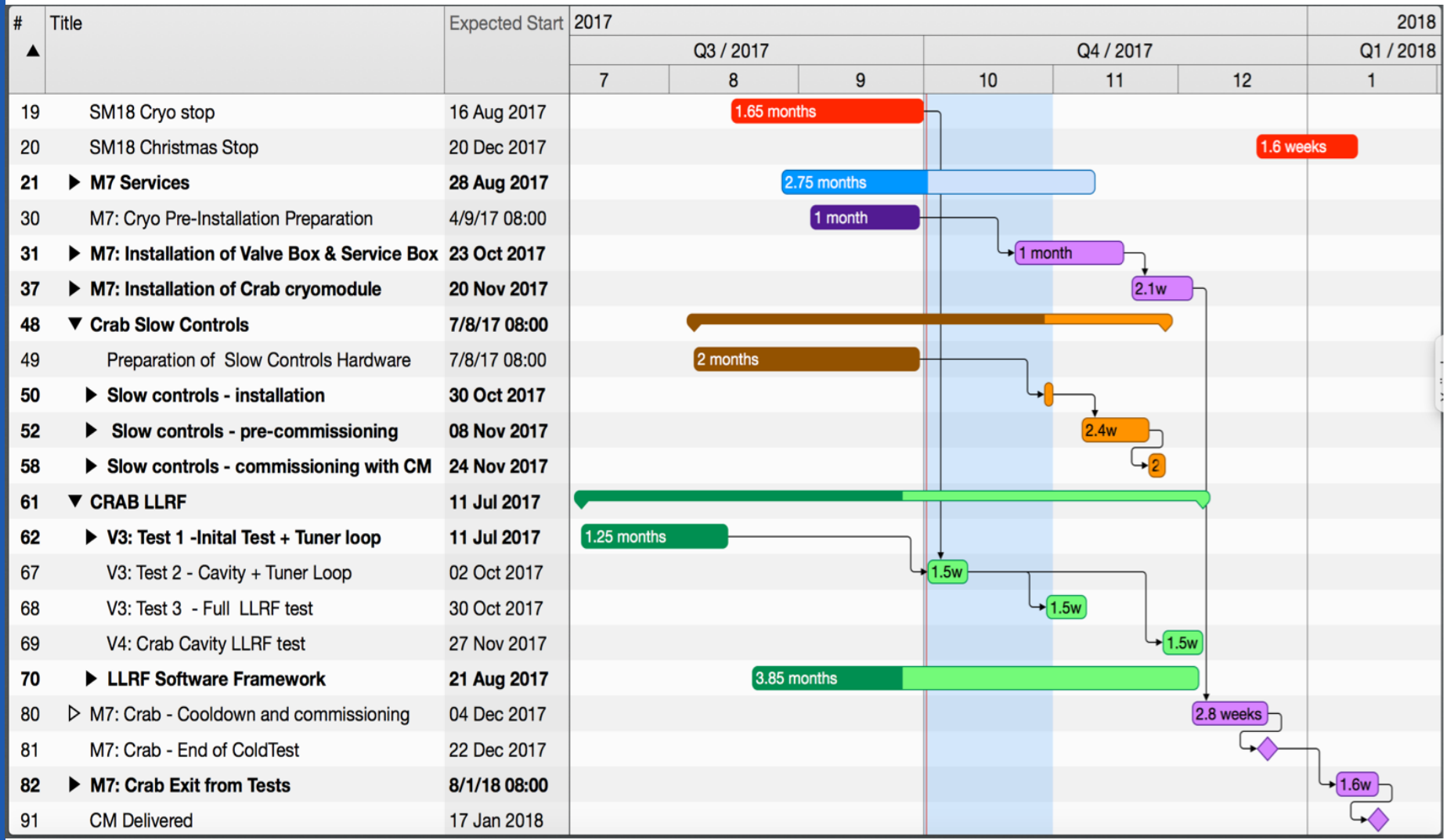
SM18 M7 Preparations for Crab Cryomofdule

A. Macpherson

Acknowledgement: S. Barriere, D. Del Alamo Mitogo

Overview of Schedule

- Planning with respect to Master_Schedule_35



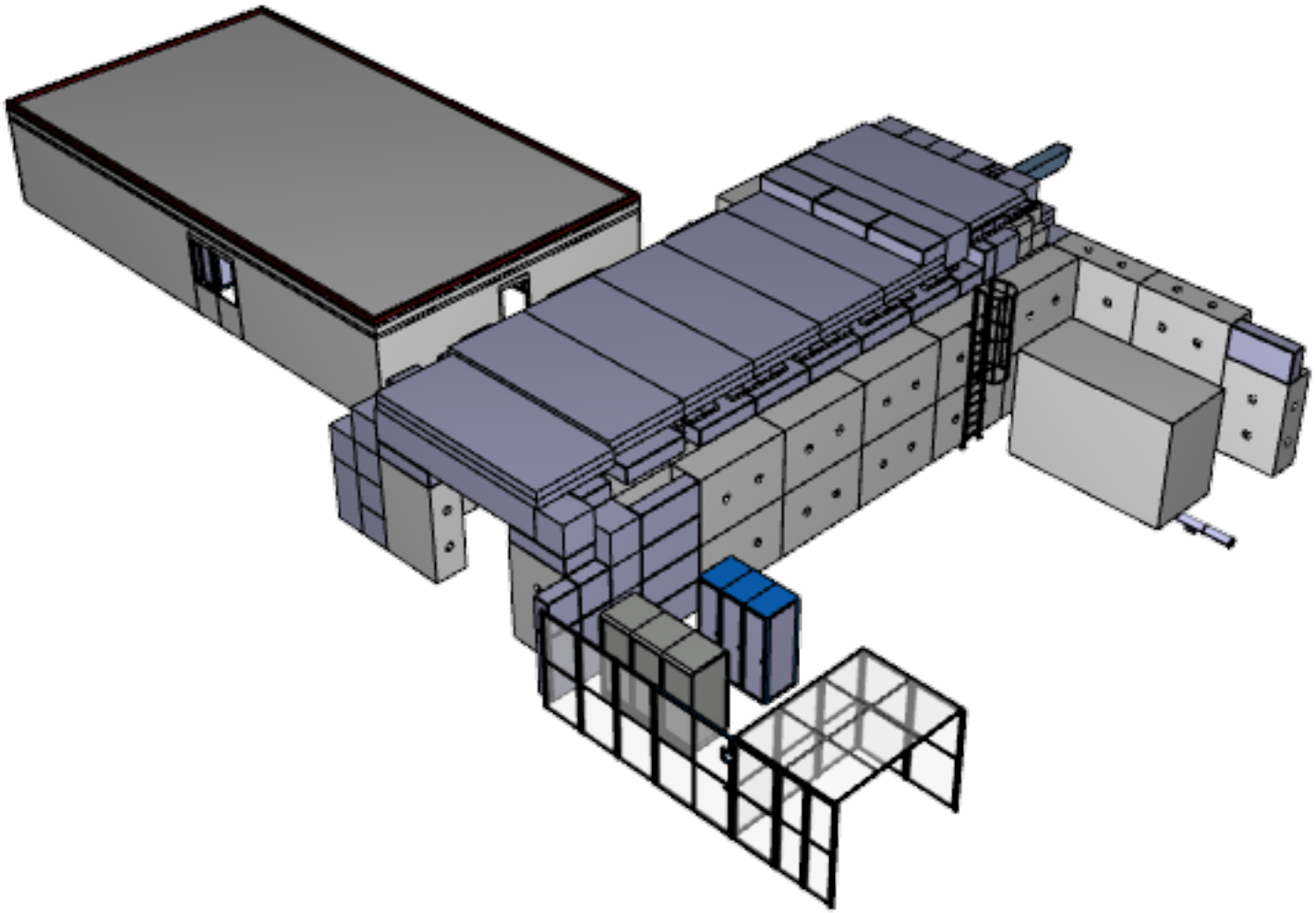
#	Title	Expected Start
19	SM18 Cryo stop	16 Aug 2017
20	SM18 Christmas Stop	20 Dec 2017
21	**M7 Services**	**28 Aug 2017**
30	M7: Cryo Pre-Installation Preparation	4/9/17 08:00
31	**M7: Installation of Valve Box & Service Box**	**23 Oct 2017**
37	**M7: Installation of Crab cryomodule**	**20 Nov 2017**
48	**Crab Slow Controls**	**7/8/17 08:00**
49	Preparation of Slow Controls Hardware	7/8/17 08:00
50	**Slow controls - installation**	**30 Oct 2017**
52	**Slow controls - pre-commissioning**	**08 Nov 2017**
58	**Slow controls - commissioning with CM**	**24 Nov 2017**
61	**CRAB LLRF**	**11 Jul 2017**
62	**V3: Test 1 -Inital Test + Tuner loop**	**11 Jul 2017**
67	V3: Test 2 - Cavity + Tuner Loop	02 Oct 2017
68	V3: Test 3 - Full LLRF test	30 Oct 2017
69	V4: Crab Cavity LLRF test	27 Nov 2017
70	**LLRF Software Framework**	**21 Aug 2017**
80	M7: Crab - Cooldown and commissioning	04 Dec 2017
81	M7: Crab - End of ColdTest	22 Dec 2017
82	**M7: Crab Exit from Tests**	**8/1/18 08:00**
91	CM Delivered	17 Jan 2018

