



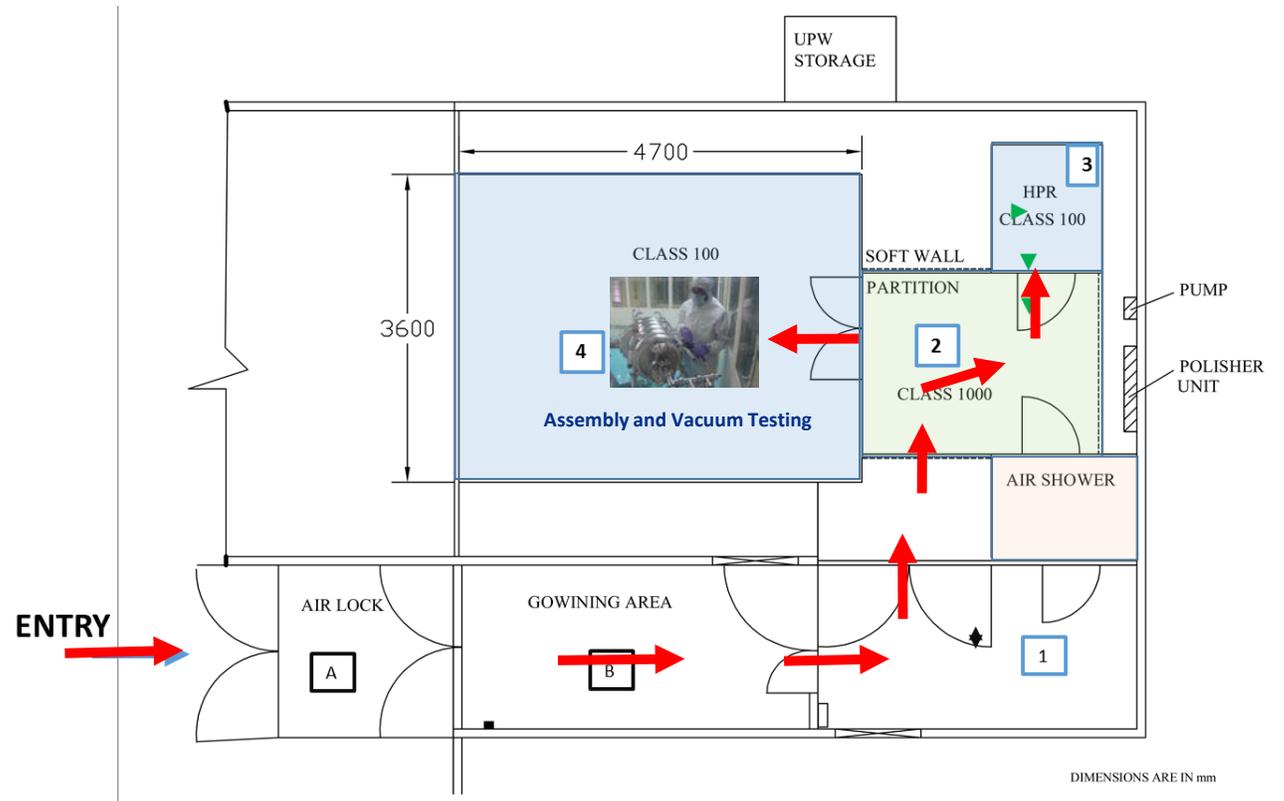
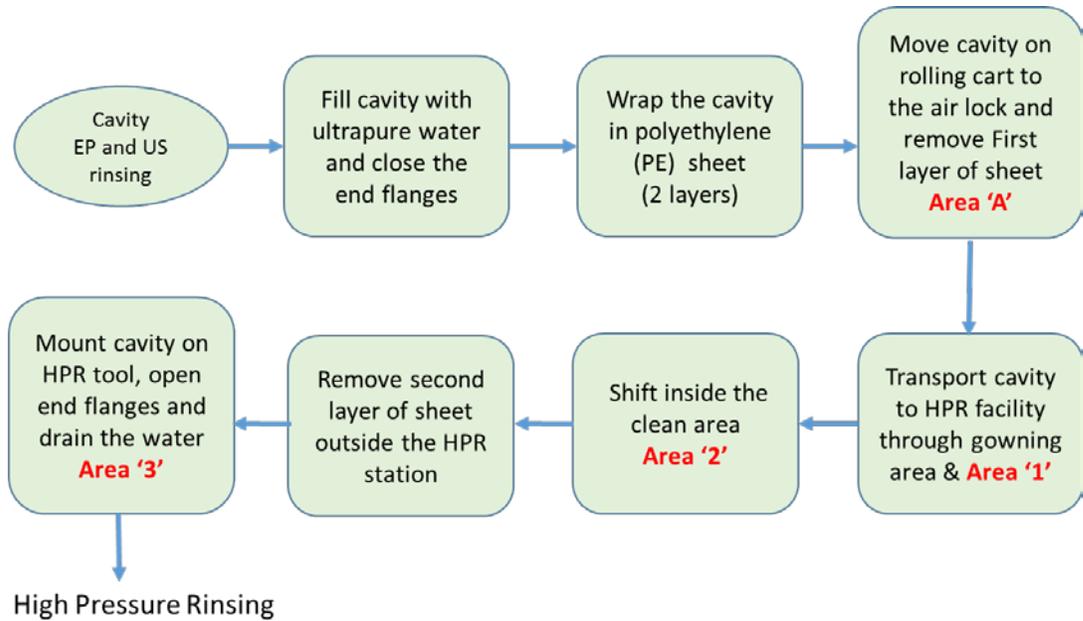
Facility Preparedness: Current facility and Cleanroom upgrade / Tooling and HPR

