

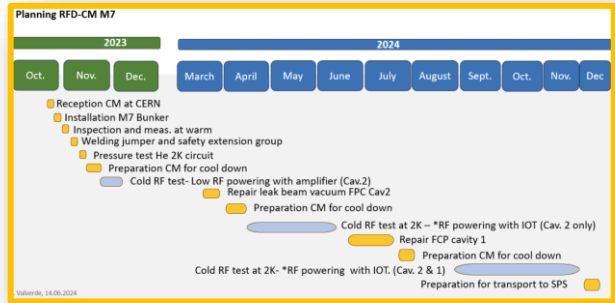
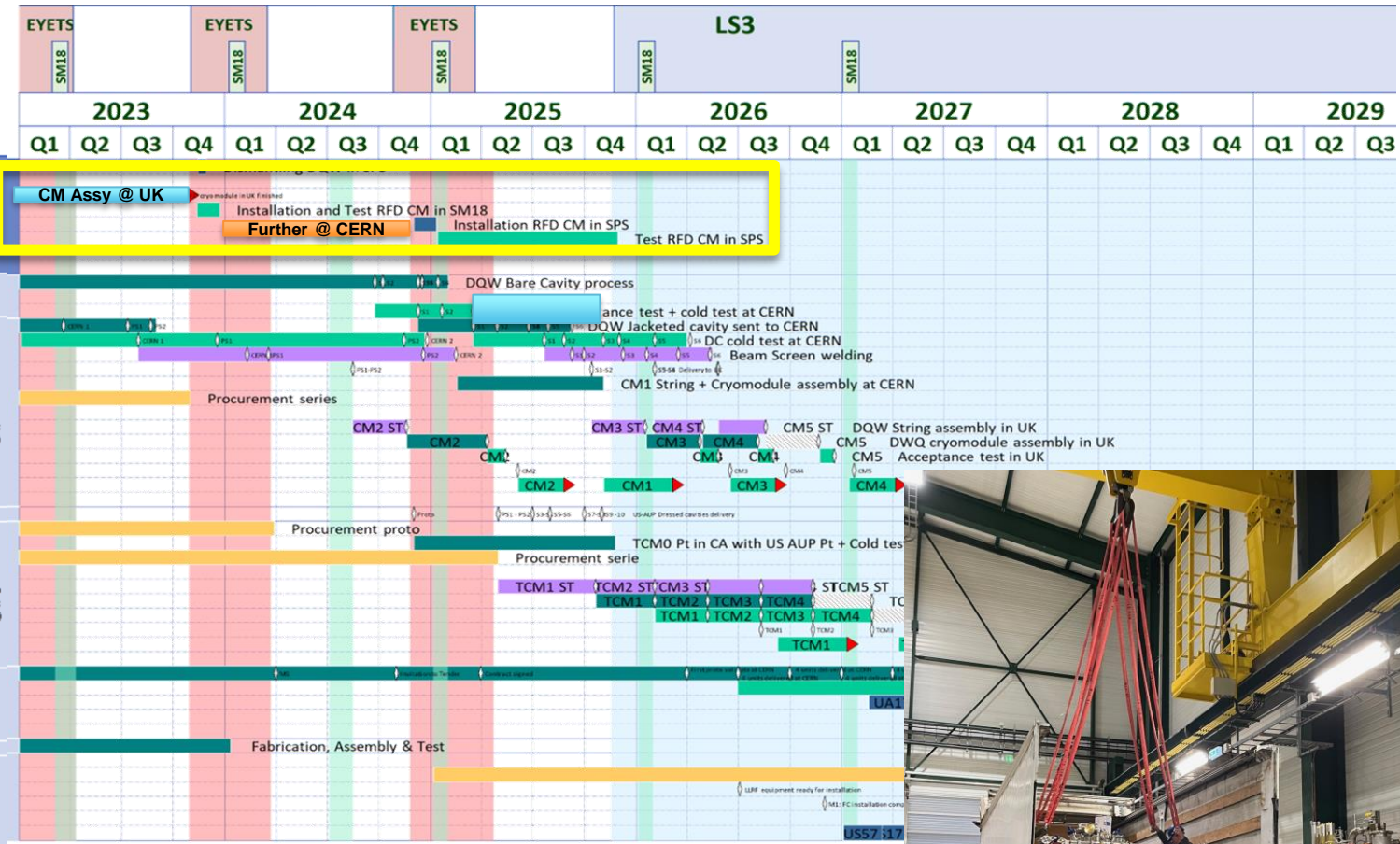
# Summary of RFD Reviews at CERN

