High Luminosity LHC

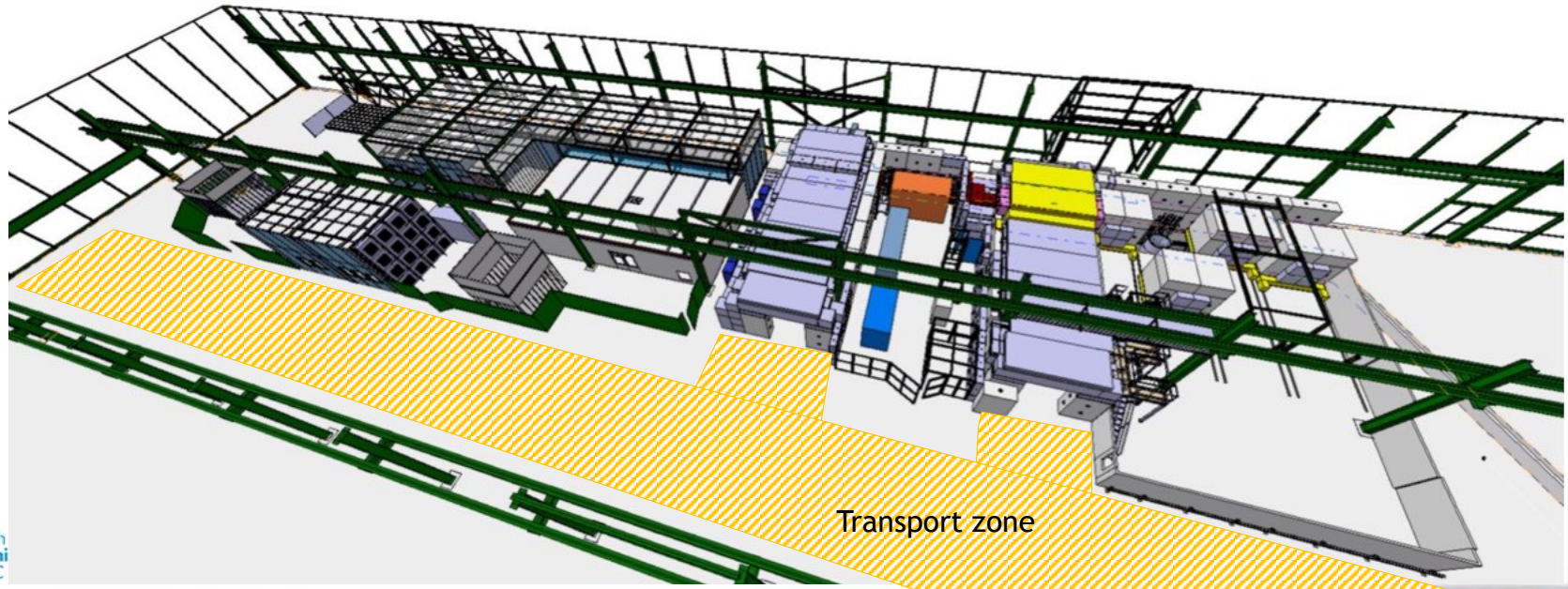
Integration in SM18 & Horizontal Tests

Alick Macpherson BE-RF-SRF
on behalf of
K. Brodzinski, A. Castilla, D. Del Alamo Mitogo, K. Hernandez Chahin, C. Jarringe, A. Kosmicki, P Maesen, E. Montesinos, K-M. Schirm, A. Tutte, G Vandoni.

The HiLumi LHC Design Study is included in the High Luminosity LHC project and is partly funded by the European Commission within the Framework Programme 7 Capacities Specific Programme, Grant Agreement 284404.

