



SM18 validation of RFD CM Prototype for SPS tests

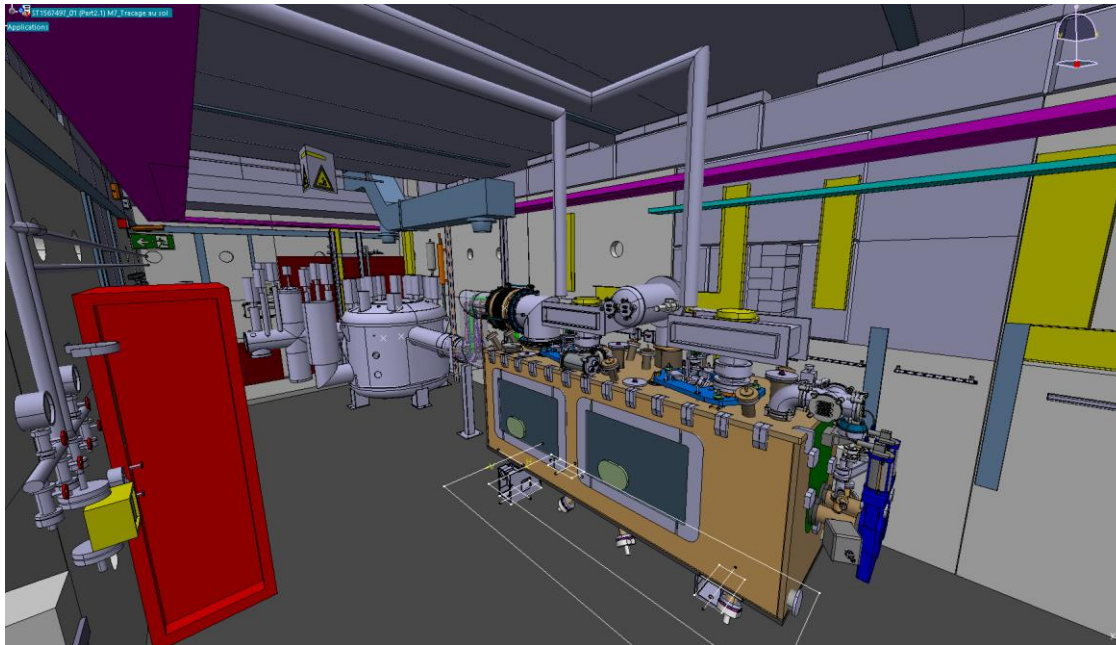
Katarzyna Turaj on behalf of WP4 and SY-RF-SRF



13th HL-LHC Collaboration Meeting, Vancouver, 25-28.09.2023

Goals of RFD CM cold test in SM18

- Testing of RFD CM is a crucial validation step of the cryomodule assembly process.
- Validation of the cryomodule at 2K is required before RFD CM installation in the SPS.

