

Installing collimators in the next long shut-down: Plans, Status and Challenges

V.Parma,
CERN, TE-MS C

On behalf of the **Collimator Upgrade Project Team:**

in particular: **R.Assman, O.Aberle, A.Bertarelli, J.Coupard, Y.Muttoni, D.Ramos, J.Ph.Tock, D.Wollmann, and WP holders**

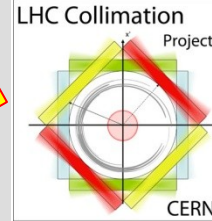


Outline

- General
- P3 DS re-layout and Integration studies
- Status of the DS collimators project (main equipment):
 - DS collimators
 - New connection cryostats
- Schedules
 - Surface activity
 - Tunnel installation
- Summary and Outlook



Collimation Upgrade Part 1 (2010 – 2013)



R.Assmann, 1st General Meeting
Collimation Upgrade, Nov.2010

- Start date of project: **1.7.2010**
- End date of project: **31.12.2013**
- Total cost to completion: **35.5 MCHF**
- Deliverables:
 - Improve collimation efficiency by factor 5-10.
 - Implement flexibility in loss location (IR3 or IR7).
- Profile:
 - 2010: 4 MCHF
 - 2011: 11 MCHF
 - 2012: 15 MCHF
 - 2013: 5.5 MCHF

What:

Upgrade of IR3 DS's with warm collimators
(DS collimator or cryo-collimator).

Moving magnets to create space.

Installation of vertical collimators in IR3 to have the possibility to move betatron cleaning into IR3 in case of SEU problems in IR7.

Installation of **high luminosity collimators?**

more in session 5



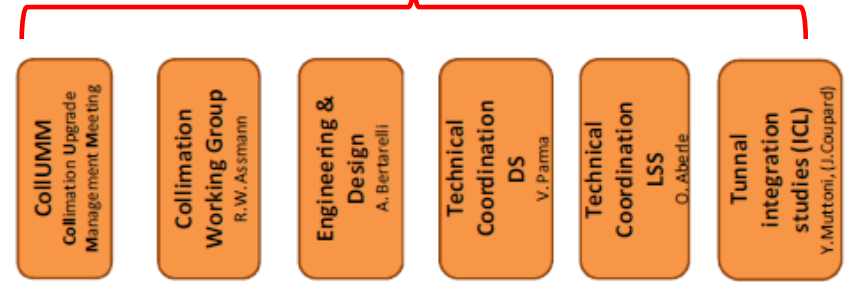
Summary of Collimators for Upgrade (part 1)

Collimator type	Orient.	To be installed	Location	To be produced	Spares (after sd)	Remark
DS Collimators	Hor.	4	DS pt3	5	1	
TCP (Primary Phase 1)	Vert.	2	LSS pt3	1	2	
TCSG (Secondary Phase 1)	Vert.	8	LSS pt3	6	2	
TCLP (Debris Absorber Ph. 1)	Hor.	4	LSS pt1,5	0	2	
TCTVA (Tertiary Phase 1)	Vert.	2	LSS pt2	0 or 2	1 or 3	To be confirmed
Total		20		12 or 14	8 or 11	



Work Breakdown Organization (1/2)

Meetings



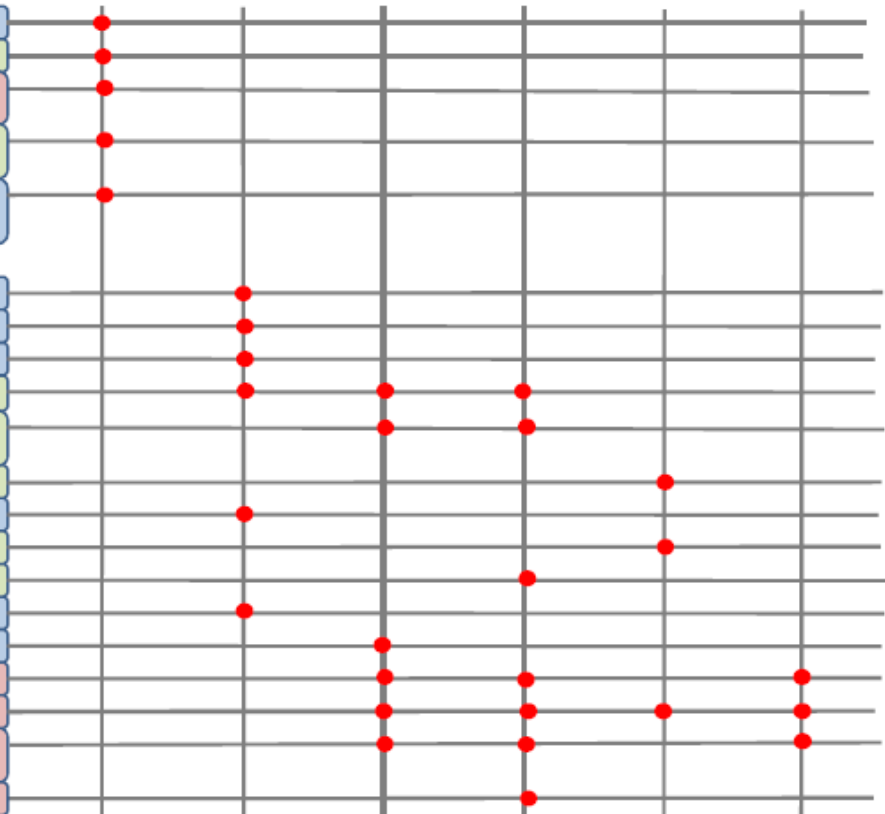
Work Packages

Project Management

Project Management	BE/ABP – R.W. Assmann
LSS technical coordination	EN/STI – O. Aberle
DS technical coordination	TE/MSc – V. Parma
Engineering, Design & Manufacture collimators	EN/MME – A. Bertarelli
Final quality control and final MTF	BE/ABP – A. Rossi

Machine Systems & Engineering studies

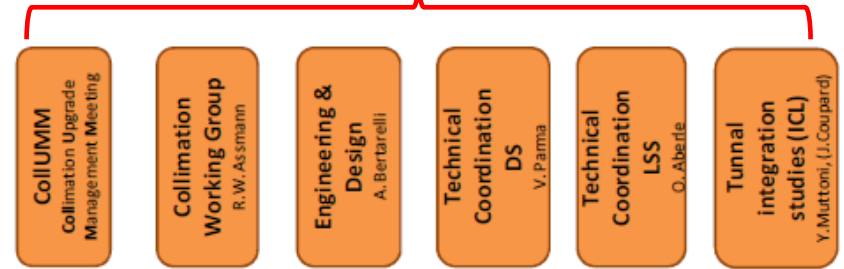
IR3 optics & Layout	BE/ABP – M. Giovannozzi
Impedance	BE/ABP – E. Metral
Performance simulations	BE/ABP – A. Rossi
FLUKA studies	EN/STI – F. Cerruti
Engineering design and production	EN/MME – A. Bertarelli
Mechanical assembly and testing	EN/STI – O. Aberle
Control software updates (top)	BE/OP – S. Redaelli
Low level controls and testing	EN/STI – A. Massi
Temperature acquisition	EN/ICE – E.B. Vinuela
Beam loss instrumentation	BE/BI – B. Dehning
BPM functionality	BE/BI – C. Boccard
Cryogenics activity	TE/CRG – R. Van Weelderden
Vacuum activity	TE/VSC – V. Baglin
Magnet, cryostats and interconnects	TE/MSc – V. Parma
Cold test of Cryo-units	TE/MSc – TBD





Work Breakdown Organization (2/2)

Meetings



Category

Work Packages

Infrastructure and General services modifications

Modification of the cooling system	EN/CV – M. Nonis
Modification of the electrical system	EN/EL – J.C. Guillaume
Modification of the access system	GS/ASE – S. Di Luca
Civil Engineering	GS/SEM – J. Osborne

Installation and commissioning 2012/2013

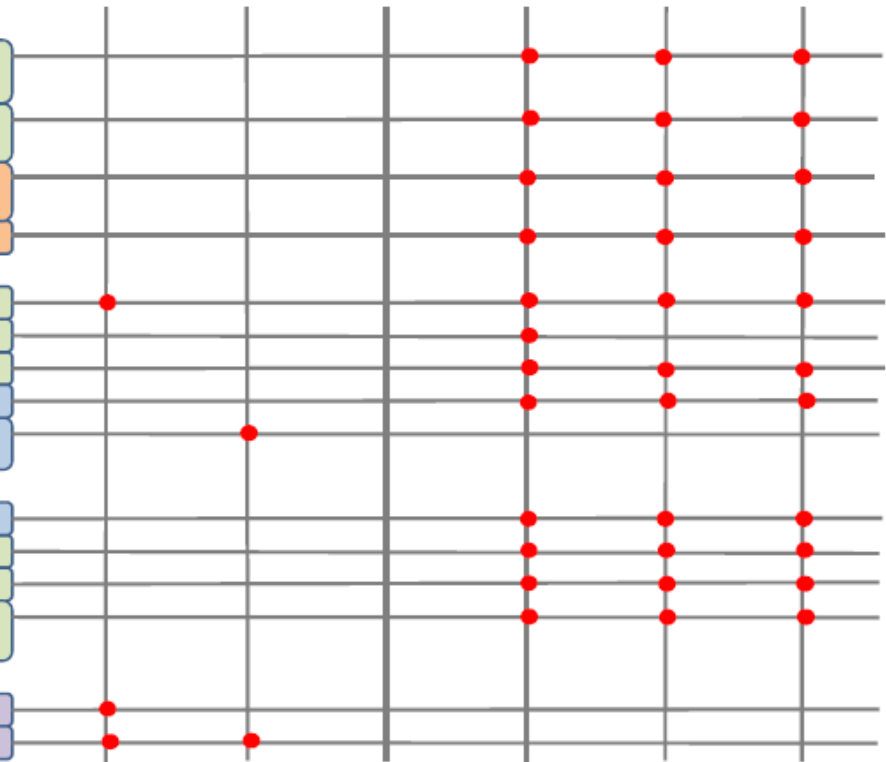
Planning, Layout and Integration	EN/MEF – J. Coupard
Jacks installation	EN/HE – A. Foreste
Transport Operation	EN/HE – C. Bertone
Survey	BE/ABP – P. Bestmann
Remote commissioning, MP tests	BE/ABP – A. Rossi BE/OP – S. Redaelli

Other studies

Remote Survey	BE/ABP – P. Bestmann
TIM train aspects	EN/HE – K. Kershaw
Remote handling	EN/HE – K. Kershaw
Optimisation of conventional transport	EN/HE – C. Bertone

Safety

General Safety	HSE/SEE – S. Roesler
Radiation protection	DGS/RP – S. Roesler

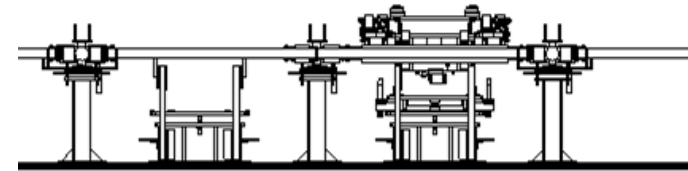


A few more WP still to be added (QPS, ELQA)

Collimators in LSS of P3

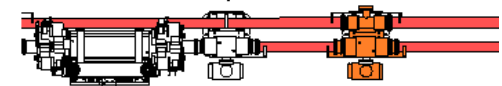
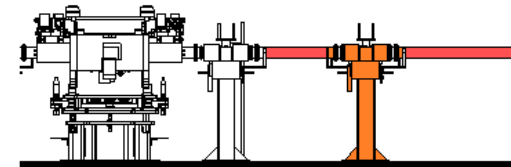
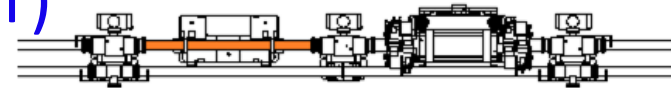
• Installation of a TCSG on TCSM slot (x8)

- Remove the vacuum chamber
- Pre-align the support
- Install the collimator
- Align the collimator
- Connect the vacuum and pump
- Bake-out and NEG activation
- Cooling and electronics connections



• Installation of a TCP on TCHS (scraper) slot (x2)

