

Cryomagnets Interconnections

Consolidations of sector 4-5 Helium level gauges status Quick interconnection overview



List of activities

- * Non-recurring / (Potentially) recurring
- * Arc / LSS
- * Risk level
- * Comparison with 7-8

Some figures

Schedule

Warm-up, Overview, Where we are, Critical path

Documents

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Replacement of failed PIMs (X ICs) [1/2] Arc / Recurrent – Risk level : Medium Procedure is known but extent of the work not

Sequence of operations (if reasonable # of collapsed PIMs) :

- 1. Ball test to localise failed PIMs (2 per beam line) to an accuracy of one half cell [Alternate V1/V2 everyday]
- 2. Venting of the concerned vacuum sector
- 3. Opening of the QQBI IC of this sector
- 4. Cutting of the PIM on the relevant line Endoscopic inspection (+/- 100m)
- 5. Installation of a replacement or dummy PIM In parallel radar type measurement
- 6. Gamma-ray of the other PIM
- 7. Loop to clear the whole sector
- 8. Test of the photometer using cut PIMs if possible
- 9. In parallel, preparation of replacing PIMs
- 10. Rewelding of PIMs Ball test to validate the sector
- 11. Leak test of beam lines Displace SSS downwards
- 12. Reclosure of IC
- **13.** Pumping and leak test of insulation vacuum RF reference measurements

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Replacement of failed PIMs (X ICs) [2/2] Arc / Recurrent – Risk level : Medium Procedure is known but extent of the work not

If most of the PIMs are collapsed :

- 1. Venting of the insulation vacuum
- 2. Opening of all the QQBI IC [#55]
- 3. Radar type measurement or Gamma-rays to identify collapsed ones
- 4. Cutting of the PIMs Installation of a replacement or dummy one
- 5. Test of the photometer using cut PIMs if possible
- 6. In parallel, preparation of replacing PIMs
- 7. Rewelding of PIMs Ball test to validate the sector
- 8. Leak test of beam lines Displace SSS downwards
- 9. Reclosure of IC
- 10. Pumping and leak test of insulation vacuum RF reference measurements

Risks / Unknowns :

- 1. Other type of collapsed PIMs
- 2. Most of the PIMs to replace (Availability ?)
- 3. Flanges : material ?
- MARIC 4. Under investigation in QQBI.12L5 and QBBI.12L5 (Gamma-rays)



Y-Line to repair (#2 or 3) Arc / Non-recurrent – Risk level : Low Loss of time for re-cooldown

Interventions :

1. 3 locations :

- Q10-Q11R4 : QBBI.11R4 (TBC) Q18-Q17L5 : QBBI.B18L5 (TBC) Q9-Q7L5 : QQBI.8L5 (TBC) (No line Y in Q7 by design)
- 2. Precise localisation could require a dedicated time for experiment (Warm-up above lambda point then re-cool-down following the lambda front propagation) : 1 day except with acquisition of relevant sensors (reconfiguration necessary) if analysis of data provides sufficient information
- 3. Opening of IC and line X
- 4. Endoscopic inspection
- 5. Repair Test Reweld line X Leak test
- 6. Reclosure of IC

Risks / Unknowns

- 1. Time to localise the defect
- MARIC 2. Procedure for repair (different type of the one in 7-8) 23/01/2008





Helium guards to repair (#8 TBC) Arc / Non-recurrent – Risk level : Low Procedure known, improved and validated

Interventions :

- 1. Vent line X to atmospheric pressure to allow endoscopic inspection and identification/ confirmation of the units to be repaired
- 2. Cutting of the damaged piece
- 3. Rewelding and testing

Also, one Helium level gauge to change (CRG)

Risks / Unknowns :

1. Number of replacement required



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Leaks to repair Arc / Potentially recurring – Risk level : Low It was possible to leave with it so ...