Activities being addressed

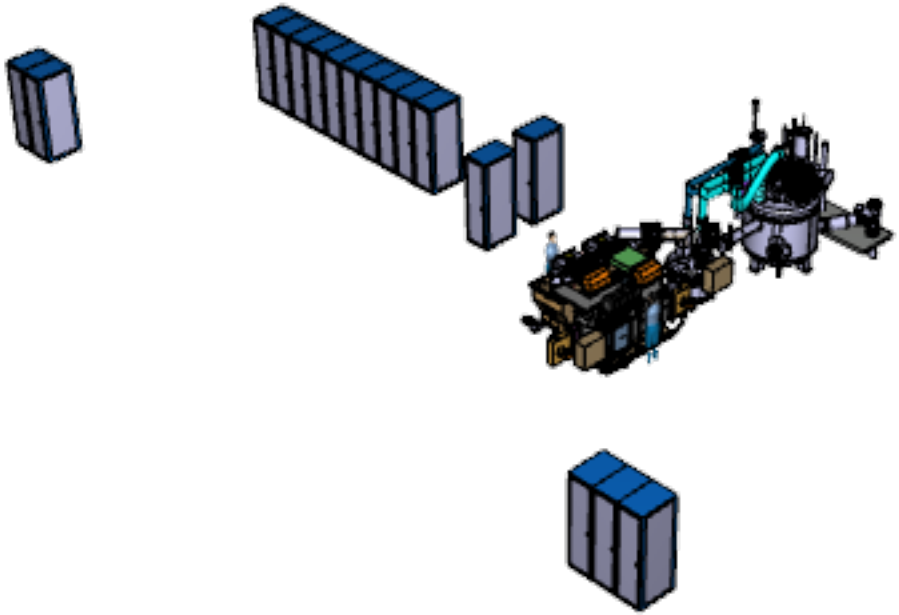
- **Installation/ Replacement of Services**
  - Electrical racks, cabling, alimentation and network
  - Water and compressed air
  - Radiation Monitoring and Access system
- **Cryogenics**
  - Installation Valve box and Service Box
  - Preparation of control process
- **Cryomodule installation**
  - Transport of Cryomodule
  - Connection of Cryomodule
- **Control of Cryomodule**
  - Slow Controls
  - LLRF development
  - RF Power