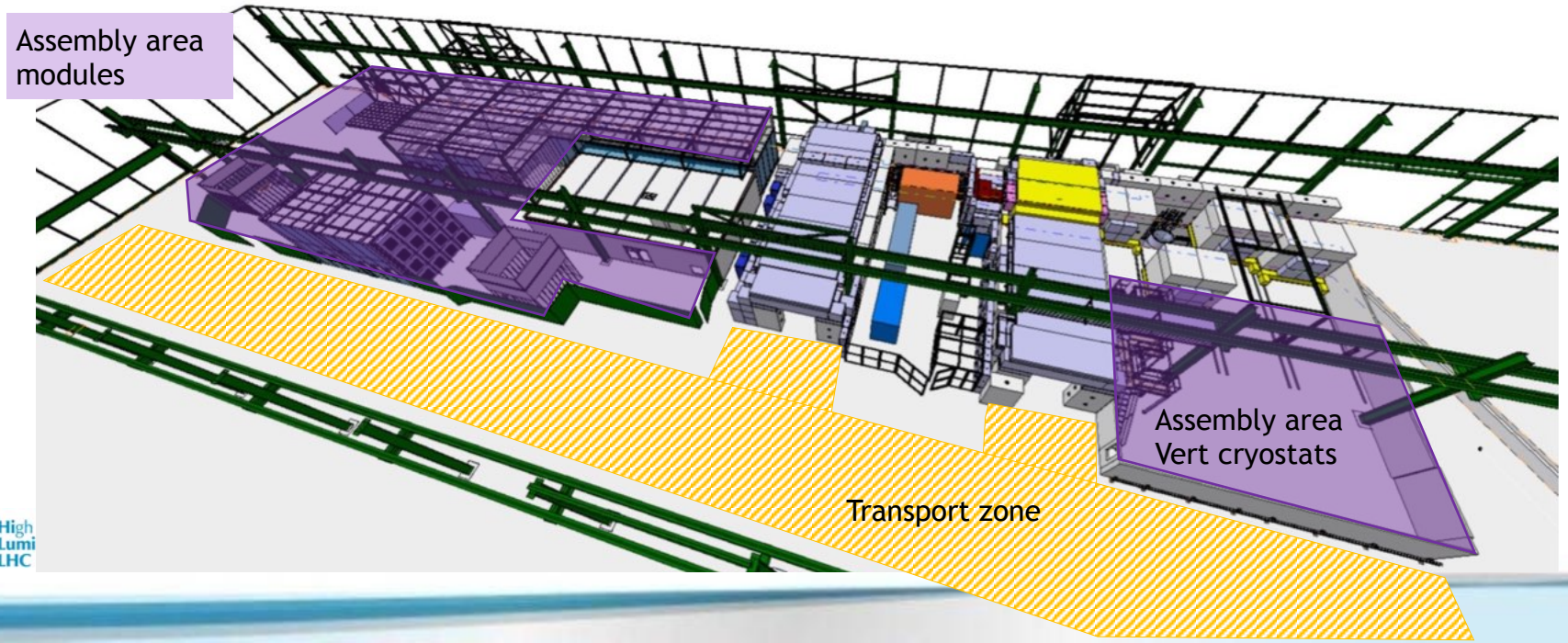
SM18 Layout

- **RF zone under preparation - full integration model**
  - **Horizontal Bunker:** LSS6 cryomodule assembly can be installed into M7
    - Design ongoing (TE-CRG-ME for cryo distribution box)
  - **Vertical Cryostats:** V3 Operational, V4 coming online (assigned to Crabs)
    - Provide backup incase dressed cavities need re-testing



