

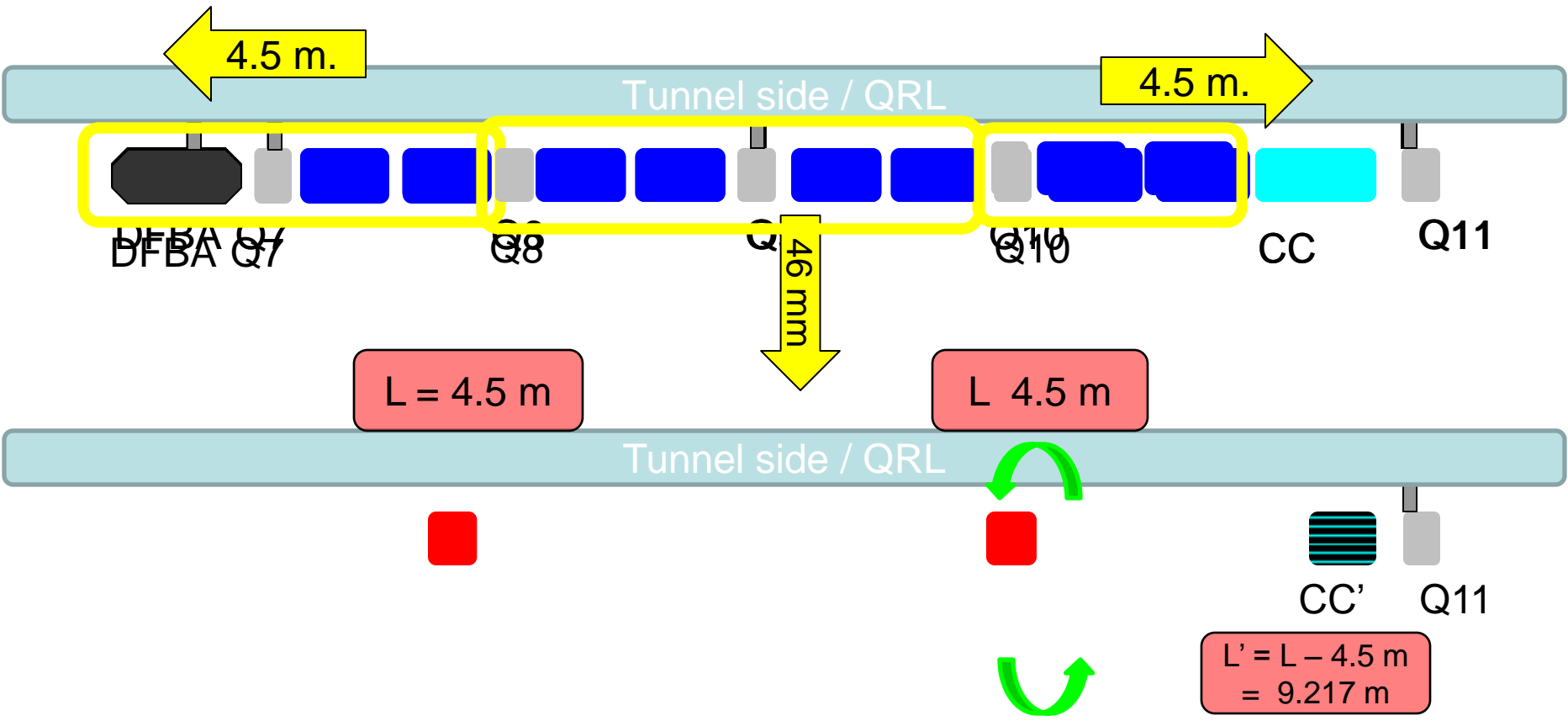
# Relayout and Integration

## Outline (25 min.)

- Overview
- Main components
  - Shortened CC
  - Jumpers extensions
  - DSLC
  - DS Collimators (See A Bertarelli presentation)
- Underground work
  - Integration at P3
  - Consequences on transport/handling
  - Warm regions
  - Tunnel IC work
  - Overall Schedule
- Conclusions

➤ Overview

Relayout and Integration



# Relayout and Integration

## ➤ Overview

### Modifications to the layout

[m]	Length	Present		With warm collimator		Delta Y	Delta R
		DCUM in	DCUM out	DCUM in	DCUM out		
DFBA			6925.880		6921.380	-4.500	
Q7	7.745	6925.880	6933.625	6921.380	6929.125	-4.500	
MB.A8	15.660	6933.625	6949.285	6929.125	6944.785	-4.500	
MB.B8	15.660	6949.285	6964.945	6944.785	6960.445	-4.500	
TC.8	4.500	NA	NA	6960.445	6964.945	NA	
Q8	7.745	6964.945	6972.690	6964.945	6972.690	0.000	0.046
MB.A9	15.660	6972.690	6988.350	6972.690	6988.350	0.000	0.046
MB.B9	15.660	6988.350	7004.010	6988.350	7004.010	0.000	0.046
Q9	9.145	7004.010	7013.155	7004.010	7013.155	0.000	0.046
MB.A10	15.660	7013.155	7028.815	7013.155	7028.815	0.000	0.046
MB.B10	15.660	7028.815	7044.475	7028.815	7044.475	0.000	0.046
TC.10	4.500	NA	NA	7044.475	7048.975	NA	
Q10	7.745	7044.475	7052.220	7048.975	7056.720	4.500	
MB.A11	15.660	7052.220	7067.880	7056.720	7072.380	4.500	
MB.B11	15.660	7067.880	7083.540	7072.380	7088.040	4.500	
LEEL.11	**	7083.540	7097.257	7088.040	7097.257	NA	
Q11	7.745	7097.257	7105.002	7097.257	7105.002	0.000	

**Acceptable for the optics**

**“J Jowett”**

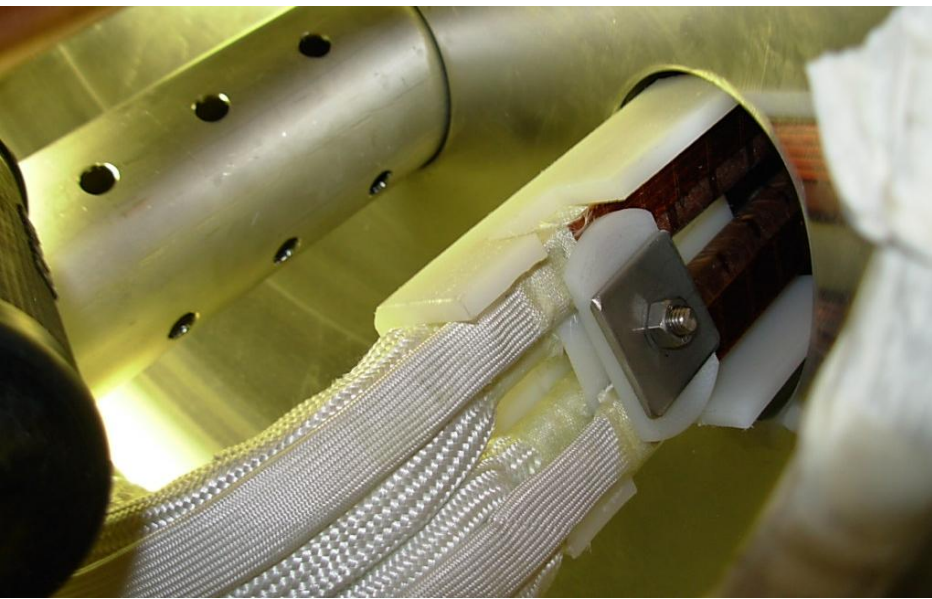
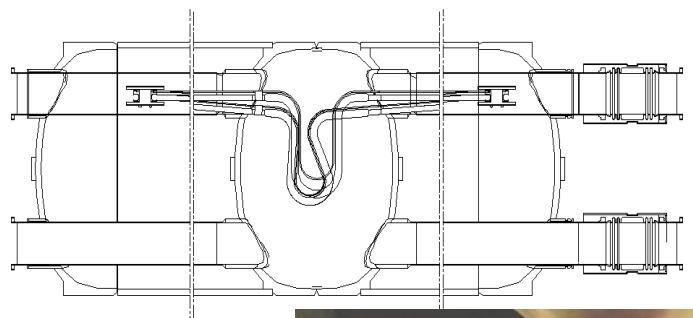
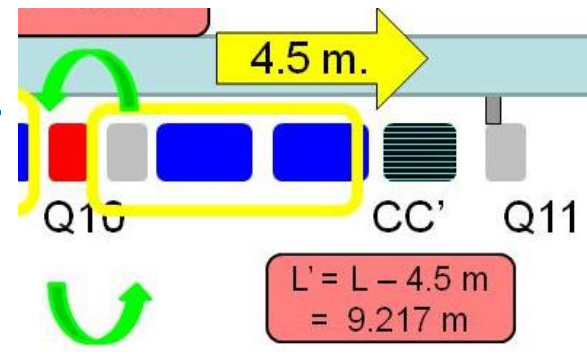
➤ Main components: Layout and Integration

➤ Shortened CC [SCC] (1/5)

+ Based on the existing design BUT

Known design issues will be corrected:

- Busbars insulation close to shuffling module
- Busbars supporting and insulation
- Lead shielding



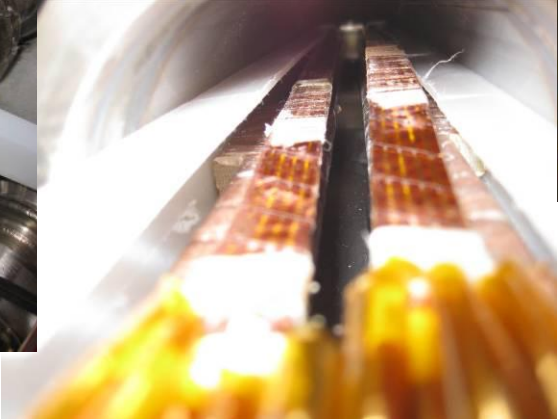
➤ Main components: Relayout and Integration

➤ Shortened CC (2/5)

+ Based on the existing design BUT

Known design issues will be corrected:

- Busbars insulation close to shuffling module
- Busbars supporting and insulation
- Lead shielding



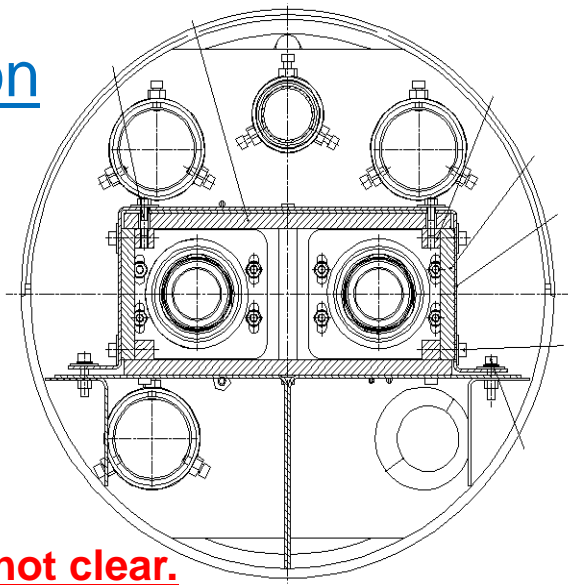
➤ Main components: Layout and Integration

➤ Shortened CC (3/5)

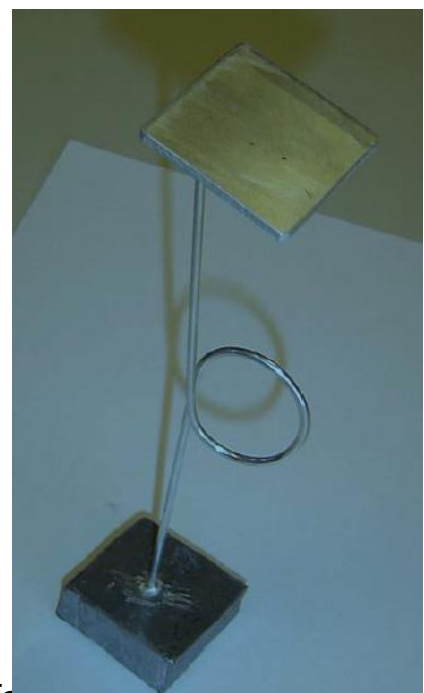
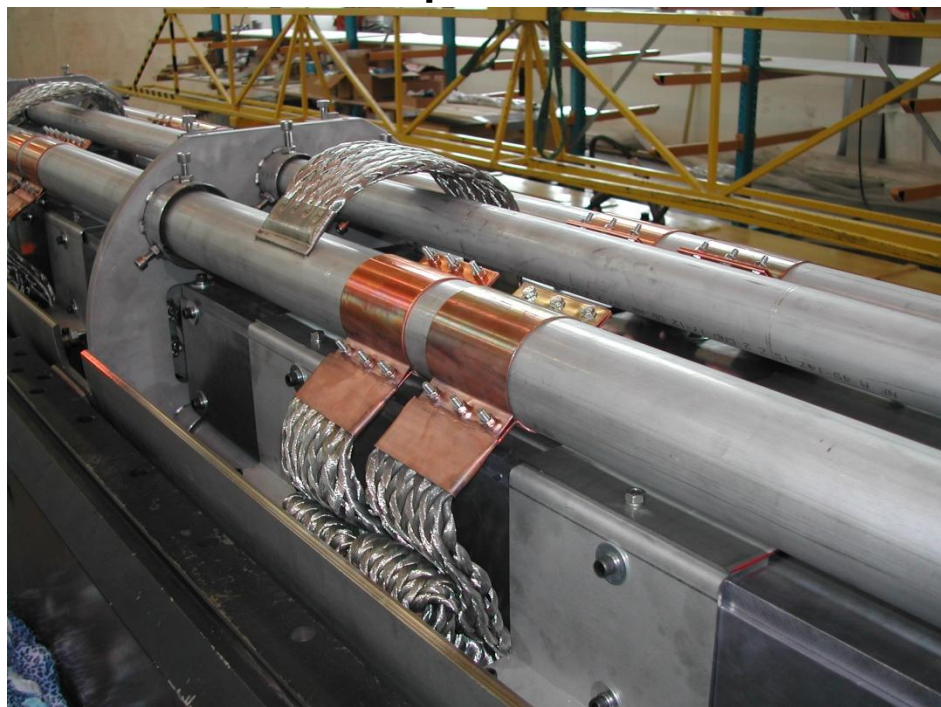
+ Based on the existing design BUT

