Equipment relocation: what can stay what has to be moved

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Outline

- Equipment review
  - Point 1(UJ14/16, UPS14/16, RR13/17)
  - Point 5 (UJ56, UPS54/56, RR53/57)
  - Point 8 (US85, UX85)
- Focus on the relocation option
- Open issues left

Equipment Review

Why:

- Evaluation of the risk due to exposure to radiation
  - Personnel and Machine safety (priority 1)
  - Long downtime (priority 2)
  - Beam quality degradation and acceptable downtime (priority 3)
  - Monitoring or no immediate impact on the machine (priority 4)
- Evaluation of the status of the equipment radiation hardness
- Investigate solutions to reduce risk

What:

- Focus on underground areas :

  US85, UX85, UJ56, RR53/57, UJ14/16, RR13/17, (partially US15, UPS14/16, UPS54/56, UW85, UJ23/87)
- Assess interdependencies between systems

How :

- Information from equipment owners via on-line survey

https://espace.cern.ch/info-r2e-documents/Lists/R2E%20Equipment%20Survey%20All%20Areas/AllItems.aspx

- Iteration process with the equipment owners

Equipment Review

- The priority is a conventional label
- The presentation is a summary
- Refer to the documents for the details

Fire, ODH

Owners: S. Grau, R. Nunes

Commercial Equipment

Failure: Loss of the fire and ODH control

- P1:
  - The fire and the ODH detectors are installed in UJ14 and UJ16, and on the wall against the tunnel in the area RR13 and RR17. In both cases, there is no central unit. The aspiration detectors will be moved while the ODH ones will remain in place.
- P5:
  - The control panel for the Fire detection of the machine and of the experimental area is located in the safe room at the ground level of UJ56. The system is based on a PLC-type device. The system will be relocated. It could be moved in the USC55 area.
  - The fire detectors are installed on the wall against the tunnel in the area UJ56 first floor, RR53 and RR57. The relocation of the aspiration detectors will be done while the ODH sensors will remain in place.
- P8:
  - The control system for the fire detection, as well as all detectors were already relocated to the UA areas. The ODH control system was relocated in UA87 too, with the respective detectors remaining at their current location.

Collimator control

Owners: A. Masi

Failure: Beam dump

- P1:
  - The collimator low-level control racks are the TYCFL01, located at level 0 of UJ14 and UJ16 areas. The system has to be relocated.
- P5:
  - The collimator low-level control racks are the TYCFL01 and TYCCR01, located at level 1 of UJ56 area. The system has to be relocated.

Remote reset and Timing

Owners: R. Chery, C. Dehavay

Commercial Electronic (PLC)

Failure: Loss of timing and then beam dump

- P1:
  - The timing and remote reset systems are installed in the racks CYTIM01 and CYFRE01 at US15. This area is considered as safe. Some equipment is also in the crate TYCFL01 for the collimator control in UJ14 and UJ16 and will be relocated.
  - 20 CB50 cables of the crate CYFRE01 will be moved according to the user's equipment relocation
- P5:
  - The timing and remote reset systems are installed in the racks CYTIM01 and CYFRE01 respectively, at UJ56 level 1 and manage the timing and the remote reset distribution for the front-end controls. Some equipment is also installed in the collimation rack TYCCR01. It will be relocated.
- P8:
  - The timing and the remote reset systems are installed at US85, level 1, in the racks CYTIM01 and CYFRE01 respectively. It will be relocated. There is another timing crate TYCCR01 in UA83 and UA87, used by the collimation control rack. The relocation is not foreseen for this area.

QPS ans Energy Extraction

Owners: R. Denz

Custom electronic (some parts are radtol)

Failure: Prohibited repowering; Possible fast abort sequence; No protection for the magnet (rare event)

- P1:
  - The equipment 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 DQSB01in RR13 and RR17 houses the energy extraction system for circuits RB.A81 and RB.A12 respectively. The equipment will be relocated from Uj14/16 (some parts are not radtol). Relocation is by far more complex for the two RRs. The study for an hardware upgrade has been started.
- P5:
  - The equipment is installed in the racks DYPG01 and DYPG02, at UJ56, level 1, 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 RR53 and RR57. The rack DQSB01in RR53 and RR57 houses the energy extraction system for circuits RB.A45 adn RB.A56 respectively. The equipment will be relocated from UJ56. This concerns the DFBX (some parts are not radtol). Relocation is by far more complex for the two RRs. The study for an hardware upgrade has been started.

