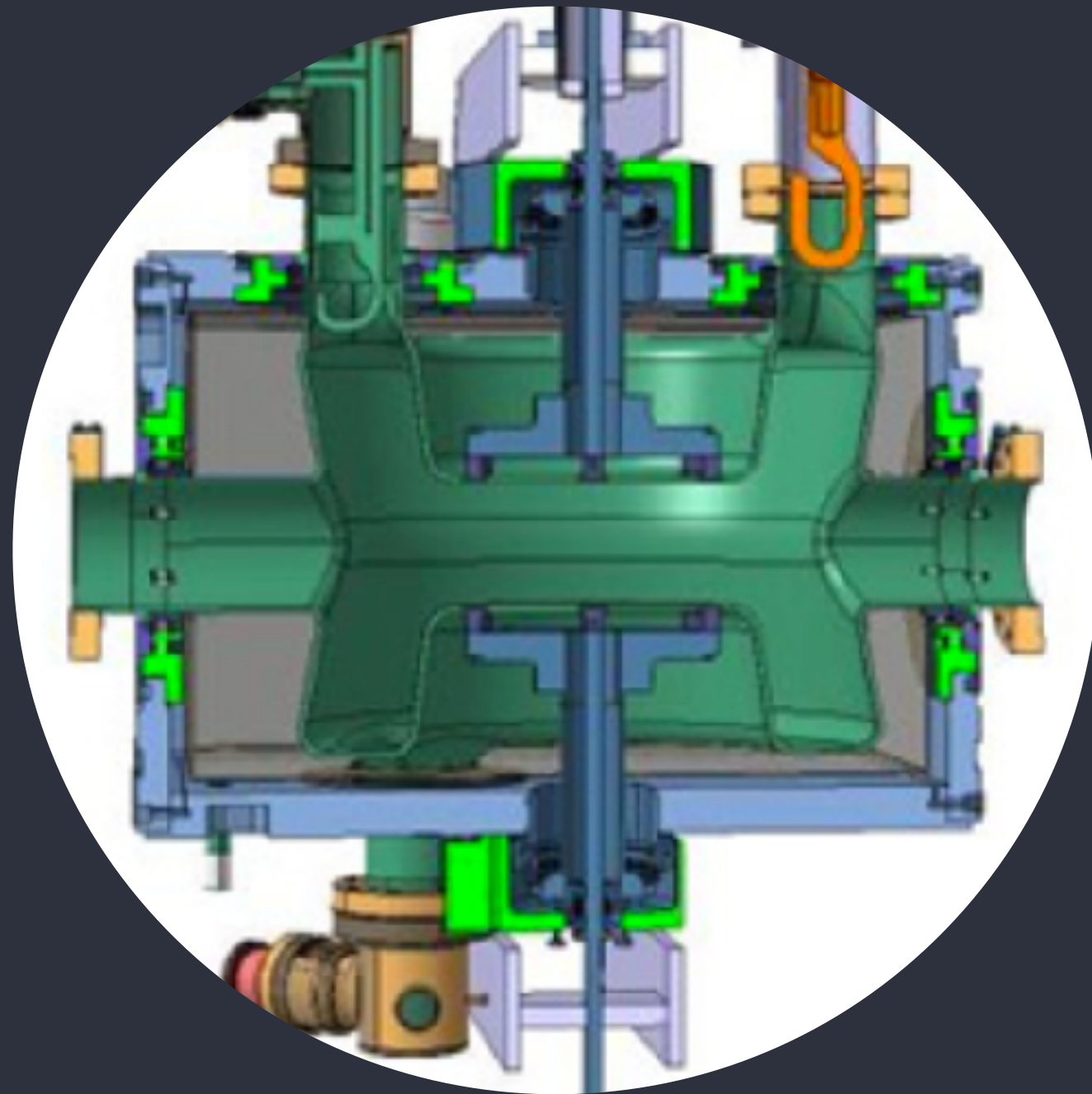


Review of clean room procedures for the HL-LHC Crab Cavity Program

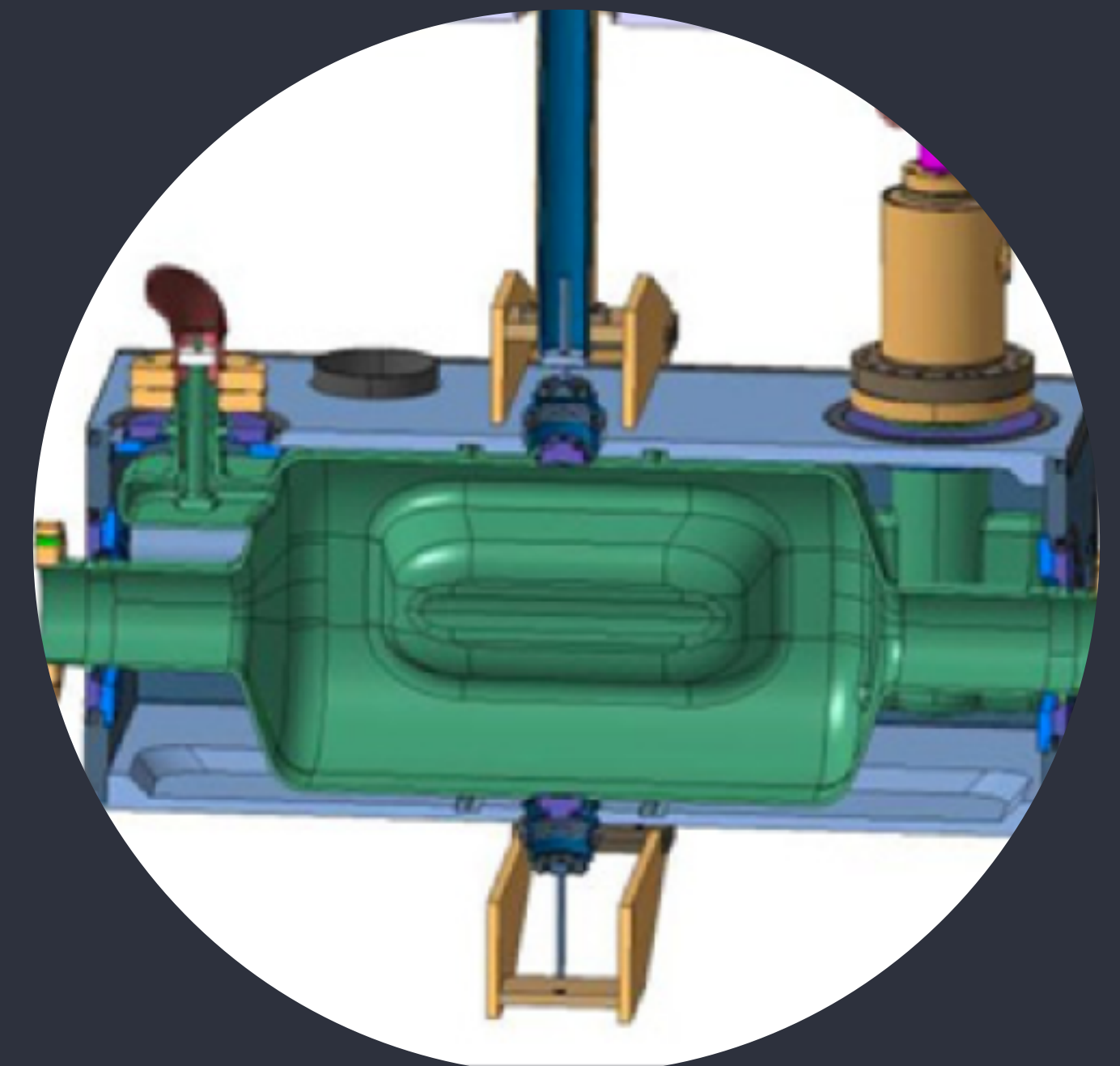
INTRODUCTION & CHARGE TO THE COMMITTEE

FRANK GERIGK

Content



- 01 History
- 02 Planning
- 03 SPS test stand
- 04 Charge to the committee

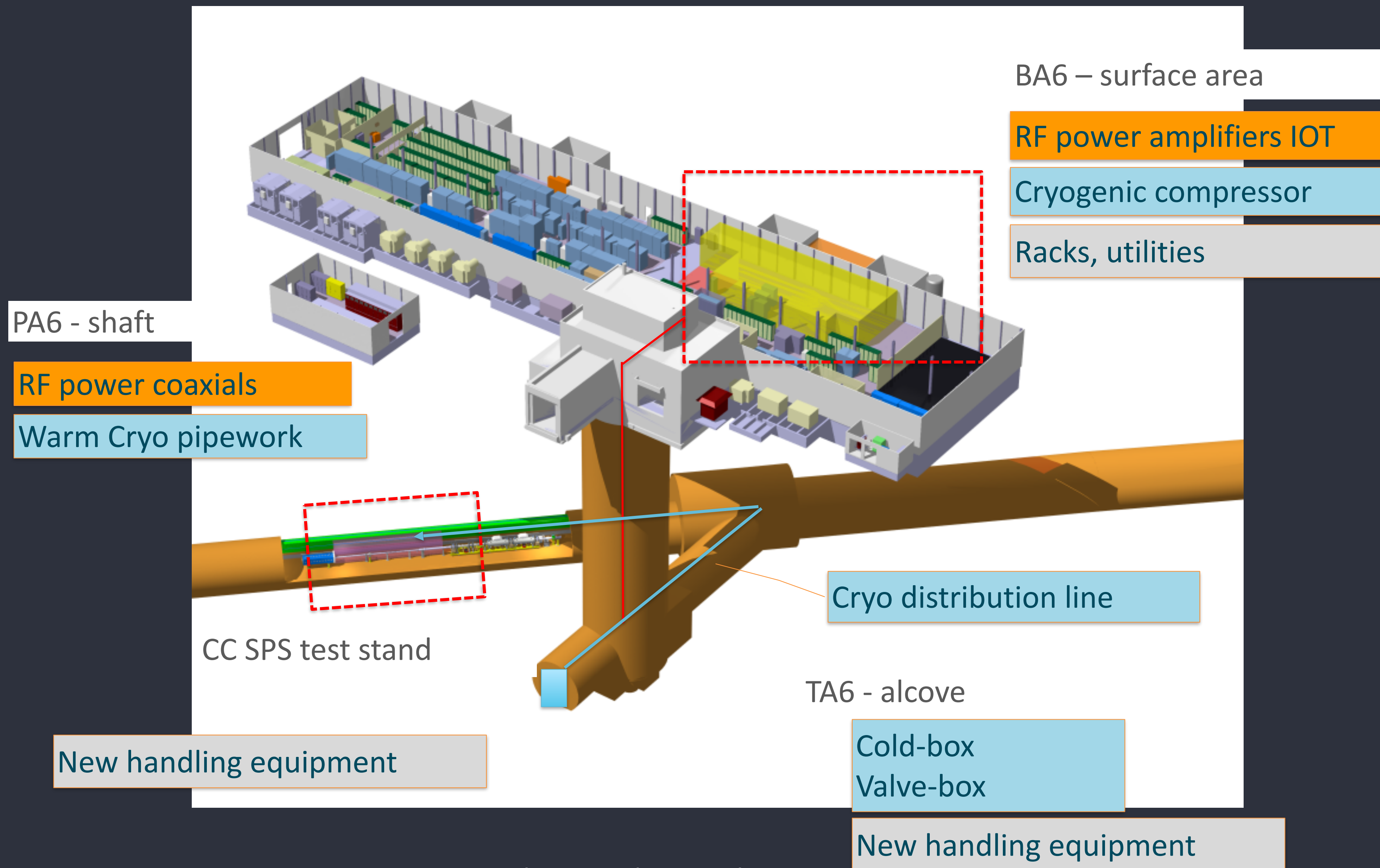