Known design issues will be corrected:

- Busbars insulation close to shuffling module
- Busbars supporting and insulation
- Lead shielding : Requires expert assessment: **Need is not clear.**



See EDMS 689786 “A Simplified Thermal Simulation of the connection cryostats”



➤ Main components: Relayout and Integration

➤ Shortened CC (4/5)

+ Components :  
Valid also for DSCollimators

<u>Component</u>	<u>Lead time</u>	<u>Comment</u>
Superconducting cable	<3 months	In stock
<b>Superconducting bus bars</b>	<b>12 months</b>	<b>Defines critical path</b>
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

+ Planning :

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

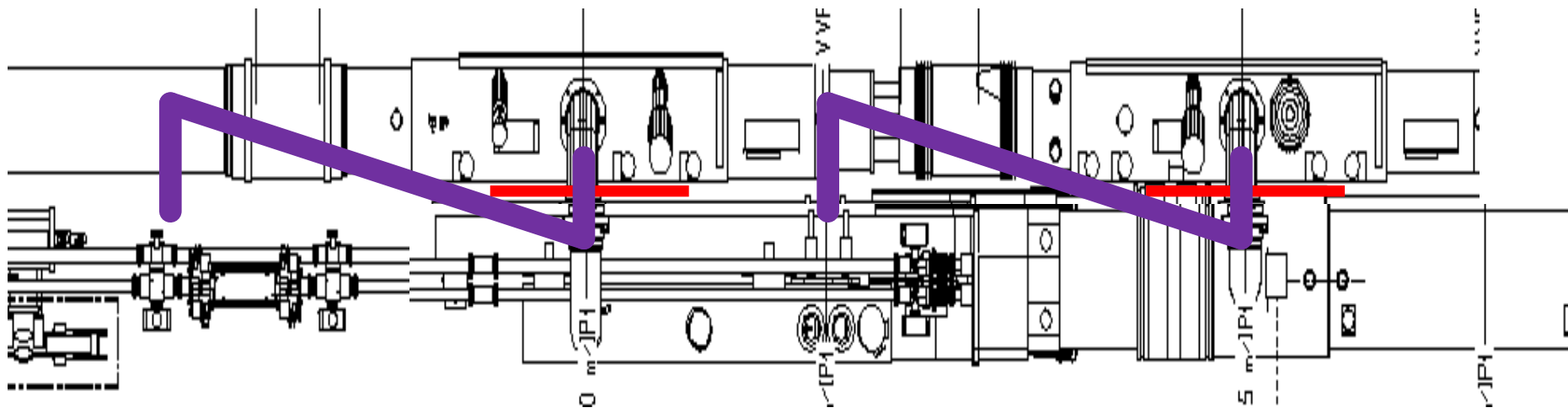
- Main components: [Relayout and Integration](#)
  - [Shortened CC \(5/5\)](#)
    - ❑ (Re)design based on existing one but correction of known weaknesses
    - ❑ [Resources will be required from MME \(design and workshop\)](#)
    - ❑ [Shielding requirement and design will require support of experts](#)
    - ❑ Will allow to recover components for spares CC
    - ❑ Can be in the shadow of the DS collimators

➤ Main components: Layout and Integration

➤ Cryogenics jumper extensions (1/3)

CRG responsibility: Infos from R Van Weelderen, A Perin, O Pirotte

+ For Q7 and DFBA jumpers (4 are required for P3 )



Task Name	Duration	Start	Finish	Timeline (2011)											
				May '11	Jun '11	Jul '11	Aug '11	Sep '11	Oct '11	Nov '11	Dec '11	Jan '12			
1 DS Collimators (TCRYO) P3	100 days?	Thu 4/1/10	Wed 4/24/13	[Timeline bar]											
26 Shortened CC for P3	607 days	Thu 7/1/10	Fri 10/26/12	[Timeline bar]											
38 Jumpers extensions	160 days	Thu 5/5/11	Wed 12/14/11	[Timeline bar]											
39 Design	3 mons	Thu 5/5/11	Wed 7/27/11	[Timeline bar]											
40 Procurement	5 mons	Thu 7/28/11	Wed 12/14/11	[Timeline bar]											
41 Fabrication	2 mons	Thu 7/28/11	Wed 9/21/11	[Timeline bar]											
42 Extensions available for IC	0 days	Wed 12/14/11	Wed 12/14/11	[Timeline bar]											

➤ Main components: Layout and Integration

➤ Cryogenics jumper extensions (2/3)

CRG responsibility: Infos from R Van Weelderen, A Perin, O Pirotte

+ 11 cryogenics extensions already in LHC ; installed by the IC team

+ Design

Feasible - to be designed

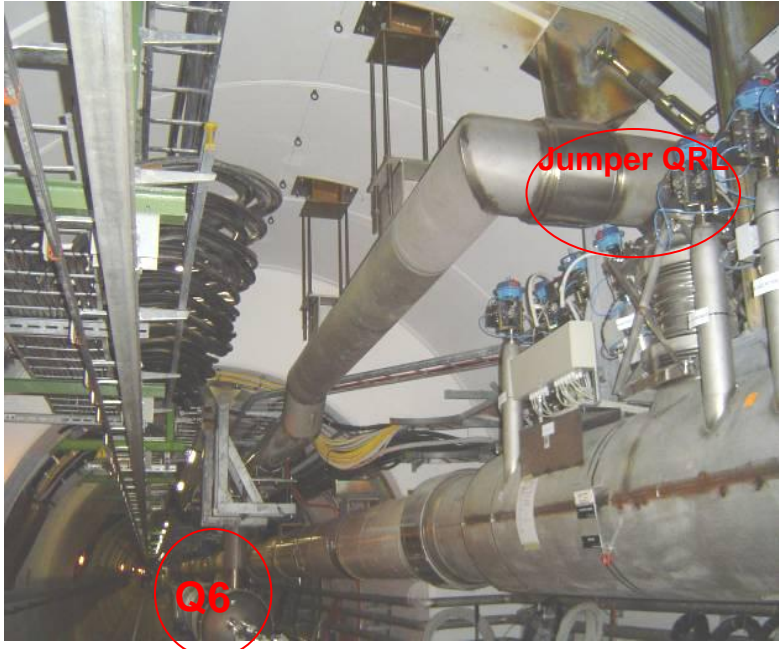
2 solutions in principle (Integration to be studied) :

on QRL or on cryomagnets

+ Tunnel work:

In the shadow of cryomagnets activities

QRLXD-Q6 @ R8



Sector	Cavern	Connected to	Position	Name	Number of elements	Pipes/Interconnection	Total # of interconnections
8-1	RH87	Q6	LSS 8R	QRLXD	1	9	2
	RR13	DFBL	LSS 1L	QRLXE	4	4	5
4-5	RUX45 et RB46	ACS	LSS 4R	QRLXF	1	6	1
	RR53	DFBL	LSS 5L	QRLXG	4	4	5
3-4	RUX45 et RB44	ACS	LSS 4L	QRLXH	1	6	1
5-6	RR57	DFBL	LSS 5R	QRLXI	4	4	5
	RA34	Q6	LSS 3L	QRLXA	2	9	3
2-3	RA27	Q6	LSS 2R	QRLXC	1	9	2
	RR17	DFBL	LSS 1R	QRLXJ	4	4	5
1-2	RH23	DFBA	LSS 2L	QRLXK	2	6	3
	RH23	Q6	LSS 2L	QRLXL	1	9	2
<b>TOTAL</b>					<b>25</b>		<b>34</b>

➤ Main components: Relayout and Integration

➤ Cryogenics jumper extensions (3/3)

CRG responsibility: Infos from R Van Weelderen, A Perin, O Pirotte

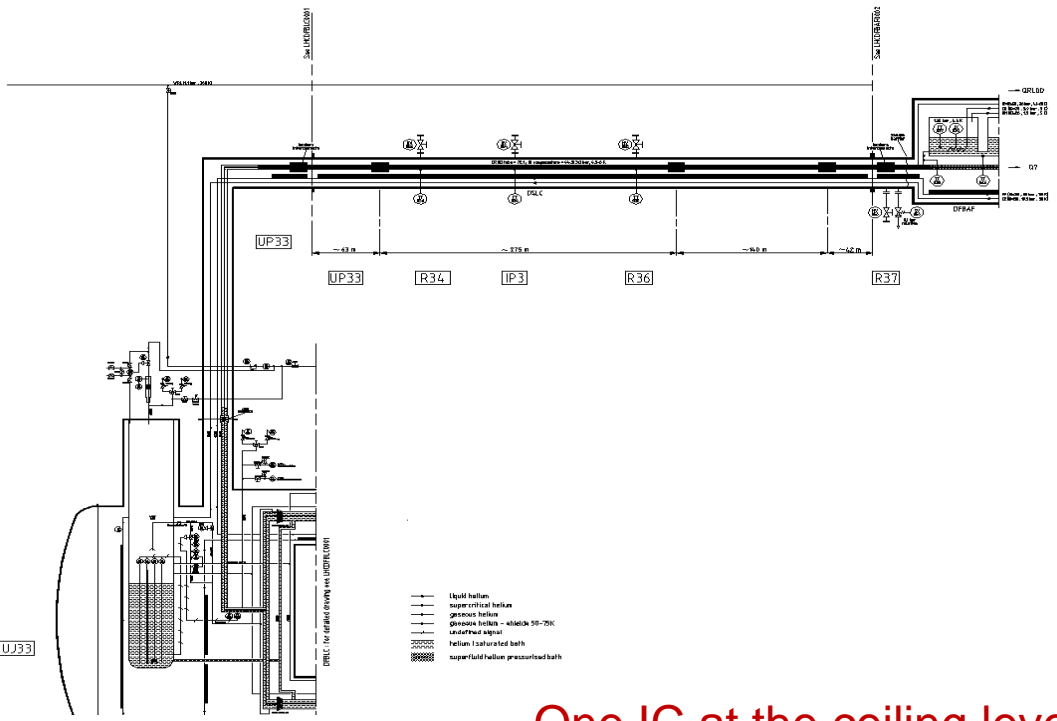
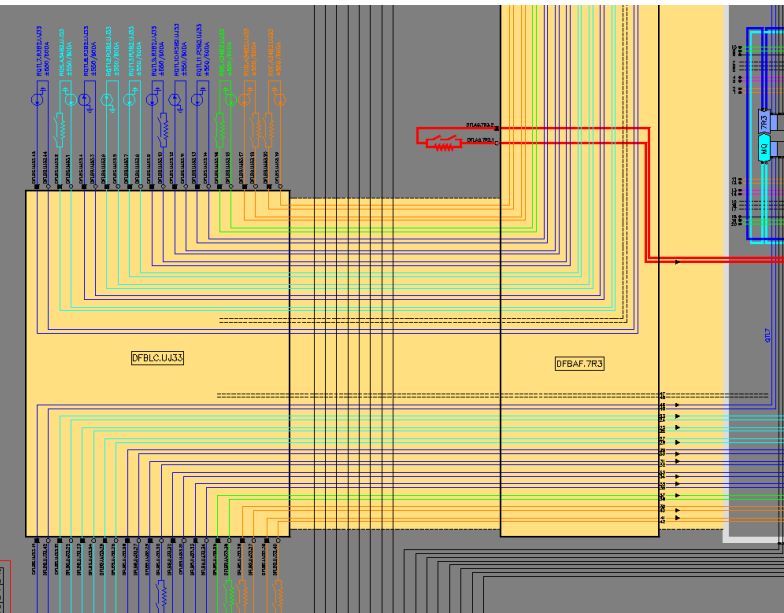
- ❑ Under CRG responsibility
- ❑ Design to be done but similar equipment exists
- ❑ Resources will be required from EN-MEF (Integration only not design and not the central workshop)
- ❑ Can be in the shadow of the DS collimators
- ❑ Coactivity in the tunnel will have to be managed but experience exists

