TE-CRG Activities

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LS2 DAYS
29-30 SEPTEMBER 2015

http://indico.cern.ch/event/436424/

Outline

1. General frame: cryogenic installations under operation, maintenance, consolidations, projects
2. Main activities definition for maintenance and consolidations
3. LS2 baseline
4. Schedule, resources & budget for maintenance, consolidations and projects
5. Conclusions

General frame: cryogenic installations under operation, maintenance, consolidations, projects

Operation, Maintenance, Consolidations		Projects
Physics LHC accelerator LHC detectors SPS-North Area HIE-Isolde	Tests facilities SM18 B.163	HL-LHC SM18 upgrade B.163 upgrade B.180; FAIR Neutrino platform
B.165 central liquefier services (including AD supply)		

Important milestone for the CRG Group:

New Operation & Maintenance contract to be implemented by 1st of July 2016, including:

✓ Maintenance (preventive, corrective, predictive) for all cryogenic installations at CERN

✓ Full delegation-results oriented operation for non-LHC cryogenics

(thus allowing staff resources to be made available for Projects)

✓ Tasks oriented operation for LHC accelerator & detectors under CERN's supervision

Main activities definition; Maintenance, consolidations

LHC accelerator & detectors

YETS:

- 3 days to 1 week maximum stop per installation for basic preventive & scheduled corrective maintenance (two teams of each Mechanics – Electricity/Instrumentation in parallel)

EYETS:

- Equivalent to YETS; extended to additional Safety Valves revision

Periodicity recently changed (SSI-M-2-3 Specific Safety Instruction for safety accessories)

LS2:

- Dominated by the major overhauling of helium compressors & associated electrical motors, cold compressors cartridges (12 months)
- Performing the full preventive maintenance plan (based on LS1 experience with less instrumentation activities) & scheduled corrective interventions (earlier diagnostic required for adequate scheduling)

Consolidations (according to the existing list, slide 10)

YETS 2015-2016

LHC accelerator; helium management

Baseline: beam stop Mon.14/12/2015

Helium inventory: 90% remains in the magnets (IT, DFB, LSS @ 20 K)

In case of plant stop (cryogenics or utilities) and restart within 12 h: no helium losses

Alternative: all sectors @ 20 K, helium inventory removed to surface; constraint for helium management: beam stop Wed. 09/12/2015

LHC accelerator; specific interventions

(Cat. A: Perturbation of Cryo-Maintain or Cat. B: Cryo-only)

- P8 (Cat. A): two weeks for repair of helium leak to insulation vacuum, cold box 18 kW @ 4.5 K (S81)
- P4 (Cat. A): two weeks oil pollution check and change of surface activated charcoal adsorber on 18 kW @ 4.5K (S34)
- P18/P2: replacement of one electrical motor
- P8: replacement of one helium compressor

YETS 2015-2016

LHC detectors

CMS specific interventions

- Chemical cleaning of the cold box (underground) in collaboration with VSC group; duration under definition
- Liquid nitrogen distribution & heat exchanger repair, leak to insulation vacuum of the cold box (underground): 2 weeks (external specialised firm)
- Primary oil removal system replacement (surface); order in preparation in the frame of an existing supply contract; duration under definition
- Repair of partially damaged cryogenic valve on top of intermediate cryostat (underground)
- Dryer commissioning

