CERN CH-1211 Geneva 23 Switzerland

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-

AD

Date: 2016-05-14

Functional Specification

CONSOLIDATION OF THE MAGNETS INTERLOCK SYSTEM FOR AD

ABSTRACT:

In order to improve the operability, reliability, availability, maintainability and safety of the interlock system for the warm magnet protection system of CERNs antiproton decelerator (AD), this system is proposed for consolidation. This document describes the scope, impact and resources estimates of the proposed consolidation and includes as well a related risk analysis. This document is used to request funding in the framework of the ATS Accelerator Consolidation Program and it serves for analysis and prioritization of all consolidation requests. It describes, the architecture of the existing system, outlines the technical details of the consolidation and presents the proposed hardware installation.

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DISTRIBUTION LIST:

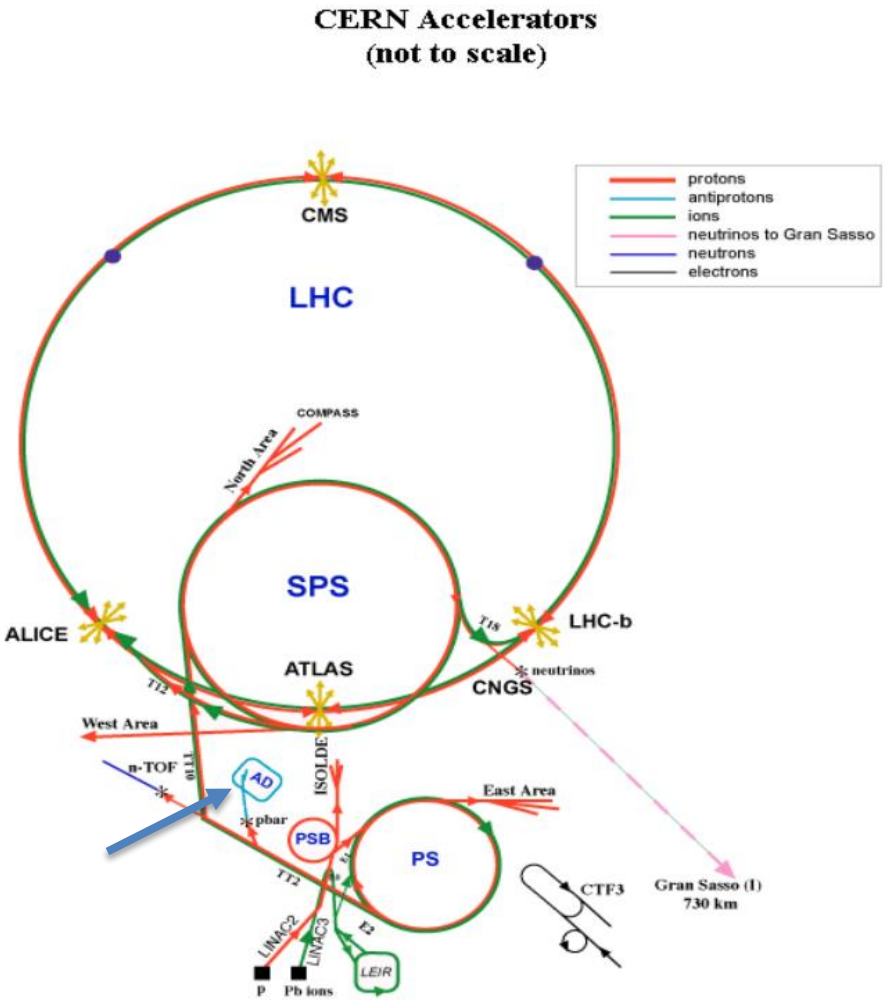
HISTORY OF CHANGES

REV. NO.	DATE	PAGES	DESCRIPTIONS OF THE CHANGES
0.1	2015-10-21	All	First version
0.2	2016-05-14	All	Second draft including comments of M. Zerlauth

TABLE OF CONTENTS

1. INTRODUCTION

The AD (Antiproton Decelerator) was built in 2000. It is part of the CERN accelerator complex and several experiment are dependent on it (ATRAP – ASACUSA - AEGIS). The starting point is a beam of proton originating from the PS (Proton Synchrotron) which is impacting on a fixed target. The antiprotons produced travel at almost the speed of light, still carrying too much energy and a too high energy spread for the production of anti-atoms. AD will shape the particles from the target into low energy beam, to provide low energy antiprotons mainly for studies and experiences of antimatter.
Currently, the EPC and MSC groups are responsible for the nearly 45 year's old legacy interlock system installed in AD. It is foreseen that the present installation is going to be renovate during LS3, as many power converters will be renovated/replaced with state of the art systems.
As a consequence, we propose to renovate as well the legacy interlock system by a standard, efficient and reliable solution which is based on "F-series" PLCs. Such systems are already very successfully in use in LINAC3, LINAC4, Booster, LEIR, SPS, the LHC and its transfer lines.



The access point for AD is located building 193, which is located in front of the Booster (PSB). It consists of a total of 189 magnets powered by some 110 power converters. There is one central supply for the Dipoles (with 12 adjusting trimmers) and two central supplies for the Quadrupoles (with 5 adjusting trimmers). A pair of two other magnets (in TT2 and Sector 4) are powered in series by two power converters while all remaining magnets are powered by a dedicated power supply.

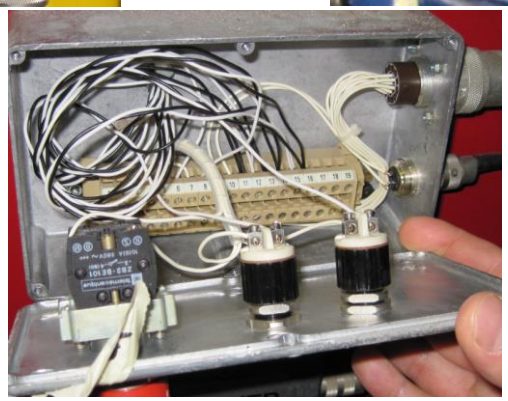
2. INSTALLED LEGACY SYSTEM

2.1 PRINCIPLE

The currently installed legacy interlock system in AD relies on thermo-switches (several switches installed in series per magnet) and flow meters for the water cooling. The information is transmitted to dedicated protection crates, which calculate and transmit a power permit to the relevant power converter.

2.2 INTERLOCK BOXES

An interlock box is installed on each of the AD magnets. As one can see on the pictures below, different types of boxes are installed. All of them contain an emergency stop button, two switches for local testing of the loop for the thermo-switches / water pressures and a flashing light which is active if the magnet is powered. It is foreseen that the emergency button and the flashing lights are going to be removed, as the magnet protection system is not conceived for the protection of personnel. Instead the standard safety procedures have to be followed for any intervention on the power part of the magnet.