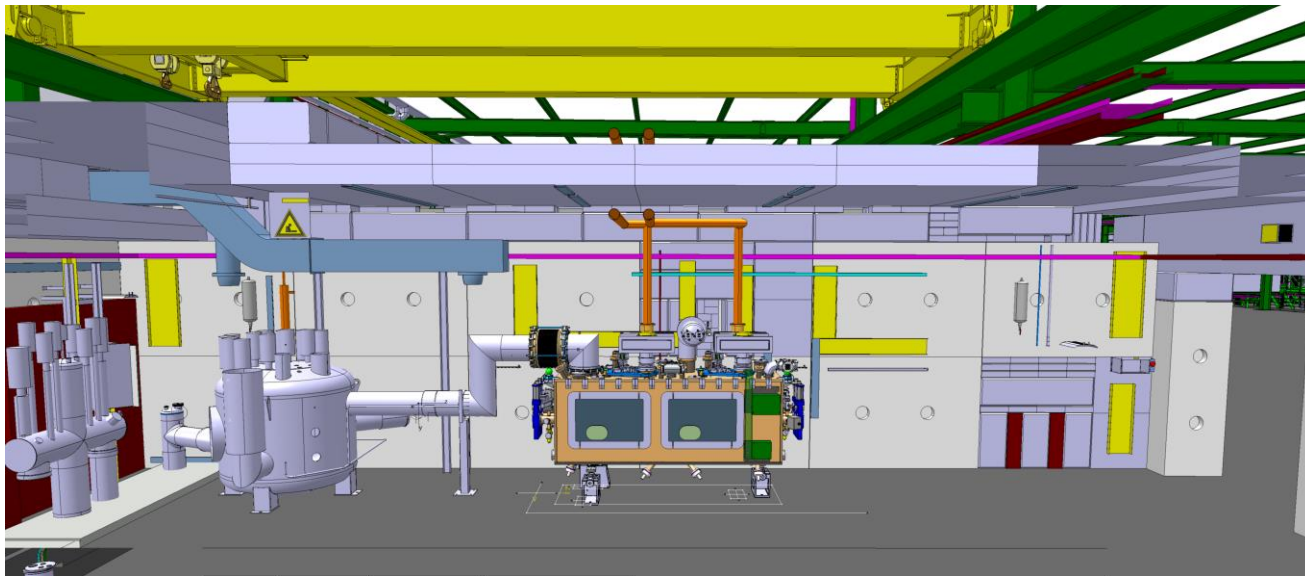


Courtesy: A. Kosmicki

K. Turaj, 26th September 2023

Infrastructure: M7 test stand

- Dedicated bunker M7 to allow full validation of CC CM.
- The test infrastructure will be compatible with both RFD and DQW cryomodules.
 - This test stand will be used to qualify all HL-LHC CM (11).
- Manufacturing and Inspection Plan : CRAB RFD CM TESTING SM18 → EDMS 2756481