Access system control and gates

Owners: R. Nunes

Commercial electronic (Pc, PLC)

Failure: false alarms, and, once broken, delays or intermittent failures during access.

- P1:
  - Access system gates: they are located at UJ14 and UJ16. The Access points can be powered down during the run, however clear procedures do not yet exist for this powering up and down. The relocation implies some important drawbacks that have yet to be studied: (Dis)alignment of the ventilation; no access to racks in UJ and UL; additional sector doors.
- P5:
  - Access system control: The racks for the access system are YYACS01, YYACS02, YYACS03, YYACS04, and YYACS05 at UJ56. More information to be given.
- P8:
  - No Equipment in the critical areas. (At our knowledge)

Ethernet switches

Owners: E. Sallaz

Commercial electronic

Failure: Loss of the Ethernet connection for the clients

- P5:
  - The network infrastructure is located at UJ56, level 1. The racks CYNET01, CYNET02, and CYFIB01 include optical fibers, UTP (Unshielded Twisted Cable) cables, and switches. The system should be relocated. Information to be completed and checked.
- P8:
  - The network infrastructure is located at US85, level 1 ((in the racks CYNET01 and CYNET02) and at UX85, level ((in the racks CYNET01). The system should be relocated. Information to be completed and checked.

Cryogenic refrigerators

Owners: M. Pezzetti, J. Bel, A. Suraci

Commercial Electronic

Failure: No input for the cryogenic system, and then beam dump

- P8:
  - The control equipment of the cryogenic refrigerators and valve positioners are located in US85. The relocation of some parts has been already done or approved by the integration team (Floor 0 & UL86). The QURC-EMC1 to 4 could be moved to US85 level 0 (with additional shielding) and the Electrical Cabinets QURA & QURCB-EM01 to the UL84. Information to be completed.

Cryogenic instr. ProfiBus

Owners: M. Pezzetti, C. Fluder

Commercial Electronic

Failure: Degradation of the cryogenic operation and then beam dump

- P1:
  - The racks for the cryogenics instrumentation on PROFI bus are located in the racks QYC01 and QYC02 in the UJ14/16. No equipment is in the RRs. The equipment has to be relocated. Information to be completed.
- P5:
  - The racks are located in the racks QYC01 and QYC03 in the UJ56. No equipment is in the RRs. The system has to be relocated.

Cryogenic instr. WorldFIP

Owners: G. Penacoba, J. Casas-Cubillos

Custom Electronic

Failure: degradation of the cryogenic operations; influence on the interlock

- P1:
  - 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). The results of the radiation tests are pretty good. The system can stay as is. Possible implementation of a remote reset to further mitigate SEU effects.
- P5:
  - The racks for the cryogenics control are the QYC02 in UJ56 and QYC01 QYC02 in RR53 and RR57. The results of the radiation tests are pretty good. The system can stay as is. Possible implementation of a remote reset to further mitigate SEU effects.

Warm Interlock Control

Owners: P. Dahlen

Commercial electronic (PLC)

Failure: No control for warm magnet; beam dump

- P8:
  - The Warm Interlock Controller (WIC) is located at US85 in the rack MYWIC01. It has to be relocated in the UA83.

Power Interlock Control

Owners: M. Zerlauth, P. Dahlen

PLC for the control part; commercial remote I/O, CPLD for the Anybus card

Failure:

- P1:
  - The Power Interlock Controller (PIC) is located in the rack CYCIP01 at level 0 of UJ14/16, and the remote I/O with the ANYBUS card is in the racks CYCIP01 in the RR13 and RR17. PLCs have to be relocated from UJs. The PIC patch-panles would move from CYCIP01=UJ14/16 into DYPG01=UL14/16 (need some 12U in the rack of QPS), while the PIC PLCs will move into CYCIB01=US152. The remote I/O and the Anybus card was tested and can stay as is in RRs. Its relocation is also complicated.
- P5:
  - The Power Interlock Controller (PIC) is located in the rack CYCIP01 at level 0 of UJ14/16, and the remote I/O with the ANYBUS card is in the racks CYCIP01 in the RR13 and RR17. PLCs have to be relocated and the final solution for the relocation will be adopted once it will be clarified the relocation of the power converters and of the QPS system. The remote I/O and the Anybus card were tested and can stay as is. Its relocation is also complicated.

