Vacuum Update

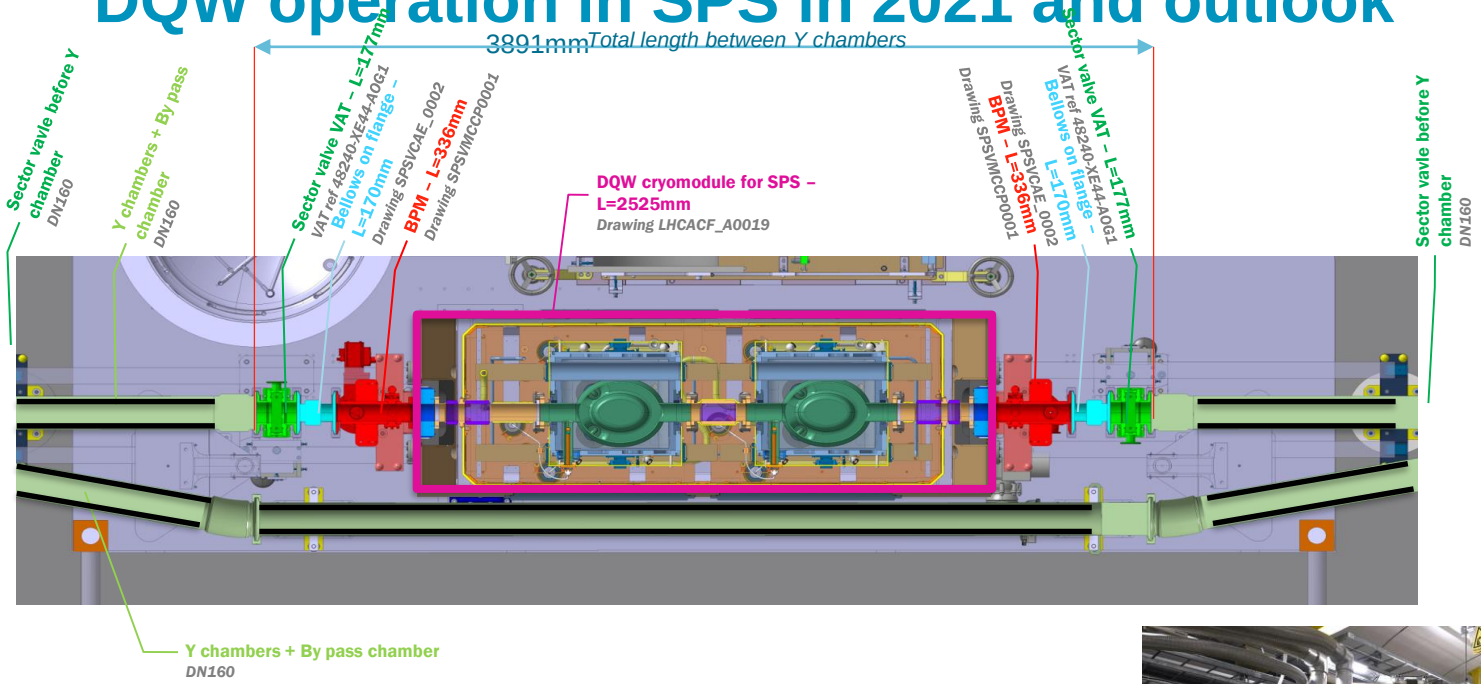
C. Pasquino on behalf of TE-VSC contributors to WP4

11th HL-LHC Collaboration Meeting – CERN, Switzerland, 20th October 2021

Outline

- DQW operation in SPS in 2021 and outlook
- WP12 to WP4 contributions:
  - Overview
  - Status of the contributions for RFD @ UK, STFC
  - Lessons learnt from production
  - Lessons learnt from assembly
- Next Steps

