QXF planning

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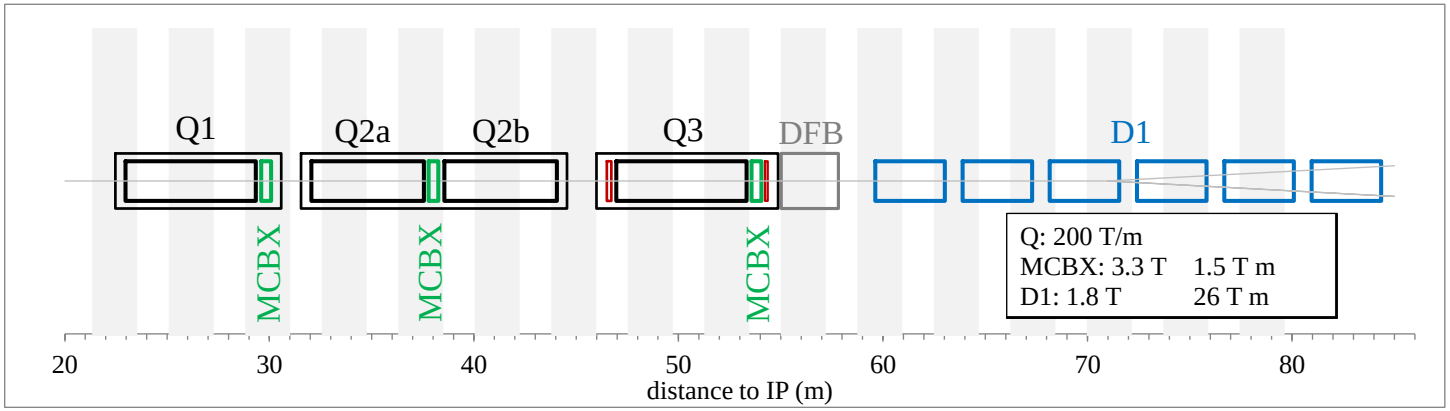
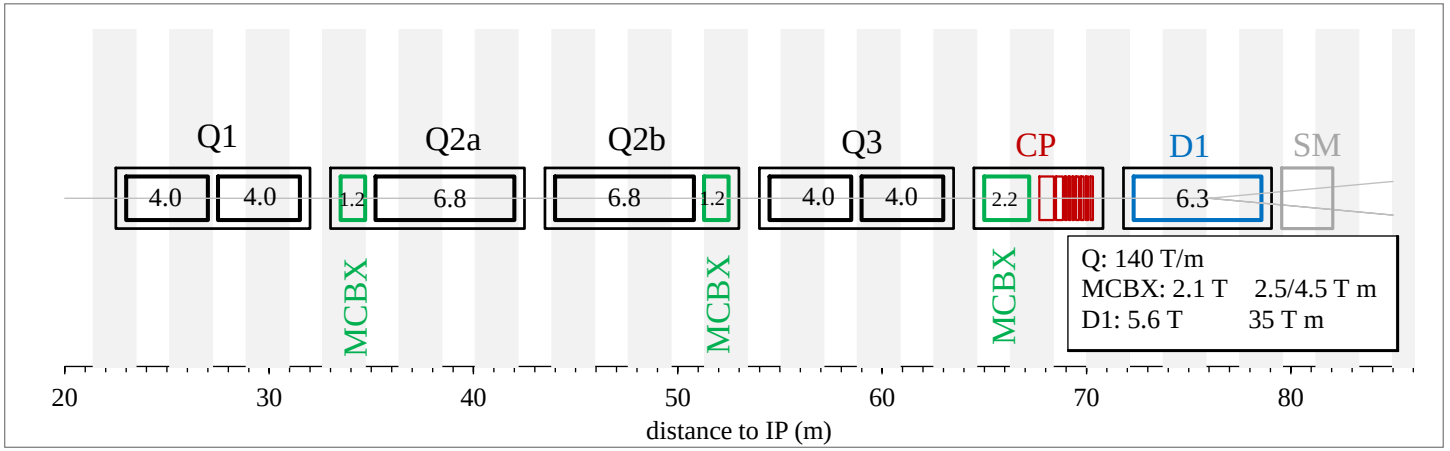
Introduction
IR layout *(by E. Todesco)*

- IR in the present LHC

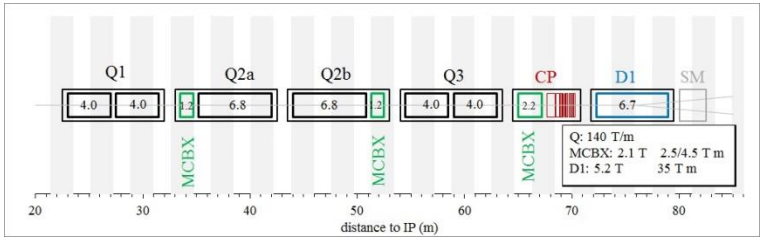


- IR in the HiLumi LHC



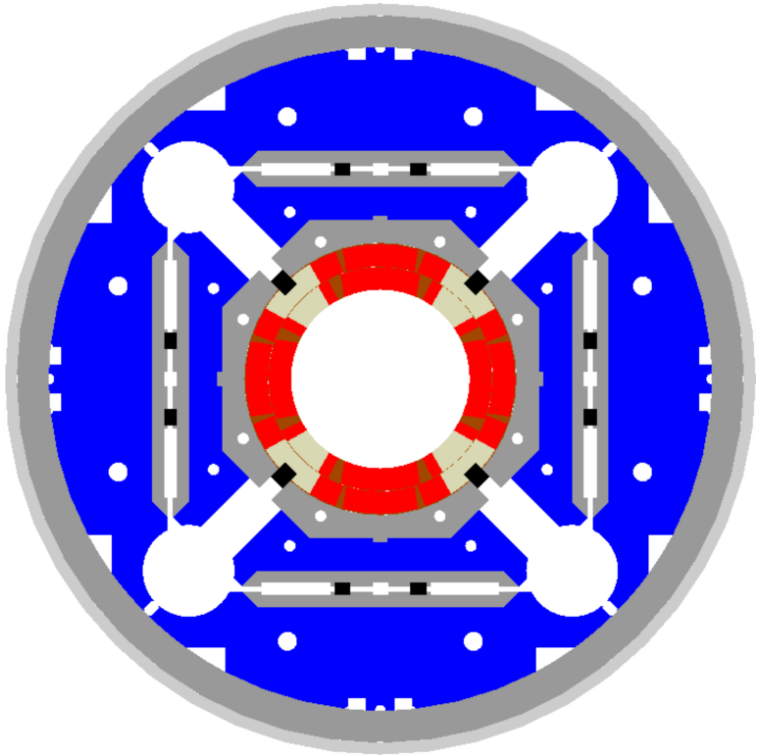
Introduction
MQXF overview

- Target: 140 T/m in 150 mm coil aperture
- To be installed in 2022 (*LS3*)



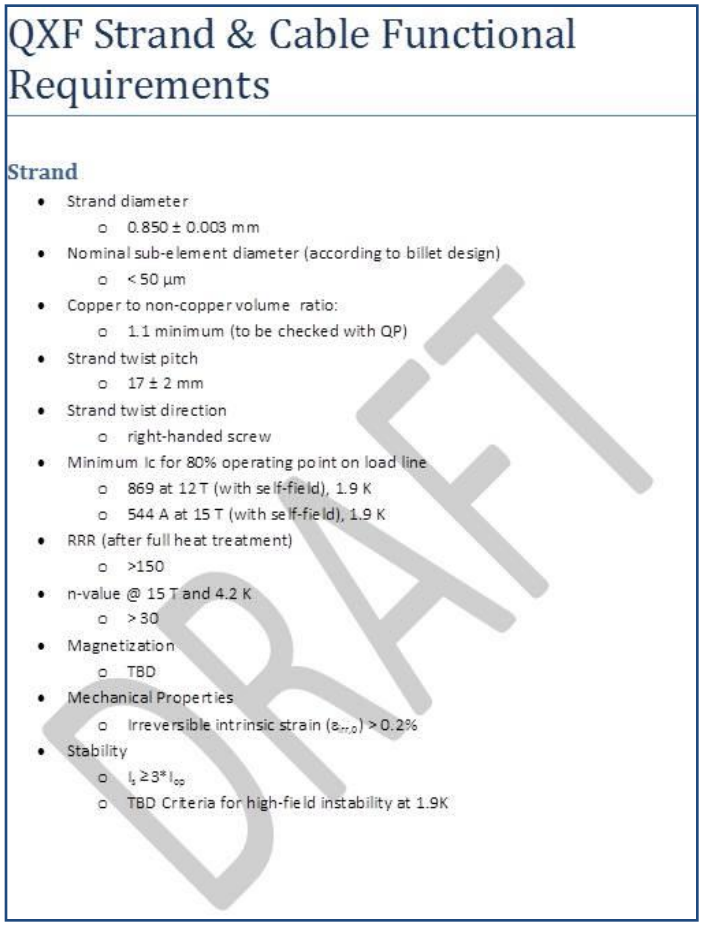
- Q1/Q3 (by US LARP collaboration)
  - 2 magnets with 4.0 m of magnetic length within 1 cold mass
- Q2 (by CERN)
  - 1 magnet of 6.8 m within 1 cold mass, including MCBX (1.2 m)

- Baseline: different lengths, same design
  - Identical short model magnets SQXF



Status

- Conductor and cable
  - HiLumi-LHC/LARP Conductor and Cable Internal Review (16-17 October 2013)
    - Main parameters defined
    - Procurement/schedule verified
      - Fine tuning of cable geometry in progress to improve mechanical stability
  - Cable fabrication for first set of short coils starts by the end 2013 / early 2014
  - Mandate to Conductor WG for setting the remaining parameters
    - 95% is done
    - Goal: Functional Requirements and Specifications ready by end of this year



QXF Strand & Cable Functional Requirements

Strand

- Strand diameter
  - 0.850 ± 0.003 mm
- Nominal sub-element diameter (according to billet design)
  - < 50 µm
- Copper to non-copper volume ratio:
  - 1.1 minimum (to be checked with QP)
- Strand twist pitch
  - 17 ± 2 mm
- Strand twist direction
  - right-handed screw
- Minimum Ic for 80% operating point on load line
  - 869 at 12 T (with self-field), 1.9 K
  - 544 A at 15 T (with self-field), 1.9 K
- RRR (after full heat treatment)
  - >150
- n-value @ 15 T and 4.2 K
  - > 30
- Magnetization
  - TBD
- Mechanical Properties
  - Irreversible intrinsic strain ($\varepsilon_{irr,0}$) > 0.2%
- Stability
  - $I_s \geq 3 * I_{op}$
  - TBD Criteria for high-field instability at 1.9K

DRAFT

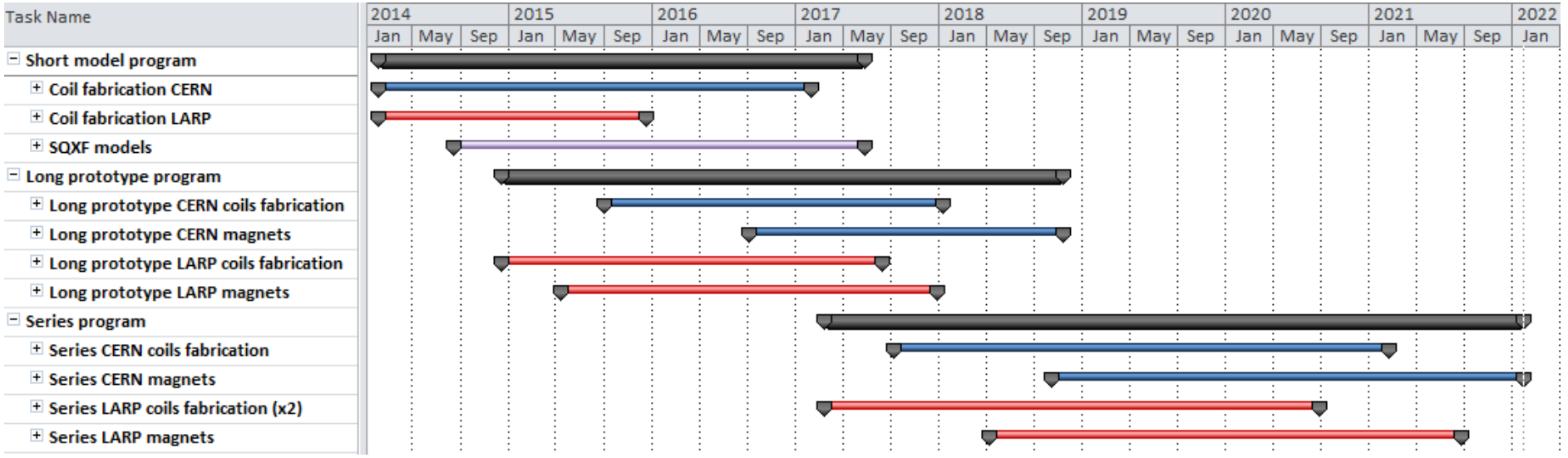
Status

- Coil
  - Cross-section and end design defined
  - End spacer optimization in progress, first short coils fabricated
- Structure
  - Baseline design completed
    - 2 identical 1.5 m long structures to be procured
  - Aluminium shells procured and detailing design of components in progress
- SQXF
  - Coil fabrication starts in early next year. First test in 2015.

