HL-LHC Pre-Series Cryomodule

Some Initial Considerations

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STFC Daresbury Laboratory (UK)

Acknowledgements: STFC, ULAN, CERN, LARP

Outline

Introduction

Some Initial Considerations

Proposed Plan

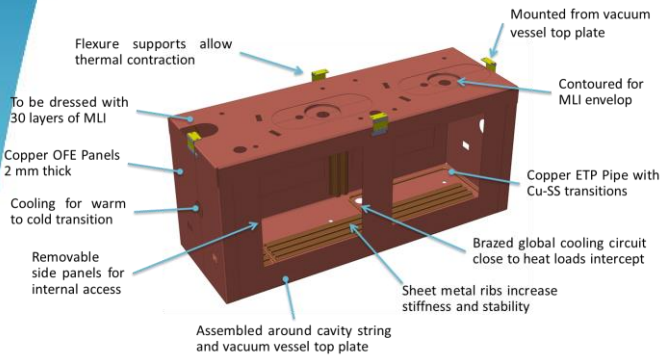
HL-LHC-UK

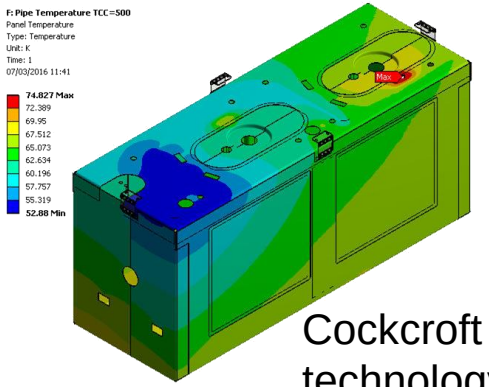
AKN: Graeme Burt

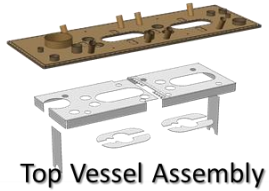
- ***HiLumi***-LHC design study FP7 2011-2015 : UK success and leadership.
- The UK hosted the ***HL-LHC*** kick-off meeting at Cockcroft Institute in November 2013.
- Discussions with STFC for UK project followed, with early SoI for LHC-UK
- SoI (final one) submitted early 2015
- Proposal submitted in March 2016
- CERN finance approved October 2015
- STFC finance approved March 2016
- 7 UK institutes as members
  - £8M of UK and CERN funding over 4 years, with institute and university money combining with STFC
  - A reflection of efficient use of resources to leverage, and UK reputation
- Formed and led by the Cockcroft Institute (Appleby spokesperson, Burt Project manager)
- Main UK activities:
  - *WP1 : Collimation*
  - *WP2 : Crab cavities*
  - *WP3 : Diagnostics*
  - WP4 : Cold powering