History

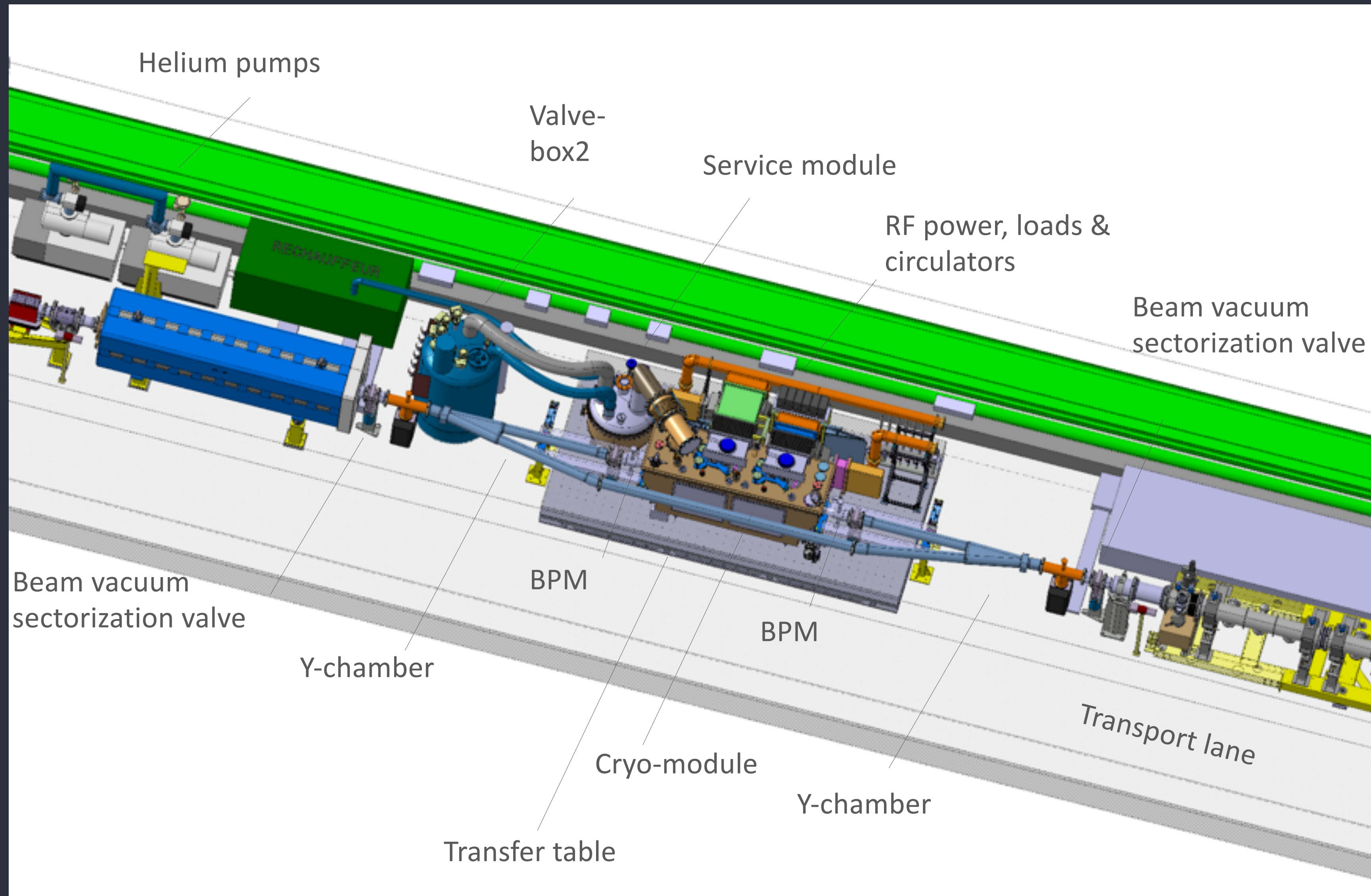
or why we are where we are

- Originally 2 types of Crab cavities (Double Quarter Wave and RF Dipole) should be tested with beam in the SPS before the 2nd long LHC shutdown (LS2).
- As it was not feasible to get both types ready before LS2, the scope was changed to a DQW test before LS2 and the RFD test after LS2.
- The DQW dressed cavities should have been delivered by the US.
- CERN took on in-sourced the DQW production in 2015 and is now ready to start assembly.
- Limited expertise in the RF group with clean room assembly of high-gradient bulk Nb cavities. Some experience was gained through the 704 MHz high-gradient program.
- At present the assembly of the HIE-ISOLDE module (Nb on Cu) is done by the magnet group with newly trained technicians with the help of external support contractors and RF group technicians.
- Only few experts remember the LHC experience (also Nb on Cu).