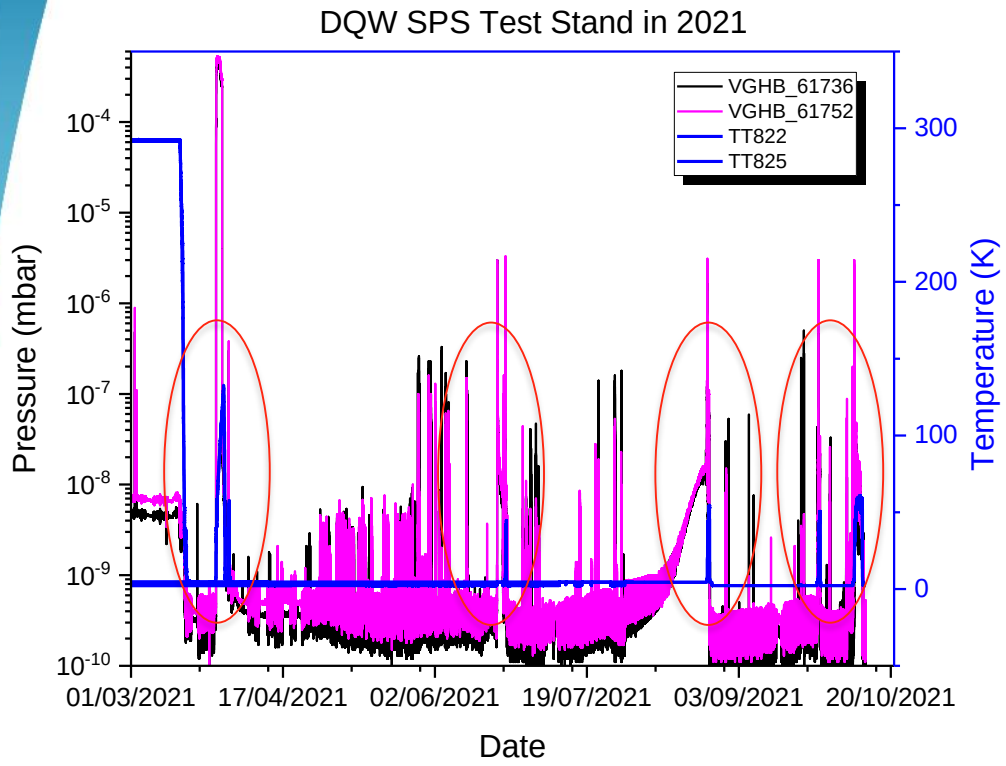
DQW operation in SPS in 2021 and outlook



Reminder:

- Y chamber and pumping units are aC coated;
- BPMs and CWT are not;
- Vacuum conditioning shall be expected due to the presece of unconditioned surfaces;

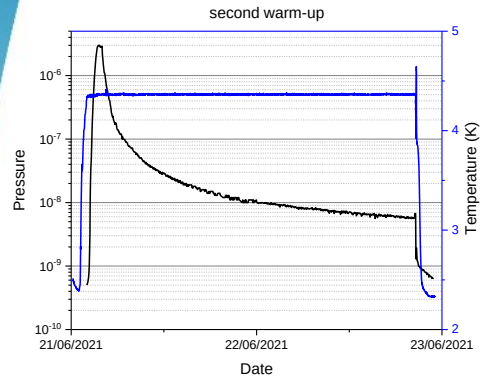
DQW operation in SPS in 2021 and outlook

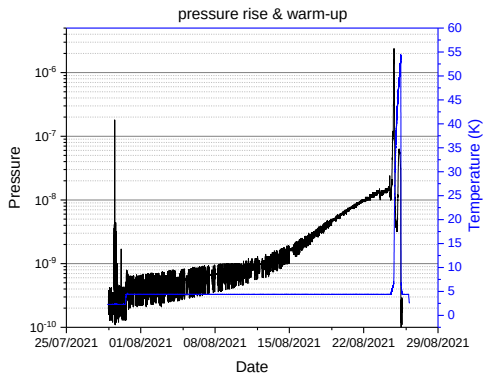


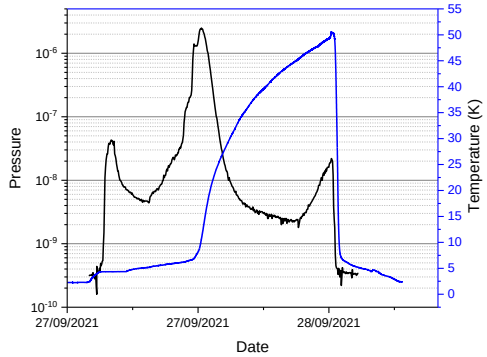
Several warm ups during the year:

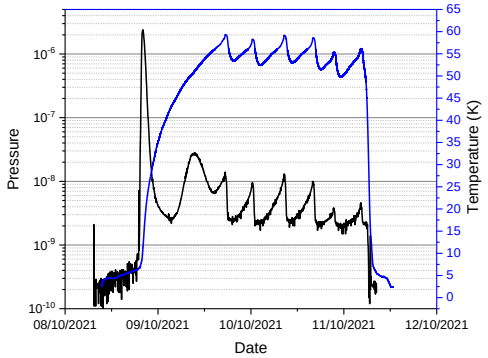
- Mid March → cooldown after LS2
- 29/03-31/03 → cryo issues: induced temperature rise to 130 K
- 24/06→ cryo issues: induced temperature rise to 4.5K
- 25/08→ pressure drift: decided to warm up to 50K (recycling)
- 28/09→ pressure spike, RF unstable, warm up to 50 K (recycling)
- 11/10→ pressure spike, RF unstable, warmup to 50 K (recycling)

DQW operation in SPS in 2021 and outlook









- Very reproducible pressure peak at 10^{-6} mbar;
- Most likely H_2 dominated;
- Are we really efficient in pumping these gas quantities out of the beamline with a 50K warm-up?
  - RGA to be performed during YETS;
- Scrubbing with beam and cavities at RT (or cryo + warm-up) is highly recommended;
- Possibility to install a fix RGA on the SPS-RFD under study.

TE-VSC To WP4 contributions

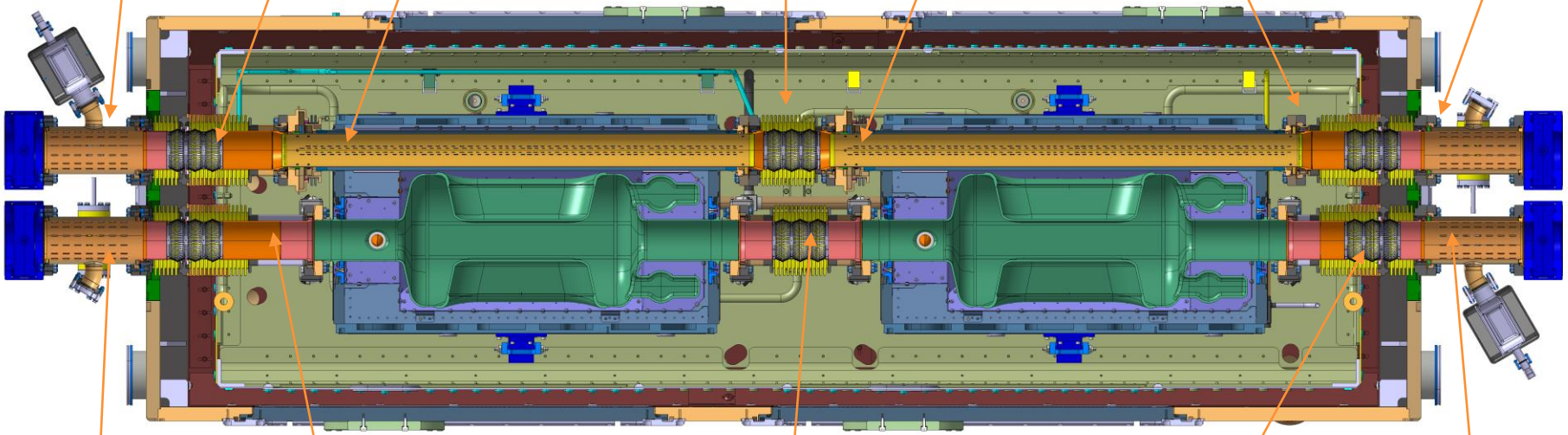
What is planned to be installed:

- SPS – LSS6 : 1 X RFD – LHC type cryomodule;
- LHC – LSS1 (L+R) : 4 (2 + 2) DQW cryomodules;
- LHC – LSS5 (L+R) : 4 (2 + 2) RFD cryomodules;

What is planned for production:

- SPS – LSS6 : 1X RFD;
- LHC: 5 (4 + 1 spare) DQW; 5 (4 + 1 spare) RFD;
- Spares: 6 Plug In Modules, 2 vacuum modules, 2 beam screens;