AKN: Graeme Burt

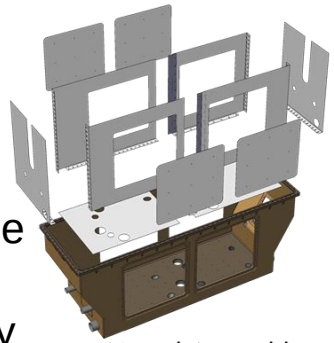
WP2.2.1 Cryomodules & Shields







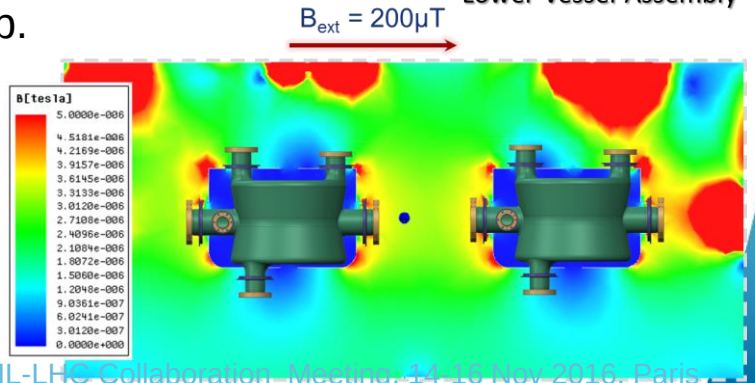
Top Vessel Assembly



Lower Vessel Assembly

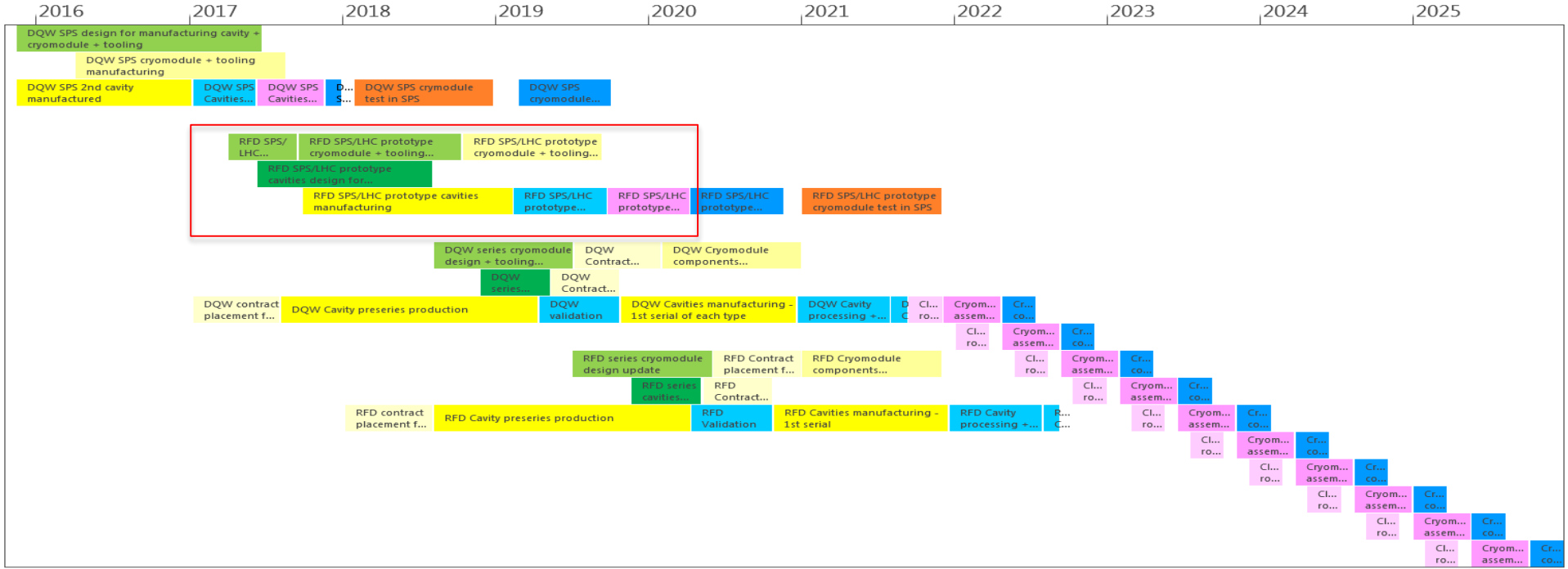
STFC have led the development of the thermal and magnetic shields for the SPS cryomodule, and Cockcroft produced the cold magnetic shield.

Cockcroft and STFC technology will produce the pre-series cryomodule for HL-LHC crab at Daresbury Lab.