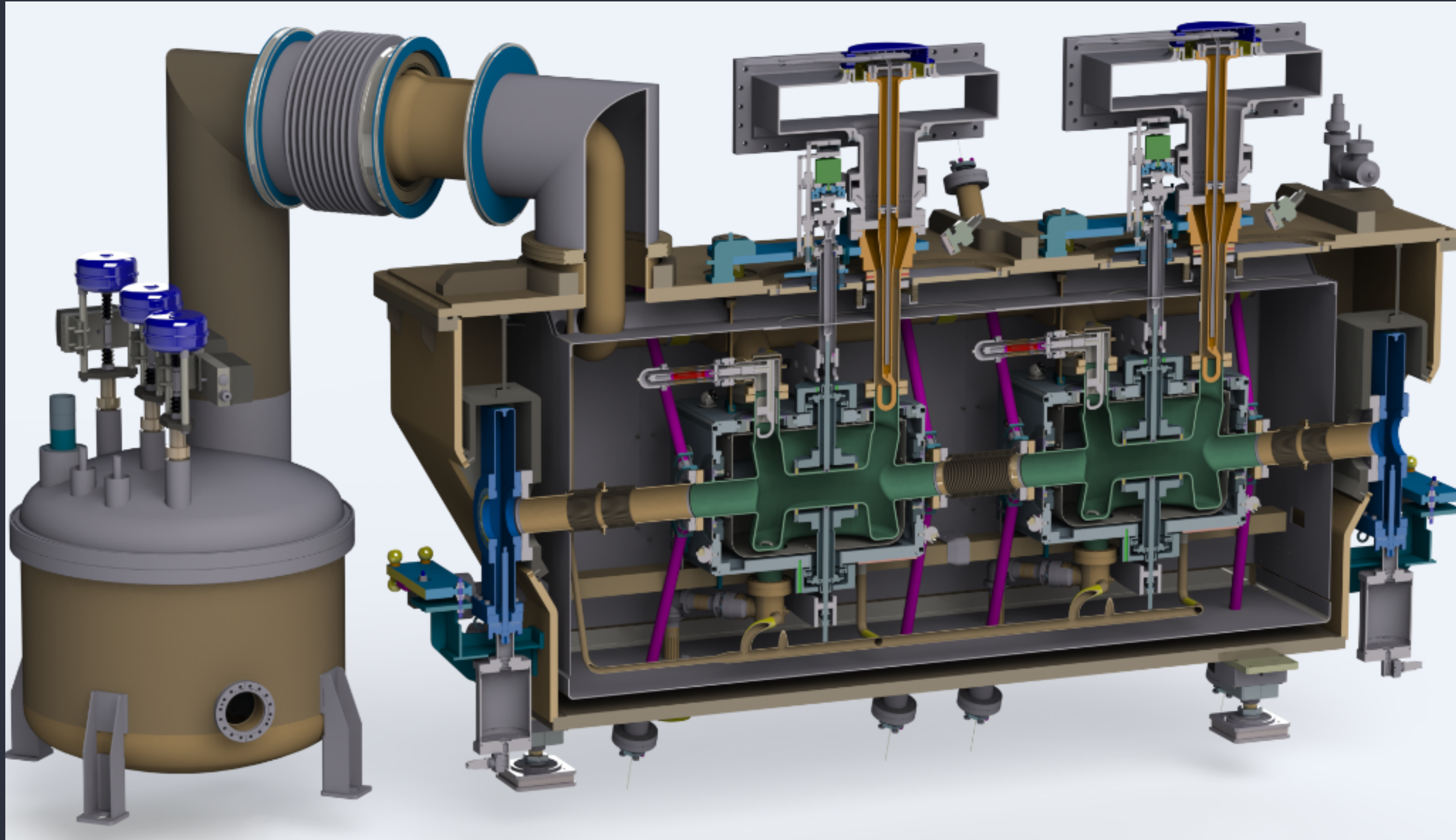
Architecture in SPS



SPS test stand layout



Parameters

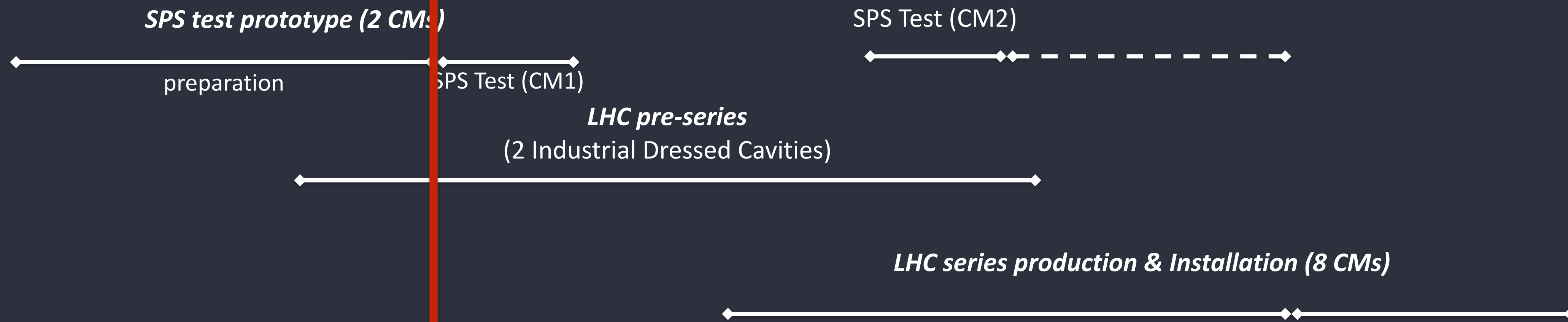
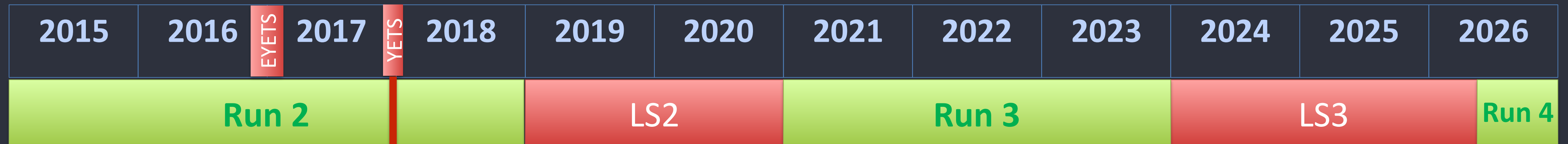


Voltage	3.4 MV/cavity
Frequency	400.79 MHz
Q_0	10^{10}
Q_{ext}	5×10^5
Cavity tuning	± 100 kHz
Temperature	2.0 K
RF power (SPS)	40 kW

- 2 cavities/beam/IP side
- for ATLAS and CMS
- 16 cavities/8 CMs in total

Timeline

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor.



YETS end: 24/2/2018

→ last installation slot

→ no time to take the module out for repairs

Changed work scope

due to insourcing of crab cavity production

	March 2015	October 2016	Remarks
Cavity construction	US delivery	CERN cavity parts ready for assembly	critical path
Cavity cleaning	Not required	Operational	HPR facility upgrade implemented;
Cavity clean room assembly	Not required	Definition of tools and procedures in progress	Clean room tools review 12 th Oct
Cryomodule	conceptual design	parts arriving at CERN	critical path
String clean room assembly, infrastructure & tooling	Requested, to be defined with CM design	Definition of tools and procedures in progress	Clean room tools review 12 th Oct
Power couplers	conceptual design	all FPCs fabricated	on time
RF power system	Tetrode/IOTs/SS	IOTs/SS	good progress
Vertical cryostats	Not required	operational	Inserts fully upgraded for cavity tests; tuner test successful with PoP cavity
Vacuum/Cryogenics	conceptual design	under procurement	