Interventions :

- VACSEC 7R4 (NC847504) CM leak to insulation vacuum of 1 10⁻⁵ mbar I /sec In DS zone, additional mobile turbo pumps are used
- VACSEC 15R4 C' K leak to insulation vacuum of 6 10⁻⁶ mbar I /sec Disappeared during localisation ; leak tightness to be verified
- 3. Check of beam lines leak tightness
- Q17L5 and Q29R4 (NC 826696 and 820313) leak air to insulation vacuum temporary solution now but to be consolidated by AT-VQC

Risks / Unknowns :

- 1. Time for localisation Extra openings to support leak localisation work
- 2. New leaks created by warm-up

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Reconnection of triplet 5L (I Slits replaces C Garion)

LSS / Non-recurrent – Risk level : High

Procedure known but on reworked extremities / on the critical path

Interventions :

- 1. Cut QRL jumpers to allow DFBX installation
- 2. Connect Q3 to DFBX and test
- 3. Connect DFBX to QRL and leak test

ID Track Manua		Duration	Olari	Elestets	9	10	11	12	13	11	15	16
10	lask Name	buration	sian	Finish	9 Tab DJ 100	10	11 Mar 0.100	14 Mar 16 100	13	14	15 Apr 6, 109	10
				-	SMTWTF:							3 3 M T W
1	TripletőL	41 day s	Mon 2/26/08	Mon 4/21/08	9						888 88	
2	Découpe s jump er s	3 day s	Mon 2/26/08	Wed 2/27/08				•				
3	Découpe Jumper 1 (enveloppe externe + lianes Internes X8, L0 1, L02, EE, CV)	i day	Mon 2/25/08	Mon 2/25/08	<u> </u>							
+	Découpe jumper 2 (enveloppe exierne +	1 day	Tue 2/25/08	The 2/25/08	···· t -,			•				
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6					••••••			•				
7	Tran sport etin stallation DFBXE	2 days	Thu 2/28/08	Fri 2/29/08								
9	Allgn emen t	3 days	Mon 3/3/08	Wed 3/5/08								
10	Q3/DFBX	20 day s	Thu 3/6/08	Wed 4/2/08								
12 7	Connections électriques + isolation	4 days	Thu 3/6/08	Tue 3/11/08				•	*****	······		
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14	Tesiélechique	1 day	Wed 3/12/08	Wed 3/12/08				•				
15	Ferme kire lignes électrique (M 1, M2, M 4)	2 days	Thu 3/ 13/08	Fri 3/ 14/08	••••••							
16	Tes l'électrique	1 day	Mon 3/17/08	Mon 3/17/08	••••••			• •				
17	Plug-in Module	1 day	Tue 3/ 18/08	Tue 3/18/08				· · · · · · · · · · · · · · · · · · ·				
18	Ferme kure lignes cryo (XBI,CY,LD, EE, FF,CC',TD, 1texible k⊖+ radios	3 days	Wed 3/19/08	Fri 3/21/08								
19	lesi de fuile (masse folde, CC/KD, XB/CY,	6 days	Mon 3/24/08	Mon 3/31/08				•		-		
20	Fermelure Q 3/DF B×	2 days	The 4/ 1/08	Wed 4/2/08								
22	Jumpers DEBX	6 day c	Tue 4/1/08	Mon 4/7/08				•				
23	Jumper 1 Hones Internes (LD 2, CY) + radios	1 dav	Tue 4/ 1/08	Tue 4/ 1/08			••••••	•				
24	lumper 2 lignes internes (FF, CS, KD, TD) + radios (FF, CS, KD, TD)	1 day	The 4/ 1/08	Tue 4/ 1/08				•				
25	Teside fulle (LD 1, CY, FF, CS, KD, TD)	1 day	Wed 4(2)08	Wed 4/2/08	••••••			•				•
25	jumper 1 lignes internes, la suite (XB, LD1, EE) + radios (EE)	1 day	Thu 4/3/08	Thu 4/3/08	•••••			•				
27	lumper 2 lignes internes , la suite (CC', DH) + radios (CC', DH)	1 day	Thu 4/3/08	Thu 4/3/08	••••••			-				
28	Teside fulle (XB, LD1, EE, CC', DH)	1 day	Fr1 4/ 4/08	Fr1 4/ 4/08				•				
29 30	Fermelure jumper 1 el 2	1 day	Mon 4/7/08	Mon 4/7/08							` _	
31	Warm Recovery Line	6 day s	Thu 3/6/08	Wed 3/12/08	••••••	· · · · · · · · · · · · · · · · · · ·		•				
32	Soudures + radios + montage	3 days	Thu 3/6/08	Mon 3/10/08		× • • • • • • • • • • • • • • • • • • •		•				•••••
33	Teside Male	2 days	Tue 3/11/08	Wed 3/12/08				•				
34								•				
35	Test de fuite vide d'isolation triplet	10 days	The #/8/08	Mon 4/21/08							••••••••••••••••••••••••••••••••••••••	



