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Point 1 – Equipment inventory

Abstract

This document describes the equipments installed in the area UJ14 UJ16, RR13, and RR17. The collected information will be used for the preparation of relocation studies of these LHC critical areas.

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History of Changes

Rev. No.	***Date***	***Pages***	***Description of Changes***

Contents

1. LAYOUT & RACK LOCATIONS

the following figures indicate the exact location of the racks listed in the previous table:

MISSING

2. TIMING AND REMOTE RESET [R. CHERY, C. DEHAVAY]

The timing and the remote reset systems are installed in the racks CYTIM01 and CYFRE01 at US15. They manage the timing and the remote reset distribution for the front-end controls. Most of the users are summarized in Fig. 1. A failure of the system creates a lack of the timing distribution for the equipments related to the beam control. Therefore, the beam must be dumped. The equipment is based on commercial devices and radiation tests were not performed. The racks for the remote reset can be relocated and the equipment owner is currently working on the specifications for that. Since this system is located in US 15, it should not be affected by radiation. However, it is taken into account for this review since some users are placed in the areas UJ14/16 that can be potentially critical.

CFP-US15-CRR1						
SOURCE RACK	Nb de câbles	DESTINATION RACK	RESET SYSTEM	TIME	OUT	No Câble
US15 CYFRE01	1	US15 VY13	PLCVACLHCUS15	5	1	1110830
US15 CYFRE01	1	US15 GYPOS01	Reserve for SURVEY	5	2	1110831
US15 CYFRE01	1	US15 GYPOS02	Reserve for SURVEY	5	3	1110832
US15 CYFRE01	1	UJ16 CYCIP01	CFP-UJ16-CIPXR1	5	4	1115431
US15 CYFRE01	1	UJ16 CYCIP01	CFP-UJ16-CIPLR1	5	5	1115432
US15 CYFRE01	1	UJ16 CYCIP01	CFP-UJ16-CIPAR1	5	6	1115433
US15 CYFRE01	1	UJ14 CYCIP01	CFP-UJ14-CIPLL1	5	7	1110833
US15 CYFRE01	1	UJ14 CYCIP01	CFP-UJ14-CIPAL1	5	8	1110834
US15 CYFRE01	1	UJ14 CYCIP01	CFP-UJ14-CIPXL1	5	9	1110835
US15 CYFRE01	1	UPS14 GYPOS01	Reserve for SURVEY	5	10	1110836
US15 CYFRE01	1	UPS16 GYPOS01	Reserve for SURVEY	5	11	1115434
US15 CYFRE01	1	UJ14 RYCA01	CFC-UJ14-RCAL3	1	12	1119046
US15 CYFRE01	1	UJ16 RYCA01	CFC-UJ16-RCAL4	1	13	1119047
US15 CYFRE01	1	UJ16 QYC01	CRYO_PA_LSS1R	5	14	1120543
US15 CYFRE01	1	UJ16 QYC01	CRYO_ET_LSS1R	5	15	1120544
US15 CYFRE01	1	UJ16 QYC01	CRYO_PA_LSS1R_QUI	5	16	1120545
US15 CYFRE01	1	UJ16 QYC01	CRYO_ET_LSS1R_QUI	5	17	1120546
US15 CYFRE01	1	UJ14 QYC01	CRYO_PA_LSS1L	5	18	1120547
US15 CYFRE01	1	UJ14 QYC01	CRYO_ET_LSS1L	5	19	1120548
US15 CYFRE01	1	UJ14 QYC01	CRYO_PA_LSS1L_QUI	5	20	1120549
US15 CYFRE01	1	UJ14 QYC01	CRYO_ET_LSS1L_QUI	5	21	1120550
US15 CYFRE01	1	UJ16 TYCFL01	MDC-2-WT-004	5	22	1124319
US15 CYFRE01	1	UJ16 TYCFL01	MDC-1-NT-002	5	23	1124320
US15 CYFRE01	1	UJ14 TYCFL01	MDC-1-NT-001	5	24	1123996
US15 CYFRE01	1	UJ14 TYCFL01	MDC-2-WT-003	5	25	1123997
US15 CYFRE01	1	US15 EYC01/15A	EFELUSA15-1	5	26	1120032
US15 CYFRE01	1	US15 EYC01/15A	EFELUSA15-2	5	27	1120033
US15 CYFRE01	1	US15 EYC01/15	EFELUS15	5	28	1107326
US15 CYFRE01	1	US15 MYWIC01	CFP-US151-CIWLR1	5	29	1125227
					30	
					31	
					32	
TOTAL	29					

Figure 1. Remote reset users

2.1 MISSING INFORMATION

The equipment was listed by checking the plan of the area. Verify that the list is complete.
Point out the difference between the timing and the remoter reset users
Type and number of cables for timing and remote reset.
Type of power line.