M. GARLASCHÈ on behalf CERN WP4 Team

# Reminder on WP4 Master Plan - RFD SPS CM

WP4 - In work for CSR2024

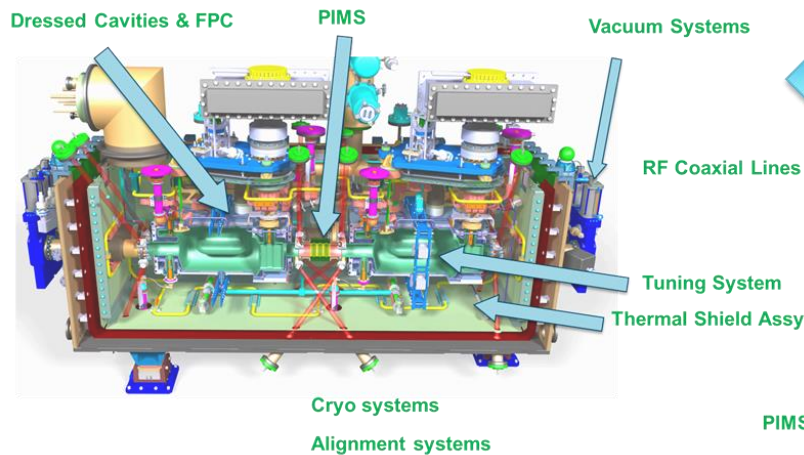
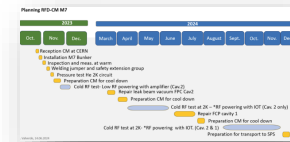
SPS @ LSS6	Cryomodule (4CC, 2CM)	
	DQW	RF cavities (CERN)
LHC @ IR1 & 5	RFD	RF cavities
		Cryomodule (5 CM in Canada (8 + 2 spare CC; 4 + 1 spare CM))
	RF Services	19 IOT series
	LLRF	New platform
		20 series



# [Jun/Jul] Internal CERN 'Review'

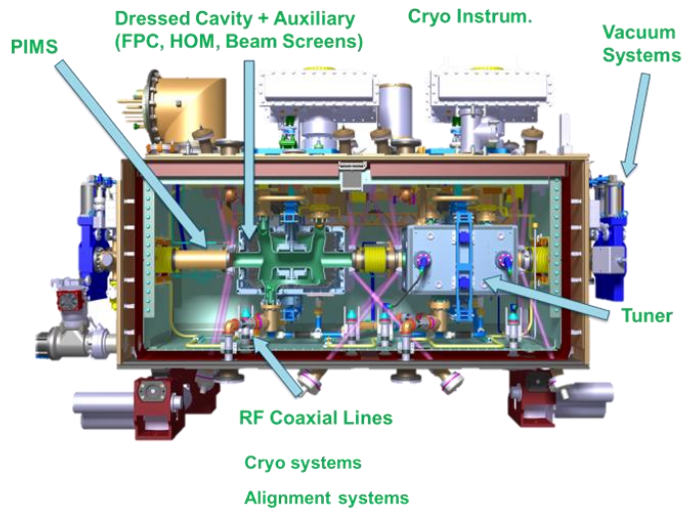
“ Experience and Feedback from RFD CM preparation and tests at CERN ”

- Focus on Technical Topics (Equipment, Activities)
- Close ranks towards RFD SPS installation in Jan'25
- Learn lessons, for HL-WP4 CM Series



(1x) RFD SPS CM

(4x) DQW Series



CERN Contribution

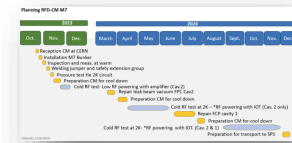
UK Contribution:

- Top/Bottom CryoLines
- Th. and Mu Shield, MLI
- OVC
- Part of Vac Systems
- ...
- Full CL and CM assy

# [Jun/Jul] Internal CERN ‘Review’

“ *Experience and Feedback from RFD CM preparation and tests at CERN* ”