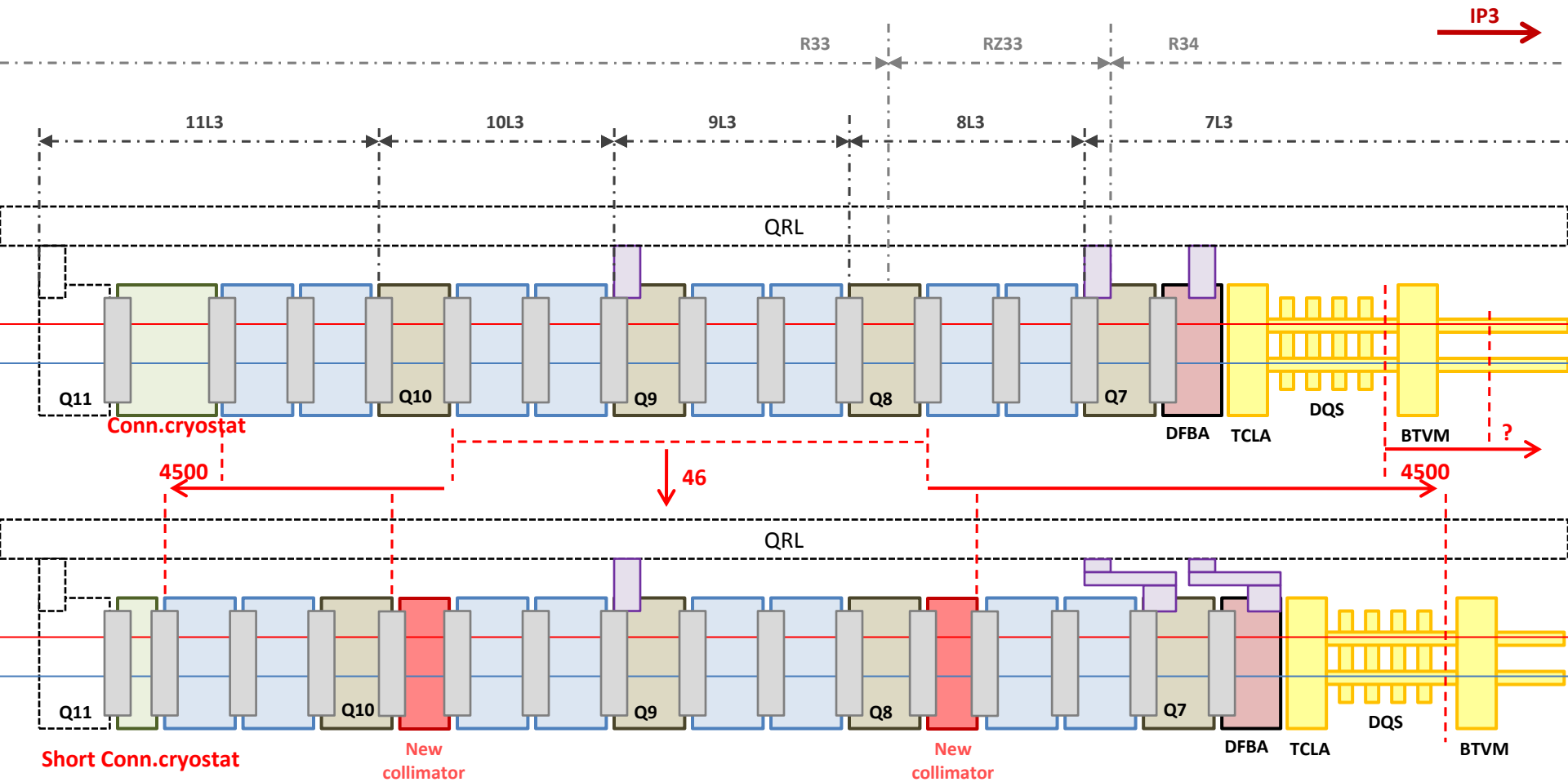
- Remove the vacuum chambers
- Relocate the pump support + new vacuum chamber
- Install and align the support of TCP
- Install the collimator
- Align the collimator
- Connect the vacuum and pump
- Bake-out and NEG activation
- Cooling and electronic connection



Engineer in charge: O.Aberle, EN-STI

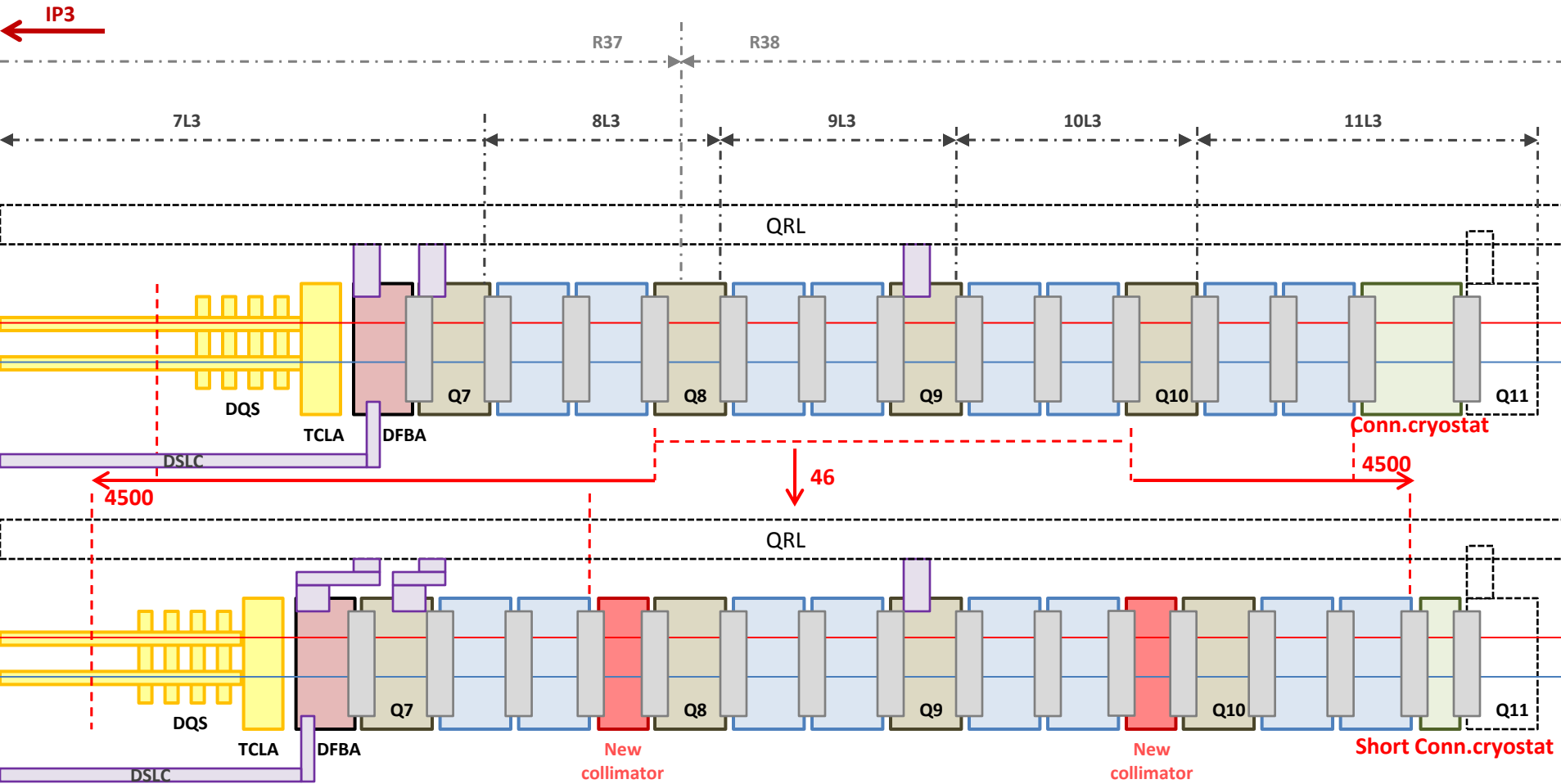


DS collimators: Left side of point 3





DS collimators: Right side of point 3

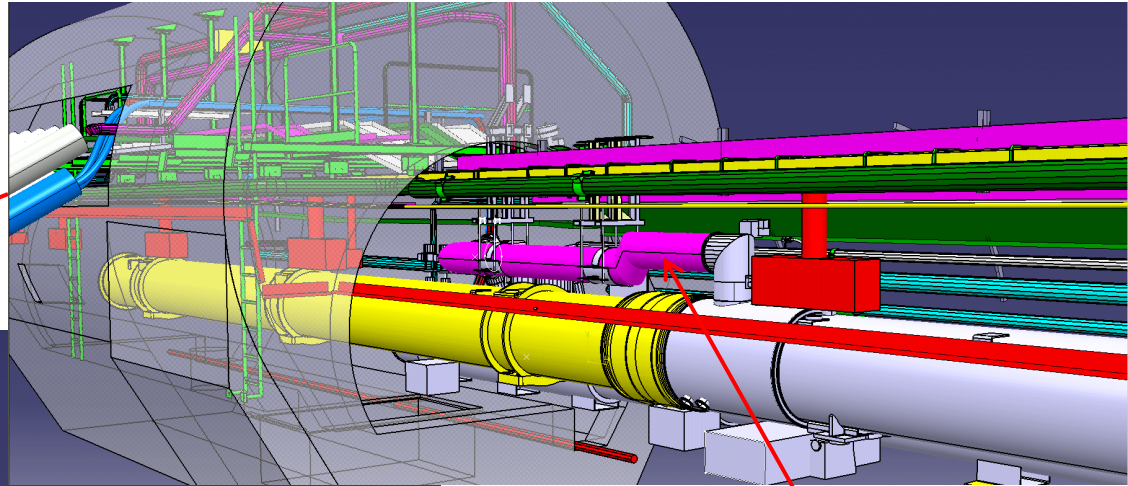




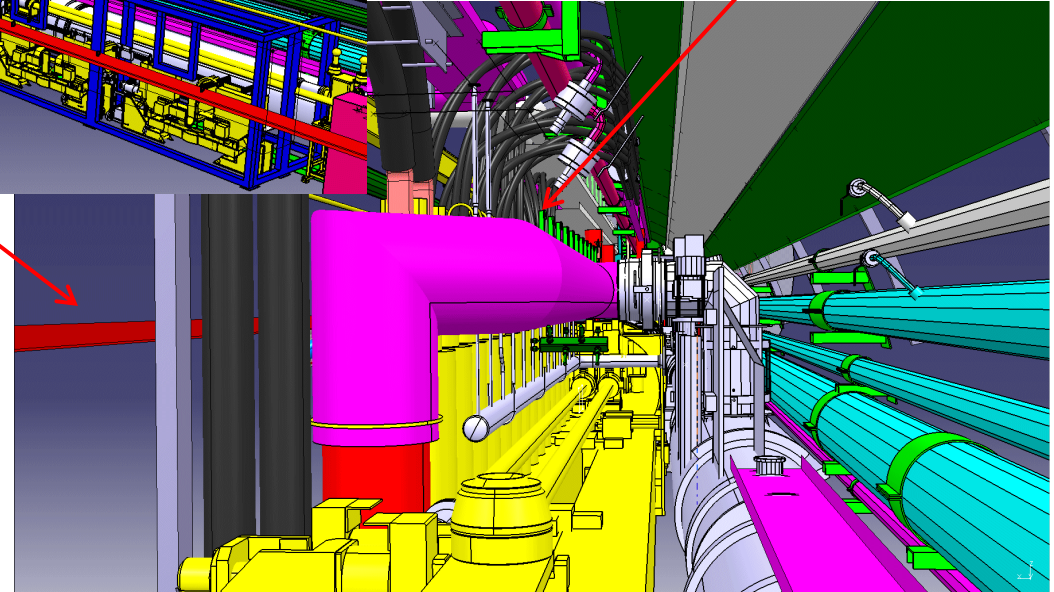
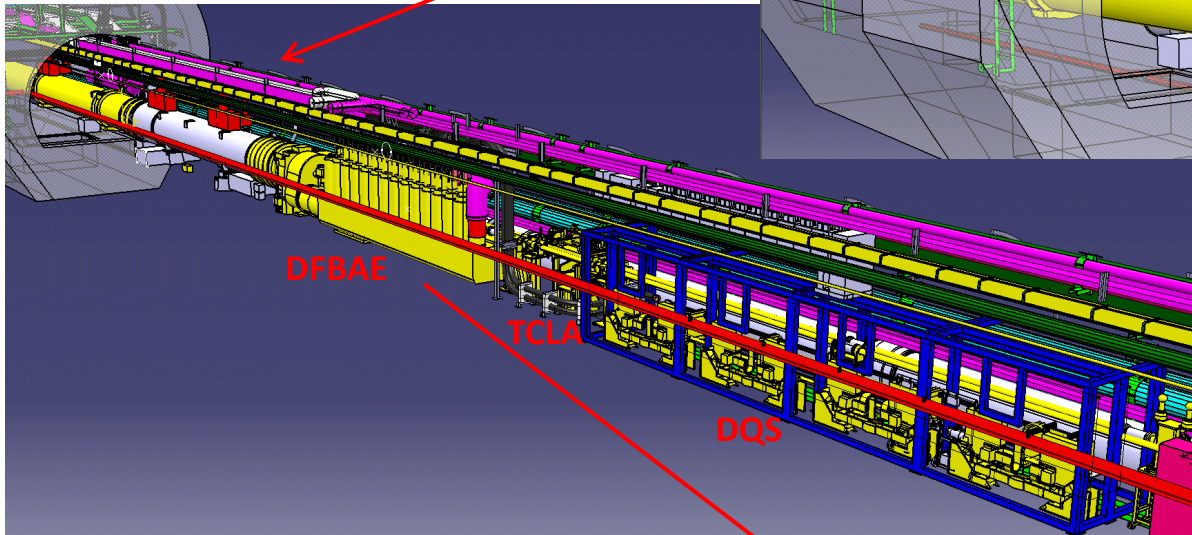
Main H/W implications (3L+3R)