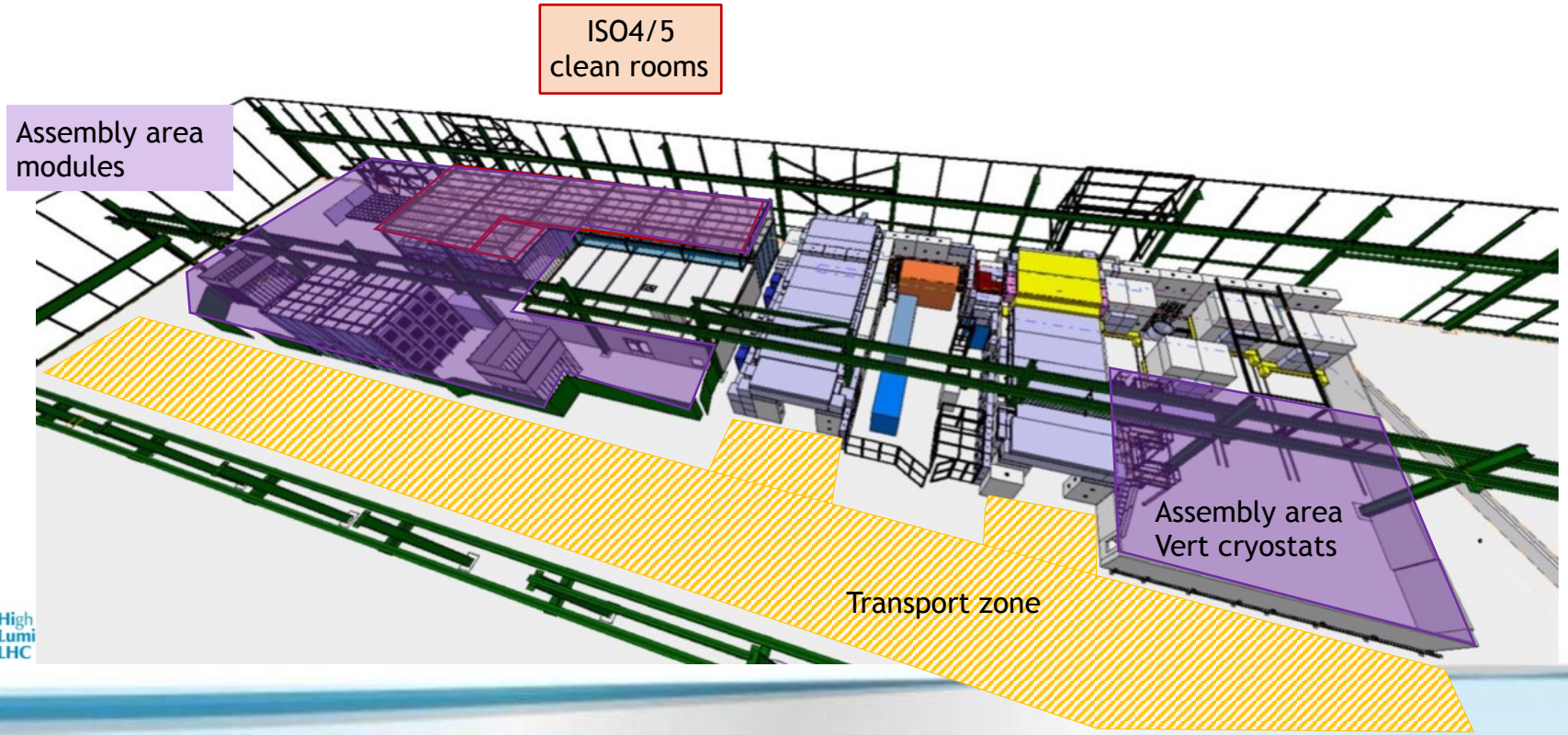
SM18 Layout

- **RF zone under preparation - full integration model**
  - **Horizontal Bunker:** LSS6 cryomodule assembly can be installed into M7
    - Design ongoing (TE-CRG-ME for cryo distribution box)
  - **Vertical Cryostats:** V3 Operational, V4 coming online (assigned to Crabs)
    - Provide backup incase dressed cavities need re-testing