# ➤ Main components: Layout and Integration

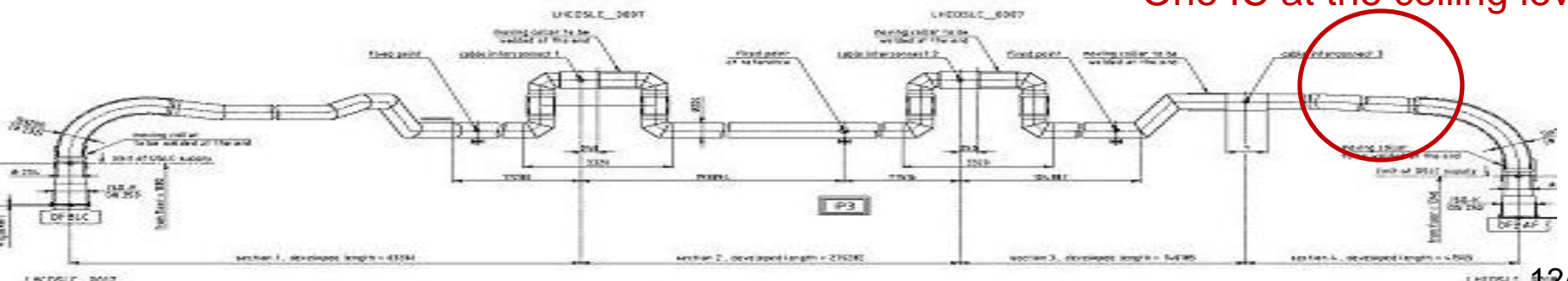
## ➤ DSLIC shortening (1/3)

CRG responsibility: Infos from R Van Weelderen, A Perin, O Pirotte

+ Only in R3 (34)



One IC at the ceiling level

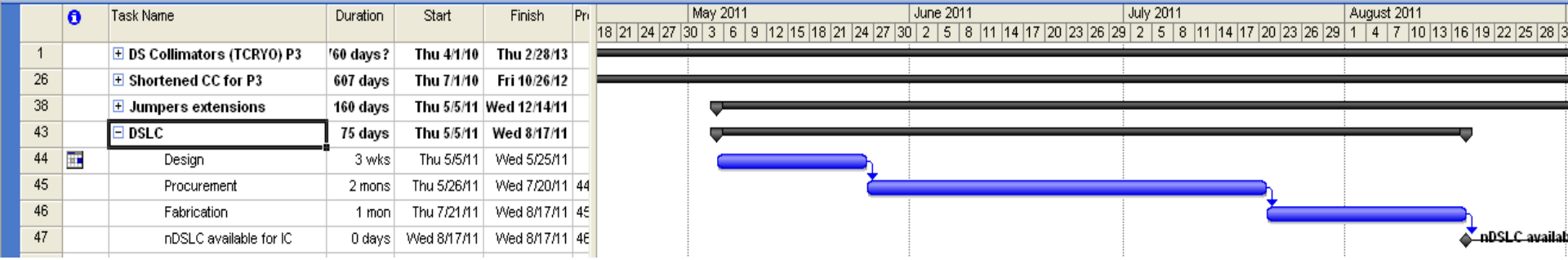
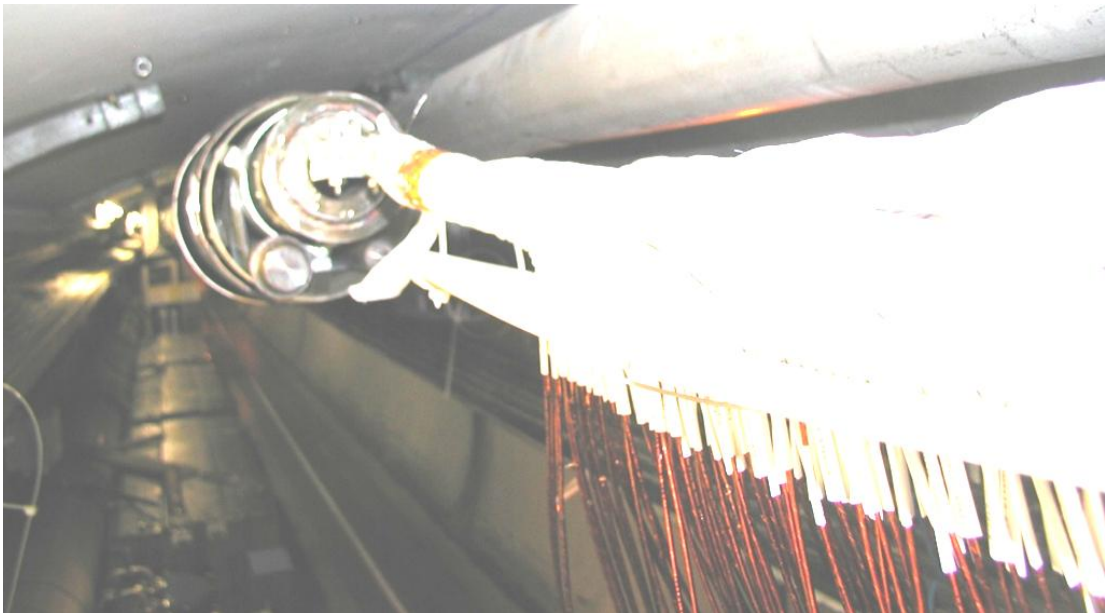


➤ Main components: Layout and Integration

➤ DSLCL shortening (2/3)

- + One IC to cut
- + DSLC to be shortened in the last section
- + Procedure for IC available but not the experienced staff any more (CERN and contractor)

CRG responsibility: Infos from R Van Weelderen, A Perin, O Pirotte



➤ Main components: Relayout and Integration

➤ DSLDC shortening (3/3)

CRG responsibility: Infos from R Van Weelderen, A Perin, O Pirotte

- ❑ Under CRG responsibility
- ❑ Design to be done but modification of existing one
- ❑ Resources will be required from MEF for integration  
(Integration only not design and not the central workshop)
- ❑ Can be in the shadow of the DS collimators
- ❑ Experienced staff not available any more
- ❑ Coactivity in the tunnel will have to be managed but experience exists

➤ Main components: Layout and Integration

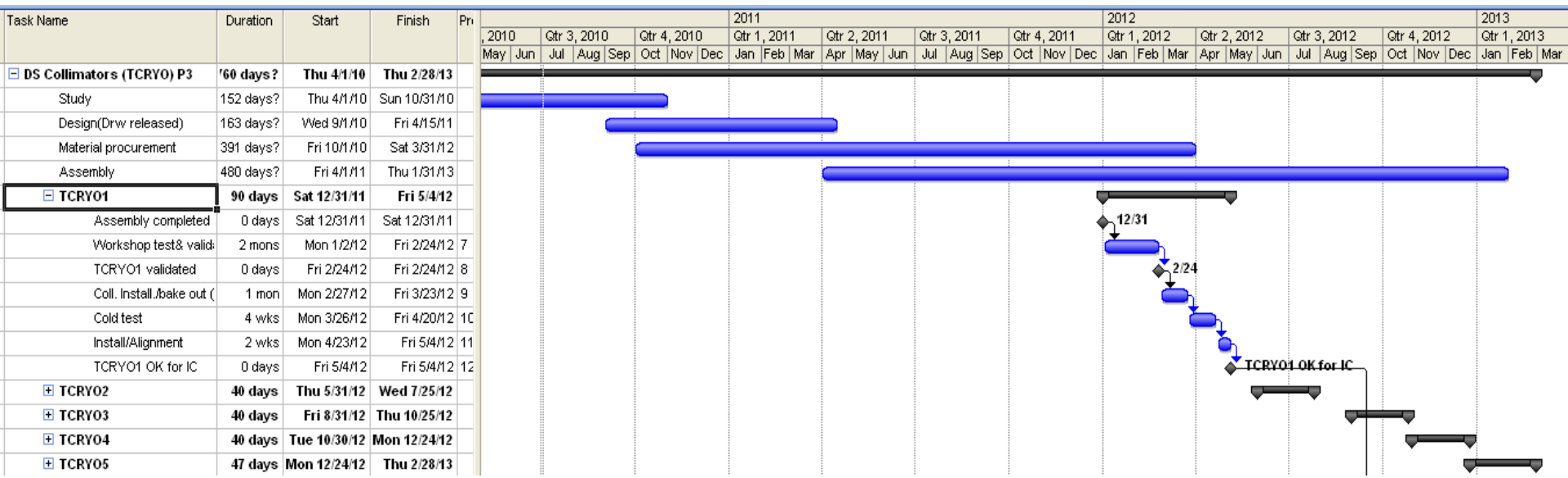
➤ DS Collimators

❑ See EN-MME presentation (A Bertarelli)

❑ Once component is validated:

- ❑ Integration of collimator itself (STI) – 2 weeks
- ❑ Bake out (VSC) – 2 weeks
- ❑ Cold test – Preparation for lowering – Transport – Alignment : 4 weeks (6 weeks for the 1<sup>st</sup> one)

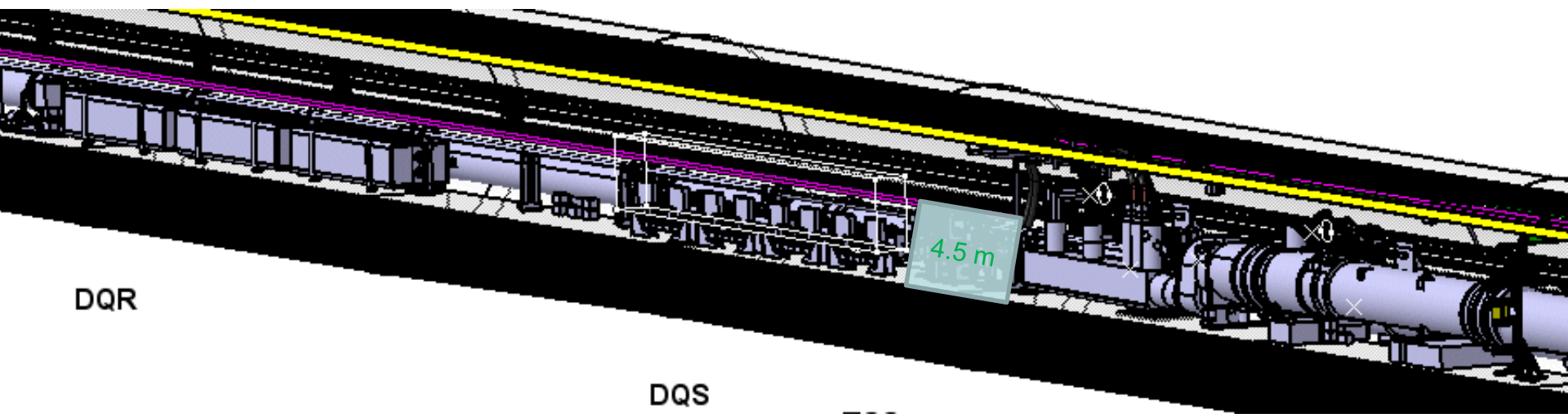
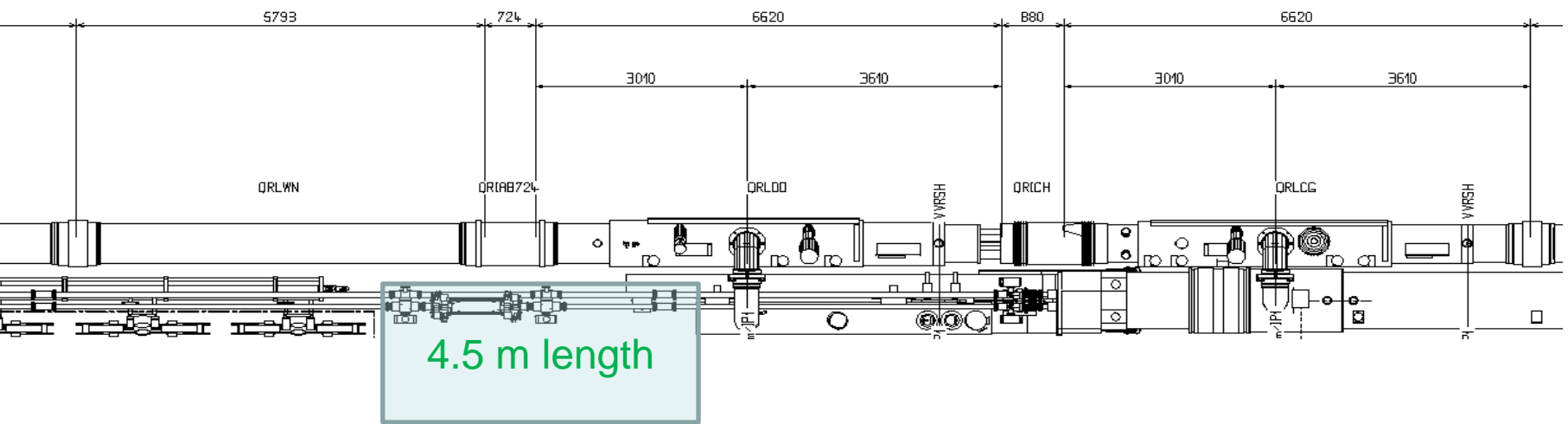
❑ On the critical path – 4<sup>th</sup> one is 3 months late wrt to splices consol. train



➤ Underground work:

Layout and Integration

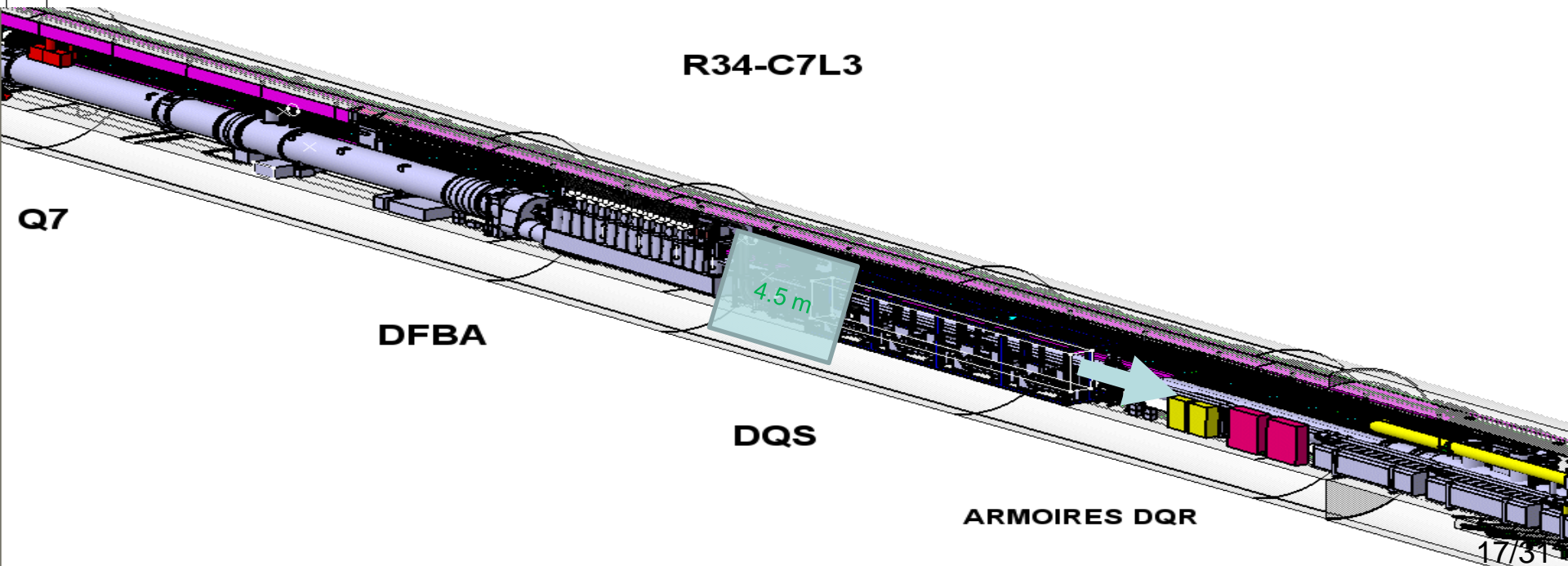
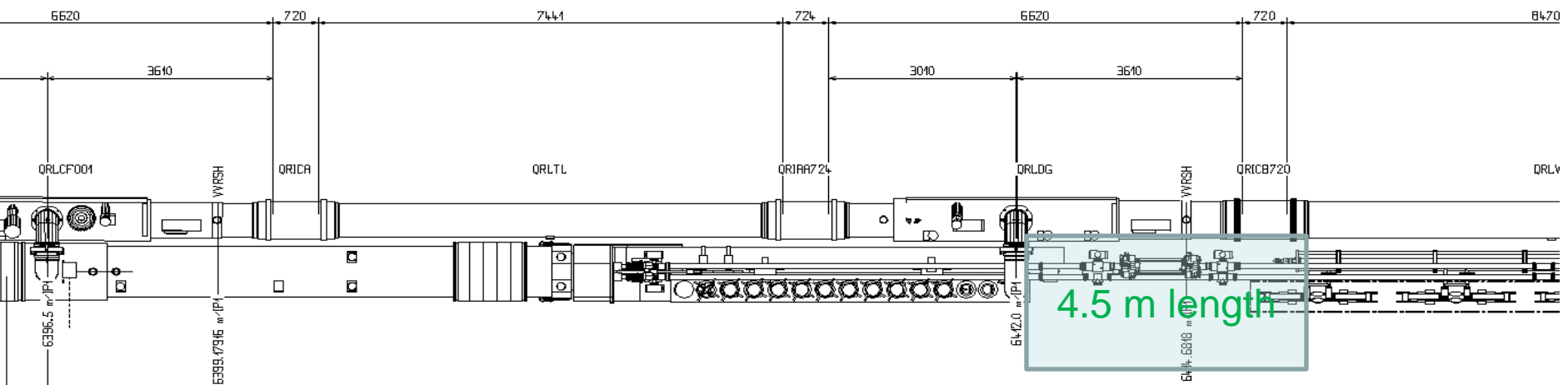
➤ Integration at P3 (R3) 1/3



➤ Underground work:

Layout and Integration

➤ Integration at P3 (L3) 2/3



➤ Underground work: [Relayout and Integration](#)

➤ Integration at P3 (L3) 3/3

- ❑ Integration is feasible because room is available
- ❑ 6 months allocated (by me) in the plan for this
- ❑ This will have to be carefully studied and prepared
- ❑ Resources from EN-MEF required
- ❑ There will be coactivity

➤ Underground work:

# Layout and Integration

➤ Consequences on transport/handling 1/3

Moving cryomagnets towards passage by 46 mm!

Unloading cryomagnets or CC is critical

Was checked (JL Grenard and J Osborne)

Civil engineering work is required

Cutting of the wall

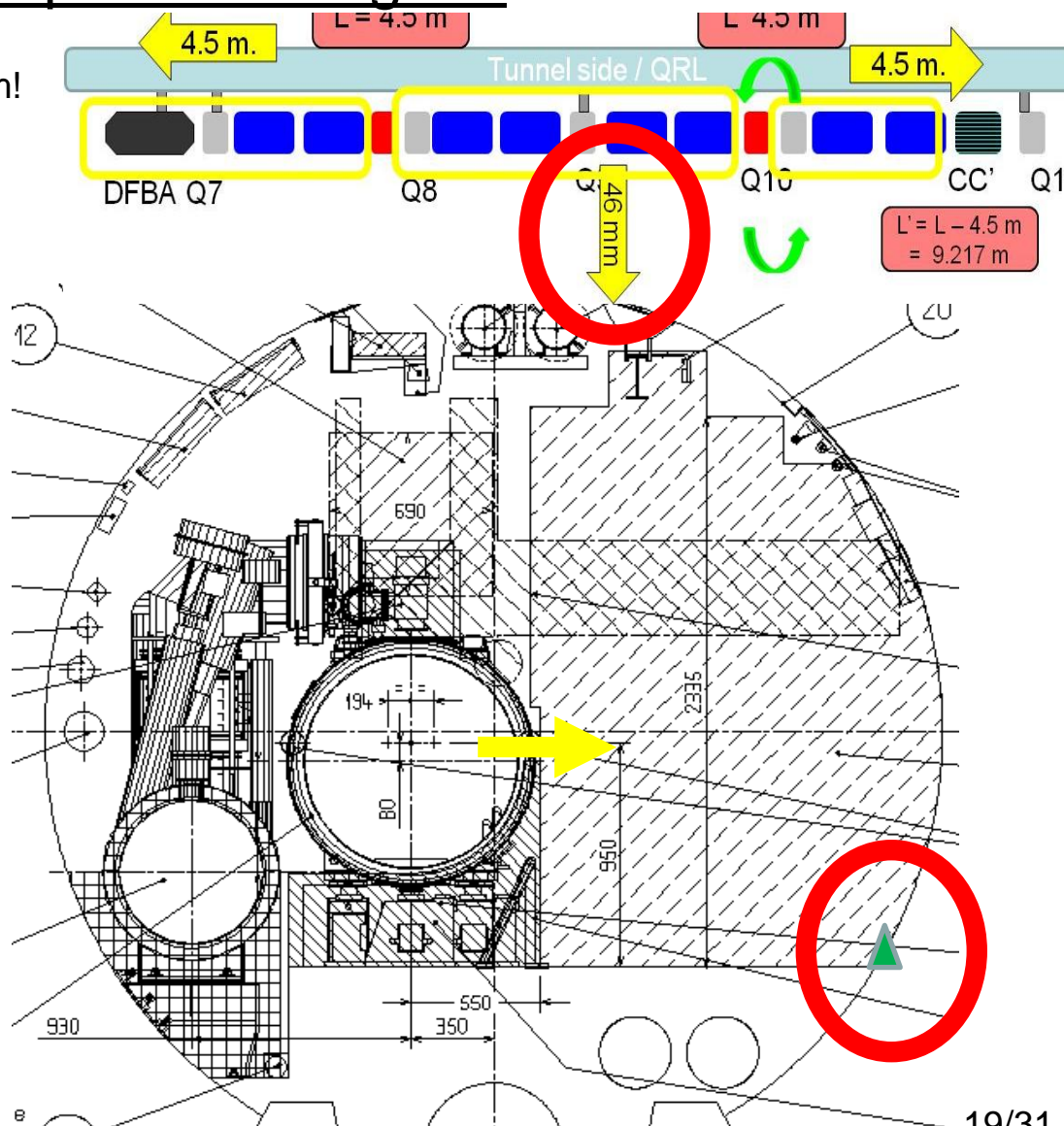
Less than what was done already

Not yet done at P3

P3 is critical (water)

Guiding line to be relocated

Gutter to be temporarily filled



➤ Underground work: [Relayout and Integration](#)

➤ Consequences on transport/handling 2/3

A lot of activities:

+ Transport to surface of :

16 cryodipoles, 8 SSSs, 2 CCs, (2 DFBA) [#26-28 comp]

+ Displacement/Installation of > 100 jacks

Interface plates to be designed and civil engineering works

+ Transport back to the tunnel of :

16 cryodipoles, 8 SSSs, 2 CCs, 4 DSColl, 4 CryoExt,(2 DFBA) [#34-36 comp]

+ All these elements have to be re-aligned

+ To avoid coactivity, transports will have to take place during the night

NB: Other transports will take place (Cryomagnets to replace in other sectors)

➤ Underground work: [Relayout and Integration](#)

➤ [Consequences on transport/handling 3/3](#)

❑ Displacement of cryomagnets and reinstallation of the new components are feasible provided that civil engineering work is performed

❑ This possibly can be done during 2010-11 Christmas break

❑ This will have to be carefully studied and prepared

❑ There will be coactivity also with other sectors

# ➤ Underground work:

## Layout and Integration

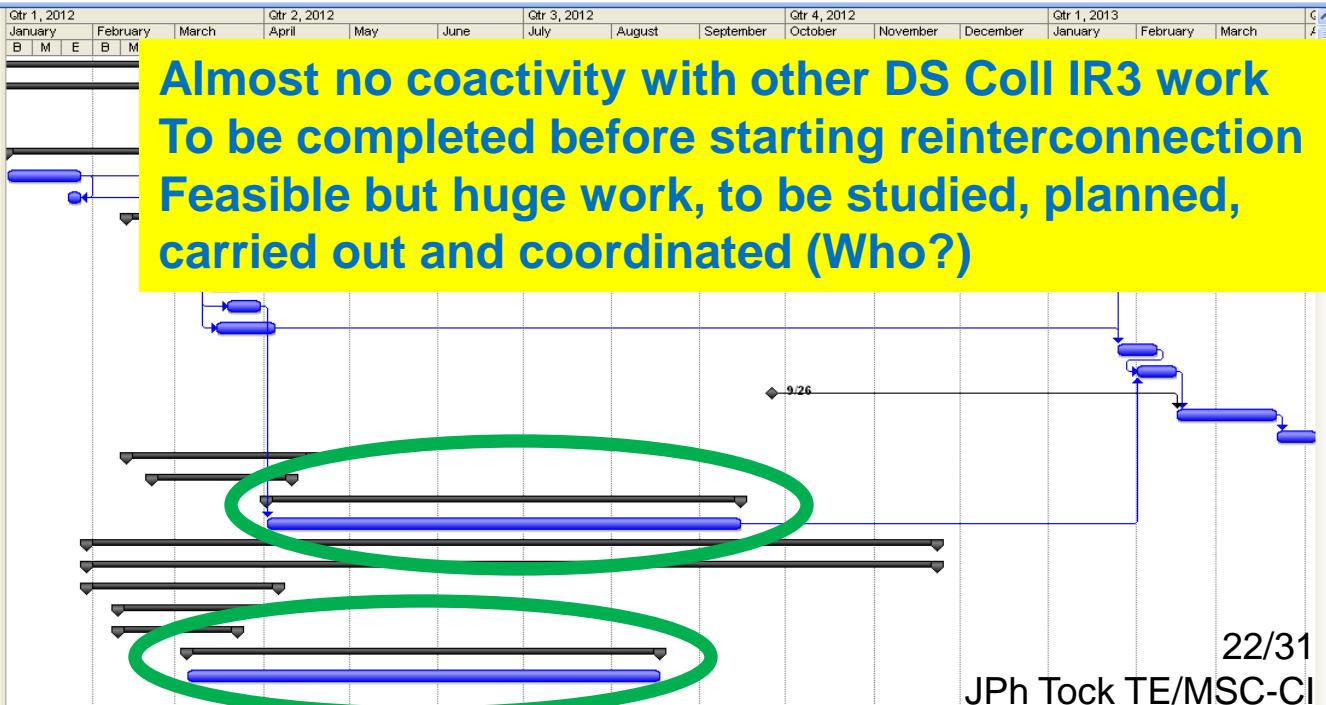
### ➤ Warm regions ❖ What is concerned:

- Installation of warm collimators in IR3
- Modification of general services
- Modification of electrical distribution system (Water Cooled cable)
- Possibly DQS (13 kA dipole circuit switches) and DQR (Discharge resistance)
- .....