- Disconnect and remove:
 - 16 dipoles, 8 SSS, 2 Connection Cryostats, 2 DFBA
- Displace by 4.5 m:
 - TCLA, DQS, BTVM (3L only, displacement to be defined)
- Re-layout of cabling:
 - ~600 cables to be shortened, ~800 cables to be extended
 - Re-routing (through new cable duct UP33/R34 ?); connections
- Civil engineering:
 - Remove, displace and fix jacks to ground
 - Grind passage wall (3-5 cm) on 2x100m length
 - Drilling new cable duct UP33/R34 ?
- Modification of jumpers of Q7, Q9 and DFBA's (on surface or in the tunnel)
- Shortening of DSLC (cryostat+superc.cables) in 3R
- Produce new equipment:
 - 4 (+1) DS collimator assemblies (LTC)
 - 2 (+1) Short Connection Cryostats (SCC)
 - 2 QRL extensions
- Re-install and interconnect DFBA, magnets, SCC, LTC

Integration studies, 3L



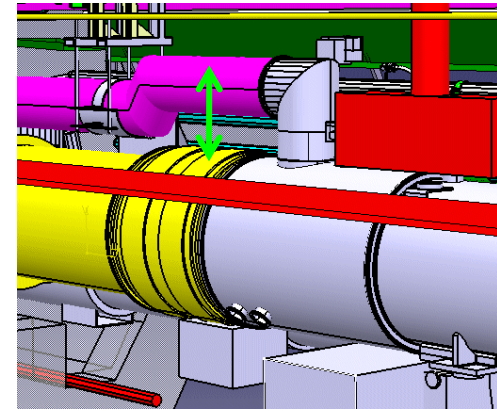
Q7/QRL cryo-line extension
DFBA/QRL cryo-line extension



Y.Muttoni, EN-MEF

Summary of Integration studies P3

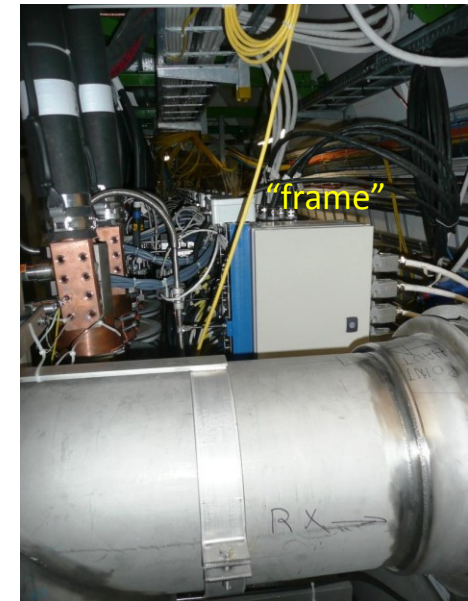
- Pending issues 3L:
 - A) Interference between cryo-extension and Q7 interconnect (soldering machine)
 - B) Integration of “frame” with proximity equipment (interference with cryo-extension)
 - C) Drill a new cable duct for cables re-routing?
 - QPS racks position wrt radiation? Fluka simulation maps in progress (EN-STI)
 - Longitudinal position of BTVM to be defined



A)



C)



B)

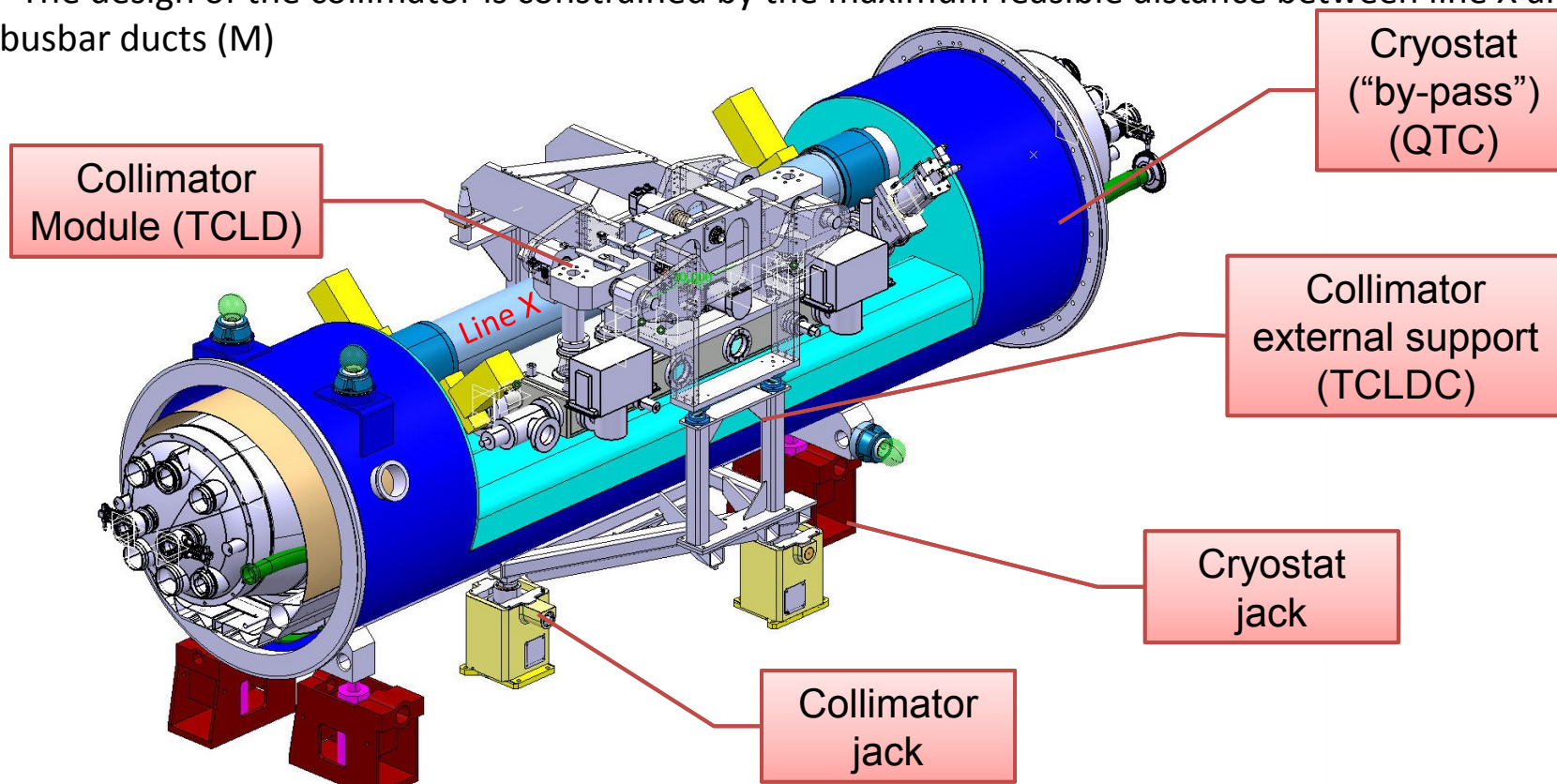
- Studies 3R OK so far (more straight-forward study)

DS Collimator Assembly (LTC)

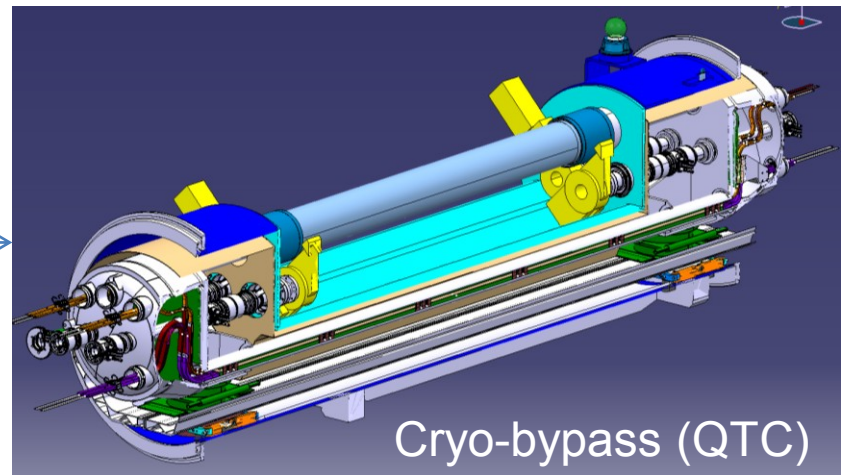
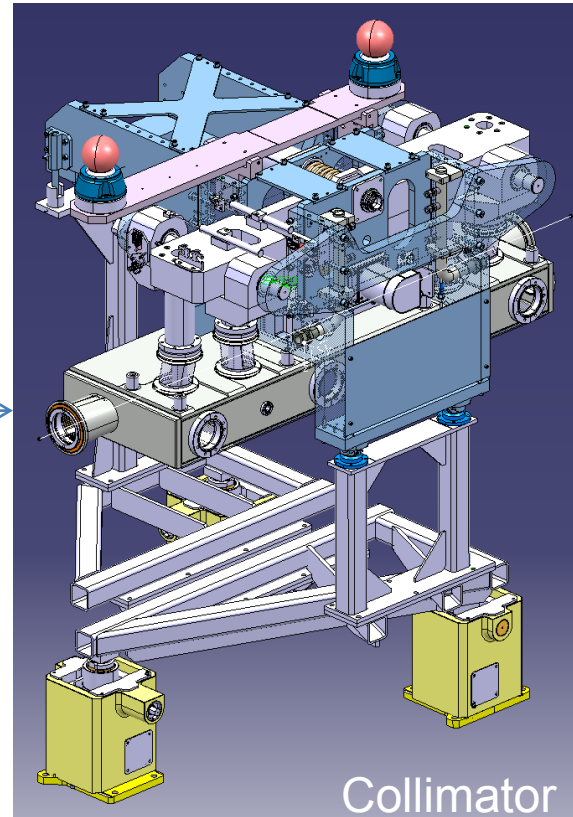
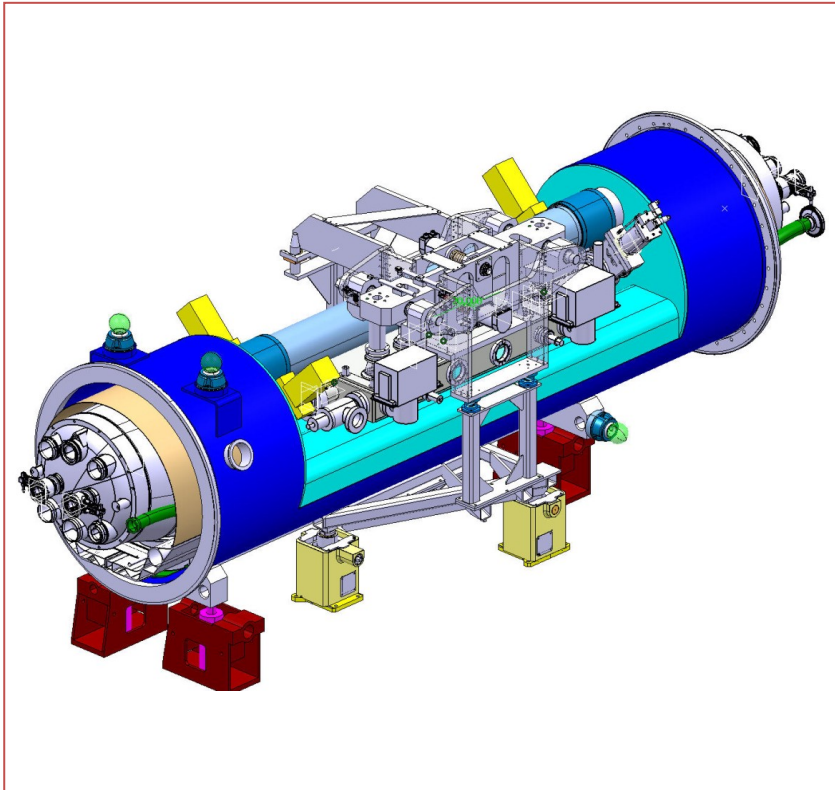
Being designed by EN-MME, in compliance with Engineering Specification EDMS 1092553