S. K. Suhane/ RRCAT
PIP-II Technical Workshop
02/12/2020

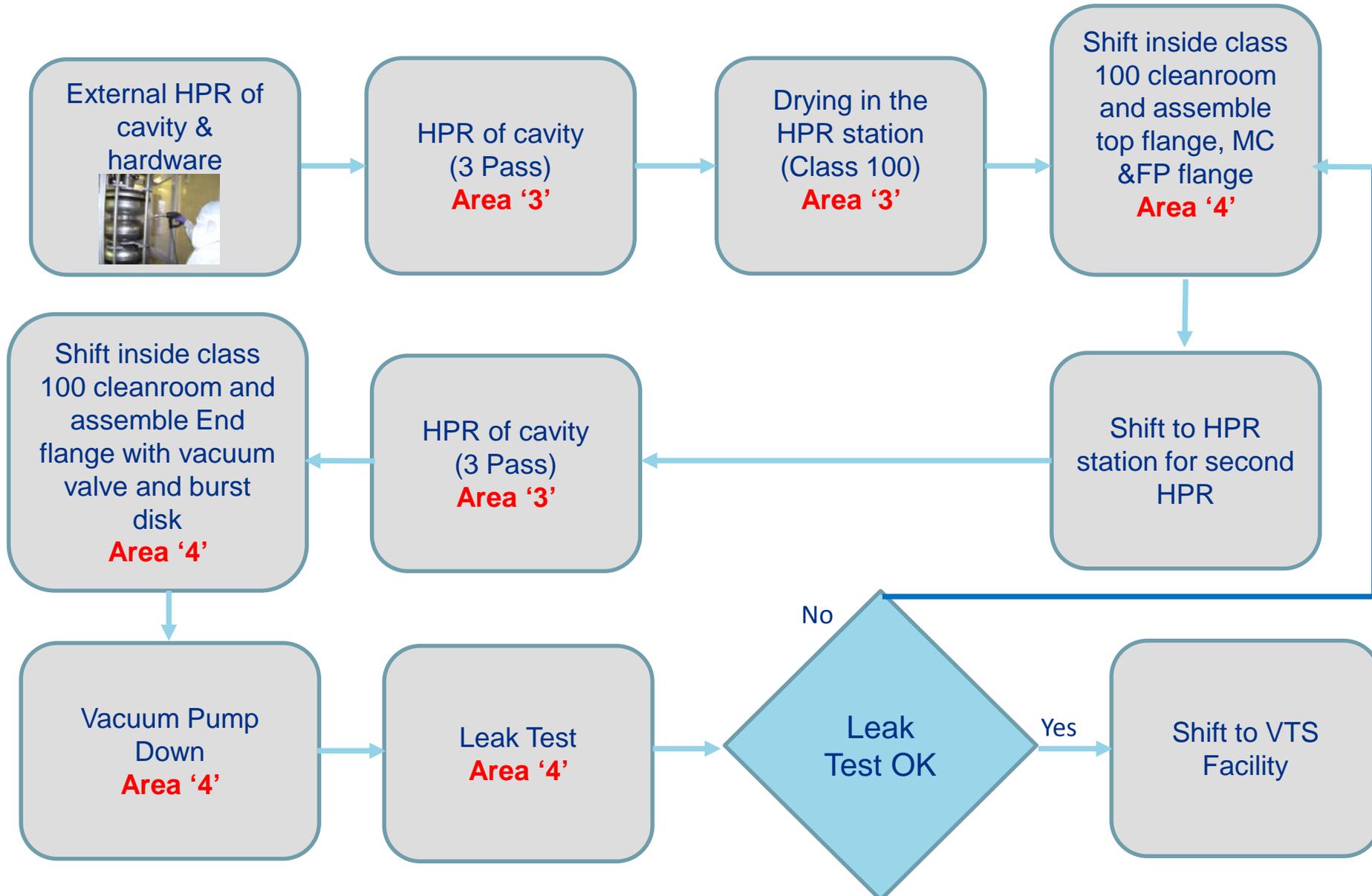
A Partnership of:
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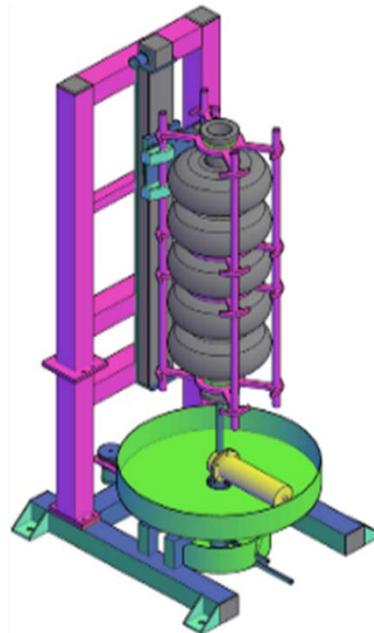
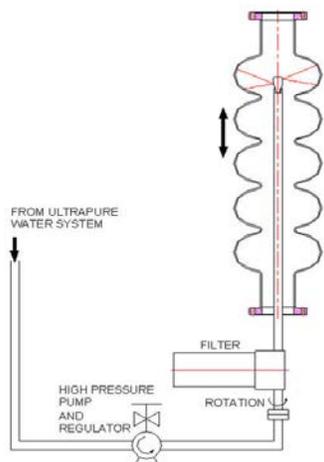
Movement of Cavity in the Cleanroom