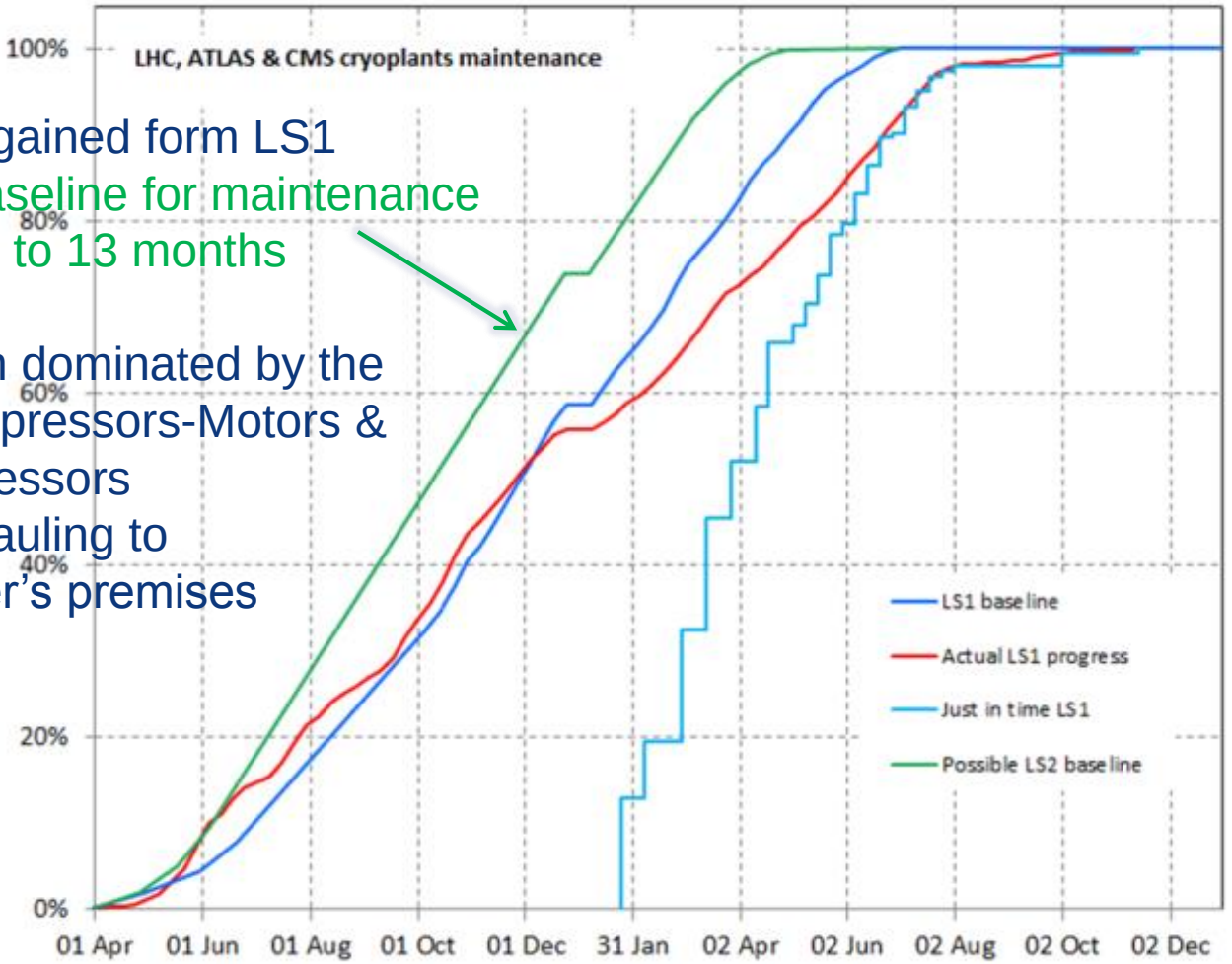
ATLAS specific interventions

- Dryer commissioning

LS2 (2019-2020) maintenance forecast based on LS1 experience

Experience gained form LS1
Ideal LS2 baseline for maintenance activities: 12 to 13 months

LS2 duration dominated by the Helium Compressors-Motors & Cold Compressors major overhauling to manufacturer's premises