3. WORLDFIP EQUIPMENT [J. PALLUEL]

WorldFIP equipment is installed on the trays for cables in UJ14 UJ16, RR13, and RR17 (Table 1). There are FipDiag and Cu/Cu (Copper copper) repeaters. The AC 220 V power supply is required and the repeaters normally use the UPS. In case of failure of the WorldFIp repeaters, the next user agent cannot respond anymore. Therefore, the impact on the machine safety and operation depends on the criticality of the users that are specified in Table 1. In case of failure of the FipDiag, the proper working of the network cannot be checked.

Radiation tests were performed on the repeaters. A ^{60}Co source at CEA (Centre d'Energie Atomique) was used to irradiate the device under test (1MB/s) which stood up to 300 Gy. No major failure was observed. Two repeaters (2.5 MB/s) were tested by using a 60 MeV proton beam at Louvain. The samples received a total dose of 215 and 500 Gy respectively. The hadron fluence is not specified. The repeaters are under test in the CNGS radiation facility. According to the preliminary results, a repeater failed at a total dose of about 160 Gy when the hadrons fluence (> 20 MeV) and the neutron fluence (1 MeV_{eq}) were about of 1.1 x 10^{12} cm^{-2} and 1.7 x 10^{12} cm^{-2} respectively. Single Event Upsets were not observed till the device failed. A second repeater was tested and did not show any failure up to a total dose of 250 Gy.

1 and 2 VE2R cables are needed for each FipDiag and each repeater respectively. The relocation can be done and the maximum distance varies from 500m to 1000m depending on the system.

Performed radiation tests suggest that the relocation is not required from the UJ14/16 RR13/17, a conclusion to be confirmed by the RadWG.

Area	Equip.	Rack	User	Power	Rem. Com.	Failure	Relocation
UJ16	2 Fipdiag	On cables tray	Cryo	230 V POWERED BY EOK113/16	Fip 1Mb/s	-	500 m 1 VE2R cable for fipdiag
UJ14 UJ16	2 Fipdiag	On cables tray	Power Converter	230 V EOK105/14 and EOK113/16	Fip 2.5Mb/s	-	1000 m 1 VE2R cable for fipdiag
UJ14 UJ16	2 Cu/Cu repeater	On cables tray	Radmon	UPS, 230V EOK105/14 and EOK113/16	Fip 1 Mb/s	No bus for next user	500 m 2 VE2R cable for repeater
RR13 RR17	Repeater	On cables tray	Radmon	UPS 230V	Fip 1 Mb/s	No bus for next user	500 m 2 VE2R cable for repeater
RR13 RR17	Fipdiag		Cryo	230V	Fip 1Mb/s	-	500 m 1 VE2R cable for fipdiag
RR13 RR17	Fipdiag	On cables tray	Power Converter	230 V	Fip 2.5Mb/s	-	1000 m 1 VE2R cable for fipdiag

RR13 RR17	Fipdiag	On cables tray	QPS	230 V	Fip 1.0 Mb/s	-	1000 m 1 VE2R cable for fipdiag

Table 1. WorldFip equipment.

3.1 MISSING INFORMATION

Verify that the equipment list is complete.
Do you have references/documents for the radiation tests carried out at CEA and Louvain?
Document summarizing the CNGS test results

4. POWER INTERLOCK CONTROLLER (PIC) [M. ZERLAUTH, B. TODD]

The Power Interlock Controller (PIC) is located in the rack CYCIP01 at level 0 of UJ14, UJ16, RR13 and RR17. The control system is based on the *PLC* from *Siemens* (installed at UJ14 and UJ16) and remote IOs (installed in the RR13 and RR17) based on ANYBUS cards and XILINX CPLD 95144 (5 V type). It requires an UPS supply and its remote communication relies on the Ethernet connection for the PLC and ProfiBus for connecting the remote IOs with the PLC in UJ14 and UJ16.

The main users are the LHC power converters, the Quench protection system and the Beam Interlock system for the transmission of the beam dump requests, whereas additional signals are transmitted via HW links (or direct PLC-PLC links) for the transmission of cryogenic conditions and the status of UPS systems and the AUG to the PIC. Following a failure of the PIC system, the beam must be dumped.