Schedule for Pre Series

Courtesy: M. Garlaschè



Design Goal

Courtesy: M. Garlaschè

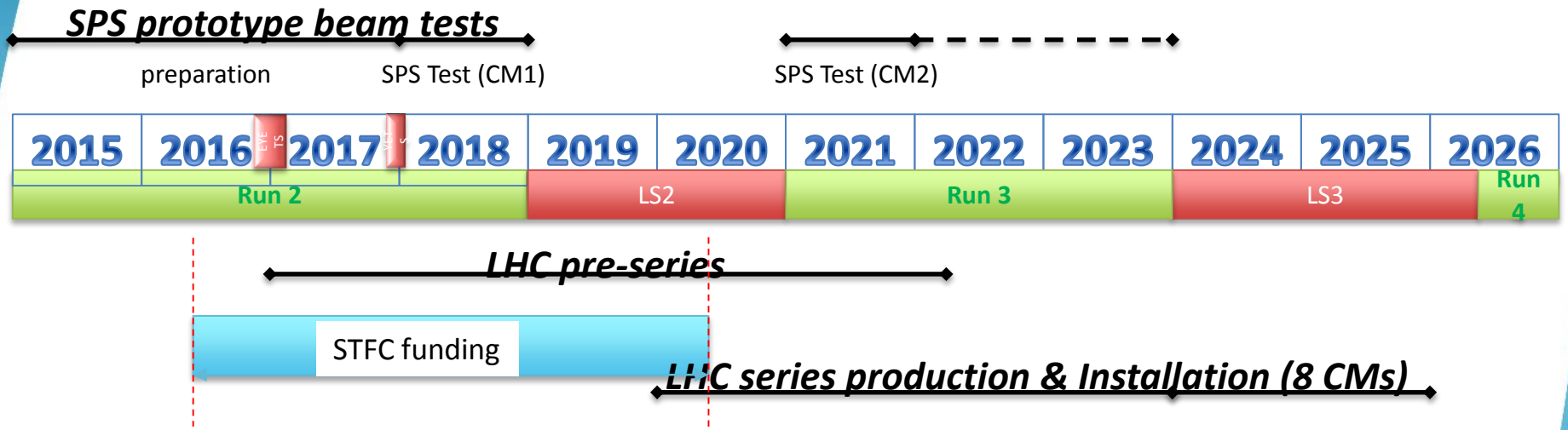
- 2 cryomodules for SPS tests
  - 1 cryomodule with 2 identical cavities (type «vertical» - DQW)
    - Design as much as possible coherent with LHC
    - To be tested in SPS in 2018
    - Design in collaboration with USLARP, UK
    - Manufacturing
      - Cavities – CERN
      - Cryomodule – CERN and UK
    - Cryomodule assembly & cold test CERN
  - 1 cryomodule with 2 identical cavities (type «horizontal» - RFD)
    - Design to be done as LHC prototype (SPS compatibility TBC)
    - To be tested in SPS after LS2, in 2021
    - Design in collaboration with USLARP, UK
    - Manufacturing
      - Cavities – CERN
      - Cryomodule – UK and CERN
    - Cryomodule assembly – UK
    - Cold test – CERN