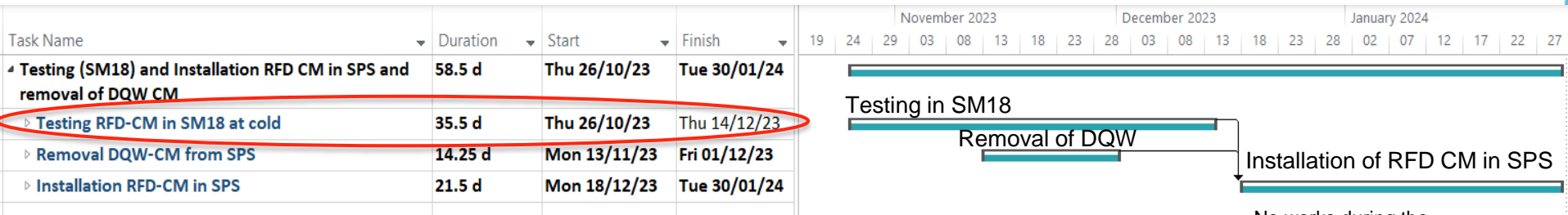


Courtesy: A. Kosmicki

K. Turaj, 26th September 2023

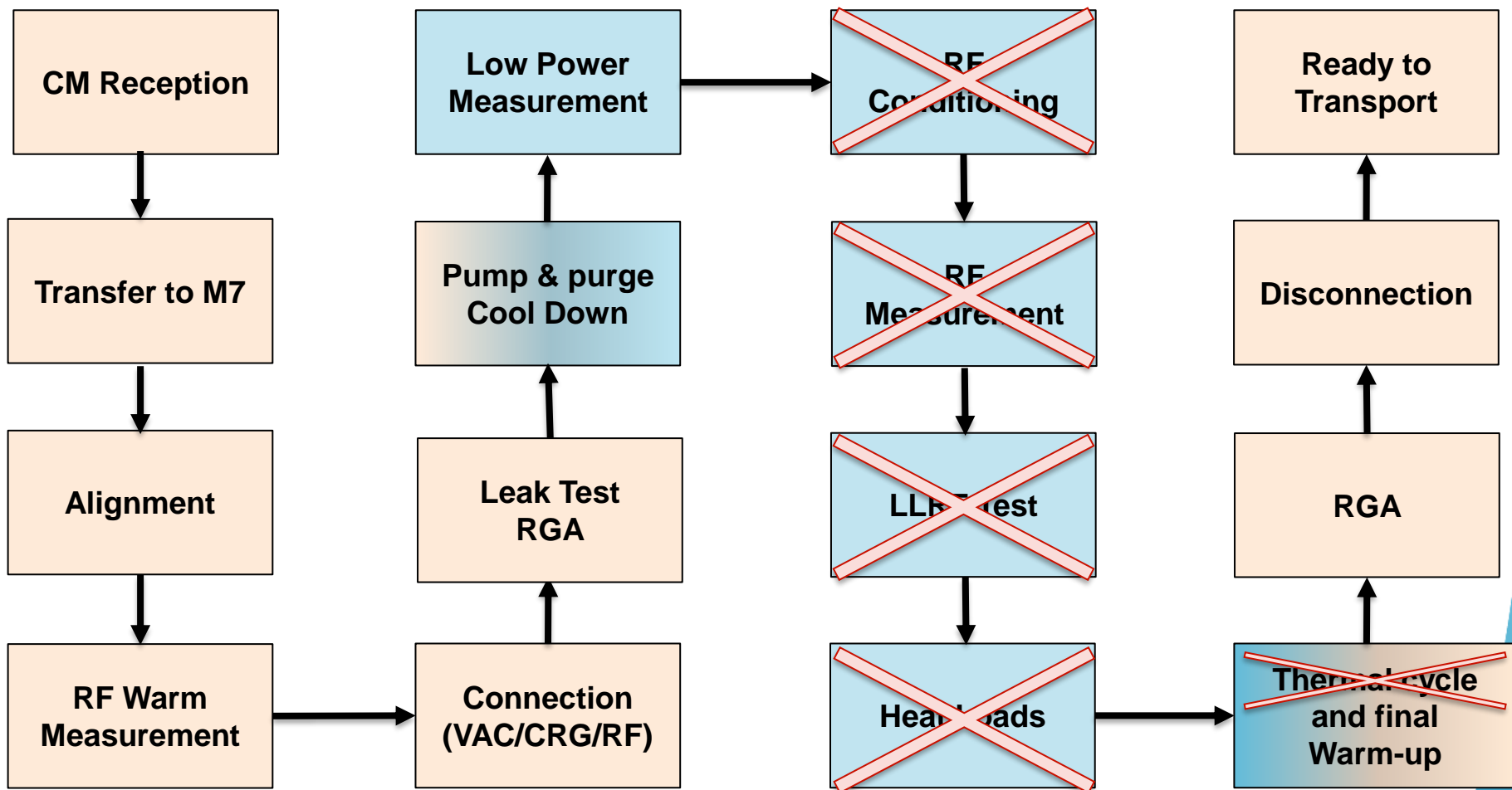
SM18 planning changes

- Due to delays in production and a short window for installation in the SPS during EYETS 2023-24 the testing program in SM18 was significantly reduced (*).
 - Test flow and steps were adjusted.
 - Duration reduced from original **4 months to 1.5 month**.
- The main goal is to perform Vacuum/Cryo-System leak tests at 2K.
- All measurements and tests at 2K were reduced to minimum.
 - No conditioning of the RF power couplers.
 - No single cavities performance tests.
 - RF tests only include measurements of the fundamental frequency, HOM spectrum and tuner response.