Activities matched with full 3D integration model

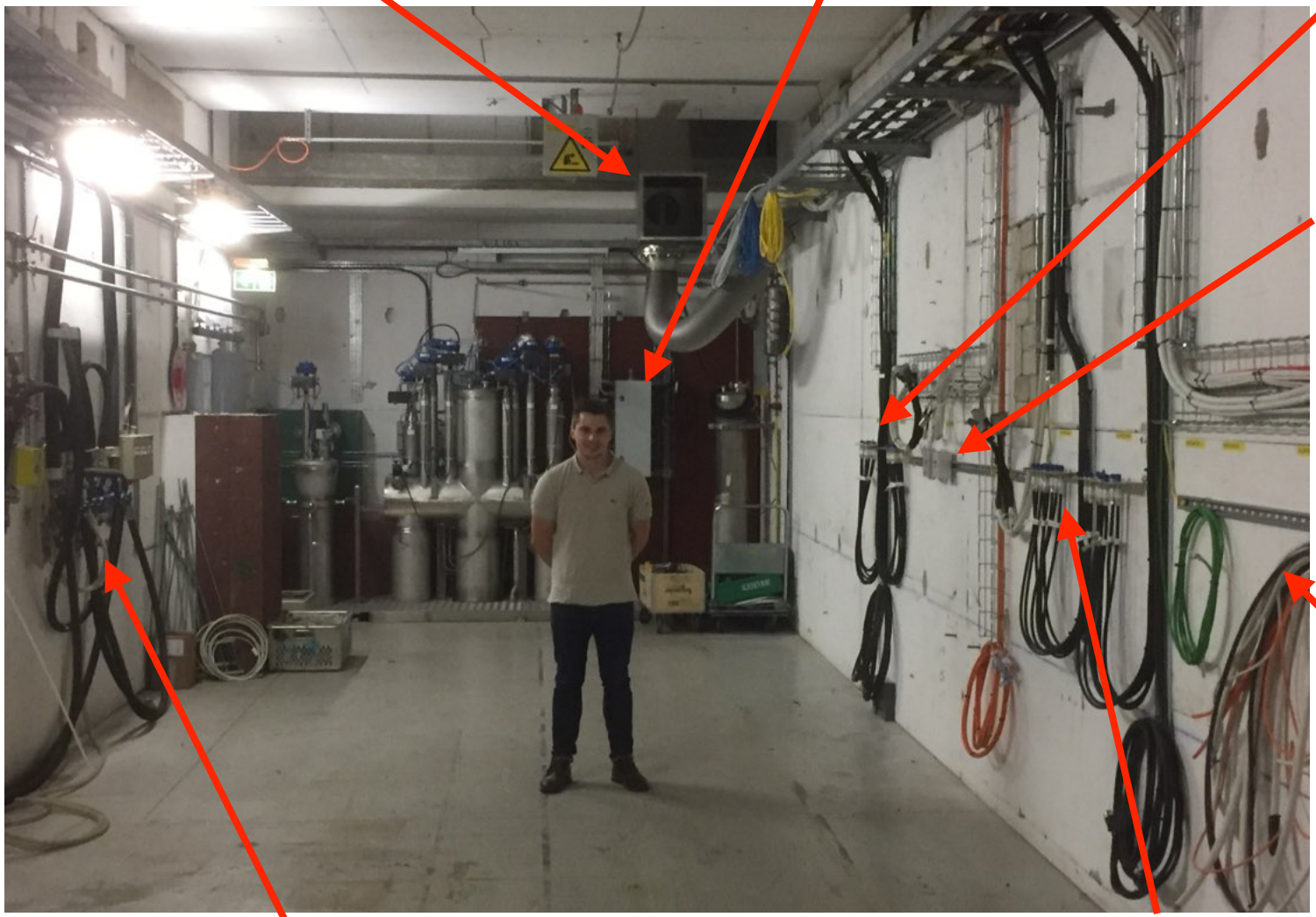
Crab Cryomodule Installation



Crab Cryomodule Installation



M7: Situation at present



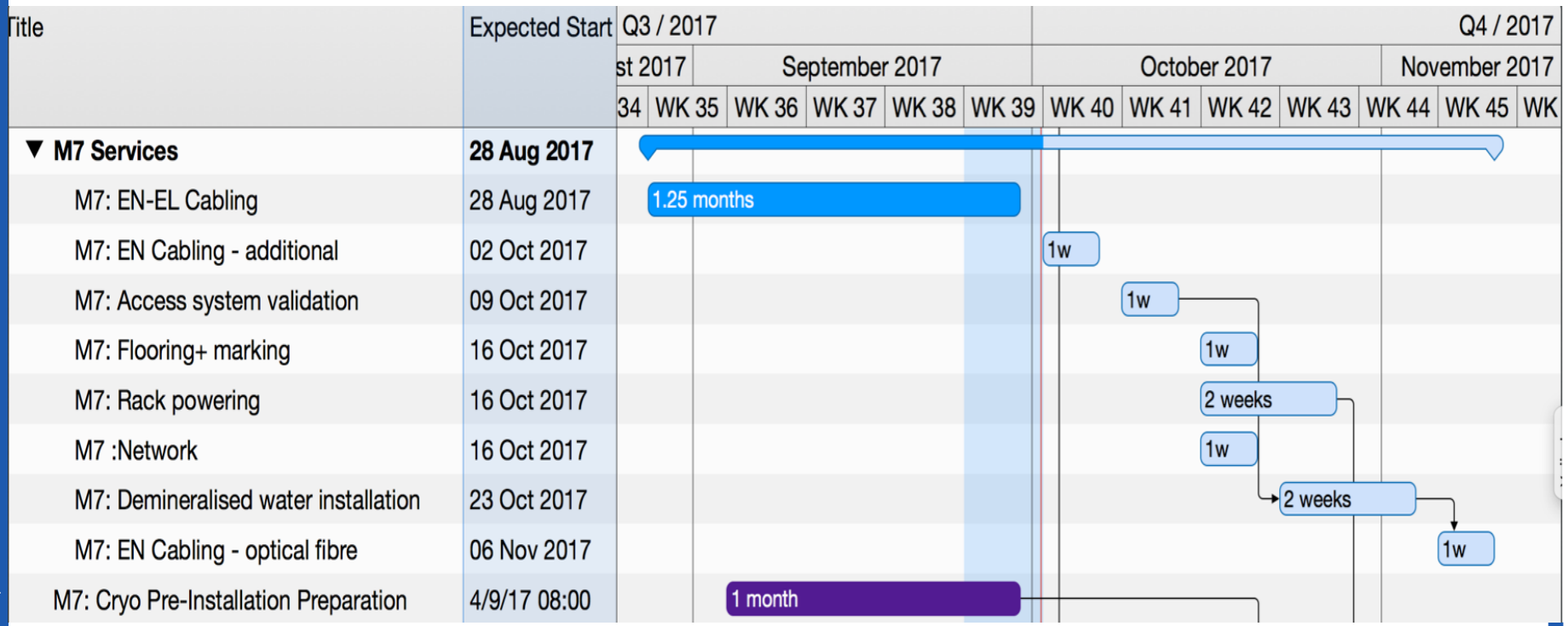
Preparations

- **Ongoing Service Infrastructure**

System	Status
Integration	**Done**
New Racks Installed	**Done**
Rack Alimentation	Starting
Rack network	Ongoing
Cabling - RF Power	**Done**
Cabling - RF LLRF	**Done**
Cabling - Vacuum	Finishing
Cabling - Alignment	Ongoing
Cabling - Cryo	**Done**
Cabling Radiation Monitors	mid October
Water	Ongoing - just completed VIC
Compressed Air	**Already available**
Renewal of floor	Can start now
Installation of Valve Box	Start 23rd October
Installation of Service Box	End of October
Transport Choreography	Mostly Done

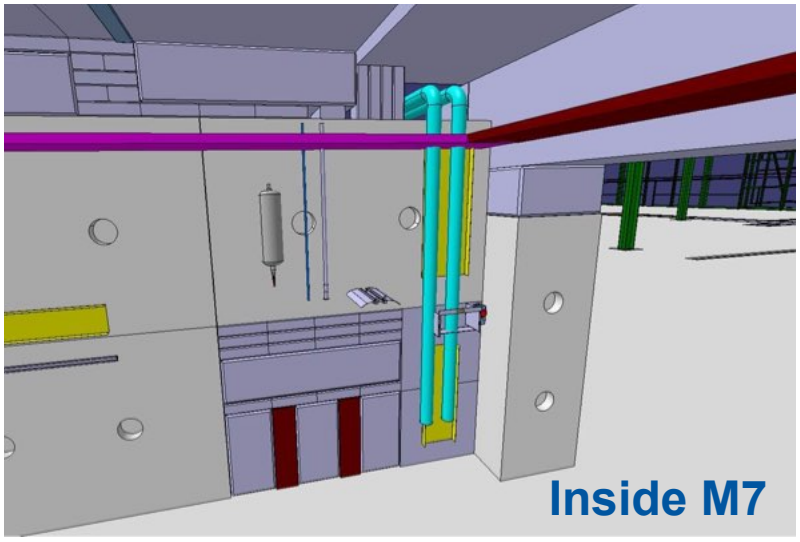
M7 Services

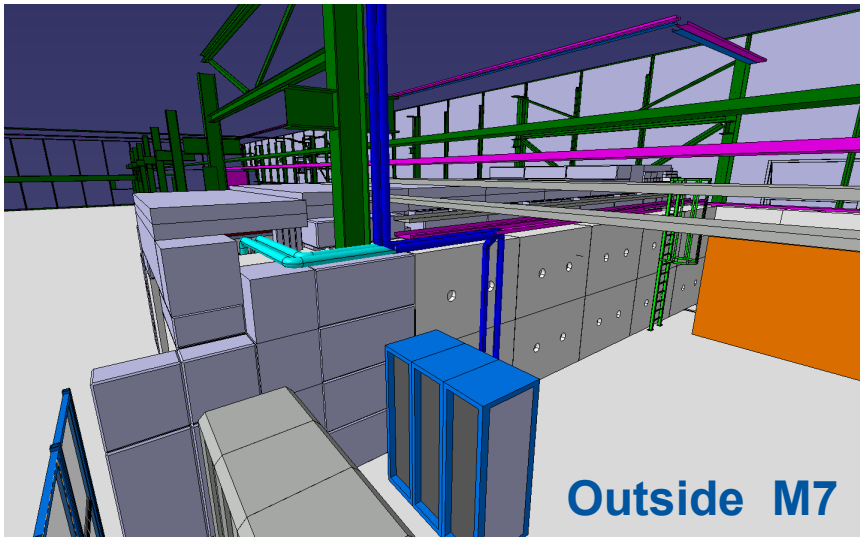
- **Racks and signal/controls cables installed**
  - Network and rack power being addressed
- **Water distribution to be upgraded over next 2 weeks**
- **Alignment optical fibre - waiting for confirmation**
- **Cryogenics:**
  - All mechanical & electrical work prior to VB install now completed



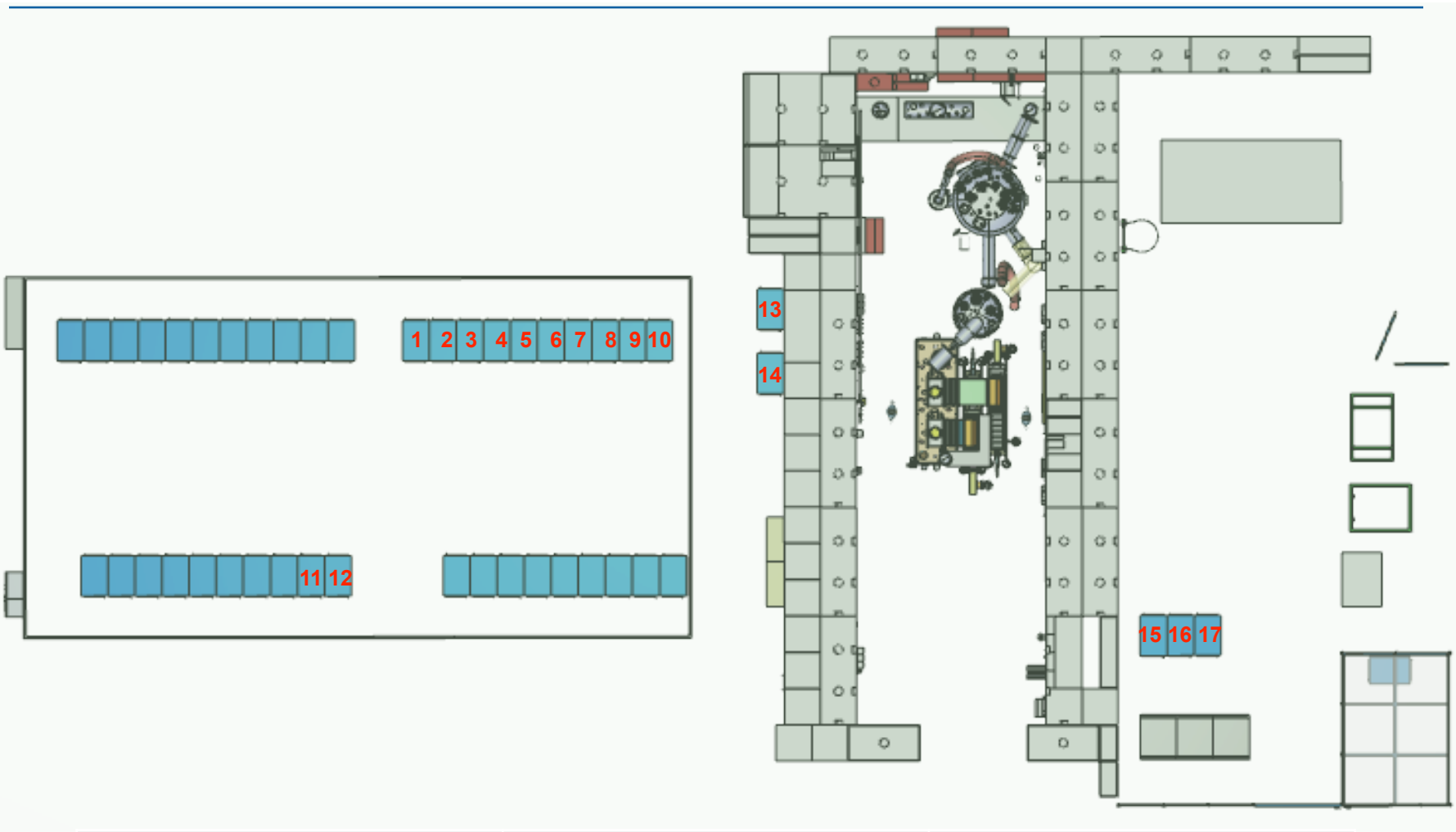
Mechanical Services

- **All required racks and cable trays installed**
  - Flexwell cable protection now being designed
- **Rack ventilation and grounding scheme cleaned up**
- **Helium emergency ventilation line agreed with HSE**
- **Water distribution**
  - Circulator & Load need 100litre/min
    => distribution being replaced and rerouted