Radiation tests have been performed at Louvain on the ANYBUS modules. A 60 MeV proton beam with a flux ranging form 0.1 x 10^8 to 5 x 10^8 *protons/(cm^2·sec)* has been used. Two ANYBUS cards have been irradiated for a time period of about 75 minutes each, the first one up to a total dose of 125 Gy and a second one achieving a total dose of 326 Gy. No major degradation of the supplied output current for an active state of the output could be observed for either of the two irradiated boards. According to the irradiation time and considering the maximum flux of 5x10^8 *protons/(cm^2·sec)*, the fluence reached the value of 2.0x10^{12} *protons/cm^2*.
Radiation tests at CNGS showed promising results. The system uses CPLDs with a very small cross-section and they fail in a safe way. The Mean Time Beetwen Failure (MTBF) is about 7 years.

The relocation of the control equipment (PLC part of the system) is possible up to few 100s meters (limit of the PROFIBUS). The study has been done for the area UJ56, UJ14, and UJ16 and the actual relocation could be done in 1 day (cables have already been ordered and new rack space allocated). For the remote I/O, the relocation is more difficult because it also involves the extension/relocation of tens of cables per system, connecting the QPS and Power converter systems.

It is suggested to relocate only the PLC equipment.

4.1 MISSING INFORMATION

Verify that the equipment list is complete.
Number and type of cables.
Do you have any references/documents for the radiation tests?

5. BEAM POSITION MONITOR [E. GIRALDO CALVO, J. L. GONZALES]

The Beam Position Monitor electronics is placed in the rack BY01 at level 0 of UJ14 and UJ16 and in the racks BY01, BY02, BY03, BY04, BY05, BY06 at level 1 of RR13 and RR17. The BPM system has 1 power supply card (linear regulation with hard-radiation voltage regulator), 1 microfip card (old version): digital card: ASICs + antifuse FPGA), 1 intensity card: analogue card (BJT transistors + amplifiers + logic gates); 4 WBTN cards: analogue card (comparators, BJT transistors, amplifiers and logic gates). The system uses the UPS power supply. The consumption of each rack depends on the number of crates installed on each.

Some crate settings like the sensitivity, and some controls for calibrating are received through the WorldFIP bus (32 kbit/s). The FIP gateways are placed at surface on the corresponding CYF racks.

Generally, each crate is the read out for 2 Beam Position Monitor. As far as only 1 crate or (even a few consecutive) fail (and depending of the type of failure) the orbit system will lose some channels, but will continue working. There are no consequences from the point of view of safety.

The WBTNs cards where tested in TTC2 in 2001. They worked till the end of the test where the accumulated dose was of ~875Gy with no significant deterioration. The microfip card was tested in PSI up to 9.8e11p/cm^2 (~400Gy) where it stopped working. The acquisition/monitoring system was too slow for monitoring the SEE, but the functionality in general was not compromised. Tests were carried out at CNGS too. The WTBN cards and the power supply did not show any degradation. The intensity card suffered a serious problem that makes it not operative with a fluence relatively of low 3×10^{10} 1MeV eq n/cm^2 and 2×10^{10} h/cm2(>20MeV). Further studies should be done on this card to find out a solution that could be implemented in future shutdowns.6 SEE over a fluence of 2×10^{12} 1Mev eq. n/cm^2 (3 of them took 1 min. in recover) were registered over the FIP. This means 0.5 SEE/ year·card, 5.2×10^{-6} SEE/s,that is 1 SEE/53h.

FIP is used only for sending the sensitivity settings of the WBTNs, launch calibrations, or monitoring the power supplies. All the errors seen consisted in return to a default state (calibration switched off, and high sensitivity). Then, the worst consequence is that 1 channel measures a high intensity beam with high sensitivity: 1 BPM channel will have for a few seconds (up to 1 minute) an offset of ~250µm. This effect is detected and can be compensated by the beam orbit feedback, which can also mask this BPM channel temporary.

The main users of the BPM are the operators for calculating the beam orbit. 2 redundant crates (x2 beams) will be used for the interlock system. This field bus and the general service of 220V are the only required for the system to work.

The maximum distance for relocation should be about some tens of meters of the beam position monitor itself. The longer the cable bringing the signals from the monitor, the worse the performance of the measure is, thus actually the reason why most of the electronics are right below the quads.

The cables are: the CMC 50-Ohm cables which should have exactly the same electrical length (<10ps) per groups of 4 and that requires many precise measures; 1 optical fiber per BPM plane (12 fibers per BPMD, and 8 BYPLM, and 6 per BPM); 1 or 2 microfip drops; 220V UPS.

According to the radiation results, the relocation can be avoided. In fact, the intensity card that failed at CNGS is used only for controlling the injection phase. The card will be analyzed to see which component failed and find out a possible solution. If the upgrade of the card will result extremely complicated, the relocation could be considered.