### ❖ Assumed to be in the shadow of other activities

➤ 6 months have been allocated

Task Name	Duration	Start	Finish	Predecessors
DS Collimators (TCRYO) P3	100 days?	Thu 4/1/10	Wed 4/24/13	
Shortened CC for P3	607 days	Thu 7/1/10	Fri 10/26/12	
Jumpers extensions	160 days	Thu 5/5/11	Wed 12/14/11	
DSLCL	75 days	Thu 5/5/11	Wed 8/17/11	
Tunnel work	329 days	Mon 1/2/12	Thu 4/4/13	
Warm-up 2-3/3-4	1 mon	Mon 1/2/12	Fri 1/27/12	
Preparation work (CRG+MS)	1 wk	Mon 1/23/12	Fri 1/27/12	49FF
R3	299 days	Mon 2/13/12	Thu 4/4/13	
Cryomagnets	289 days	Mon 2/27/12	Thu 4/4/13	
Disconnection	3 wks	Mon 2/27/12	Fri 3/16/12	49,74SS+1 mon,2
TransportToSui	2 wks	Mon 3/12/12	Fri 3/23/12	53FS-1 wk
SupportsDispla	2 wks	Mon 3/19/12	Fri 3/30/12	54SS+1 wk
CryomagnetsSt	3 wks	Thu 3/15/12	Wed 4/4/12	54SS+3 days
TransportToTur	2 wks	Fri 1/25/13	Thu 2/7/13	54,56,19,22,37
Alignment	2 wks	Fri 2/1/13	Thu 2/14/13	57FS-1 wk,71
Team arrival	0 days	Wed 9/26/12	Wed 9/26/12	
Reconnection	5 wks	Fri 2/15/13	Thu 3/21/13	59,58
Leak test	2 wks	Fri 3/22/13	Thu 4/4/13	60
DFBA	47 days	Mon 2/13/12	Tue 4/17/12	
Jumpers (2: DFBAF)	35 days	Wed 2/22/12	Tue 4/10/12	
Warm regions	120 days	Mon 4/2/12	Fri 9/14/12	
Allocated	6 mons	Mon 4/2/12	Fri 9/14/12	55
L3	214 days	Mon 1/30/12	Thu 11/22/12	
Cryomagnets	214 days	Mon 1/30/12	Thu 11/22/12	
DFBA	49 days	Mon 1/30/12	Thu 4/5/12	
Jumpers (2 DFBAE)	35 days	Fri 2/10/12	Thu 3/29/12	
DSLCL	30 days	Fri 2/10/12	Thu 3/22/12	
Warm regions	120 days	Mon 3/5/12	Fri 8/17/12	
Allocated	6 mons	Mon 3/5/12	Fri 8/17/12	76



# ➤ Underground work:

## ➤ Tunnel IC work (1/7):

A lot of (almost) standard work

Provided that standards IC are kept

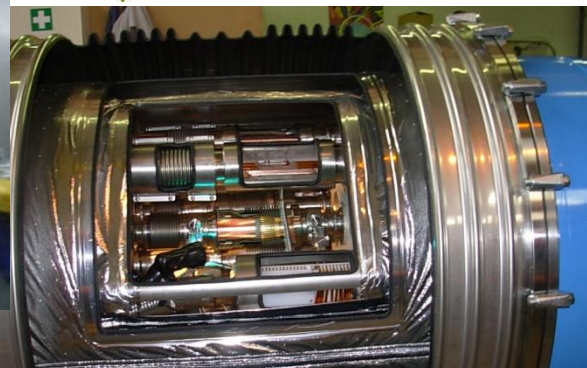
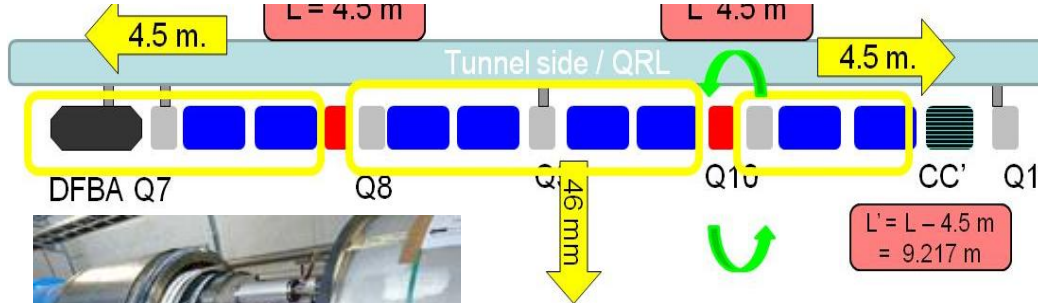
Experienced resources are necessary

Specific components to be manufactured

Concentrated in a zone of 2 \* 200 m close to P3:

- Easier for supervision
- Space limited / Coactivity !

# Layout and Integration



Volume of work (rough estimates):

ICs concerned : 2% of total

Amount of work : 15% of splice cons

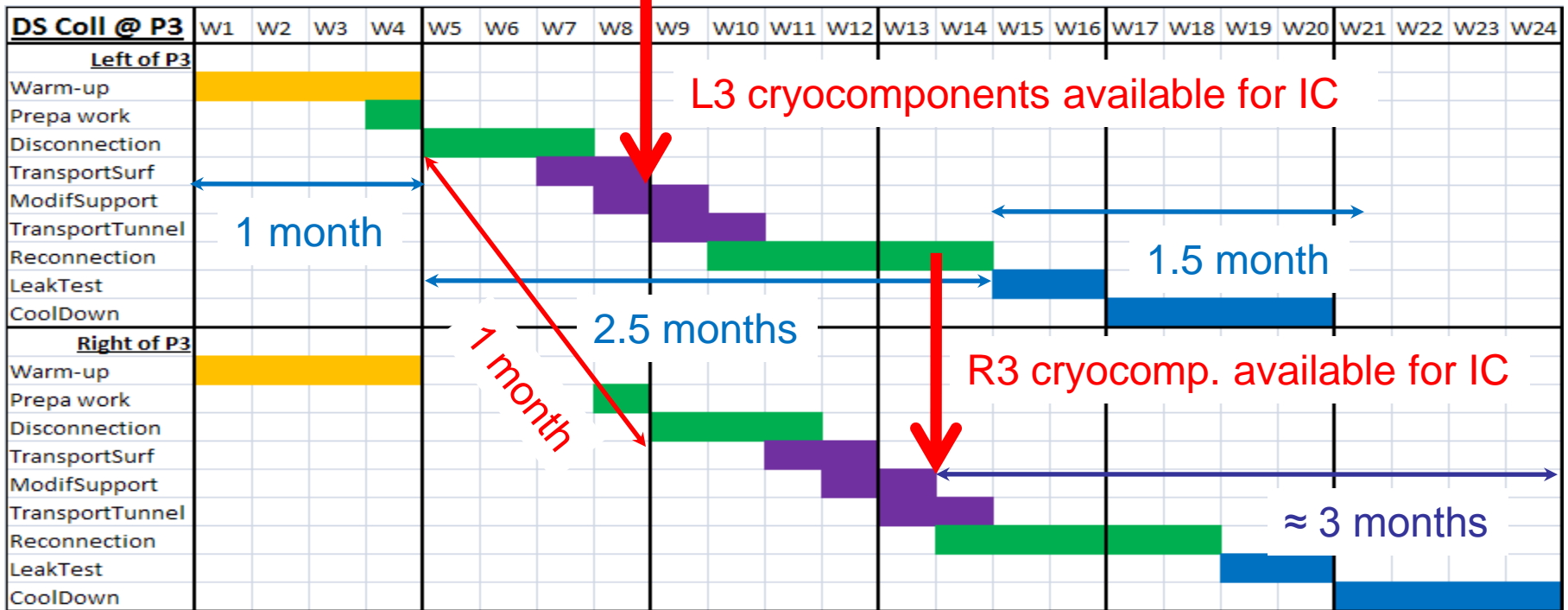
Similar to half of the 34 repair

IC to cut	# 28	Some special ones (DS)
Jumpers to cut	# 6	5 to reconnect (Cryoextensions)
Cryostats to move	# 26	7 Longitudinally / 6 Radially
DFBA to move	# 2	Affect also warm region
DS Collimators	# 4	TCRYO
New cryostats	# 3	1 CC' of $\approx 9 \text{ m}$ length
Jumper longi motion	# 4	DFBA & Q7: Not standard
Modif line N	# 6 (8)	

➤ Underground work:

Relayout and Integration

➤ Tunnel IC work (2/7): Independent schedule



Assumptions:

2 shifts of 12 to 15 persons + transport during the nights

Trained resources are available (After splices !)

Parallelism with warm regions work acceptable

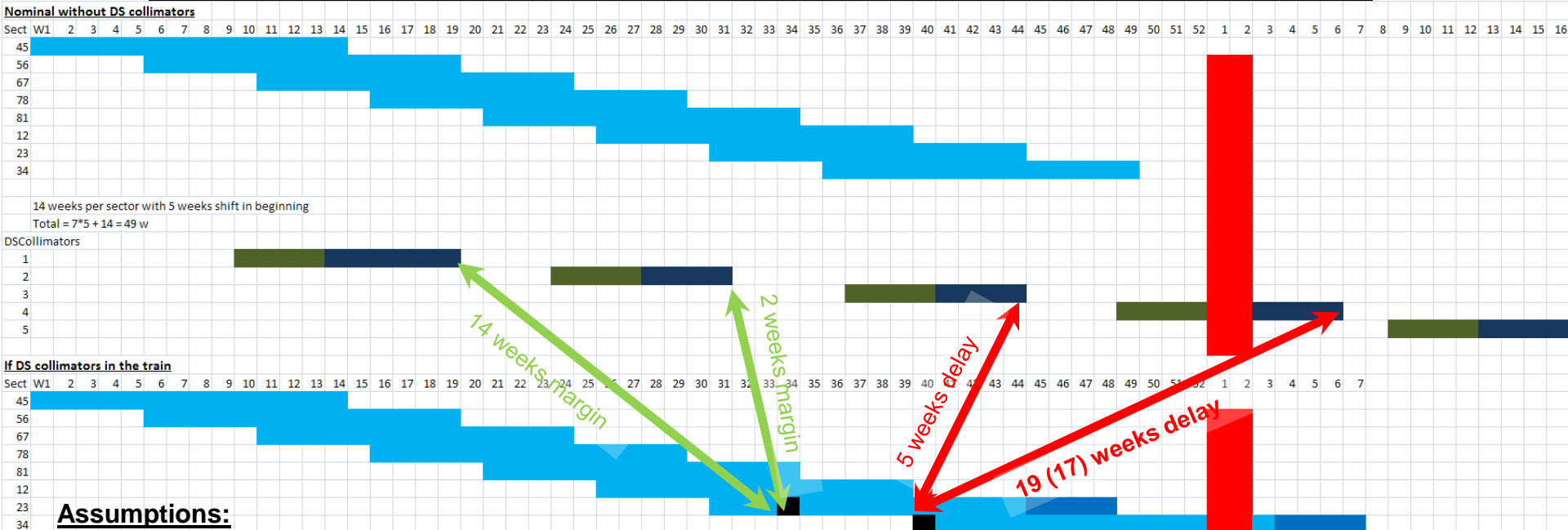
Fit in a 6 months stop for one IR

(Re)commissioning not included

➤ Underground work:

Relayout and Integration

➤ Tunnel IC work (3/7): Integration in the splices train ?



**Assumptions:**

- ❖ Splices alone: 14 weeks per sector / 5 weeks shift between consecutive sectors so total of 49 weeks (optimised but sectors shall be consecutive) – 4 extra weeks per sector for DSColl reconnection
- ❖ DSCollimators: From validation by MME, 2 weeks for collimator integration in bypass (STI), 2 weeks for bake-out (VSC), 4 (6 for 1<sup>st</sup>) weeks for cold test, prep for lowering, transport, installation and alignment
- ❖ Team: Reconnection done by the team working on the splices

- ❑ 4.5 months to recover on 4<sup>th</sup> DSColl production to integrate it in the train OR delay start of shutdown OR both
- ❑ No contingency: 5<sup>th</sup> DSColl not considered
- ❑ Duration increase : 2 working months (Second Christmas break effect: 2.5 months)

➤ Underground work:

Relayout and Integration

➤ Tunnel IC work (4/7): When ?

	With splices (2012)	At the end of splices work (2012/2013)	Next long shutdown (2015+/-1?)	Remark
<u>Trained resources</u>	Critical	OK		Later will smooth the workload
<u>ALARA</u>	+	+	- -	Really critical ?
<u>Budget</u>	+ / -	+ / -	+ / -	Limited impact(5%)
<u>Preparation</u>	-	+ /-	+ +	Cold DSColl could be envisaged later
<u>LHC Luminosity</u>	+ +	+ +	- -	When will it limit LHC?

In parallel with splices is almost impossible due to unavailability of trained resources

Performing the work at the end of 2012 / Beginning of 2013 seems a good compromise

The extension of the shutdown duration is about 2-3 months

➤ Underground work:

Relayout and Integration

➤ Tunnel IC work (5/7): Dedicated polyvalent team ?