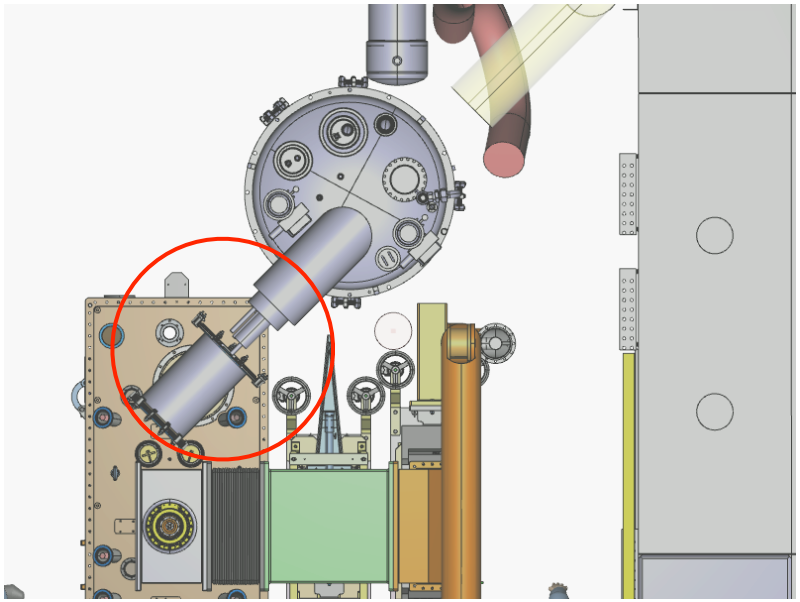
Control room layout



1: Cryogenics Instrumentation	7: Power - Cavity 1	13: Vacuum Rack
2: Alignment	8: Power Operations	14: Cryo Instrumentation
3: LLRF - Cavity 1	9: Power - Cavity 2	15: Power - Cavity 1
4: LLRF - Operation	10: Access	16: Power Controls
5: LLRF - Cavity 2	11: RF Fast Radiation monitor	17: Power - Cavity 2
6: Operation/Controls	12: RP Radiation Monitoring	

Mechanical: Cryomodule Installation

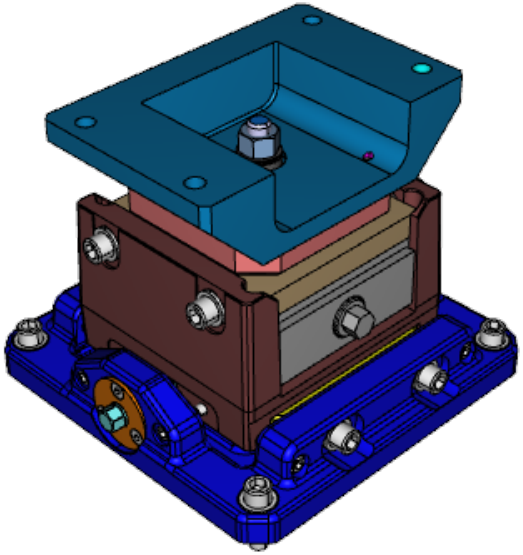
- **Installation: Transport see no real issue**
  - Proposal: Use ORMIG lifter to install CCCM with
    - Available: start of November
    - CM lifted from above: 4 point lift using CM lift points
  - No issue with installation choreography
    - Placement wrt Valve Box: placement to ± 1mm

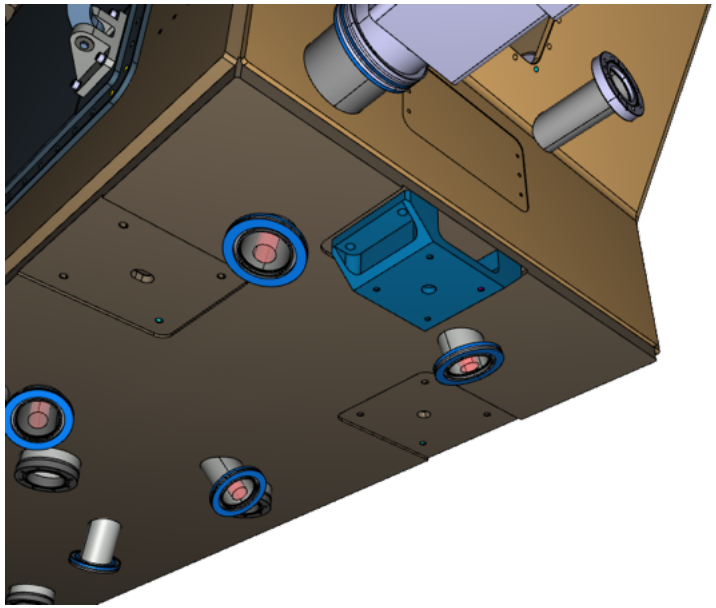


Placement of cryomodule

- **Recommendation is to use existing feet**
  - Feet to be pre-installed in M7
    - simple interface to CM
    - Well defined positioning
    - Ability for horizontal and vertical adjustment once CM installed
  - Feet removed from M7 and transferred to SPS once test is finished