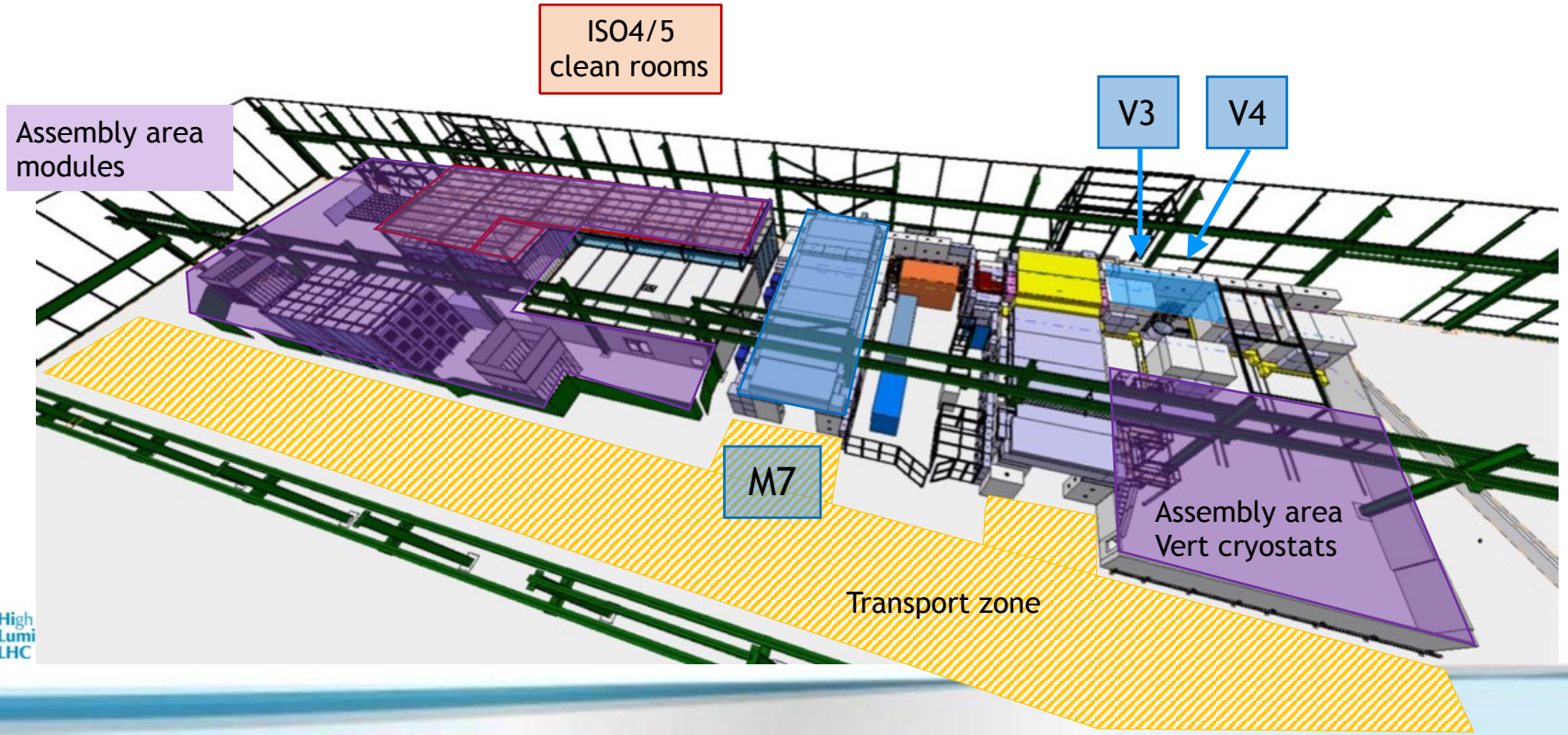
SM18 Layout

- **RF zone under preparation - full integration model**
  - **Horizontal Bunker:** LSS6 cryomodule assembly can be installed into M7
    - Design ongoing (TE-CRG-ME for cryo distribution box)
  - **Vertical Cryostats:** V3 Operational, V4 coming online (assigned to Crabs)
    - Provide backup incase dressed cavities need re-testing



SM18 Layout

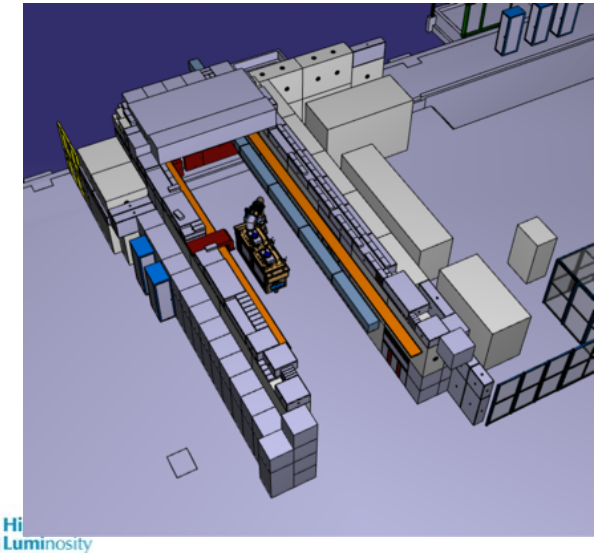
- **RF zone under preparation - full integration model**
  - **Horizontal Bunker:** LSS6 cryomodule assembly can be installed into M7
    - Design ongoing (TE-CRG-ME for cryo distribution box)
  - **Vertical Cryostats:** V3 Operational, V4 coming online (assigned to Crabs)
    - Provide backup incase dressed cavities need re-testing



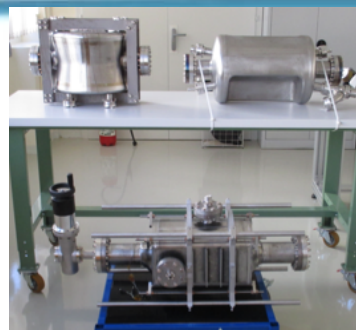
SM18 Cryomodule assembly and test bunker





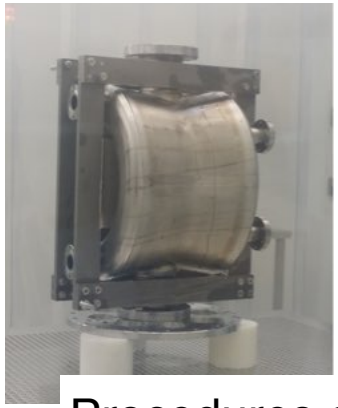
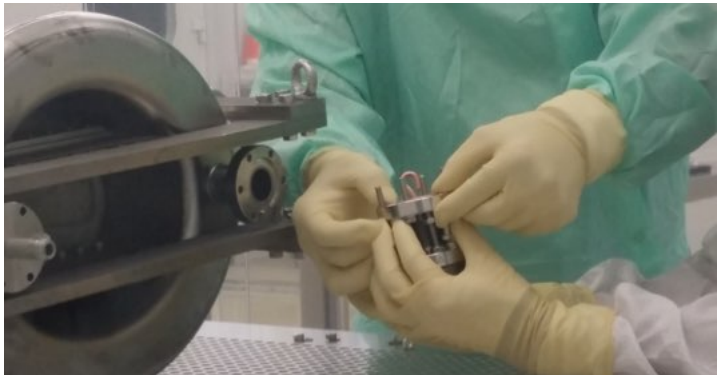