HPR and Cleanroom Processing



HPR set up for HB650 cavity

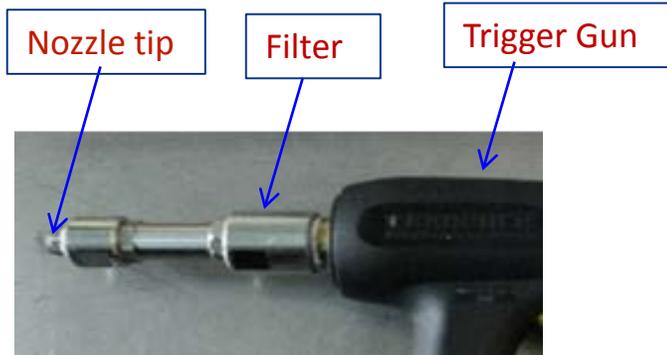


HPR Set up details

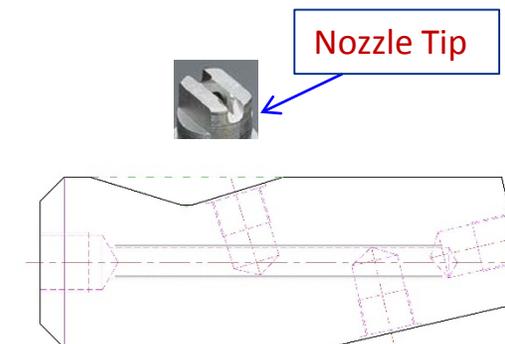
Structure support	304 SS Sq. Pipes
Wetted parts	316 S.S.
Nozzle material	Hardened S.S.
Type of pump	Reciprocating piston
Final Filter	0.05 micron
Cavity rotation	Timing belt drive
Enclosure	Polycarbonate
Cleanliness	Class 100 (ISO-5)
Jacketed cavity rinsing	<ul style="list-style-type: none"> Wand adjustment Mounting bracket

Bare Cavity HPR

Jacketed Cavity HPR



External HPR Arrangement



Nozzle Holder

High Pressure Rinsing Process

HPR Parameters	
Jet pressure	80-100 bar
Pump Flow rate	8-10 LPM
Wand Rotation	2-5 RPM
Cavity vertical travel	5-20 mm/min
Nozzles type	40° fan jet
Nozzle arrangement	Two oppositely placed nozzles
HPR duration	(3+1+3) passes of HPR after light EP, total duration of 7 hours.

Q.C. in HPR process

- ❖ Online monitoring of UPW parameters
- ❖ Flushing of piping is done before every HPR cycle
- ❖ HPR structure, fixtures, clean enclosure walls are thoroughly cleaned with IPA using lint free cloth regularly
- ❖ Water from rinsed cavity is collected and sent for microbial analysis
- ❖ Wand filter cartridge is changed every year
- ❖ Polisher unit is run in recirculation mode to maintain purity of UPW
- ❖ Collection of water from rinsed cavity for particulate analysis (Planned in new HPR set up)