5.1 MISSING INFORMATION

The equipment was listed by checking the plan of the area. Verify that the list is complete.
Confirm that the equipment can stay as is.
Do you have any reports/documents for the TCC2 tests?

6. CURRENT LEAD HEATERS [S. LE NAOUR]

The equipment control of the current lead heater is installed in the rack DYXA01 and DYXB01, at level 0 of UJ14 and UJ16 respectively, and in the racks DYAA01; DYAB01 at first level of RR13, and RR57, respectively. They provide the temperature regulation of the top part of current leads. There are 28 regulators and 28 solid state relays in UJ14 and UJ16, and 56 regulators and 56 relays for each RRs area. They are based on commercial electronics that act on the basis of the feedback signal of the temperature sensors installed on the leads.

The power supply is a 230 V AC. There is no remote communication. If the regulator or relay is down, no heating of the top part of the current lead is provided. If the temperature of the top part of the current lead is below a threshold (set to 280°C and controlled by the Cryogenic supervision system), the LHC power converter cannot start. In case of failure, the resistive part of the current lead could freeze if the current circulating in the circuit is low (current at injection level or no current). Therefore, a problem comes up only at the restarting of the machine. The alarm in case of malfunctioning is provided by the cryogenic control system.

Radiation tests were already carried out at CNGS in 2008 and 2009. One burnout at $1.3 \times 10^{10} cm^{-2}$ for Neutron 1MeV equivalent ($0.6 \times 10^{10} cm^{-2}$ for hadrons with energy >

20 MeV) and 1 SEU at 3.2^{10} cm^{-2} for Neutron 1MeV (1x10^{10}cm^{-2} for hadrons with energy > 20 MeV))equivalent were observed.

It is suggested to relocate the system or allow for a functional modification so that it can remain in place (*e.g.*, ELMB-like solution, reset or similar).

6.1 MISSING INFORMATION

Verify that the list is complete.

7. BEAM LOSS MONITOR [B. DEHNING, E. EFFINGER]

The beam loss monitor equipment is located at RR13/17. The equipment, made of custom electronics, aims at monitoring the beam losses. In case of failure the tuning of the machine is not possible and the beam must be dumped. The electronic parts were tested and the system is considered radiation tolerant.
On this basis, the equipment can stay as is.

7.1 MISSING INFORMATION

Confirm that no relocation is required
If relocation is required, please, provide a more detailed description of the system (rack name and location), the power needs, the remote bus and the type and the number of the cables.

8. COLLIMATOR CONTROL EQUIPMENT [A. MASI]

The collimator low-level control racks are the TYCFL01, located at level 0 of UJ14 and UJ16 areas. The equipment consists of a National Instrument PXI equipped with ADC, DAC and FPGA cards, power Supply Custom electronics for excitation of LVDTs and resolvers (power buffer) and I/O modules compact RIO. The system requires AC 230V power supply, 2KW, and an AC 230V UPS power supply (800W). The remote communication is based on the Ethernet protocol. In case of failure, the beam must be dumped.

The system depends on the Beam Interlock System (CIBU in TYCFL01) Timing (Timing crate in Rack TYCCR01) and Remote Reset (from CYFRE01 rack).

A full collimator control system has been tested in the CERF facility. The entire control electronic received a high-energy hadrons fluence of about 1-2x10^{7}cm^{-2} and no SEU have been observed during the irradiation.

The system can be relocated up to a distance of 200 m because of the cable length limitation for sensor and stepper motor driver. The cables are NE48 for sensors (12 cables: 1514028, 1514029, 1514031, 1514032, 1514033, 1514035, 1514036, 1514037, 1514039, 1514040, 1514041, 1514043), NH48 for Motors (4 Cables: 1514044, 1514045, 1514046, 1514047), CB50 for remote Reset (2 Cables: 1516215, 1516216).

It is recommended to relocate the system because it is critical in terms of LHC operation safety.

8.1 MISSING INFORMATION

The equipment was listed by checking the plan of the area. Verify that the list is complete.
Where is it placed the beam interlock rack on which you depend? In TYCFL01? Is it the user interface part?
Verify the cabling information. They were derived from the information given at point 5, UJ56.

9. POWER CONVERTER [Y. THUREL]

The location and the rack names of the power converters are resumed in Table 2.