- Foot interface: Fix to floor. Single 1-bolt interface between foot & CM





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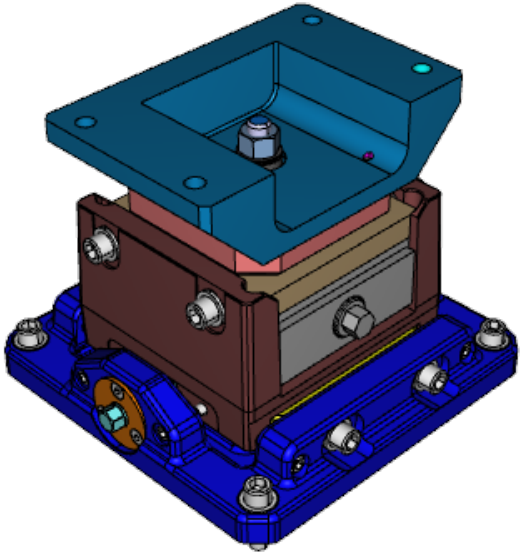
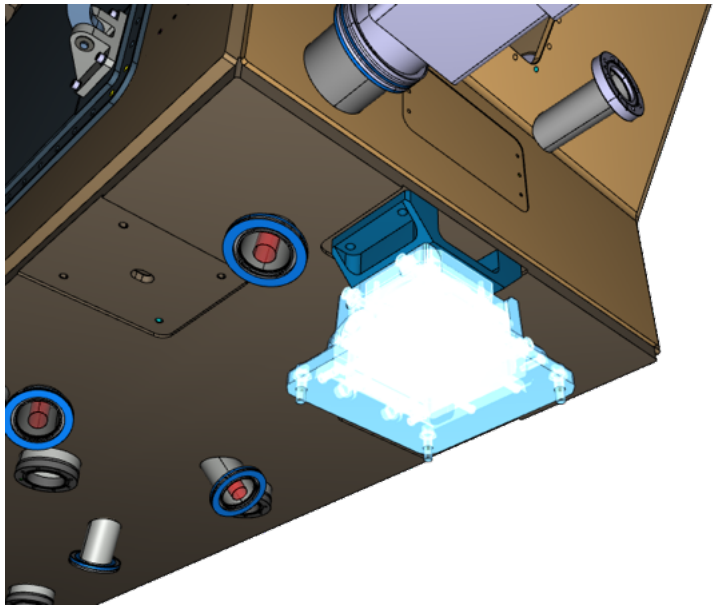
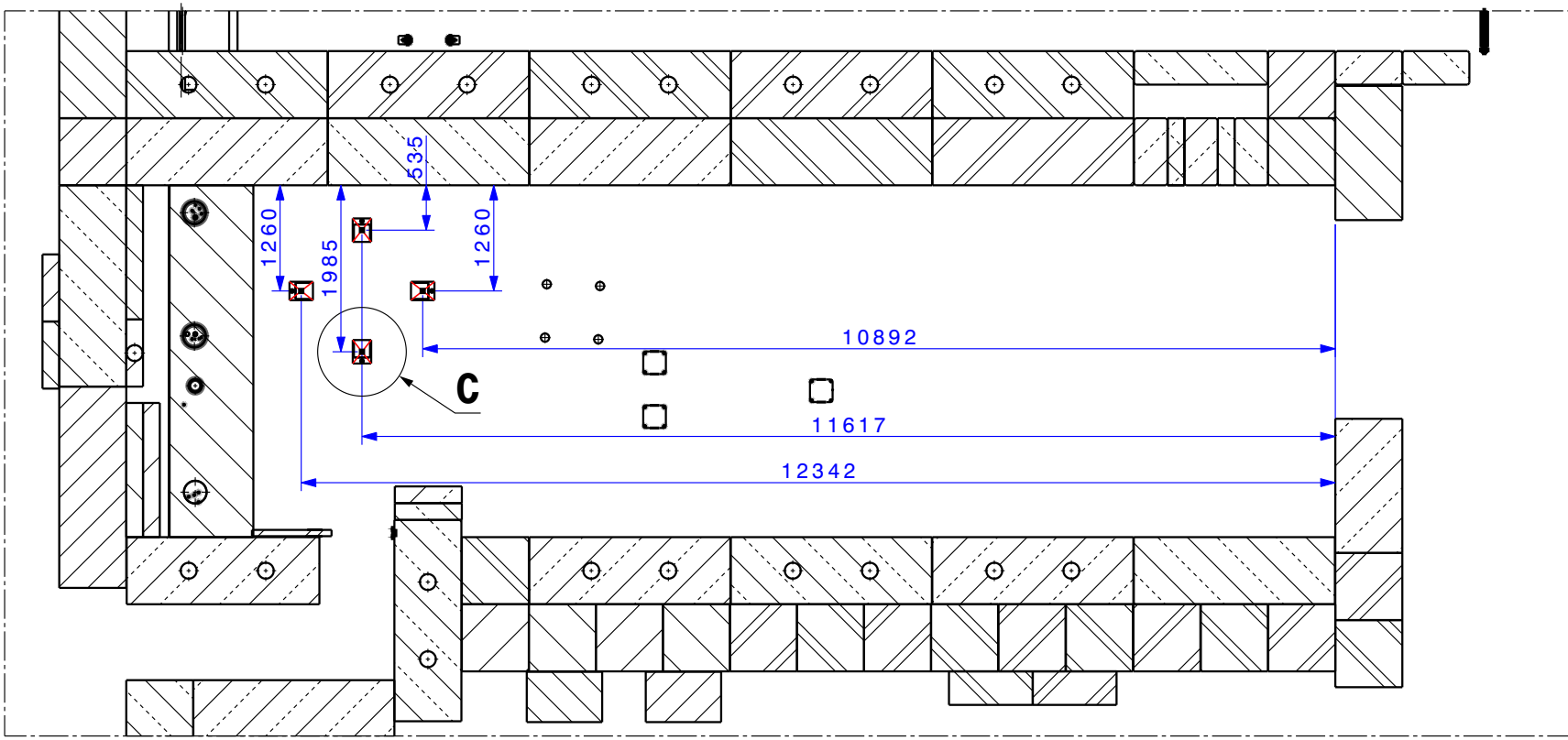
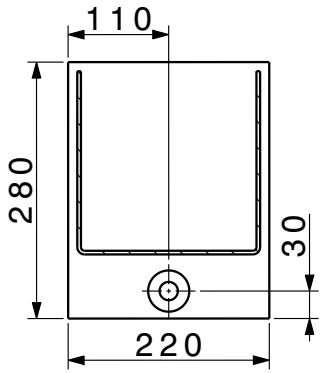




Placement in M7





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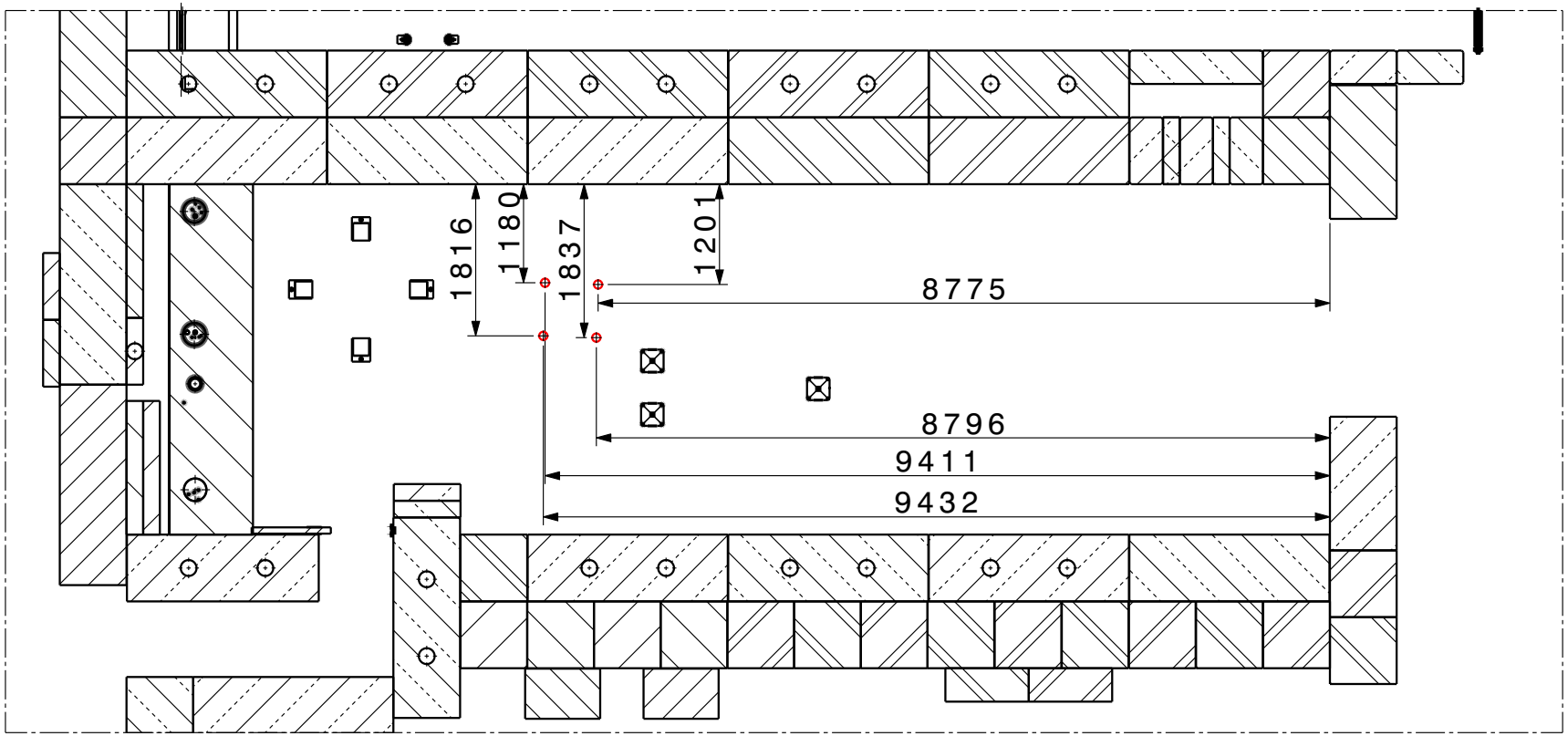
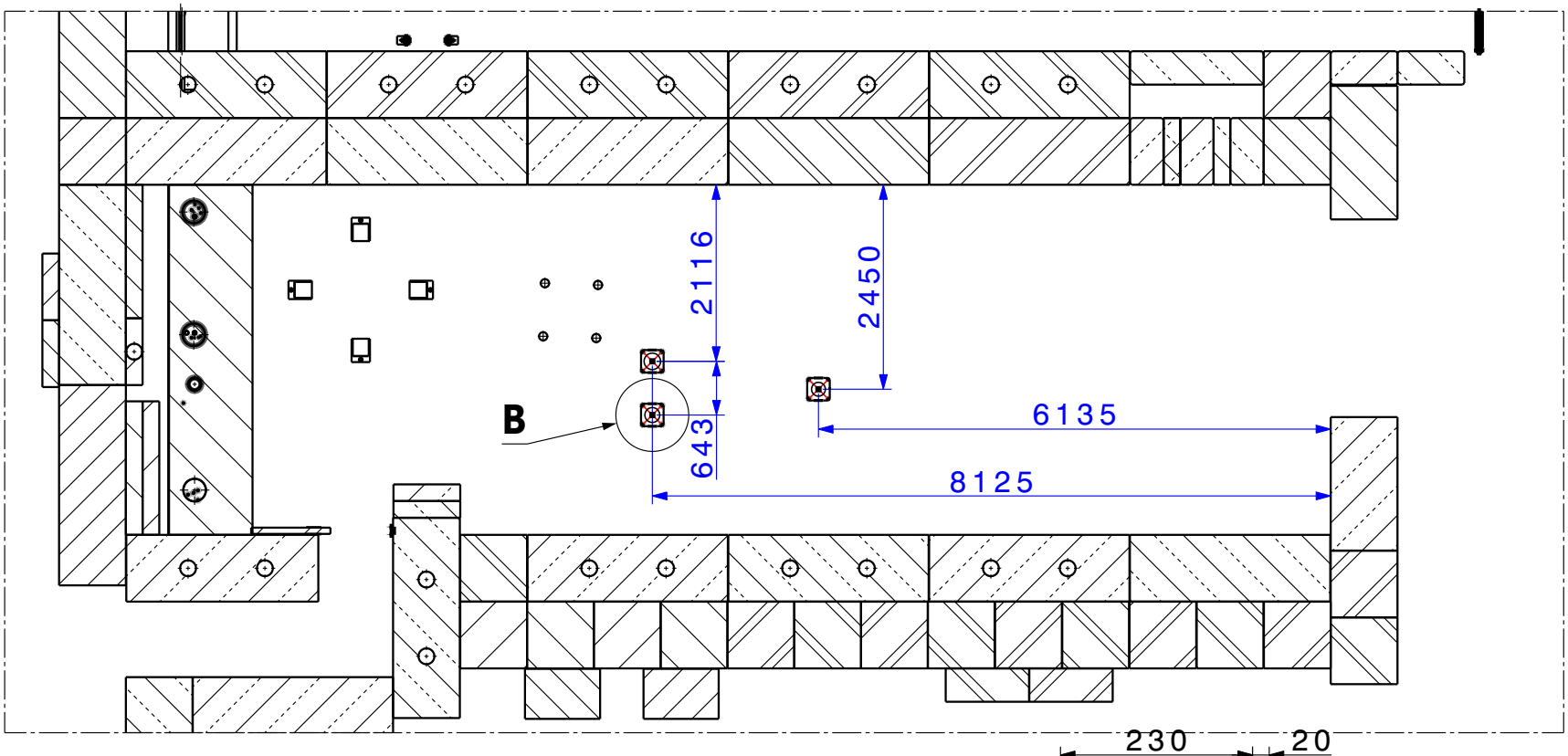
Position of the valve Box