Outline

- Overview
- Short model program (SQXF)
- Long model program (prototypes)
- Series production

Overview



- Short model program: *5 CERN-LARP models*, **2014-2016**
  - Coil fabrication starts in 02/2014
  - First magnet test (SQXF1) in 05/2015
- Long model program: *2 (CERN) + 3 (LARP) models*, **2015-2018**
  - Coil fabrication starts in 2015: 01 (LARP), 09 (CERN)
  - First magnet test in 08/2016 (LARP) and 07/2017 (CERN)
- Series production: *10 (CERN) + 10 (LARP) cold masses*, **2017-2021**

Outline

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- Long model program (prototypes)
- Series production

SQXF plan and schedule

- Definition of cable geometry in 06/2013
- Update of coil design in 07/2013
- Coil parts fabrication/optimization in progress
  - Decision on end parts for first set of coils: 12/2013
    - End spacer turn-around: ~2 months
- Coil tooling
  - Procurement
    - Parallel coil fabrication LARP-CERN
      - CERN: 1 Wind&Curing + 2 React&impreg
      - LARP: 1 Wind&Curing + 2 React&impreg
  - Winding and curing tooling by 11/2013
  - Reaction and impregnation tooling by 02/2014
- Fabrication of full practice coil starts, both at CERN and in the US, in 02/2014
- Fabrication of second set of coils starts in 03/15 (LARP), 05/15 (CERN)
- Possibility of fine tuning cable geometry by 06/2014

SQXF plan and schedule
Coil fabrication

- CERN
  - Number of coils
    - First set
      - 2 practice coils + 1 mirror coil
      - 5 RRP coils
    - Second set
      - 6 PIT coils
      - 5 RRP coils
  - Fabrication steps
    - Winding + curing + reaction + impregnation
  - Fabrication time
    - ~100 days (5 months) per coil
    - 1 coil produced
      - every 2 months in the 1st year
      - every 1.5 months in the 2st year
      - every 1 months in the 3st year
- LARP
  - Number of coils
    - First set
      - 2 practice coils + 1 mirror coil
      - 5 RRP coils
    - Second set
      - 5 RRP coils
  - Fabrication steps
    - First set
      - FNAL & LBNL: winding + curing
      - BNL & FNAL : reaction + impregnation
    - Second set
      - LBNL on SQXF
      - FNAL and BNL on LQXF
  - Fabrication time
    - ~100 days (5 months) per coil
    - 1 coil produced every month

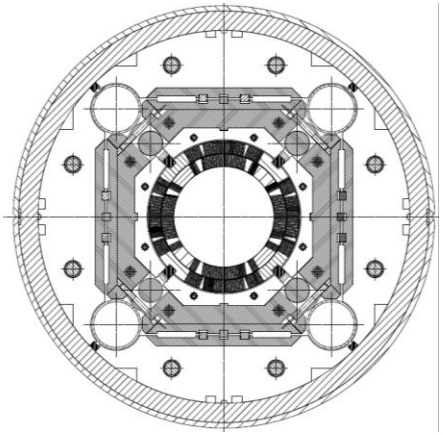
SQXF plan and schedule
Coil fabrication

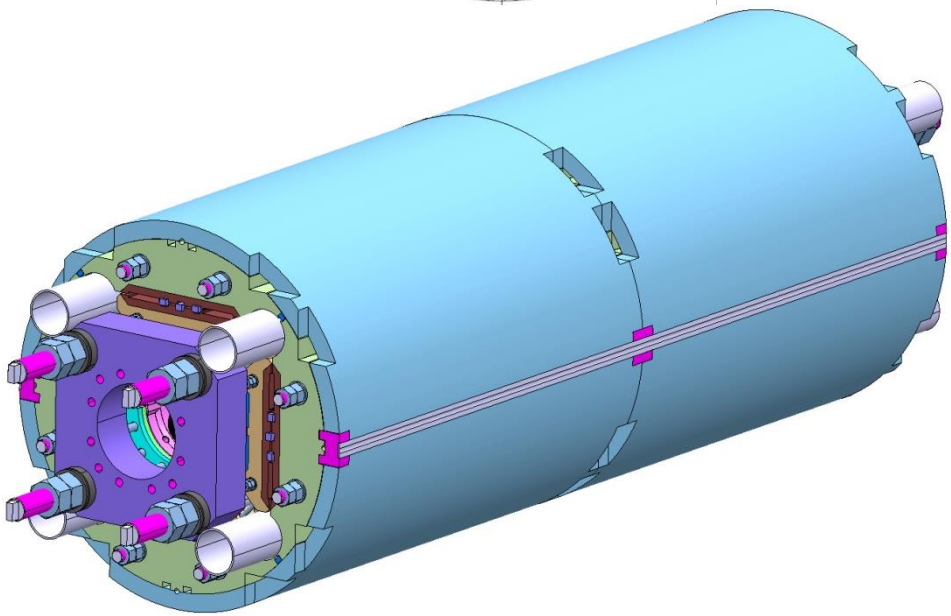
Gantt Chart

	Task Mode	Task Name	Duration	Start	Finish	Pre
25		Fine tuning of cable geometry	0 days	Mon 02/06/14	Mon 02/06/14	
26		**Coil fabrication CERN**	**806 days**	**Wed 08/01/14**	**Wed 08/02/17**	
27		End parts decision	0 days	Wed 08/01/14	Wed 08/01/14	
28		**First set**	**445 days**	**Mon 03/02/14**	**Fri 16/10/15**	
29		**Coil C1 (RRP practice)**	**120 days**	**Mon 03/02/14**	**Fri 18/07/14**	
34		**Coil C2 (PIT practice)**	**120 days**	**Mon 28/04/14**	**Fri 10/10/14**	
39		**Coil C3 (RRP) for mirror**	**100 days**	**Mon 21/07/14**	**Fri 05/12/14**	
44		**Coil C4 (RRP)**	**100 days**	**Mon 22/09/14**	**Fri 06/02/15**	
49		**Coil C5 (RRP)**	**100 days**	**Mon 24/11/14**	**Fri 10/04/15**	
54		**Coil C6 (RRP)**	**100 days**	**Mon 26/01/15**	**Fri 12/06/15**	
59		**Coil C7 (RRP)**	**100 days**	**Mon 30/03/15**	**Fri 14/08/15**	
64		**Coil C8 (RRP)**	**100 days**	**Mon 01/06/15**	**Fri 16/10/15**	
69		**Second set**	**398 days**	**Mon 03/08/15**	**Wed 08/02/17**	
70		**Coil C9 (PIT)**	**100 days**	**Mon 03/08/15**	**Fri 18/12/15**	
75		**Coil C10 (PIT)**	**100 days**	**Thu 17/09/15**	**Wed 03/02/16**	
80		**Coil C11 (PIT)**	**100 days**	**Tue 03/11/15**	**Mon 21/03/16**	
85		**Coil C12 (PIT)**	**100 days**	**Fri 18/12/15**	**Thu 05/05/16**	
90		**Coil C13 (PIT)**	**100 days**	**Wed 03/02/16**	**Tue 21/06/16**	
95		**Coil C14 (PIT)**	**100 days**	**Mon 21/03/16**	**Fri 05/08/16**	
100		**Coil C15 (RRP)**	**100 days**	**Thu 05/05/16**	**Wed 21/09/16**	
105		**Coil C16 (RRP)**	**100 days**	**Thu 09/06/16**	**Wed 26/10/16**	
110		**Coil C17 (RRP)**	**100 days**	**Thu 14/07/16**	**Wed 30/11/16**	
115		**Coil C18 (RRP)**	**100 days**	**Thu 18/08/16**	**Wed 04/01/17**	
120		**Coil C19 (RRP)**	**100 days**	**Thu 22/09/16**	**Wed 08/02/17**	
125		**Coil fabrication LARP**	**488 days**	**Wed 05/02/14**	**Fri 18/12/15**	
126		**First set**	**301 days**	**Wed 05/02/14**	**Wed 01/04/15**	
127		**Practice Coil #L1**	**108 days**	**Wed 05/02/14**	**Fri 04/07/14**	
132		**Practice Coil #L2**	**120 days**	**Thu 13/03/14**	**Wed 27/08/14**	
138		**Coil #L3 (for mirror test)**	**88 days**	**Mon 14/04/14**	**Wed 13/08/14**	
143		**Coil #L4**	**107 days**	**Mon 07/07/14**	**Tue 02/12/14**	
150		**Coil #L5**	**102 days**	**Mon 28/07/14**	**Tue 16/12/14**	
156		**Coil #L6**	**120 days**	**Mon 18/08/14**	**Fri 30/01/15**	
163		**Coil #L7**	**98 days**	**Wed 01/10/14**	**Fri 13/02/15**	
169		**Coil #L8**	**116 days**	**Wed 22/10/14**	**Wed 01/04/15**	
176		**Second set**	**207 days**	**Thu 05/03/15**	**Fri 18/12/15**	
177		**Coil L9**	**107 days**	**Thu 05/03/15**	**Fri 31/07/15**	
184		**Coil L10**	**107 days**	**Thu 09/04/15**	**Fri 04/09/15**	
191		**Coil L11**	**107 days**	**Thu 14/05/15**	**Fri 09/10/15**	
198		**Coil L12**	**107 days**	**Thu 18/06/15**	**Fri 13/11/15**	
205		**Coil L13 (spare)**	**107 days**	**Thu 23/07/15**	**Fri 18/12/15**	

SQXF plan and schedule
Support structure

- LARP/CERN design
- 2 SQXF structures procured by CERN
- From conceptual design to assembly and qualification
  - Beginning of 2013 to end of 2014

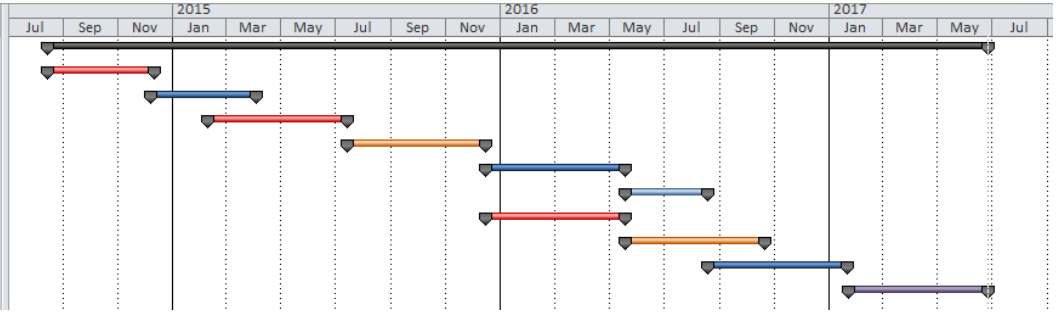




SQXF plan and schedule
Tests

- From assembly to disassembly: 5 months
- 1st generation coils
  - First **LARP coil mirror test** in 12/2014 (Dedicated structure)
  - First **CERN coil mirror test** (mirror) in 04/2015 (SQXF structure with practice coils or LARP mirror structure)
  - First magnet test (**SQXF1**) in 05/2015
    - Assembled ad tested by LARP with 3 LARP coils and 1 CERN coil
  - Then **SQXF1b** (LARP), **SQXF2** (CERN), **SQXF2b** in series (2015-2016)
    - All the coil fabricated to date will be available for 1 magnet (not shared)
  - Test of LHe containment in **SQXF2b**
- 2nd generation coils
  - LARP RRP: **SQXF3** and **SQXF3b** (2016)
  - CERN PIT: **SQXF4** (2016-2017)
- Test of 2-magnets in 1-cold-mass: **SQXF5** (2017)

