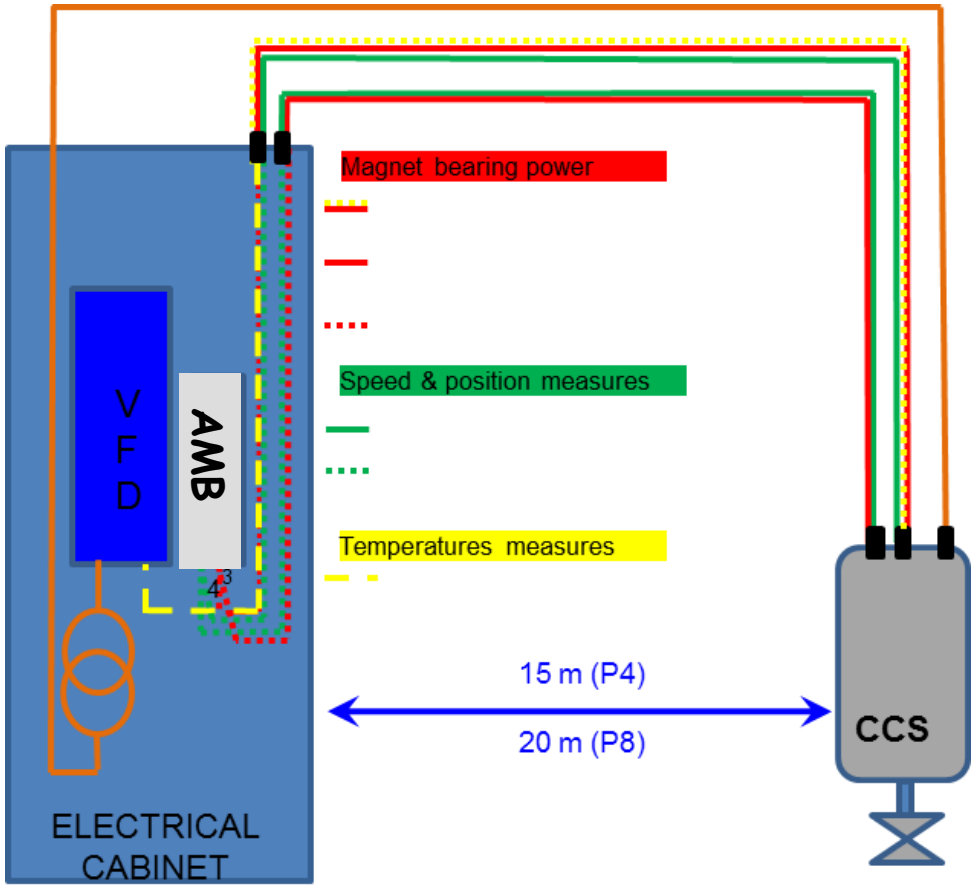
R2E for LHC cold compressor equipments.

M. Pezzetti, Bert Ivens
TE/CRG/CE

CCS configuration principles



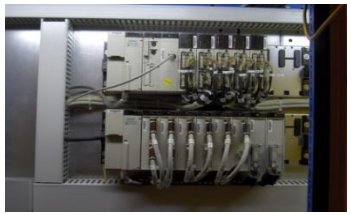
- No radiation tolerant.
-20 m limitation distance between compressors and AMB electronic.

Radiation sensitivity

Expected devices sensitivity based on **experience**.....

CCS cryo Control cabinets

Active Magnetic
Bearing controllers & PLCs (Schneider)



- Electro-pneumatic valves positioners
- PROFIBUS DP/PA couplers and links

I/O card (Schneider)

Electrical devices

R2E: P8 Main modifications and phases

		PLC's	Magnetic Bearings	Valve Positioners
QURCa	UX85	Yes	Yes	Yes
QUI	UX85	Yes	-	Yes
			Jul'08	2009
			Ph 1	Ph 2
QURA	US85	Yes	-	-
QURCb	US85	Yes	Yes	Yes
				Ph 3
				2011

Strategy considered for this case:

- Radiation monitoring system in UX85 and US85 to assess real situation w.r.t hypothesis
- We take reasonable precautions where we know there will be a problem