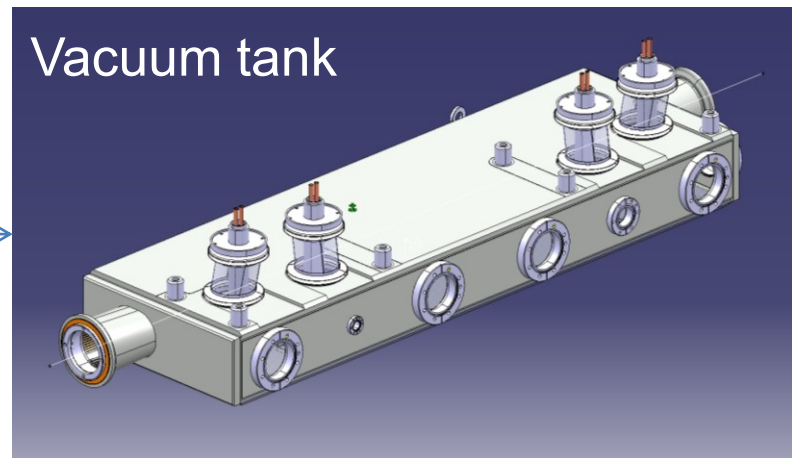
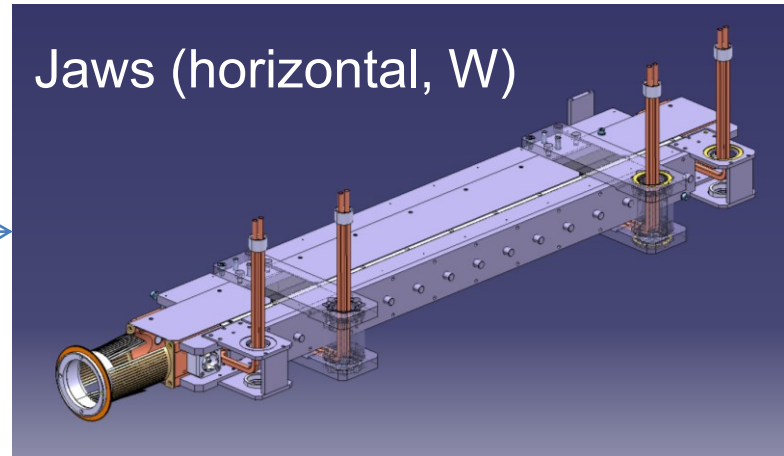
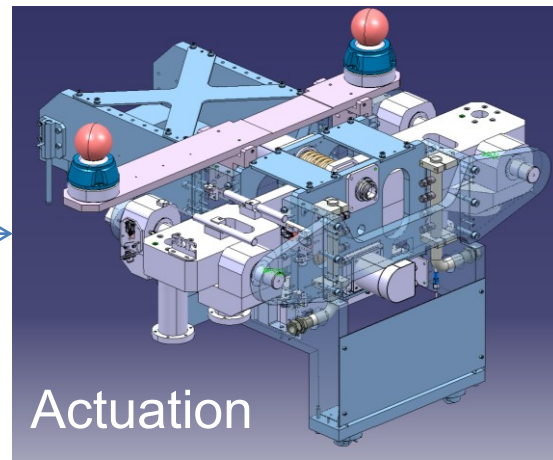
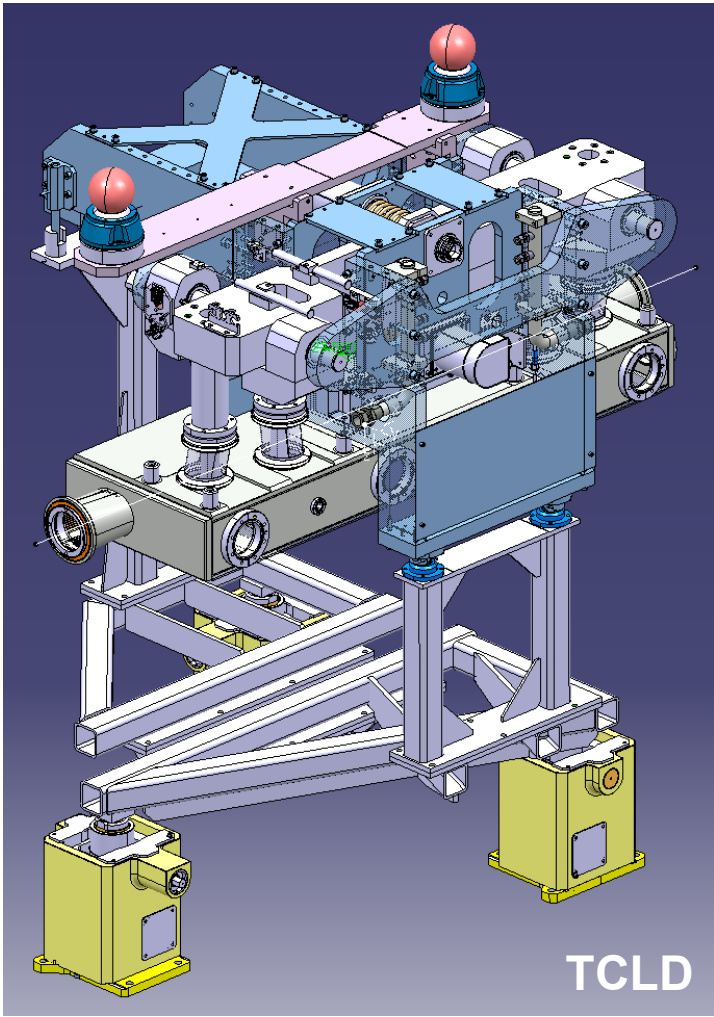
Main features and constraints

- 4 (+ 1 spare) units
- Total length between interconnect planes: 4.5 m
- Collimator can be plugged-in (removed) on the cryostat *in situ*.
- Collimator supported/aligned independently from the cryostat
- RF-shielded sector valves impose grouping of M1 and M3 busbars in the same duct
- The design of the collimator is constrained by the maximum feasible distance between line X and busbar ducts (M)

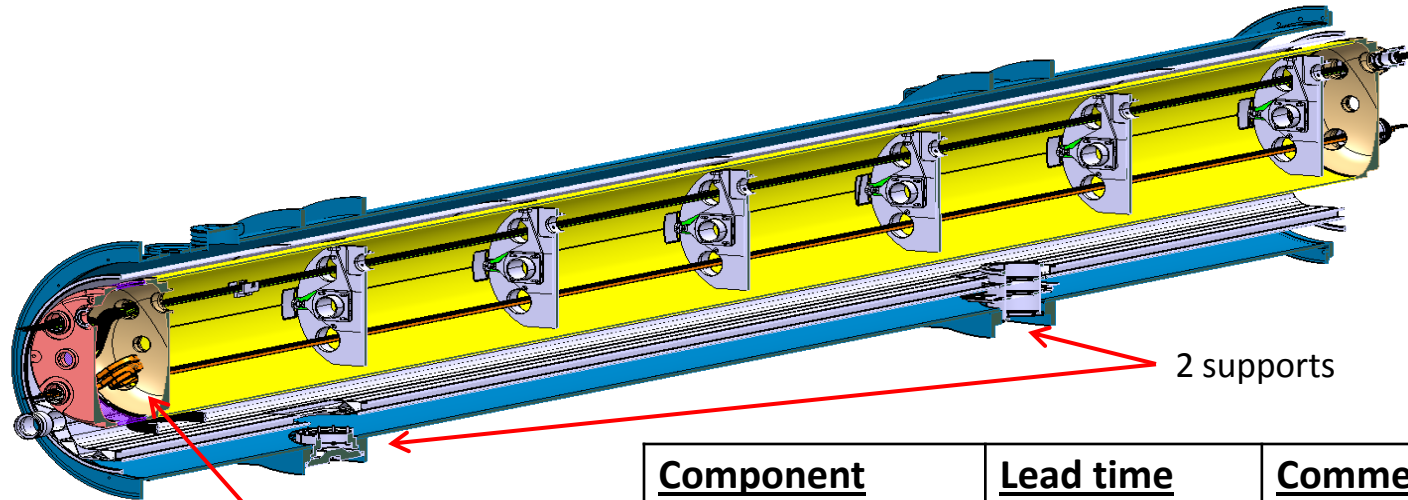


Product breakdown





Short Connection Cryostat: WP from TE/MSC



shuffling module with bus-bars lyras

2 supports

Main features:

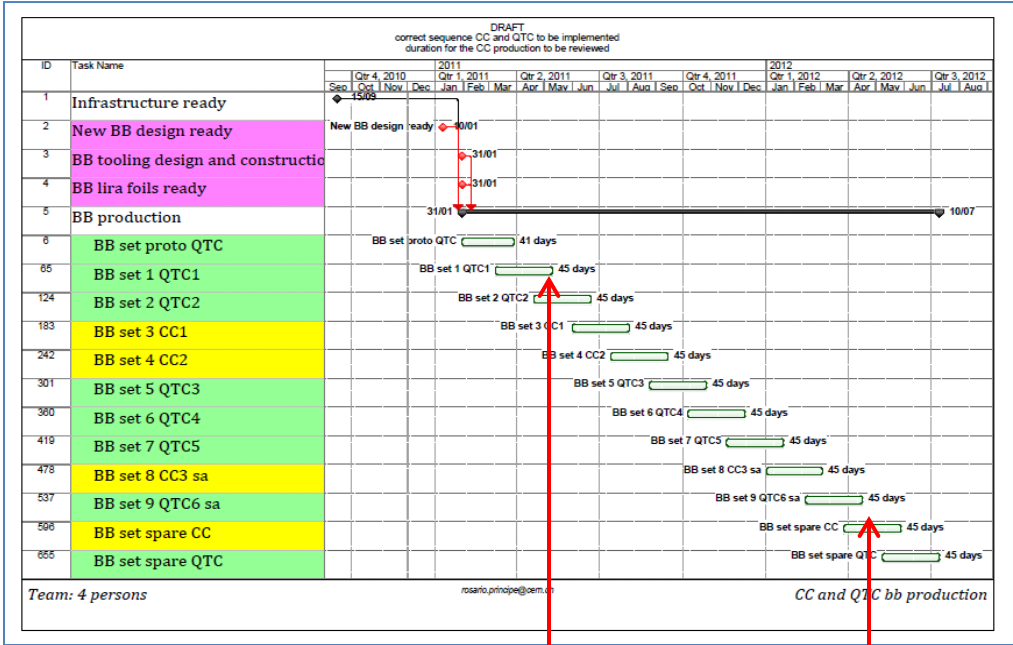
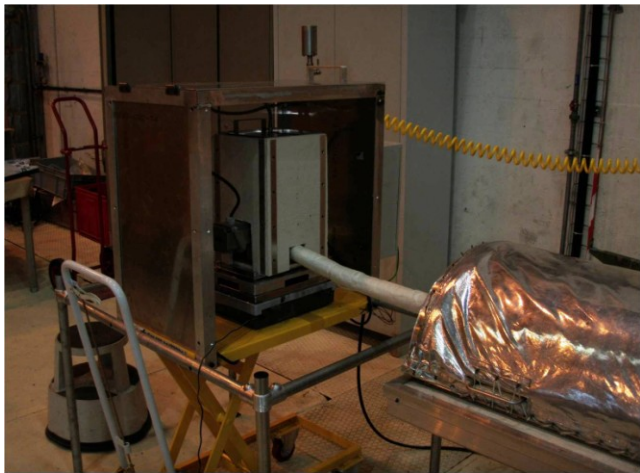
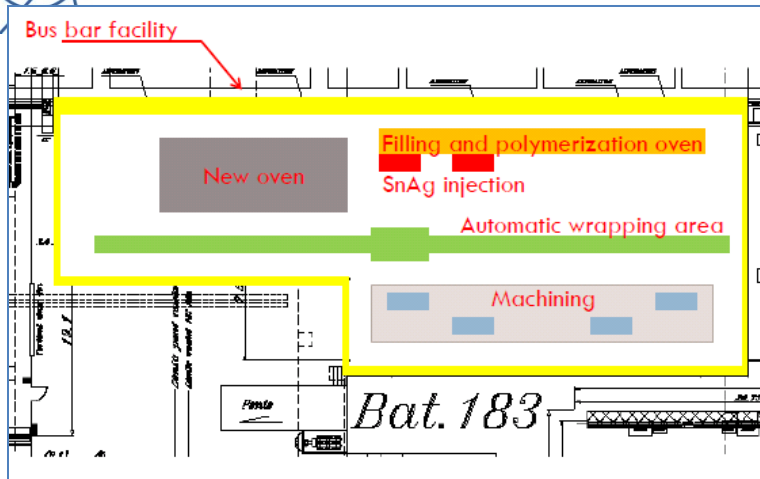
- 2 (+1 spare) units
- 8 m long (4.5 m shorter than standard ones) → 2 supports only (=isostatic, so better!)
- Re-use of standard components (supports, end-caps, thermal shielding, MLI...)
- New superconducting bus-bar sets needed
- Cold mass and cryostat assembly tooling to be modified and manufactured

<u>Component</u>	<u>Lead time</u>	<u>Comment</u>
Superconducting cable	<3 months	In stock
Vacuum vessels	<12 months	To be ordered
Superconducting bus bars	12 months	Defines critical path
Cold bores and Beam screens	<12 months	Raw mat. in stock
Heat exchanger line	<6 months	Raw mat. in stock
Bus bars helium vessel	<12 months	Standard pipe construction
Support posts	<3 months	In stock
Thermal shielding	< 6 months	Raw mat. in stock
MLI	< 6 months	To be ordered
End covers	<6 months	Raw mat. in stock