	Task Mode	Task Name	Duration	Start	Finish
212		SQXF models	748 days	Thu 14/08/14	Mon 26/06/17
213		SQXF mirror (LARP)	85 days	Thu 14/08/14	Wed 10/12/14
219		SQXF mirror (CERN)	85 days	Mon 08/12/14	Fri 03/04/15
225		SQXF1 (LARP); coil L4,L5,L6,C4	111 days	Mon 09/02/15	Mon 13/07/15
229		SQXF1b (LARP)	111 days	Tue 14/07/15	Tue 15/12/15
233		SQXF2 (CERN)	111 days	Wed 16/12/15	Wed 18/05/16
237		SQXF2b (CERN) with Lhe containment	66 days	Thu 19/05/16	Thu 18/08/16
241		SQXF3 (LARP): RRP II set	111 days	Wed 16/12/15	Wed 18/05/16
245		SQXF3b (LARP)	111 days	Thu 19/05/16	Thu 20/10/16
249		SQXF4 (CERN): PIT II set	111 days	Fri 19/08/16	Fri 20/01/17
253		SQXF5 (CERN): RRP II set & SQXF3b	111 days	Mon 23/01/17	Mon 26/06/17



Outline

- Overview
- Short model program (SQXF)
- Long model program (prototypes)
- Series production

Long model program
Plan and schedule

CERN

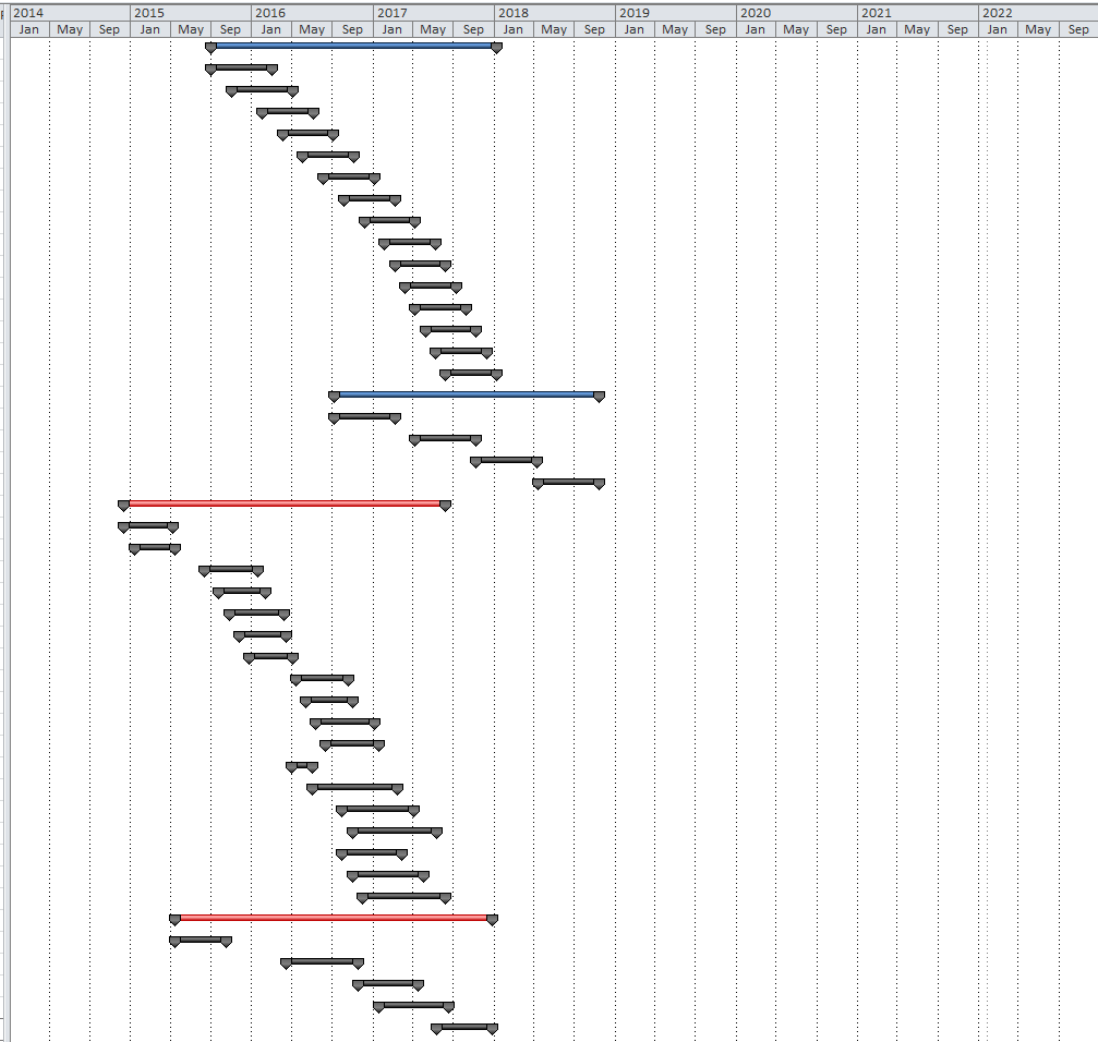
- Number of coils
  - 3 practice
  - 1 mirror
  - 11 real (5 RRP + 6 PIT)
  - Coil winding starts **09/2015**
- Models/tests
  - 2 models, 3 tests
  - Horiz. “simplified” tests
  - Mirror test in **11/2016**
  - First model test in **07/2017**
  - Last test **10/2018**

LARP

- Number of coils
  - 1 practice
  - 1 mirror
  - 16 real
  - Coil winding starts **01/2015**
- Models/tests
  - 3 models, 4 tests
  - Vertical tests (workshop in Dec.)
  - Mirror test in **10/2015**
  - First model test in **08/2016**
  - Last test **11/2017**

Long model program
Plan and schedule

	Task Name	Duration	Start	Finish
237	Long prototype CERN coils fabrication	616 days	Tue 01/09/15	Tue 09/01/18
238	Practice coil 1 (Cu)	133 days	Tue 01/09/15	Thu 03/03/16
242	Practice coil 2 (RRP)	132 days	Mon 02/11/15	Tue 03/05/16
246	Practice coil 3 (PIT)	110 days	Tue 02/02/16	Mon 04/07/16
250	Coil 4 (RRP mirror coil)	110 days	Mon 04/04/16	Fri 02/09/16
254	Coil 5 (RRP)	110 days	Fri 03/06/16	Thu 03/11/16
258	Coil 6 (RRP)	110 days	Thu 04/08/16	Wed 04/01/17
262	Coil 7 (RRP)	110 days	Wed 05/10/16	Tue 07/03/17
266	Coil 8 (RRP)	110 days	Tue 06/12/16	Mon 08/05/17
270	Coil 9 (RRP)	110 days	Mon 06/02/17	Fri 07/07/17
274	Coil 10 (PIT)	110 days	Wed 08/03/17	Tue 08/08/17
278	Coil 11 (PIT)	110 days	Fri 07/04/17	Thu 07/09/17
282	Coil 12 (PIT)	110 days	Tue 09/05/17	Mon 09/10/17
286	Coil 13 (PIT)	110 days	Thu 08/06/17	Wed 08/11/17
290	Coil 14 (PIT)	110 days	Mon 10/07/17	Fri 08/12/17
294	Coil 15 (PIT)	110 days	Wed 09/08/17	Tue 09/01/18
298	Long prototype CERN magnets	572 days	Mon 05/09/16	Tue 13/11/18
299	MQXFLP mirror; coil 4	132 days	Mon 05/09/16	Tue 07/03/17
303	MQXFLP1; coil 5,6,7,8	132 days	Tue 09/05/17	Wed 08/11/17
307	MQXFLP1b; coil 6,7,8,9	132 days	Thu 09/11/17	Fri 11/05/18
311	MQXFLP2; coil 10,11,12,13	132 days	Mon 14/05/18	Tue 13/11/18
315	Long prototype LARP coils fabrication	692 days	Fri 12/12/14	Mon 07/08/17
316	Long QXF Practice Coil	106 days	Fri 12/12/14	Fri 08/05/15
322	Lcoil #1 (for mirror)	89 days	Mon 12/01/15	Thu 14/05/15
327	Lcoil #2	113 days	Thu 13/08/15	Mon 18/01/16
334	Lcoil #3	101 days	Fri 25/09/15	Fri 12/02/16
340	Lcoil #4	119 days	Mon 26/10/15	Thu 07/04/16
347	Lcoil #5	101 days	Tue 24/11/15	Tue 12/04/16
353	Lcoil #6	95 days	Wed 23/12/15	Tue 03/05/16
359	Lcoil #7	113 days	Fri 13/05/16	Tue 18/10/16
366	Lcoil #8	101 days	Mon 13/06/16	Mon 31/10/16
372	Lcoil #9	129 days	Tue 12/07/16	Fri 06/01/17
379	Lcoil #10	117 days	Wed 10/08/16	Thu 19/01/17
385	Lcoil #11 (W&C PC at BNL)	45 days	Mon 02/05/16	Fri 01/07/16
389	Lcoil #12 (full coil at BNL)	183 days	Mon 04/07/16	Wed 15/03/17
395	Lcoil #13	155 days	Fri 30/09/16	Thu 04/05/17
400	Lcoil #14	182 days	Mon 31/10/16	Tue 11/07/17
405	Lcoil #15	128 days	Fri 30/09/16	Tue 28/03/17
411	Lcoil #16	155 days	Mon 31/10/16	Fri 02/06/17
417	Lcoil #17	180 days	Tue 29/11/16	Mon 07/08/17
422	Long prototype LARP magnets	683 days	Fri 15/05/15	Tue 26/12/17
423	LQXF mirror	110 days	Fri 15/05/15	Thu 15/10/15
429	LQXF1	156 days	Wed 13/04/16	Wed 16/11/16
438	LQXF1b	130 days	Thu 17/11/16	Wed 17/05/17
446	LQXF2 horizontal test	150 days	Fri 20/01/17	Thu 17/08/17
451	LQXF3 w MQXF structure	120 days	Wed 12/07/17	Tue 26/12/17



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Pre-series and series production

(based on "Production Plan" from M. Anerella)

CERN (Q2) full length

- 10 cold masses
  - 2 pre-series/spares, 8 series
- 10 magnets
  - 2 pre-series, 8 series
- 45 coils
  - 4.5 per magnet
- 80 days per coil
- 1 coil every 15 days

LARP (Q1/Q3) half length

- 10 cold masses
  - 2 pre-series/spares, 8 series
- 10+10 magnets
  - 4 pre-series, 16 series
- 45+45 coils
  - 4.5 per magnet
- 80 days per coil
- 1 coil every 15 days
- 2 production lines

Pre-series and series production

(based on "Production Plan" from M. Anerella)

- Tooling per production line (both CERN and LARP)
  - 1 oven
  - 1 vacuum impregnation tank
  - 2 winding mandrel assembly
    - Winding while curing outer layer
  - 3 reaction tooling
    - Preparation for reaction
    - Reaction
    - Preparation for impregnation
  - 2 impregnation tooling

Pre-series and series production

(based on "Production Plan" from M. Anerella)

CERN (Q2)

- Coil winding starts **09/2017**
- Coil fabric. ends by **02/2021**
- First magnet test in **04/2019**
- Last magnet test in **10/2021**

LARP (Q1/Q3)

- Coil winding starts **03/2017**
- Coil fabric. ends by **08/2020**
- First magnet test in **11/2018**
- Last magnet test in **05/2021**