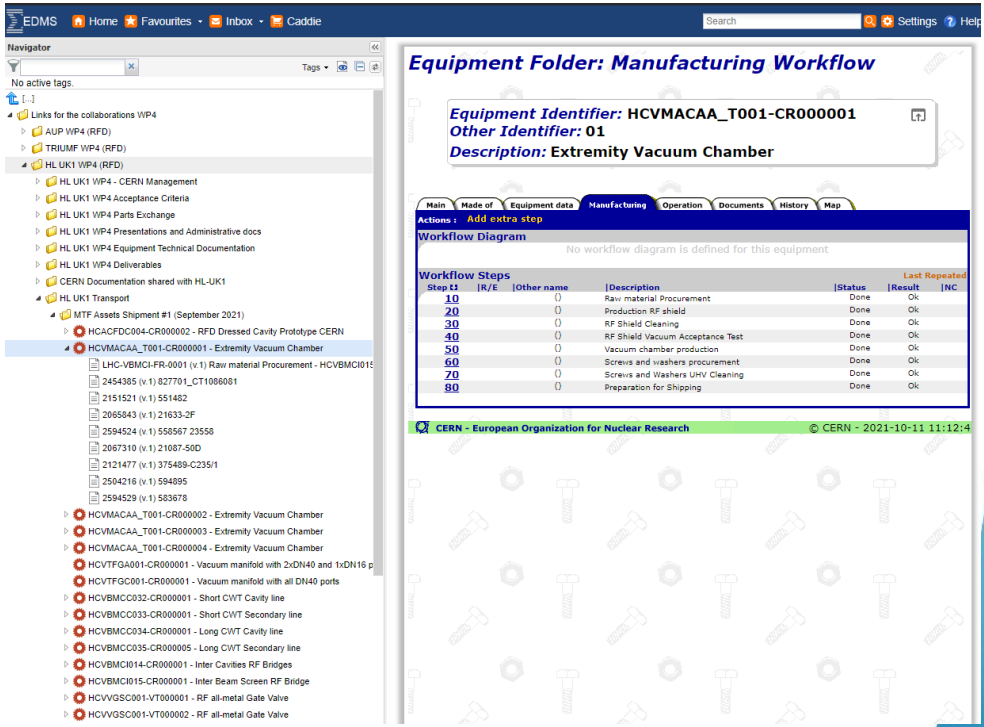
WP12 to WP4 contributions



Courtesy of T. Capelli

Project & quality management

- ✓ Workflows for each component;
  - ✓ MTF structure in place;
  - ✓ Updated following the RFD experience;
- ✓ Follow-up on costs and expenditures (e.g. unit price for PIMS) to anticipate on possible budget issues;
- ✓ EVM reporting;
- ✓ Monthly internal reporting about the project status.



WP12 to WP4 contributions: status

- RFD components:
  - First delivery to UK (27th September 2021):
    - 6xPIMS
    - 4xVacuum modules
    - 4xValves
    - Beam vacuum instrumentation, ancillaries and ion pumps.
  - Second delivery to UK (foreseen by end October 2021):
    - Gauges and safety valve for insulation vacuum.

WP12 to WP4 contributions: status

- Beam screen production:
  - 14 RFD beam screens produced/ 11 are pressure tested;
  - 2/14 carbon coated and inserted in RFD1 and RFD2 cavities;
  - DQW beam screens are under production (half shells ready).
- Bellows procurement for HL-LHC:
  - Blanket contract being put in place (November 2021) for the future procurement for bellows for HL-LHC. First bellows delivery expected for June 2022.

Lessons learnt from production

- Very difficult bellows procurement:
  - Raw material derogation (1.4441 to 1.4404);
  - Modification of the end collars to ease production both at CERN and at the company;
  - Blanket contract will be crucial for a smooth and timely supplying of these items for the remaining of the project.

Lessons learnt from assembly

- Beam screens are ISO7 before assembly → PIMS of the non crabbed line assembled outside of the clean room;
- Plasma cleaning is very efficient for HydroCarbons removal from the cold bore;