Activity	2010				2011				2012				Remark	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		
Design/ Drafting														
Engineering														
Components														Critical : busbar production 1 year
Construction of 1st SCC														
Validation, test and ready for IC														Available for IC Mid September 2012
Construction of 2nd SCC														
Validation, test and ready for IC														Available for IC end of October 2012

J.Ph.Tock, TE-MSC

Production of bus bars sets for “by pass” and SCC



1st set: May 2011

Last set: April 2012

- New facility at CERN, starting production
- 4+1 sets for DS coll.bypass
- 2+1 sets for SCC
- Supply on critical path
- Deserves correct support to avoid slippage

Input: R.Principe, TE-MS



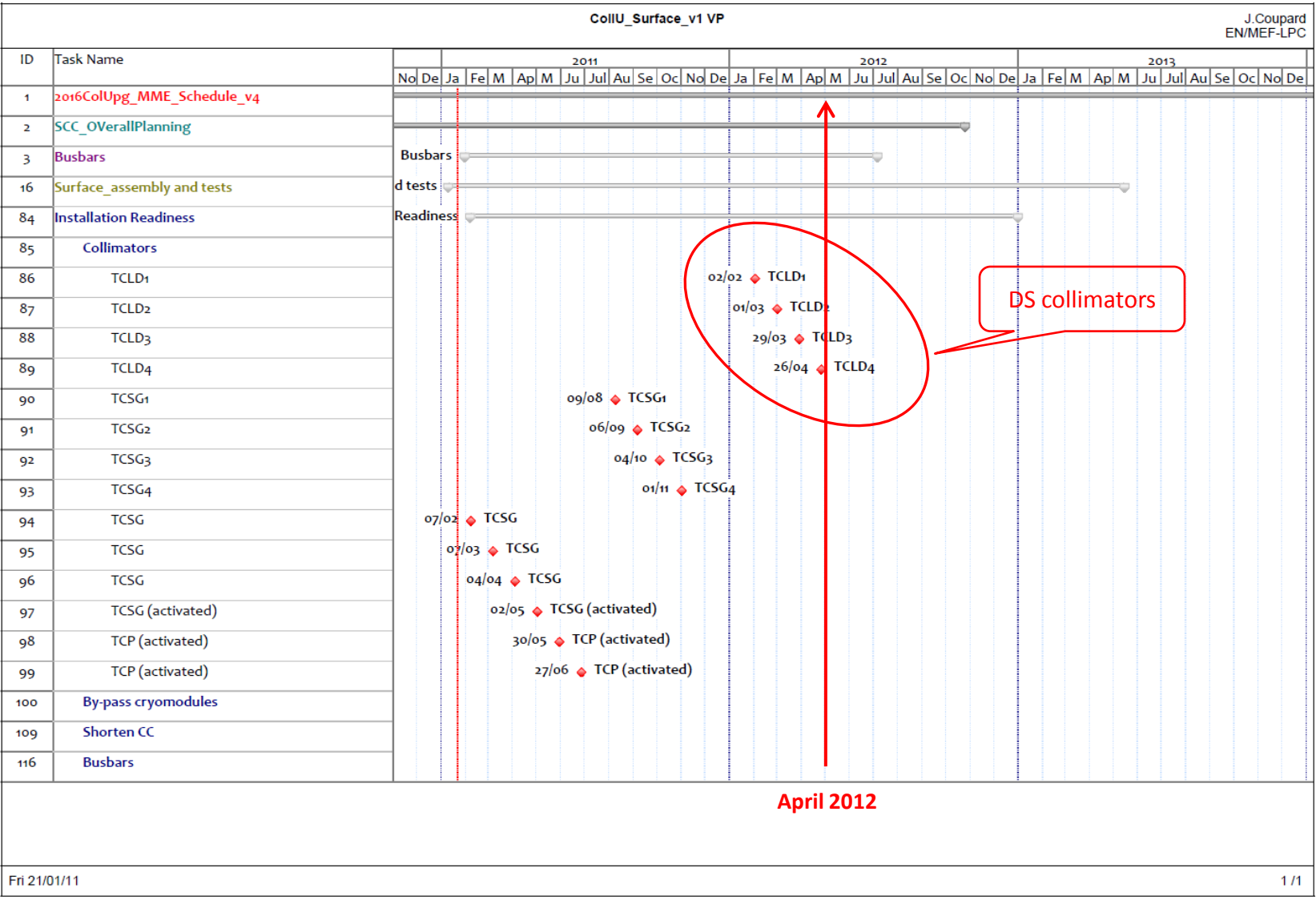
Summary of surface activity

- Status of DS Collimators
 - Design of Cryostat and Collimator Module well advanced (manufacturing drawings to be released by late April 2011)
 - Procurement of strategic components and materials under way
 - Subcontracting of machined parts to be launched
 - Assembly to start in Mechanical Workshop mid summer 2011
- Status of Short Connection Cryostats
 - Design well advanced, final drawings by end March 2011
 - Assembly of 1 st cold mass starts in July 2011
- Supply of critical components:
 - Bus bars (CERN), in progress
 - End caps (LHC dipole type): order placed, first units available in May 2011
- Still outstanding (work just started):
 - Study of test bench connections (SM18) for power testing at cold of Collimator by-pass and Short Connection Cryostats



Surface activities: schedule

Collimators availability dates (not on critical path for 2012 shut-down)

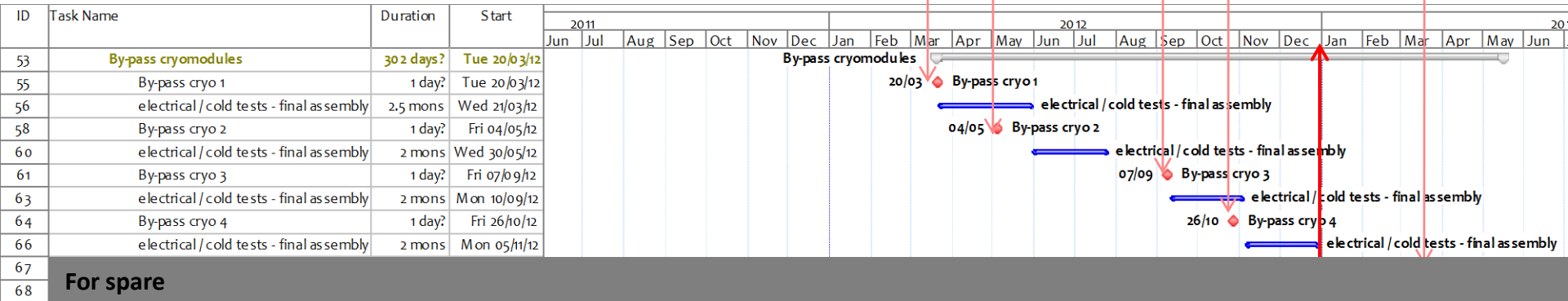
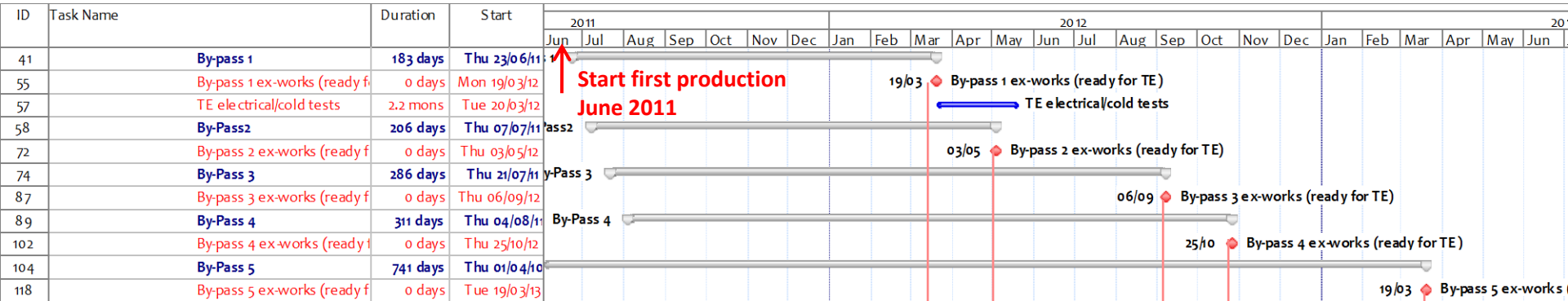


Input (Nov.2010): A.Bertarelli, EN-MME; Schedule: J.Coupard, EN-MEF



Surface activities: schedule (cont.d)

DS Collimator cryostat ("by pass")



**Last collimator cryostat («by-pass»)
ready for installation: December 2012**

Input (Nov.2010, to be reviewed): A.Bertarelli, EN-MME; Schedule: J.Coupard, EN-MEF



Tunnel work for DS collimators:

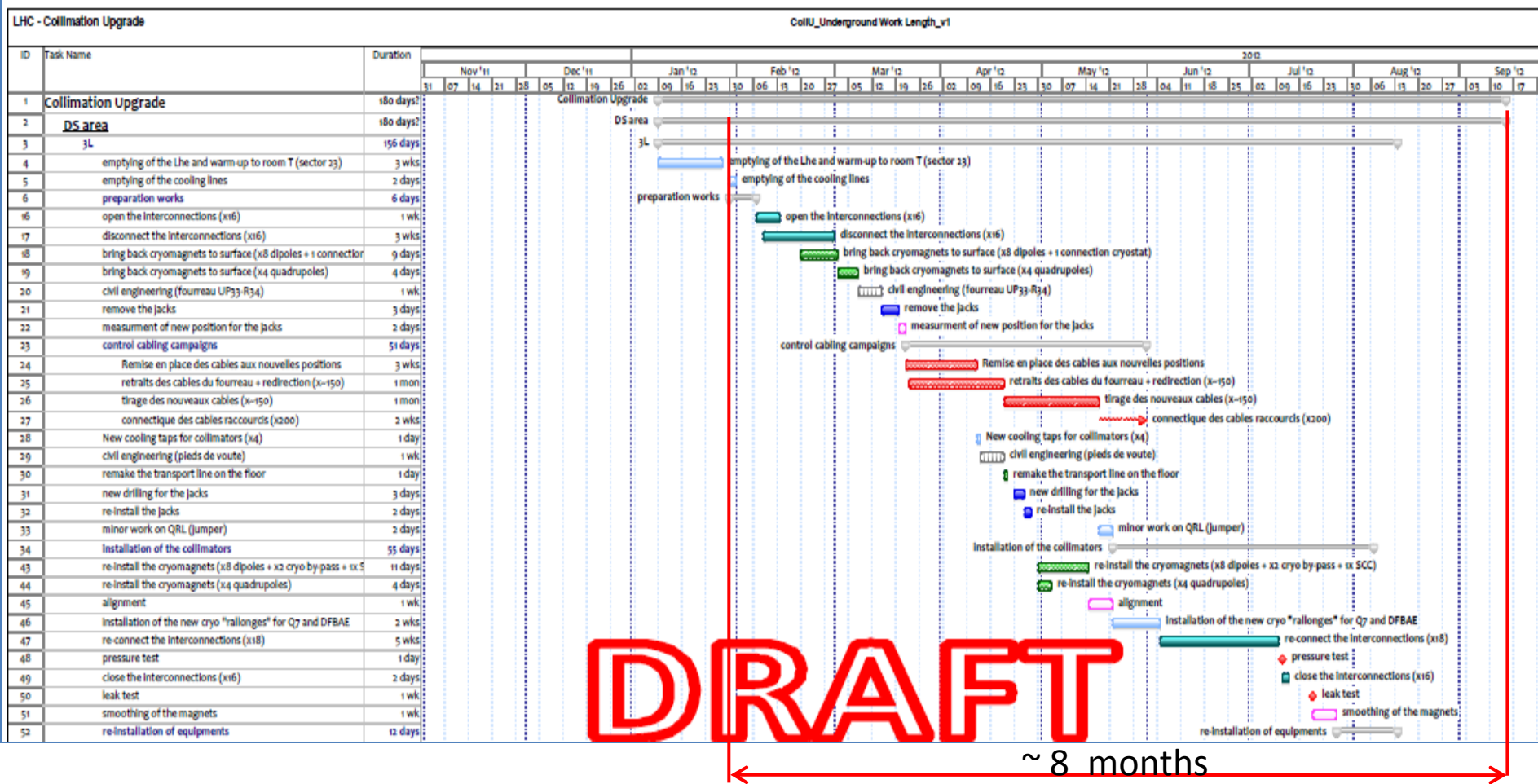
- Working assumptions:
 - Based on first input from system responsables
 - All works on one (extended) shift, and night transport
 - 3L and 3R mostly parallel work
 - All magnets up to surface (dipoles from PMI2, quads from P4)
 - DFBAs moved to P4
 - 4 teams for cabling (DS, LSS&DFBA, connections, water-cooled cables)
- Limits:
 - Planning not merged with other activities/projects
 - No resource sharing with other activities/projects (especially interconnects!)
 - No transport sharing with other activities/projects
 - ...no contingency!