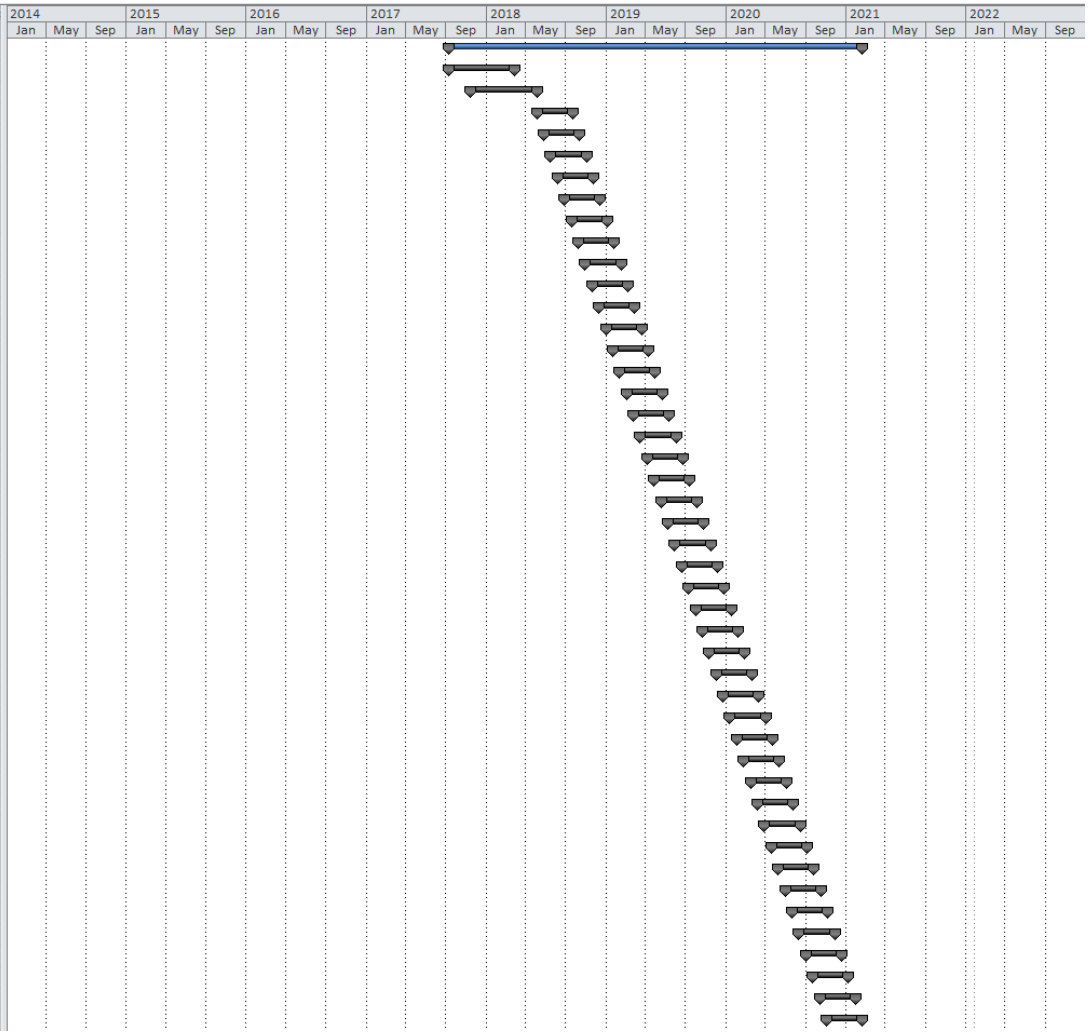
Pre-series and series production

(based on "Production Plan" from M. Anerella)

- This plan foresees LARP series magnets tested and delivered without LHe containment and cryostat
  - Cold mass and cryostat assembly, and testing at CERN of LARP magnet still to be included in the plan
- Alternative scenarios under consideration
  - Cold mass as LARP deliverable
  - Cold mass with cryostat as LARP deliverable
    - No correctors in Q1/Q3
  - Deliverable still to be tested at CERN before installation
- Also to be added: integration work

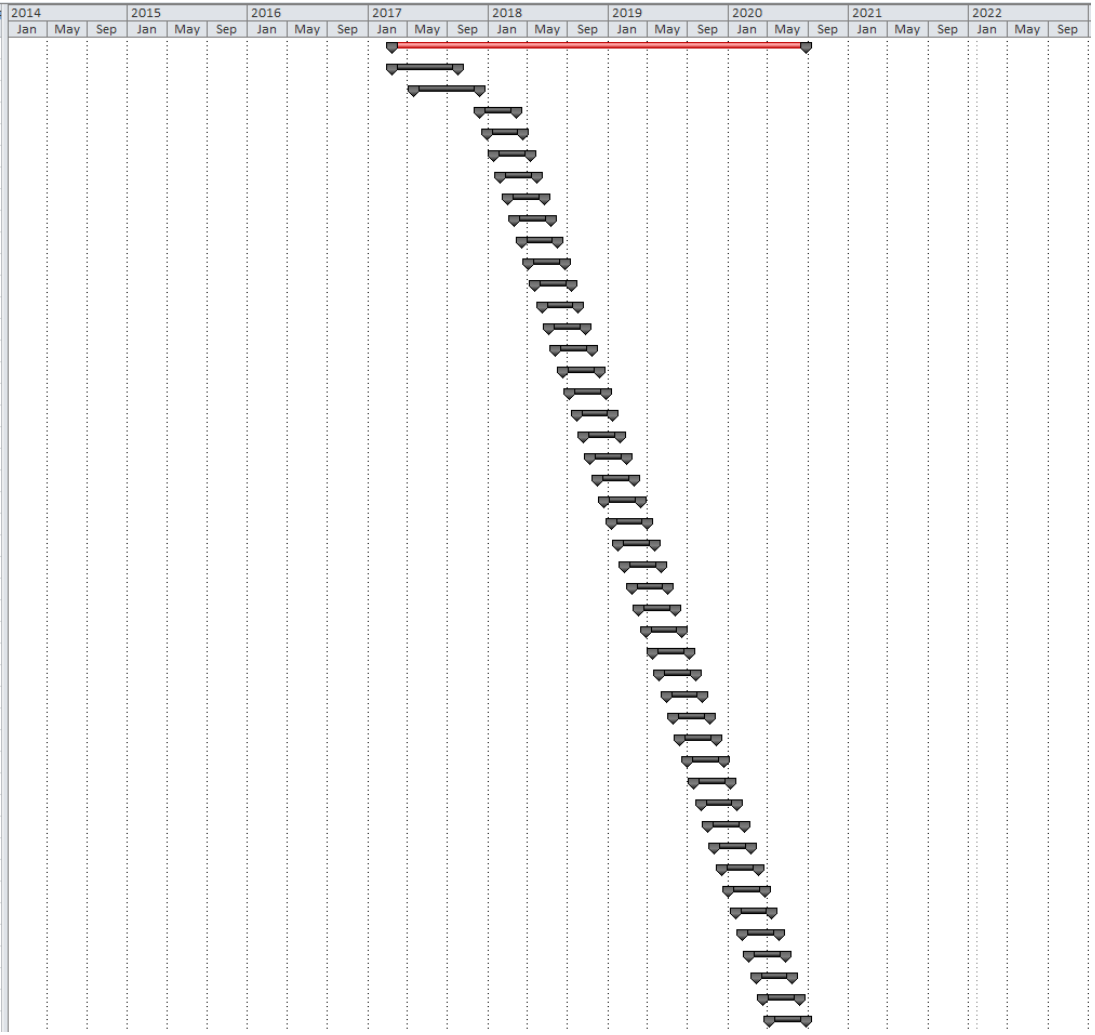
Pre-series and series production
CERN coil production

	Task Name	Duration	Start	Finish
457	Series CERN coils fabrication	901 days	Fri 08/09/17	Fri 19/02/21
458	Coil 1	144 days	Fri 08/09/17	Wed 28/03/18
462	Coil 2	144 days	Wed 15/11/17	Mon 04/06/18
466	Coil 3	79 days	Tue 05/06/18	Fri 21/09/18
470	Coil 4	79 days	Tue 26/06/18	Fri 12/10/18
474	Coil 5	79 days	Tue 17/07/18	Fri 02/11/18
478	Coil 6	79 days	Tue 07/08/18	Fri 23/11/18
482	Coil 7	79 days	Tue 28/08/18	Fri 14/12/18
486	Coil 8	79 days	Tue 18/09/18	Fri 04/01/19
490	Coil 9	79 days	Tue 09/10/18	Fri 25/01/19
494	Coil 10	79 days	Tue 30/10/18	Fri 15/02/19
498	Coil 11	79 days	Tue 20/11/18	Fri 08/03/19
502	Coil 12	79 days	Tue 11/12/18	Fri 29/03/19
506	Coil 13	79 days	Tue 01/01/19	Fri 19/04/19
510	Coil 14	79 days	Tue 22/01/19	Fri 10/05/19
514	Coil 15	79 days	Tue 12/02/19	Fri 31/05/19
518	Coil 16	79 days	Tue 05/03/19	Fri 21/06/19
522	Coil 17	79 days	Tue 26/03/19	Fri 12/07/19
526	Coil 18	79 days	Tue 16/04/19	Fri 02/08/19
530	Coil 19	79 days	Tue 07/05/19	Fri 23/08/19
534	Coil 20	79 days	Tue 28/05/19	Fri 13/09/19
538	Coil 21	79 days	Tue 18/06/19	Fri 04/10/19
542	Coil 22	79 days	Tue 09/07/19	Fri 25/10/19
546	Coil 23	79 days	Tue 30/07/19	Fri 15/11/19
550	Coil 24	79 days	Tue 20/08/19	Fri 06/12/19
554	Coil 25	79 days	Tue 10/09/19	Fri 27/12/19
558	Coil 26	79 days	Tue 01/10/19	Fri 17/01/20
562	Coil 27	79 days	Tue 22/10/19	Fri 07/02/20
566	Coil 28	79 days	Tue 12/11/19	Fri 28/02/20
570	Coil 29	79 days	Tue 03/12/19	Fri 20/03/20
574	Coil 30	79 days	Tue 24/12/19	Fri 10/04/20
578	Coil 31	79 days	Tue 14/01/20	Fri 01/05/20
582	Coil 32	79 days	Tue 04/02/20	Fri 22/05/20
586	Coil 33	79 days	Tue 25/02/20	Fri 12/06/20
590	Coil 34	79 days	Tue 17/03/20	Fri 03/07/20
594	Coil 35	79 days	Tue 07/04/20	Fri 24/07/20
598	Coil 36	79 days	Tue 28/04/20	Fri 14/08/20
602	Coil 37	79 days	Tue 19/05/20	Fri 04/09/20
606	Coil 38	79 days	Tue 09/06/20	Fri 25/09/20
610	Coil 39	79 days	Tue 30/06/20	Fri 16/10/20
614	Coil 40	79 days	Tue 21/07/20	Fri 06/11/20
618	Coil 41	79 days	Tue 11/08/20	Fri 27/11/20
622	Coil 42	79 days	Tue 01/09/20	Fri 18/12/20
626	Coil 43	79 days	Tue 22/09/20	Fri 08/01/21
630	Coil 44	79 days	Tue 13/10/20	Fri 29/01/21
634	Coil 45	79 days	Tue 03/11/20	Fri 19/02/21



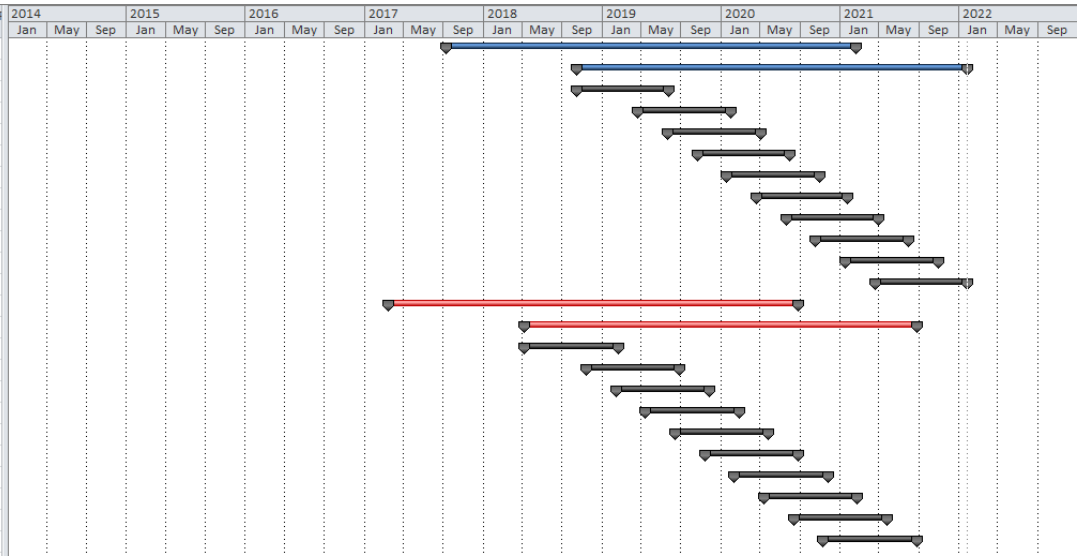
Pre-series and series production
LARP coil production