DS Coll @ P3	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	...	...	...	...	...	...	...	WN	N+1	N+2	N+3	N+4	N+5	N+6	N+7	N+8	N+9	N+10	N+11	N+12	N+13	N+14	N+15	N+16			
<u>Left of P3</u>	Warm-up																																						
Warm-up	Yellow																																						
Prepa work				Green																																			
Disconnection					Green																																		
TransportSurf																																							
ModifSupport																																							
TransportTunnel																																							
Reconnection																																							
LeakTest																																							
CoolDown																																							
<u>Right of P3</u>	Warm-up																																						
Warm-up	Yellow																																						
Prepa work																																							
Disconnection																																							
TransportSurf																																							
ModifSupport																																							
TransportTunnel																																							
Reconnection																																							
LeakTest																																							
CoolDown																																							

Not included in the splices consolidation train

Completed 3 months after the availability for IC of the last DS collimator

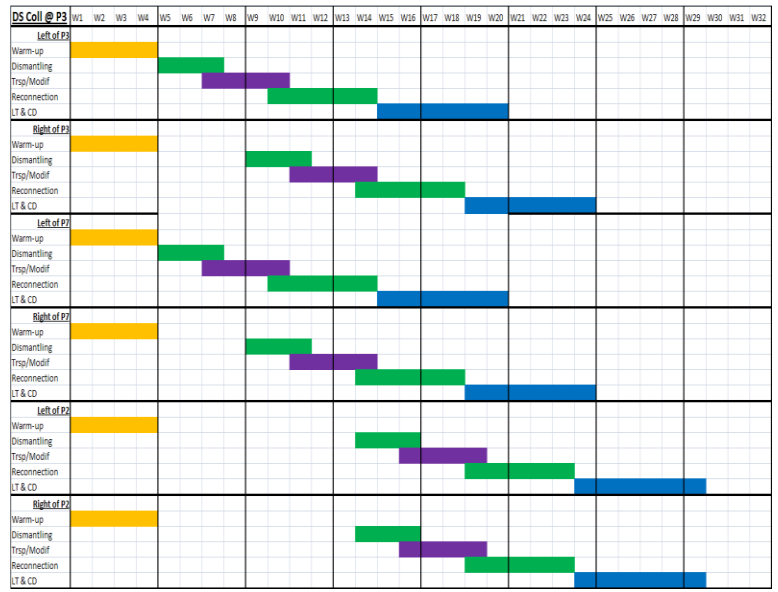
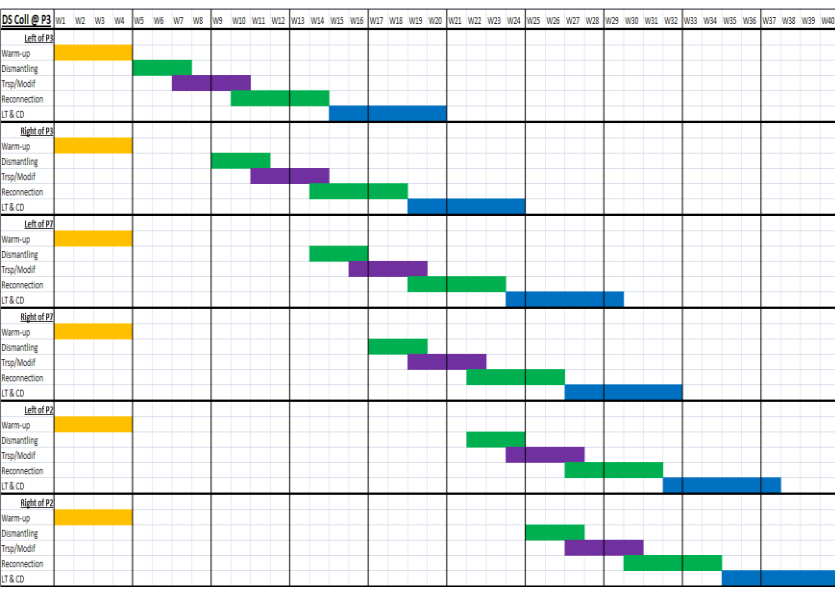
Impact on overall schedule depends on the availability of the components and of the resources

but is at minimum 2-3 months [Experienced trained resource fully involved in splices consolidation]

➤ Underground work:

Relayout and Integration

➤ Tunnel IC work (6/7): 3 IRs (P2,3,7) in parallel ?



• If 12-15 experienced persons in 2 shifts : 10 months from cold to cold (To compare with 6 months for one IR)

• If 25-30 experienced persons in 2 shifts so 2 fully parallel worksites: 7.5 months from cold to cold (To compare with 6 months for one IR)

Assuming 3 IRs during next long SD: pros and cons are:

- + More time to prepare and optimise DSColl
- Cold solutions - Higher field dipoles - ..
- + Leveling of resources (not a lot foreseen on the machine in this SD (but who knows ...))

- + LHC Luminosity could be limited by collimation before
- + No possibility to feed back IR3 experience to IRs7&2

➤ Underground work:

Relayout and Integration

➤ Tunnel IC work (7/7): Resources for IR3 (Preliminary)

MSC Staff	[FTE]	2010	2011	2012	2013	TOTAL
	Cat 2	1.4	1.8	1.7	0.7	5.6
	Cat 3	1.0	1.2	1.3	0.6	4.1
	Cat 4	0.0	1.0	3.6	1.1	5.7
	<b>TOT</b>	<b>2.3</b>	<b>4.0</b>	<b>6.6</b>	<b>2.4</b>	<b>15.3</b>
	Fellow	0.6	1.2	1.2	0.9	3.9
	<b>GD TOT</b>	<b>2.9</b>	<b>5.2</b>	<b>7.8</b>	<b>3.3</b>	<b>19.2</b>

32 FTE staff asked for 3 IRs in 2 SD

Material	[kCHF]	2010	2011	2012	2013	TOTAL	
Transport	0	100	215	215	530	215/IRside	
EN-MME	194	194	167	110	664	Integration, SCC, I/F	
Material	508	1503	3109	1500	6621		
<b>TOTAL:</b>	<b>702</b>	<b>1797</b>	<b>3492</b>	<b>1825</b>	<b>7815</b>		

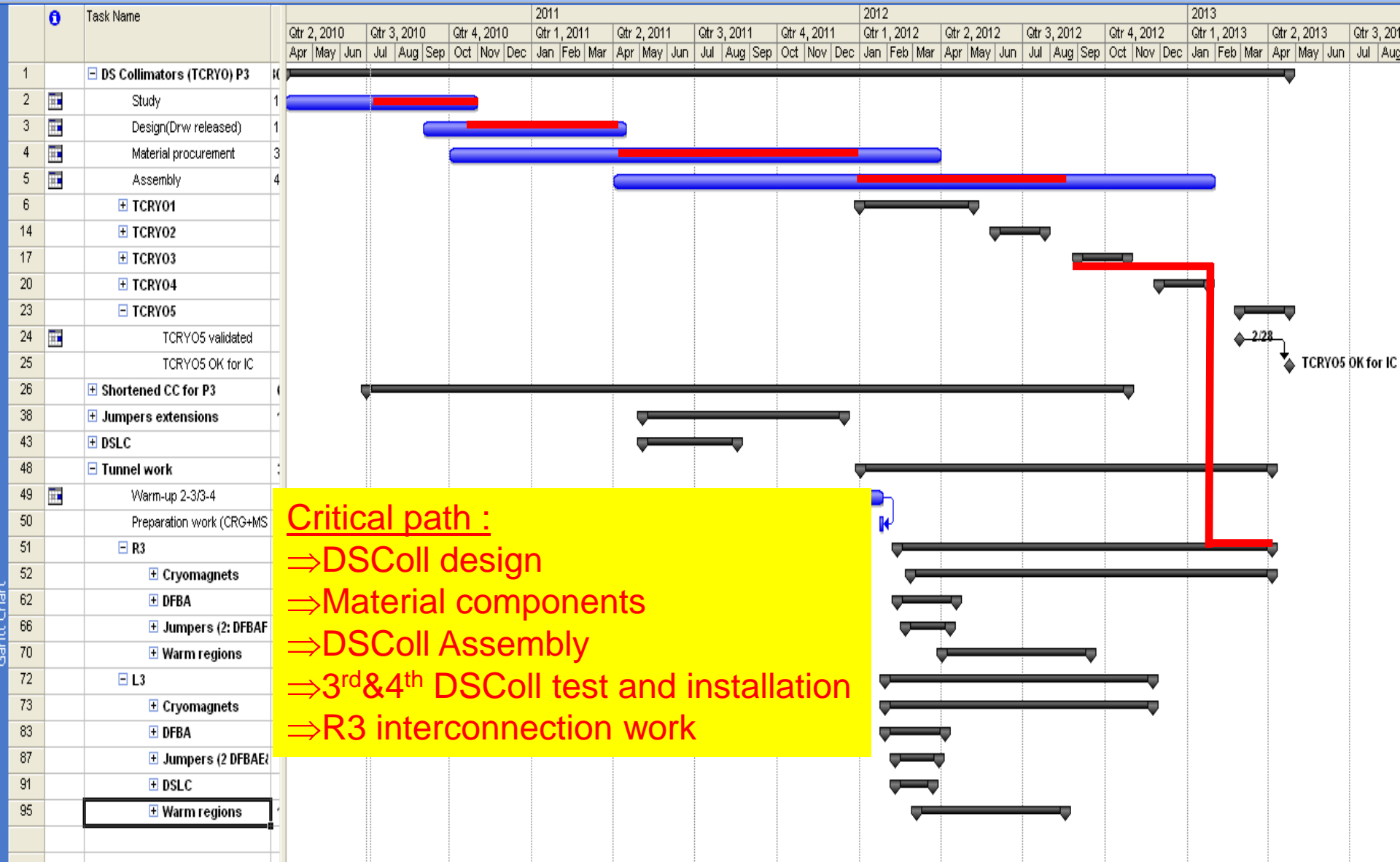
14 MCHF asked for 3IRs

Not considered :

- Warm-up, cooldown, recommissioning costs
- Modifications of environment : Services, civil engineering, electrical supply
- Impact of working in a radioactive environment (Higher later)

# ➤ Overall schedule:

## Layout and Integration



**Critical path :**  
 ⇒ DSColl design  
 ⇒ Material components  
 ⇒ DSColl Assembly  
 ⇒ 3<sup>rd</sup>&4<sup>th</sup> DSColl test and installation  
 ⇒ R3 interconnection work

## Relayout and Integration

### ➤ CONCLUSIONS:

- Installing DS Collimators at the end of the 2012-13 shutdown is feasible provided no major issues found and resources available
- The impact on the SD duration is between 2 and 4 months depending on the chosen solution for tunnel work.
- Delaying start of SD would buy contingency for surface work (DSColl and SCC) and also reduce parallelism with splices consolidation
- Only the warm bypass solution can be foreseen within this timeframe
- The organisation has to be defined – Technical coordination required
- **Availability of trained and experienced resources is a must**
- The radiation aspects needs to be assessed by experts

# Reserve slides

## **SPECIFICATION FOR SHIELDING COMING FROM LHC-LE-ES-0001**

### **SHIELDING**

The dose maps as given in LHC Project Note 296, which are based on the assumption that no shielding is foreseen, show unacceptable high radiation levels in and around the “LE”. The typical values are of several hundreds to thousands gray per year close to the cryostat. Shielding is required to reduce the annual dose in and around the “LE” to values similar to those of the arc magnet interconnects. Such a shielding might consist of 50 mm thick steel or 15 mm thick lead cylinders, located around the cold bores (private communication by C.A. Fynbo) and reducing the radiation level to ~100 gray per year. In any case, the shielding shall consist of non-magnetic material.

**RESOURCES:**

**15.15 FTE IN MSC 2011-2016 + 0.55 IN CI IN 2010**

		<u>2010</u>	<u>2011</u>	<u>2012</u>	<u>2013</u>	<u>2014</u>	<u>2015</u>	<u>2016</u>	<u>TOTAL</u>
<b>Staff</b>	<b>[FTE]</b>	2.9	5.2	7.8	4.7	6.7	4.7	0.0	32.0
<b>Material</b>	<b>[kCHF]</b>	508	1503	3109	3054	3522	2299	0	13996

# In parallel with splices ?

If yes, implies “warm” cryo collimators for schedule reasons

	With splices	Few months later	2-3 years later	Remark
Trained resources	Critical	OK		Later will smooth the workload
ALARA	+	+	- -	Really critical ?
Budget	+ / -	+ / -	+ / -	Limited impact (5%)
Preparation	-	+ /-	+ +	Cold CColl could be envisaged later
Physics (Luminosity)	+ +	+ +	- -	When will it limit LHC?