SM18: Bare Cavity Tests

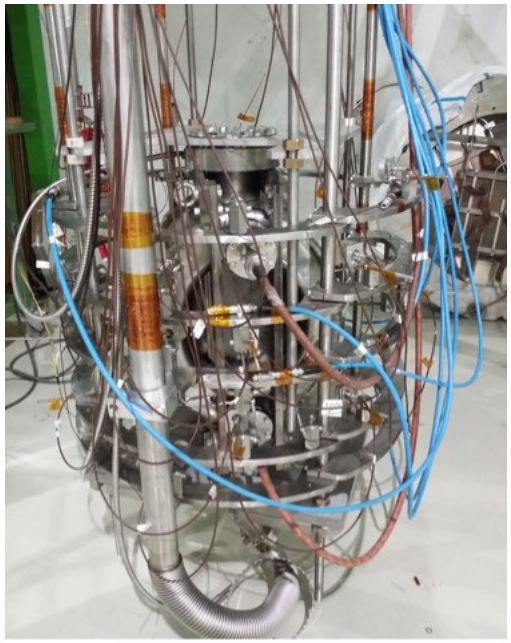


- **Vertical test program well established**
  - Permits development of SRF techniques, RF surface preparation and RF performance analysis
- **PoP Crab bare cavity measurements**
  - Cavity Performance measurements
  - Effect of ambient B-field and cool down on RF performance
  - Cross-calibration tests of SM18 with other labs
  - Development + qualification of cleanroom assembly steps
  - Qualification of HPR and drying procedure
  - Controls and LLRF prototype tests
- **Horizontal Bunker (M7)**
  - Test stand to be installed and equipped: Planned for 2016