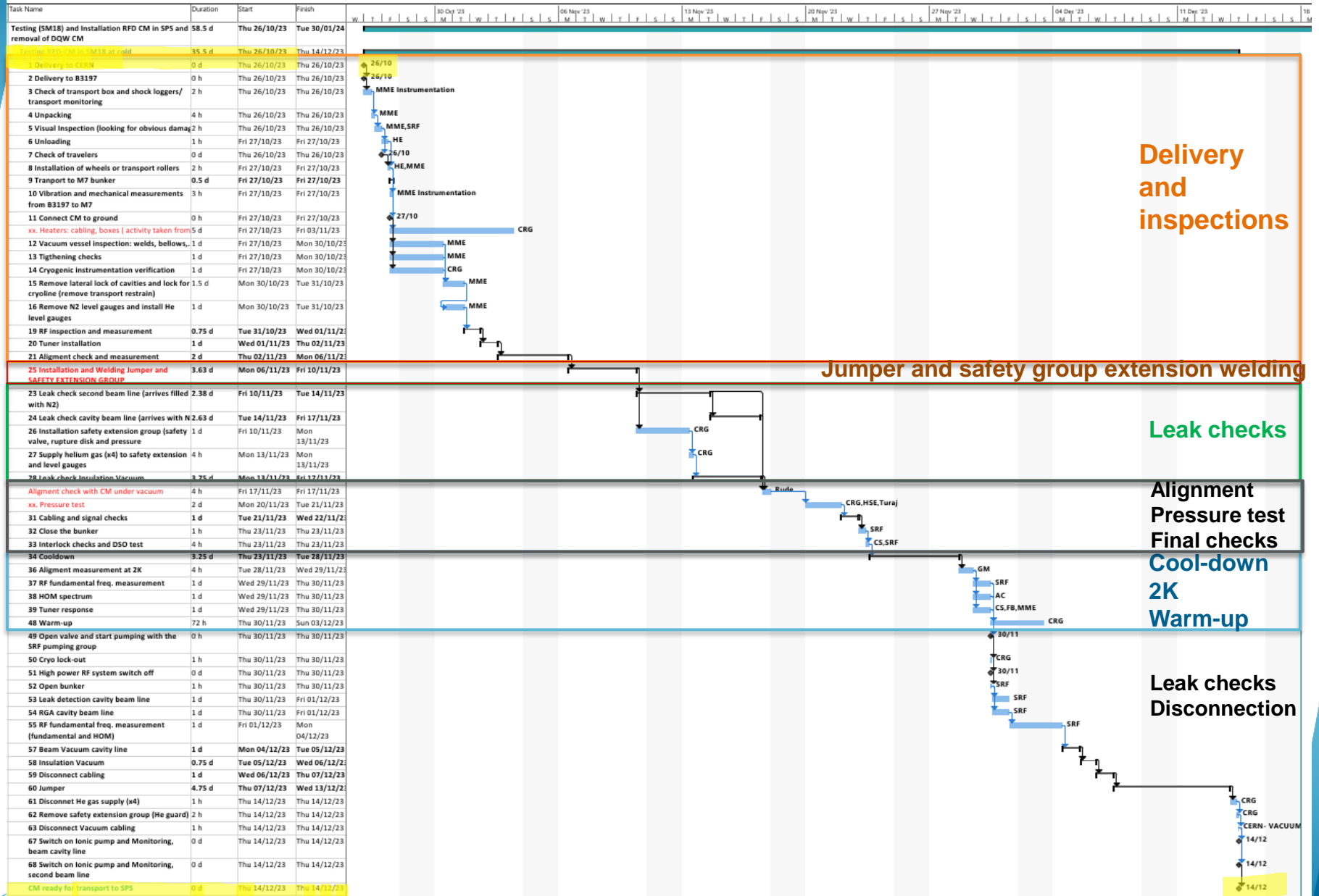
(*) [12th HL-LHC Collaboration Meeting, : RFD-CM reception at CERN & acceptance tests](#)