# With splices consolidation or later ?

Material budget estimate (Preliminary)

Per side of IR [To be X 4 (6)]

Activity	[kCHF] FSU + comp.	Remark
Interconnection	493	64 for splices
DFBA	164	
Cryoextensions	88	
nCC	400	Not cryocollimators
<u>TOTAL</u>	1145	*4 = 4.6 MCHF *6 = 6.9 MCHF

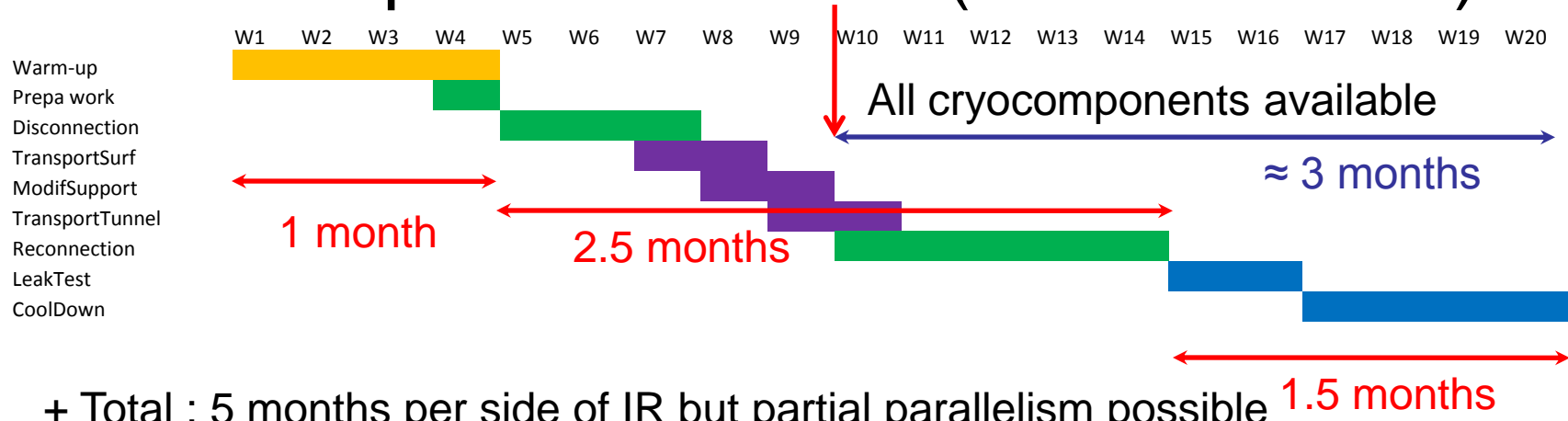
Not considered :

- Warm-up, cooldown, recommissioning costs
- Integration studies
- Modifications of environment
- Impact of working in a radioactive environment (Higher later)
- Optimised for cryocollimators schedule (Neither for money nor for production efficiency)

## Planning:

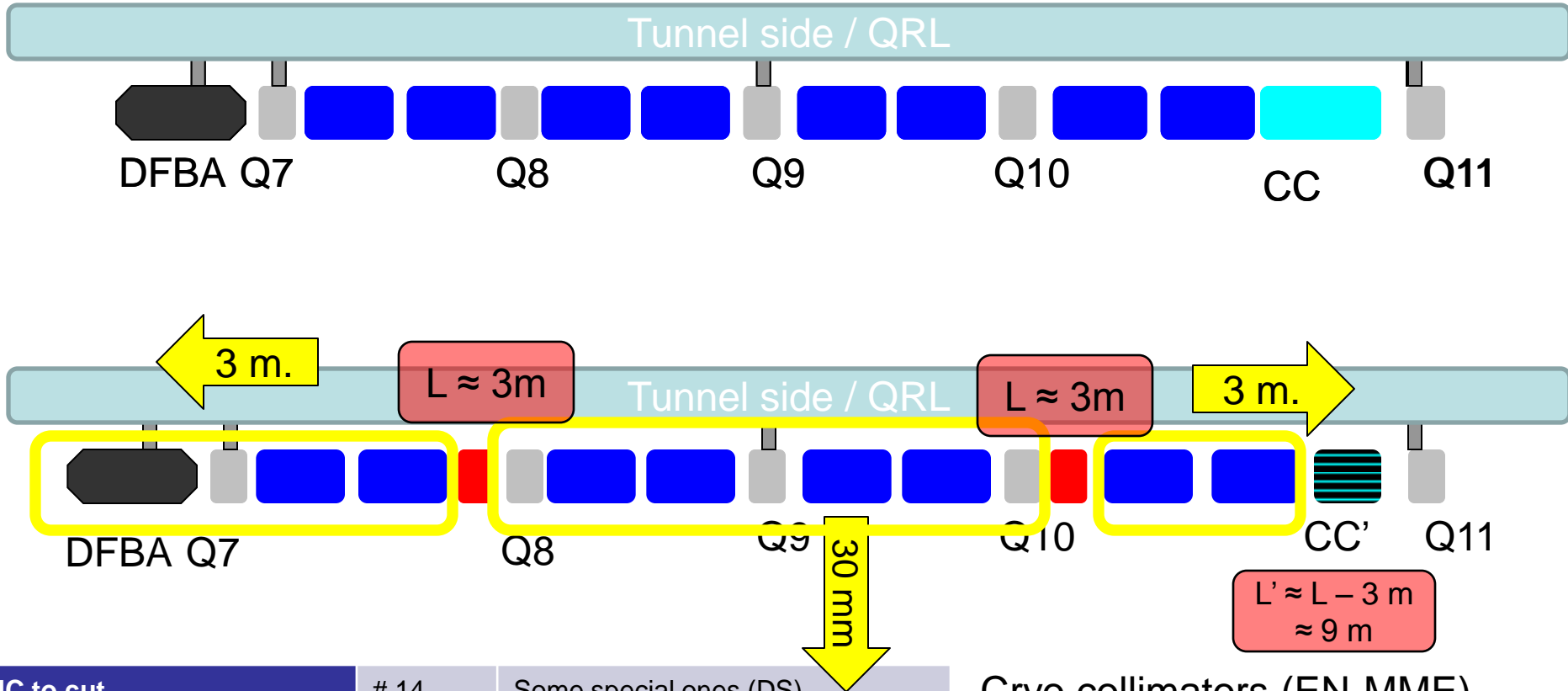
- In 2012: + 2-3 months but resources limited and production (DS Coll, CC) almost critical
- Later : Can fit in a 6 months shutdown provided not too much parallel work.

# Simplified schedule (one side of IR)



- + Total : 5 months per side of IR but partial parallelism possible
- + Second front (2<sup>nd</sup> side of same IR) : Extra 4 weeks
- + 2 shifts of 12-15 persons each (excluding transport)
- + Transport during the night
- + No cold test of cryomagnets before lowering but recommended for DS Coll
- + Assumes that trained resources are available
- + DFBA in parallel
- + Cryogenics extensions integrated
  
- + Can fit in a 6 months shutdown
- + If in parallel with splices, resources availability will be critical

# DSR\_: Baseline (As presented in March at the TF on LHC upgrade)



IC to cut	# 14	Some special ones (DS)
Jumpers to cut	# 3	5 to reconnect (Cryoextensions)
Cryostats to move	# 13	6 Longitudinally / 7 Radially
DFBA to move	# 1	Affect also warm region
CTW Modules	# 4	Cold To Warm : 2 per collimator
New cryostats	# 3	1 CC' of $\approx 9m$ length and 2 CColl
Jumper longi motion	# 2	DFBA & Q7: Not standard
Modif line N	# 1 (2)	

## Cryo collimators (EN-MME)

➤ Interfaces are of the magnet type

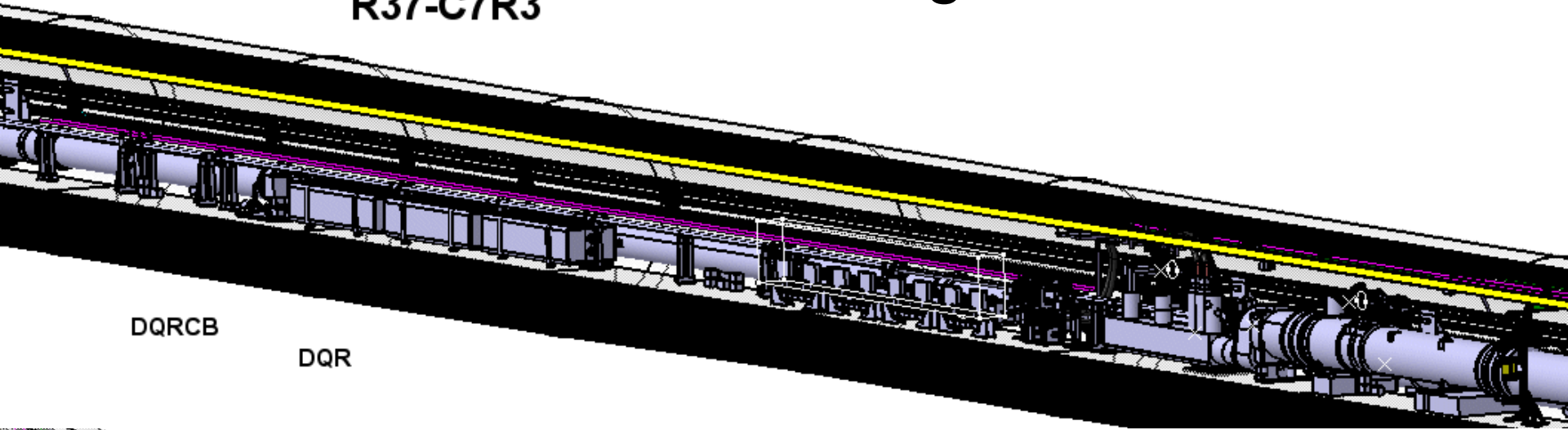
➤ Length of 3 meters

Impact of increasing it slightly ( $\approx 1.5m$ ) is limited except for transport zone

[If 6 m, then 60 mm radial displacement]

