

TE-CRG Activities

A. Perin, on behalf on the Cryogenics Group

Outline

1. General frame: cryogenic installations under operation, maintenance, consolidations, projects
2. Maintenance and consolidation activities with a focus on LHC for EYETS, YETS & LS2
3. TE-CRG projects 2016-2020
4. 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 in 2016 for the CRG Group:

New Operation & Maintenance contract started on 1st of July 2016:

- ✓ Maintenance (preventive, corrective, predictive) for all cryogenic installations at CERN
- ✓ Full delegation results-oriented operation for non-LHC cryogenics
- ✓ Tasks oriented operation for LHC accelerator & detectors under CERN's supervision

Main activities definition; Maintenance, consolidations

LHC accelerator & detectors

EYETS 2016

- Basic preventive & scheduled corrective maintenance (two teams of each Mechanics – Electricity/Instrumentation in parallel); extended to additional Safety Valves revision.
- Corrective maintenance: possible cleaning of cold boxes in P6 & P4 + repair of QRL bellows following S12 warmup.

YETS 2017

- Basic preventive & scheduled corrective maintenance (two teams of each Mechanics – Electricity/Instrumentation in parallel)

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, slides 9 &10)

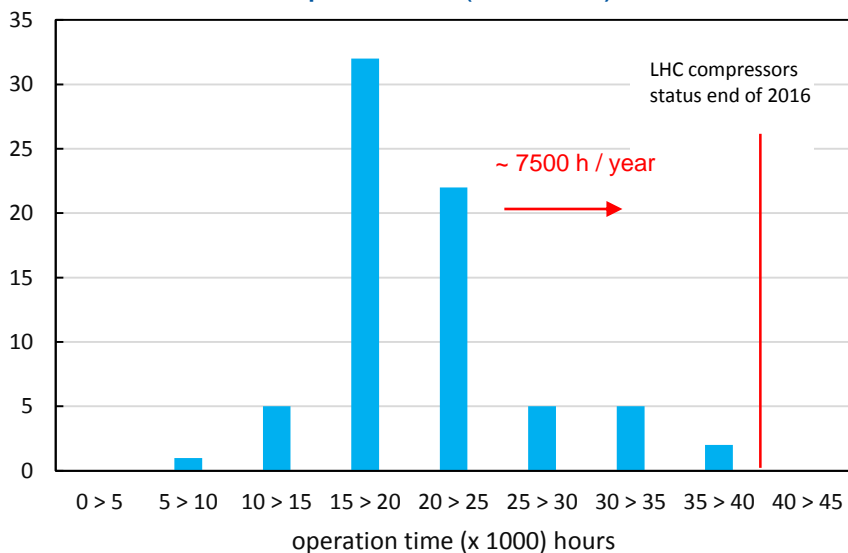
LHC compressors & motors overhauling

Compressors require a major overhaul (off CERN site) after 40'000 hours

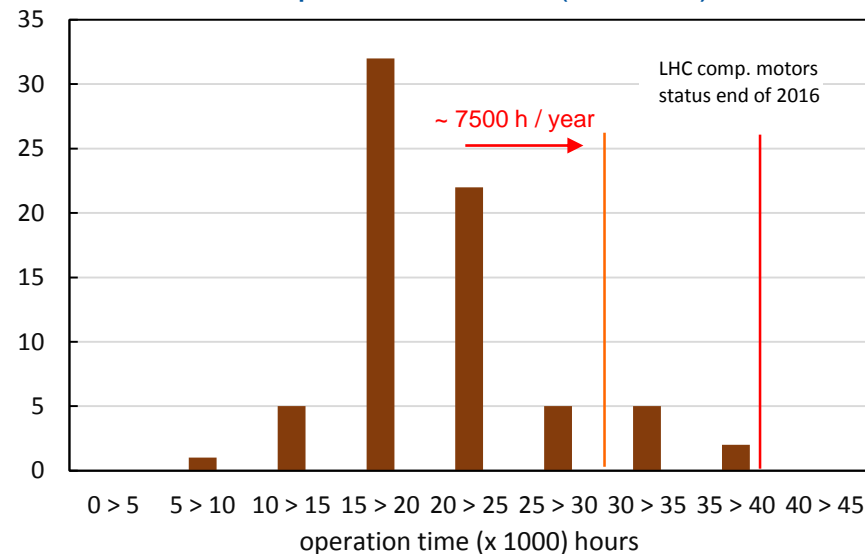
Electric Motors for compressors require a major overhaul (off CERN site) every 30'000 or 40'000 hours