- Focus on Technical Topics (Equipment, Activities)
- Close ranks towards RFD SPS installation in Jan'25
- Learn lessons, for HL-WP4 CM Series



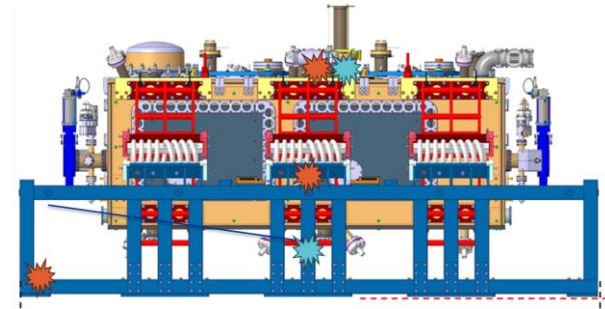
Review Topics	
Measurements during transport	M. Guinchard
Qualification and NCRs	J. Debeux
Vacuum testing at M7	N. Valverde
FPC NCR : Repair actions	Capelli, Barriere, Swieszek
Testing : Tuner	K. Artoos
CM Mechanical Assy & Welding @ CERN	S. Barriere
Alignment	V. Rude
Cryogenics	L. Delprat, R. Maun
Planning M7 : Reception > testing > SPS ready	K. Turaj
Testing LLRF	G. Hagmann
RP Measurements	A. Infantino
Testing : CERN Software and Controls	M. Jaussi
RF Conditioning Testing Summary	E. Montesinos, R. Calaga

= @ this HL-Week

# Conclusions ☺ [..Review Feedback]

## Transport

- We think we got **transport in the bag**, until each time we have to ship again (paperwork...)
- CM Transport UK ↔ CERN: good experience and data source
- A limited set of **instrumentation** may be used from now on
- Internal instrumentation based on optical fibers can be **useful also during assembly** operations and as acceptance after transports
- Envisage/Create **Local Experts** (@ STFC & TRIUMF in the future) : trained to support CERN team activities remotely, also profit to monitor during assy



## Quality Assurance

- RFD-SPS, a **huge school for CERN and for STFC** (readying Eng. Spec. and drawings for series, correct interpretation of specs and handling HL-QA nonConfs)  
→ UK and CERN WP4 have become at ease with HL-QA procedures
- Importance of NCR Evaluation : **Root cause but and also implications**
  - **Ex: RFD-SPS Biphase line: NCRs on bellows > New Pressure Test > NCR due to Plastic deformation of bellows**

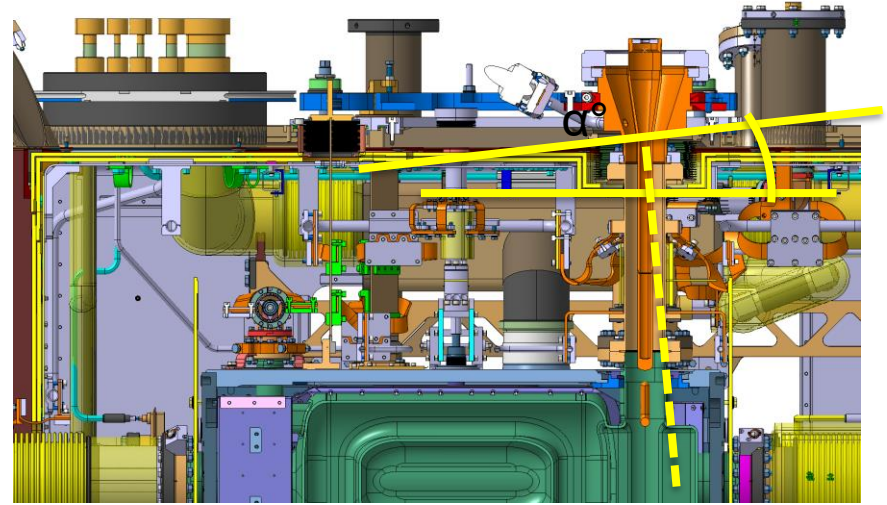
Attention to:

- compliancy with CERN **Safety Rules and Normative**. Implicit within CERN Tech Spec.
- mismatch between **CERN Spec requirements & Drawings VS. translations by collabs** (read ISO vs. ASME).

Collaboration is responsible to abide to these ( → DevReqs, PMAs, ...)