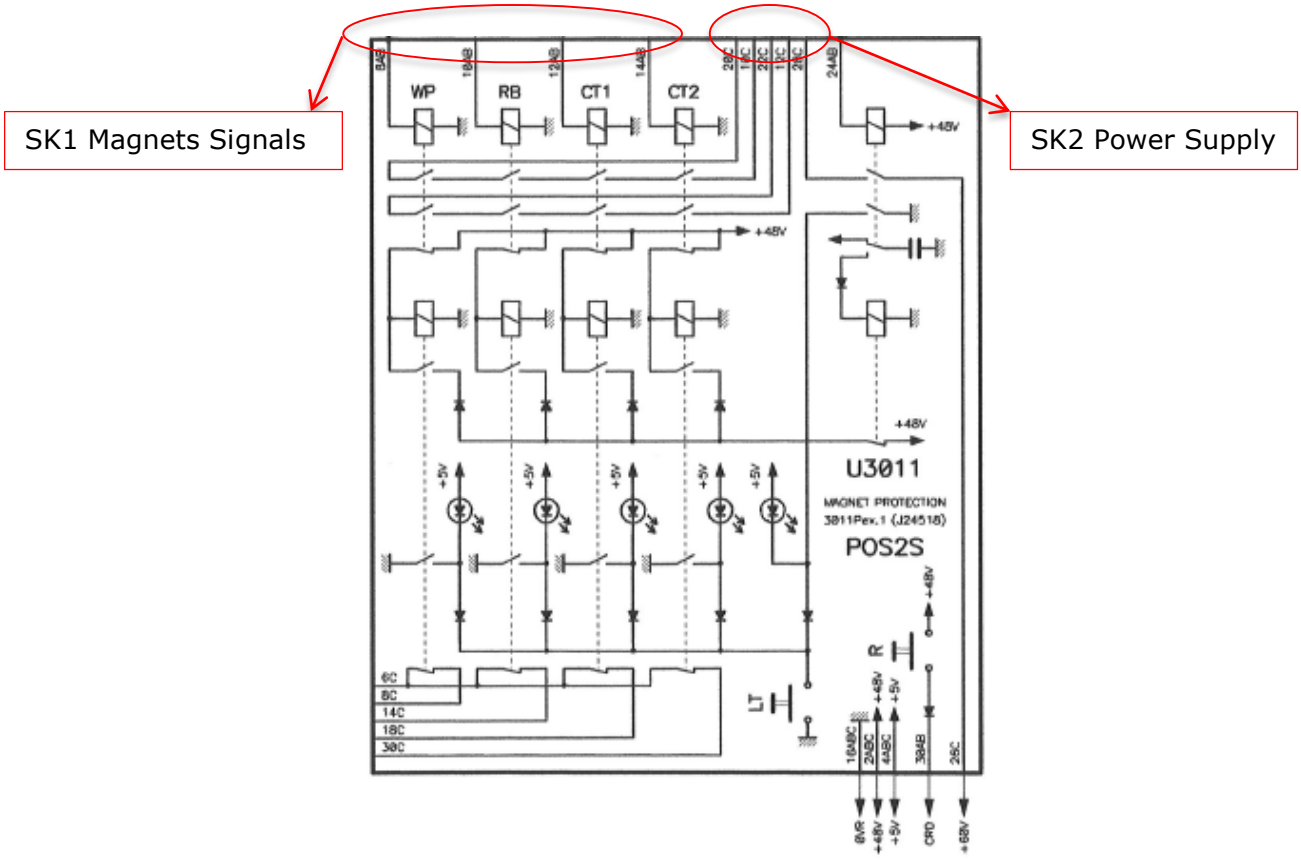


2.3 CABLING CONVENTION « MAGNET TO PROTECTION »

Name	Magnet side	Protection side
ST_MAG_WATERPRESSURE +	Pin 1	Pin 1
ST_MAG_WATERPRESSURE -	Pin 2	Pin 2
ST_MAG_REDBUTTON +	Pin 3	Pin 3
ST_MAG_REDBUTTON -	Pin 4	Pin 4
ST_MAG_OVERTEMP1 +	Pin 5	Pin 5
ST_MAG_OVERTEMP1 -	Pin 6	Pin 6
ST_MAG_OVERTEMP2 +	Pin 7	Pin 7
ST_MAG_OVERTEMP2 -	Pin 8	Pin 8
SPARE	Pin 9 – Pin 18	Pin 9 – Pin 18

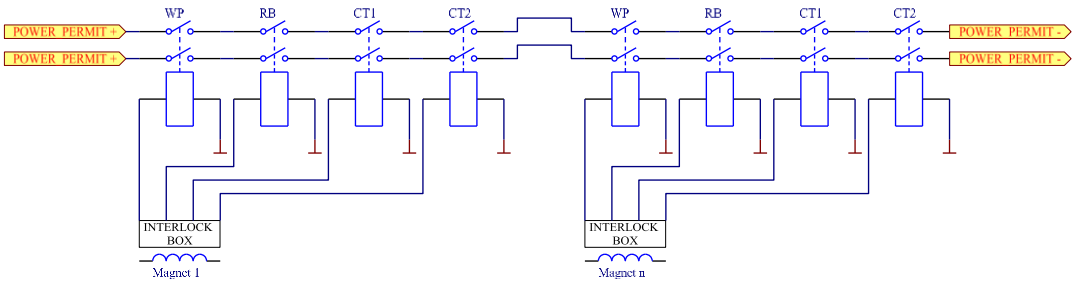
2.4 PROTECTION CRATES

The overheating and water pressure signals are transmitted to the surface via copper cable (18 pins). They are connected on chassis (again different type of chassis exists) which are composed by several electro-mechanical protection crates.
The figure below depicts an example of the schematics of the protection crates. The hardware used in every crate is similar, nevertheless their layout is not exactly the same. Depending on the chassis type, several connections are made in the back to ensure the serialization for dipole and quadrupole chains or to ensure the serialization of water pressure signals.



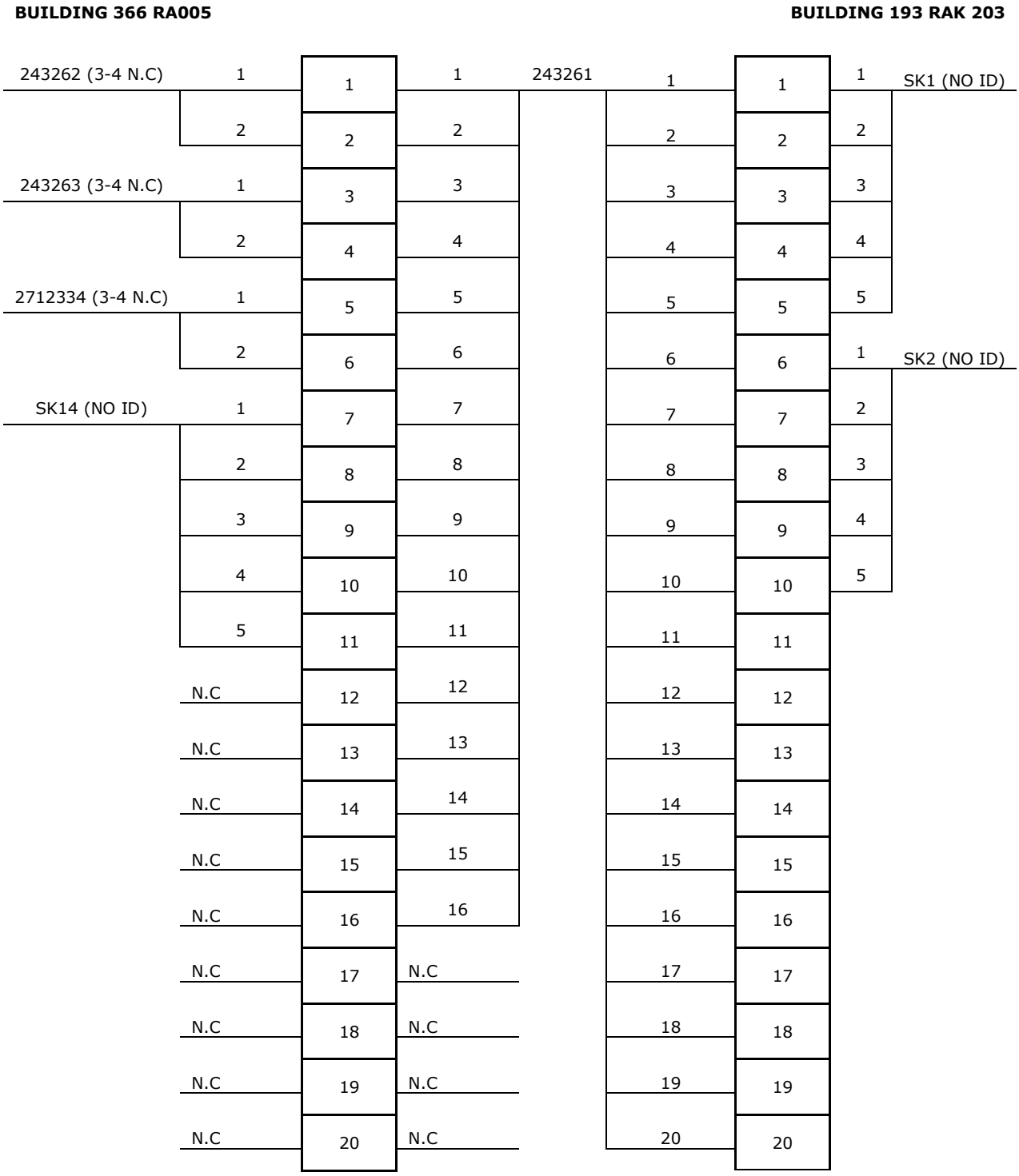
2.5 DIPOLE AND QUADRUPOLE CHAIN

The main magnets (dipoles and quadrupoles) in the AD ring are powered by central supplies and several trim converters which adjusts the current for a subset of the magnet chain. A serialization in the back of the chassis is done so that the power permit can be sent to the set of relevant power converters when a fault occurs on any of those magnets. Two separates lines are used for redundancy. A schematic view of such a serial connection is shown in the figure below.



2.6 TERMINAL

It is possible to cut the mains (dipole and quadrupoles of the ring line) with an emergency button located near from the AD control room (building 193). The other cables are used to transmit the signals from other interlock systems like (EIS – BIS). A water pressure signal is also transmitted via this terminal.



2.7 PLC

A PLC is used to simultaneously turn off the trim power converters with the central supply if a fault occurs on the mains chain. It is also used to acquire the signals from other interlock systems which may request and abort of the magnet powering.

CRATE NAME	NAME	CABLE ID	BLDG / RACK / CHASSIS	COMMENTS
OLD CHASSIS (HAVE BEEN REPLACED BY THE PLC BELOW BUT IT IS STILL POSSIBLE TO SEE IF EVERYTHING IS WORKING PROPERLY)	SK3	243182	366 / RA005 / C20675	B-MAIN
	SK4	243181	366 / RA005 / C20675	Q-MAIN1
	SK5	243271	366 / RA005 / C20675	B-MAIN
	SK6	2712146	366 / RA005 / C20675	B-TRIM
	SK7	243301	366 / RA005 / C20675	Q-MAIN1
	SK8	2712147	366 / RA005 / C20675	Q-TRIM1
	SK9	2712148	366 / RA005 / C20675	Q-TRIM2
	SK10	2712149	366 / RA005 / C20675	Q-TRIM3
	SK11	2712150	366 / RA005 / C20675	Q-TRIM4
	SK12	2714485	366 / RA005 / C20675	Q-TRIM5
	SK14	NO NUMBER	366 / RA005 / C20675	Connected on the terminal
INTERFACE FOR SIMATIC	**NAME**	**CABLE ID**	**LOCATION / TYPE**	**COMMENTS**
BENDING	SK1	2712070	366 / RA008 / C20635	DR.BHZTR05/06
	SK2	2712071	366 / RA008 / C20635	DR.BHZTR08/09
	SK3	2712072	366 / RA008 / C20635	DR.BHZTR11/12
	SK4	2712073	366 / RA008 / C20635	DR.BHZTR17/18
	SK5	2712074	366 / RA008 / C20635	DR.BHZTR20/21
	SK6	2712075	366 / RA008 / C20635	DR.BHZTR23/24
	SK7	2712076	366 / RA008 / C20635	DR.BHZTR33/34
	SK8	2712077	366 / RA008 / C20635	DR.BHZTR36/37
	SK9	2712078	366 / RA008 / C20635	DR.BHZTR39/40
	SK10	2712079	366 / RA008 / C20635	DR.BHZTR45/46
	SK11	2712080	366 / RA008 / C20635	DR.BHZTR48/49
	SK12	2712081	366 / RA008 / C20635	DR.BHZTR51/52
	SK25B	2712089	366 / RA008 / C20635	Control/Fault Ring Supplies DR.BHZ-MAIN
	SK26T	2712087	366 / RA008 / C20635	Control/Fault Ring Supplies DR.QUAD-MAIN2 (MIGHT BE)
INTERFACE FOR SIMATIC	**NAME**	**CABLE ID**	**LOCATION / TYPE**	**COMMENTS**
QUAD	SK31	2712082	366 / RA008 / C20635	Power Permit DR.QUAD TRIM 1
	SK32	2712083	366 / RA008 / C20635	Power Permit DR.QUAD TRIM 2
	SK33	2712084	366 / RA008 / C20635	Power Permit DR.QUAD TRIM 3
	SK34	2712085	366 / RA008 / C20635	Power Permit DR.QUAD TRIM 4
	SK35	NO NUMBER	366 / RA008 / C20635	Power Permit DR.QUAD TRIM 5
	SK36Q	2712088	366 / RA008 / C20635	Control/Fault Ring Supplies DR.QUAD-MAIN1