Normal operation time limits can be exceeded with spares available and specific monitoring

Compressors (77 units)



Compressor motors (77 units)



EYETS/YETS: major overhauling only if no risk to cryo availability

LS2: full maintenance of all compressors (reset all to "0" hours)

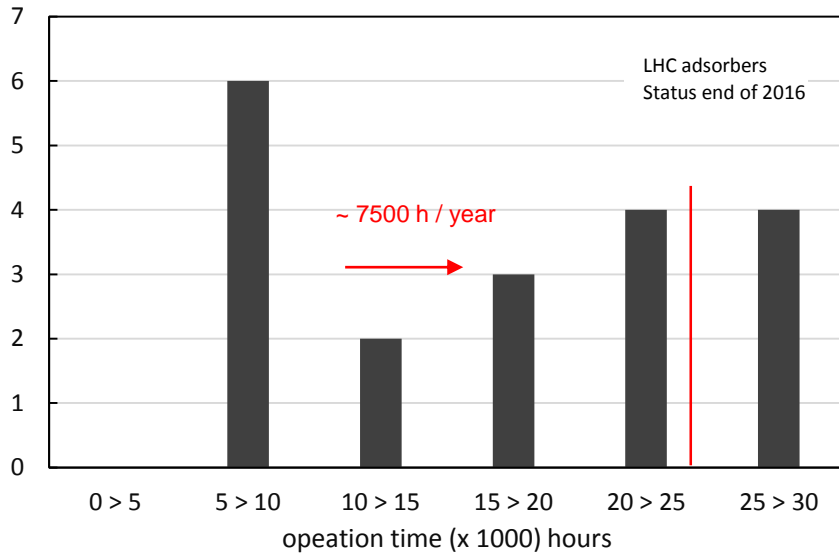
	Compressors	Motors
EYETS 2016	0	1
YETS 2017	7	11
LS2	70	65



LHC activated charcoal for compressors and safety valves

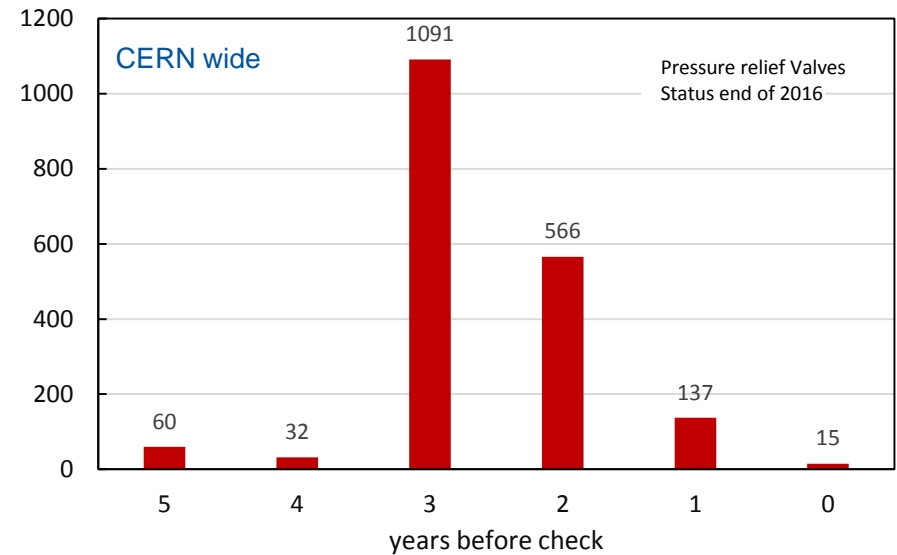
Compressor stations activated charcoal (19 units)

Replacement every 24'000hrs



Pressure relief valves (1901 units)

check by HSE 2, 3, 4, 5 years (requires demounting)



Pressure relief valves: many valves reach check date before LS2 but some cannot be removed during EYETS, YETS, TS: strategy: check the ones that can be removed, postpone to LS2 the ones that cannot be removed (approach to be agreed with HSE).