Tooling for Cavity Handling in Cleanroom



S.S. cart with swivel castors for movement of cavity in the cleanroom



Fixture with toggle clamps for holding the cavity cage



Loading of cavity on HPR set up



Holding fixture for jacketed cavity



Cleanroom compatible cart for cavity lifting and swivelling



Cleanroom Preparation of Cavity

Cavity Assembly Process

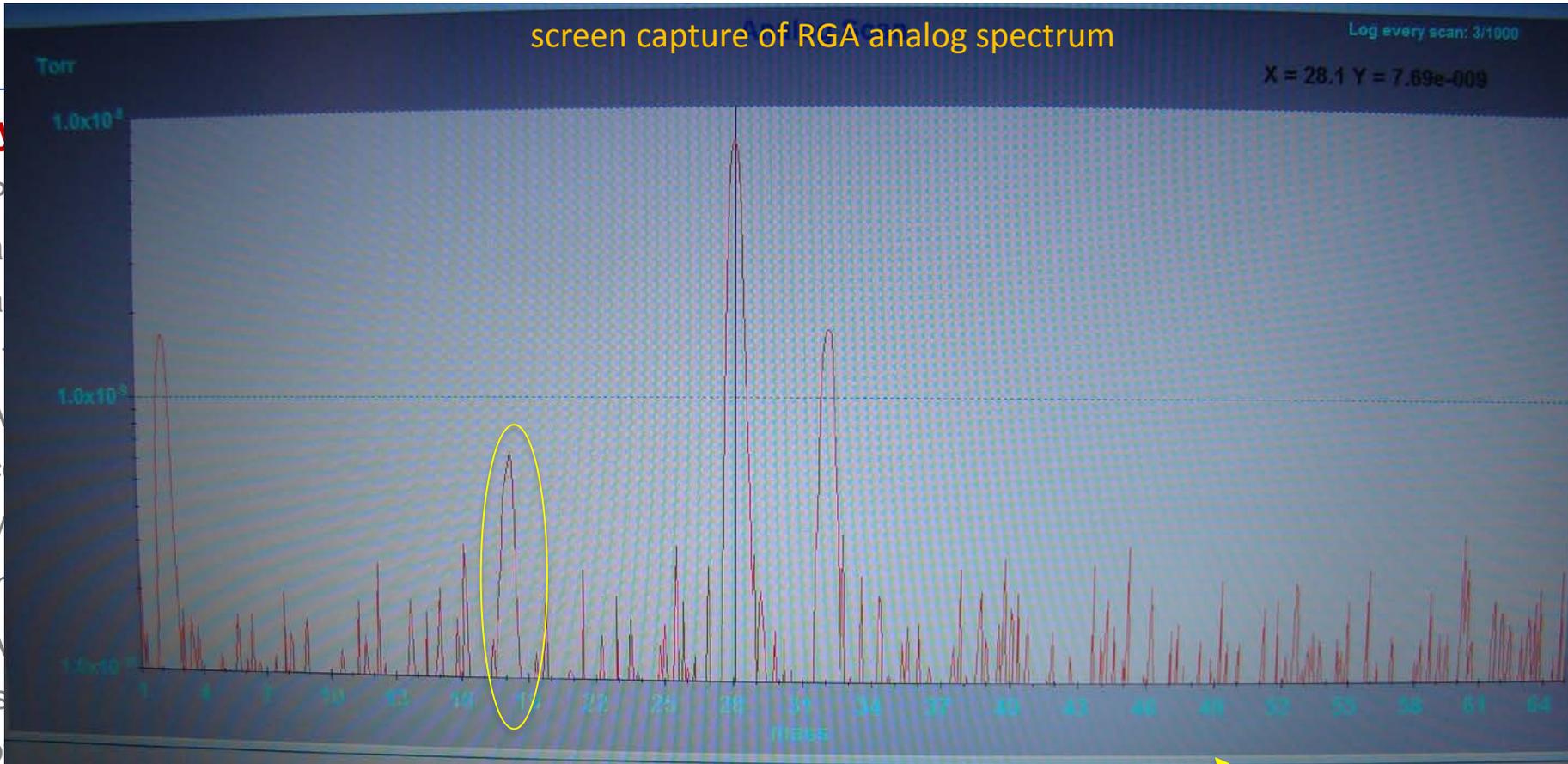
- ❖ All tools and hardware cleaned with ultrasonic cleaning before taking them inside the cleanroom
- ❖ Flanges and fasteners are rinsed with ultrapure water and after drying, cleaned with nitrogen using ionizing blow-off gun.
- ❖ Particle count measured during each step of cavity assembly
- ❖ Torque wrench used for bolt tightening
- ❖ Aluminum seal and copper gasket carefully checked and cleaned with IPA then purged with nitrogen blow-off gun
- ❖ High purity nitrogen gas (99.9995 %) is used for purging
- ❖ All movements and operations inside cleanroom are performed slowly and cautiously
- ❖ Thorough cleaning of cleanroom walls, floor and furniture regularly