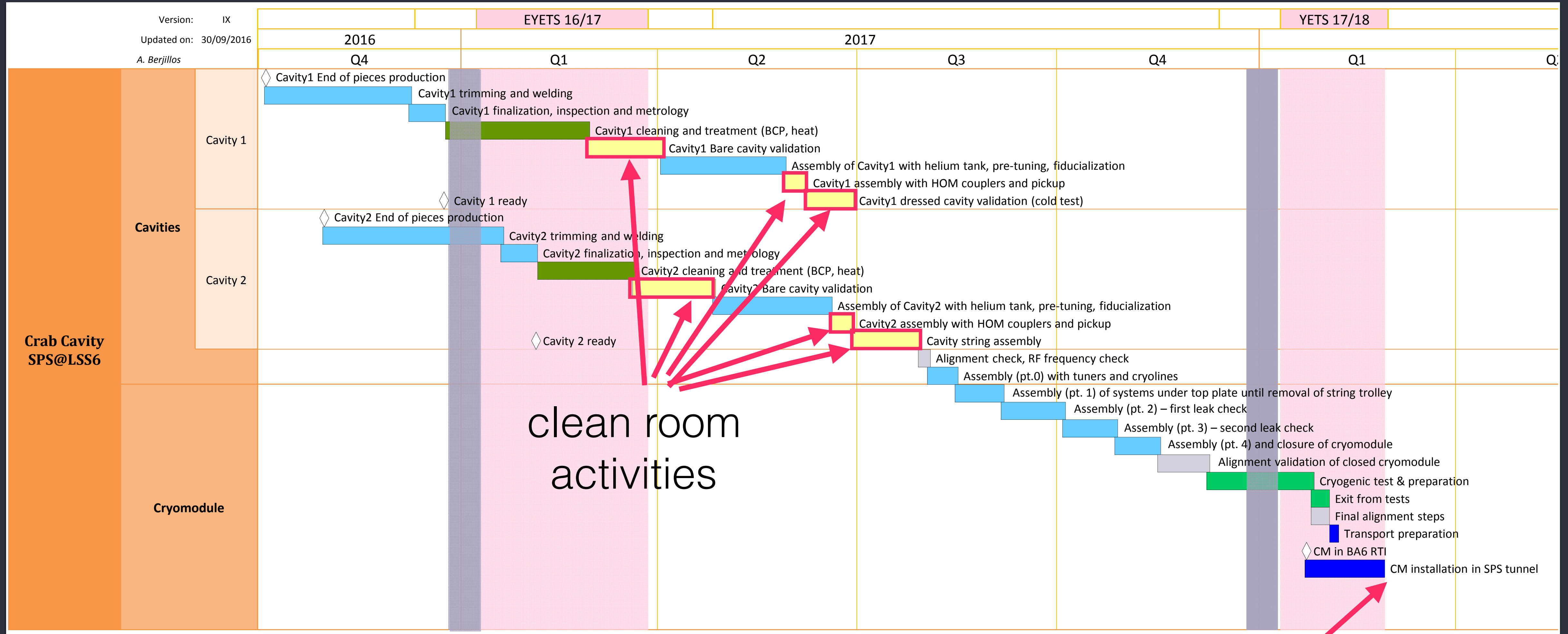
Top-down planning

	2016				2017				2018
	Qtr1	Qtr2	Qtr3	Qtr4	Qtr1	Qtr2	Qtr3	Qtr4	Jan
RF Power	2 IOTs SM18 2 IOTs in BA6 (FPC Conditioning)								
LLRF/Controls	SM18-Vertical Tests Setup		Deploy for VTA		BA6-SM18 Setup High Power & deployment				
Dressed Cavities	Cavity 1 Fabrication (Treatment + Cleanroom tooling)				Cav 2 Fabrication + Cav 1 & 2 Treatment/Testing + Clean room assembly				
FPCs	2xFPCs in SM18 Cleanroom				FPC Conditioning (TB)				
Cryomodule	Cryostat & Tooling Design/ Procurement		Cryomodule/Tooling Preparation				CM Assembly	Cold Tests	SPS
Cryogenics	Cryogenic Distribution & Valve Box SM18/SPS							CM + VB	
Movable Table	Design & Manufacturing						Tests at CERN		
SPS Infrastructure	Clear				Infrastruc ture				CM +VB,rf, cryo