	Charcoal
EYETS 2016	6
YETS 2017	5
LS2	8

LHC EYETS 2016 maintenance

LHC accelerator: helium management

Helium inventory: S1-2 warmed up to 300 K for magnet replacement, all other sectors @ 20 K.

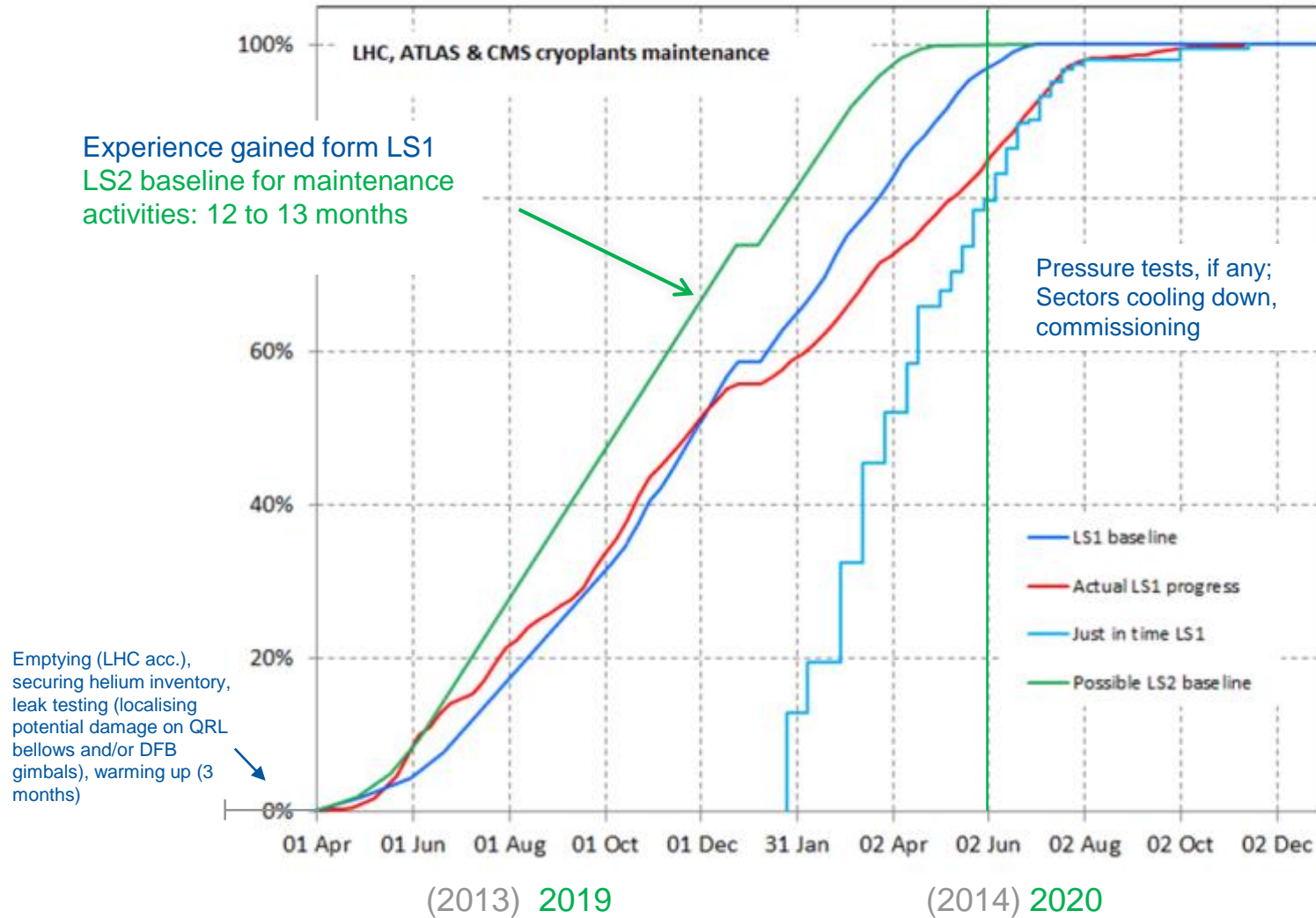
The helium inventory will be removed to surface. Very limited risk of losing helium in case of major breakdowns.