→ Not presented/discussed earlier, consider as **first draft!**



DS 3L planning snapshot (2013 shut-down)

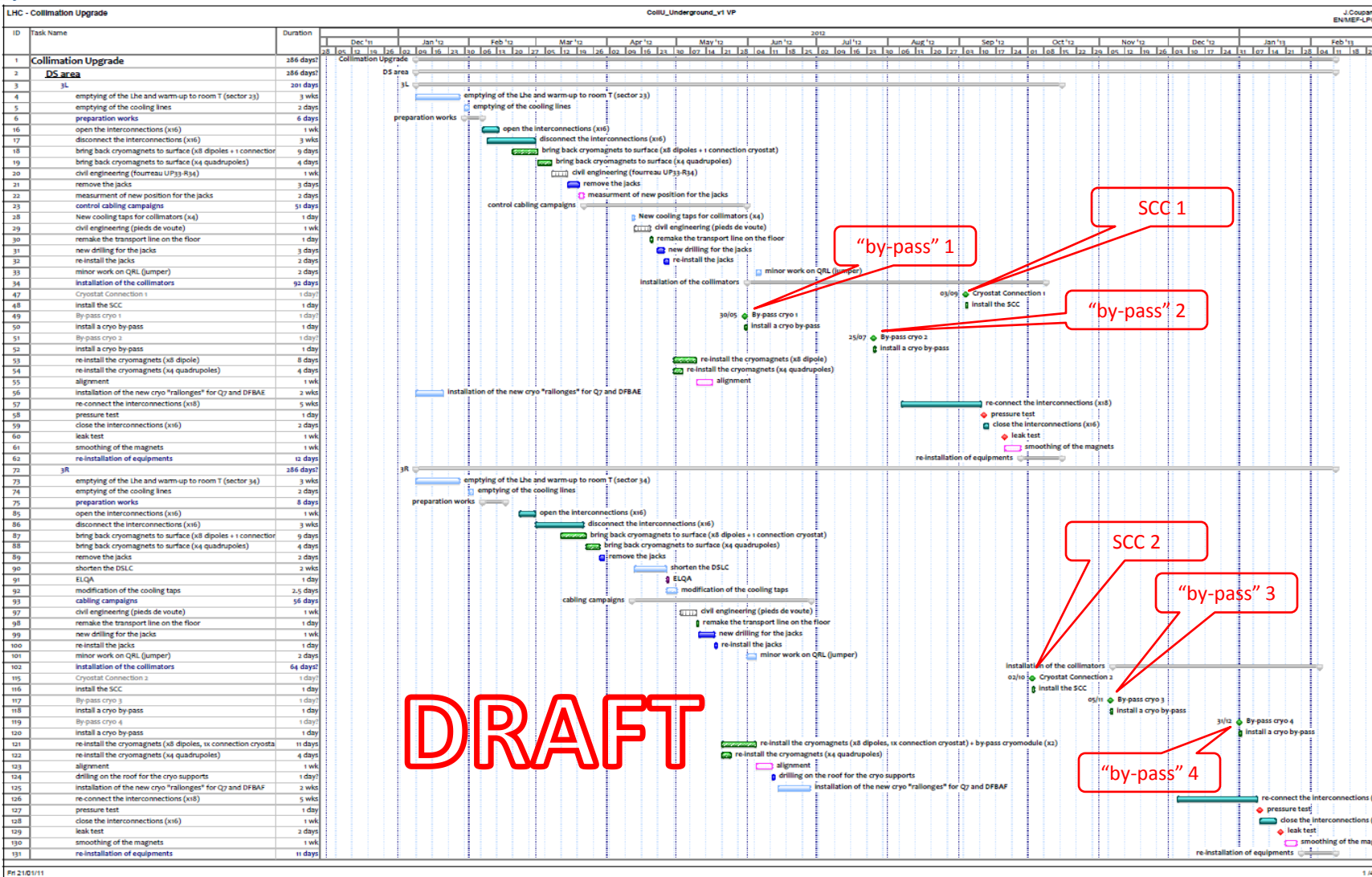
(for full planning see spare slides)



- All new equipment (DS collimators, SCC, cryogenic extensions...) available for installation
- ~8 months installation (after warm-up), 3L and 3R in parallel
- DS Collimator upgrade installation: February 2013 - September 2013
- Installation of LSS collimators also completed by September 2013

Schedule: J.Coupard, EN-MEF

2012 shut-down: tunnel schedule matched to availability of “by-passes” and SCC



- ~12 months installation (+ 4 months as compared to 2013 schedule)
- DS Collimator upgrade installation: February 2012 - February 2013
- Installation of LSS collimators also completed by February 2013

Schedule: J.Coupard, EN-MEF



Summary and Outlook

- The [Collimator Upgrade \(part 1\) project](#), aimed at improving collimation efficiency (factor 5-10), has [started in July 2010](#), is now structured and [proceeding full steam](#)
- The DS collimators part requires [a challenging re-layout and integration study](#), which is well advanced but with some issues still outstanding ([but no show-stopper expected](#))
- The [design of the new DS equipment](#) (DS collimators, and Short Connection Cryostats) is well advanced, and will be [finished by Spring 2011](#)
- The manufacture of [bus bars](#) at CERN is in good progress but [deserves close follow-up](#) as it is, so far, on the critical path for a shut-down in 2012
- Procurement of other long-lead components under control
- Planned [availability dates](#) for installation of the [DS collimator “by-pass” cryostats](#):
 - [1st unit available: May 2012](#), [4th unit available: December 2012](#)
- First draft schedule for [2012 shut-down](#), conditioned by the availability dates of the “by-passes” and SCC, yields a [~12 months installation](#) for the DS collimators (+LSS collimators), in the period [February 2012 – February 2013](#).
- The same draft schedule, [shifted to a 2013 shut-down](#), yields a [~8 months installation](#), in the period [February-September 2013](#).
- This [preliminary schedule needs consolidation and matching](#) with those of [other shut-down projects](#) (resources allocation, co-activity, transport sharing, etc.) so its duration could be considerably longer ([up to 3 months?](#)).