**CAUTION:** strong difference on ability to derogate, between preSeries ↔ LHC series.

# FPCs Nonconformity



- Acceptance at CERN highlighted the following Nonconformities:
  - FPC#1 : Coupler Tilted: physical contact between FPC and cavity extremity
  - FPC#2 : Coupler also tilted (no contact) + small leak @ FPC flange
- UK & CERN quickly identified cause : issue during preparation & insertion of “FPC+Plate” assembly with Top Plate
- **NCR opened ..successful repair.. test.. NCR closing**

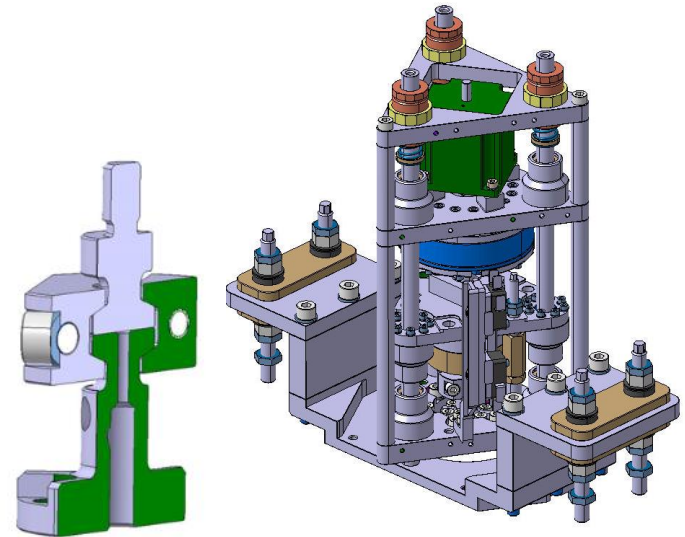
## For Series :

- Set **stronger hold point for this & most critical steps**. Give ourselves the time to check
- Adding an acceptance FPC check at UK and at CERN
- No design change for major equipment. But changes in terms ass.y tooling and addtln checks during activity
- NC allowed to **define and successfully pull-out a strategy for a major repair** (which will never be needed again ☺)

# Critical Components

RFD CM allowed for additional testing of the **Tuner** design and operation

- Ongoing upgrade design actuator (radHard, accessibility, better response to actuation)
- **Impacts external parts only**, under CERN manufacturing and assembly responsibility



## CRYO instrumentation

- Initial training and discussions with UK went really well
- For series: more **direct and timelier communication** between CERN Cryo and STFC Cryo (both resp. person and reference specialized technician)
- Needed for: Cryo quality assurance is met, who does what and when (procurement, installation), discussing specific cryo hold-points and intermediate checks
- **Next Week at CERN : dedicated Technical Meetings** (also Cryo), **Visits and "Training"** on specific equipment with UK and TRIUMF teams

# Critical Components [Ctnd]

**Production** of some CM Components has shown criticalities

**Biphase and cryolines** : materialised in the **most prominent delays and nonconfs**

- Biggest driver of delayed CM delivery for SPS tunnel assembly
- Some final acceptance tests @ UK performed at CERN (greenlighted by CERN)

**PIMs and Coaxial lines** : currently **longest lead items** for Series. **Highly technical** productions. PIMs **assy procedure vs CL requirements**

Any component with **material from CERN Spec**



**Biphase and cryolines** → Anticipation

- ✓ **Strategy** for UK **series procurement** of byphase/cryo lines defined asap
- ✓ UK avoiding **companies** w/o strong ability in Accelerator systems production.
- ✓ Reduction of **subcontracting** levels (bellows, **surface treatments**)
- ✓ Much more attentive to have **complete initial QA** for such items as early as possible (qualifications, material certificates prior to physical production)

We Worked towards decision asap on **PIMs** assy procedure vs. CL vs. shipping condition

**Critical Material** for series secured asap, and also through CERN

**Part Exchange Update** was instrumental

- WP4 CM has been designed for CERN needs and with CERN experience
- For Series : CERN ready to provide any (sub)component needed



# Critical Technical Activities

## Some CM assembly activities have shown criticalities

Some activities have been reviewed for series:

- Progress on initial steps and preparation
- **Redundant systems**
  - RF testing of cavities at STFC
  - Tuner testing, transport equipm., alignment check