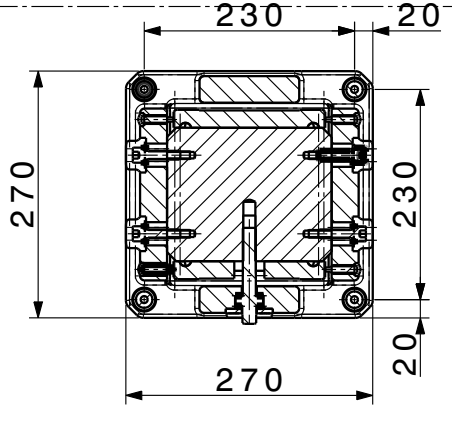
Placement in M7



Position of the Service Box

Placement in M7





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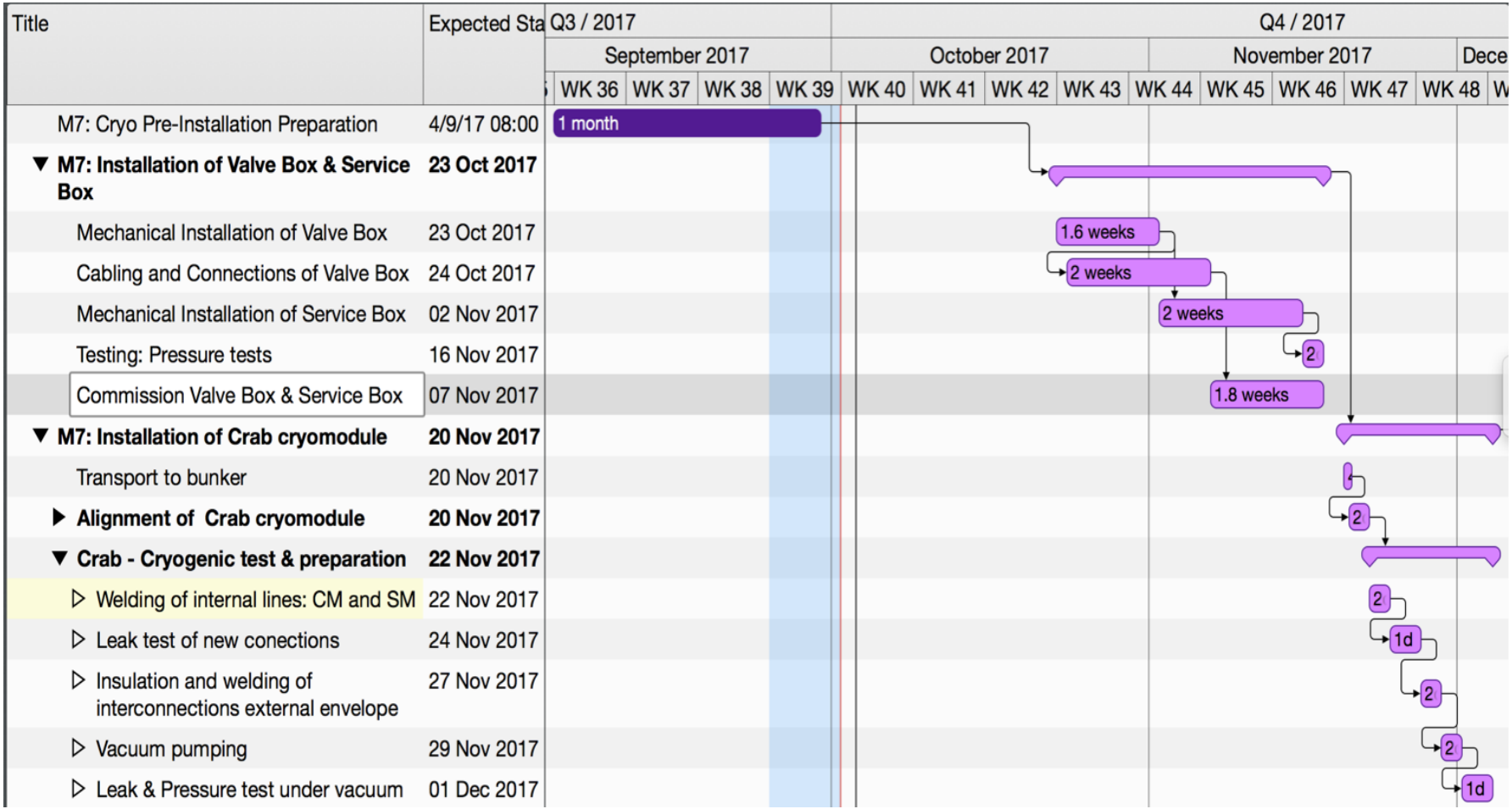
Position of the CCCM

Cryogenics Planning

- **Work managed with Olivier Pirotte and Andrew Lees**
  - Valve Box and Service Box installed before 7th Nov.
    - Supporting instrumentation & services installed by 7th Nov.
  - Cryomodule expected in M7 : 20th Nov.



