proposed Ultra Pure Water System Upgrade

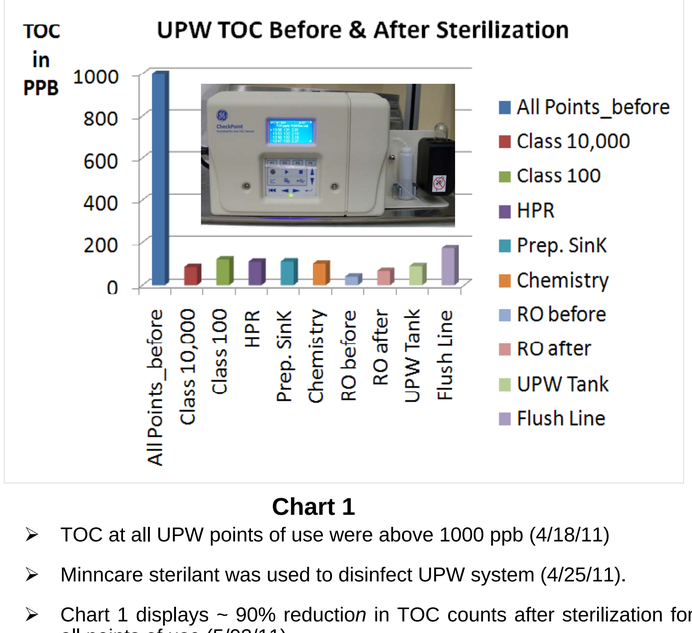


Chart 1

➢ TOC at all UPW points of use were above 1000 ppb (4/18/11)
➢ Minncare sterilant was used to disinfect UPW system (4/25/11).
➢ Chart 1 displays ~ 90% reduction in TOC counts after sterilization for all points of use (5/02/11).

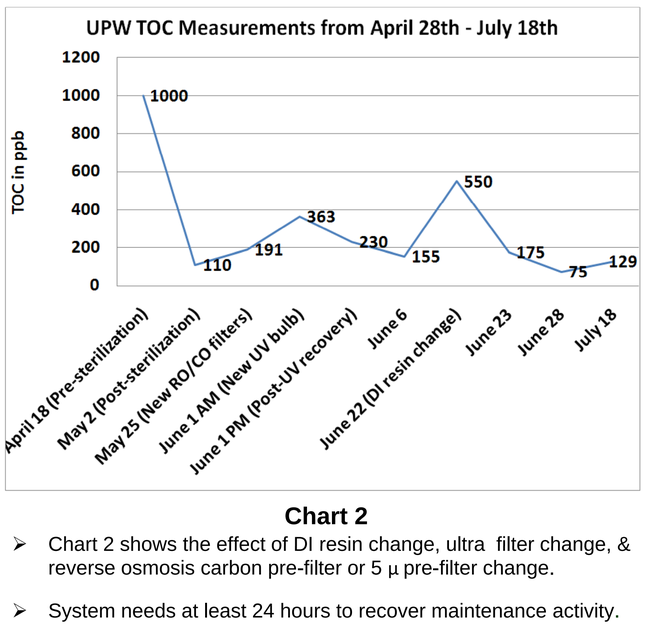


Chart 2

➢ Chart 2 shows the effect of DI resin change, ultra filter change, & reverse osmosis carbon pre-filter or 5 µ pre-filter change.
➢ System needs at least 24 hours to recover maintenance activity.

CLEANROOM SURFACE PARTICLE COUNTS

➢ A surface particle counter (QIII+ by Pentagon Technologies) is used in the cleanroom to qualify cleanliness of cavities & components prior to assembly to vertical test insert

➢ Surface particle counts are collected before vacuum assembly of β=0.085 QWRs (Figure 3) and will be analyzed with vertical test result data

➢ Niobium samples were processed similar to a cavity (degreased, 100 micron BCP and 5.25 sec/in² HPR). The surface counts indicate particle free surface. See poster TUPO016

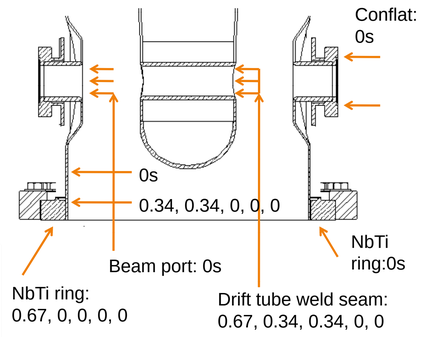


Figure 3. Surface particle counts for QWR. Particle size per in² (0.3, 0.5, 1.0, 5.0, 10.0 micron). Cleanroom background: 0s.

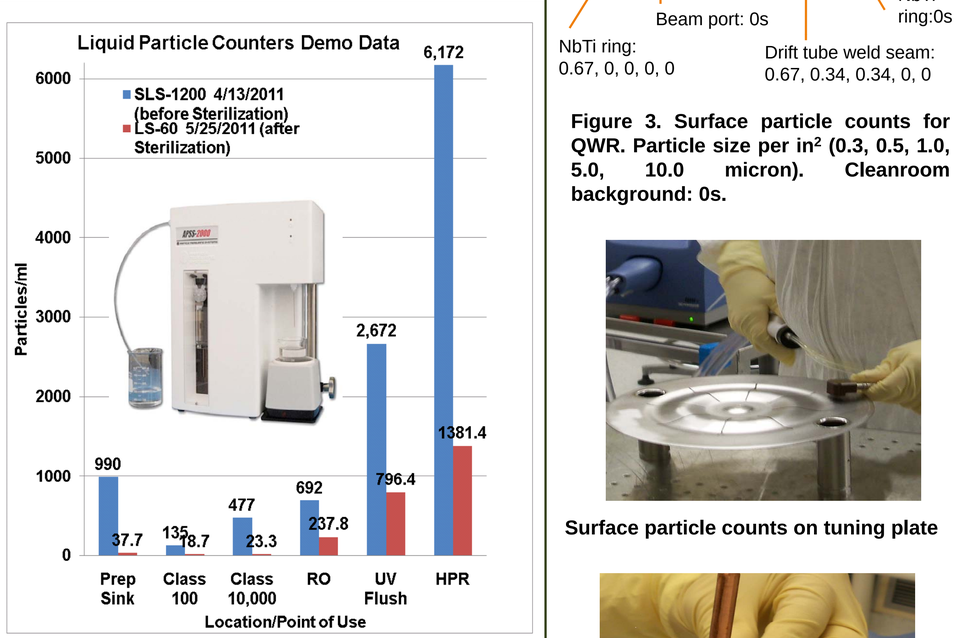
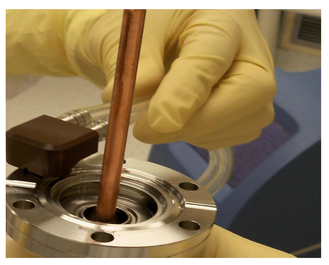


Chart 3

➢ Chart 3 displays results for 2 different liquid particle counter devices (SLS-1200 by Particle Measuring Systems & LS-60 by Lighthouse Worldwide) demoed at NSCL before & after ultrapure water system sterilization. There was an overall reduction of about 92% in cumulative particle counts (0.2, 0.3, 0.4, 0.5, 1 & 2 µm).

Surface particle counts on tuning plate



Surface particle counts on coupler port

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