SM18: Bare cavity Testing

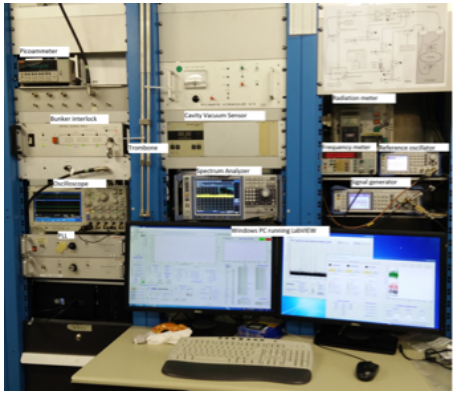




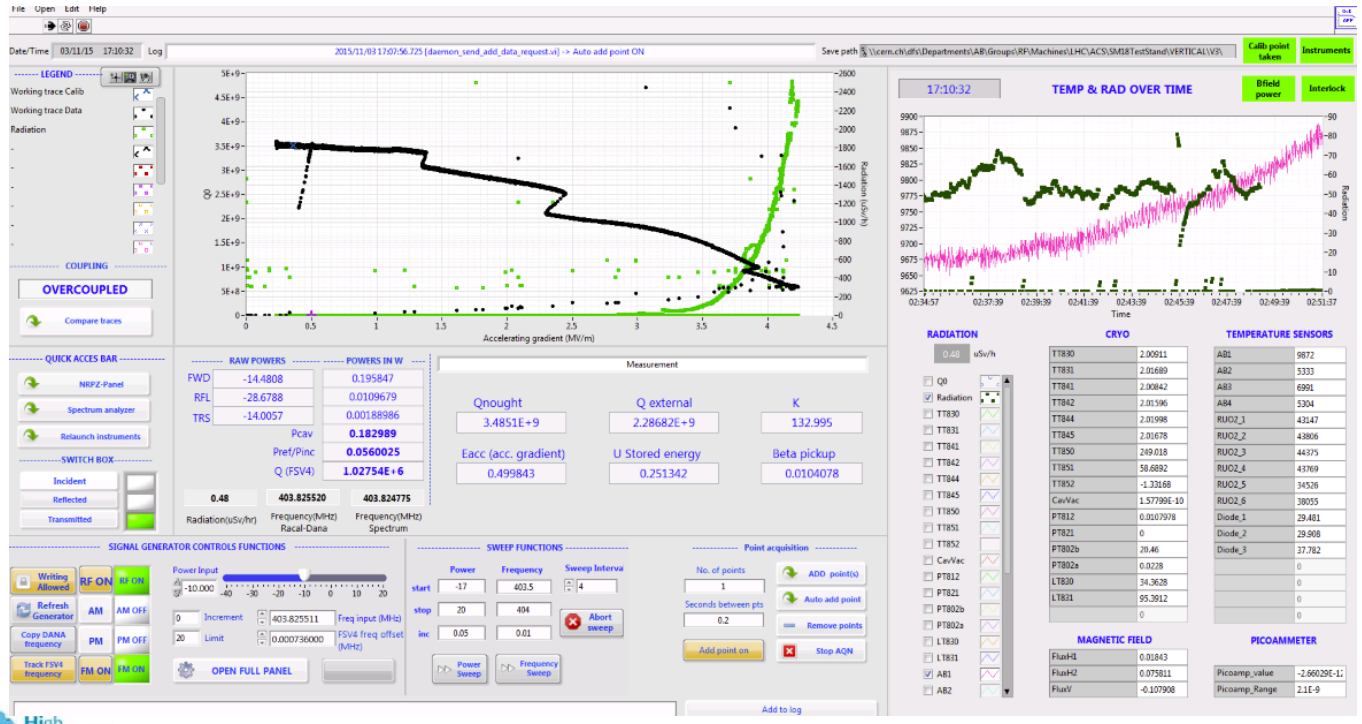

Procedures and calibration of test stand well established


Test Stands: Sowftare and Interfaces

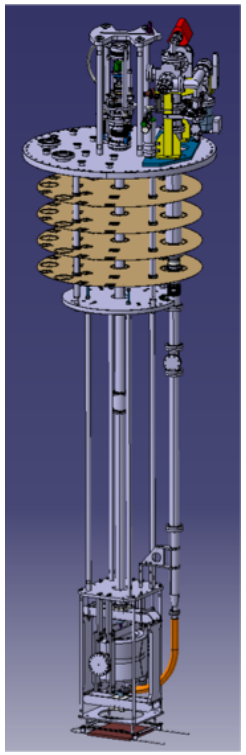
- Vertical Test stands:
  - LabView based measurement stand
  - Horizontal Bunker: to be resurrected in 2016
    - Based on standard LHC controls platform

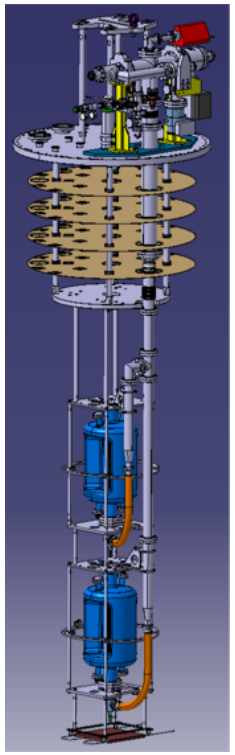




Status: Testing of Bare and Dressed Cavities

- **V3 Cryostat:** Operational and used for bare cavity testing
- **V4 Cryostat:** Dedicated to Crabs - Not yet operational





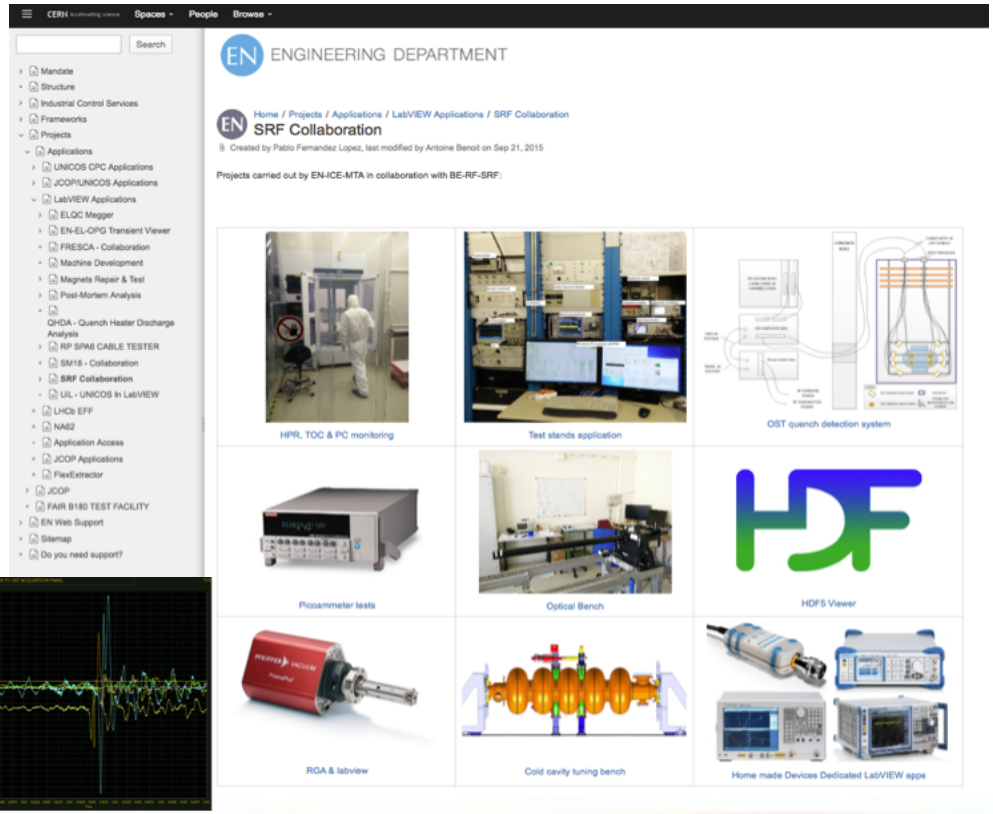
- **Insert upgrade: Launched in April 2015**
  - Common insert design for V3 and V4
  - Needed for bare cavity + tuner test
  - Possibility of installing two cavities
  - New pumping line with RGA analysis
- **Assembly expect Jan 2016**
  - Cold test of DQW+ tuner before SM18 cryo stop (15/03/16)