TE-CRG: detailed planning

ID	Task Name	Duration	Start	Finish
269	**7.1.3 Installation of Valve Box**	**41 days**	**Mon 11/09/17**	**Mon 06/11/17**
270	**7.1.3.1 Mechanical**	**38 days**	**Mon 11/09/17**	**Wed 01/11/17**
271	7.1.3.1.1 Modification to Infra warm piping	5 days	Mon 11/09/17	Fri 15/09/17
272	7.1.3.1.2 Warm flow meter (7FC805)	1 day	Mon 18/09/17	Mon 18/09/17
273	7.1.3.1.3 Valve box delivery	0 days	Fri 20/10/17	Fri 20/10/17
274	7.1.3.1.4 Positioning of Valve box	1 day	Mon 23/10/17	Mon 23/10/17
275	7.1.3.1.5 Interconnection SM-VB	5 days	Tue 24/10/17	Mon 30/10/17
276	7.1.3.1.6 Warm piping to valve box	2 days	Tue 31/10/17	Wed 01/11/17
277	**7.1.3.2 Local cabling and connections**	**10 days**	**Tue 24/10/17**	**Mon 06/11/17**
278	**7.1.4 Installation of CCSB**	**10 days**	**Thu 02/11/17**	**Wed 15/11/17**
279	**7.1.4.1 Mechanical**	**10 days**	**Thu 02/11/17**	**Wed 15/11/17**
280	7.1.4.1.1 Delivery and positioning of CCSB	2 days	Thu 02/11/17	Fri 03/11/17
281	7.1.4.1.2 Connect TL1 & TL2	5 days	Mon 06/11/17	Fri 10/11/17
282	7.1.4.1.3 Connect warm piping to CCSB	3 days	Mon 13/11/17	Wed 15/11/17
283	**7.1.4.2 Local cabling, connections & installation of CCCM rack**	**5 days**	**Mon 06/11/17**	**Fri 10/11/17**
284	**7.1.5 Testing**	**2 days**	**Thu 16/11/17**	**Fri 17/11/17**
285	7.1.5.1 Pressure Test	1 day	Thu 16/11/17	Thu 16/11/17
286	7.1.5.2 Global leak test	1 day	Fri 17/11/17	Fri 17/11/17
287	**7.1.6 Commissioning VB+CCSB (partial)**	**12 days**	**Tue 07/11/17**	**Wed 22/11/17**
288	**7.1.6.1 Valve initialisation**	**9 days**	**Tue 07/11/17**	**Fri 17/11/17**
289	7.1.6.1.1 Valve Box	3 days	Tue 07/11/17	Thu 09/11/17
290	7.1.6.1.2 CCSB	2 days	Thu 16/11/17	Fri 17/11/17
291	**7.1.6.2 Syncro Test (Valves and instrumentation)**	**3 days**	**Mon 20/11/17**	**Wed 22/11/17**
292	**7.1.7 Installation of CCCM**	**11 days**	**Mon 20/11/17**	**Mon 04/12/17**
293	**7.1.7.1 Mechanical**	**11 days**	**Mon 20/11/17**	**Mon 04/12/17**
294	7.1.7.1.1 Delivery and positioning of CCCM	2 days	Mon 20/11/17	Tue 21/11/17
295	7.1.7.1.2 Connect CCSB Jumper	5 days	Wed 22/11/17	Tue 28/11/17
296	7.1.7.1.3 Pumping of vacuum	2 days	Wed 29/11/17	Thu 30/11/17
297	7.1.7.1.4 Purge and global leak test - Max operation pressure	2 days	Fri 01/12/17	Mon 04/12/17
298	**7.1.7.2 Local cabling and connections**	**2 days**	**Wed 29/11/17**	**Thu 30/11/17**
299	**7.1.7.3 Syncro Test (Valves and instrumentation)**	**2 days**	**Fri 01/12/17**	**Mon 04/12/17**
300	**7.1.8 Commissioning and Test of CCSB-CCCM**	**23 days**	**Tue 05/12/17**	**Thu 18/01/18**
301	7.1.8.1 Cryo commissioning (interlocks, SM PS, mixing chamber)	3 days	Tue 05/12/17	Thu 07/12/17
302	7.1.8.2 Cavities cooldown to 150K, deltaT<50K	5 days	Fri 08/12/17	Tue 12/12/17
303	7.1.8.3 LLRF testing & conditioning	0 days	Tue 12/12/17	Tue 12/12/17
304	7.1.8.4 Cavities cooldown to 50K as fast as possible, deltaT<50K	2 days	Wed 13/12/17	Thu 14/12/17
305	7.1.8.5 Cavities thermalization 50K	0 days	Thu 14/12/17	Thu 14/12/17
306	7.1.8.6 Shield cooldown	5 days	Fri 15/12/17	Tue 19/12/17
307	7.1.8.7 Cavities cooldown to 4.5 K	1 day	Wed 20/12/17	Wed 20/12/17
308	7.1.8.8 Cavities LHe filling	0.5 days	Thu 21/12/17	Thu 21/12/17
309	7.1.8.9 Cavities cooldown to 2K	1 day	Thu 21/12/17	Fri 22/12/17
310	7.1.8.10 Tests at 2K (RF testing)	0 days	Fri 22/12/17	Fri 22/12/17
311	7.1.8.11 Warm up 2K -> 4.5K	0.5 days	Fri 22/12/17	Fri 22/12/17
312	7.1.8.12 Warm Up to 300K, deltaT<50K	4 days	Mon 08/01/18	Thu 11/01/18
313	**7.1.8.13 Removal of CCSB & CCCM**	**5 days**	**Fri 12/01/18**	**Thu 18/01/18**
314	7.1.8.13.1 Cut jumper connection	2 days	Fri 12/01/18	Mon 15/01/18
315	7.1.8.13.2 Cut Service Box Connection	2 days	Fri 12/01/18	Mon 15/01/18
316	7.1.8.13.3 Transport preperation	2 days	Tue 16/01/18	Wed 17/01/18
317	7.1.8.13.4 Transport to BA6	1 day	Thu 18/01/18	Thu 18/01/18

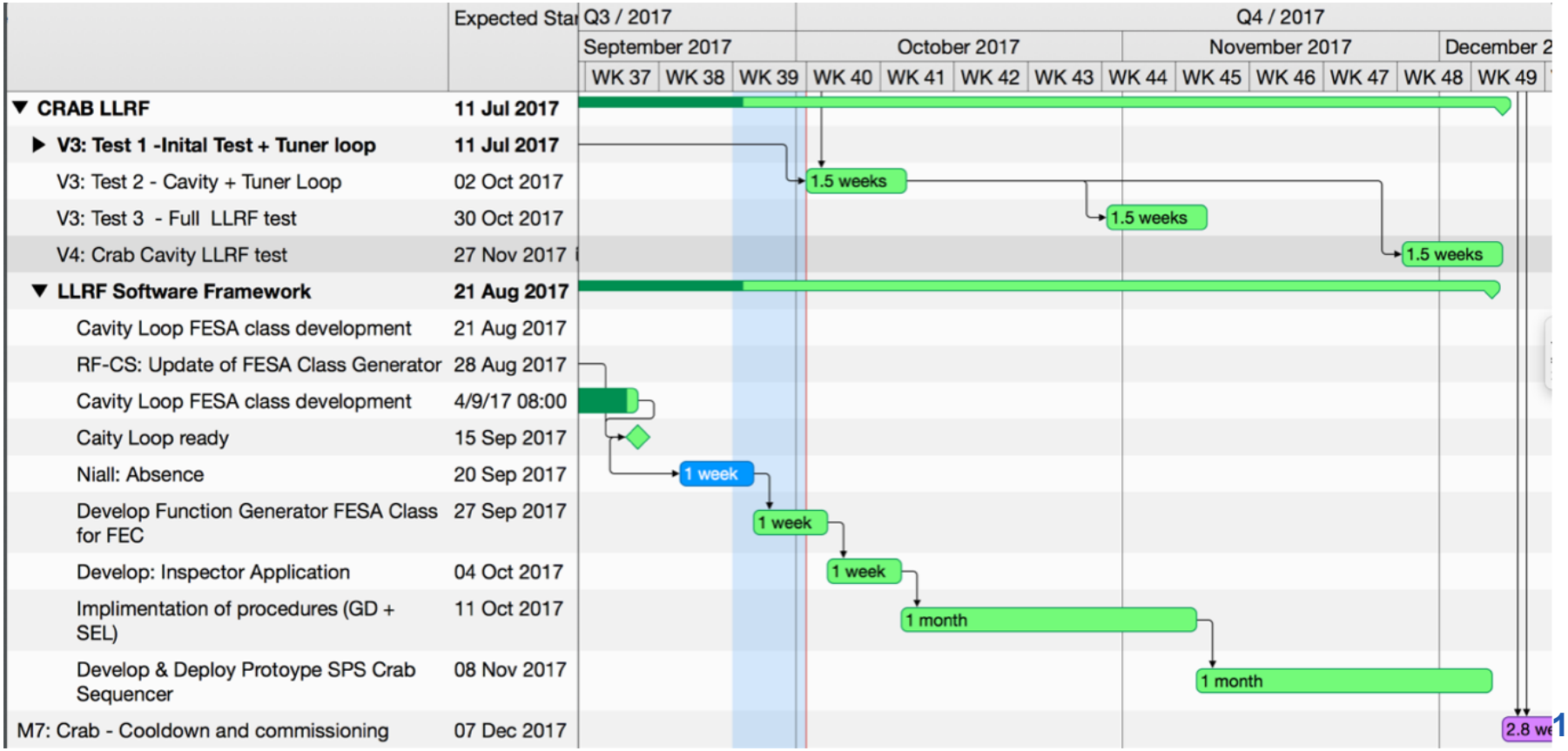
Cryomodule Slow Controls

- **Hardware is ready**
  - Installation into racks is waiting on completion of rack power and network installation
- **Slow control FESA class - standard implementation**
  - interleaved with LLRF software development