Workflow of RFD CM in SM18



 cancel

SM18 planning



Delivery and inspections

Jumper and safety group extension welding

Leak checks

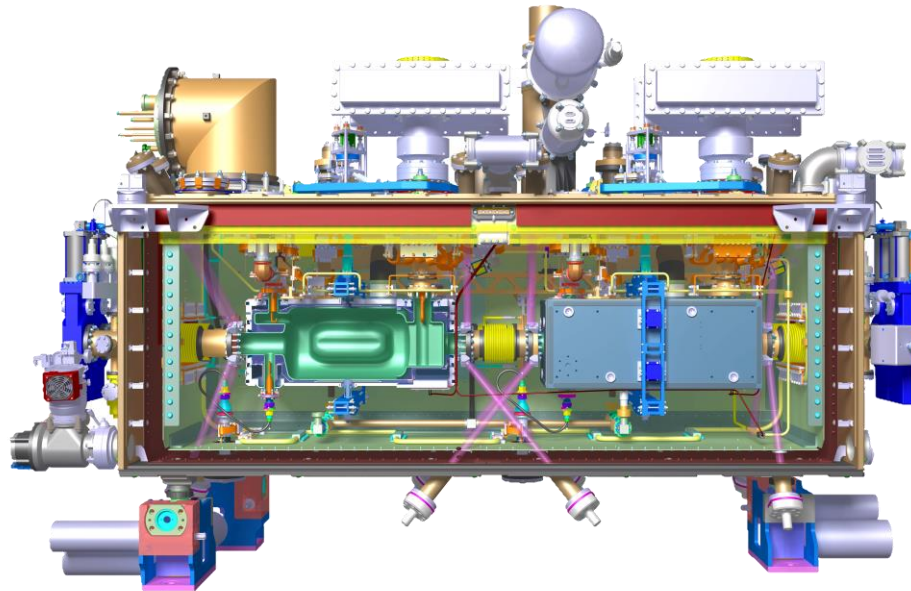
Alignment Pressure test Final checks

Cool-down 2K Warm-up

Leak checks Disconnection

Conclusions

- The test infrastructure is ready to enable validation of the RFD CM.
- A validation and testing program is being developed. Includes procedures, reports and full data logging.
- Due to delays in production, the test program was reduced.
- The main goal of the SM18 test is to verify Vacuum/Cryo-System leak tightness at 2K.
- Only low power RF measurements are intended.



Courtesy: T. Capelli



Thank you very much!



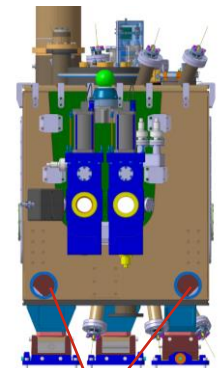
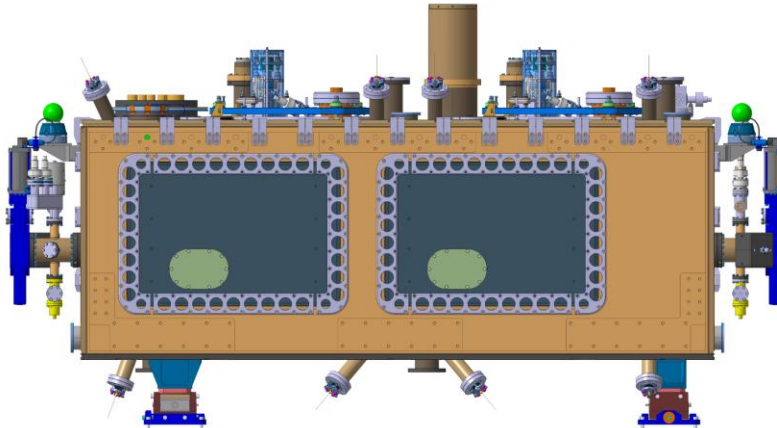
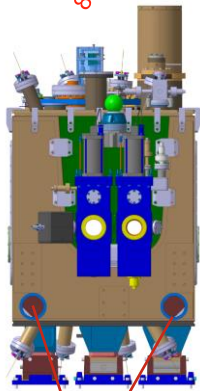
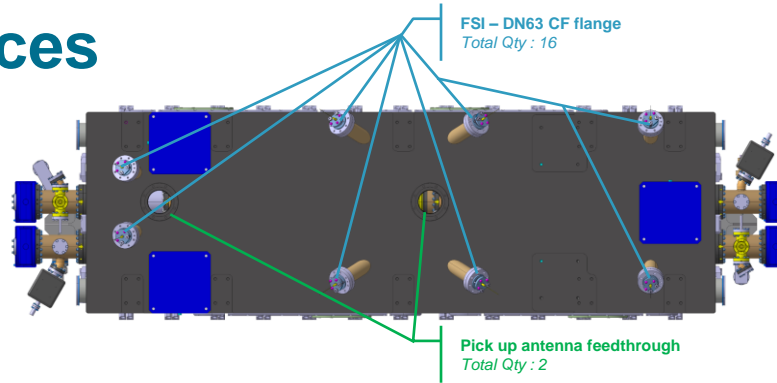
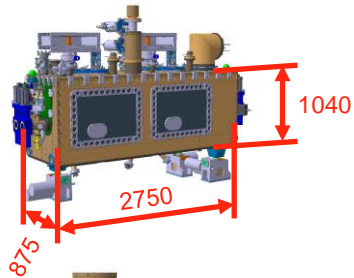
RFD CM Test Program