Cleanroom assembly of Cavity

Cavity Vacuum Pumping

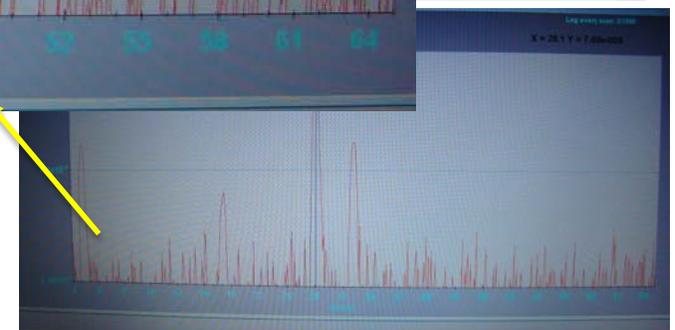
screen capture of RGA analog spectrum



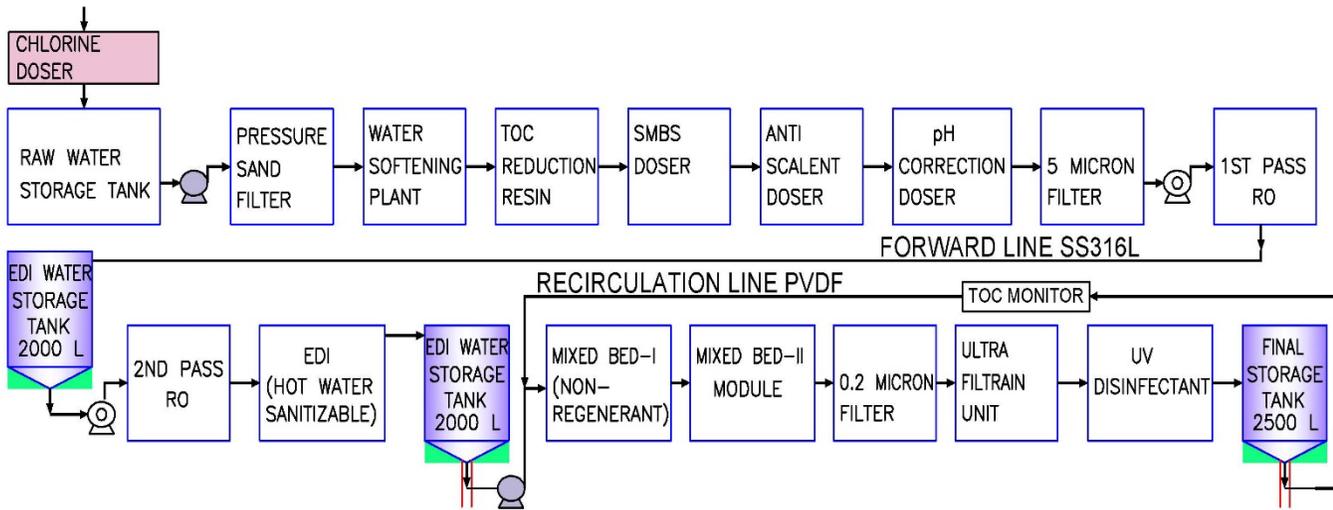
Cavity

- ❖ P
- ❖ a
- ❖ a
- ❖ fi
- ❖ A
- ❖ C
- ❖ V
- ❖ th
- ❖ A
- ❖ is
- ❖ o
- ❖ Cavity is sealed at ultimate vacuum of 2×10^{-7} mbar