Beam Interlock Control

Owners: B. Puccio, B. Todd

VME controller (only monitoring), VME cards, CIBU on the user side and FMCM (powering monitor)

Failure: Beam dump or beam dump request (FMCM)

- P5:
  - The beam interlock equipment is in the rack CYCB01 at UJ56, level 1. The control part of the BIC and the FMCM will be moved in USC55. The CIBU can be considered radiation tolerant. However, it is always installed on the USER side. Therefore, any relocation of so called "USER SYSTEMS" which have a CIBU, will require a re-installation of cables between the BIC and CIBU. The BIC owners must be aware of these changes as soon as they are formalised.

Current Leads heater

Owners: N. Catalan, S. Le Naour

Commercial electronic (solid state relays)

Failure: Possible downtime for operation

- P1:
  - 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 RR17, respectively. It is suggested to relocate the system or put in place a remote reset as a mitigation option.
- P5:
  - The equipment is installed in the rack DYXF01, at UJ56-level 1, in the racks DYAI01, DYLD01 at RR53, and in DYAJ01, DYLE01 at RR57. It is suggested to relocate the system or put in place a remote reset as a mitigation option.

Survey

Owners: Andreas Herty, A. Marin

Commercial electronic

Failure: no alignment for low beta magnet, then issue for operation

- P1:
  - Three racks on level 1 of US15 host the electronics of the low beta magnet monitoring and repositioning system (data acquisition and motor drivers). This area is considered as safe.
  - The sensors used for monitoring the low beta magnets and the electronics are installed in the UPS14 and UPS16 survey galleries. The relocation is not possible (sensor constraint) and not necessary. (electronic was tested)
- P5:
  - Three racks on level 1 of UJ56 host the electronics of the low beta magnet monitoring and repositioning system (data acquisition and motor drivers). Motor driver never tested. Data acquisition suffers SEUs. They should be relocated despite of a cable length constraint on the left side.
  - The sensors used for monitoring the low beta magnets and the electronics are installed in the UPS54 and UPS56 survey galleries. The relocation is not possible and not necessary. (space constraint and electronic was tested).

Survey -cont

Owners: Andreas Herty, A. Marin

Commercial electronic

Failure: no alignment for low beta magnet, then issue for operation

- P8:
  - The installation in point 8 is independent for each side (8L and 8R). The racks (GYPOS) are in UA83 for 8L and UA87 for 8R (2 racks on each side for the data acquisition and motor driver). Relocation is not required.
  - The electronics for the sensor is installed in the UJ84 (2 electronics racks) and UL86 (1 electronics rack) and cannot be displaced due to these constraints. One electronics rack is installed in UX85 and will be relocated in US85 in order to be out of the LHCb cavern and accessible for maintenance reasons via the tunnel.

GSM repeaters

Owners: F. Chapron

Commercial electronic (GSM probe)

Failure: Loss of the GSM service in the tunnel

- P5:
  - GSM equipment, named GSP UJ56-28, is located in the rack CYRR01 at UJ56 level 0 in the safe-room. The relocation depends on the GSM signals propagation. Since the system is not so critical, the relocation could be avoided.
- P8:
  - GSM equipment is located at US85 level 0 in the safe-room. The relocation depends on the GSM signals propagation. Since the system is not so critical, the relocation could be avoided. Information to be confirmed.

Beam Position Monitor

Owners: E. Calvo Giraldo, J. L. Gonzales

Custom electronic (pw card, microfip, ASIC, FPGA, intensity cards)

Failure: Possible degradation of the beam orbit reading

- P1:
  - The Beam Position Monitor electronics is placed in the rack BY01 at level 0 of UJ14 and UJ16 and in the racks BY01 at level 1 of RR13 and RR17. The results of the radiation tests are pretty good. Many parts are redundant. Then, the system can stay as is. An improvement of the intensity card (only used in the injection phase) will be considered.
- P5:
  - The Beam Position Monitor electronics is placed in the rack BY01 at level 1 of UJ56 and in the racks BY01 at level 1 of RR53 and RR57. The results of the radiation tests are pretty good. Many parts are redundant. Then, the system can stay as is. An improvement of the intensity card will be considered..