LHC accelerator: noteworthy interventions

- P18/P2: replacement of activated charcoal for QSCCB (1.9 K system)
- P4: replacement of charcoal for QSCCA (1.9 K system)
LHCA cold box (ex-LEP), investigation for the presence of oil.
Installation of a 4th coalescing filter
- P6: LHCA cold box (ex-LEP), investigation for the presence of oil.
Installation of a 4th coalescing filter
- P6: replacement of charcoal for QSCCB (1.9 K system)
- Sector 1-2: X-ray to be performed on all QRL multilayer bellows with possible repairs. Possible to absorb 2 repairs, if any, without delaying EYETS.

LS2 LHC cryoplants maintenance forecast

Based on LS1 experience (2013-2014)



TE-CRG consolidations & spares program

The overall picture for the 2016-2020 period

Status	Budget code	Group	Activity (work unit)	Project	2015	2016	2017	2018	2019	2020
Active	99571	TE-CRG	NA62 second transfer line (IEFC)	ADCONS	100	100				
Draft 5	99571	TE-CRG	New AD cryo distribution (IEFC)	ADCONS	if approved, postponed to 2021-2022					
Draft 5	22086	TE-CRG	HIE-ISOLDE compressor station: spares (IEFC)	ISO-CONS		400				
Active	99508	TE-CRG	New central liquefier recovery compressor (IEFC)	LHC-CONS	Canceled					
Active	22085	TE-CRG	LHC 24 V surface redundancy consolidation (LMC)	LHC-SPARES		90	90	90	90	
Active	99511	TE-CRG	Electricity & instrumentation consolidation (LMC) (completed)	LHC-SPARES	200	100				
Active	99572	TE-CRG	Migration to the UNICOS/PVSS controls system (IEFC)	LHC-CONS	200	250	200			
Planned	99500	TE-CRG	DFB spares (LMC)	LHC-SPARES		500				
Active	99500	TE-CRG	Continuation of the compressor station consolidation : cold spares (LMC)	LHC-SPARES	200	1,000				
Draft 3	22084	TE-CRG	Continuation of the compressor station consolidation: hot spares (LMC)	LHC-CONS					2,000	1,000
Draft 5	22085	TE-CRG	LHC sectorisation upgrade (Chamonix) (not approved)	LHC-SPARES					971	
Draft 5	22084	TE-CRG	Quench line consolidation (LMC)	LHC-CONS	Canceled					

To be taken in charge by the project; on going

Active

To be taken in charge by the operation budget (2016-2017); on-going

Completed

Stand-by / not approved

LHC consolidations for LS2 (not in previous slide)

Mechanics

- Possible replacement of ageing compressor station of Pt2 (alternative to hot spares).
- Consolidation of the oil removal systems in LHCA cryoplants in P4 & P6 (ex-LEP cryoplants).