	Task Name	Duration	Start	Finish
679	Series LARP coils fabrication (x2)	901 days	Wed 15/03/17	Wed 26/08/20
680	Coil 1	144 days	Wed 15/03/17	Mon 02/10/17
684	Coil 2	144 days	Mon 22/05/17	Thu 07/12/17
688	Coil 3	79 days	Fri 08/12/17	Wed 28/03/18
692	Coil 4	79 days	Fri 29/12/17	Wed 18/04/18
696	Coil 5	79 days	Fri 19/01/18	Wed 09/05/18
700	Coil 6	79 days	Fri 09/02/18	Wed 30/05/18
704	Coil 7	79 days	Fri 02/03/18	Wed 20/06/18
708	Coil 8	79 days	Fri 23/03/18	Wed 11/07/18
712	Coil 9	79 days	Fri 13/04/18	Wed 01/08/18
716	Coil 10	79 days	Fri 04/05/18	Wed 22/08/18
720	Coil 11	79 days	Fri 25/05/18	Wed 12/09/18
724	Coil 12	79 days	Fri 15/06/18	Wed 03/10/18
728	Coil 13	79 days	Fri 06/07/18	Wed 24/10/18
732	Coil 14	79 days	Fri 27/07/18	Wed 14/11/18
736	Coil 15	79 days	Fri 17/08/18	Wed 05/12/18
740	Coil 16	79 days	Fri 07/09/18	Wed 26/12/18
744	Coil 17	79 days	Fri 28/09/18	Wed 16/01/19
748	Coil 18	79 days	Fri 19/10/18	Wed 06/02/19
752	Coil 19	79 days	Fri 09/11/18	Wed 27/02/19
756	Coil 20	79 days	Fri 30/11/18	Wed 20/03/19
760	Coil 21	79 days	Fri 21/12/18	Wed 10/04/19
764	Coil 22	79 days	Fri 11/01/19	Wed 01/05/19
768	Coil 23	79 days	Fri 01/02/19	Wed 22/05/19
772	Coil 24	79 days	Fri 22/02/19	Wed 12/06/19
776	Coil 25	79 days	Fri 15/03/19	Wed 03/07/19
780	Coil 26	79 days	Fri 05/04/19	Wed 24/07/19
784	Coil 27	79 days	Fri 26/04/19	Wed 14/08/19
788	Coil 28	79 days	Fri 17/05/19	Wed 04/09/19
792	Coil 29	79 days	Fri 07/06/19	Wed 25/09/19
796	Coil 30	79 days	Fri 28/06/19	Wed 16/10/19
800	Coil 31	79 days	Fri 19/07/19	Wed 06/11/19
804	Coil 32	79 days	Fri 09/08/19	Wed 27/11/19
808	Coil 33	79 days	Fri 30/08/19	Wed 18/12/19
812	Coil 34	79 days	Fri 20/09/19	Wed 08/01/20
816	Coil 35	79 days	Fri 11/10/19	Wed 29/01/20
820	Coil 36	79 days	Fri 01/11/19	Wed 19/02/20
824	Coil 37	79 days	Fri 22/11/19	Wed 11/03/20
828	Coil 38	79 days	Fri 13/12/19	Wed 01/04/20
832	Coil 39	79 days	Fri 03/01/20	Wed 22/04/20
836	Coil 40	79 days	Fri 24/01/20	Wed 13/05/20
840	Coil 41	79 days	Fri 14/02/20	Wed 03/06/20
844	Coil 42	79 days	Fri 06/03/20	Wed 24/06/20
848	Coil 43	79 days	Fri 27/03/20	Wed 15/07/20
852	Coil 44	79 days	Fri 17/04/20	Wed 05/08/20
856	Coil 45	79 days	Fri 08/05/20	Wed 26/08/20



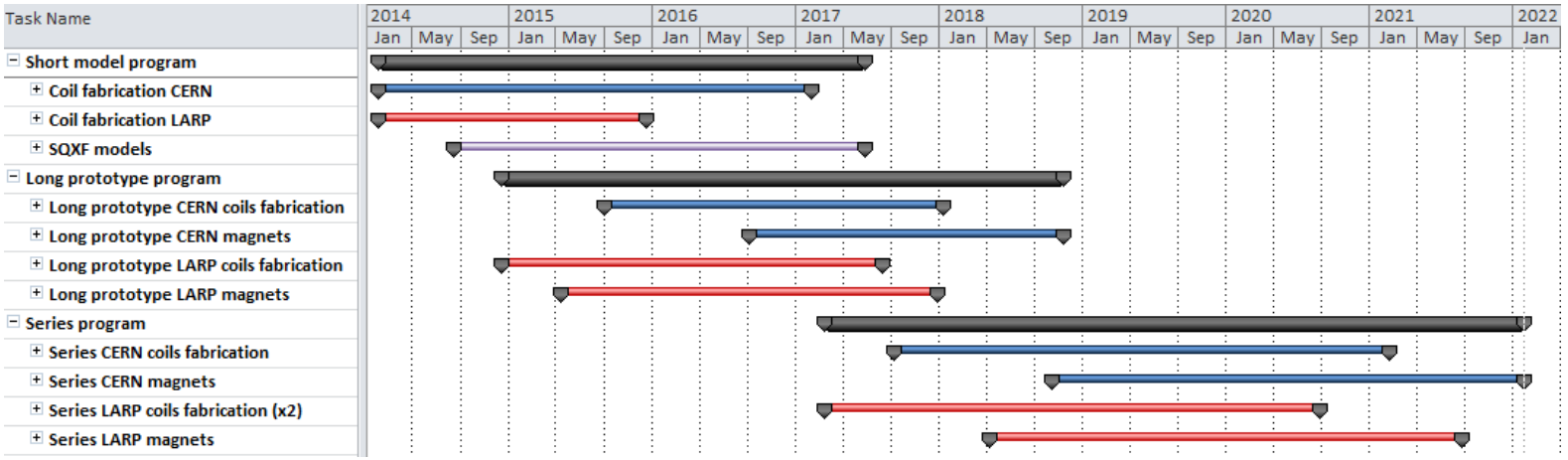
Pre-series and series production
Overview of magnet production

	Task Name	Duration	Start	Finish
457	Series CERN coils fabrication	901 days	Fri 08/09/17	Fri 19/02/21
638	Series CERN magnets	860 days	Mon 15/10/18	Fri 28/01/22
639	LMQXFC1	205 days	Mon 15/10/18	Fri 26/07/19
643	LMQXFC2	205 days	Mon 22/04/19	Fri 31/01/20
647	LMQXFC3	205 days	Mon 22/07/19	Fri 01/05/20
651	LMQXFC4	205 days	Mon 21/10/19	Fri 31/07/20
655	LMQXFC5	205 days	Mon 20/01/20	Fri 30/10/20
659	LMQXFD1	200 days	Mon 20/04/20	Fri 22/01/21
663	LMQXFD2	205 days	Mon 20/07/20	Fri 30/04/21
667	LMQXFD3	205 days	Mon 19/10/20	Fri 30/07/21
671	LMQXFD4	205 days	Mon 18/01/21	Fri 29/10/21
675	LMQXFD5	205 days	Mon 19/04/21	Fri 28/01/22
679	Series LARP coils fabrication (x2)	901 days	Wed 15/03/17	Wed 26/08/20
860	Series LARP magnets	860 days	Wed 09/05/18	Tue 24/08/21
861	MQXF #1	205 days	Wed 09/05/18	Tue 19/02/19
865	MQXF #2	205 days	Wed 14/11/18	Tue 27/08/19
869	MQXF #3	205 days	Wed 13/02/19	Tue 26/11/19
873	MQXF #4	205 days	Wed 15/05/19	Tue 25/02/20
877	MQXF #5	205 days	Wed 14/08/19	Tue 26/05/20
881	MQXF #6	205 days	Wed 13/11/19	Tue 25/08/20
885	MQXF #6	205 days	Wed 12/02/20	Tue 24/11/20
889	MQXF #8	205 days	Wed 13/05/20	Tue 23/02/21
893	MQXF #9	205 days	Wed 12/08/20	Tue 25/05/21
897	MQXF #10	205 days	Wed 11/11/20	Tue 24/08/21



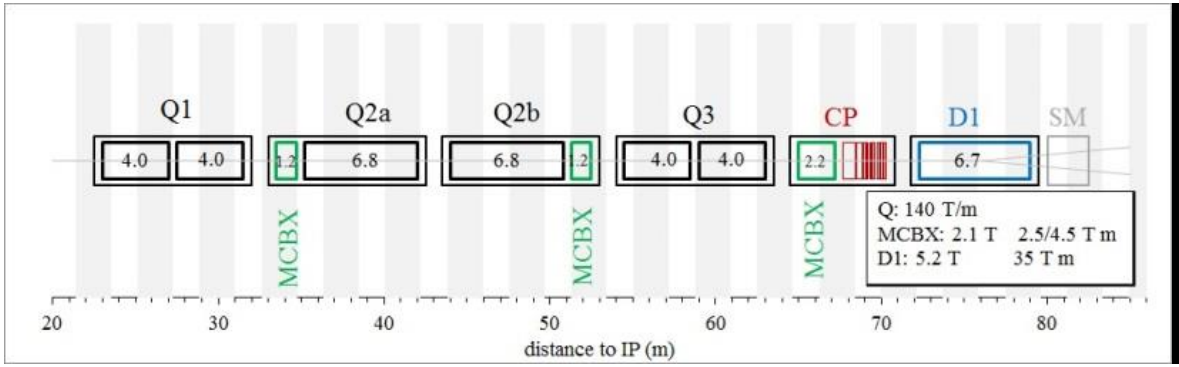
Conclusion/comments

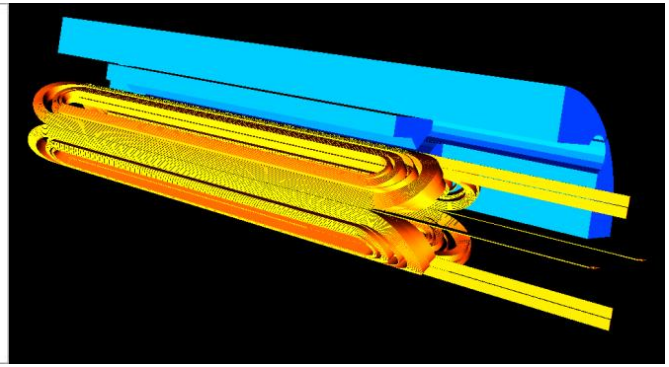
- Integrated development of CERN and LARP schedules
  - Useful to verify plans, integration and check consistency
  - CERN 180 team to join asap for prototype and production schedule/plans
- Short model program plan reasonably well defined
  - 5 models, fully integrated CERN/LARP, 2014-2016 period
- More work to do on long prototypes
  - 2+3 prototypes in the 2015-2018 period
  - Enough model and time? Can we say 5 models in total?
- Much more work on series production
  - Still to be defined many *what* and *where*