Consolidation of sector 4-5 Intervention on Q5R4 LSS / Non-recurrent – Risk level : High Still under discussion

Short circuit on a corrector circuit ; suspected between corrector and D4 busbars

Interventions :

- 1. Open the D4/Q5 IC
- 2. Open the busbar line
- 3. Endoscopic inspection
- 4. Repair

Risks / Unknowns

- 1. Location of the defect
- 2. Possibility to repair
- 3. The DFBML link could be required to be opened
- 4. What if it is not accessible from the IC ?

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Consolidation of sector 4-5

Planned interventions : Arc / Non-recurrent

* Improve splices of CC instrumentation (same as 7-8)

1 day work / Risk level : very low Planned interventions : Arc / Non-recurrent

* Intervention on JT valves of the triplets and possibly DFBs (CRG)
 In the shadow / Risk level : low

* If QBQI ICs are opened, verification of the instrumentation (CRG)

Preparation activity :

* Removal of BLM (No survey instrumentation in this sector)

Potential critical issues :

* Electrical issues discovered during commissioning : Nothing up to now but ...

<u>* Leaks during the closure phase (impact on schedule)</u>

<u>* Sector 4-5 shutdown is on the critical path for the LHC</u> <u>general schedule</u>



Some figures

- About 45 (24 for PIMs) ICs to open [220 in 7-8]
- 35 persons involved (not full time)
- Several teams :
 - MCS, MEI, CRG, VAC, IEG, FSU, TS-SU, AB-BI, TS-IC, ICIT
- From MCS: 18 persons (various proportion)
- A Bastard, F Bertinelli, N Bourcey, O Denis, H Dupont, M Duret, D Etiembre, M Felip, JM Hubert, A Jacquemod, A Musso, M Pozzobon, F Savary, I Slits, P Thonet, J Ph Tock, S Triquet, L Williams
- Duration: 8 weeks [6+2];
- Starting date to be defined to allocate resources



Helium guards status

Sector	To be replaced	Done	Remark
1-2	24	12	Planned W 6-7-8
2-3	9	8	End for W4
3-4	3	3	Completed
4-5	8 ?	0	During shutdown of 4-5
5-6	13 ?	0	After warm-up
6-7	18 ?	0	Endoscopy W 5 ; planned W6-7
7-8	7	7	Completed
8-1	1	1	Completed

- * Components available for 2-3
- * Next batch delivery on W5 so critical for 1-2 and 6-7
- * Endoscopic inspections will confirm quantity
- * Improved procedure, not requiring the opening of the IC is validated in 2-3 (N Bourcey)
- * 1-2 and 6-7 partially in parallel (Priority ?)
- * If impact on schedule, necessity to replace has to be assessed (No failure in 7-8, 4-5, 5-6)

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<u>QDQI.</u>7 Quick IC overview

Sector	On-going	Planned
1-2	Closure of last lcs	Leak test, closure of ICs and Helium LT replacement
2-3	Replacement of He level gauge	Purge and flushing
3-4	NA	ELQA - Purge and flushing
4-5	Q1/Q2/Q3 IC	Consolidation from W10?
5-6	Cold	Cooldown
6-7	5 openings to check BPMs	Helium LT replacement
7-8	NA	Cool-down
8-1	Leak Test	One IC to close W4 or 5