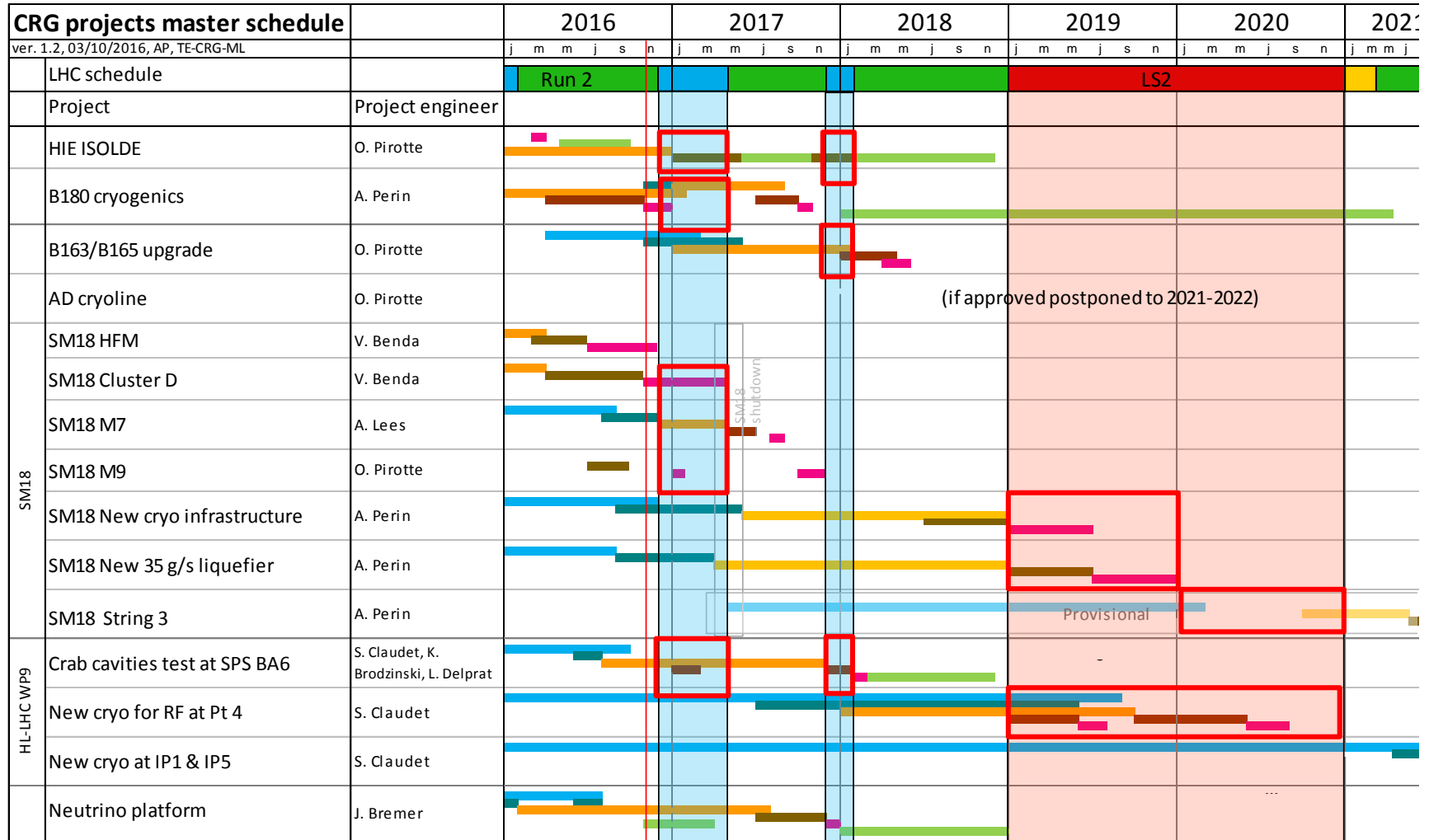
Controls

- CPU upgrades in ATLAS & CMS
- Replacement of cabling and cabinets (premature embrittlement of cabling).

Instrumentation

- R2E Issues: Valve positioners (> 6 kGy in 2016). Rad-qualification campaign foreseen to establish maintenance strategy.
- Ageing: Cables close to high radiation areas, discrete electrical components (fuses, electrolytic capacitors)
- DFB-HTS current lead thermometers: 600 A leads increase voltage rating of cables and replace subD connectors
- Obsolesce/unavailable parts: communication with nano-FIP, etc.