Linde QURC @ UX45

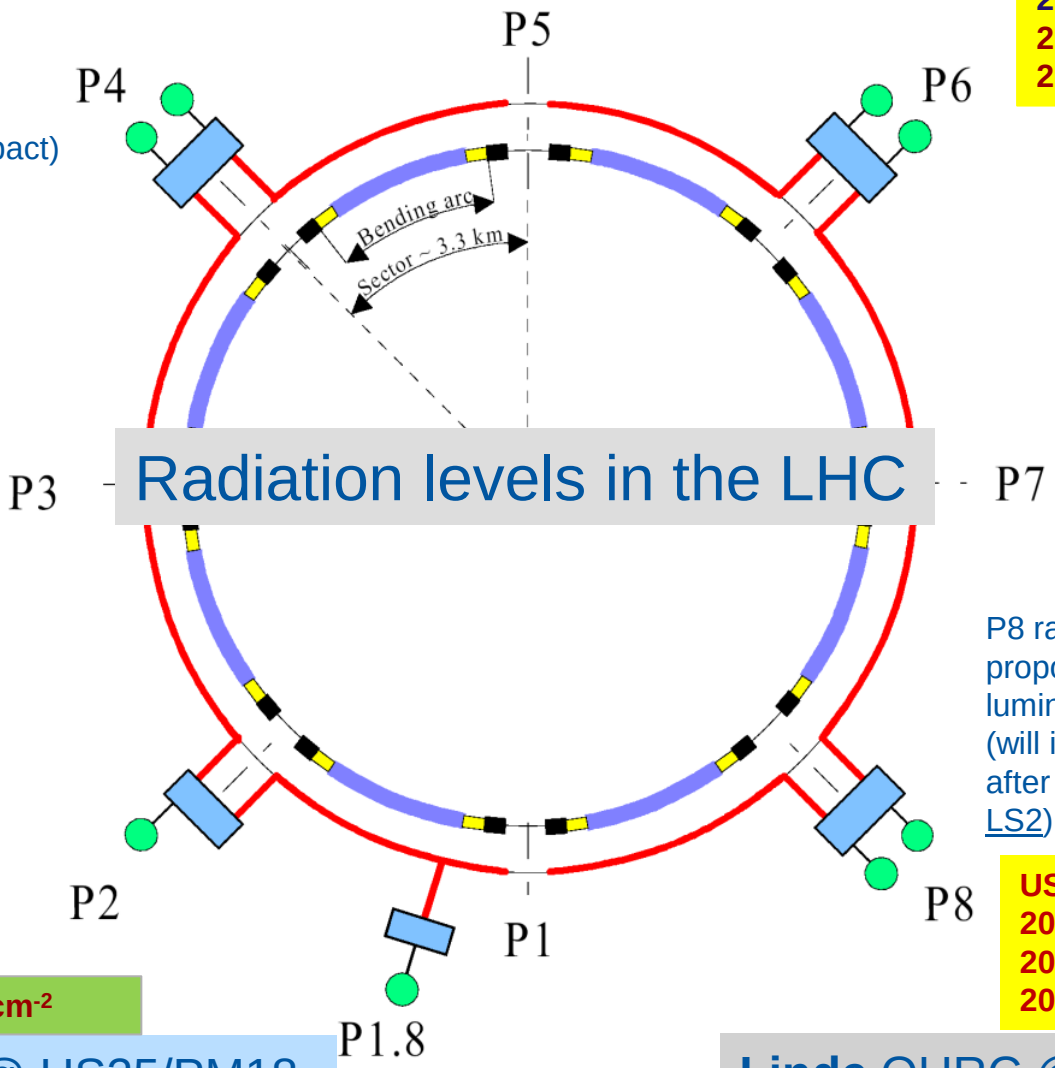
UX45 Radiation level
2011: 2.6×10^6
2012: 1.4×10^7 ncm^{-2}
2015: 2×10^8 ncm^{-2}

(depending on overall 25ns impact)

P4/6 radiation levels are due to beam-residual gas interaction.

Air Liquide QURC @ UX65

UX65 Radiation level
2011: N/A
2012: 1×10^6 ncm^{-2}
2015: $<1 \times 10^7$ ncm^{-2}



Radiation levels in the LHC

P8 radiation is directly proportional to the cumulated luminosity.
(will increase by a factor of few after LHCb upgrade, not before LS2)

US85 Radiation level
2011: 4×10^7
2012: 8×10^7 ncm^{-2}
2015: 8×10^8 ncm^{-2}

Low radiation level $<1 \times 10^3$ ncm^{-2}

Air Liquide QURC @ US25/PM18

Linde QURC @ UL84/US85

P4 R2E Mitigation action planning

H4IRRAD test for AMB cross section sensitivity	December 2012
AMB failure analysis (P4 critical for LHC 2015 physic run!!)	January 2013
TE-TM presentation / recommandations. Full P4 Relocation (200 KCHF). P6-P8 divided into Phase I (2014- cabling) and Phase II (relocation in any Chrismast break). (75 KCHF)	09 April 2013
ECR & DIC preparation	May 2013
DIC validated by EN/EL	June 2013
“New AMB” delivered at CERN by MECOS® (up to 80 meters distance limitation)	January 2014
EN/EL Cabling in P4	March 2014
EN/EL Cabling in P6-P8	Sept / Nov 2014
TE/CRG Cabinet relocation	March/April 2014
TE/CRG Commissioning	April/May 2014