3. WIC PROPOSED SOLUTION

You can find a full description of the Warm Magnet Interlock Controller in EDMS.
Document ID : **ATS-CIW-ES-0001**
Hyperlink: EDMS Document - WIC Generic description

4. PROJECT RESPONSIBILITIES / STAKEHOLDERS / SPONSORS

A number of systems supplied by different groups of CERN are required in a magnet supply chain. In the following list the services involved in this consolidation programme:

The involved teams/groups in the warm magnet interlock controller renovation are the following:

- The Machine Interlock section (from TE/MPE group) named hereafter MPE/MI
- The Industrial Support section (from BE/ICS group) named hereafter ICS/PLC and ICS/SCD for PLC and PVSS supervision software.
- The Magnet team (from TE/MSC) named hereafter MSC/MNC
- The Power Converters team named hereafter TE/EPC

The MPE group will assume the responsibilities for the design and installation of the magnet interlock system, its software and supervision applications. Colleagues from TE/MSC, TE/EPC, and operation groups will be involved and trained, during the commissioning period to allow them an independent operation of the system once in operation.

A detailed planning for the different sub-projects is proposed as follows:

- Installation and connection of the dry contacts (thermos-switches and flow-meters) and the *magnet interlock boxes* on the magnets by TE/MSC (the magnet interlock boxes will be provided by TE/MPE).
- Installation of interfaces between *Interlock boxes* and WIC (cables, patch panels for interlock racks) by EN/EL for cables, MPE/MI for patch panels.
- Installation of interfaces between power converters and WIC (cables, patch panels for interlock racks) by EN/EL for cables, MPE/MI for patch panels.
- Preparation and installation of the interlock racks (PLC, Profibus links, IO-Modules) by MPE/MI.
- Preparation of the hardware configuration file => MPE/MI
- Software for PLCs => ICS/PLC.
- Software for WIC Supervision => ICS/SCD.
- Commissioning of system => MPE/MI + MSC/MNC + TE/EPC
- Maintenance => MPE/MI + MSC/MNC* + TE/EPC**

(*) On magnet side, MPE/MI responsibility's limit until the level the magnet Interlock box (box included)
(**) On converter side, MPE/MI responsibility's limit until the level the output cable to the Power Converter.

5. ORAMS ASPECTS

5.1 OPERABILITY ASPECTS

The WIC system features remote diagnostics and monitoring of all input and output status information as well as internal diagnostics via a dedicated WinCC supervisory system. This supervisory system is available for the operation crews in the CCC (integrated in the standard Console Manager of the respective machine) as well as for system experts via dedicated terminal servers from any remote location. RBAC roles are used to protect expert actions such as remote testing features from erroneous use.

5.2 RELIABILITY ASPECTS

The WIC system is a generic system that has been deployed in identical form already in most of the CERN accelerator complex such as the LHC, SPS, PSB, LINAC4, LEIR, LINAC3 and transfer lines such as Ti2, Ti8, TT40 and TT60. Since the first deployment in 2005, the WIC system (based on commercial off-the-shelf PLC components) has shown to be extremely reliable and largely exceeded the initial dependability predictions. Despite the fact that the system is based on a fail-safe logic implementation, none of the today 33 operational systems has caused a single false trigger since the first system started operation in 2005.

5.3 AVAILABILITY ASPECTS

Due to its failsafe implementation, the WIC system has to be fully operational and commissioned in the given complex in order to allow any magnet powering. This is true for beam operational periods, but as well for periods of hardware commissioning, for which the interlock system has to be commissioned prior to the start of powering tests. For this reason, once commissioned, the systems are kept operational throughout the full year, including technical or end-of-year stops.

5.4 MAINTAINABILITY ASPECTS

Only a negligible number of interventions had to be performed on the systems installed, mostly related to failures of redundant power supplies which can be exchanged transparently for operation. The WIC system - being a generic system -allows for an easy and efficient exchange of components with (tested) spare components from the operational stock. Due to the criticality of the system for equipment protection, an adapted recommissioning of the exchanged parts is nevertheless obligatory. The system will be managed as other similar installation regarding potential hardware or software upgrades, and the installed and spare components will be integrated into CERNs standard inventory.

5.5 SAFETY ASPECTS

By definition, the Warm Magnet Interlock system is solely concerned with equipment protection and not personnel protection. While some of the legacy interlock systems sometimes played a role in personnel protection, these parts of the functionalities will be removed during the consolidation and instead become part of the respective access/personnel protection system.
The WIC system itself is based on industrial automation hardware components (PLC), powered with 230 VAC from the rack or 230VAC sockets for the deported units in the tunnel. The controls cabling and input/output module cards all operate at 24 VDC.
While the interlock installation does not pose any particular electrical risk to personnel, the systems associated to (and interlocked by) the WIC such as magnets and power converters may operate at considerably higher voltages and currents. As the WIC cannot be considered a personnel safety system, standard safety rules and procedures apply for interventions on the actual power part of the magnet circuit. This will call for ab electrical condemnation of the complete circuit for any intervention in its vicinity.

6. IMPACT ON UTILITIES / ON SERVICES / ON SAFETY

Requirement	Yes	No	Comments
Cooling, Ventilation and Compressed air			Nothing to declare.
Cryogenics			Nothing to declare.
Electricity, cable pulling DEC/DIC (Demande enlèvement/installation câbles) (power, signal, optical fibres, signal, control…)			The current interlock system has at least, 45 years old. All the cables are going to be remove and replace during this consolidation program. As well as the interlock boxes (Red Button & Flashing light)
Vacuum (bake outs, sectorisation…)			Nothing to declare.
Special transport/ handling: (Scaffolding…)			Nothing to declare.
Civil engineering works			Nothing to declare.
EIS-Access, EIS-Beam, EIS-Machine			The current interlock system is connected with the EIS-Access / EIS-Beam and might have an impact on these utilities.
Operational radiation protection (DIMR, ALARA committee…):			Nothing to declare.
Radioactive waste:			The old cables / interlock boxes might be considered as radioactive waste.

7. RISK ASSESSMENT

Warm Magnet Interlock Controller		Risk Score	
		Before consolidation	After consolidation
Probability of failure (P)	Rare (once in 10 to 25 years) = 1 Possible (once in 5 to 10 years) = 2 Likely (once in 2 to 5 years) = 3 Frequent (once a year) = 4	3	1
Impact on CERN's scientific objectives (Io)	Insignificant (loss of 1 day of physics or less) **= 1** Moderate (between 1 day and 1 week of physics lost) **= 2** Major (up to 1 month of physics lost) **= 3** Catastrophic (no more operation, failure to meet scientific objectives for the year) **= 5**	1	1
Impact on CERN's (AB's) reputation (Ir)	Insignificant = 1 Moderate (problem dealt with inside ATS) = 2 Major (problem discussed at Executive Board or Governing bodies) = 3	1	1
Financial Impact of failure (If)	Insignificant (<0.1% of ATS annual operation budget or less than 100 kCHF) = 1 Moderate (between 0.1% and 1% of ATS annual operation budget or 0.1 – 1 MCHF) = 2 Major (additional budget essential for repair i.e. > 1 MCHF) = 3 Catastrophic (report to Council, could jeopardize CERN's future) = 5	1	1
Safety Impact of failure (Is)	Insignificant (i.e. no injury or environmental consequence) = 1 Moderate (i.e. injury requiring medical attention, but no loss of working days) = 2 Major (i.e. serious injury requiring medical attention and loss of working days) = 3	1	1

	Catastrophic (i.e. loss of life) = 5		
Facilities Concerned (i)	LHC scientific program (i = 0.3) LHC test beams (i = 0.1) SPS fixed target scientific program (i = 0.15) PS fixed target scientific program (including nTOF) (i = 0.15) AD scientific program (i = 0.15) ISOLDE scientific program (i = 0.15)	0.15	0.15
The Risk score (Rs) is calculated as	$Rs = P \times \max(Io;Ir;If;Is)$	3	1
The weighted Risk score (Rs') is calculated as	$Rs' = Rs \times \sum i$	0.45	0.15

8. BUDGET

The cost of the materials (including contingency) includes, the material itself (controller – crates – patches) and the cost of the DIC (DEC not included as we're not the owner of the currently installed cables). The cost of the "Profibus" cable between the buildings is included in the estimates. A total of 6 months at 100% for one Fellow/Student has to be taken into account for the conceptual study, the Hardware test and the installations / commissioning of the AD protection system. An additional FSU resource will be needed during 6 months for the construction of the patches / crates and interlock boxes as well as the final installation on site. External collaboration from EN/ICE, TE/MSC & TE/EPC and the TE/MPE staff's participation during the commissioning of the system hasn't been included in this budget.