**Travellers and Acceptance** after Transport.

- In general smooth
- But need to ameliorate (CERN side) communication on acceptable nonconfs (e.g. PIMs) & standardise packaging
- CERN ability to check UK Procedures for Assembly & Controls

# Important Other

Manpower is critical:

- **Loss of experience / project seniority, if too high turnover.** Current issue mainly in specialised manpower for CL and CM assy @ UK
- Lack of direct accessibility to some services has caused some delays
- For **CERN** : senior ref. person for **Clean Room**

WP4 Crab Cavities Cryomodules CERN Front Line and Responsibilities	
Project ACTIVITY	RESPONSIBLE
General	Mercio GARLASCHÉ
Tracking of design changes, 'as built'	Teddy CAPELLI
CERN Components Center (i.e. CERN Production Readiness, feedbacks fro production,...)	Simon BARRIERE
Tracking of assets. CERN Logistics & Shipping IN / OUT	Simon BARRIERE
WP4 QA/QC Follow-up (+ Welding)	Jules DEBEUX, Mylène BENAÏMED
Conformity to HL Quality Assurance & Control (CERN Reference Entity) + DevReqs	Hector GARCÍA GAVELA
Specifications & Conformity thereof (ref. person for WP4 CERN)	Luca DASSÀ, Isabel BEJAR ALONSO
MTF steps approval, procedures, NCRs, DevReqs drafting, ...	EDMS distribution list: WP4_Cryomodule_LKCCERN, WP4_Cryomodule_CANADACERN
Conformity to Specifications	EDMS distribution list: WP4_Cryomodule_LKCCERN, WP4_Cryomodule_CANADACERN
Cryomodule ACTIVITY	CERN KEY PERSON
Overall Cryomodule Design, Assembly (& support thereof)	Teddy CAPELLI, Laurene GIORDANINO
Vacuum	Giuseppe BREGLIOZZI
Alignment	Vivien RUDE
Cryogenics	Laurent DELPRAT, Vanessa GAHIER
Materials	Adria GALLIFA TERRICABRAS, Claudia SANTOS MALDONADO
Transport Engineering & Design	Kurt ARTOOS
Clean Room	Nuria VALVERDE
RF testing + CM SM1B Activities	Rama CALAGA, Nuria VALVERDE
Component	
Couplers & RF	Eric MONTESINOS, Sebastianm CALVO
Tuners	Kurt ARTOOS
Transport Equipment	Simon BARRIERE, Kurt ARTOOS
Jacketed Cavity	Nuria VALVERDE
PIMS & Vac Components	Giuseppe BREGLIOZZI

	Non-critical		Critical
	1 or 2	3	4 or 5
Standards and specifications	L. Dassa		O. Capatina
Transport engineering and Tuner	K. Artoos		O. Capatina
General Design - Test - RF compliance	N. Valverde		R. Calaga
General Design - Design & calculations	T. Capelli		O. Capatina
Manufacturing & assembly & Welding & Logistics	J. Debeux / S. Barriere	M. Garlasche	
Materials	C. Santos Maldonado	I. Aviles	S. Spobba
Survey	V. Rude	M. Sosin	H. Mainaud
Vacuum compliance	G. Bregliozzi		
Cryogenic compliance	L. Delprat/K. Brodzinski		
Cleanroom & RF cavity compliance	N. Valverde		R. Calaga
RF Tests	K. Turaj		R. Calaga
Low level RF	G. Haggmann		R. Calaga
RF Controls	A. Butterworth		R. Calaga
RF Power compliance	E. Montesinos		
Beam dynamics compliance	N. Mounet		R. Tomas
HL Quality	G. Prica		H. Garcia Gavela
Integration, Installation	G. Cipolla		P. Fessia/M. Modena
HL safety	C. Gaigant		T. Otto
Transport and handling on site	M. Perez Ornedo		C. Bertone
Safety conformity	D. Tshilumba/L. Dassa		S. Marsh
Configuration	M. Zerlauth		

## Lower-level Planning (CM Assy):

- Proven instrumental for CERN-UK interactions (visits, hold points, feedback on procedures, ...)
- Further implement for series: to avoid lag time, considering the larger timespan of CM series assy

**Excellent communication and exchange between UK and CERN, highly appreciated**  
**Also thanks for the full commitment of all UK team on solving technical challenges!**