RGA



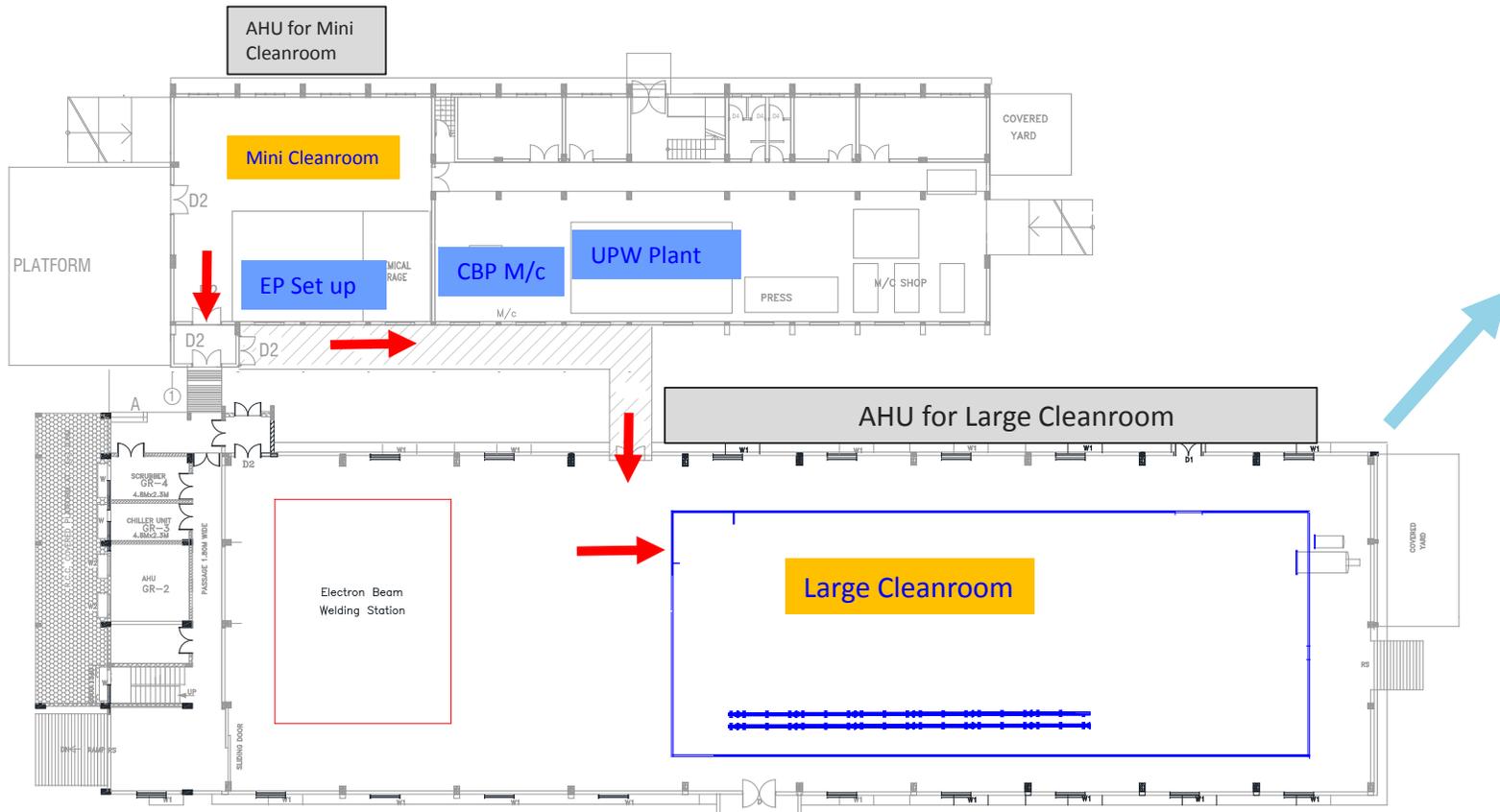
Ultrapure Water Generation Plant



- Ultrapure water generation plant installed close to new mini cleanroom facility
- Storage tank made of virgin PP fitted with 0.22 micron PTFE vent filter
- Pump MOC: SS316
- Piping made of electropolished Stainless Steel grade 316
- Online Conductivity, Resistivity meter and TOC monitor
- Sample collection port for microbial analysis

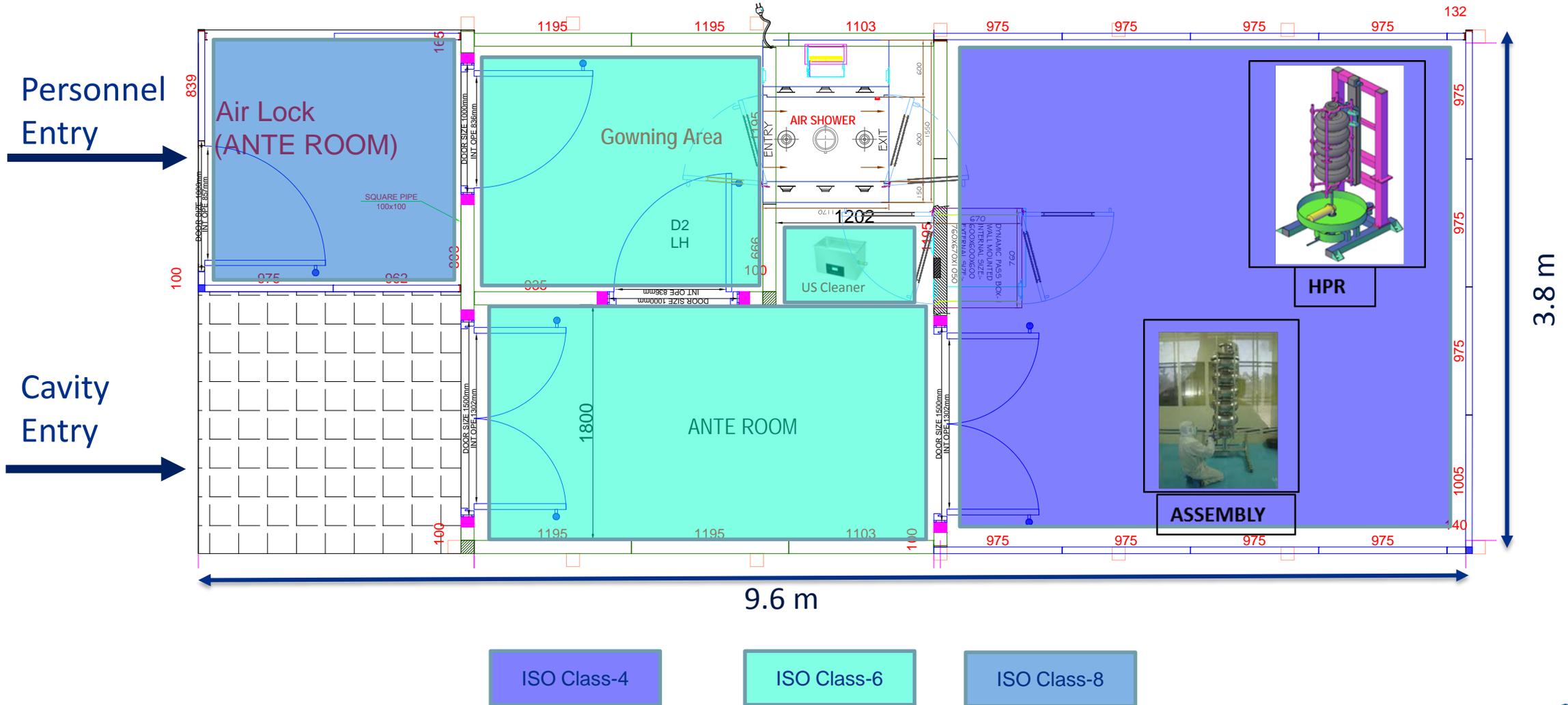
Parameter	Value
Resistivity	$\geq 18 \text{ M}\Omega\text{-cm}$
TOC	$< 30 \text{ ppb}$
Total Bacteria Count	$< 1 \text{ cfu}/100\text{ml}$
Flow Rate	800 LPH
Final Storage Tank	2500 litre
Gasket	PTFE