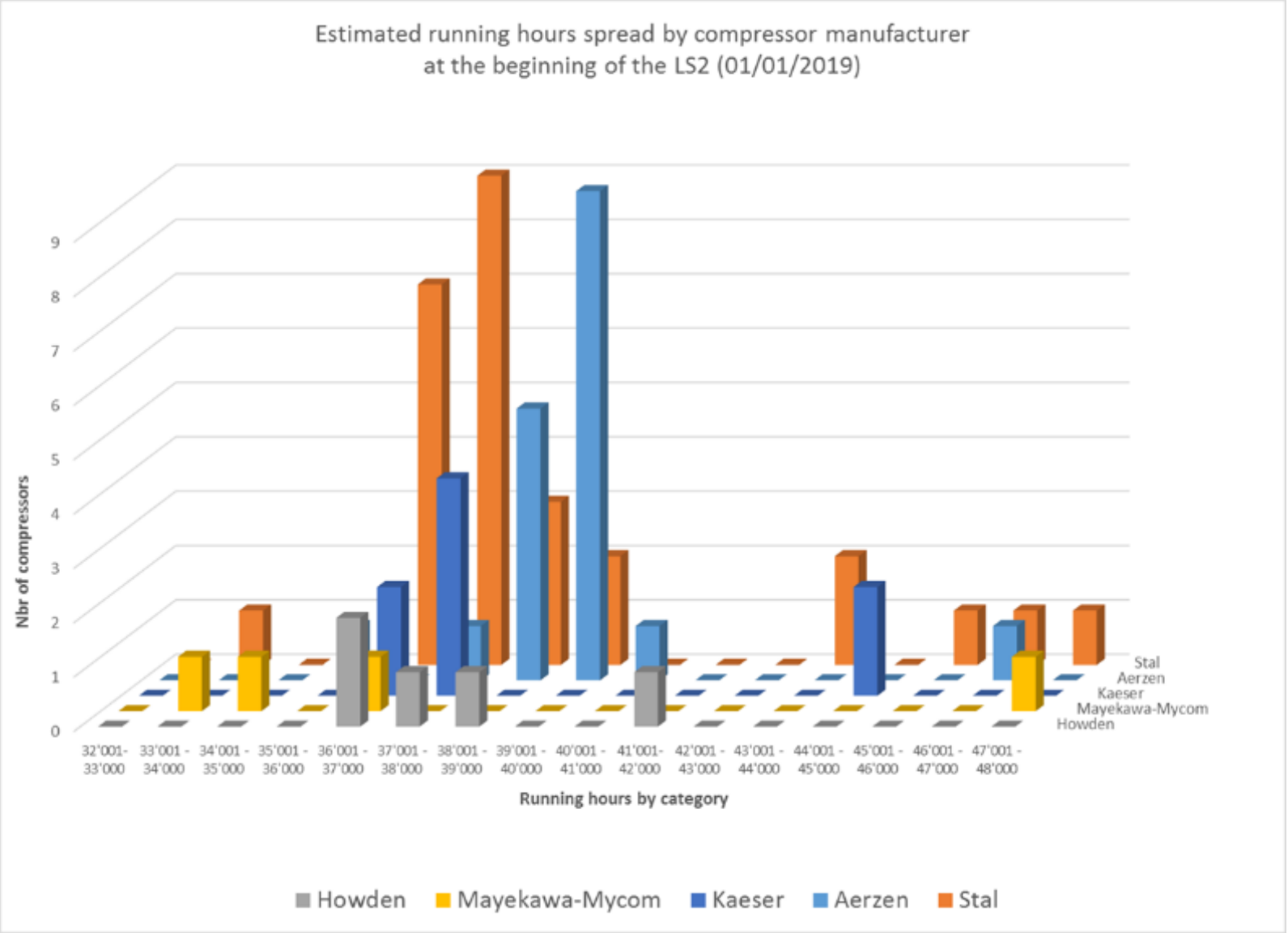


Emptying (LHC acc.), securing helium inventory, leak testing (localising potential damage on QRL bellows and/or DFB gimbals), warming up (3 months)

Pressure tests, if any; Sectors cooling down, commissioning

2013-2014 & 2019-2020

Major overhauling of helium compressors-motors stations



Helium Compressors major overhauling forecast (& experience from LS1)

Helium Compressors sent for major overhaul during LS1 per manufacturer with average major overhaul period per compressor and total major overhaul period

Manufacturer	Major overhaul per Compressor [wks]	Nbr of compressors for major overhaul	Total Periode [wks]
Aerzen	2.4	*17*	*41 wks*
Stal	1.5	*24*	*36 wks*
Kaeser	3	*6*	*18 wks*
Mayekawa-Mycom	6	*3*	*18 wks*
Howden	6	*4*	*24 wks*

LS2 forecast for helium compressors major overhaul to manufacturer's premises

Manufacturer	YETS 2015/16 RH >40'000	EYETS 2016/17 RH >40'000	YETS 2017/18 RH >40'000	LS2
Aerzen	2* repair	0	1	18
Stal	0	0	7	27
Howden	0	0	0	5
Mayekawa-Mycom	0	0	0	4
Kaeser	0	0	0	8

