



CONS and HL-LHC day

Analysis of needs from BE-RF

Frank Gerigk, Erk Jensen, Carlo Rossi

Joint CONSOLIDATION project and HL-LHC project consolidation day

CONS and HL-CONS approved requests

(for HL-CONS except spares)

Item n.	Description	Approved Budget [kCHF]	Funding (CONS/HL-CONS) %	Budget to be allocated in the years
1	AD consolidation	965	100/0	2017-2019
2	LHC cavities and couplers	2256	100/0	2017-2020
3	Linac3 total	1410	100/0	2017-2020
4	PS total	1437	100/0	2017-2020
5	SPS total	3158	100/0	2017-2020

Note: In HL-CONS we have only spares (for crab cavities and their power couplers), for a total of CHF 6.3M, but since for the above list the request was “except spares”, they do not show up.

CONS and HL-CONS requests pending approval or refused

(items that are more important in view of HL-LHC marked in red)

Item n.	Description	Budget request [kCHF]	Budget to be allocated in the years	Pending [kCHF]	Refused [kCHF]
1	LHC cavities & couplers extra cost (co-funding sought)	2950	2017-2020	2950	0
2	Linac3 completion Bertronix replacement	830	2020-2021	830	0
(3)	LEIR Finemet cores	185	2018	0	185

to come out of operations budget

Note: “Co-funding sought” means that we’re identifying synergies with FCC study and SRF R&D programs, which can be exploited to share the cost. Cost increase because more items have to be re-made than anticipated in the beginning & aiming for one additional CM instead of “only” spare cavities.

ITEM: 1, LHC Cavities & Couplers

Rational of the request

We have one complete & tested LHC module to swap in case of failure. Once this happens, we have no valid spare for a significant time. For this case, and for the case that the failure is major (more than 1 CM affected), we are working towards a 2nd.

Total Budget request	Budget to be allocated in years 2017 to 2020				Total
	2017	2018	2019	2020	
Material budget request	900	1338	1160	546	3944
Personnel budget request [FTE/kCHF]	6/647	8.6/925	8.6/913	7/753	30.2/3240

Consequences of suppression of request:

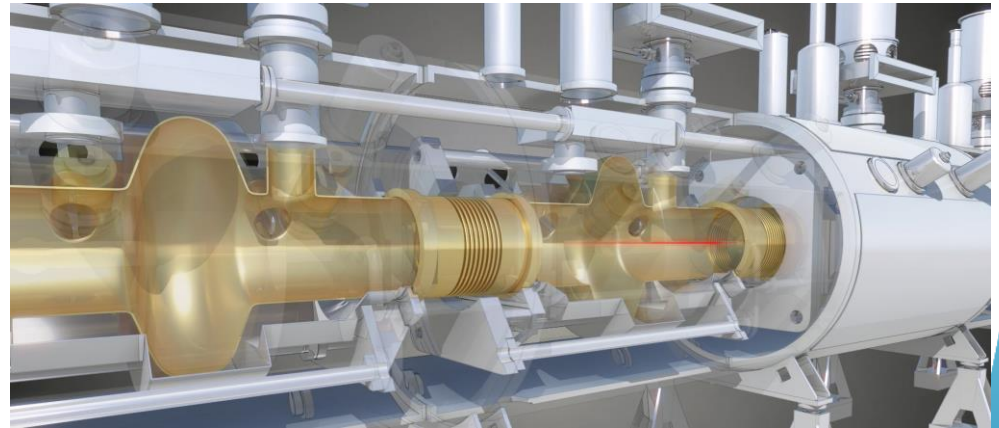
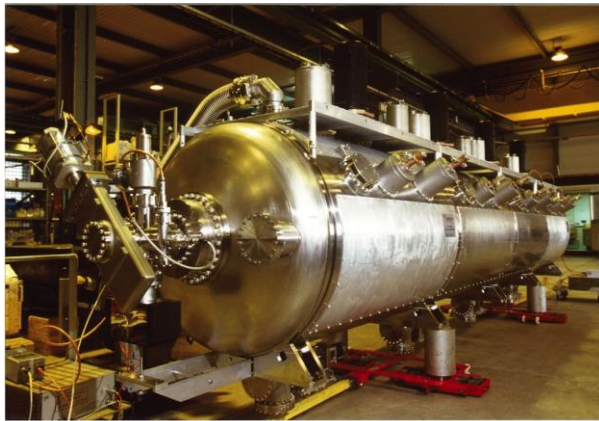
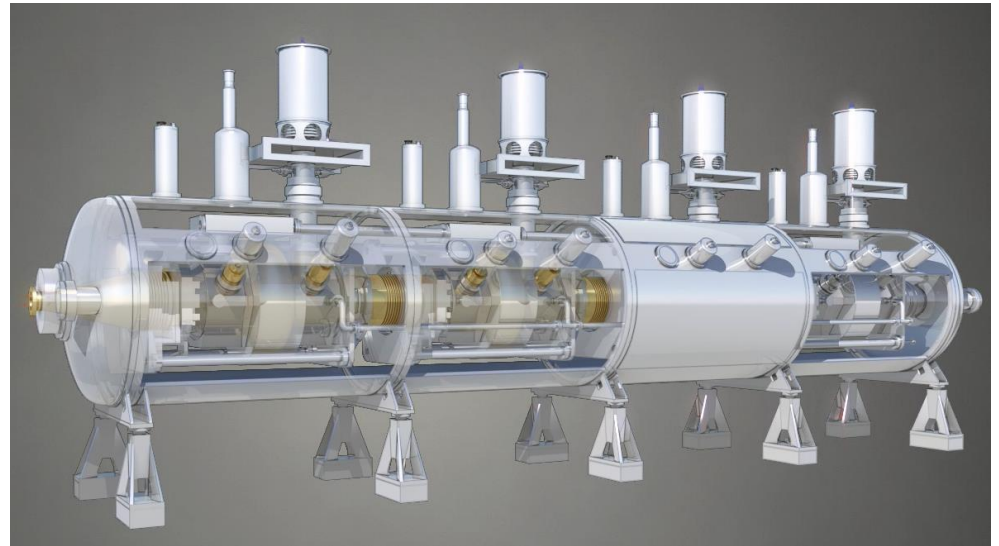
Increased risk of extended down time in the LHC (see slide 9 below)

Consequences of delay of request:

Increased risk of extended down time in the LHC while not implemented.

LHC RF Cryomodule

- 4 cryomodules of 4 cavities
- Nb-coated Cu-cavities operating at 4.5 K
- 8 - 16 MV/beam
- 400.790 MHz \pm 100 kHz
- 1 spare module
- 1 spare^(*) dressed cavity



**) Processing and probably new Nb-coating required*

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Motivation

- A full vacuum aperture (100 mm) opening near the LHC cavities will result in He-vessel rupture and cavity collapse. Opening of one beam pipe aperture will be survivable with the existing rupture discs (2.1 bars). 3-4 incident was a near miss.
- Failure of the FPC ceramic window in LHC could result in the contamination of two cryomodules, i.e. eight cavities.
- Today it would take more than a year to recondition/replace a faulty cavity in a cryomodule.
- Lead-time for new spare cavities expected to be 3-4 years
- LEP experience:
 - None of cavities in the machine was ever scrapped due to damage.
 - One vacuum sector was vented in Pt 8 and one cavity was polluted. It was rinsed, with a total down total time of 3 months.