QBBI.B20 R OBQI.20

BQI.9

QQBI.9

2BBI.10

BBI.11

2BQI.10 R QBI.10 R

20 ICs to close: 15 in the arc 5 in L5 triplet

QQBI.20	R	VAC					QBQI.22	L				Г
QBBI.A21	R	VAC					QQBI.21	L				Г
QBBI.B21	R	VAC					QBBI.B21	L				Г
QBQI.21	R	VAC					QBBI.A21	Ē				t
QQBI.21	R						QBQI.21	L				t
QBBLA22	R						QQB1.20	L				t
OBBI.B22	R						OBBI.B20	L				t
OB01.22	R						OBBLA20	L				t
00BL22	R						OBOI.20	Ē				t
OBBLA23	R						00BL19	Ē	VAC			t
OBBL B23	R						OBBL B19	Ē	VAC			t
0B0L23	R						OBBLA19	ī				t
00BI.23	R						OBOL19	Ē				t
OBBLA24	R						00BL18	ĩ				t
OBBL B24	R						OBBL B18	Ē				t
0B01.24	R						OBBLA18	ī				t
00BL24	R						OBOL 18	Ĩ.				t
OBBL A25	R						00BL17	i i				t
OBBL B25	R						OBBL B17	1				t
0B01.025	b b						OBBL A17	1				t
00BL25	D D						OBOL 17	1				t
OPPLA26	È						00RI 16	-				ł
OBBL B26	B						OBBL B16	5				ł
0B0126	B						OBBLA16	-				ł
00BL26	B						OBOL 16	-				ł
OPPLA27	B						00BL 15	-				ł
OPPL P27	B						OPPL P15	-				ł
0P01.027	E I						OPPLA15	5				ł
00PL 27	6						OBOL 15	-				ł
OBBL A29	E I						008111	-				ł
QBBL B28	R				 	 	QUBL 14	-				ł
QBDI.DZ0	R						QDDI.D14	<u>L</u>				ł
QBQ1.20	R						QDDLA14	<u>L</u>				ł
QUBI.28	R						0601.14	L.				ł
QBBLA29	R						QQBI.13	L.				ł
QBBI.B29	ĸ						QBBI.B13	L.				ł
QBQI.29	ĸ						QBBI.A13	L.				ł
QQBI.29	R						QBQI.13	L.				ł
QBBLA30	R						QUBL12	L.				ł
QBBI.B30	ĸ						OBBI.B12	L.				ł
QBQ1.30	ĸ						QBBI.A12	L.				ł
QQBI.30	R						QBQL12	L.				ł
QBBLA31	R						QQEL11	L				ł
QBBI.B31	к						QEBI.11	L				Ł
QBQI.31	R						QBBI.11	L				4
QQBI.31	R						QBQI.11	L				4
QBBI.A32	R						QQBI.10	L				4
QBBI.B32	R						QBBI.10	L				L
QBQI.32	R						QBQI.10	L				4
QQBI.32	R						QQBL9	L				4
QBBI.A33	R						QBBI.9	L				Į.
QBBI.B33	R						QBQI.9	L				ſ.
QBQ1.33	R						QQBI.8	L				1
QQBI.33	R						QBBI.8	L				4
QBBI.A34	R						QBQI.8	L				4
QBBI.B34	R						QQDI.7	L				ſ
OB0134	IR I								L act II	ndate:	22-1	a.

1.2 2.3 3.4 4.5 5.6 6.7 7.8 8.1

3R 4R 5R 6R 7R 8R

1R 2R

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Last Update: 22-Jan

1-2 2-3 3-4 4-5 5-6 6-7 7-8 8-1

4L 5L 6L 7L 8L 1L

2L

QQBI.34 L

QBBI.B34 L QBBI.A34 L QBQI.34 I QQBI.33 | QBBI.B33 | QBBI.A33

QBQI.33

QQBI.32 |

QBBI.B32 L QBBI.A32 L

QBQI.32 L

QQBI.31

QQBI.22 L QBBI.B22 L

QBBI.A22 L

3L