Maintenance, Consolidations & Spares: schedule, resources and budget

Maintenance & Operation activities 2015-2020					LS2			
	2015	2016	2017	2018	2019	2020		
Present maintenance contract C199 (ending by 30/06/2016)	2.1	1.05	0	0	0	0	3.15	MCHF
New maintenance & operation contract Exxx (starting by 01/07/2016)	0	3.05	6.1	6.6	7.4	6.1	29.25	
Total	2.1	4.1	6.1	6.6	7.4	6.1		

					LS2		
	2015	2016	2017	2018	2019	2020	Approved
Consolidations & spares overall	3.55	1.65	0.65	2.25	2.55	0.00	Draft: Still to be approved
							Team account

Consolidations & spares details		2015			2016			2017			2018			LS2 2019			2020		
		2	3&4	MCHF	2	3&4	MCHF	2	3&4	MCHF	2	3&4	MCHF	2	3&4	MCHF	2	3&4	MCHF
NA62 consolidation	99571	0.05	0.1	0.2															
New central liquefier recovery compressor	99508	0.05	0.1	0.35															
Migration to Unicos/PVSS controls	99572	0.05	0.2	0.35	0.05	0.2	0.3												
LHC Continuation of compressor stations consolidation: spares	99500	0.05		1.2															
LHC DFB: spares	99500				0.1		0.5												
Electricity & Instrumentation consolidation: spares	99511	0.05	0.1	0.3															
LHC detectors purifier consolidation	Team	0.3	0.3	1															
Central liquefier upgrade	99534	0.1	0.2	0.15															
Spare stock increase before Exxx Operation and Maintenance contract						0.1	0.35												
New AD cryo-distribution	xxxxx							0.1	0.3	0.55	0.1	1	0.25						
HIE-Isolde compressors station consolidation: spares	xxxxx				0.1		0.4												
LHC 24 V surface redundancy consolidation	xxxxx					0.1	0.1		0.1	0.1									
LHC Quench line consolidation	xxxxx													0.1	0.7	0.575			
LHC Continuation of compressor stations consolidation	99500										0.1	0.5	2	0.1	0.5	1			
LHC sectorization upgrade	xxxxx													0.1	0.3	0.971			
Total		0.65	1.00	3.55	0.25	0.40	1.65	0.10	0.40	0.65	0.20	1.50	2.25	0.30	1.50	2.55	0.00	0.00	0.00

Projects: schedule, resources and budget

	LS2										
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Projects overall	**5.0**	**6.4**	**2.6**	**11.2**	**14.4**	**0.2**	**0.1**	**24.0**	**25.9**	**29.9**	**4.3**

Projects details			2015			2016			2017			2018			2019			2020		
			2	3&4	MCHF	2	3&4	MCHF	2	3&4	MCHF	2	3&4	MCHF	2	3&4	MCHF	2	3&4	MCHF
HIE-ISOLDE	Cryogenics	99580	1.25	1.6	0.15															
HL-LHC	Cryo Infrastructure	92705			0			0			0			0.963			0.963			0
	Cryoplant at P4	92706			0.15			0.9			0.863			1.238			2.475			0
	Cryoplants at P1/P5	92707			0			0			0			0			0			0
	Cryogenic Distribution at P4	92708			0			0			0.325			0.975			1.95			0
	Cryogenic distribution at P1/P5	92709			0			0			0			0			0			0
	Cryogenic Instrumentation & Controls	92710			0.1			0.1			0			0.199			0.464			0
	FTE CERN	92700	1.3	2.7		1.6	3.1		2.3	4.6		3.6	7.2		3.9	7.9		2.7	5.6	
	M4P	92700			0.32			0.32			0.22			0.45			0.86			0.18
SM18_Tests	RF Cryogenic Infrastructure	69828	1.2	0.55		1.2	0.55													
	HFM	99510	1.5	1.4	0.8	0.55	0.55	0.38												
	Cluster D	99510	0.45	0.3	0.42	0.75	0.9	0.9												
	HL-LHC String	xxxxx	0.1	0.1	0	0.1	0.1	0	0.5	0.5	0.2	2	3	1	0.8	1.3	1.3			
SM18_UPG	Cryoplant/infra upgrade	99514	0.3	0.4	0.2	0.4	0.5	0.3	0.4	0.7	0.4	1	2	6.4	1	2	6.4			
B163_Tests	Cryogenic Infrastructure in B163	xxxxx				0.4	1	0.45	0.1	2	0.45									
P18-BA7	LHC Helium management P18	xxxxx					0.1			0.2	0.1									
Other Projects	Neutrino Plateform	xxxxx	0.5	0.5		1	1		1	1		1	1		1	1		0.5	0.5	
	CIEMAT	35434	0.5																	
	FCC studies	10815			0.15			0.36			0.08									
	FCC staff	90023	0.2			0.2			0.2			0.2								
	ILC staff	xxxxx	0.1			0.1			0.1			0.1								
	B 180 Cryogenics FAIR	99565	2.1	2.6	2.7	1.7	2.0	2.7												
Total			**9.5**	**10.2**	**5.0**	**8.0**	**9.8**	**6.4**	**4.6**	**9.0**	**2.6**	**7.9**	**13.2**	**11.2**	**6.7**	**12.2**	**14.4**	**3.2**	**6.1**	**0.2**