Resources request	2015	2016	2017	2018	2019	2020	2021	2022
Material AD [kCHF]	-	-	-	-	-	-	600	
FSU [kCHF]	-	-	-	-	-	60		
Fellows/students [kCHF]	20			10		30		
Total TT2 – NToF [kCHF]	720							

The participation of two staff members (15% / year each) of the TE/MPE team is required for the finalization of the consolidation project during LS3 (2021 & 2022), it concerns:

- Overall project lead and design
- Generation of the configuration file / Hardware configuration of the controller crate.
- Hardware test in Lab + Software commissioning.
- Installations of the crates in the rack, connection of the cables installed by EN/EL.
- Commissioning with clients (TE/MSC & TE/EPC).

Personnel resources	2015	2016	2017	2018	2019	2020	2021	2022
Needed staff	-						0.6	
Pledged staff	-						0.6	

9. SCHEDULE

This section has been left empty, as the consolidation hasn't been fully approved. The installation being tentatively planned for LS3 only, hence no detailed planning is yet available.

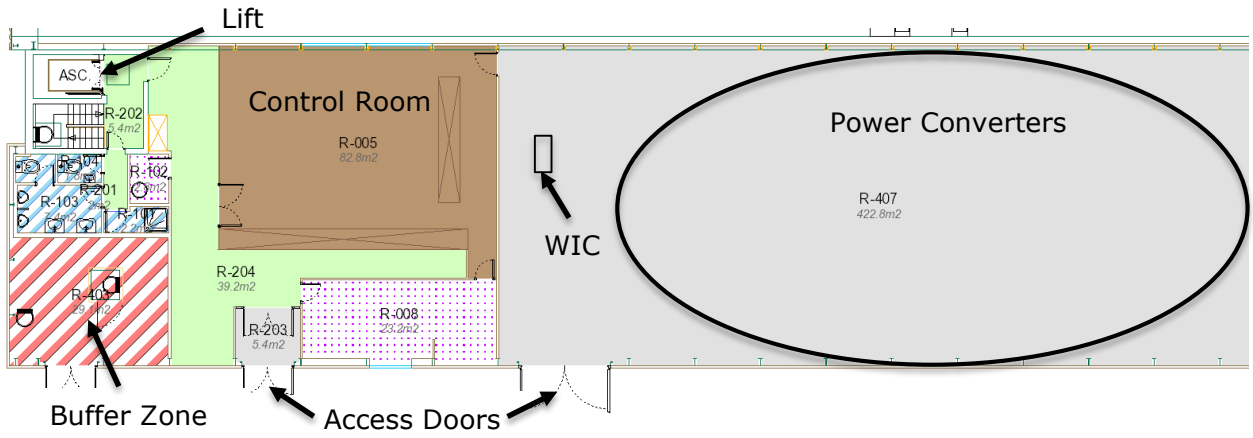
10. CONCEPTUAL STUDY

10.1 LAYOUT

10.1.1 BUILDING

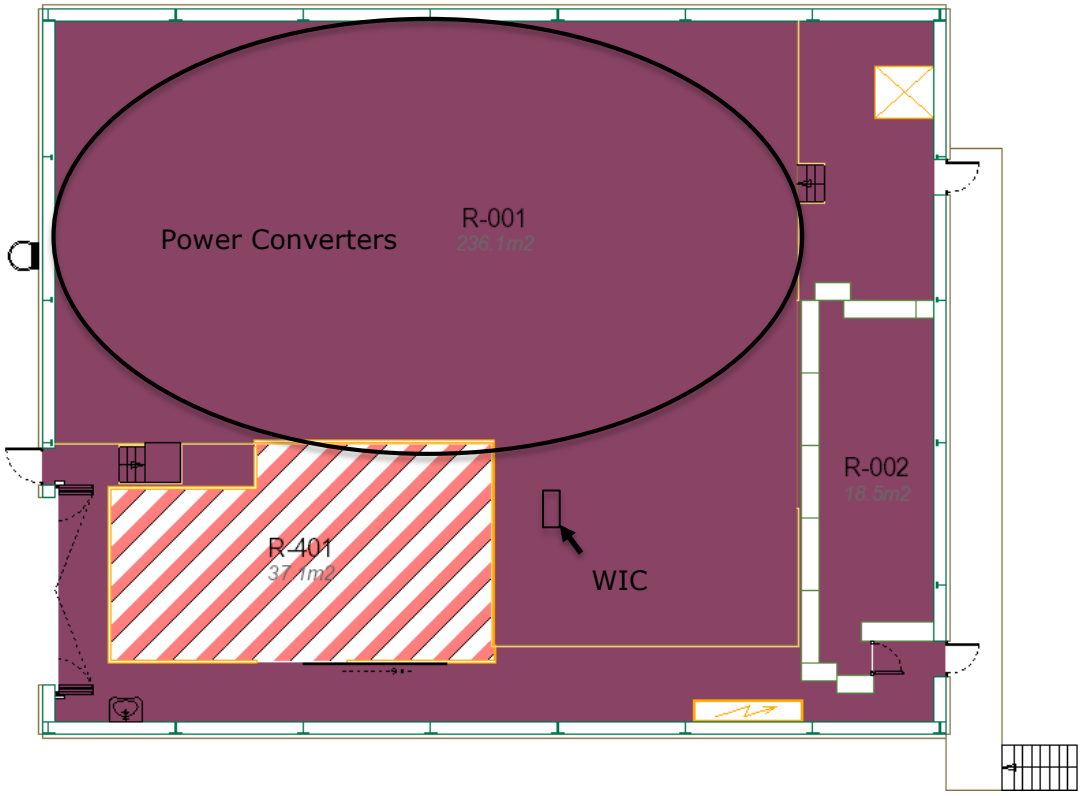
10.1.1.1 193

In the building 193, you'll find the powering system as well as the protection system of the magnets located in the injection / extraction lines of the AD.



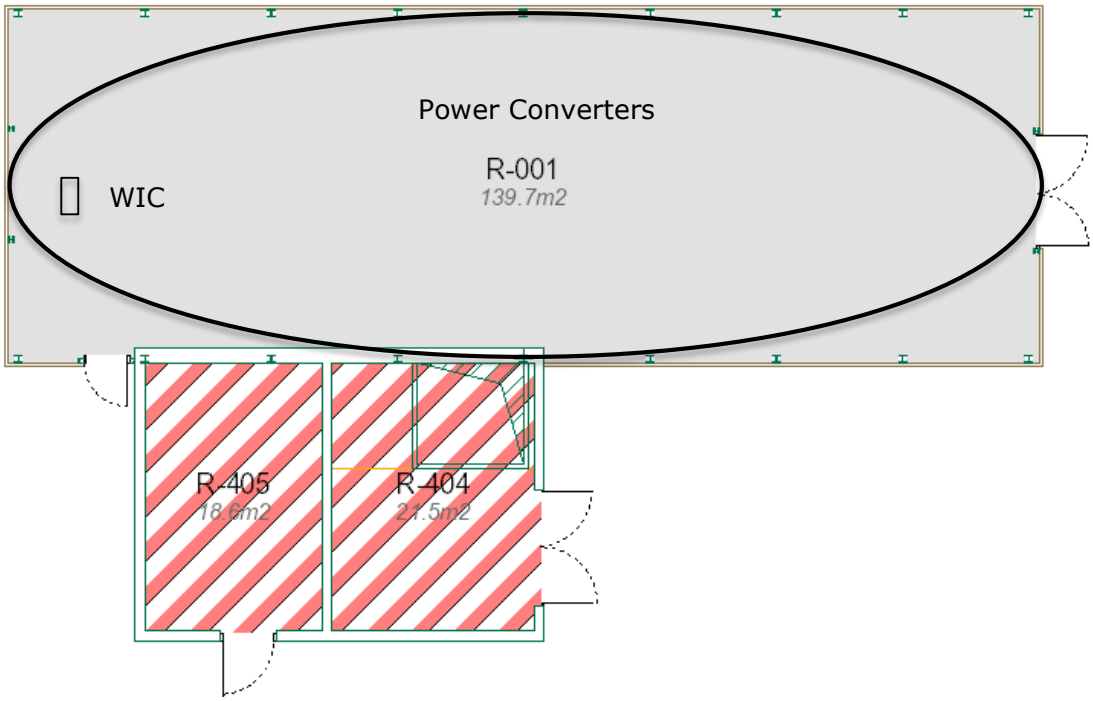
10.1.1.2 195

In the building 195, you'll find the powering system as well as the protection system of the magnets located in the experimental area of the AD.