Location	Rack
UJ14 UJ16 Level 0	RYLB01 (LHC120A/10V), RYLC01 (LHC120A/10V), RYMCB01 (LHC600A/10V), RYMCB02 (LHC600A/10V), RYMCB03 (LHC600A/10V), RYMCB04 (LHC600A/10V), RYSA01 (Spares parts), RYSA02 (Spares parts), RYSA03 (Broken modules), RYSC01 (Powered spares), RYCA01 (DCCT calibration rack), RYCA02 (DCCT calibration rack), RYHF01 (RQX LHC8kA/8V), RYHG01 (RQTX2 LHC6kA/8V), RYMCB01 (RTQX1 LHC600A/10V IT)
RR13 and RR17; ground floor	RYHG01 (LHC6kA/8V), RYHG02 (LHC6kA/8V), RYHG03 (LHC6kA/8V), RYHG04 (LHC6kA/8V), RYHG05 (LHC6kA/8V), RYHG06 (LHC6kA/8V), RYHG07 (LHC6kA/8V), RYHG08 (LHC6kA/8V), RYHG09 (LHC6kA/8V), RYHG10 (LHC6kA/8V), RYHG11 (LHC6kA/8V), RYSA03(Powered spares), RYLC01 (LHC120A/10V), RYLB01(LHC120A/10V)
RR13 and RR17; 1st floor	RYLB04 (LHC120A/10V), RYLB03 (LHC120A/10V), RYLB02 (LHC120A/10V), RYMCB03 (LHC600A/10V), RYMCB02 (LHC600A/10V), RYMCB01 (LHC600A/10V), RYMCA02 (LHC600A/10V), RYMCA03 (LHC600A/10V), RYMCA01 (LHC600A/10V), RYMCA04 (LHC600A/10V), RYSA01 (Spares parts), RYSC01 (Powered spares), RYSA02 (Spares parts).

Table 2. Power converter equipment.

Generally, they contain the voltage source and the related Function Generator Controller, FGC, (communication module, processor module, I/O module, memory modules) with the associated DCCT (current sensor) conditioning electronics. In particular, the RYCA01 and RYCA02 are calibration racks. The systems require the 230 VAC and the UPS. The remote communication is based on the WorldFip bus (2.5 Mbit/s).

The failure of the power converters will cause the beam loss since the magnets are not supplied correctly and no redundancy is implemented. In case of failure, the power converter sends a signal to the interlock system (*Powering failure*). Viceversa, the action of the power converters can be disabled by the Interlock system (*PC_permit* and *PC_FastAbort* signals) on the basis of other alarms. The WorldFip for communication and control of the power converter, the AC Network (normal + UPS), the water cooling (LHC600A/10V, LHC4-6-8kA/8V) and the PIC systems are required to allow for proper working of the power converter system.

The different type of FGCs (generic FGC, PSU FGC, and FGC DOC) use components like mosfet, memory, CPLD, that are known to be sensitive to radiations. Error mitigation is foreseen at software level for the generic FGC. Some parts are under test at CNGS facility.

As far as the relocation is concerned, the limiting factor is the cable resistance (the maximum output voltage of the power converter is 8 or 10V). More details concerning impact of failure, as well as mitigation constraints can be found in a dedicated summary summary document. [REF see link: http://r2e.web.cern.ch/R2E/Related/RadiationTesting/SummaryPCs_24june09_v4.pdf] as well as in the talks of the power-converter review (see link: http://indico.cern.ch/event/PowerConverterDay_2010) .

Owing to the dimensions of the equipments, a complete relocation is considered as very difficult without new civil engineering actions. Thus also other options (radiatio tolerant design, superconducting links) are considered in parallel.

A decision will be taken on the basis of the review.

9.1 MISSING INFORMATION

10. CRYOGENICS INSTRUMENTATION AND ELECTRONICS (FIP BUS) [G. PENACOBA]

The racks for the cryogenics control are located at UJ14 and UJ16 at level 0 (QYC01 and QYC02) and at RR13 RR17 at first floor (QYC01, QYC02, and QYC03). They have custom made cryogenic instrumentation with the following electronics: 1) Conditioners, measuring temperature, pressure, liquid helium level and digital valves status 2) Actuators, providing AC and DC power.

In case of failure, the LHC cryogenics operations are affected; misbehaviors on the interlocks signals are also possible.

The system requires the UPS power supply (~10 A), the WorldFIP bus at 1 Mb/s, the ethernet networks, and PLC and PVSS servers.

Radiation tests on the custom electronics have been done at CNGS and the results are resumed in Table 3.

On the basis of these results, the system can stay as is.