Beam Loss Monitor

Owners: B. Dehning, E. Effinger

Custom electronic

Failure: no detection of the beam losses, and then beam dump

- P1:
  - The beam loss monitor equipment is located at RR13/17. The results of the radiation tests are pretty good. The system can stay as is.
- P5:
  - The beam loss monitor equipment is located at RR13/17. The results of the radiation tests are pretty good. The system can stay as is.

Optical fibers

Owners: D. Ricci

Patch panels (passive elements such as optic fibres and connectors)

Failure: radiation induced attenuation of light

- P5:
  - Patch panels for optical fibres are installed at UJ56, level 1, in the rack CYFIB01. The system itself can stay in place. A relocation can be required if it can make easier the relocation of the related network equipments (switches).
- P8:
  - Patch panels for optical fibres are installed in the rack CYFIB01 at US85, level 1. The system itself can stay in place. A relocation can be required if it can make easier the relocation of the related network equipments (switches).

WorldFip repeaters

Owners: J. Palluel, R. Brun

Cu/Cu repeaters, optical repeaters, FipDiag modules

Failure: loss of the FIP network for the next users (repeaters); Loss of the diagnostic (Fip Diag)

- P1:
  - WorldFIP equipment is installed on the cable trays in UJ14 UJ16, RR13, and RR17.
- P5:
  - The WorldFIP equipment is installed in the racks CYFRE01 and GYPOS02/03 at UJ56 and in the RR53/57.
- P8:
  - The WorldFIP equipment is installed in the racks CYFRE01 at US85 and in the rack 7Y-LHCB-MSS=UX85 at UX85.
- Results of radiation tests (total dose and SEU) are pretty good, then the system can stay as is.

Cooling and Ventilation (some open points)

Owners: H. Jena

Commercial electronics

Failure: loss of ventilation or water pumping, and then operational stops

- P1:
  - Units are installed in UJ14 UJ16 (PLC), RR13/17 (relays and switch board). PLC unit in UJ14/16 should be relocated.
- P5:
  - Units are installed in UJ56 (PLC) and RR53/57 (no control parts). The PLC unit in UJ56 should be relocated.

Cooling and Ventilation (some open points) -cont

Owners: H. Jena

Commercial electronics

Failure: loss of ventilation or water pumping, and then operational stops

- P8:
  - Units in RE82/88, UX85A, Uas and UJs are not considered in this review. Considered as safe.
  - US85 ventilation: The ventilation system in US85 is based on the air handling units UAUQ-01851 and UAUQ-01852 (local cooling zone US85) with regulation valve (servomotor) and temperature sensors. They are controlled in hardwired mode by the UIAO-00850 in UW85. They could stay as are.
  - US85 cooling: The cooling system in US85 is based on the cryo cooling station (pumps, flow switches, pressure switches) controlled by control cubicle UIAC-00852 which contains no components supposed to be sensitive to radiation. There are also the expansion tank controller PNEUMATEX (brain cube), PLC S7-200 for alarm transmission. There are some weak parts and the whole station could be moved with a huge effort to UW85. To be further analyzed.
  - Some critical units (controller and PLCs) difficult to relocate are installed in the UW85 (pumping station). But UW85 is considered as safe.

Open Issues

- Power converters at point 1 and 5 (UJ and RR): Long story. Too bulky for a simple relocation.
- Electrical Equipment (work in progress)
  - point 1 (UJ and RR): many systems could stay in place since they are based on components like relays and switch board which are not supposed to be sensitive to radiation. Sensitive parts like the monitoring units are not considered vital by the owner.
  - point 5 (UJ56 safe room): many parts in the safe room at UJ56 have microprocessors and solid state switches (EBS, EYC, ECU, EOD, EYP, racks). The lost of the monitoring can be tolerated (DIRIS part in the ETZ racks).
  - point 5 (RR): many units could remain in place since they do not have any critical components. The EOD racks have parts for the monitoring but its lost could be tolerated.
  - Point 8 (safe room): Analysis to be completed.