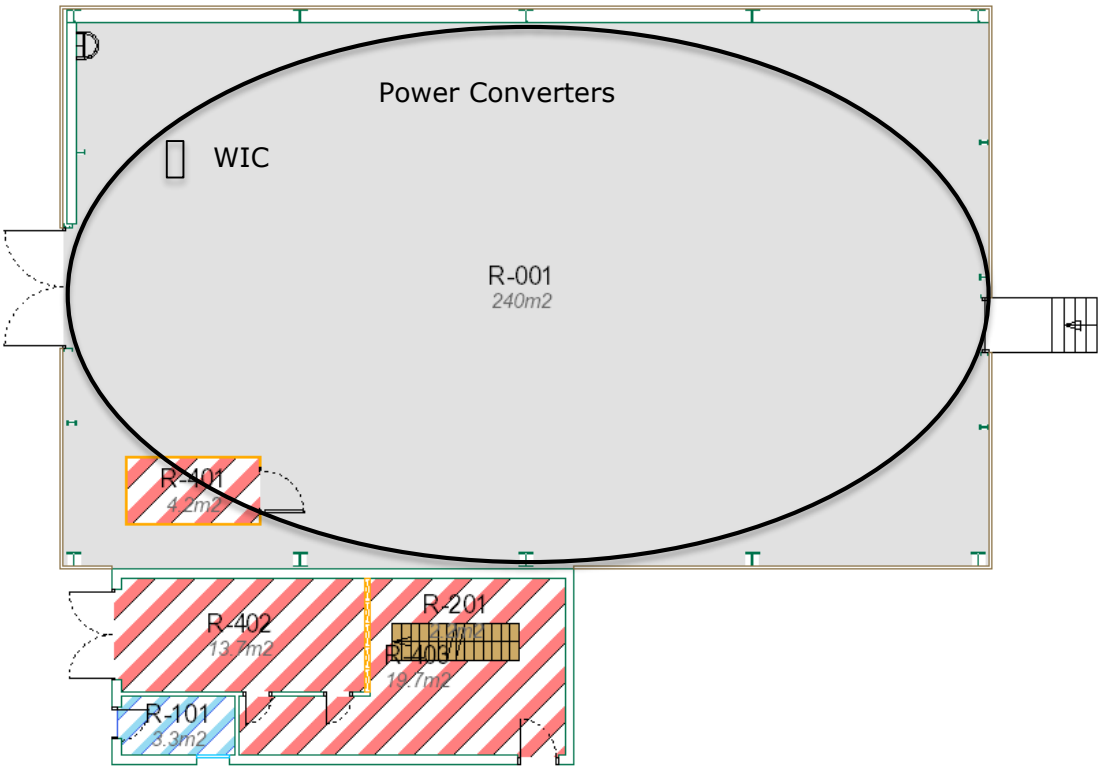
10.1.1.3 366

In the building 366, you'll find the powering system as well as the protection system of the magnets located in the ring of the AD.



10.1.1.4 370

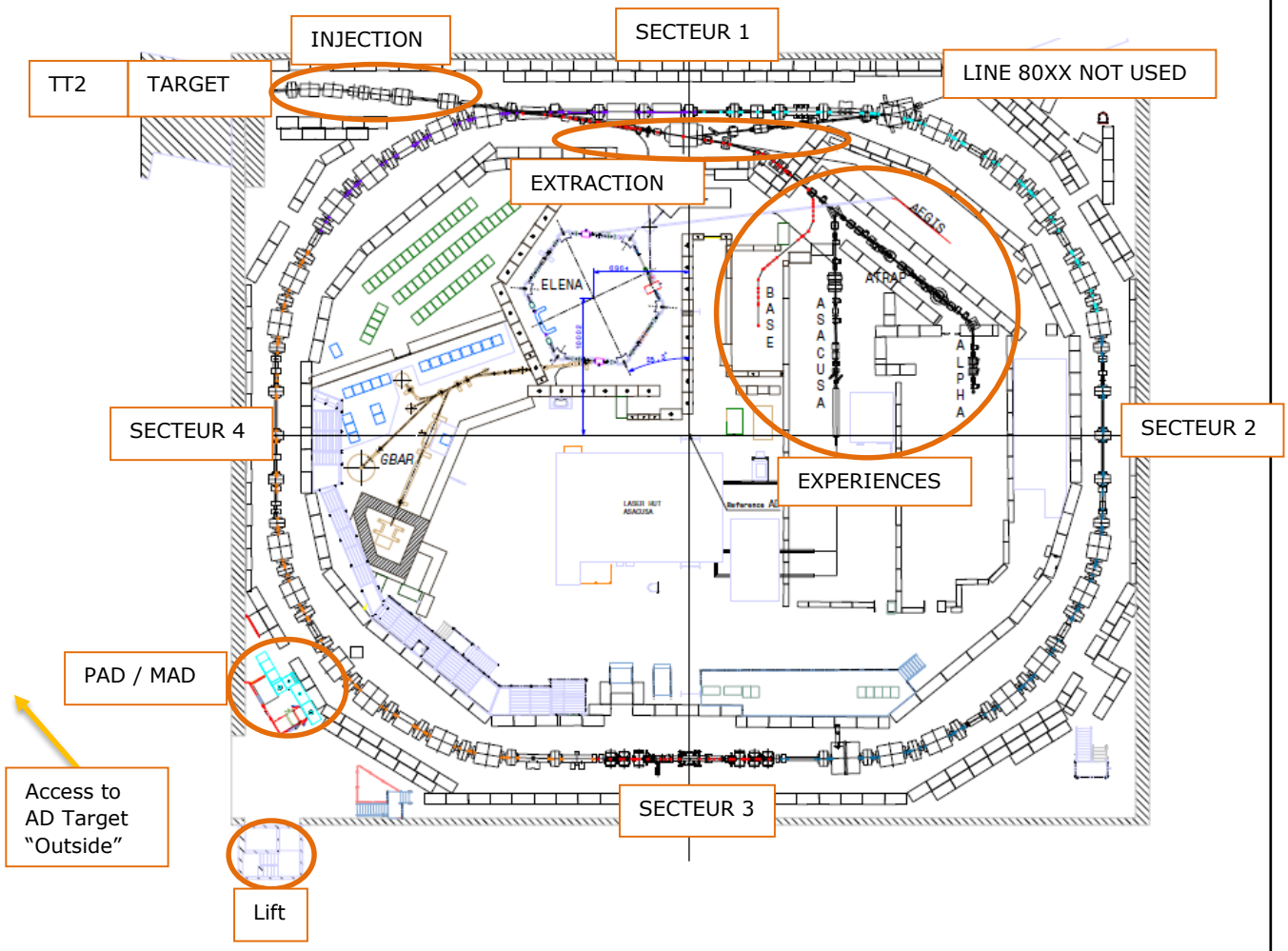
In the building 370, you'll find the powering system as well as the protection system of the magnets located in the target area before the AD, it also contains newly installed systems.



10.1.2 UNDERGROUND

Several magnets which are part of the injection line are located physically in TT2, the access point is the building 269. The TT2 protection system cover all the magnets of the TL up to QDE9010 (first magnet of AD injection line).

The AD-Target area is highly radioactive, the access point is right next to the AD-Hall entrance.



10.2 LIST OF CIRCUITS AND POWER CONVERTERS

10.2.1 TARGET

TARGET - MAGNETS ARE IN AD TARGET					
Magnet	**SK1**	**Protection**	**Building / Rack / Chassis**	**SK2**	**Power Converter**
QDE9050	243552	FTA.QDE9050	193 / RA K203 / C8014	229300	FTA.QDE9050
QFO9052	243553	FTA.QFO9052	193 / RA K203 / C8014	229297	FTA.QFO9052
QDE6010	243391	QDE6010	370 / - / -	243451	DI.QDE6010
QFO6020	243392	QFO6020	370 / - / -	243452	DI.QFO6020
BHZ6024	243393	BHZ6024	370 / - / -	243453	DI.BHZ6024
BHZ6025	243394	BHZ6025	370 / - / -	243454	DI.BHZ6025
QDE6030	243395	QDE6030	370 / - / -	243455	DI.QDE6030
BHZ6034	243396	BHZ6034	370 / - / -	2719508	DI.BHZ6034
BHZ6035	243397	BHZ6035	370 / - / -	2719507	DI.BHZ6035
QFO6040	247498	QFO6040	370 / - / -	233458	DI.QFO6040
BHZ6044	243399	BHZ6044	370 / - / -	2719505	DI.BHZ6044
BHZ6045	243400	BHZ6045	370 / - / -	2719504	DI.BHZ6045
QDE6050	243401	QDE6050	370 / - / -	243461	DI.QDE6050
QFO6060	243402	QFO6060	370 / - / -	243462	DI.QFO6060
BHZ6064	243403	BHZ6064	370 / - / -	243463	DI.BHZ6064
BHZ6065	243404	BHZ6065	370 / - / -	243464	DI.BHZ6065

10.2.2 INJECTION & EXTRACTION

INJECTION LINE [90XX]- MAGNETS ARE IN TT2					
Magnet	**SK1**	**Protection**	**Building / Rack / Chassis**	**SK2**	**Power Converter**
QDE9010	243541	FTA.QDE9010	193 / RA K203 / C8014	229259	FTA.QDE9010
BTI9015	243542	FTA.BTI9015	193 / RA K203 / C8014	229261	FTA.BTI9015S
BTI9016	243543	FTA.BTI9016	193 / RA K203 / C8014	N.C	FTA.BTI9015S
QFO9020	243544	FTA.QFO9020	193 / RA K203 / C8014	229260	FTA.QFO9020
DHZ9028	243545	FTA.DHZ9028	193 / RA K203 / C8014	229262	FTA.DHZ9028
DHZ9029	243546	FTA.DVT9029	193 / RA K203 / C8014	229263	FTA.DVT9029
QDE9030	243547	FTA.QDE9030	193 / RA K203 / C8014	229264	FTA.QDE9030
QFO9040	243548	FTA.QFO9040	193 / RA K203 / C8014	229253	FTA.QFO9040
BVT9044	243549	FTA.BVT9044	193 / RA K203 / C8014	229298	FTA.BVT9044
BVT9045	243550	FTA.BVT9045	193 / RA K203 / C8014	229254	FTA.BVT9045
DHZ9047	243551	FTA.DHZ9047	193 / RA K203 / C8014	229255	FTA.DHZ9047