Additional slides

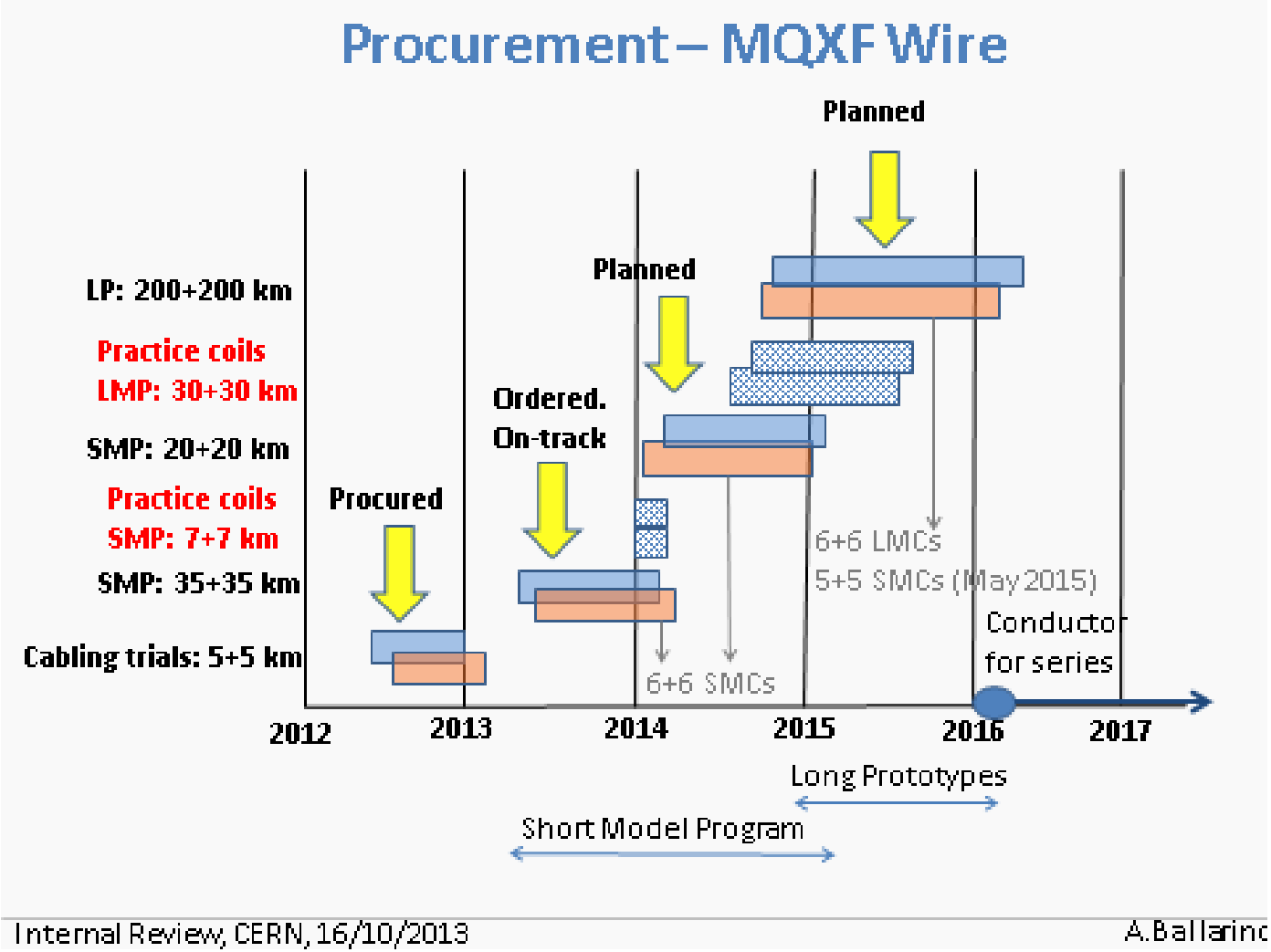
Lengths





	Short model	Q1/Q3 (half unit)	Q2
Magnetic length [m]	1.2	4.0	6.8
“Good” field quality [m]	0.5	3.3	6.1
Coil physical length [m]	1.5	4.3	7.1
Cable unit length per coil [m]	150	430	710
Strand per coil [km]	6.5	18	30

CERN procurement plan



CERN specifications

Strand diameter	0.850 ± 0.004 mm
Nominal sub-element diameter (according to billet design)	< 50 μm
Copper to non-copper volume ratio:	
minimum	1.10
maximum	1.30
Strand twist pitch	19 ± 3 mm
Strand twist direction	right-handed screw
Minimum critical current at 4.222 K	361 A at 15 T
	(632 A at 12 T)
RRR (after full heat treatment)	> 150
n-value @ 15 T and 4.2 K	> 30

Strand Procurement and Cabling Plan

Month	LARP Strand Delivery kg	Cabling Run end End Use / [Coil ID]	Coil Winding Start Date	Strand Req. kg	Cable Unit Lengths	Ta 108/127 0.85 mm kg	Tf 108/127 0.85 mm kg	Tf 108/127 0.85 mm CDP kg	Tf 144/16 9 0.85 mm kg	Tf 144/169 0.85 mm CDP kg
Oct-13		SQXF- PC01		39	1	124	350			
Nov-13		SQXF- PC02	[illegible]	39	1	124	310			
Dec-13		SQXF-03		39	1	124	271			
Jan-14		SQXF-04,05		79	2	124	192			
Feb-14		SQXF-06,07	SQXF- PC01	79	2	124	114			
Mar-14	90	SQXF-08	SQXF- PC02	39	1	124	75		90	
Apr-14		SQXF-09	SQXF C03	39	1	124	165	90	51	
May-14	165						165		396	180
Jun-14			SQXF C04				165		396	
Jul-14			SQXF C05				165		486	90
Aug-14		LQXF-PC01	SQXF C06	104	1		61		486	
Sep-14		LQXF-C01	SQXF C07	104	1		61		382	
Oct-14			SQXF C08				61		382	
Nov-14		SQXF-C10		39	1		61		343	
Dec-14		SQXF-C11	LQXF-PC01	39	1		61		303	
Jan-15		SQXF-C12	LQXF-C01	39	1		61		264	
Feb-15		SQXF-C13	SQXF-09	39	1		61		225	
Mar-15			SQXF-10				61		225	
Apr-15		LQXF-C02		104	1		61		121	
May-15		LQXF-C03	SQXF-11	104	1		61		267	250
Jun-15		LQXF-C04	SQXF-12	104	1		61		163	
Jul-15	200	LQXF-C05	SQXF-13	104	1		61		259	
Aug-15		LQXF-C06	LQXF-C02	104	1		61		155	
Sep-15	200		LQXF-C03				61		355	
Oct-15	150		LQXF-C04				61		505	
Nov-15			LQXF-C05						505	
Dec-15		LQXF-C07	LQXF-C06	104	1				401	
Jan-16		LQXF-C08		104	1				297	
Feb-16		LQXF-C09&C11		208	2				89	
Mar-16	200	LQXF-C10&C12		104	2				185	
Apr-16			LQXF-C07						185	
May-16	150		LQXF-C08						335	
Jun-16		LQXF-C13&C15	LQXF-C09&C11	104	2				231	
Jul-16		LQXF-C14&C16	LQXF-C10&C12	104	2				127	
Aug-16		LQXF-C17		104	1				23	
Sep-16			LQXF-C13&C15						23	
Oct-16			LQXF-C14&C16							
Nov-16			LQXF-C17							

Present Specification

LARP-MAG-M-8004 Rev. A

Strand Diameter, mm	0.85
J_c(12 T) at 4.2 K, A/mm^2	> 2650
I_c, A	> 684
J_c(15 T) at 4.2 K, A/mm^2	> 1400
I_c, A	> 381
d_s, µm (nominal)	< 60
Cu-fraction, %	> 53
Cu/non-Cu	> 1.13
RRR	> 150
Piece length	> 750 m

108/127

Reduced-Sn content to obtain high RRR

d_s *sub-element diameter*
J_c *Critical Current Density*
RRR residual resistivity ratio

Strand needs for the production

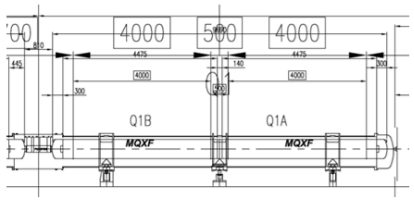
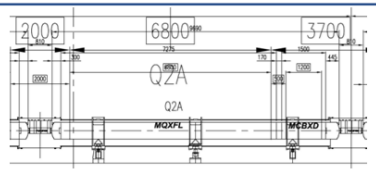
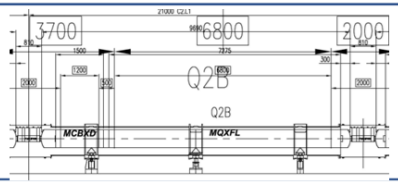
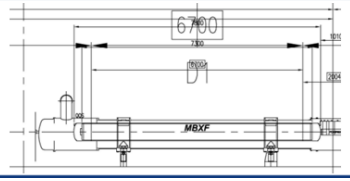
Q2

Strand per coil: 30 km
# of cold mass: 10 (2 pre-series and 8 series)
# of coil per cold mass: 4.5
Total # of coils: 45
Total quantity of strand: 1350 km

Q1/Q3 (half unit)

Strand per coil: 18 km
# of cold mass: 20 (4 pre-series and 16 series)
# of coil per cold mass: 4.5
Total # of coils: 90
Total quantity of strand: 1620 km

Naming (proposal) 1/3

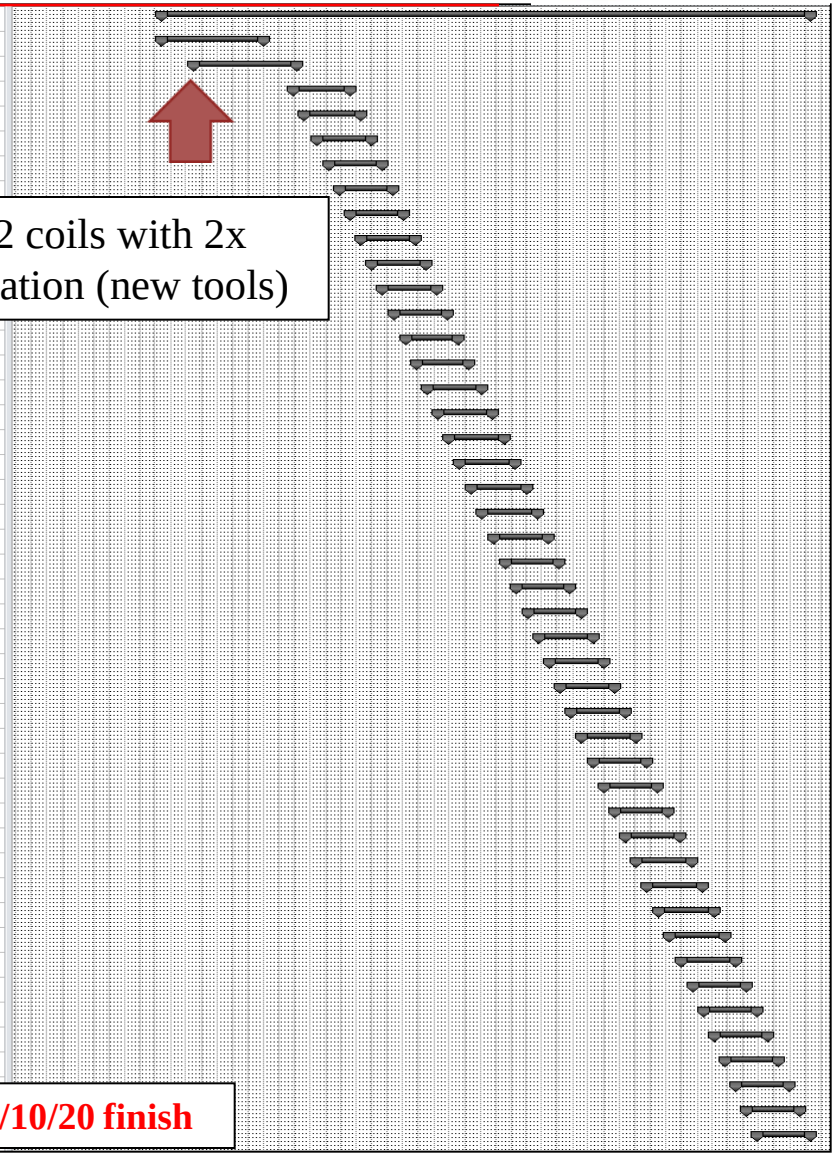
	Drawing	Cryo-magnet	Cold mass	Magnets
Q1		LQXFA	LMQXFA	MQXF
Q3		(LQXFB)	(LMQXFB)	
Q2a		LQXFC	LMQXFC	MQXFL + MCBXFA/B
Q2b		(LQXFD)	(LMQXFD)	
D1		LBXF	LMBXF	MBXF

Complete Coil schedule (1/2 production x 2 locations)