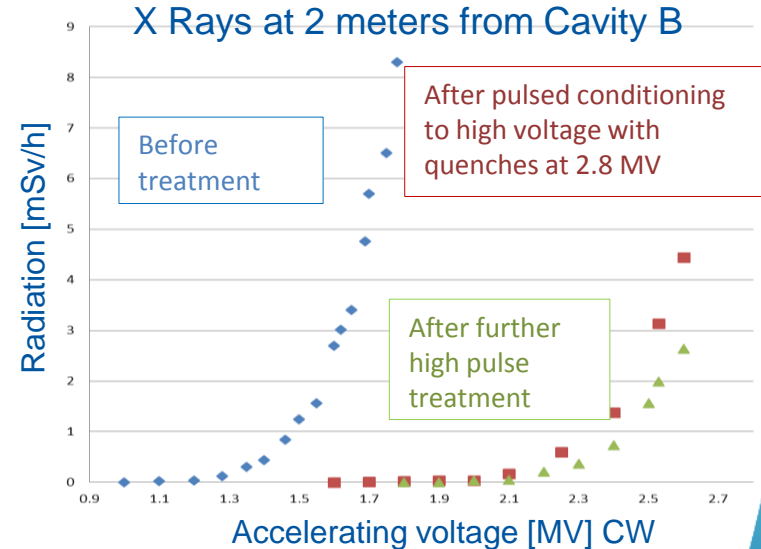
Some references:

- *E. Ciapala: RF PREPARATION FOR BEAM IN 2009, Proceedings of Chamonix 2009 workshop on LHC Performance*
- *E. Ciapala: Justification for derogation to fit 1.8 bar pressure release valves, Aug-2007 (EDMS 880723)*

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Replacement of LHC Cryomodule

- From 2009, Cavity 3 Beam 2 was quenching after a few minutes at 2 MV CW nominal
- Despite careful conditioning after each technical stop, no change of behavior
- LHC ACS module M1.B2 *America* with faulty cavity was replaced by the spare module *Europa* during LS1 (3 months)
- After successful conditioning in pulsed mode the nominal > 2 MV was regained in Dec 2015 in SM-18
- America* now a valid (**and only**) spare module and stored in SM18
- Another cold test of *America* is planned for 2017.



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F. Gerigk, E. Jensen & C. Rossi for BE-RF