STFC Task 2.2 Objective

To match STFC funding and schedule constraints
to HL-LHC global plan

Objective

Courtesy: Rama Calaga
Lisbon 2016



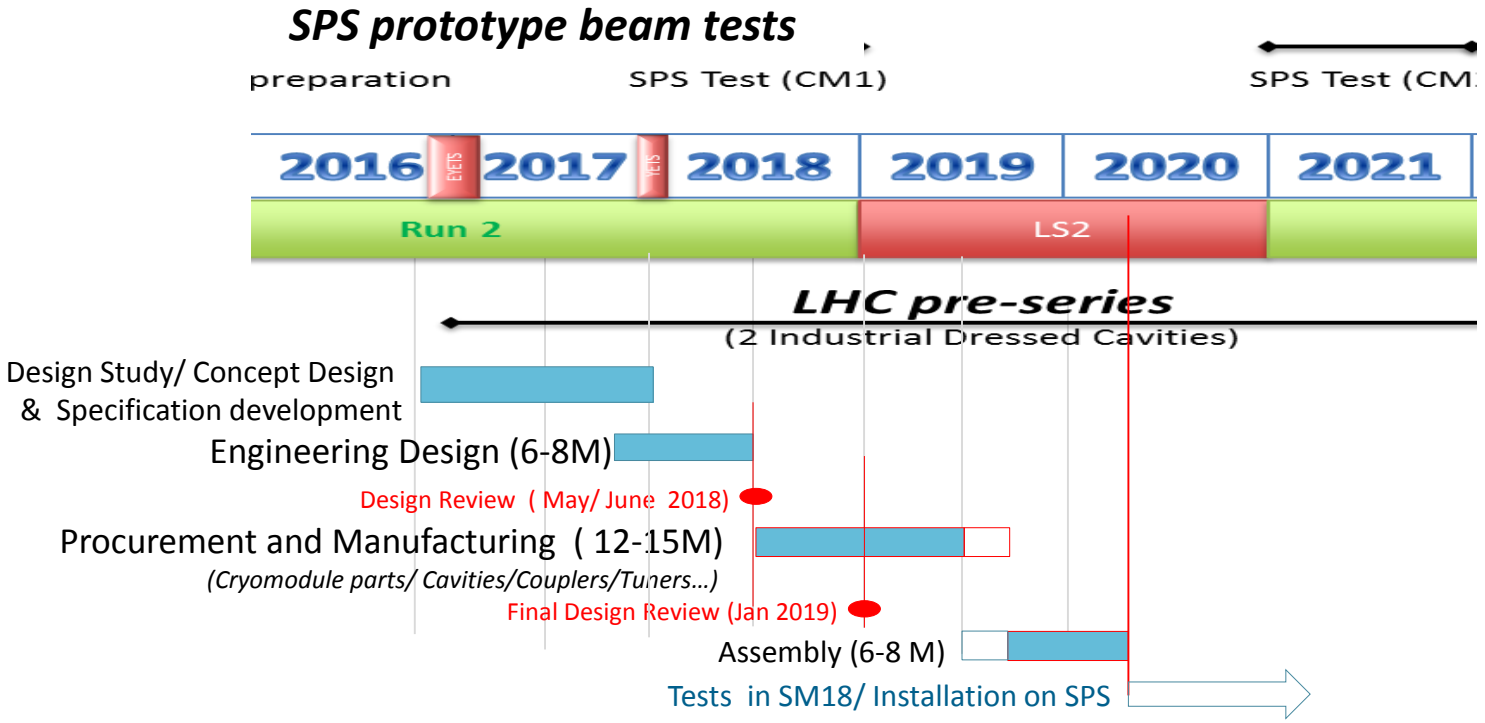
Goal: Match STFC requirements to HL-LHC Global Plan

Infrastructure/ Facilities Upgrade at STFC

STFC also has other commitments

- Beam Tubes for ESS (March 2019)
- 84 x Hi Beta Cavities for ESS (March 2020)
- Possible SRF Cavities for PIP-II (March 2019 onwards)
- …..
- …..

Proposed Plan



Summary

- Pre-series cryomodule to be designed for RFD Crab Cavities
- SPS-CM for DQW will be used as a reference design
- Pre-Series CM will be compatible with SPS as well as HL-LHC
- **CERN and STFC will continue to work as a single team**

- STFC funding requires to deliver the Pre-series cryomodule by **March 2020**

- A Design Review in **May-June 2018** will be necessary to allow 12 months for procurement and manufacturing of the components followed by 6-8 months of assembly.