Back up slides: Equipment per point

Point 1: UJ14/16, UPS

Equipment	Rack	Radiation test	Failure consequences	Option	Description	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 of the ASD detectors ODH detectors stay as is		R. Nunes S . Grau
Electrical equipment	See text	Not tested Control part supposed to be sensitive	Loss of power supply monitoring	Shielding Relocation of the digital control parts		A.Burdairon M. Codoceo
Collimation control	TYCFL01	CERF test ~10^7 h/cm^2	Beam dump	Relocation up to 200 m		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)		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)	Remain, Partly Redesign		R. Denz

Point 1: UJ14/16, UPS

Equipment	Rack	Radiation test	Failure consequences	Option	Description	Contact
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	a) Relocation, Redesign, or SCLs	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, US152)	2 (machine safety but the system is redundant)	M. Zerlauth P. Dahlen

Point 1: UJ14/16, UPS

Equipment	Rack	Radiation test	Failure consequences	Option	Description	Contact
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, US152)	2 (machine safety but the system is redundant)	M. Zerlauth P. Dahlen
Cooling and Ventilation	PLCs, servomotoers and ventilaotrs	Sensitive (failure at CNGS)	No CV for Equipment Possible operational stop	Relocation	2 (Downtime)	H. Jena B. Jensen
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	ideally Redesign (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	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

Point 1: UJ14/16, UPS

Equipment	Rack	Radiation test	Failure consequences	Option	Description	Contact
Cryogenics Instrumentation and Electronics (FIP bus)	QYC01 QYC02	Tested at CNGS	Beam dump if failure in DFB temperature channels	Stay as is		J.Bremen E. Gousiou G. Penacoba
Survey	US15: GYPS01, GYPS02, GYPS03	Acquisition system tested Motor driver not tested	No alignment for low beta magnets. Issue for operation	Stay as is		A.Marin
Survey	UPS14 UPS16:sensor electronics	Tested at CNGS	No alignment for low beta magnets. Issue for operation	Stay as is (relocation not possible)		A.Marin
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 QPS		J. Palluel D. Caretti (BE/CO)

Point 1: RR13/17

Equipment	Rack	Radiation test	Failure consequences	Option	Description	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 of the ASD detectors ODH detectors stay as is	1 (Safety issue)	R. Nunes S. Grau
Electrical equipment	See text	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)	Redesig Relocation is very complicate	2 (machine protection, redundant)	R. Denz

Point 1: RR13/17

Equipment	Rack	Radiation test	Failure consequences	Option	Description	Contact
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	a) Relocation with redesign (increase voltage) b) 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
Cooling and Ventilation	Ventilators and powewr racks	Not tested	No CV for Equipment Possible operational stop	Relocation?	2 (Downtime)	H. Jena B. Jensen
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

Point 1: RR13/17

Equipment	Rack	Radiation test	Failure consequences	Option	Description	Contact
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 QYC03	Tested at CNGS	Beam dump if failure in DFB temperature channels	Stay as is		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

Point 5: UJ56, UPS

Equipment	Rack	Radiation test	Failure consequences	Option	Description	Contact
Fire/ODH control	SYAFD01	Not tested Supposed very sensitive	No fire detection, no ODH detection Failure affects also the areas UJ US UX RE	Relocation	1 (Safety issue)	R. Nunes S. Grau
Fire/ODH detectors	SFDEI – xxxx	CNGS experience ~10^7 h/cm^2	No fire detection; if two more detectors are in fail mode, an evacuation is triggered	Relocation of the fire detectors ODH detectors stay as is	1 (Safety issue)	R. Nunes S. Grau
AUG control	AU	Not tested	Loss of the AUG logic	Relocation	1 (safety)	A.Burdairon M. Codoceo
UPS	EBS/ESS	Not tested	Loss of Cryogenics, vacuum, QPS, Beam monitoring.	Relocation	1(many system depend on it)	A.Burdairon M. Codoceo
Electrical equipment	See text	Not tested Control part supposed to be sensitive	Loss of power supply and possible loss of the safety lighting	Shielding Relocation of the digital control parts	1	A.Burdairon M. Codoceo
Collimation control	TYCFL01 TYCCR01	CERF test ~10^7 h/cm^2	Beam dump	Relocation up to 200 m	1 (machine safety)	A Masi
Remote-Reset & Timing	CYTIM01 CYFRE01 TYCCR01	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 DYPG03	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