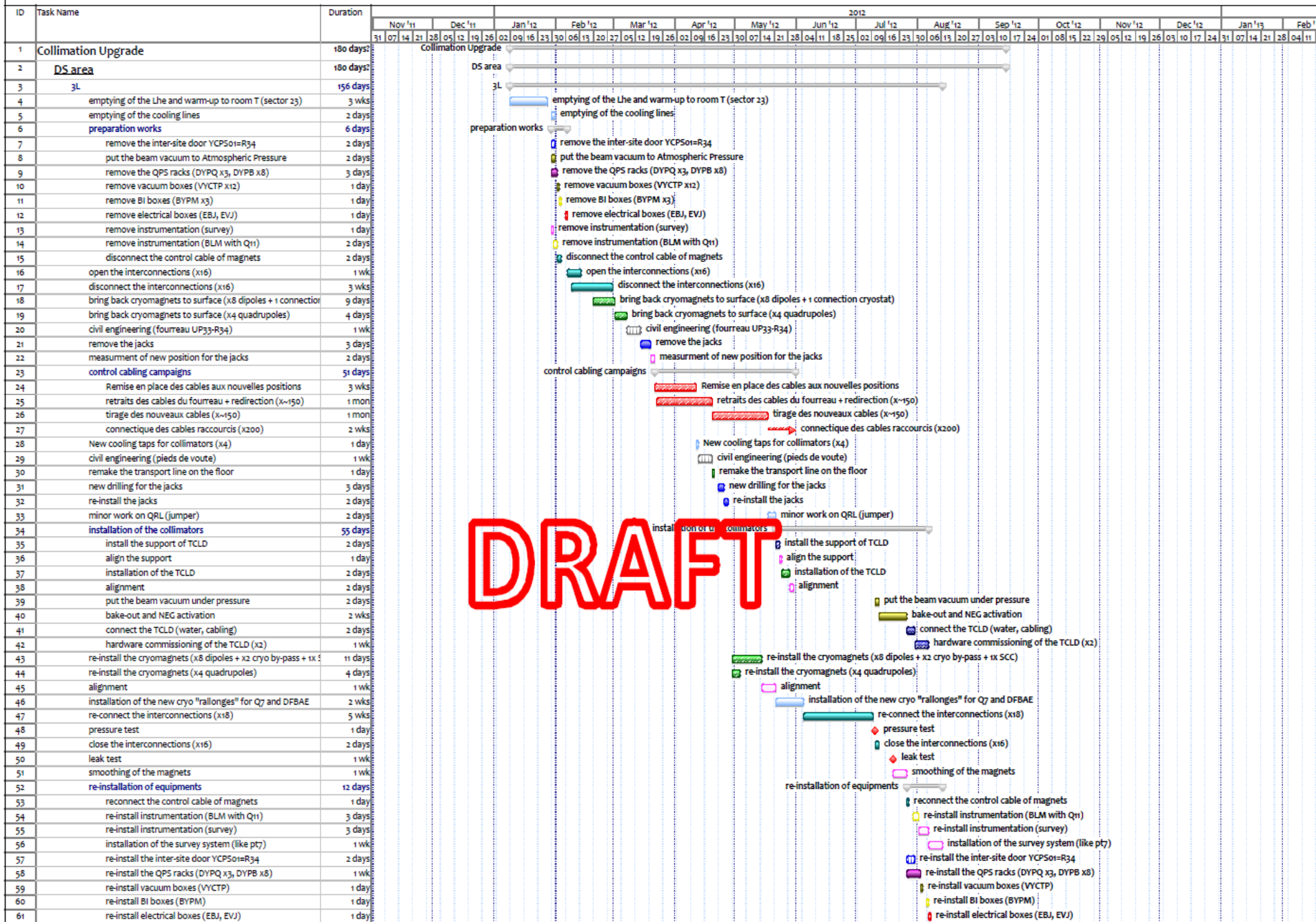
**Thank you
for your attention!**



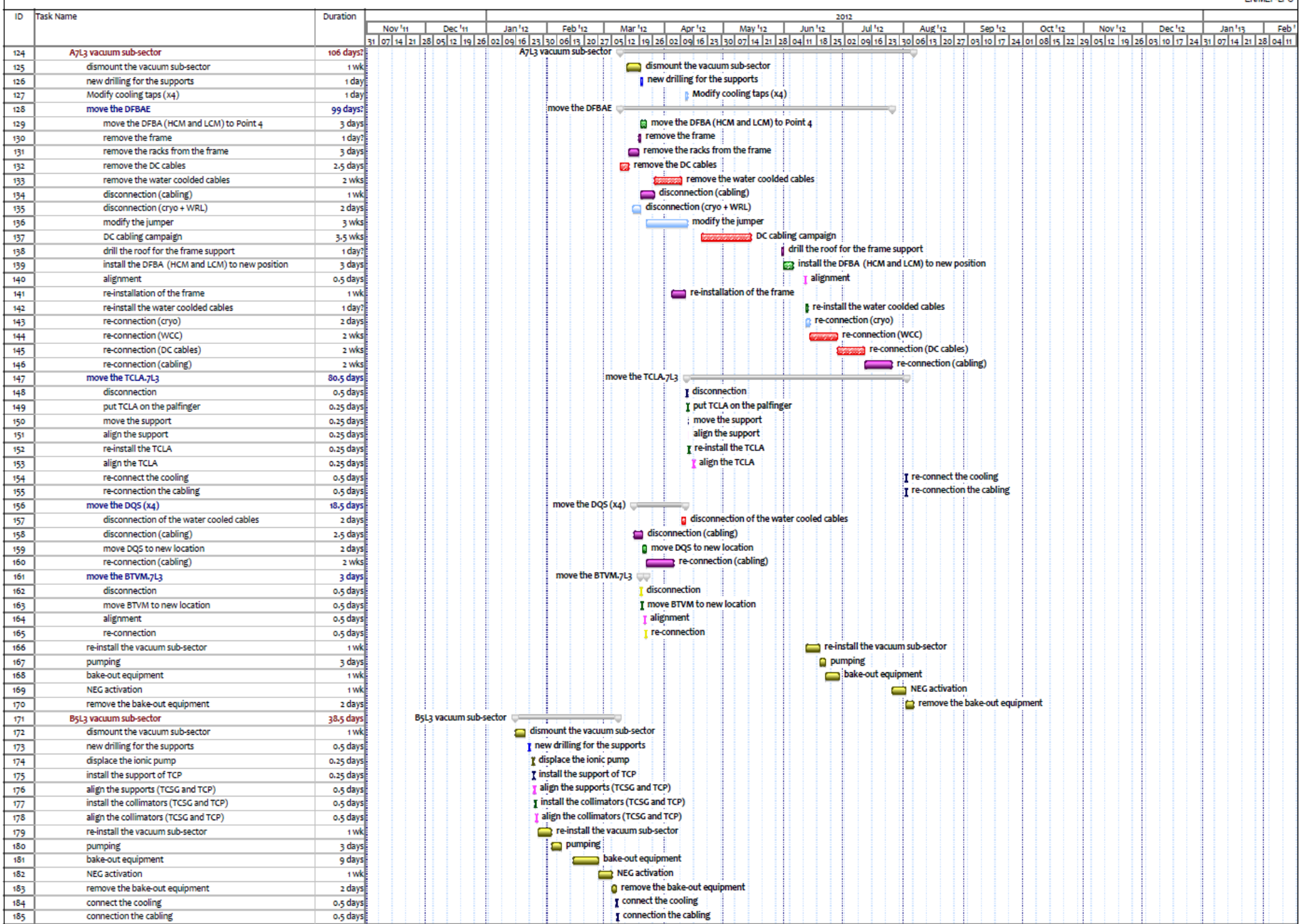
Spare slides



Tunnel schedule 2013, next 5 slides



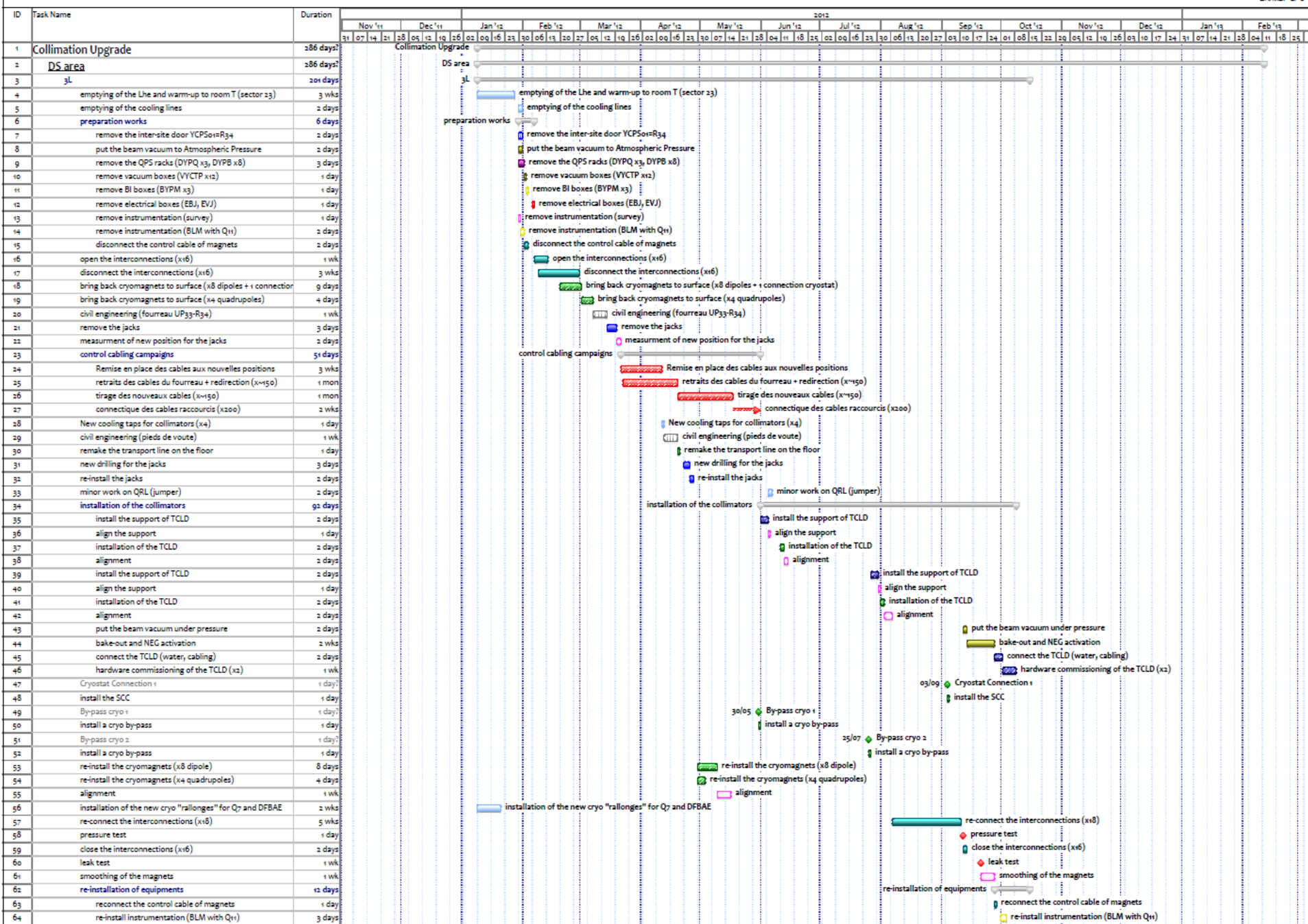
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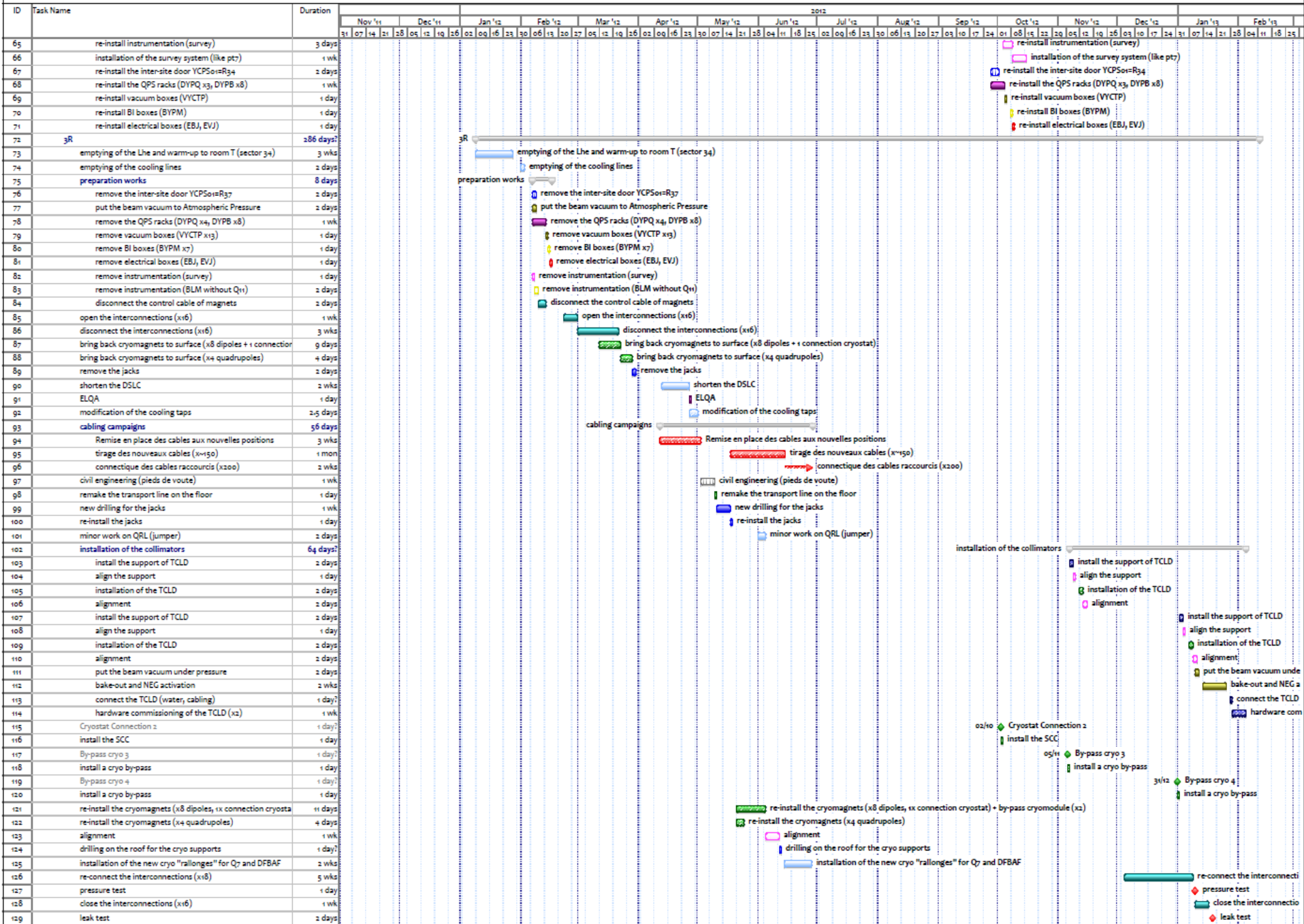


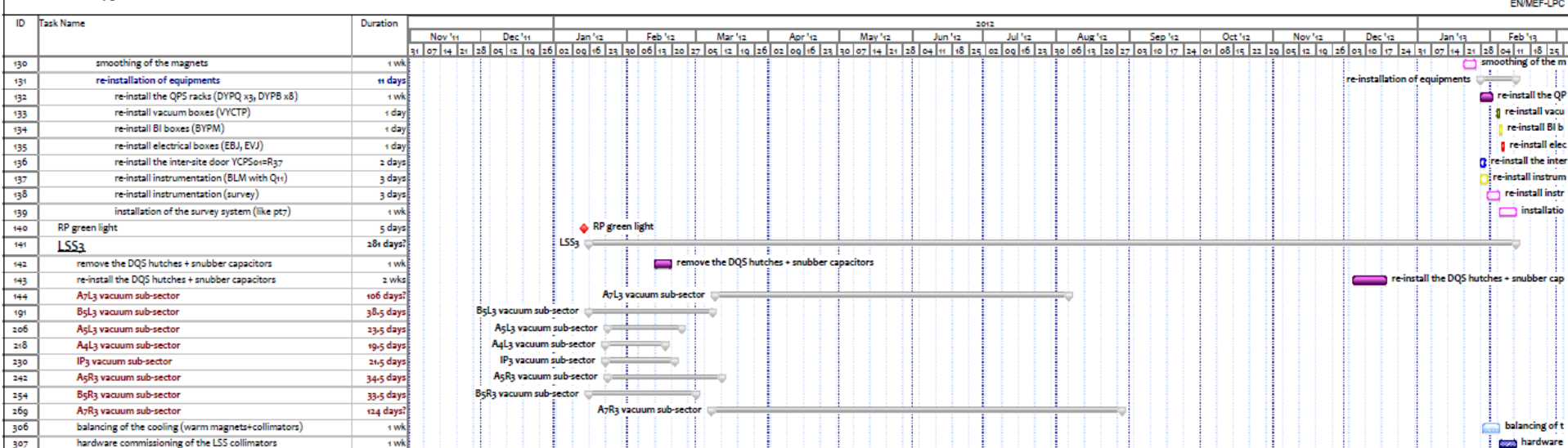
ID	Task Name	Duration	2012																														
			Nov '11	Dec '11	Jan '12	Feb '12	Mar '12	Apr '12	May '12	Jun '12	Jul '12	Aug '12	Sep '12	Oct '12	Nov '12	Dec '12	Jan '13	Feb '13															
			01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
186	A5L3 vacuum sub-sector	23.5 days	A5L3 vacuum sub-sector																														
187	remove the replacement chamber (x2)	1 day	remove the replacement chamber (x2)																														
188	re-align the support (TCSG x2)	0.5 days	re-align the support (TCSG x2)																														
189	install the collimators (TCSG x2)	0.5 days	install the collimators (TCSG x2)																														
190	align the collimators (TCSG x2)	0.5 days	align the collimators (TCSG x2)																														
191	connect the vacuum	1 day	connect the vacuum																														
192	pumping	2 days	pumping																														
193	bake-out equipment	5 days	bake-out equipment																														
194	NEG activation	1 wk	NEG activation																														
195	remove the bake-out equipment	2 days	remove the bake-out equipment																														
196	connect the cooling	0.5 days	connect the cooling																														
197	connection the cabling	0.5 days	connection the cabling																														
198	A4L3 vacuum sub-sector	19.5 days	A4L3 vacuum sub-sector																														
199	remove the replacement chamber	1 day	remove the replacement chamber																														
200	re-align the support (TCSG)	0.5 days	re-align the support (TCSG)																														
201	install the collimators (TCSG)	0.5 days	install the collimators (TCSG)																														
202	align the collimators (TCSG)	0.5 days	align the collimators (TCSG)																														
203	connect the vacuum	1 day	connect the vacuum																														
204	pumping	2 days	pumping																														
205	bake-out equipment	6 days	bake-out equipment																														
206	NEG activation	1 wk	NEG activation																														
207	remove the bake-out equipment	2 days	remove the bake-out equipment																														
208	connect the cooling	0.5 days	connect the cooling																														
209	connection the cabling	0.5 days	connection the cabling																														
210	IP3 vacuum sub-sector	21.5 days	IP3 vacuum sub-sector																														
211	remove the replacement chamber	1 day	remove the replacement chamber																														
212	re-align the support (TCSG)	0.5 days	re-align the support (TCSG)																														
213	install the collimators (TCSG)	0.5 days	install the collimators (TCSG)																														
214	align the collimators (TCSG)	0.5 days	align the collimators (TCSG)																														
215	connect the vacuum	1 day	connect the vacuum																														
216	pumping	2 days	pumping																														
217	bake-out equipment	6 days	bake-out equipment																														
218	NEG activation	1 wk	NEG activation																														
219	remove the bake-out equipment	2 days	remove the bake-out equipment																														
220	connect the cooling	0.5 days	connect the cooling																														
221	connection the cabling	0.5 days	connection the cabling																														
222	A5R3 vacuum sub-sector	34.5 days	A5R3 vacuum sub-sector																														
223	remove the replacement chamber (x2)	1 day	remove the replacement chamber (x2)																														
224	re-align the support (TCSG x2)	0.5 days	re-align the support (TCSG x2)																														
225	install the collimators (TCSG x2)	0.5 days	install the collimators (TCSG x2)																														
226	align the collimators (TCSG x2)	0.5 days	align the collimators (TCSG x2)																														
227	connect the vacuum	1 day	connect the vacuum																														
228	pumping	2 days	pumping																														
229	bake-out equipment	5 days	bake-out equipment																														
230	NEG activation	1 wk	NEG activation																														
231	remove the bake-out equipment	2 days	remove the bake-out equipment																														
232	connect the cooling	0.5 days	connect the cooling																														
233	connection the cabling	0.5 days	connection the cabling																														
234	B5R3 vacuum sub-sector	33.5 days	B5R3 vacuum sub-sector																														
235	dismount the vacuum sub-sector	1 wk	dismount the vacuum sub-sector																														
236	new drilling for the supports	0.5 days	new drilling for the supports																														
237	displace the ionic pump	0.25 days	displace the ionic pump																														
238	install the support of TCP	0.25 days	install the support of TCP																														
239	align the supports (TCSG and TCP)	0.5 days	align the supports (TCSG and TCP)																														
240	install the collimators (TCSG and TCP)	0.5 days	install the collimators (TCSG and TCP)																														
241	align the collimators (TCSG and TCP)	0.5 days	align the collimators (TCSG and TCP)																														
242	re-install the vacuum sub-sector	1 wk	re-install the vacuum sub-sector																														
243	pumping	3 days	pumping																														
244	bake-out equipment	9 days	bake-out equipment																														
245	NEG activation	1 wk	NEG activation																														
246	remove the bake-out equipment	2 days	remove the bake-out equipment																														
247	connect the cooling	0.5 days	connect the cooling																														