- We look forward to launching ***Pre-series design study*** in January 2017

- **How about a Pre series Kick off meeting at Daresbury in Jan 2017 ?**

CERN

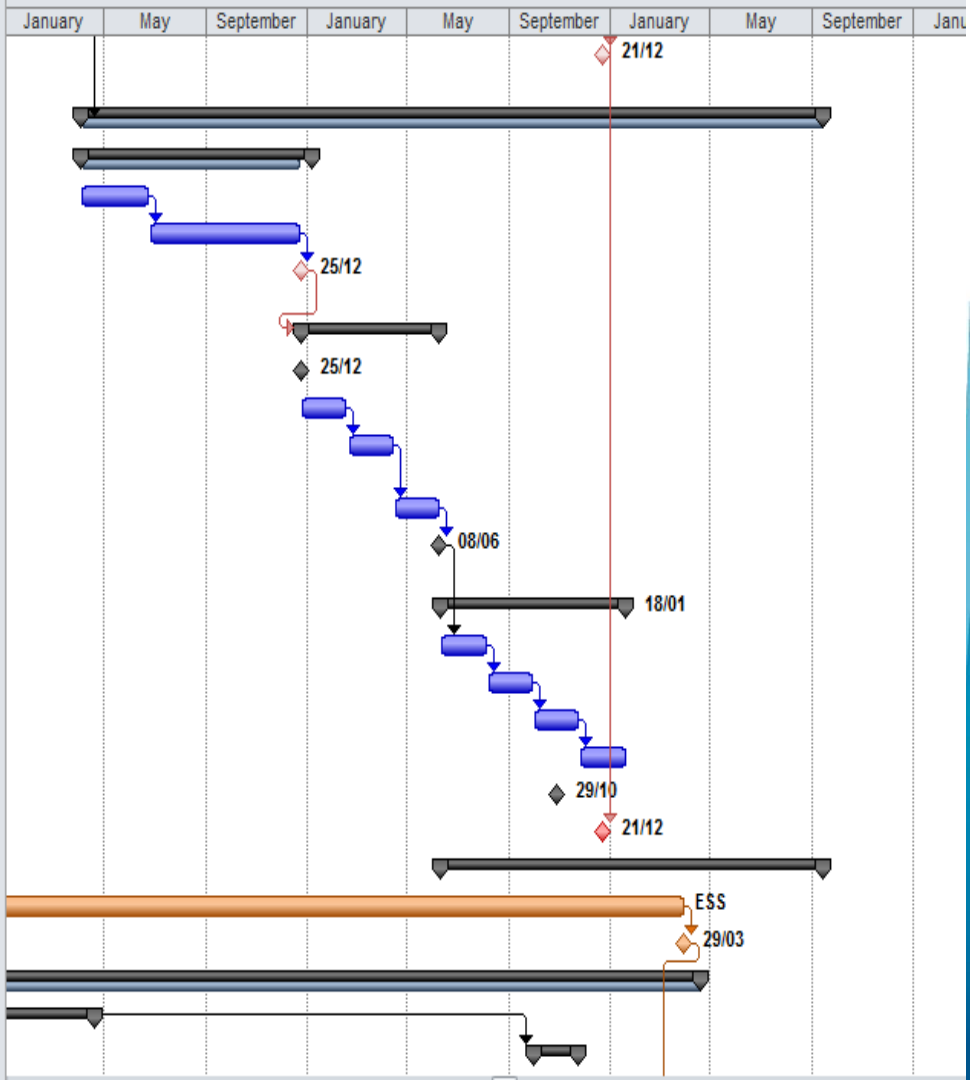
Science & Technology Facilities Council

Thank You


HiLumi
HL-LHC PROJECT


CERN

	Task Name	Duration	Start	Finish	Predec
20	SPS Results (External Constraint- Controlled by CERN)	0 days	Fri 21/12/18	Fri 21/12/18	19
21	**HILumi Pre Series Cryomodule**	**640 days**	**Mon 03/04/17**	**Fri 13/09/19**	6
22	**Design Study PS/SPS CM**	**200 days**	**Mon 03/04/17**	**Fri 05/01/18**	
23	Develop Base-line requirements	3 mons	Mon 03/04/17	Fri 23/06/17	
24	Develop Concept Design	6.5 mons	Mon 26/06/17	Fri 22/12/17	23
25	Decision on Cavity/ PS/SPS+ (External Constraint - Contrroled by CERN)	0 days	Mon 25/12/17	Mon 25/12/17	24
26	**Engineering Design and Analysis**	**120 days**	**Mon 25/12/17**	**Fri 08/06/18**	25
27	Preliminary Functional Specifications	0 days	Mon 25/12/17	Mon 25/12/17	
28	Cavity String with Couplers and Tuners	2 mons	Mon 25/12/17	Fri 16/02/18	
29	Vacuum Vessel, Supports and Internal Cryogenics	2 mons	Mon 19/02/18	Fri 13/04/18	28
30	Integration with External Facilities	2 mons	Mon 16/04/18	Fri 08/06/18	29