Card Type	**# Cards**
CT, CL, CV, MMW, CK, CJ, PA	42
CY	11
CH *	2

CNGS_09 tests: CT, CL, CV, MMW, CK, CJ, PA			
No Failures detected until	**TID (Gy)**	**NIEL (n/cm2)**	**>20MeV (p/cm2)**
	360	5.05E+12	2.62E+12
with safety factor 2	**180**	**2.53E+12**	**1.31E+12**

CNGS_09 tests: CY			
Failures detected at	**TID (Gy)**	**NIEL (n/cm2)**	**SEU cross section (cm-2)**
	126	1.77E+12	2.24E-09
with safety factor 2	**63**	**8.83E+11**	**4.47E-09**
CNGS_09 tests: CH *			
Failures detected at	**TID (Gy)**	**NIEL (n/cm2)**	-
	5	7.11E+10	-
with safety factor 2	**3**	**3.55E+10**	-

Table 3. Radiation tests for the cryogenic instrumentation * CH cards are not needed for normal machine operation; needed only during cooling-down phase.

10.1 MISSING INFORMATION

Verify that the equipment list is complete.
Please, confirm that the relocation can be avoided.

11. CRYOGENICS INSTRUMENTATION (PROFI BUS) [P. GOMES, M. PEZZETTI]

The racks for the cryogenics instrumentation on PROFI bus are located in the racks QYC01 QYC02 QYC03. The racks contain valve positioners, remote I/O modules, and actuators. In case of failure, no inputs are given to the cryogenic control system and, consequently, a beam dump can be triggered.

Since the electronic parts of the system are supposed to be sensitive to radiations, it is suggested to relocate the equipment.

11.1 MISSING INFORMATION

Please, provide a more complete description of the system.
Do you have PLC too?
Could you better clarify the location of your equipment? Is it in the same rack as the cryogenics instrumentation on FIP bus (see par. 13)?
Which systems does your equipment need to work (power, ethernet?)?
Please, specify the number and the type of cables required by your equipment.

12. QUENCH PROTECTION SYSTEM AND ENERGY EXTRACTION [R. DENZ]

The equipment for the Quench protection system is installed in the racks DYPG01 and DYPG02, at UJ14 and UJ16, level 0, and in the racks DYPI01(13 kA Interface Module Rack for Energy Extraction Switches), DYPG01-03 (General Quench Protection), DYPE01-04 (600 A energy extraction), at level 1 of RR13 and RR17. The rack DQSB01 contains the energy extraction switches. The WorldFip bus provides the remote communication.

A failure of this equipment will prohibit the re-powering; a fast power abort sequence could be triggered; in rare cases, the protection for the magnets is not assured.

Most of the electronics has been tested or is under test
.
A redesign of the weak parts is under investigation. Alternatively, the digital parts of the system could be relocated.
(Infomation was derived from the LHC layout database).

12.1 MISSING INFORMATION

verify statement on impact on magnet protection
Verify that the equipment list is complete.
please provide the conclusions of the radiation tests
Please, provide a more complete description of the system.
In case of relocation, specify the number and the type of cables required by your equipment.

13. FIRE DETECTORS AND ODH [S. GRAU, R. NUNES]

The fire detectors are installed on the wall against the tunnel in the area RR13 and RR17. The common equipment name is SFDEI-xxxx. Cables are needed to link the detectors to the central control system which provides the power supply as well. The communication is based on the Ethernet bus.

The users of the system are the operators, the XCR and the Fire brigade. In case of failure, a fire could not be detected in the RR areas. In case of relocation, testing is necessary to move the stuff in a more safe location, and a pipe must be installed (2-3 inch diameter) in order to bring the air sample to the detector that is located further away. The routing of the pipe could pose an integration problem.

The relocation of the system is recommended for safety issues.

13.1 MISSING INFORMATION

14. ELECTRICAL SUPPLY AND DISTRIBUTION [G. BURDET, M. CODOCEO]

The equipment is located in the rack ERD1/14 and ERD1/16 at levelo 0 of at UJ14 and UJ166, and in the rack ERD1/13, ERD1/17, EBD1/3, EBD 1/17, EOD1/13 and EOD1/17 at level 1 of RR13 and RR17.

- **EAD/EBD/ERD/ESD/EOD/EQD** They contain low voltage switchboards with fuses, bornes, switch breakers, which normally do not have electronics in their inside. Some of these racks contain voltage monitoring relays. We have not been able to find out which are the exact components in their inside. Anyhow, these relays do not realize any safety functions; they just enable our control system to detect the mains supply. In case they do not work properly our monitoring system will either have no alarm or a false alarm. We have as well monitoring equipment and displays (DIRIS) which do not realize any safety function, if they do not work properly our monitoring system would not get the right measurements of the switchboard and we would lose the supervision of the switchboards.