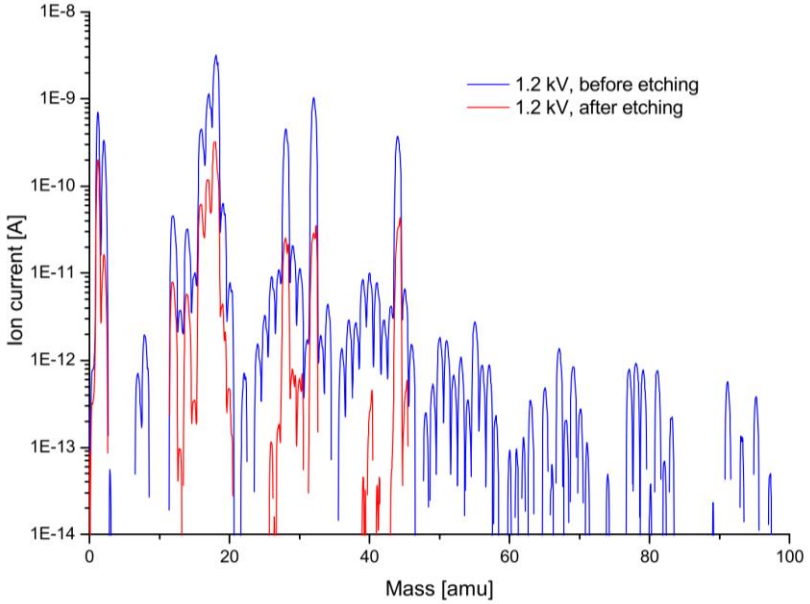


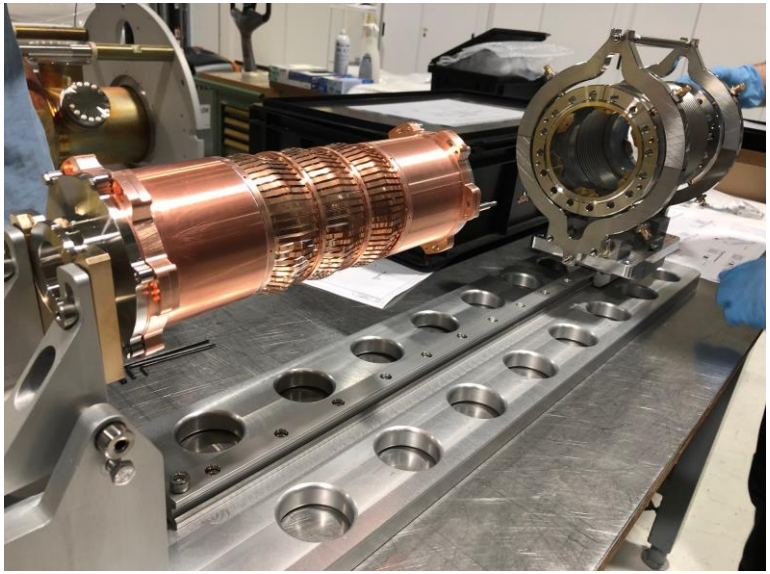
Figure 10. Mass scan of substances with masses between 1 and 100 present in the system before the etching process start (blue), and after finishing the etching process (red).

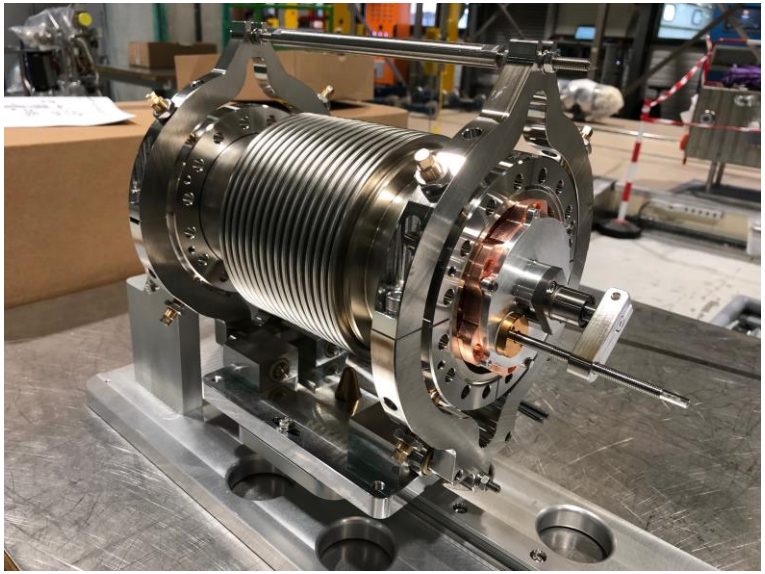
Lessons learnt from assembly

- PIMS of the crabbed line have been rinsed and UHV cleaned several times before finding the correct sequence that lead to ISO4 compliance before assembly:
  - Cleaning of the bellows with detergent + Ultra Sonic bath;
  - Rinsing with water and alcohol;
  - Particle counting.

Lessons learnt from assembly

- Tooling for assembly outside and inside clean room was crucial: it needed some adjustments (mechanical tolerances, centering pins..) on the run.





Next Steps

- Wrap up on the first assembly experience and define a final procedure for beam screen and PIMS assembly;
- Study the vacuum layout for the integration of the RFD in the SPS;
- Study the feasibility of installing an RGA in LSS6;
- Evaluate the impact of the LHC LSS1 and LSS5 crab cavities integration modification on the vacuum layout;
- DQW PIMS design approval and production;
- Beam screen production follow-up.

Thanks to all VSC, RF, MME colleagues that made this first assembly possible!