31	Design Review for Procuring Long Lead items (Most Critical Project Requirement)	0 days	Fri 08/06/18	Fri 08/06/18	30
32	**Engineering Drawings (for manufacturing)**	**160 days**	**Mon 11/06/18**	**Fri 18/01/19**	
33	Release set 1 (Long lead items -e.g. OVC)	2 mons	Mon 11/06/18	Fri 03/08/18	31
34	Release set 2 (Clean room tooling)	2 mons	Mon 06/08/18	Fri 28/09/18	33
35	Release set 3 (Ancillaries)	2 mons	Mon 01/10/18	Fri 23/11/18	34
36	Release set 4 (Thermal and Magnetic Shield)	2 mons	Mon 26/11/18	Fri 18/01/19	35
37	Functional Specifications	0 days	Mon 29/10/18	Mon 29/10/18	
38	Design Review (Milestone - CERN Requirement)	0 days	Fri 21/12/18	Fri 21/12/18	19
39	**Manufacturing and Procurement**	**330 days**	**Mon 11/06/18**	**Fri 13/09/19**	
51	(Extrernal Constraint - ESS Tasks in ETC - Clean Room)	780 days?	Mon 04/04/16	Fri 29/03/19	
52	Clean Room Handover	0 days	Fri 29/03/19	Fri 29/03/19	51
53	**Facilities Development at DL**	**643 days**	**Wed 02/11/16**	**Fri 19/04/19**	
54	**Develop Requirements**	**120 days**	**Wed 02/11/16**	**Tue 18/04/17**	
59	**Develop Assembly Proceudres**	**40 days**	**Mon 01/10/18**	**Fri 23/11/18**	54