Point 5: UJ56, UPS

Equipment	Rack	Radiation test	Failure consequences	Option	Description	Contact
Power Converter	RYHF01 (RQX LHC8kA/8V), RYHG01 (RQTX2 LHC6kA/8V), RYMCB01 (RTQX1 LHC600A/10V IT), RYCA01 (DCCT calibration rack), RYCA02 (DCCT calibration rack), RYMCB02 (LHC600A/10V), RYMCB03 (LHC600A/10V), RYMCB04 (LHC600A/10V), RYLC01 (LHC120A/10V), RYLB01 (LHC120A/10V), RYMCB05 (LHC600A/10V), RYSC01 (Powered spares), RYSA01 (Spares parts), RYSA02 (Spares parts), RYSA03 (Spares parts), RYSA04 (Broken modules).	Tested at CNGS	Beam dump	a) Relocation with redesign (increase voltage) b) RadTol design d) SC link (feasibility)	2 (downtime)	Y. Thurel
Access System Control	YYACS01 YYACS02 YYACS03 YYACS04 YYACS05	Controls not tested. 60Co for switches	Misbehave could generate alarms and stop of the machine	Relocation	2 Downtime (Operation)	R. Nunes
Ethernet	CYNET01 CYNET02 CYFIB01	Tested in the past	Loss of the Ethernet connection for the clients	Relocation of the switches (max length structured cable 90 m)	2 (Many systems depend on it)	E. Sallaz

Point 5: UJ56, UPS

Equipment	Rack	Radiation test	Failure consequences	Option	Description	Contact
Cooling and Ventilation	PLC, ventilators, power racks, raw water cubicle	Sensitive (failure at CNGS)	No CV for Equipment Possible operational stop	Relocation	2 (Downtime)	H. Jena B. Jensen
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)	C. Fluder M. Pezzetti
Power Interlock	CYCIP01	Sensitive	Beam dump Users: Power converters, QPS, BIC, Cryogenics, UPS, AUG	Relocation PLC (Wait for the final solution for PC and QPS)	2 (machine safety but the system is redundant)	M. Zerlauth P. Dahlen
Beam Interlock	CYCIB01	Total dose test at PSI for the CIBU Test at CNGS: Test at Louvain FMCM not tested	Beam dump Users: Vacuum. Collimation, PIC, CMS and Totem Exp.	Relocation of control part in USC55	2 (downtime/machine safety but the system is redundant)	B. Puccio B. Todd
Current Leads Heaters	DYAI0 DYLD01	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
Survey	GYPS01, GYPS02, GYPS03	Acquisition system tested at CNGS Driver for motors not tested	No alignment for low beta magnets. Issue for operation	Relocation	4	A.Marin
GSM Repeaters	CYRR01 **room**	Not tested. Supposed to be sensitive	Loss of the GSM service in the tunnel	Relocation	4 (not intended for safety)	F. Chapron
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

Point 5: UJ56, UPS

Equipment	Rack	Radiation test	Failure consequences	Option	Description	Contact
Optical Fiber	CYFIB01	Insensitive to SEU Tested with 60Co	Radiation induces attenuation of light	Depend on the Ethernet switches		D. Ricci
Survey	UPS54-56	Sensor electronic tested	No alignment for low beta magnets. Issue for operation	Stay as is (Relocation not possible)		A.Marin
AUG Buttons	LHC underground	Tested	Loss of full functionality	Annual test		A.Burdairon M. Codoceo
Cryogenics Instrumentation and Electronics (FIP bus)	QYC02	Tested at CNGS	Beam dump if failure in DFB temperature channels	Stay as is		J. Casas-Cubillos G.Penacoba
WorldFip	CYFRE01 GYPOS02 GYPOS03	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