# Point 3 Integration

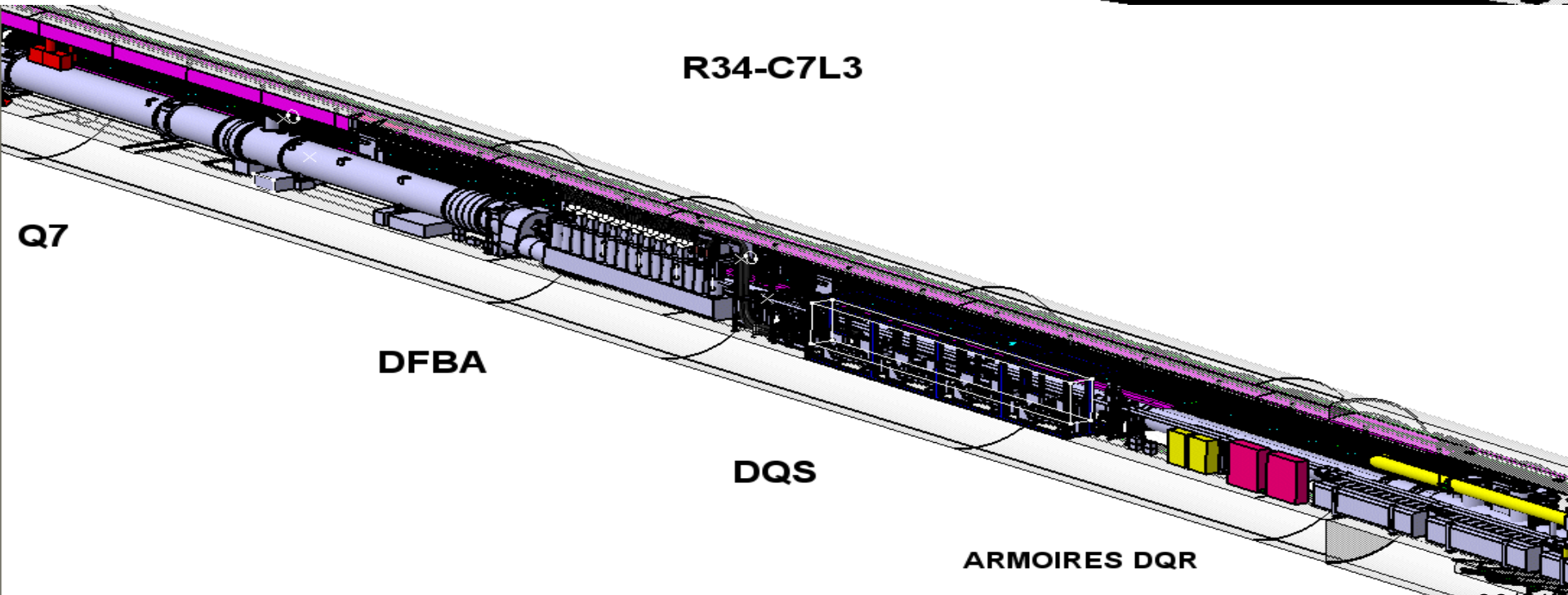
R37-C7R3



DQRCB

DQR

R34-C7L3



Q7

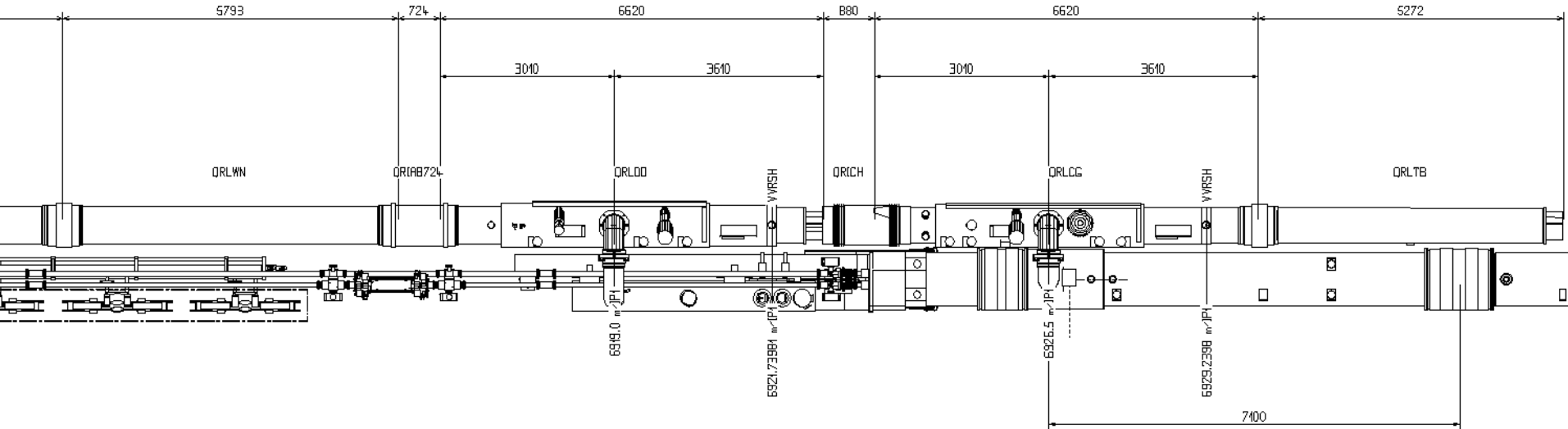
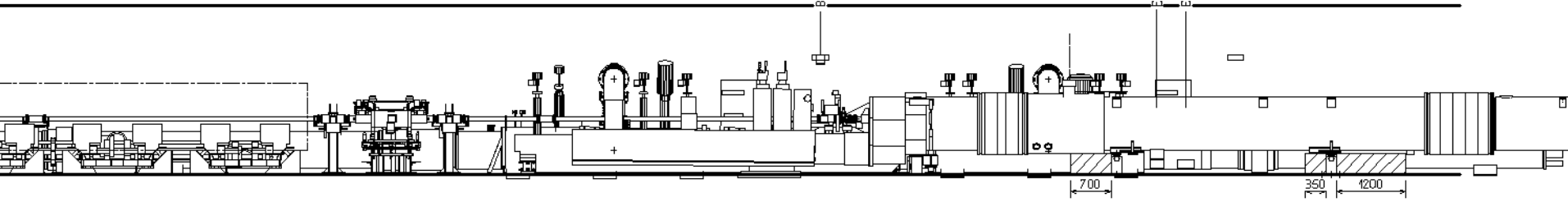
DFBA

DQS

ARMOIRES DQR

# R3 integration

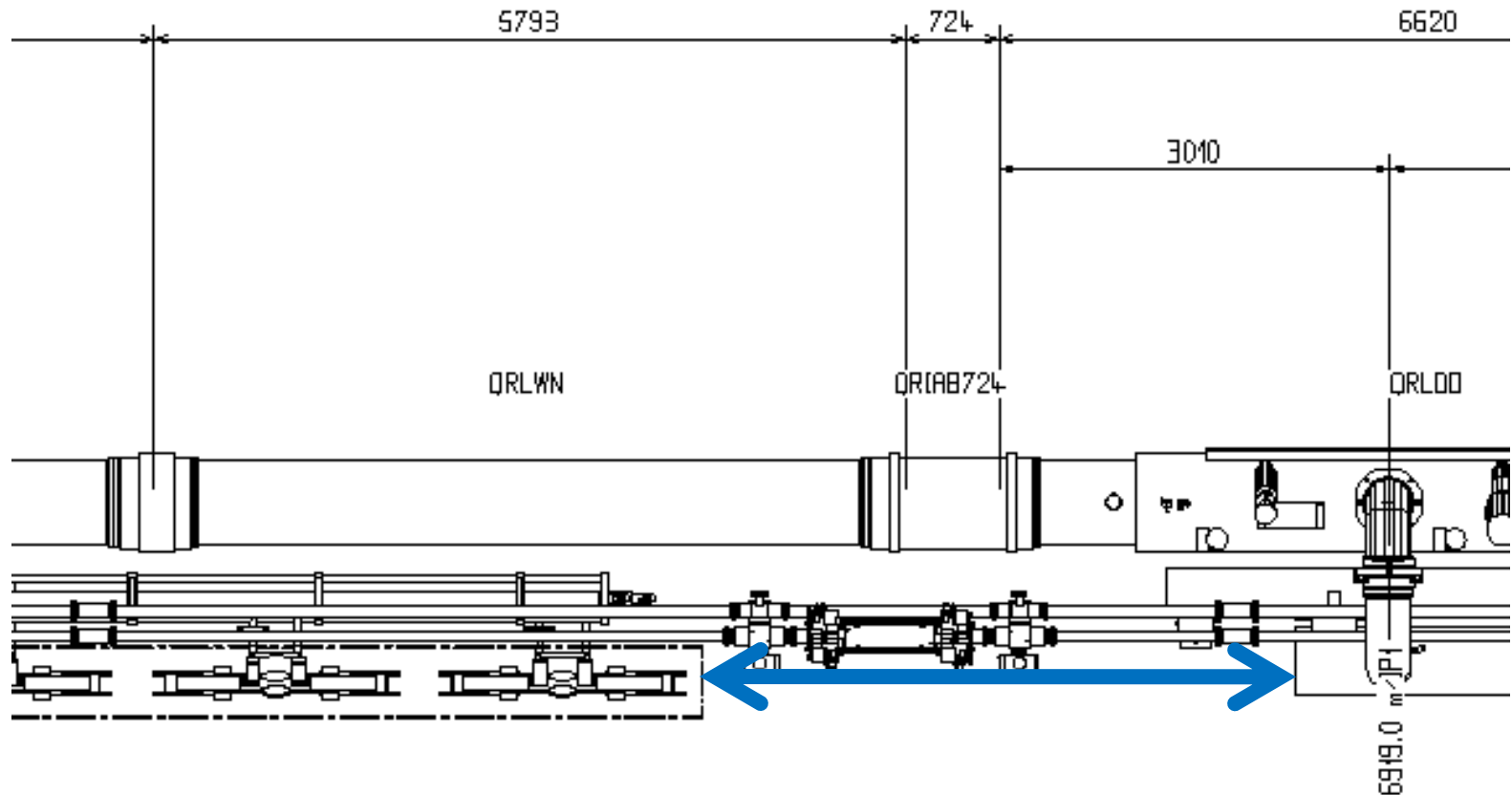
R37



FOR OPTICAL DRAWING SEE LHCLSX\_\_0006

Samy.Chemli@cern.ch  
 DEMI-CELLULE: C7R3  
 PLAN: L0742035PL  
 Not Valid for Installation  
 DATE: 26-Feb-2008 13:48 **40**

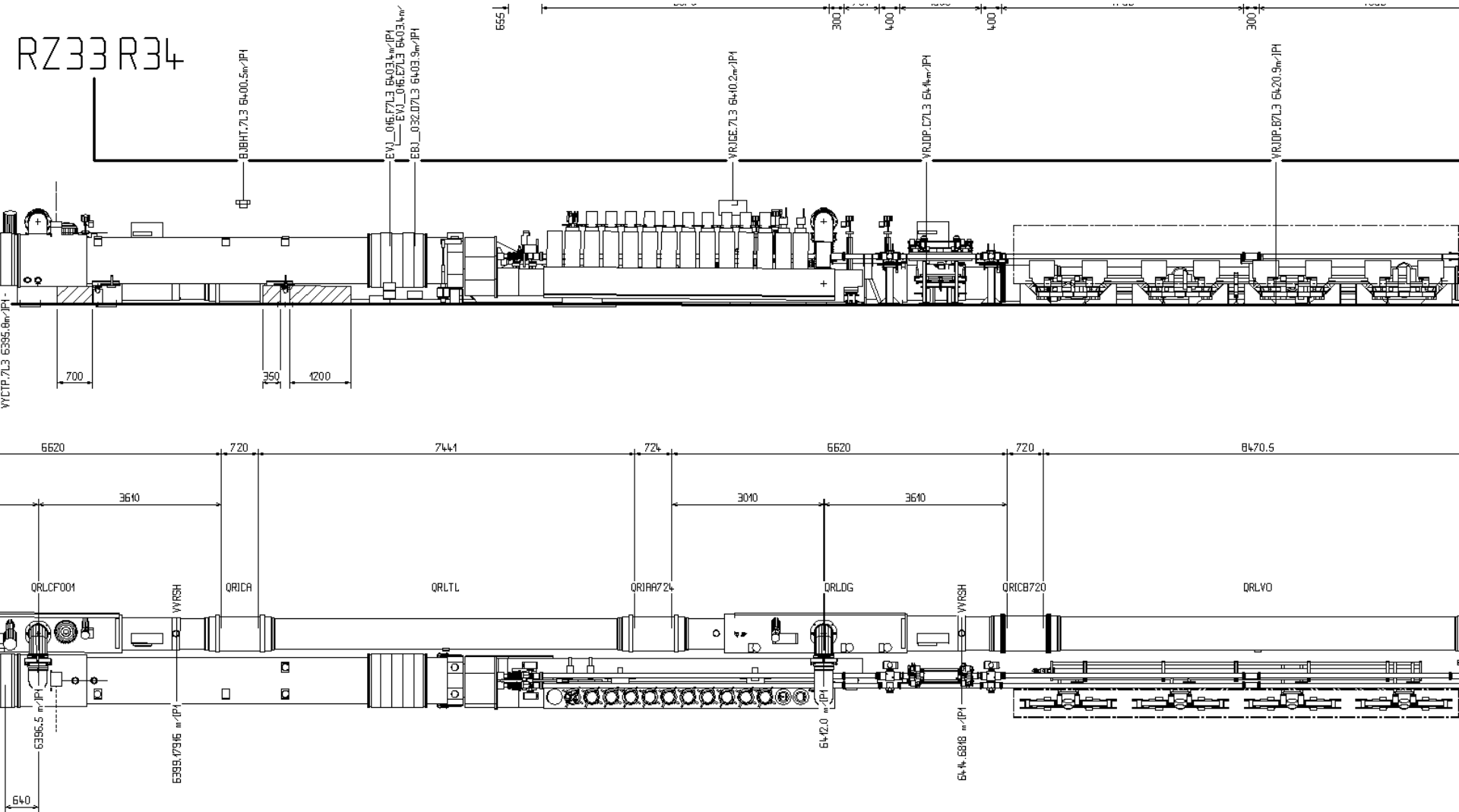
# R3 integration



FOR OPTICAL DRAWING SEE LHCLSX\_\_0006

Samy.Chemli@cern.ch  
DEMI-CELLULE: C7R3  
PLAN: L0742035PL  
Not Valid for Installation  
DATE: 26-Feb-2008 13:48 41

# L3 integration



FOR OPTICAL DRAWING SEE LHCLSX\_\_0005

Samy.Chemli@cern.ch  
DEMI-CELLULE: C7L3  
PLAN: L074-2028PL  
Not Valid for Installation  
DATE: 16-Feb-2008 15:42



# Considerations update

- Not necessary to decide NOW (was 4/3/2010) on the installation time  
But this influences the work: more work if different solutions for different points so a decision soon is preferable
- But design+study for “warm” cryo-collimators shall start/continue/increase  
WG (Alessandro / Vittorio)
- The situation could be reviewed in 6 months (Now 3 months)
  - More info on actual LHC limitations due to collimation  
No major difference identified so far
  - Integration can be studied in more details  
Focus on P3 ; feasible but huge work
  - Production(CC and Ccollimators) schedule can be refined  
See MME  
Only warm solution seems feasible for the end of the 2012 shutdown
- Can the splices consolidation be delayed to give more time for DSColl and CC production?
- Availability of experienced resources is a key & critical parameter
- Implications of working in radioactive environment have to be assessed



# Introduction (R Assmann)

❖ Present configuration (Phase I collimation) does not allow safe operation at nominal intensity and energy

Phase 1 provides optimum robustness but ideal performance limited to ~40% of nominal intensity, less with imperfections. Phase 2 is prepared to maximum and allows nominal and ultimate intensities!

❖ Phase II collimation includes many interventions : cryo collimators at P3/P7 (P2)

IR	Hardware		
		4(6) DS zones concerned : L3, R3, L7, R7, (L2,R2) <i>[P2 not studied here]</i> <u>4 sectors to be warmed-up : 23,34,67,78</u>	
1	TCLP installed TCTH, TCTVA TCT (new type?)		
2	TCTH installed	2	Improve <b>signal acceptance in ZDC</b>
	TCRYO installed	2	Remove limit on <b>ion luminosity</b>
3	TCSM installed	8	<b>Lower impedance (1/2), faster setup (h → s), longer lifetime LSS3 (x 3)</b>
	Shift positions of 24 SC magnets by 3m, 3cm TCRYO installed	4	Space for collimators at critical loss locations <b>Better efficiency (x 15-90)</b> with collimators in SC dispersion suppressor
5	TCLP installed TCTH, TCTVA moved TCT (new type?) installed	2 4 4	Interaction debris for <b>nominal luminosity</b> (after removal of Roman Pots) Phase 1 IR upgrade (if change in D2-D1 region) Phase 1 IR upgrade (reduced aperture in matching section)
6	TCLA installed	2	<b>Reduce quench risk</b> after TCDQ
7	TCSM	22	<b>Lower impedance (1/2), faster setup (h → s), longer lifetime (x 3), lower R2E (1/6 - 1/2)</b>
	Shift positions of 24 SC magnets by 3m, 3cm TCRYO installed	4	Space for collimators at critical loss locations <b>Better efficiency (x 15-90)</b> with collimators in SC dispersion suppressor