TE-CRG Projects Master Schedule: 2016 - 2020

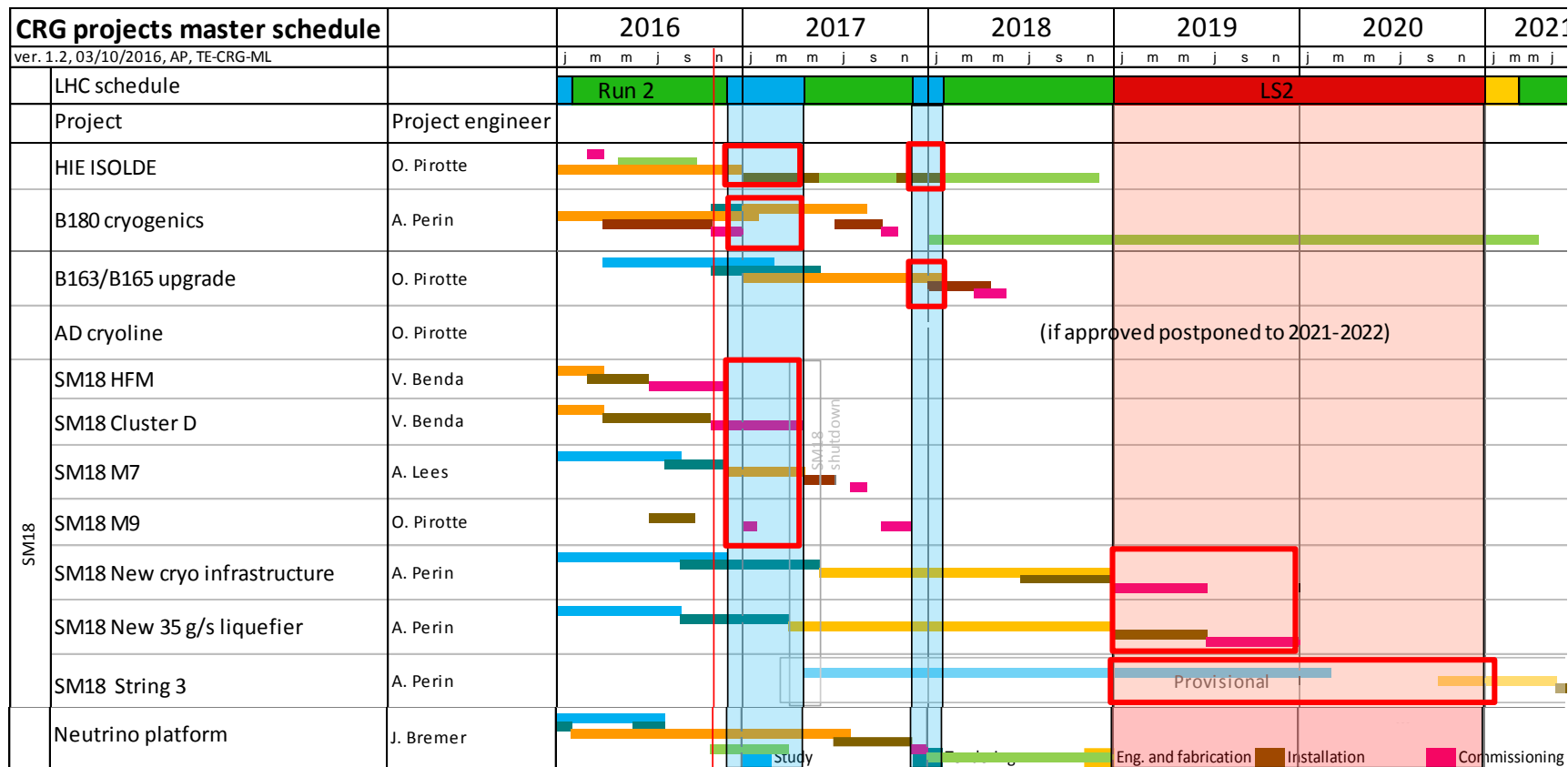


■ Study
 ■ Tendering
 ■ Eng. and fabrication
 ■ Installation
 ■ Commissioning

 Critical activities during TS & LS



Projects (non HL-LHC)



Projects with critical activities during EYETS, YETS & LS2

- EYETS 2016-2017: B180, HIE ISOLDE (additional modules), SM18 (HFM, cluster D, M7, M9)
- YETS 2017-2018: HIE ISOLDE (additional modules), B163/B165 (FRESCA 2)
- LS2 2019-2020: SM18 upgrade, String 3 cryogenics

Projects: HL-LHC cryogenics (WP9)

CRG projects master schedule		2016	2017	2018	2019	2020	2021
ver. 1.2, 03/10/2016, AP, TE-CRG-ML		j m m j s n	j m m j s n	j m m j s n	j m m j s n	j m m j s n	j m m j
	LHC schedule	Run 2		LS2			
HL-LHC WP9	Crab cavities test at SPS BA6	S. Claudet, K. Brodzinski, L. Delprat					
	New cryo for RF at Pt 4	S. Claudet					
	New cryo at IP1 & IP5	S. Claudet					

Cryogenics for Crab Cavities at SPS BA6 must be operational in 2018 (only window)!