INJECTION LINE [60XX] - MAGNETS ARE IN AD RING					
Magnet	**SK1**	**Protection**	**Building / Rack / Chassis**	**SK2**	**Power Converter**
DVT6067	243571	DI.DVT6067	193 / RA K203 / C8015	243121	DI.DVT6067
QDE6070	243572	DI.QDE6070	193 / RA K203 / C8015	229241	DI.QDE6070
QFO6080	243573	DI.QFO6080	193 / RA K203 / C8015	229256	DI.QFO6080
DVT6081	243575	DI.DHZ6081	193 / RA K203 / C8015	243122	DI.DHZ6081
DHZ6081	243574	DI.DVT6081	193 / RA K203 / C8015	229242	DI.DVT6081

EXTRACTION LINE [70XX] - MAGNETS ARE IN AD RING					
Magnet	**SK1**	**Protection**	**Building / Rack / Chassis**	**SK2**	**Power Converter**
BHZ7010	2711338	DE.BHZ7010	193 / RA K203 / C8015	229299	DE.BHZ7010-2
DVT7013	2711339	DE.DVT7013	193 / RA K203 / C8015	229231	DE.DVT7013-2
DVT7043	2711343	DE.DVT7043	193 / RA K203 / C8015	243123	DE.QFO7020-2
DHZ7042	2711342	DE.DHZ7042	193 / RA K203 / C8015	224266	DE.DHZ7042
QDE7030	2711341	DE.QDE7030	193 / RA K203 / C8015	243124	DE.QDE7030-2

10.2.3 RING

10.2.3.1 SECTOR 1

AD RING - MAGNETS ARE IN SECTEUR 1					
Magnet	**SK1**	**Protection**	**Building / Rack / Chassis**	**SK2**	**Power Converters**
QFW48	243200	QFW48	366 / RA004 / C7550	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM3
BHW48	243231	BHW48	366 / RA004 / C7559	N.C	DR.BHZ-MAIN & DR.BHZTR48/49
QDW49	243201	QDW49	366 / RA004 / C7550	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM2
BHW49	243232	BHW49	366 / RA004 / C7559	N.C	DR.BHZ-MAIN & DR.BHZTR48/49
QFW50	243202	QFW50	366 / RA004 / C7550	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM3
QDW51	243203	QDW51	366 / RA004 / C7550	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM2
BHN51	243233	BHN51	366 / RA004 / C7559	N.C	DR.BHZ-MAIN & DR.BHZTR51/52
QFW52	243204	QFW52	366 / RA004 / C7550	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM1
BHS52	243234	BHS52	366 / RA004 / C7559	N.C	DR.BHZ-MAIN & DR.BHZTR51/52
QDC53	243205	QDC53	366 / RA004 / C7550	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
QFC54	243206	QFC54	366 / RA004 / C7550	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
DHZ5404	2712573A	DHZ5404	366 / RA005 / C8051	2712666	DR.DHZ5404
DVT5408	2712574A	DVT5408	366 / RA005 / C8051	2712667	DR.DVT5408
QDN55	243207	QDN55	366 / RA004 / C7550	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
QFN56	243208	QFN56	366 / RA004 / C7550	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
QDN01	243151	QDN01	366 / RA004 / C7548	243151	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
QFN02	243152	QFN02	366 / RA004 / C7548	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
DHZ0204	2712575	DHZ0204	366 / RA005 / C8051	2712668	DR.DHZ0204
DVT0208	2712593	DVT0208	366 / RA005 / C8051	2712669	DR.DVT0208
QDN03	243153	QDN03	366 / RA004 / C7548	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
QFN04	243154	QFN04	366 / RA004 / C7548	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
QDN05	243155	QDN05	366 / RA004 / C7548	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
BHN05	243211	BHN05	366 / RA004 / C7548	243282	DR.BHZ-MAIN & DR.BHZTR05/06
QFW06	243156	QFW06	366 / RA004 / C7548	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM1
BHN06	243212	BHN06	366 / RA004 / C7548	N.C	DR.BHZ-MAIN & DR.BHZTR05/06
QDW07	243157	QDW07	366 / RA004 / C7548	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM2
QFW08	243158	QFW08	366 / RA004 / C7548	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM3
BHW08	243213	BHW08	366 / RA004 / C7548	N.C	DR.BHZ-MAIN & DR.BHZTR08/09
QDW09	243159	QDW09	366 / RA004 / C7548	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM2
BHW09	243214	BHW09	366 / RA004 / C7548	N.C	DR.BHZ-MAIN & DR.BHZTR08/09

QFW10	243160	QFW10	366 / RA004 / C7548	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM3

10.2.3.2 SECTOR 2

AD RING - MAGNETS ARE IN SECTEUR 2					
Magnet	**SK1**	**Protection**	**Building / Rack / Chassis**	**SK2**	**Power Converters**
QDW11	243161	QDW11	366 / RA004 / C7548	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM2
BHN11	243215	BHN11	366 / RA004 / C7548	N.C	DR.BHZ-MAIN & DR.BHZTR11/12
QFW12	243162	QFW12	366 / RA004 / C7548	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM1
BHN12	243216	BHN12	366 / RA004 / C7548	N.C	DR.BHZ-MAIN & DR.BHZTR11/12
QDN13	243163	QDN13	366 / RA004 / C7548	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
DVT1304	2712742	DVT1304	366 / RA005 / C8051	2712670	DR.DVT1304
QFN14	243164	QFN14	366 / RA004 / C7548	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
QSK1404	243235	QSK1404	366 / RA005 / C8051	?	DR.QSK1404
QDN15	243165	QDN15	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
QFN16	243166	QFN16	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
DVT1608	2712743	DVT1608	366 / RA005 / C8051	2712671	DR.DVT1608
QDN17	243167	QDN17	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
BHN17	243217	BHN17	366 / RA004 / C7548	N.C	DR.BHZ-MAIN & DR.BHZTR17/18
QFW18	243168	QFW18	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM1
BHN18	243218	BHN18	366 / RA004 / C7548	N.C	DR.BHZ-MAIN & DR.BHZTR17/18
QDW19	243169	QDW19	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM2
QFW20	243170	QFW20	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM3
BHW20	243219	BHW20	366 / RA004 / C7548	N.C	DR.BHZ-MAIN & DR.BHZTR20/21
QDW21	243171	QDW21	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM2
BHW21	243220	BHW21	366 / RA004 / C7548	N.C	DR.BHZ-MAIN & DR.BHZTR20/21
QFW22	243172	QFW22	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM3
QDW23	243173	QDW23	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM2
BHW23	243221	BHW23	366 / RA004 / C7548	N.C	DR.BHZ-MAIN & DR.BHZTR23/24
QFW24	243174	QFW24	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM1
BHN24	243222B	BHN24	366 / RA004 / C7548	N.C	DR.BHZ-MAIN & DR.BHZTR23/24
QDN25	243175	QDN25	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
QFN26	243176	QFN26	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
DVT2608	2712594	DVT2608	366 / RA005 / C8051	2712672	DR.DVT2608

10.2.3.3 SECTOR 3

AD RING - MAGNETS ARE IN SECTEUR 3					
Magnet	**SK1**	**Protection**	**Building / Rack / Chassis**	**SK2**	**Power Converters**
QDN27	243177	QDN27	366 / RA004 / -	2712335	DR.QUAD-MAIN2
QDN28	2711725	QDN28	366 / RA004 / -	N.C	DR.QUAD-MAIN2
QFN29A	243178	QFN29A	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM5
DVT2904	2712596	DVT2904	366 / RA005 / C8051	2712674	DR.DVT2904
DHZ2904	2712595	DR.DHZ2904	370 / - / -	2714854	DR.DHZ2904
DHZ2908	2712597	DR.DHZ2908	370 / - / -	2714850	DR.DHZ2908
DHZ2913	2712598	DR.DHZ2913	370 / - / -	2714849	DR.DHZ2913

DHZ2917	2712599	DR.DHZ2917	370 / - / -	2714855	DR.DHZ2917
DVT2917	2712600	DVT2917	366 / RA005 / C8051	2712678	DR.DVT2917
QFN29B	243182	QFN29B	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM5
QDN30	243181	QDN30	366 / RA004 / -	N.C	DR.QUAD-MAIN2
QDN31	243183	QDN31	366 / RA004 / -	N.C	DR.QUAD-MAIN2
DVT3105	2712664	DVT3105	366 / RA005 / C8051	2712679	DR.DVT3105
SOL3106	2715466	EC Sol 3106	193 / RA K203 / C8015	2715468	DR.SCOMP3106