SM18 RF Test stand: Infrastructure development

- Infrastructure upgrade: Ongoing in 2015; almost completed
  - Strong emphasis on diagnostics environmental conditions

    https://wikis.web.cern.ch/wikis/display/EN/SRF+Collaboration

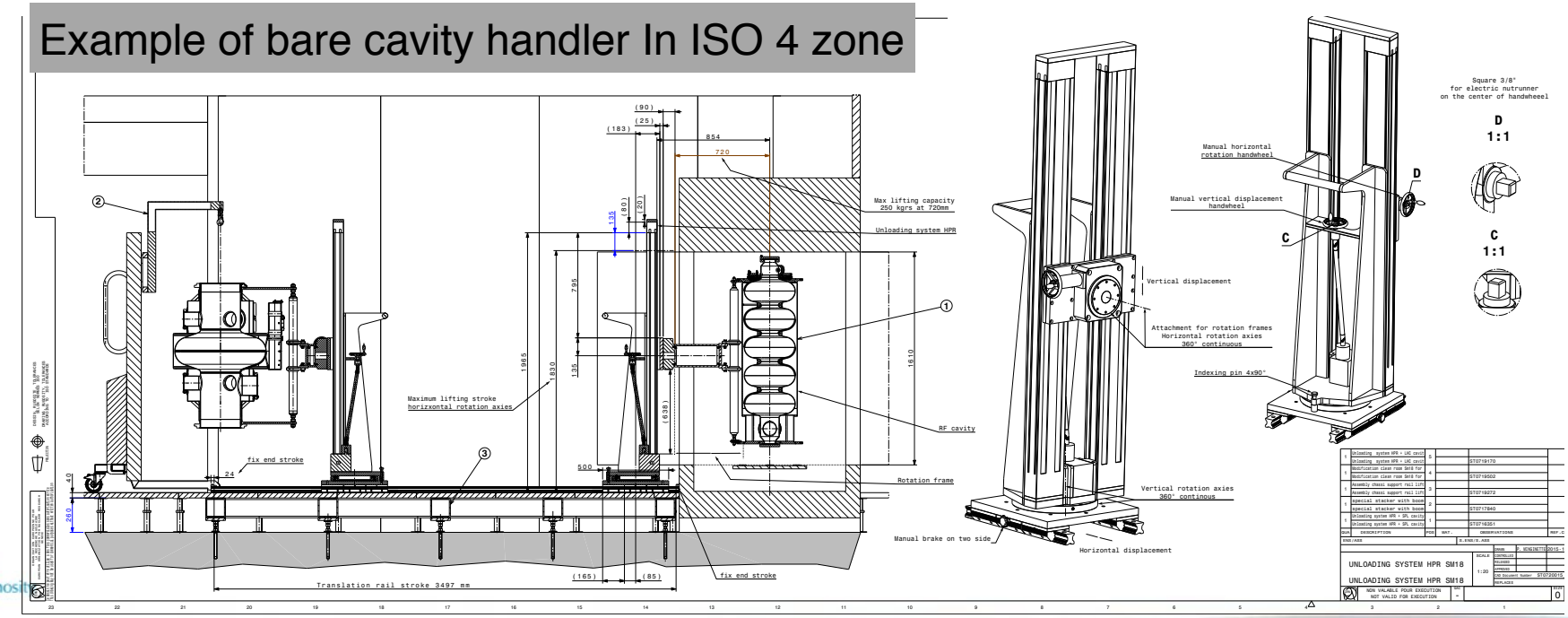
- Includes
  - Ambient B-field control
  - RGA analysis
  - HPR quality control
  - 2nd Sound OST readout
  - Quench localisation
  - Cavity Thermometry
  - Material properties



SM18 Cleanroom

- Clean room tooling design:
  - Handling of bare cavities: design compatible ongoing projects
  - String assembly: Designs ongoing, (See talk by P Minginette)
- Present schedule: Tooling should be in place by Q4 2016
  - Validation of assembly process and handling in Q4 of 2016