1	Wind/Cure/React/Impregnate	883 days	Wed 3/15/17	Thu 9/10/20
2	Coil 1	139 days	Wed 3/15/17	Fri 9/29/17
7	Coil 2	139 days	Wed 5/17/17	Tue 12/5/17
12	Coil 3	74 days	Wed 11/29/17	Mon 3/19/18
17	Coil 4	74 days	Wed 12/20/17	Mon 4/9/18
22	Coil 5	74 days	Mon 1/15/18	Mon 4/30/18
27	Coil 6	74 days	Tue 2/6/18	Mon 5/21/18
32	Coil 7	74 days	Wed 2/28/18	Tue 6/12/18
37	Coil 8	74 days	Wed 3/21/18	Tue 7/3/18
42	Coil 9	74 days	Wed 4/11/18	Thu 7/26/18
47	Coil 10	74 days	Wed 5/2/18	Thu 8/16/18
52	Coil 11	74 days	Wed 5/23/18	Thu 9/6/18
57	Coil 12	74 days	Thu 6/14/18	Thu 9/27/18
62	Coil 13	74 days	Mon 7/9/18	Thu 10/18/18
67	Coil 14	74 days	Mon 7/30/18	Thu 11/8/18
72	Coil 15	74 days	Mon 8/20/18	Mon 12/3/18
77	Coil 16	74 days	Mon 9/10/18	Mon 12/24/18
82	Coil 17	74 days	Mon 10/1/18	Thu 1/17/19
87	Coil 18	74 days	Mon 10/22/18	Thu 2/7/19
92	Coil 19	74 days	Tue 11/13/18	Fri 3/1/19
97	Coil 20	74 days	Wed 12/5/18	Fri 3/22/19
102	Coil 21	74 days	Thu 12/27/18	Fri 4/12/19
107	Coil 22	74 days	Mon 1/21/19	Fri 5/3/19
112	Coil 23	74 days	Mon 2/11/19	Fri 5/24/19
117	Coil 24	74 days	Tue 3/5/19	Mon 6/17/19
122	Coil 25	74 days	Tue 3/26/19	Wed 7/10/19
127	Coil 26	74 days	Tue 4/16/19	Wed 7/31/19
132	Coil 27	74 days	Tue 5/7/19	Wed 8/21/19
137	Coil 28	74 days	Tue 5/28/19	Wed 9/11/19
142	Coil 29	74 days	Wed 6/19/19	Wed 10/2/19
147	Coil 30	74 days	Fri 7/12/19	Wed 10/23/19
152	Coil 31	74 days	Fri 8/2/19	Thu 11/14/19
157	Coil 32	74 days	Fri 8/23/19	Thu 12/5/19
162	Coil 33	74 days	Fri 9/13/19	Fri 12/27/19
167	Coil 34	74 days	Fri 10/4/19	Tue 1/21/20
172	Coil 35	74 days	Fri 10/25/19	Tue 2/11/20
177	Coil 36	74 days	Mon 11/18/19	Wed 3/4/20
182	Coil 37	74 days	Mon 12/9/19	Wed 3/25/20
187	Coil 38	74 days	Tue 12/31/19	Wed 4/15/20
192	Coil 39	74 days	Thu 1/23/20	Wed 5/6/20
197	Coil 40	74 days	Thu 2/13/20	Wed 5/27/20
202	Coil 41	74 days	Fri 3/6/20	Wed 6/17/20
207	Coil 42	74 days	Fri 3/27/20	Wed 7/8/20
212	Coil 43	74 days	Fri 4/17/20	Wed 7/29/20
217	Coil 44	74 days	Fri 5/8/20	Wed 8/19/20
222	Coil 45	74 days	Fri 5/29/20	Thu 9/10/20

3/15/17 start (after last R&D coil)

1st 2 coils with 2x duration (new tools)



9/10/20 finish

LARP

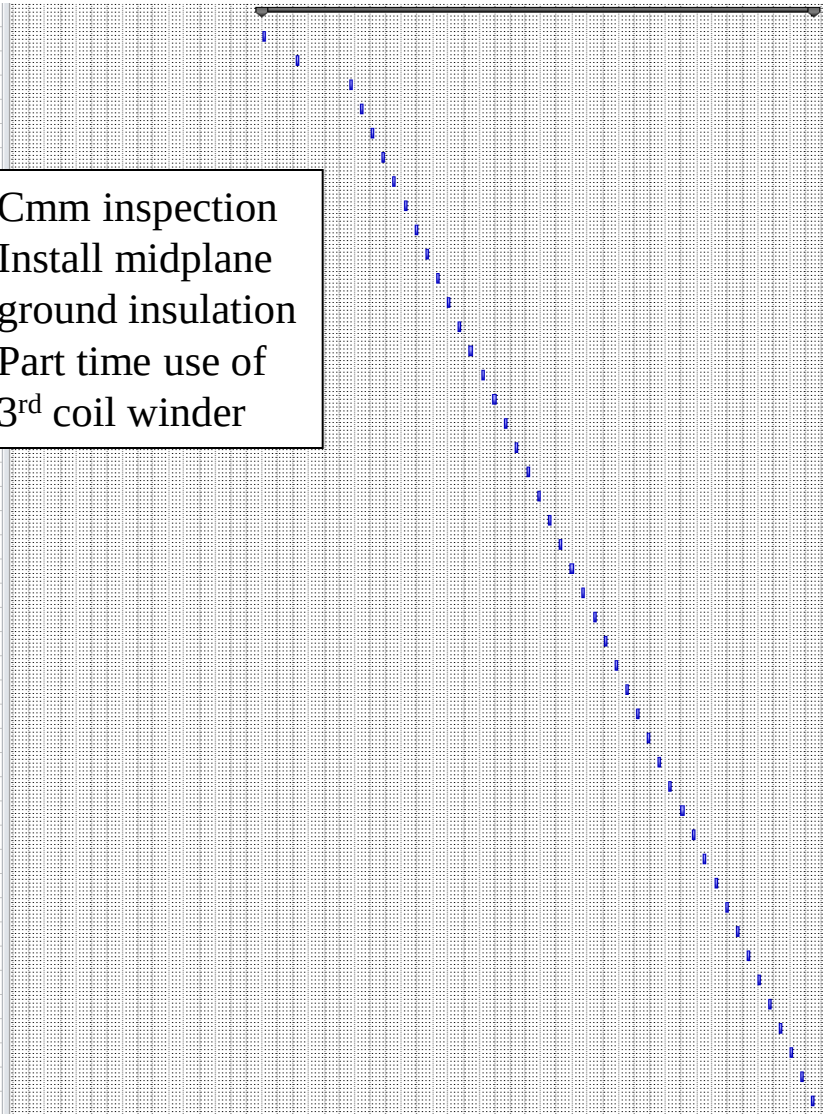
High Luminosity LHC

U.S. LARP

Coil Prep schedule (1/2 production x 2 locations)

228	Coil Inspection & Insulation	749 days	Mon 10/2/17	Thu 9/17/20	
229	1	5 days	Mon 10/2/17	Fri 10/6/17	2
230	2	5 days	Wed 12/6/17	Tue 12/12/17	7
231	3	5 days	Tue 3/20/18	Mon 3/26/18	12
232	4	5 days	Tue 4/10/18	Mon 4/16/18	17
233	5	5 days	Tue 5/1/18	Mon 5/7/18	22
234	6	5 days	Tue 5/22/18	Mon 5/28/18	27
235	7	5 days	Wed 6/13/18	Tue 6/19/18	32
236	8	5 days	Fri 7/6/18	Thu 7/12/18	37
237	9	5 days	Fri 7/27/18	Thu 8/2/18	42
238	10	5 days	Fri 8/17/18	Thu 8/23/18	47
239	11	5 days	Fri 9/7/18	Thu 9/13/18	52
240	12	5 days	Fri 9/28/18	Thu 10/4/18	57
241	13	5 days	Fri 10/19/18	Thu 10/25/18	62
242	14	5 days	Fri 11/9/18	Fri 11/16/18	67
243	15	5 days	Tue 12/4/18	Mon 12/10/18	72
244	16	5 days	Wed 12/26/18	Wed 1/2/19	77
245	17	5 days	Fri 1/18/19	Thu 1/24/19	82
246	18	5 days	Fri 2/8/19	Thu 2/14/19	87
247	19	5 days	Mon 3/4/19	Fri 3/8/19	92
248	20	5 days	Mon 3/25/19	Fri 3/29/19	97
249	21	5 days	Mon 4/15/19	Fri 4/19/19	102
250	22	5 days	Mon 5/6/19	Fri 5/10/19	107
251	23	5 days	Mon 5/27/19	Mon 6/3/19	112
252	24	5 days	Tue 6/18/19	Mon 6/24/19	117
253	25	5 days	Thu 7/11/19	Wed 7/17/19	122
254	26	5 days	Thu 8/1/19	Wed 8/7/19	127
255	27	5 days	Thu 8/22/19	Wed 8/28/19	132
256	28	5 days	Thu 9/12/19	Wed 9/18/19	137
257	29	5 days	Thu 10/3/19	Wed 10/9/19	142
258	30	5 days	Thu 10/24/19	Wed 10/30/19	147
259	31	5 days	Fri 11/15/19	Thu 11/21/19	152
260	32	5 days	Fri 12/6/19	Thu 12/12/19	157
261	33	5 days	Mon 12/30/19	Mon 1/6/20	162
262	34	5 days	Wed 1/22/20	Tue 1/28/20	167
263	35	5 days	Wed 2/12/20	Tue 2/18/20	172
264	36	5 days	Thu 3/5/20	Wed 3/11/20	177
265	37	5 days	Thu 3/26/20	Wed 4/1/20	182
266	38	5 days	Thu 4/16/20	Wed 4/22/20	187
267	39	5 days	Thu 5/7/20	Wed 5/13/20	192
268	40	5 days	Thu 5/28/20	Wed 6/3/20	197
269	41	5 days	Thu 6/18/20	Wed 6/24/20	202
270	42	5 days	Thu 7/9/20	Wed 7/15/20	207
271	43	5 days	Thu 7/30/20	Wed 8/5/20	212
272	44	5 days	Thu 8/20/20	Wed 8/26/20	217
273	45	5 days	Fri 9/11/20	Thu 9/17/20	222

- Cmm inspection
- Install midplane ground insulation
- Part time use of 3rd coil winder

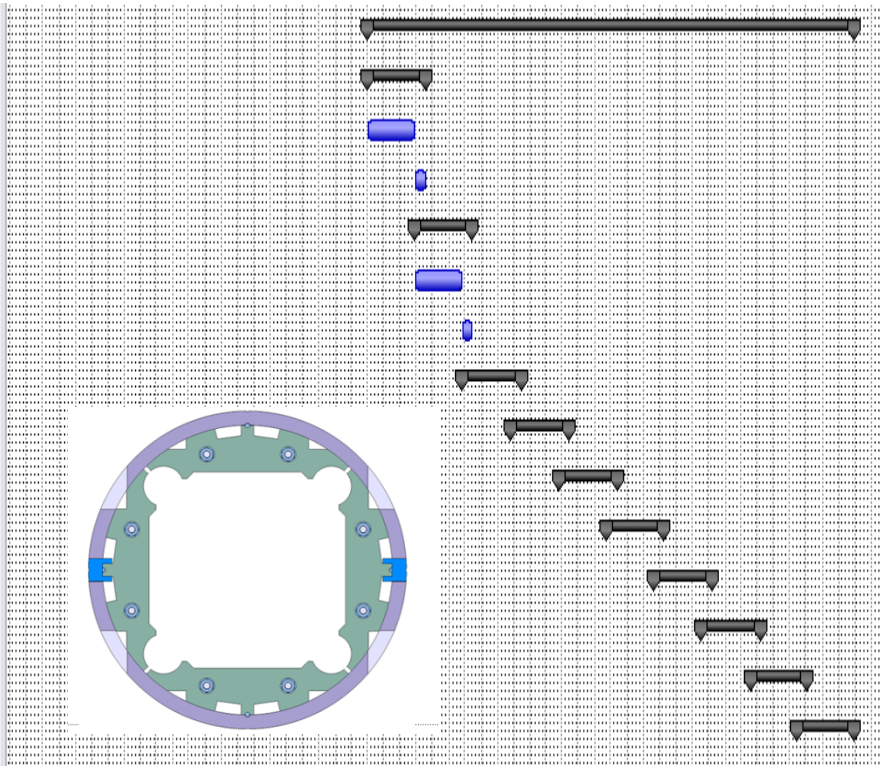


Yoke / Shell Subassembly (1/2 production shown x 2 parallel lines)

- Parallel effort to production
- Early start due to (slightly) longer task duration
- Assembly (2 x 2 Techs), Strain Gauge Installation (1 Tech) performed in parallel
  →All subassemblies available for production, including shipping time

Need date

Shell & Yoke Assembly	633 days	Mon 4/2/18	Mon 9/28/20	
Quad #1	75 days	Mon 4/2/18	Wed 7/18/18	**10/3/18**
Shell & yoke Assembly	62 days	Mon 4/2/18	Wed 6/27/18	
strain gauge instl / cabling / QA	13 days	Thu 6/28/18	Wed 7/18/18	277
Quad #2	75 days	Thu 6/28/18	Fri 10/12/18	**3/11/19**
Shell & yoke Assembly	62 days	Thu 6/28/18	Tue 9/25/18	277
strain gauge instl / cabling / QA	13 days	Wed 9/26/18	Fri 10/12/18	280
Quad #3	75 days	Wed 9/26/18	Mon 1/14/19	
Quad #4	75 days	Wed 12/26/18	Fri 4/12/19	
Quad #5	75 days	Wed 3/27/19	Fri 7/12/19	
Quad #6	75 days	Mon 6/24/19	Tue 10/8/19	
Quad #7	75 days	Fri 9/20/19	Tue 1/7/20	
Quad #8	75 days	Wed 12/18/19	Mon 4/6/20	
Quad #9	75 days	Thu 3/19/20	Wed 7/1/20	
Quad #10	75 days	Mon 6/15/20	Mon 9/28/20	**1/7/21**