10.2.3.4 SECTOR 4

AD RING - MAGNETS ARE IN SECTEUR 4					
Magnet	**SK1**	**Protection**	**Building / Rack / Chassis**	**SK2**	**Power Converters**
QFN32	243184	QFN32	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
QDN33	243185	QDN33	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
BHN33	243223	BHN33	366 / RA004 / C7548	N.C	DR.BHZ-MAIN & DR.BHZTR33/34
QFW34	243186	QFW34	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM1
BHN34	243224	BHN34	366 / RA004 / C7548	N.C	DR.BHZ-MAIN & DR.BHZTR33/34
QDW35	243187	QDW35	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM2
QFW36	243188	QFW36	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM3
BHW36	243225	BHW36	366 / RA004 / C7559	N.C	DR.BHZ-MAIN & DR.BHZTR36/37
QDW37	243189	QDW37	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM2
BHW37	243226	BHW37	366 / RA004 / C7559	N.C	DR.BHZ-MAIN & DR.BHZTR36/37
QFW38	243190	QFW38	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM3
QDW39	243191	QDW39	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM2
BHN39	243227	BHN39	366 / RA004 / C7559	N.C	DR.BHZ-MAIN & DR.BHZTR39/40
QFW40	243192	QFW40	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM1
BHN40	243228	BHN40	366 / RA004 / C7559	N.C	DR.BHZ-MAIN & DR.BHZTR39/40
QDN41	243193	QDN41	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
XRC4108	243237	XRC4108	366 / RA004 / C7559	N.C	DR.XRC16+41
QFN42	243194	QFN42	366 / RA004 / C7549	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
QDN43	243195	QDN43	366 / RA004 / C7550	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
QSK4308	243238	QSK4308	366 / RA005 / C8051	2712675	DR.QSK4308
QFN44	243196	QFN44	366 / RA004 / C7550	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
DVT4408	2712741	DVT4408	366 / RA005 / C8051	2712665	DR.DVT4408
QDN45	243197	QDN45	366 / RA004 / C7550	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM4
BHN45	243229	BHN45	366 / RA004 / C7559	N.C	DR.BHZ-MAIN & DR.BHZTR45/46
QFW46	243198	QFW46	366 / RA004 / C7550	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM1
BHN46	243230	BHN46	366 / RA004 / C7559	N.C	DR.BHZ-MAIN & DR.BHZTR45/46
QDW47	243199	QDW47	366 / RA004 / C7550	N.C	DR.QUAD-MAIN1 & DR.QUAD-TRIM2

10.2.4 EXPERIENCES

10.2.4.1 DE0

EXPERIENCE LINE [DE0] - MAGNETS ARE IN AD HALL					
Magnet	**SK1**	**Protection**	**Building / Rack / Chassis**	**SK2**	**Power Converter**

DE0.BHZ12	2711286	DE0.BHZ12	195 / RYX AD 19 / C8021.1	2711232	DE0.BHZ12
DE0.DHZ35	2711287	DE0.DHZ35	195 / RYX AD 19 / C8021.1	2711234	DE0.DHZ35
DE0.DVT35	2711288	DE0.DVT35	195 / RYX AD 19 / C8021.1	2711238	DE0.DVT35
DE0.QN40	2711292	DE0.QN40	195 / RYX AD 19 / C8021.1	2711239	DE0.QN40
DE0.DHZ45	2711293	DE0.DHZ45	195 / RYX AD 19 / C8021.1	2711240	DE0.DHZ45
DE0.DVT45	2711294	DE0.DVT45	195 / RYX AD 19 / C8021.1	2711241	DE0.DVT45
DE0.QN50	2711295	DE0.QN50	195 / RYX AD 19 / C8021.1	2711242	DE0.QN50
DE0.QN60	2711296	DE0.QN60	195 / RYX AD 19 / C8021.1	2711243	DE0.QN60
DE0.QN70	2711297	DE0.QN70	195 / RYX AD 19 / C8021.1	2711243	DE0.QN70
DE0.QN80	2711298	DE0.QN80	195 / RYX AD 19 / C8021.1	2711244	DE0.QN80
DE0.DHZ85	2711299	DE0.DHZ85	195 / RYX AD 19 / C8021.2	2711245	DE0.DHZ85
DE0.DVT85	2711300	DE0.DVT85	195 / RYX AD 19 / C8021.2	2711246	DE0.DVT85
DE0.QN90	2711301	DE0.QN90	195 / RYX AD 19 / C8021.2	2711247	DE0.QN90
DE0.QN100	2711302	DE0.QN100	195 / RYX AD 19 / C8021.2	2711248	DE0.QN100
Q4202	2711285	DE0.QN10	195 / RYX AD 19 / C8021.1	2711231	DE0.QN10
DE0QN30	2711291	DE0.QN30	195 / RYX AD 19 / C8021.1	2711237	DE0.QN30
DE0QN20	2711290	DE0.QN20	195 / RYX AD 19 / C8021.1	2711236	DE0.QN20
DE0BHZ18	2711289	DE0.BHZ18	195 / RYX AD 19 / C8021.1	2711235	DE0.BHZ18

10.2.4.2 DE1

EXPERIENCE LINE [DE1] - MAGNETS ARE IN AD HALL					
Magnet	**SK1**	**Protection**	**Building / Rack / Chassis**	**SK2**	**Power Converter**
DE1.BHZ10	2711303	DE1.BHZ10	195 / RYX AD 19 / C8021.2	2711249	DE1.BHZ10
DE1.QN20	2711304	DE1.QN20	195 / RYX AD 19 / C8021.2	2711250	DE1.QN20
DE1.DHZ25	2711305	DE1.DHZ25	195 / RYX AD 19 / C8021.2	2711251	DE1.DHZ25
DE1.DVT25	2711306	DE1.DVT25	195 / RYX AD 19 / C8021.2	2711252	DE1.DVT25
DE1.QN30	2711307	DE1.QN30	195 / RYX AD 19 / C8021.2	2711253	DE1.QN30
DE1.QN40	2711308	DE1.QN40	195 / RYX AD 19 / C8021.2	2711254	DE1.QN40
DE1.DHZ28	2711309	DE1.DHZ28	195 / RYX AD 19 / C8021.2	2711255	DE1.DHZ28
DE1.DVT28	2711310	DE1.DVT28	195 / RYX AD 19 / C8021.2	2711256	DE1.DVT28
DE1.QN50	2711331	DE1.QN50	195 / RYX AD 19 / C8021.4	2711258	DE1.QN50
DE1.QN60	2711332	DE1.QN60	195 / RYX AD 19 / C8021.4	2711259	DE1.QN60

10.2.4.3 DE2

EXPERIENCE LINE [DE2] - MAGNETS ARE IN AD HALL					
Magnet	**SK1**	**Protection**	**Building / Rack / Chassis**	**SK2**	**Power Converter**
DE2.BHZ10	2711311	DE2.BHZ10	195 / RYX AD 19 / C8021.2	2711257	DE2.BHZ10
DE2.DHZ15	2711312	DE2.DHZ15	195 / RYX AD 19 / C8021.2	2711277	DE2.DHZ15
DE2.DVT15	2711313	DE2.DVT15	195 / RYX AD 19 / C8021.3	2711278	DE2.DVT15
DE2.QN20	2711314	DE2.QN20	195 / RYX AD 19 / C8021.3	2711260	DE2.QN20
DE2.QN30	2711315	DE2.QN30	195 / RYX AD 19 / C8021.3	2711261	DE2.QN30
DE2.DHZ35	2711316	DE2.DHZ35	195 / RYX AD 19 / C8021.3	2711279	DE2.DHZ35
DE2.DVT35	2711317	DE2.DVT35	195 / RYX AD 19 / C8021.3	2711280	DE2.DVT35

10.2.4.4 DE3

EXPERIENCE LINE [DE3] - MAGNETS ARE IN AD HALL					
Magnet	**SK1**	**Protection**	**Building / Rack / Chassis**	**SK2**	**Power Converter**
DE3.QN20	2711319	DE3.QN20	195 / RYX AD 19 / C8021.3	2711281	DE3.QN20
DE3.BVT10	2711318	DE3.BVT10	195 / RYX AD 19 / C8021.3	2711264	DE3.BVT10
DE3.BVT25	2711320	DE3.BVT25	195 / RYX AD 19 / C8021.3	2711266	DE3.BVT25

10.2.4.5 DE4

EXPERIENCE LINE [DE4] - MAGNETS ARE IN AD HALL					
Magnet	**SK1**	**Protection**	**Building / Rack / Chassis**	**SK2**	**Power Converter**
DE4.BVT10	2711321	DE4.BVT10	195 / RYX AD 19 / C8021.3	2711267	DE4.BVT10
DE4.QN20	2711322	DE4.QN20	195 / RYX AD 19 / C8021.3	2711282	DE4.QN20
DE4.BVT25	2711323	DE4.BVT25	195 / RYX AD 19 / C8021.3	2711269	DE4.BVT25

10.2.4.6 DEM

EXPERIENCE LINE [DEM] - MAGNETS ARE IN AD HALL					
Magnet	**SK1**	**Protection**	**Building / Rack / Chassis**	**SK2**	**Power Converter**
DEM.DVT52	2718487	DEM.DVT52	195 / RYX AD 19 / C8021.4	2718494	DEM.DVT52
DEM.DHZ52	2718486	DEM.DHZ52	195 / RYX AD 19 / C8021.4	2718493	DEM.DHZ52
DEM.BHZ35	2718490	DEM.BHZ35	195 / RYX AD 19 / C8021.4	2718497	DEM.BHZ35
DEM.QN50	2718489	DEM.QN50	195 / RYX AD 19 / C8021.4	2718496	DEM.QN50
DEM.QN40	2718488A	DEM.QN40	195 / RYX AD 19 / C8021.4	2718495	DEM.QN40
DEM.DVT10	2715943A	DEM.DVT10	195 / RYX AD 19 / C8021.3	2711276	DEM.DVT10
TYPE1HD	2715942A	DEM.DHZ10	195 / RYX AD 19 / C8021.3	2711270	DEM.DHZ10
QNP02/2	2711326	DEM.QN30	195 / RYX AD 19 / C8021.3	2715325	DEM.QN30
DHZ32	2718484A	DEM.DHZ32	195 / RYX AD 19 / C8021.4	2718491	DEM.DHZ32
DVT32	2718485A	DEM.DVT32	195 / RYX AD 19 / C8021.4	2718492	DEM.DVT32
QNP02A-1	2711324	DEM.QN20	195 / RYX AD 19 / C8021.3	2715324	DEM.QN20

10.3 NON CONFORMITIES

Those power converters are on the list transmitted by EPC but their associated magnet doesn't possess any kind of thermal protection as it is not included in the legacy interlock system.