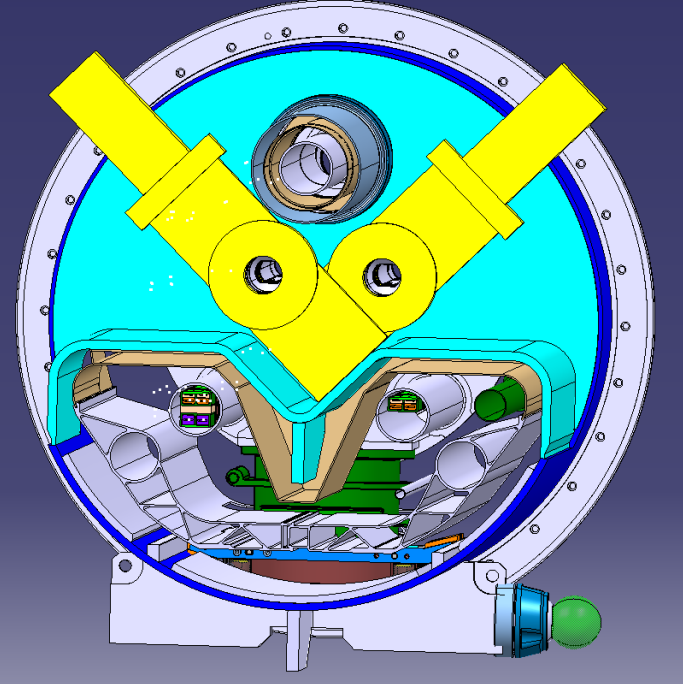
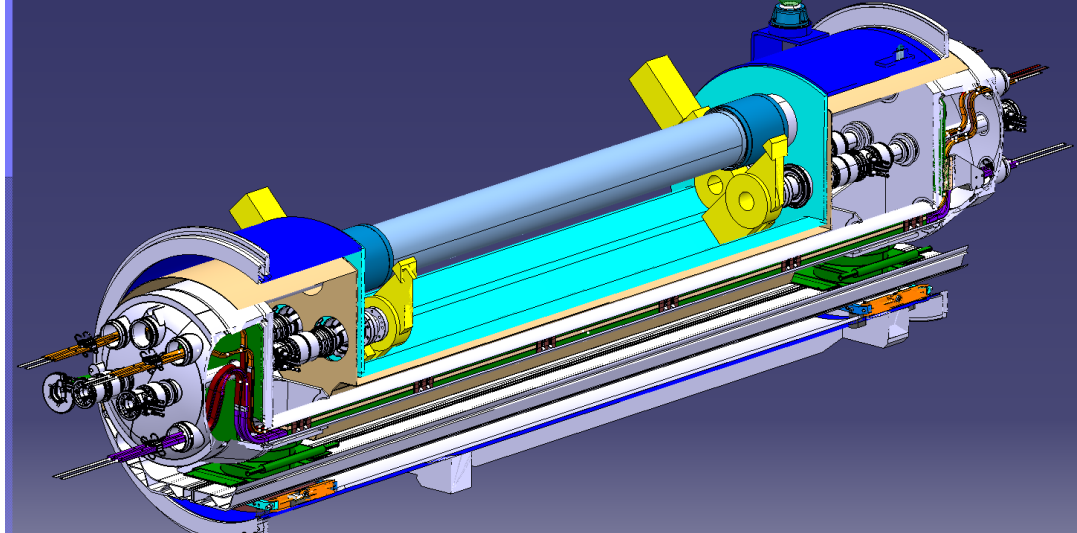
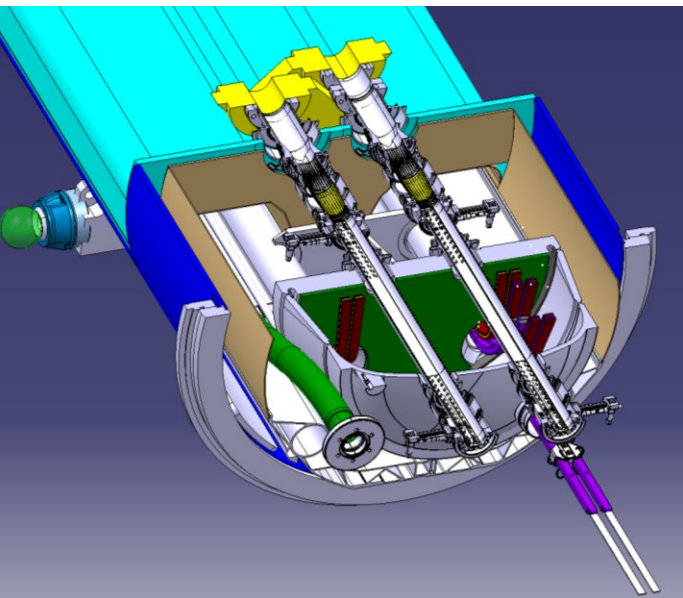
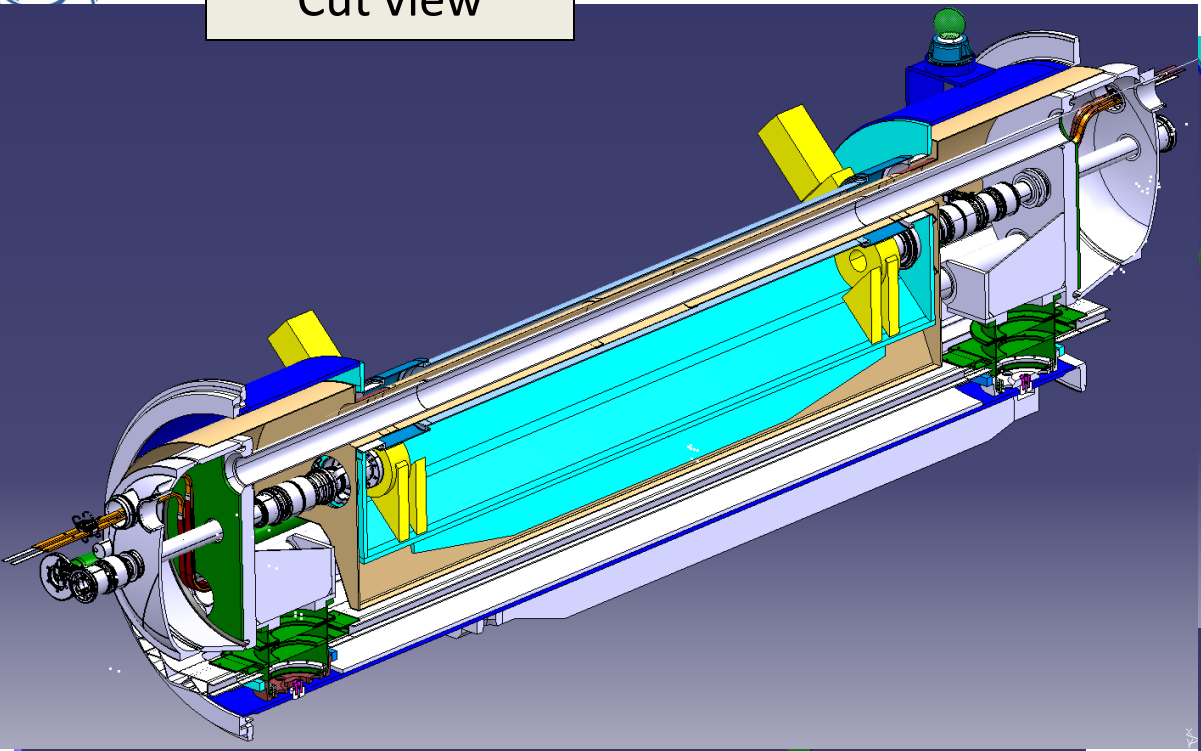
Tunnel schedule 2012, next 3 slides



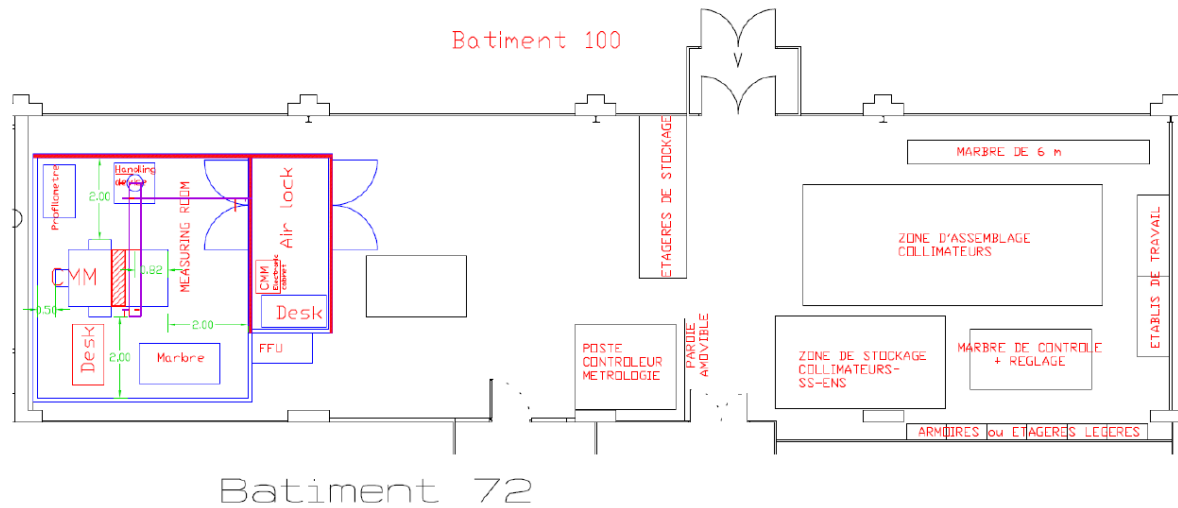




Cut view



Assembly areas at CERN



- Collimators → **new area planned** close to workshop metrology
- Collimator cryostats (“by-pass”) → Bd.112 **existing shop**
- Short Connection Cryostats → SMI2 **existing shop**

Collimators: WP of EN-MME

Scope of the Work-package:

1. Engineering, design, manufacturing and assembly of **5 integrated DS Collimators (LTC)** as proposed by Joint working group and approved by Technical Review (8 July 2010).
2. Design (of required updates), manufacturing and assembly of **1 TCP** and **6 TCSG** Complete collimators (based on Phase 1 design).
3. Manufacturing of **2 support stands** and **10 lower plug-in sets** as required by EN-STI for installation.
4. Procurement of material and possible manufacturing (after Management decision – Chamonix 2011?) of **2 TCT** based on Phase 1 design (no BPM).