Bottom-up workflow

	Task	Location		Object	Link person	Time	Tests	Tools	Activity block/ Milestone	Comments	Milestone link person	Main group	Time estimation (days)	Transport Time (days)	Total time estimation (days)	
19	Mount handling frame	72		bare cavity + frame	Marco	1 day		Frame for handling	Cavity cleaning and treatment (BCP, heat)	Frame for handling during BCP, cleaning etc... If available, mount directly the stiffening frame	Leonel	TE-VSC	1	0	36.5	
20	Cleaning + Heavy BCP	B102 + B118		bare cavity + frame	Leonel	4 weeks	ing speed vs bath speed (July to se	PVDF/PVC flanges + Support at height to allow gravity emptying + tool for bath etching speed vs bath speed		Cleaning before/after included, availability of tools?	15	1	15 days for Cavity1 10 days for Cavity2			
21	RF frequency, with antenna for cold tests	72		bare cavity + frame	Rama/ Alick?	1 day				Bead pull, antenna used here is the low power coupler	1	1				
22	Alternative Tuning	72		bare cavity + frame	Marco	1 week				OPTIONAL if the cavity frequency shift is here considered no to be manageable by the pretuning with the He tank (on the dressed cavity)	5	0				
23	RF frequency	72		bare cavity + frame	Rama					if tuning needed						
24	Metrology	72		bare cavity + frame	Marco, Mateusz	3 days				if tuning step 15, then repeat step 11	3	0				
25	Cleaning	B102		bare cavity + frame	Leonel	3 days					1.5	0				
26	Heat treatment	B153		bare cavity + frame (?)	Leonel	1 week		To be defined depending on RRR tests.		> if needed, remove handling frame > 650 C. > with Titanium foil wrapping for RRR protection? (Specification and wrapping by Alick) > oven must be qualified to preserve RRR.	3	0				
27	Light BCP	B118		bare cavity + frame	Leonel	1 week					5	0				
28	HP Water Rinsing	SM18		bare cavity + frame	Alick	3 days					3	1	included in C2			
29	Assembly of test antenna	SM18	clean room	bare cavity + frame	Alick	1 day				1	0	Deleted in Cavity2				
30	Mount stiffening frame	SM18		bare cavity + stiff. frame	Alick	1 day		Frame for supporting the cavity during cold test	120 C	1	0					
31	Assembly on insert and bake out	SM18		bare cavity + frame	Alick	1 day			Frame for supporting cavity during cold test. Can be the bolted helium tank or part of it.	1	0					
32	Cold RF test, leak test and warm up	SM18		bare cavity + stiff. frame	Alick	3 weeks				15	0					
33	Removal stiffening frame	SM18		bare cavity + frame	Alick	1 day				1	0					
34	Removal of test antenna	SM18	clean room	bare cavity + frame	Alick	1 day				1	0					
35	RF frequency	72		bare cavity + frame	Rama	1 day				1	1					

Bottom-up master plan



- LEGEND
- Marco (EN-MME)
- Alick (BE-RF)
- Mateusz (EN-ACE)
- Krzysztof (TE-CRG)
- Giovanna (BE-RF)
- Leonel (TE-VSC)
- Christmas

Charge to the committee

Review existing procedures and give advise on possible improvements in the following areas:

- Assembly procedures (including assembly for vertical cold tests)
- Handling procedures
- Clean room workflow
- Installation of fundamental power coupler and HOM couplers
- Clean room tooling
- Transport issues into the clean room and transport in the clean room
- ... and on everything else you consider important.

We request a preliminary report for the close-out session on Thursday, and a finalised set of slides by the end of October.

Agenda, 12 Oct

Chair: John Mammosser, facilitator: Frank Gerigk

TIME	WEDNESDAY, 12 OCTOBER	SPEAKER
08:30	Scope of the review, charge to the committee	Frank Gerigk
09:00	Overview of clean room facilities and clean room practices in SM18	Karl Schirm
09:20	Discussion	
09:35	Clean room work practises and procedures	Thomas Jones
10:00	Discussion	
10:25	Coffee break (conference room)	
10:55	Bare and Partially Dressed cavity preparation for cold test validation	Alejandro Castilla Loeza
11:25	Discussion	
11:55	Higher Order Mode Couplers	Eric Montesinos
12:10	Discussion	
12:30	Lunch break	
14:00	Fundamental power coupler	Eric Montesinos
14:30	Discussion	
14:50	Clean room string assembly	Alick Macpherson
15:20	Discussion	
15:40	Coffee break (conference room)	
16:00	Discussion	
	Closed session	

If clarification is needed on any point, please tell me by the end of day 1, so that we can schedule additional presentations or question time tomorrow morning.

Introduction & charge to the committee, F. Gerigk

Agenda, 13 Oct

Chair: John Mammosser, facilitator: Giovanna Vandoni

TIME	THURSDAY, 13 OCTOBER	SPEAKER
08:30	Closed session + potential clarifications	
12:30	Lunch break	
14:00	Report by the reviewers, close-out	

Lunch will be in Restaurant 1 with everyone who wants to join.