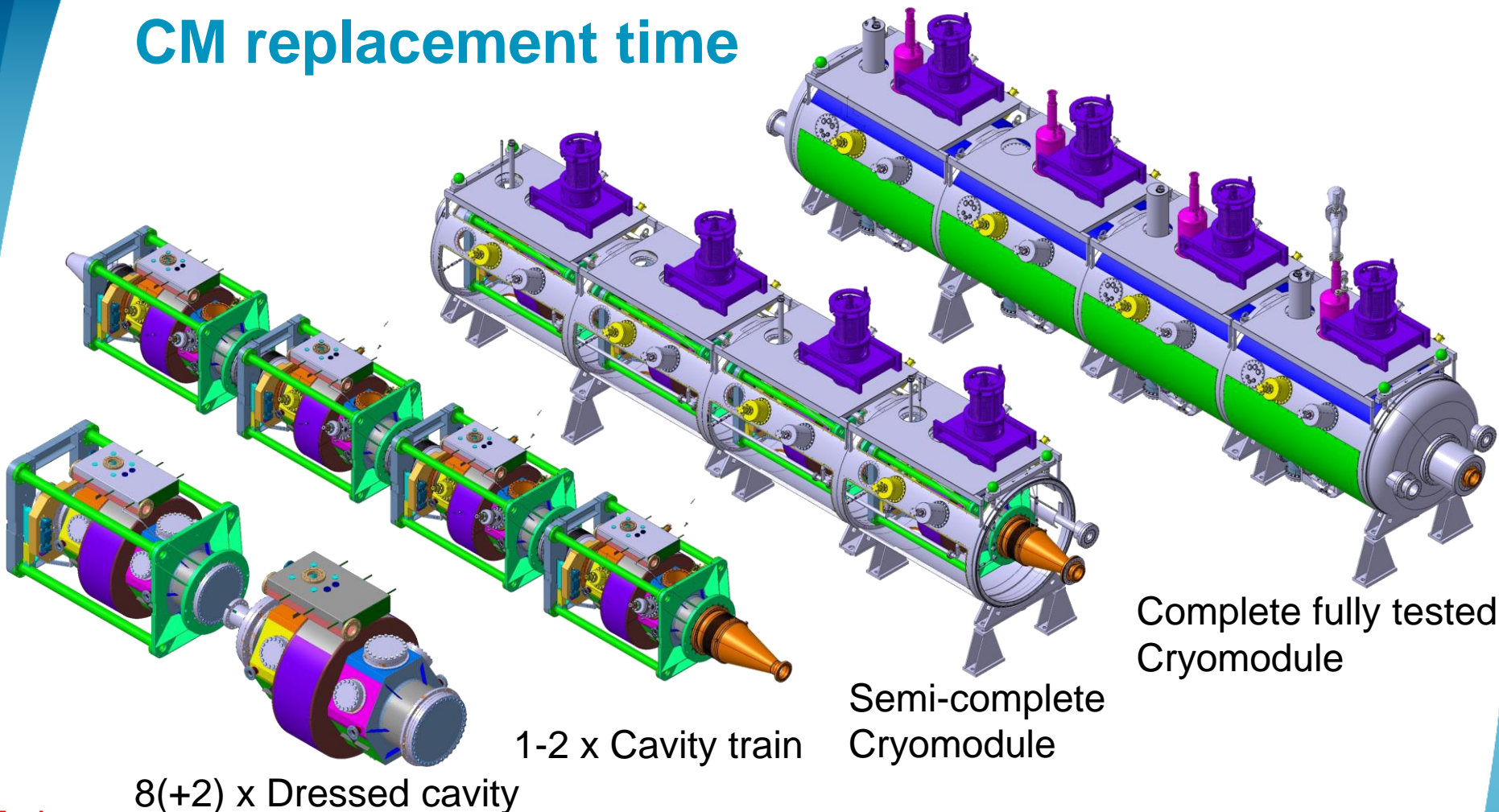
LHC Spare Cryomodule project goals

- Re-establishment of:
 - Cryomodule testing capability in M9,
 - Cryomodule assembly line,
 - Cavity production line including He-tank.
- Training of personnel on design, construction, operation, and maintenance of LHC (and other) SRF cavities and cryomodules
- **Production of 8 dressed cavities for 1 spare cryomodule + 4 dressed spares.**

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CM replacement time



8(+2) x Dressed cavity

1-2 x Cavity train

Semi-complete Cryomodule

Complete fully tested Cryomodule

Today

>1 yr (*)

27 w

23 w

16 w

4 w

Time to cryomodule at 4.5 K in LHC

*) Reconditioning of 4 modules in LHC

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Thanks to Mikko Karppinen & team

New requests in view of HL-LHC installation

(to meet HL-LHC goals)

New requests for conversion of LHC into HL-LHC

Item n.	Description	Budget request	Budget to be allocated in years (from-to)	Priority (1-3) 1 top 3 low

Description sheets for new requests

ITEM: DDD, FFFF

Rational of the request

Total Budget request		Budget to be allocated in years (from-to)	
Material budget request		Personnel available [y/n] in addition to personnel budget request	
Personnel budget request (M2P budget for MPAs and fellows)			

Consequences of suppression of request on HL performance

Consequences of delay of request to LS4 or later

ITEM: AAA, BBB descriptive slide

Summary

Priority (1-3) in decreasing order of importance	Item n.	Description	Approval Status: <ul style="list-style-type: none">• <i>Approved by CONS</i>• <i>Approved by HL-CONS</i>• <i>Not Approved by CONS</i>• <i>Not Approved by HL-CONS</i><ul style="list-style-type: none">• <i>New</i>