tle	Expected Start
▼ **Crab Slow Controls**	**7/8/17 08:00**
Preparation of Slow Controls Hardware	7/8/17 08:00
▼ **Slow controls - installation**	**30 Oct 2017**
Install hardware in racks	30 Oct 2017
▼ **Slow controls - pre-commissioning**	**08 Nov 2017**
test communication: tuner motors test box	08 Nov 2017
▼ **supervision SILECS + FESA + GUI**	**08 Nov 2017**
implement and Test	08 Nov 2017
test external signals (VAC CRYO ACCESS)	22 Nov 2017
test connections with LLRF & RF 1kW amplifier	23 Nov 2017
▼ **Slow controls - commissioning with CM**	**24 Nov 2017**
Connect all signals & retest tuner motor control	24 Nov 2017
commission switch on procedure with RF power	27 Nov 2017
▷ M7: Crab - Cooldown and commissioning	04 Dec 2017

LLRF Development

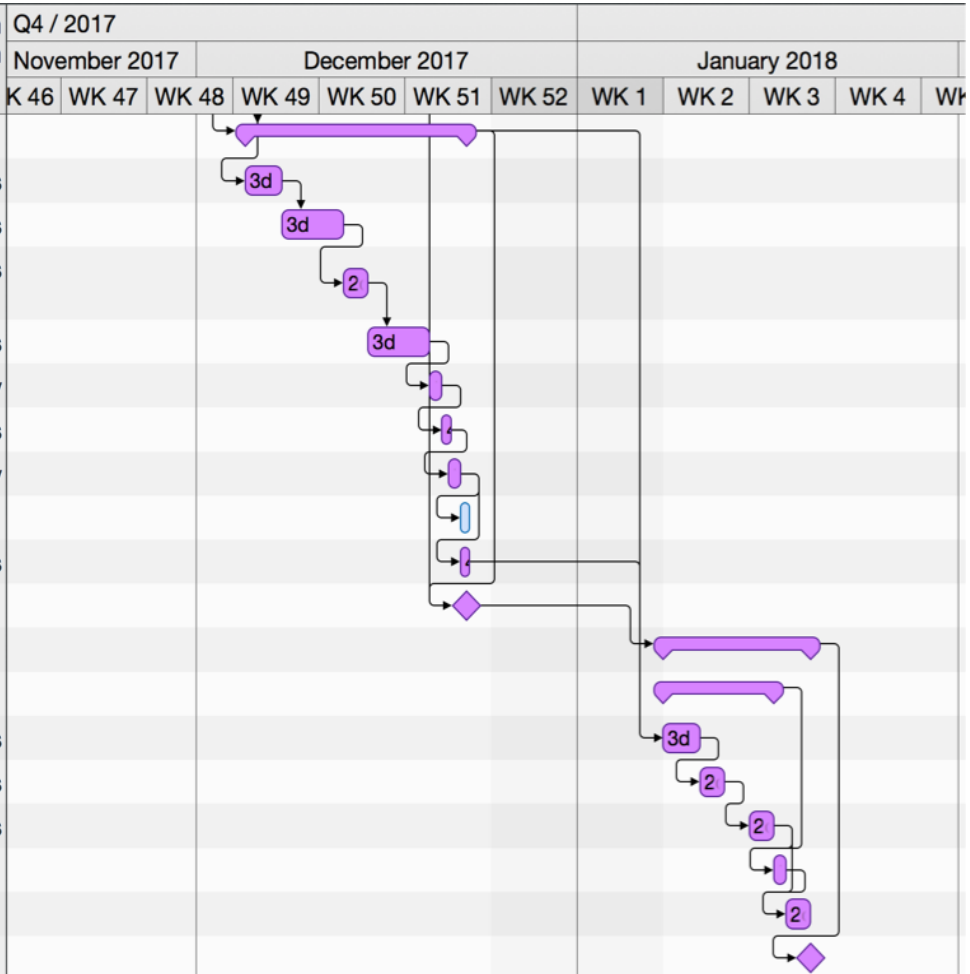
- **Status: Tuner loop validated; cavity loop in test**
  - Next Cold test of cavity + tuner: Starting today!
- **Procedures & Sequencer:**
  - 2-month development starting wk 41
  - Slow Controls FESA class to be incorporated wk 45 & 46



Cold Test planning of Cryomodule

- **Cryomodule Cold Test:** Cryo planning from K. Brodsinski
  - Schedule is tight and no time for dedicated RF tests
  - Schedule has to advance a few days as evacualtion of liquid should be by the 20th of Dec.

Title	Expected Start	Given Duration
▼ **Cryomodule Cold Test**	**05 Dec 2017**	
Cryo Commissioning	05 Dec 2017	3 days
Cavity Cooldown to 150K, ΔT<50K	07 Dec 2017	5 edays
Cooldown to 50 K, as fast as possible with ΔT<50K	13 Dec 2017	2 days
Shield Cooldown	14 Dec 2017	5 edays
Cavities cooldown to 4.5K	20 Dec 2017	1 day
Filling with LHe	21 Dec 2017	0.5 days
Cavities cooldown to 2K	21 Dec 2017	1 day
RF Testing ?	22 Dec 2017	
Warm up 2K -> 4.5 K	22 Dec 2017	0.5 days
M7: Crab - End of ColdTest	22 Dec 2017	
▼ **M7: Crab Exit from Tests**	**8/1/18 08:00**	
▼ **M7: Crab - Exit from tests**	**8/1/18 08:00**	
Warm up to 300K with ΔT<50K	8/1/18 08:00	3 days
Cutting Jumper connection	11 Jan 2018	2 days
Cutting Service box connection	15 Jan 2018	2 days
▶ **M7: Crab -Final alignment steps**	**16 Jan 2018**	
▷ Transport preparation	18 Jan 2018	
CM Delivered ready for transport	19 Jan 2018	



Safety

- **Radiation Monitoring System**
  - Personnel Protection system in place and tested ny RP
  - Mobile monitoring system:
    - Option 1: Of the shelf system with 1 sec readout
    - Option 2: Awaiting reply from RP re fast monitoring (1 ms)

- **Access**
  - **All access to M7:** Contact A. Macpherson or S. Barriere beforehand
  - **Access system:** In-situ control of access system starting 9th Oct.

- **Access conditions: Radiation Protection constraints**
  - BE-RF has full RF testing program from now till end of year
    - => Restricted access to vertical cryostats, RF power area, M9
    - Access to M7 (with RF testing ongoing)
      - Only possible if cryogenic trench is covered
  - **For access to all RF testing or power areas:**
    - **Contact A. Macpherson or A. Castilla beforehand**

  - **Implication:**
    - Install of Valve box to Service module (wk 43)=> all RF testing must stop

Still to be addressed

- **Details still to be resolved**
  - Specifics of radiation monitoring installation
  - Specifics of vacuum pumping line controls
  - Specifics of cryo's instrumentation rack installation
  - Specifics of RF Power conditioning team

- **Control room set up and workspace management**
  - Organise control room so different teams can work effectively
    - RF Power, Slow controls, Alignment, LLRF

- **Planning Issues**
  - Start to have regular meetings for sub-system integration
  - Understand any potential issues with SM18-RF testing activities
    - Planning of co-activity in SM18 RF
  - Schedule: will need to keep tight control to avoid spill over of cold test into Christmas break