R2E P4 status

What? **Cryo cabinet relocation** (Cable length +/- 50m)

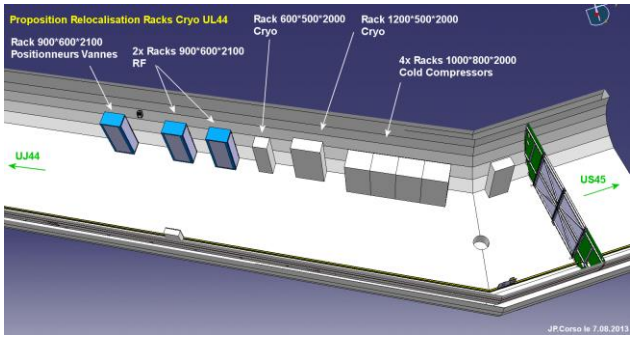
[US45 - level 2] QURA	**[~20 SIPART positioner (?)]**
[UX45 – level 2] QURC	**[8 cabinet QURC (AMB, Drive, local PLC & 45 SIPART positioner (?)]**
[US45 - level 1] QUI	**[1 cabinet (PROFIBUS & 20 SIPART positioner)]**
[UX45 – level 1] QURC	**[2 cabinet (PLC, EH Power controller & PROFIBUS)]**
[UX45 – level 0] Cryo RF	**[4 cabinet (PROFIBUS & EH Power controller)]**

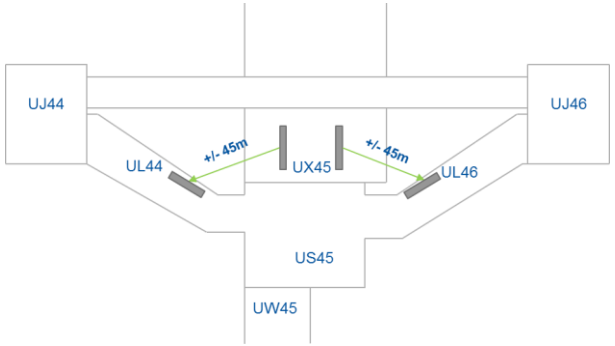
Where? From UX45 (L2) to UL44/46 (see pictures below)

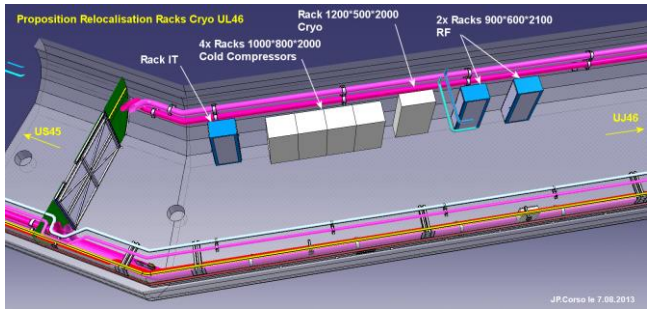
When? **March 2014 – May 2014**

How?

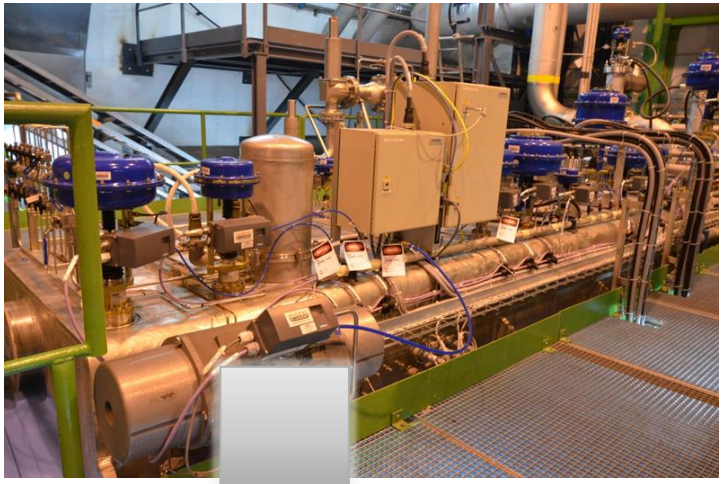
Uls space reservation	(ICL committee) ✓
TE/CRG cabling manufacturing	(50 KCHF – 2013 budget) ✓
New AMB MECOS electronics	(150 KCHF – 2013 & mainly 2014) ✓
EN/EL cabling	(in progress, 2014 budget) ✓
new SIPART	Ph1 cabling (35 KCHF 2014)- Ph2 installation (215 KCHF 2015 or later) ✓
Commissioning	(35K CHF – 2014 budget) ✓