2021			2022			2023			2024			2025			Total			
2	3&4	MCHF	2	3&4	MCHF	2	3&4	MCHF	2	3&4	MCHF	2	3&4	MCHF	2	3&4	Staff	MCHF
															1.25	1.6	2.85	0.15
		0			3.1			3.9			0			0	0	0	0	8.9
		0			0			0			0			0	0	0	0	5.6
		0			16.13			16.13			21.5			0	0	0	0	53.8
		0			0			0			0			0	0	0	0	3.3
		0			3.75			3.75			7.5			3.75	0	0	0	18.8
		0			0.705			1.49			0.465			0.465	0	0	0	4.0
3	7		5.7	11.7		6.1	12.5		4.4	8.9		2	4.1		36.6	75.3	111.9	0.0
		0.07			0.34			0.67			0.4			0.13	0	0	0	4.0
															2.4	1.1	3.5	0
															2.05	1.95	4	1.18
															1.2	1.2	2.4	1.32
															3.5	5	8.5	2.5
															3.1	5.6	8.7	13.7
															0.5	3	3.5	0.9
																0.3		
															5	5	10	0
															0.5	0	0.5	0
															0	0	0	0.59
															0.8	0	0.8	0
															0.4	0	0.4	0
															3.8	4.6	8.4	5.406
3.0	**7.0**	**0.1**	**5.7**	**11.7**	**24.0**	**6.1**	**12.5**	**25.9**	**4.4**	**8.9**	**29.9**	**2.0**	**4.1**	**4.3**	**61.12**	**104.66**	**165.78**	**124.11**