The 48 V system generator is based on a technology presenting tirystor and ondulators for the anti panic light. This technology will be studied to understand his behaviour in presence of radiation.
The relocation of the most critical racks should be done.

14.1 MISSING INFORMATION

The equipment was listed by checking the plan of the area. Verify that the list is complete.
Can the lost of monitoring (see **EAD/EBD/ERD/ESD/EOD/EQD**) be tolerated for long periods (~time between two technical shutdown)?

15. ACCESS SYSTEM GATES (R. NUNES)

The access system gates are located at UJ14 and UJ16. The system is PC based and is supposed to be sensitive to radiations.

In case of failure, false alarms can be generated and, consequently, the beam is stopped. Besides, a failure of the access gates can also delay the interventions in the tunnel.

On this basis, the system could be switched off during operation. The owner should check if that procedure can generate further drawbacks. In such a case, the system must be relocated. A respective procedure was proposed and is currently under way.

15.1 MISSING INFORMATION

Please provide information on: System description; list of the system required by your own system; power requirement; remote bus requirement. Type and number of cables for relocation. Alternatively, a survey can be filled on the web.
https://espace.cern.ch/info-r2e-documents/Lists/R2E%20Equipment%20Survey%20All%20Areas/overview.aspx
Is the procedure to switch off the access system prepared and set up -> please provide reference?

16. SUMMARY TABLES UJ14/16, RR13/17

Equipment	Rack	Radiation test	Failure consequences	Option	Priority	Contact

Electrical equipment	ERD1/14 ERD1/16	Not tested Control part supposed to be sensitive	Loss of power supply monitoring	Shielding Relocation of the digital control parts	1	A.Burdairon M. Codoceo
Collimation control	TYCFL01	CERF test ~10^7 h/cm^2	Beam dump	Relocation up to 200 m	1 (machine safety)	A Masi
Remote-Reset & Timing	CYTIM01 CYFRE01	Not tested Supposed very sensitive	Loss of timing Beam dump	Relocation Most of clients in safer areas such as USC(P5)	2 (many systems depend on it)	R. Chery
QPS and Energy Extraction	DYPG01 DYPG02	Tested at CNGS-2008	Prohibited re-powering Possible fast power abort sequence No protection for the magnets (rare)	Redesign, or Relocation of the digital parts	2 (machine protection, redundant)	R. Denz
Power Converter	RYLB01 (LHC120A/10V), RYLC01 (LHC120A/10V), RYMCB01 (LHC600A/10V), RYMCB02 (LHC600A/10V), RYMCB03 (LHC600A/10V), RYMCB04 (LHC600A/10V), RYSA01 (Spares parts), RYSA02 (Spares parts), RYSA03 (Broken modules), RYSC01 (Powered spares), RYCA01 (DCCT calibration rack), RYCA02 (DCCT calibration rack), RYHF01 (RQX LHC8kA/8V), RYHG01 (RQTX2 LHC6kA/8V), RYMCB01 (RTQX1 LHC600A/10V IT)	Tested at CNGS	Beam dump	Relocation with redesign (increase voltage) RadTol design SC link (feasibility)	2 (downtime)	Y. Thurel
Cryogenics Instrumentation and Electronics (PROFI bus)	QYC01 QYC02	Tested at TCC2 Sensitive	No input for Cryogenic system that could drive a beam dump	Relocation	2 (down time)	P. Gomes M. Pezzetti
Power Interlock	CYCIP01 (PLC)	sensitive	Beam dump Users: Power converters, QPS, BIC, Cryogenics, UPS, AUG	Relocate PLC (up to 100 m)	2 (machine safety but the system is redundant)	M. Zerlauth P. Dahlen
Current Leads Heaters	DYXA01 (UJ14) DYXB01 (UJ16)	Burn out at ~10^{10}h/cm^2	No heating of the top part of the current lead. Pose an issue only for the machine restart	Relocation	3 (beam down time)	A.Ballarino S. Le Naour
Access system gates		Not tested Supposed to be sensitive	Misbehave could generate alarms and stop of the machine Delay in the intervention	Relocation Switch the system off during operation (check if that can create other problems) and then relocation	3 (beam down time)	R. Nunes
Beam Position Monitors	BY01	Problem on the intensity card. Not an issue for operation	Possible degradation of the beam orbit reading	It can stay Possible redesign of the intensity card.	4	Eva Calvo Giraldo Jose Luis Gonzales
Cryogenics Instrumentation and Electronics (FIP bus)	QYC01 QYC02	Tested at CNGS	No input for Cryogenic system that could drive a beam dump	It can stay?		J.Bremen E. Gousiou G. Penacoba
WorldFip	Cable trays	Repeaters tested CNGS	Repeater: loss of the network for the next users FipDiag: Loss of the network diagnostic	It can stay Depend on the clients Power converter, Radmon, Experiment Survey, Cryogenics		J. Palluel D. Caretti

					QPS		

Table 4. Equipments in UJ14 and UJ16. The two areas present the same layout.