Cavity Processing Facility Building



Air conditioned envelope in PEB for housing Large Cleanroom

New Mini Cleanroom



New Mini Cleanroom



Mini Cleanroom under construction

Expected to be operational by
Early next year

Features of New Mini Cleanroom

- ❖ Required for High Pressure Rinsing, Drying, Assembly and Evacuation of SCRF cavities
- ❖ Located in the vicinity of EP facility
- ❖ Floor area ~ 36 m² , Room height - 4 m
- ❖ Cleanliness : ISO class 4 to class8
- ❖ Temperature 20°C ± 2°C, RH 55% ± 5%.
- ❖ Flooring: Raised floor with perforated panels
- ❖ Air shower for entering ISO class 4 area
- ❖ Dynamic Pass Box for tool/component entry
- ❖ Portable particle counter with measuring range range from 0.1 to 5.0 micron
- ❖ S.S. tubing for high purity gases and vacuum line
- ❖ Fire and smoke detectors
- ❖ Dedicated cleanroom garment laundry facility

Proposed HPR set up in New Mini Cleanroom

- The existing HPR set up will be relocated to the new cleanroom with certain modifications in the structure
- New cleanroom has raised floor in the ISO 4 area. Base structure of HPR has been modified for installation on the raised floor.
- Suitable opening shall be made in the raised floor for installing HPR structure
- Vertical frame has been suitably stiffened to support both the bare as well as dressed cavity.
- The existing high pressure reciprocating pump will be replaced with a new diaphragm type pump.
- PP/PVDF pipeline for ultrapure water distribution from the UPW plant will be installed



Support Structure for new HPR setup

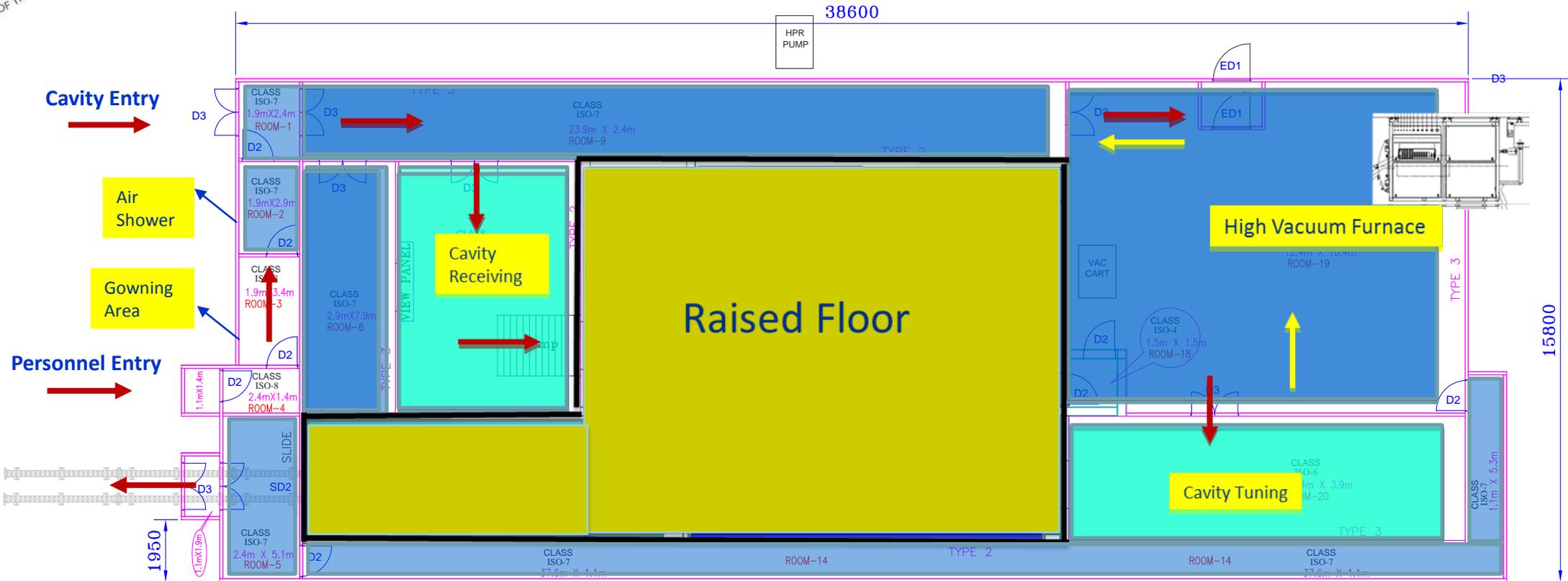


Triplex Diaphragm Pump



Aerosol particle counter

Integrated Large Cleanroom Facility



Dimensions of Cleanrooms:

Total Area of cleanrooms: 600 m²

Area of ISO class 4 rooms: 140 m²

HPR Room Height: 4 m

Raised Floor Height: 0.5 m

Legends:

ISO Class-4

ISO Class-6

ISO Class-5

ISO Class-7

Salient Features of cleanrooms

- ✓ Cleanrooms installed in a Pre-Engineered building having separate HVAC system for conditioning of the circulating air
- ✓ Cleanroom design and construction as per ISO 14644
- ✓ Perforated raised flooring in ISO 4 and 5 areas to maintain uniform unidirectional flow of air
- ✓ Supply air from ceiling mounted filter units and return air through side walls/ under the raised floor
- ✓ ISO class 4 areas have ceiling with physical filter coverage of 87-99 % with ACPH of 410 – 470
- ✓ Room air pressure ranging from 6 Pa in Dynamic Air lock to 40 Pa in HPR area (ISO class 4)
- ✓ Static dissipative floor, wall and door materials to prevent charge buildup and resultant particle attraction
- ✓ Two sets of floor mounted rails installed underneath the raised floor in string assembly area
- ✓ ISO class 4 rooms constructed using double walls at 250 mm inter-spacing for return air
- ✓ 60 mm thick double skin wall panels with 1 mm thick Stainless Steel 304 sheet on both sides and PUF as infill are used in ISO class 4 walls
- ✓ Outer most walls constructed using 100 mm thick double skin wall panel with 1.6 mm thick anodized aluminum sheet on both faces with inbuilt return air risers and PUF as infill

Salient Features of cleanrooms

- ✓ HVAC system type: Ducted with positive plenum concept
- ✓ Ducting from AHU to Cleanroom plenum are made of anodized aluminum
- ✓ Individual filters connected to the plenum through flexible ducting
- ✓ Filter type: ULPA-HEPA filter bank for ISO 4 and 5 Areas ; HEPA filters for ISO 6, 7, 8 Areas
- ✓ HEPA and ULPA filters in SS box casing with full face gasket sealing
- ✓ Personnel entry to cleanrooms through Air shower
- ✓ Dynamic pass box for entry of tools and fittings
- ✓ Sequential type particle monitoring system with 32 channel manifold. Particle size range of the monitor :
0.1 – 5.0 μm
- ✓ Electropolished Stainless steel tubing with manifold for high purity gases and vacuum line
- ✓ Analog Addressable Fire Alarm System with Dry-Sprinkler type Fire Suppression System
- ✓ Cleanroom validation by a certified third party agency



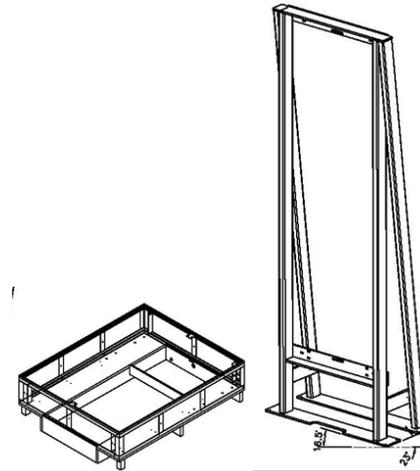
Current Status



- Contract for design and construction has been awarded
- Site survey and measurement has been done by the contractor
- Cleanroom and HVAC design has been completed by the contractor
- Construction drawings have been completed
- Design documents and drawings have been reviewed by RRCAT
- Procurement of cleanroom systems, components and equipment by the contractor is under progress
- Rails under raised floor for string assembly area are installed

HPR set up for large cleanroom

- A new HPR facility for HB 650 cavity is planned in the integrated cleanroom. It will have a structure similar to the new HPR stand in FNAL
- The HPR structure will be installed on the raised floor of cleanroom
- Base support has been modified to suit the height of raised floor.
- Suitable opening shall be made in the raised floor for installing the structure
- The facility can be used to rinse bare as well as jacketed cavity by adjusting the wand position
- The cavity frame holding fixture on the HPR structure is made common for both bare as well jacketed cavity
- Components and sub-systems required for the new HPR set up are under procurement
- Structure assembly is under fabrication
- For loading of cavity on the new HPR structure, suitable cleanroom compatible lifting cart with wider legs opening is under procurement



Support Structures in fabrication



Linear Actuator for Cavity Translation



Geared motor for wand rotation



Cavity Loading Cart

Conclusion and Future Plans

- Presently Cavity EP and HPR facility are at different locations.
- New mini cleanroom for HPR and cavity assembly under construction in the close proximity of EP facility.
- HPR facility will be set up in the mini cleanroom
- An integrated cleanroom facility for HPR, cavity assembly, string assembly, tuning and high temperature degassing is under construction in the cavity fabrication and processing facility building
- An improved HPR facility common for bare and jacketed HB650 cavity is under construction and will be installed in the integrated cleanroom

Thank you for your kind attention