Point 5: RR53/57

Equipment	Rack	Radiation test	Failure consequences	Option	Description	Contact
Fire/ODH detectors		CNGS experience ~10^7 h/cm^2	No fire detection; if two more detectors are in fail mode, an evacuation is triggered	Relocation of the fire detectors ODH detectors stay as is	1 (Safety issue)	R. Nunes S. Grau
Electrical equipment		Not tested Control part supposed to be sensitive	Loss of power supply and possible loss of the safety lighting	Shielding Relocation of the digital control parts	1	A.Burdairon M. Codoceo
QPS and Energy Extraction	DYPG01 DYPG02 DYPG03	Tested at CNGS-2008	Prohibited re-powering Possible fast power abort sequence No protection for the magnets (rare)	Redesign of the weak parts. Relocation is complex	2 (machine protection, redundant)	R. Denz

Point 5: RR53/57

Equipment	Rack	Radiation test	Failure consequences	Option	Description	Contact
Power Converter	Level0 : 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), RYHG12 (LHC6kA/8V), RYHG13 (LHC6kA/8V), RYHG14 (LHC6kA/8V), RYHG15 (LHC6kA/8V), RYLB01 (LHC120A/10V),RYLC01 (LHC120A/10V) Level1 : RYLB04 (LHC120A/10V), RYLB03 (LHC120A/10V), RYMCB03 (LHC600A/10V), RYMCB02 (LHC600A/10V), RYMCA02 (LHC600A/10V), RYMCB01 (LHC600A/10V), RYMCA03 (LHC600A/10V), RYMCA01 (LHC600A/10V), RYMCA04 (LHC600A/10V), RYLB02 (LHC120A/10V), RYSA01 (Spares parts), RYSC01 (Powered spares), RYSA02 (Spares parts), RYSA03 (Broken modules).	Tested at CNGS	Beam dump	a) Relocation with redesign (increase voltage) b) RadTol design SC link (feasibility)	2 (downtime)	Y. Thurel
Cooling and Ventilation	Ventilators, poewr racks	Not tested	No CV for Equipment Possible operational stop	Relocation?	2 (Downtime)	H. Jena B. Jensen
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)	C. Fluder M. Pezzetti
Power Interlock (remote I/O)	CYCIP01	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

Point 5: RR53/57

Equipment	Rack	Radiation test	Failure consequences	Option	Description	Contact
Current Leads Heaters	RR53 level 1: DYAI01 DYLD01 RR57 level 1 DYAJ01 DYLE01	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
Cryogenics Instrumentation and Electronics (FIP bus)	QYC01 QYC02	Tested at CNGS	Beam dump if failure in DFB temperature channels	It can stay		J. Casas-Cubillos 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

Point 7: UJ76

Equipment	Rack	Radiation test	Failure consequences	Option	Description	Contact
Fire/ODH control	SYAFD01 SYODH	Not tested Supposed very sensitive	No fire detection, no ODH detection Failure affects also the areas UJ US UX RE	Relocation	1 (Safety issue)	R. Nunes S. Grau
Fire/ODH detectors	UJ87, SSFDEI – 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
AUG control	AU	Not tested	Loss of the AUG logic	Relocation	1 (safety)	A.Burdairon M. Codoceo
UPS	EBS/ESS	Not tested	Loss of Cryogenics, vacuum, QPS, Beam monitoring.	Relocation	1(many system depend on it)	A.Burdairon M. Codoceo
Electrical equipment	See text	Not tested Control part supposed to be sensitive	Loss of power supply and possible loss of the safety lighting	Shielding Relocation of the digital control parts	1	A.Burdairon M. Codoceo
Remote-Reset & Timing	CYTIM01 CYFRE01	Not tested Supposed very sensitive	Loss of timing Beam dump	Relocation	2 (many systems depend on it)	R. Chery
Access System Control	YYACS01 YYACS02 YYACS03	Controls not tested. 60Co for switches	Misbehave could generate alarms and stop of the machine	Relocation	2 Downtime (Operation)	R. Nunes
Power Converter	RYME01-12 RYSC01	Tested at CNGS	Beam dump	a) Relocation with redesign (increase voltage) b) RadTol design d) SC link (feasibility)	2 (downtime)	Y. Thurel
Ethernet	CYNET01	Tested in the past	Loss of the Ethernet connection for the clients	Relocation of the switches (max length structured cable 90 m)	2 (Many systems depend on it)	E. Sallaz