Quadrupole Assembly & Test (1/2 production x 2 locations)

LARP

High Luminosity LHC

307	**Quad Assembly and Test**	**841 days**	**Tue 5/8/18**	**Mon 8/30/21**	
308	**Quad #1**	**318 days**	**Tue 5/8/18**	**Mon 8/12/19**	
309	**Assembly**	**159 days**	**Tue 5/8/18**	**Fri 12/21/18**	
310	Coil Pack Assembly	98 days	Tue 5/8/18	Tue 9/25/18	233
311	QA	5 days	Wed 9/26/18	Tue 10/2/18	310
312	Coil Structure Assembly	49 days	Wed 10/3/18	Wed 12/12/18	311
313	QA	7 days	Thu 12/13/18	Fri 12/21/18	312
314	**Cold Test**	**159 days**	**Mon 12/24/18**	**Mon 8/12/19**	
315	He Vessel, Cryostat Assy	15 days	Mon 12/24/18	Tue 1/15/19	313
316	Leak check Testing	9 days	Thu 1/17/19	Tue 1/29/19	315
317	Setup	40 days	Wed 1/30/19	Wed 3/27/19	316
318	Test: 30 calendar days	22 days	Thu 3/28/19	Fri 4/26/19	317
319	Disconnect	15 days	Mon 4/29/19	Fri 5/17/19	318
320	Vessel, Cryostat Disassy	20 days	Mon 5/20/19	Mon 6/17/19	319
321	Ship to CERN	38 days	Tue 6/18/19	Mon 8/12/19	320
322	**Quad #2**	**197 days**	**Wed 12/19/18**	**Mon 9/30/19**	
323	**Assembly**	**88 days**	**Wed 12/19/18**	**Thu 4/25/19**	
324	Coil Pack Assembly	53 days	Wed 12/19/18	Thu 3/7/19	241,325SS-4
325	QA	5 days	Mon 3/4/19	Fri 3/8/19	326SS-5 day
326	Coil Structure Assembly	27 days	Mon 3/11/19	Tue 4/16/19	327SS-27 da
327	QA	7 days	Wed 4/17/19	Thu 4/25/19	329SS-7 day
328	**Cold Test**	**109 days**	**Fri 4/26/19**	**Mon 9/30/19**	
329	He Vessel, Cryostat Assy	10 days	Fri 4/26/19	Thu 5/9/19	330SS-10 da
330	Leak check Testing	6 days	Fri 5/10/19	Fri 5/17/19	331SS-6 day
331	Setup	20 days	Mon 5/20/19	Mon 6/17/19	319
332	Test: 20 calendar days	15 days	Tue 6/18/19	Wed 7/10/19	331
333	Disconnect	10 days	Thu 7/11/19	Wed 7/24/19	332
334	Vessel, Cryostat Disassy	10 days	Thu 7/25/19	Wed 8/7/19	333
335	Ship to CERN	38 days	Thu 8/8/19	Mon 9/30/19	334
336	**Quad #3**	**204 days**	**Mon 3/11/19**	**Thu 12/26/19**	
337	**Assembly**	**92 days**	**Mon 3/11/19**	**Fri 7/19/19**	
338	Coil Pack Assembly	53 days	Mon 3/11/19	Wed 5/22/19	325,245
339	QA	5 days	Thu 5/23/19	Wed 5/29/19	338
340	Coil Structure Assembly	27 days	Thu 5/30/19	Wed 7/10/19	339
341	QA	7 days	Thu 7/11/19	Fri 7/19/19	340
342	**Cold Test**	**109 days**	**Thu 7/25/19**	**Thu 12/26/19**	
343	He Vessel, Cryostat Assy	10 days	Thu 7/25/19	Wed 8/7/19	341,333
344	Leak check Testing	6 days	Thu 8/8/19	Thu 8/15/19	343
345	Setup	20 days	Fri 8/16/19	Thu 9/12/19	344
346	Test: 20 calendar days	15 days	Fri 9/13/19	Thu 10/3/19	345
347	Disconnect	10 days	Fri 10/4/19	Thu 10/17/19	346
348	Vessel, Cryostat Disassy	10 days	Fri 10/18/19	Thu 10/31/19	347
349	Ship to CERN	38 days	Fri 11/1/19	Thu 12/26/19	348

Coil 5 done

1st assy with 2x duration

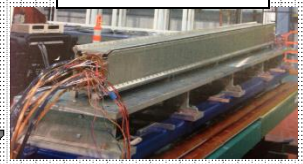
1st test with 1.5x duration

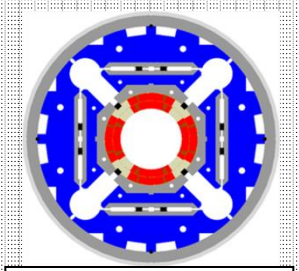
Test time based on FNAL (BNL test time TBD)

Coil 15 done

Coil Pack (2 techs) in parallel w/ Structure (2 techs)

Test setup in parallel w/ He vessel , cryostat assy (2nd set of vessels req'd) (2 testing techs, 4 assy/disassy techs)





NOT Optimized yet

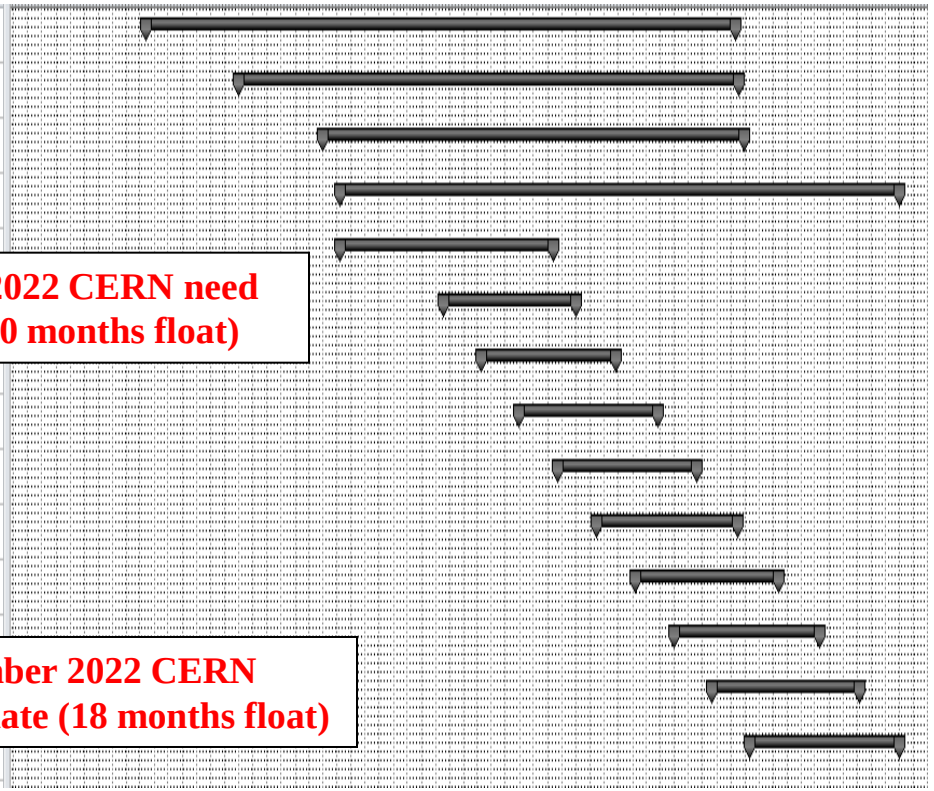
High Luminosity LHC U.S. LARP

Complete Production Schedule (1/2 production x 2 locations)

1	Wind/Cure/React/Impregnate	883 days	Wed 3/15/17	Thu 9/10/20
227	Coil Inspection & Insulation	749 days	Mon 10/2/17	Thu 9/17/20
273	Shell & Yoke Assembly	633 days	Mon 4/2/18	Mon 9/28/20
304	Quad Assembly and Test	841 days	Tue 5/8/18	Mon 8/30/21
305	Quad #1	318 days	Tue 5/8/18	Mon 8/12/19
319	Quad #2	197 days	Wed 12/19/18	Mon 9/30/19
333	Quad #3	204 days	Mon 3/11/19	Thu 12/26/19
347	Quad #4	207 days	Thu 5/30/19	Wed 3/25/20
361	Quad #5	210 days	Fri 8/23/19	Thu 6/18/20
375	Quad #6	213 days	Thu 11/14/19	Mon 9/14/20
389	Quad #7	216 days	Fri 2/7/20	Fri 12/11/20
403	Quad #8	219 days	Thu 4/30/20	Wed 3/10/21
417	Quad #9	222 days	Tue 7/21/20	Fri 6/4/21
431	Quad #10	225 days	Mon 10/12/20	Mon 8/30/21

April 2022 CERN need date (30 months float)

December 2022 CERN need date (18 months float)



SQXF plan and schedule

	Task Name	Duration	Start	Finish	Predecessors
1	Completed tasks	1218 days	Mon 01/10/12	Wed 31/05/17	
2	Cable R&D	131 days	Mon 01/10/12	Mon 01/04/13	
6	Coil design and parts	329 days	Mon 01/10/12	Thu 02/01/14	
13	Traces	154 days	Mon 03/06/13	Thu 02/01/14	
16	Coil tooling	264 days	Wed 06/02/13	Mon 10/02/14	
32	Coil fabrication CERN	582 days	Tue 11/02/14	Wed 04/05/16	
33	Coil #1 (copper)	89 days	Tue 11/02/14	Fri 13/06/14	
38	Coil #2 (RRP practice)	120 days	Thu 15/05/14	Wed 29/10/14	
43	Coil #3 (RRP)	100 days	Thu 18/09/14	Wed 04/02/15	
48	Coil #4 (RRP)	100 days	Thu 23/10/14	Wed 11/03/15	
53	Coil #5 (RRP)	100 days	Thu 27/11/14	Wed 15/04/15	
58	Coil #6 (RRP)	100 days	Thu 01/01/15	Wed 20/05/15	
63	Coil #7 (RRP)	100 days	Thu 05/02/15	Wed 24/06/15	
68	Coil #8 (PIT practice)	100 days	Thu 12/03/15	Wed 29/07/15	
73	Coil #9 (PIT)	100 days	Thu 30/07/15	Wed 16/12/15	
78	Coil #10 (PIT)	100 days	Thu 03/09/15	Wed 20/01/16	
83	Coil #11 (PIT)	100 days	Thu 08/10/15	Wed 24/02/16	
88	Coil #12 (PIT)	100 days	Thu 12/11/15	Wed 30/03/16	
93	Coil #13 (PIT)	100 days	Thu 17/12/15	Wed 04/05/16	
98	Coil fabrication LARP	365 days	Tue 11/02/14	Mon 06/07/15	
99	Coil #1 (RRP practice)	120 days	Tue 11/02/14	Mon 28/07/14	
104	Coil #2 (RRP practice)	100 days	Tue 17/06/14	Mon 03/11/14	
109	Coil #3 (RRP)	100 days	Tue 30/09/14	Mon 16/02/15	
114	Coil #4 (RRP)	100 days	Tue 04/11/14	Mon 23/03/15	
119	Coil #5 (RRP)	100 days	Tue 09/12/14	Mon 27/04/15	
124	Coil #6 (RRP)	100 days	Tue 13/01/15	Mon 01/06/15	
129	Coil #7 (RRP)	100 days	Tue 17/02/15	Mon 06/07/15	
134	Support structure	625 days	Mon 01/10/12	Fri 20/02/15	
144	SQXF1 (RRP)	143 days	Tue 24/03/15	Thu 08/10/15	
148	SQXF1b (RRP)	143 days	Fri 09/10/15	Tue 26/04/16	
152	SQXF2 (PIT)	143 days	Wed 27/04/16	Fri 11/11/16	
156	SQXF2b (PIT)	143 days	Mon 14/11/16	Wed 31/05/17