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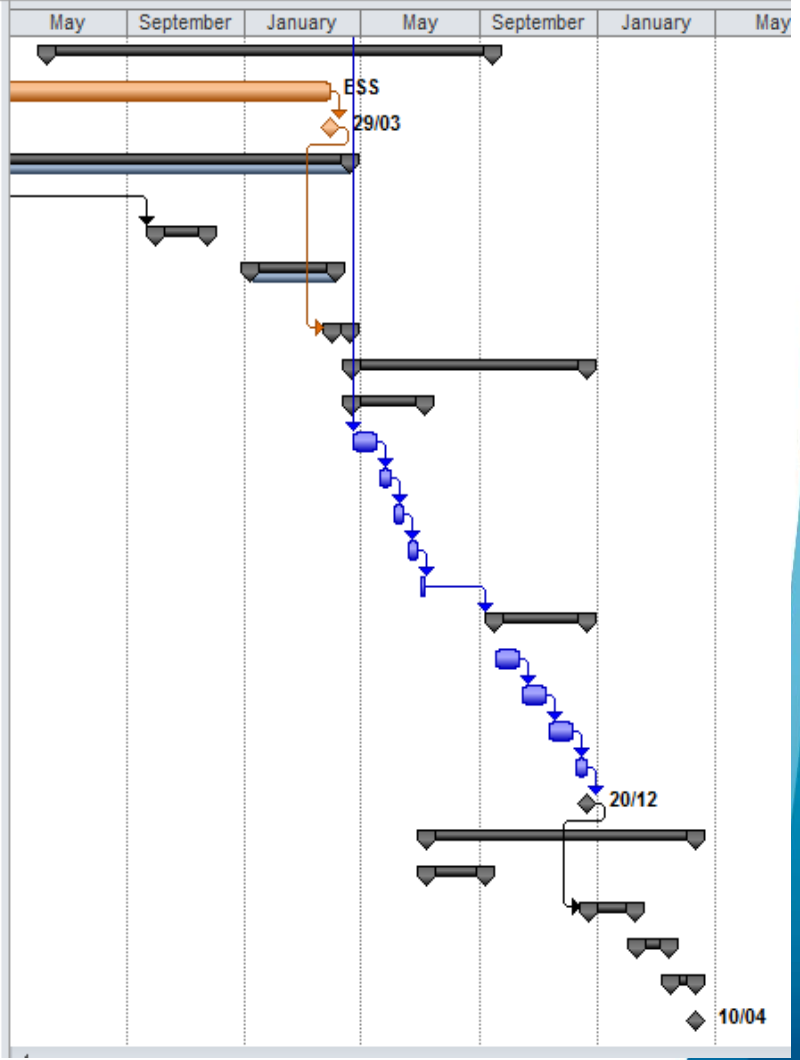
59	**Develop Assembly Proceudres**	**40 days**	**Mon 01/10/18**	**Fri 23/11/18**	**54**
62	**Set up General Assembly Area (Outside Clean Room)**	**65 days**	**Mon 07/01/19**	**Fri 05/04/19**	**61**
68	**Set up Clean Room**	**15 days**	**Mon 01/04/19**	**Fri 19/04/19**	**52**
72	**Pre-Series CM Assembly**	**175 days**	**Mon 22/04/19**	**Fri 20/12/19**	**71**
73	**Pre-Assembly in Clean room**	**55 days**	**Mon 22/04/19**	**Fri 05/07/19**	
74	Assemble Bellows and Valves etc.	4 wks	Mon 22/04/19	Fri 17/05/19	35
75	Assembly of Tuners	2 wks	Mon 20/05/19	Fri 31/05/19	46,74
76	Set Up Clean Room Tooling for cavities	2 wks	Mon 03/06/19	Fri 14/06/19	41,75
77	Mock up Assembly	2 wks	Mon 17/06/19	Fri 28/06/19	76
78	Qualify Clean Room for cavities	1 wk	Mon 01/07/19	Fri 05/07/19	77
79	**Assemble Cavity String in Clean room**	**70 days**	**Mon 16/09/19**	**Fri 20/12/19**	**78**
80	Assemble HOMs + HOM Couplers	4 wks	Mon 16/09/19	Fri 11/10/19	50
81	Assemble FPC	4 wks	Mon 14/10/19	Fri 08/11/19	80
82	Assemble Beam Pipe Components	4 wks	Mon 11/11/19	Fri 06/12/19	81
83	Final Leak checks/ Acceptance Tests	2 wks	Mon 09/12/19	Fri 20/12/19	82
84	Cavity String Assembled and Qualified	0 days	Fri 20/12/19	Fri 20/12/19	83
85	**General Assembly (Outside Clean Room)**	**200 days**	**Mon 08/07/19**	**Fri 10/04/20**	**40**
86	**Pre assembly**	**45 days**	**Mon 08/07/19**	**Fri 06/09/19**	
91	**Cavity String Integration with top plate**	**35 days**	**Mon 23/12/19**	**Fri 07/02/20**	**42,84,**
97	**Integration with Vacuum Vessel**	**25 days**	**Mon 10/02/20**	**Fri 13/03/20**	**96**
103	**Acceptance Tests**	**20 days**	**Mon 16/03/20**	**Fri 10/04/20**	**102**
107	**Project Complete**	0 days	Fri 10/04/20	Fri 10/04/20	106



ID	Task Name	Duration	Start	Finish	Predecessors
1	**UK HL-LHC WP2.2**	1050 days	Mon 04/04/16	Fri 10/04/20	
2	SPS Cryomodule Development	710 days	Mon 04/04/16	Fri 21/12/18	
3	Design to Operation	710 days	Mon 04/04/16	Fri 21/12/18	
4	CERN Tasks	710 days	Mon 04/04/16	Fri 21/12/18	
5	STFC Tasks	430 days	Mon 04/04/16	Fri 24/11/17	
6	CM Component Design and Drawings	260 days	Mon 04/04/16	Fri 31/03/17	
10	SRF Infrastructure at CERN	180 days	Mon 04/04/16	Fri 09/12/16	
15	SPS Cryomodule Assembly	60 days	Mon 04/09/17	Fri 24/11/17	
19	SPS Opearation (External Constraint: Controlled by CERN)	14 mons	Mon 27/11/17	Fri 21/12/18	18
20	SPS Results (External Constraint- Controlled by CERN)	0 days	Fri 21/12/18	Fri 21/12/18	19
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