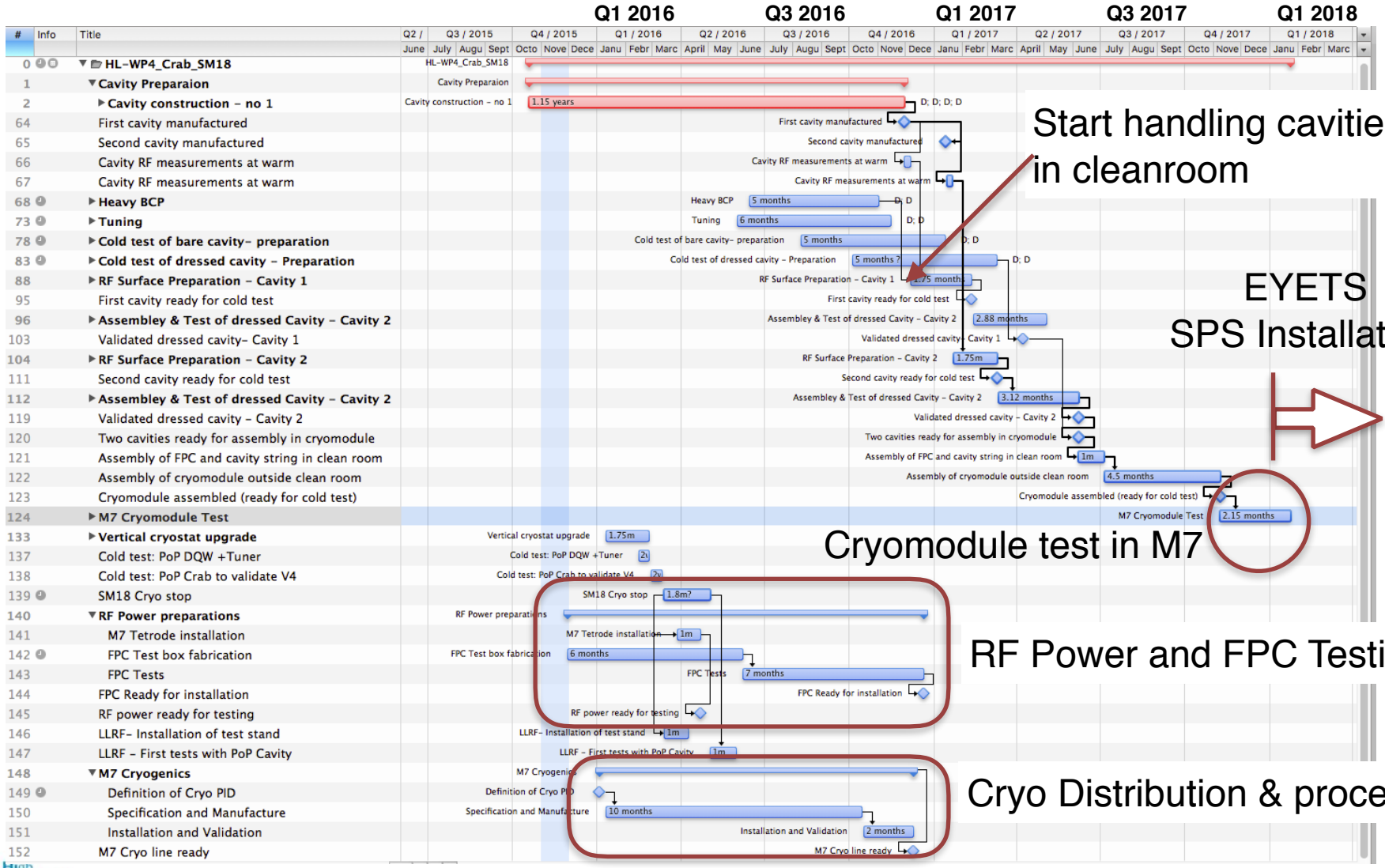
Example of bare cavity handler In ISO 4 zone



SM18 Cryo preparations

- **Cryo Process Control**
  - V3: operational. V4: installed and ready for testing
    - Operations to test instrumentation & update supervision panel
    - Includes new instrumentation for V4
  - M7: Process is to be defined by end of 2015 (O. Pirotte)
    - Planning is for delivery of validated system by end of 2016
    - Cryo module + service module to be tested in M7: no buffer tank
    - Test of SM18 infrastructure in terms of thermal shielding 50-80K
      - Requested for December 2015 (TBC)
    - M7 PID prepared assuming thermal shield is OK for operation

Schedule


Q1 2016
Q3 2016
Q1 2017
Q3 2017
Q1 2018
Start handling cavities in cleanroom
EYETS
SPS Installation
Cryomodule test in M7
RF Power and FPC Testing
Cryo Distribution & process

Cryo Module Testing: breakdown of tests

- Planning based on experience from LHC module testing
  - Assumes that cavities can be conditioned in parallel
    - Potential issue with helium capacity of SM18

Activity	Duration
Q_ext measurements at 300K	1 day
Cooldown to 2K	2 week
Low Power measurements	1week
RF Conditioning (FPC + Cavity)	2 weeks /cavity
Cavity Performance measurements	3 days
LLRF Gymnastics	1 week
HOM efficiency measurements	1 week
Heat Run	2 days
Warm up	1 week
	9 weeks

Schedule Issues

- **Cavity RF surface preparation:** if to be done at CERN, requires optimisation of procedures. Close collaboration with TE_VSC
  - 2016 has to be used to validate surface preparation process
- **M7 CM Tests:** CM ready in Nov 2017 => Limited time for SM18 testing
  - 9 week program risks cutting into SPS installation window
  - Assumption: assumes both cavities can be tested in parallel
- **Crab test program**
  - Assumes only 1 cold test per cavity for bare & dressed cavities
  - CM program: tight planning for a first-time set of tests
- **2016 test program in SM18 = Essential**
  - V3&V4: DQW+ tuner, LLRF + cavity, HPR procedure validation
  - RF power + controls commissioning
  - Must use SM18 shutdown in 2016 to install infrastructure