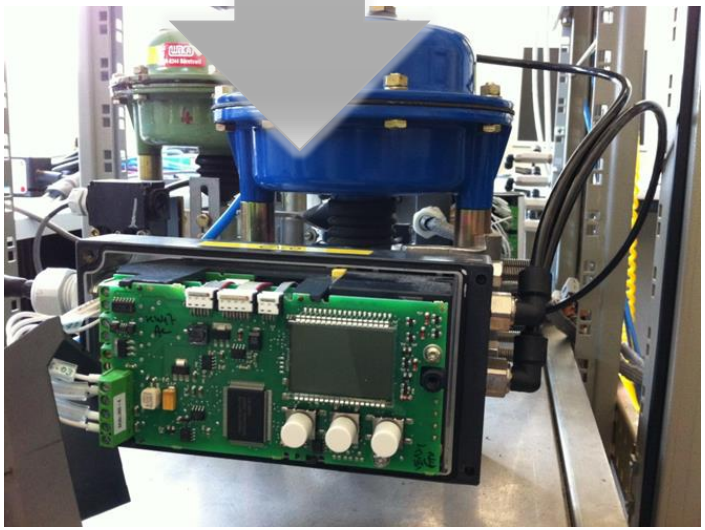






P4 SEU Mitigation for valve positionner controller



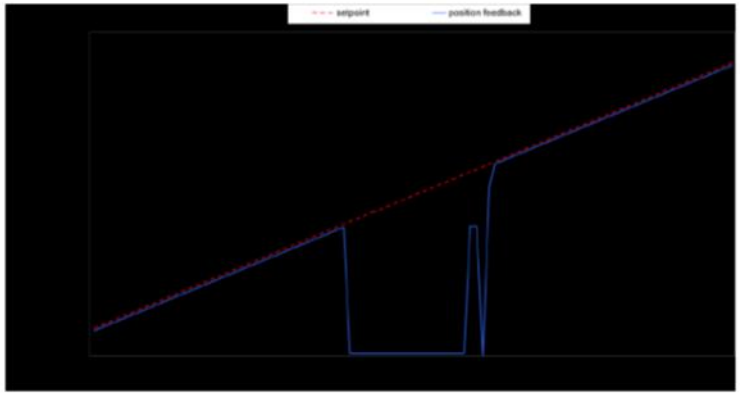


Cross Section estimation

From LHCperC 4-SEPT-2008 (R. Bailey)

In 2000, it was not possible to measure exactly the hadron flux in the SPS test area. The Radmon system did not exist and the RP ionization chambers saturated at each SPS extraction. To estimate the SEE cross section, I used the experimental Radmon data from 2003 and scaling down the intensity on the T6 target. This gives a **SEE cross section of 2.4E-8 cm² per device for drop outs events.**

Example of a typical drop out event :



b./ Hadron fluence in the first year of LHC operation UX85 beam level and 1m from floor UX85

Conclusion

AMB failure cross-section measured at H4IRRAD in agreement with LHC operational experience.

→New SEU mitigation action required for the P4 AMB equipment.

R&D in progress for new electronic without 20 m cabling limitation. → no showstopper

→ Sipart positioner relocation action required as in P8??

Alternative plan for Sipart positioner if SEU rate are higher than excepted during 2015/2016 operation : implementation of Phases 1 (cabling) during LS1 and Phases 2 (during a Christmas stop.

end

R2E P4 budget status (budget code 99547)

TE/CRG cabling manufacturing	50 KCHF – 2013 budget
New AMB MECOS electronics (R&D + prod.)	30 KCHF 2013 & 120 KCHF 2014
EN/EL cabling	in progress, 2014 budget
new SIPART	Ph1 cabling (35 KCHF 2014)- Ph2 installation (215 KCHF 2015 or later)
AMB Commissioning	35K CHF – 2014 budget
Others	20 KCHF
TOTAL	**~300 KCHF or (with SIPART ~550KCHF)**