Activities during EYETS, YETS & LS2

- EYETS 2016-2017: **SPS BA6** Cryogenic Line, Warm Piping, Helium pumps, cabling?
- 2017: SPS BA6 Surface preparation for GHe & LN2 storage tanks, vessels and surface piping
- YETS 2017-2018: **SPS BA6** Valve boxes, Compressor & Cold Box, Service box, Local piping connections, Controls, + Global commissioning
- LS2 2019-2020: **P4-RF** Cryoplant (new or upgrade), distribution (new or upgrade of local RF part of QRL_45), general & cryo infrastructure (EL, CV, GHe) + Global commissioning

Conclusions

- Cryogenic operation, maintenance & consolidation activities for the LHC accelerator and detectors were defined taking into account the requirements of EYETS 2016 and YETS 2017.
- The baseline for the maintenance and major overhauling of the cryogenic equipment is 12 months, complying with the schedule of LS2.
- Several projects are being managed in parallel with the cryogenic operation and maintenance activities during 2017-2020: the two most critical ones are the SM18 upgrade and HL-LHC activities (SPS BA6 CC & LHC P4).



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Tasks managed by TE-CRG in PLAN & tracked for LS2

Only major activities (no small actions or reserve of slot in case), and created "types" and "Activity status":

Types:

- Maintenance
- Consolidation
- Project

CRG Activity status:

- Fully Approved (FA)
- Approved Not funded (AN)
- Approval Pending (AP)

PLAN priorities
1. Safety
2. Activities needed to reach 200 fb ⁻¹ during run 3
3. HL-LHC and LIU projects
4. Approved projects
4a. Approved if budgeted
5. Approved studies
6. Others

CRG status *	PLAN ID	PLAN priority	Title	Period	Technical Responsible
	10499	2	Maintenance of the cryoplants of LHC, ATLAS and CMS	EYETS 2016-2017	P. Gayet
	10500	2		YETS 2017-2018	
	10501	2		LS2	
FA	10504	2	Major overhauling of LHC cryoplants compressors: LS2	EYETS 2016-2017	O. Pirotte
	10506	2		LS2	
	10507	2	Major overhauling of LHC cryoplants compressor motors: LS2	LS2	M. Pezzetti
	10522	2	LHC 24V surface redundancy consolidation	EYETS 2016-2017	M. Pezzetti
	10523	2		YETS 2017-2018	
	10525	2		LS2	
AP	10527	2	Continuation of consolidation of LHC compressor stations	2018	O. Pirotte
	10529	2		2019	
	10531	2	Consolidation of electrical and control system	EYETS 2016-2017	M. Pezzetti
	10533	2		YETS 2017-2018	
	10534	2		LS2	
FA	10537	3	New cryo-infrastructure for HL-LHC (QXL)	2018	S. Claudet
	10539	3		2019	
FA	10540	3	New cryoplant at IP4	2016	S. Claudet
	10542	3		2017	
	10543	3		2018	
FA	10547	3	New cryogenic distribution at IP4	2016	S. Claudet
	10548	3		2017	
	10553	3		2018	
	10554	3		2019	
FA	10556	3	Cryo for crab cavities at SPS:2016	2016-2018	S. Claudet
FA	10559	4	New liquefier in PM18 for LHe storage	2016	L. Herblin
	10562	4		2017	
	10565	5	Upgrade of cryogenic infrastructure for RF tests in SM18		O. Pirotte
FA	10609	3	HL-LHC string 3 in SM18	2017	A. Perin
	10612	3		2018	
	10613	3		2019	
	10614	3		2020	
FA	10566	3	New cryogenic infrastructure for SM18	2016	A. Perin
	10587	3		2017	
	10588	3		2018	
	10589	3		2019	
FA	10619	4	HIE ISOLDE phase 2a 2017	a 2017	O. Pirotte
	10620	4	HIE ISOLDE phase 2b 2018	b 2018	
FA	10623	4a	New cryodistribution for AD	2017	O. Pirotte
	10624	4a		2018	
FA	10626	4	B180 cryogenics	2016	A. Perin
	10628	4		2017	
FA	10629	4a	B165 & 163, cryolab upgrade	2016	O. Pirotte
	10630	4a		2017	
FA	10634	4	Neutrino platform	2016	J. Bremer
	10635	4		2017	
	10636	4		2018	
	10637	4		2019	
	10638	4		2020	