Equipment	Rack	Radiation test	Failure consequences	Option	Priority	Contact
Fire/ODH detectors	On the wall SYFDEI-xxxx	CNGS experience ~10^7 h/cm^2	No fire detection; if two more detectors are in fail mode, an evacuation is triggered	Relocation	1 (Safety issue)	R. Nunes S. Grau
Electrical equipment	ERD1/13, ERD1/17, EBD1/3, EBD 1/17, EOD1/13 and EOD1/17	Not tested Control part supposed to be sensitive	Loss of power supply monitoring	Shielding Relocation of the digital control parts	1	A.Burdairon M. Codoceo
QPS and Energy Extraction	DYPI01, DYPG01 DYPG02 DYPG03, DYPE01, DYPE02, DYPE03, DYPE04	Tested at CNGS-2008	Prohibited re-powering Possible fast power abort sequence No protection for the magnets (rare)	Redesign, or Relocation of the digital parts	2 (machine protection, redundant)	R. Denz
Power Converter	Level 0 : RYHG01 (LHC6kA/8V), RYHG02 (LHC6kA/8V), RYHG03 (LHC6kA/8V), RYHG04 (LHC6kA/8V), RYHG05 (LHC6kA/8V), RYHG06 (LHC6kA/8V), RYHG07 (LHC6kA/8V), RYHG08 (LHC6kA/8V), RYHG09 (LHC6kA/8V), RYHG10 (LHC6kA/8V), RYHG11 (LHC6kA/8V), RYSA03(Powered spares), RYLC01 (LHC120A/10V), RYLB01(LHC120A/10V) Level 1 : RYLB04 (LHC120A/10V), RYLB03 (LHC120A/10V),RYLB02 (LHC120A/10V),RYMCB03 (LHC600A/10V),RYMCB02 (LHC600A/10V),RYMCB01 (LHC600A/10V),RYMCA02 (LHC600A/10V),RYMCA03 (LHC600A/10V),RYMCA01 (LHC600A/10V),RYMCA04 (LHC600A/10V), RYSA01 (Spares parts), RYSC01 (Powered spares), RYSA02 (Spares parts).	Tested at CNGS	Beam dump	Relocation with redesign (increase voltage) RadTol design SC link (feasibility)	2 (downtime)	Y. Thurel
Cryogenics Instrumentation and Electronics (PROFI bus)	QYC01 QYC02 QYC03	Tested at TCC2 Sensitive	No input for Cryogenic system that could drive a beam dump	Relocation	2 (down time)	P. Gomes M. Pezzetti
Power Interlock (remote I/O)	CYCIP01 (Remote I/O)	Test on Anybus card at TCC2, 60 MeV protons CNGS facility; (but it can have Latchups)	Beam dump Users: Power converters, QPS, BIC, Cryogenics, UPS, AUG	Ok for RR (remote I/O)		M. Zerlauth P. Dahlen
Current Leads Heaters	DYAA01 (RR13) DYAB01 (RR17)	Burn out at ~10^{10}h/cm^2	No heating of the top part of the current lead. Pose an issue only for the machine restart	Relocation	3 (beam down time)	A.Ballarino S. Le Naour
Beam Position Monitors	BY01, BY02, BY03, BY04, BY05, BY06	Problem on the intensity card. Not an issue for operation	Possible degradation of the beam orbit reading	It can stay Possible redesign of the intensity card.	4	Eva Calvo Giraldo Jose Luis Gonzales
Beam loss monitor		tested	No machine tuning Beam dump	Stay as is	4	B. Dehning E. Effinger

Cryogenics Instrumentation and Electronics (FIP bus)	QYC01 QYC02 QYC01 QYC02 QYC03	Tested at CNGS	No input for Cryogenic system that could drive a beam dump	It can stay?		J.Bremen E. Gousiou G. Penacoba
WorldFip	Cable trays and walls	Repeaters tested CNGS	Repeater: loss of the network for the next users FipDiag: Loss of the network diagnostic	It can stay Depend on the clients Power converter, Radmon, Experiment Survey, Cryogenics QPS		J. Palluel D. Caretti

Table 5. Equipments in RR13 and RR17.