Point 7: UJ76

Equipment	Rack	Radiation test	Failure consequences	Option	Description	Contact
Cooling and Ventilation		Sensitive (failure at CNGS)	No CV for Equipment Possible operational stop	Relocation	2 (Downtime)	H. Jena B. Jensen
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
Vacuum	VY01-27	Not tested	Beam dump	Relocation	2 (downtime)	
Beam Television Monitor	BY03	Not tested	Loss of the monitor. Operation only in Inject and dump mode	Relocation (VME crate to surface)	3 (will b moved)	E. Bravin
Ramses	PYMR01	Not tested	Delay in the intervention	Relocation	3 (downtime)	A Day
GSM Repeaters	CYRR01	Not tested. Supposed to be sensitive	Loss of the GSM service in the tunnel	Relocation	4 (not intended for safety)	F. Chapron
Beam loss monitor	BY02	Custom electronics	No machine tuning Beam dump	Temporary instr.	4(will be moved to surface)	B. Dehning
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
Optical Fiber	CYFIB01	Insensitive to SEU Tested with 60Co	Radiation induces attenuation of light	Depend on the Ethernet switches		D. Ricci
WorldFip	CYFRE01	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

Point 8: US85 UW 85

Equipment	Rack	Radiation test	Failure consequences	Option	Description	Contact
Fire/ODH control	US85, SYAFD01 SYODH	Not tested Supposed very sensitive	No fire detection, no ODH detection Failure affects also the areas UJ US UX RE	Already reloaceted in UA87	1 (Safety issue)	R. Nunes S. Grau
Fire/ODH detectors	UJ87, SSFDEI – xxxx	CNGS experience ~10^7 h/cm^2	No fire detection; if two more detectors are in fail mode, an evacuation is triggered	Fire detectors already moved. ODH stay as is.	1 (Safety issue)	R. Nunes S. Grau
AUG control	US85, AU	Not tested	Loss of the AUG logic	Relocation	1 (safety) ?	A.Burdairon M. Codoceo
UPS	US85, EBS/ESS	Not tested	Loss of Cryogenics, vacuum, QPS, Beam monitoring.	Relocation	1(many system depend on it)	A.Burdairon M. Codoceo
Electrical equipment	US85, See text	Not tested Control part supposed to be sensitive	Loss of power supply and possible loss of the safety lighting	Shielding Relocation of the digital control parts	1	A.Burdairon M. Codoceo
Remote-Reset & Timing	US85, 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
Ethernet	US85, CYNET01 CYNET02 CYFIB01	Tested in the past	Loss of the Ethernet connection for the clients	Relocation of the switches (max length structured cable 90 m)	2 (Many systems depend on it)	E. Sallaz
Cooling and Ventilation	UW85, UA83/87, UJ83/84/87, US85, UX85A	Sensitive (failure at CNGS)	No CV for Equipment Possible operational stop	Relocation (in some point is not possible)	2 (Downtime)	H. Jena B. Jensen
Cryogenics refrigerators and valve positioners	US,85, UX85, see text	Tested at TCC2 Sensitive	No input for Cryogenic system that could drive a beam dump	Relocation	2 (down time)	M. Pezzetti JF. Bel A Suraci
Warm Magnet Interlock	US85, MYWIC01	sensitive	No control for warm magnets Beam dump	Relocate upt to 500 m	2 (machine safety)	P. Dahlen

Point 8: US85 UW 85

Equipment	Rack	Radiation test	Failure consequences	Option	Description	Contact
Survey	US85, UX85B	Electronics tested	No alignment for low beta magnets. Issue for operation	Sensor electronics in UX85b will be moved to US85		A.Marin
Survey	UA83 UA87 GYPS01 GYPS02	Electronics tested Acquisition system tested	No alignment for low beta magnets. Issue for operation	Stay as is		A.Marin
Survey	UJ84 UL83	Electronics tested	No alignment for low beta magnets. Issue for operation	Stay as is (Relocation not possible)		A.Marin
GSM Repeaters	US85, CYRR01	Not tested. Supposed to be sensitive	Loss of the GSM service in the tunnel	Relocation		F. Chapron
Optical Fiber	US85, CYFIB01	Insensitive to SEU Tested with 60Co	Radiation induces attenuation of light	Depend on the Ethernet switches		D. Ricci
WorldFip	US85, CYFRE01 UX85	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