- Manufacturing and Inspection Plan: CRAB RFD CM TESTING SM18 → EDMS 2756481

Tests (Eng. spec. EDMS2043014)	Comments
RF Frequencies of deflecting mode	RF VNA measurements (after string assembly) Target frequencies, 400 MHz: $S_{11} \leq -25 \text{ db}$, HOMs: $S_{21} \geq 0.25 \text{ db}$
Q_0 - V_t curve including power dissipated at 4.1MV at 2K	Calorimetric measurements
Quench field value	
Lorentz Force Detuning test	
dF/dp test	
HOM frequencies & Q's	With particular care to frequencies around 760 MHz for RFD and 960 MHz for DQW
Output power through HOM coupler	
Test on modes around 760 MHz	
External coupling verification of ancillaries	External quality factor of several HOMs External quality factor of the field antenna (at fundamental mode frequency)
Field emission onset (Emitted radiation from cavity)	$< 50 \mu\text{Sv/hr}^2$
Multipacting levels	Sustained RF full power within vacuum limit of $1 \cdot 10^{-8}$ mbar
Effect of thermal cycling (15K-2K)	3 cycles. The variation of all the parameters in this table shall be within a range of +/- 5%

RFD cryomodule ports/interfaces

- RF connexions**
SY/RF
- Alignment and position monitoring**
BE/GM
- Insulation vacuum**
TE/VSC
- Beam vacuum**
TE/VSC
- Cryogenic**
TE/CRG



Insulation vacuum pumping port 1/2
Total Qty : 4- iso K DN100

Level gauges feedthrough
2x / 2x ConFlat (CF) DN40

FSI - DN63 CF flange
Total Qty : 16

Insulation vacuum pumping port 2/2
Total Qty : 4- iso K DN100

Cryogenic jumper
Iso K DN400
Total Qty : 1

Beam vacuum instrumentation 2/2
Total Qty : 4
See drawings XXXXX

Insulation vacuum instrumentation - Iso K DN100
Total Qty : 1

Beam vacuum instrumentation 1/2
Total Qty : 4
Drawing under preparation

Insulation vacuum pressure relief - Iso K DN160
Total Qty : 1

Instrumentation port
3 Flanges ISO K DN100

HOMS feedthrough
Total Qty : 4

Cryogenic safety port for pressure measurement
1 Flanges ISO K DN63

Instrumentation port
1 Flange ISO K DN100