HL-LHC

94.3 MCHF
111.9 FTE
4.0 MCHF

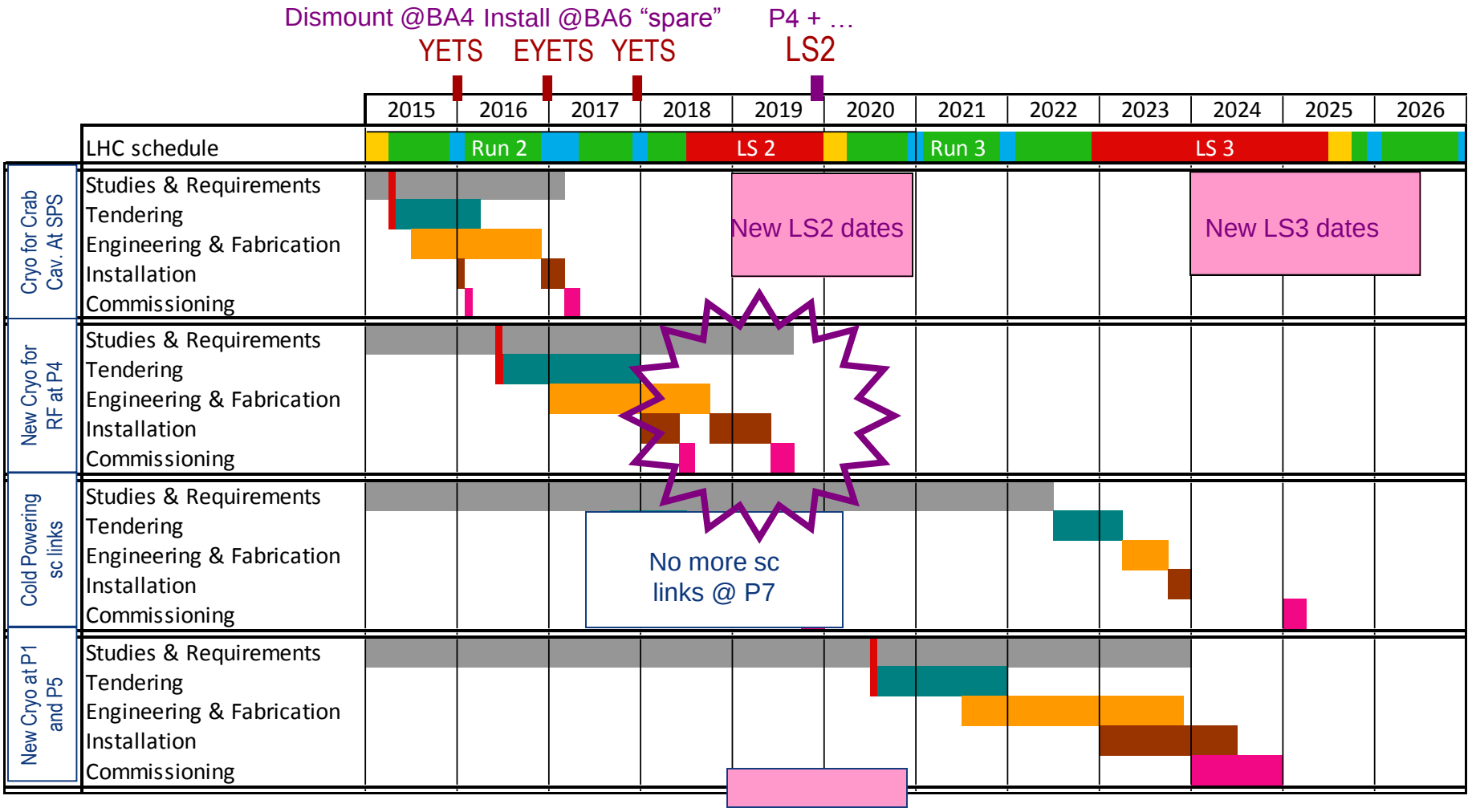
18.7 MCHF
27.1 FTE

SM18-UPG

Overall CRG project support to:

- SM18-UPG (2015-2020) accounts for 27.1 FTE (18.7 MCHF) &
- HL-LHC (2015-2025) accounts for 111.9 FTE (94.3 MCHF)

HL-LHC, cryogenics general schedule



+ 11T dipoles @ P2 ?

+ possible work on some Q5@P6, LSS2-LSS8 beam-screens?

Conclusions (1/2)

- Cryogenic operation, maintenance & consolidation activities for LHC accelerator and detectors adapted to YETS & EYETS definition and duration
- Specifically for YETS 2015-2016 special attention is given to CMS interventions, in order to fulfil the Collaboration's requirements and schedule
- The CRG group has an important milestone by the implementation of a new Operation & Maintenance contract by the 1st of July 2016, fulfilling two major objectives:
  - ✓ To cover all EYETS, YETS and LS2 maintenance activities
  - ✓ The full delegation-results oriented operation for non-LHC cryogenics (thus allowing staff resources to be made available for Projects)

Conclusions (2/2)

- The major overhauling of the cryogenic equipment to manufacturer's premises is well adapted to the new LS2 duration and experience gained from LS1 performance can be applied
- *During the warming-up phase, in case of discovery of mechanical damages to QRL or DFB components a dedicated team has to be allocated (in collaboration with VSC and MME groups)*
- In parallel with the cryogenic operation activities CERN wide, during 2015-2020, a strong CRG support to projects is on schedule, in particular for the SM18 upgrade and HL-LHC activities

Thank you for your attention