Power Converter	STATUS	RESPONSIBLE
DE.DVT7043	INSTALLED	Emilien Coulot
DE0.DHZ87	INSTALLED	Jean-Luc Blanc
DE1.DHZ110	INSTALLED	Christophe Machado
DE1.DVT110	INSTALLED	Christophe Machado
DE1.DHZ120	INSTALLED	Christophe Machado
DE1.DVT120	INSTALLED	Christophe Machado
DE1.QDN130	INSTALLED	Stephane Joffe
DE1.QDN140	INSTALLED	Stephane Joffe
DE1.LESSOL3	INSTALLED	Christophe Machado
DE1.RFQ	INSTALLED	Julien Parra-Loppez
DE1.RFQ-SN01	INSTALLED	Christophe Machado
DE1.RFQ-SN02	INSTALLED	Christophe Machado
DE1.DHZ65	INSTALLED	Jean-Luc Blanc
DE1.DHZ67	INSTALLED	Jean-Luc Blanc

DE1.DVT65	INSTALLED	Jean-Luc Blanc
DE1.DVT67	INSTALLED	Jean-Luc Blanc
DE5.BHZ10	IN MANUFACTURING	Jean-Luc Blanc
DE5.BHZ25	IN MANUFACTURING	Jean-Luc Blanc
DE5.BHZ35	IN MANUFACTURING	Jean-Luc Blanc
DE5.DHZ38	IN MANUFACTURING	Jean-Luc Blanc
DE5.DVT28	IN MANUFACTURING	Jean-Luc Blanc
DE5.DVT33	IN MANUFACTURING	Jean-Luc Blanc
DE5.DVT38	IN MANUFACTURING	Jean-Luc Blanc
DE5.QN20	IN MANUFACTURING	Jean-Luc Blanc
DE5.QN30	IN MANUFACTURING	Jean-Luc Blanc
DE5.QN40	IN MANUFACTURING	Jean-Luc Blanc
DR.EC-CBH	SPARE	Christophe Machado
DR.EC-CBV	INSTALLED	Christophe Machado
DR.EC-CDH	INSTALLED	Christophe Machado
DR.EC-DBG	INSTALLED	Christophe Machado
DR.EC-DBH	INSTALLED	Christophe Machado
DR.EC-DBV	INSTALLED	Christophe Machado
DR.EC-DCHV	INSTALLED	Christophe Machado
DR.EC-GBH	INSTALLED	Christophe Machado
DR.EC-GBV	INSTALLED	Christophe Machado
DR.EC-TBH	INSTALLED	Christophe Machado
DR.EC-TBV	INSTALLED	Christophe Machado
DR.EC-UBH	INSTALLED	Christophe Machado
DR.EC-UBV	INSTALLED	Christophe Machado
DR.ECIBBC1	INSTALLED	Christophe Machado
DR.ECIBBC2	INSTALLED	Christophe Machado
DR.ECISTRF	INSTALLED	Christophe Machado
DR.ECVCATODE	INSTALLED	Christophe Machado
DR.ECVREPELLER	INSTALLED	Christophe Machado
DR.ECIFILAMENT	INSTALLED	Gilles Simonet
DR.SMI5306	INSTALLED	Sven Putz
DR.SME5307	INSTALLED	Stephane Joffe
DR.SME5307.SPARE1	SPARE	Stephane Joffe
DR.SCOMP2607	INSTALLED	Emilien Coulot
DR.ECVCOLLECTOR	INSTALLED	Julien Parra-Loppez
DR.ECISOLENOID	INSTALLED	Emilien Coulot
F16.BTI247S	INSTALLED	Christophe Mutin

Several protections crates does not respect the family positions and it might be useful to move them to the right building but EPC might need to move their power converter with the protection.

MAGNET NAME	CABLE ID	CURRENT LOCATION	NEW LOCATION
QDE9050	243552	BLDG. 193	BLDG. 370
QFO9052	243553	BLDG. 193	BLDG. 370
DHZ2904	2712595	BLDG. 370	BLDG. 366
DHZ2908	2712597	BLDG. 370	BLDG. 366
DHZ2913	2712598	BLDG. 370	BLDG. 366
DHZ2917	2712599	BLDG. 370	BLDG. 366

To keep a good structure, the names of the two first magnets should be changed as well as the location of the Power Converter corresponding to their family and emplacement (part of FTA line).

10.4 REQUIERMENTS SUMMARY

As a consequence of the number of magnets and power converters to be supervised, the following requirements regarding the WIC architecture are proposed for the AD interlock system, which will be scattered between four different building (if nothing change from EPC).

Basically, this is a rough estimation of the number of I/Os required. We calculated it on the basis that all the magnets are going to receive a "two way interlock boxes".

10.4.1 INJECTION / EXTRACTION (193)

ACRONYME	EQUIPMENTS	QUANTITY	INPUTS QTY	OUTPUTS QTY
BHZ	Horizontal Bending Dipole	1	2	2
BVT	Vertical Bending Dipole	2	4	4
BTI	"Split" Bending Dipole	2	4	4
QDE	Defocusing Quadrupole	4	8	8
QFO	Focusing Quadrupole	3	6	6
DHZ / DVT	H/V Corrector Decapole	9	18	18
-	Power Converters	21	21	42
-	Beam Interlock System	0	0	0
TOTAL (required - magnets)			***42***	***42***
TOTAL (required – power converters)			***21***	***42***

10.4.2 EXPERIMENTS (195)

ACRONYME	EQUIPMENTS	QUANTITY	INPUTS QTY	OUTPUTS QTY
BHZ	Horizontal Bending Dipole	5	10	10
BVT	Vertical Bending Dipole	4	8	8
QN	Focusing / Defocusing Quadrupole	20	40	40
QNP	Quadrupole ?	2	4	4
DHZ / DVT	H/V Corrector Decapole	19	38	38
-	Others (Type1HD, Q4202)	2	4	4
-	Power Converters	52	52	104
-	Beam Interlock System	0	0	0
TOTAL (required - magnets)			***104***	***104***
TOTAL (required – power converters)			***52***	***104***

10.4.3 RING (366)

ACRONYME	EQUIPMENTS	QUANTITY	INPUTS QTY	OUTPUTS QTY
BH	Horizontal Bending Dipole	24	48	48
QF	Focusing Quadrupole	28	56	56
QD	Defocusing Quadrupole	29	58	58
QSK	Skew Quadrupole	2	4	4
DH / DV	H / V Corrector Decapole	15	30	30
SOL	Solenoid	1	2	2
XRC	Sextupole	1	2	2
-	Power Converters	54	54	108
-	Beam Interlock System	0	0	0
TOTAL (required - magnets)			***200***	***200***
TOTAL (required – power converters)			***54***	***108***

10.4.4 TARGET (370)

ACRONYME	EQUIPMENTS	QUANTITY	INPUTS QTY	OUTPUTS QTY
BHZ	Horizontal Bending Dipole	8	16	16
QDE	Defocusing Quadrupole	4	8	8
QFO	Focusing Quadrupole	4	8	8
-	Power Converters	16	16	32
-	Beam Interlock System	0	0	0
TOTAL (required - magnets)			***32***	***32***
TOTAL (required – power converters)			***16***	***32***

10.5 WIC AD

10.5.1 INJECTION / EXTRACTION (193)

The power converters, and so the associated protection system are scattered between four building. We propose to put one controller next to the AD control room (for the "SCADA" communication), and to pull some "Profibus" cable between the others interlock racks.

RACK AD - INJECTION / EXTRACTION

CRATE 1 : WIC GENERIC "POWER SUPPLY"

CRATE 2 : WIC GENERIC "CONTROLLER"

CRATE 3 : WIC GENERIC "POWER CONVERTERS"

PATCH 1 : WIC GENERIC "POWER CONVERTERS" 1xB48P & 6xB8P & 24xB12P

10.5.2 EXPERIMENTS (195)

As a consequence of the number of crates to be installed in the building 195, we have to split our configuration between two racks. We propose to dedicate one rack for collecting the magnets statuses, and one rack for receiving the power statuses and sending the power permit via patches to the power converters.

RACK AD – EXPERIMENTS "MAGNETS"

CRATE 1 : WIC GENERIC "POWER SUPPLY"
CRATE 2 : WIC GENERIC "MAGNETS"
CRATE 3 : WIC GENERIC "MAGNETS"
CRATE 4 : WIC GENERIC "MAGNETS"

RACK AD – EXPERIMENTS "POWER CONVERTERS"

CRATE 2 : WIC GENERIC "POWER CONVERTERS"
CRATE 3 : WIC GENERIC "POWER CONVERTERS"
CRATE 4 : WIC GENERIC "POWER CONVERTERS"
PATCH 1 : WIC GENERIC "POWER CONVERTERS" 1xB48P & 6xB8P & 24xB12P
PATCH 2 : WIC GENERIC "POWER CONVERTERS" 1xB48P & 6xB8P & 24xB12P
PATCH 3 : WIC GENERIC "POWER CONVERTERS" 1xB48P & 6xB8P & 24xB12P

10.5.3 RING (366)

As a consequence of the number of crates to be installed in the building 195, we have to split our configuration between two racks. We propose to dedicate one rack for collecting the magnets statuses, and one rack for receiving the power statuses and sending the power permit via patches to the power converters.

RACK AD – RING "MAGNETS"

CRATE 1 : WIC GENERIC "POWER SUPPLY"
CRATE 2 : WIC GENERIC "MAGNETS"
CRATE 3 : WIC GENERIC "MAGNETS"
CRATE 4 : WIC GENERIC "MAGNETS"
CRATE 5 : WIC GENERIC "MAGNETS"
CRATE 6 : WIC GENERIC "MAGNETS"

RACK AD – RING "POWER CONVERTERS"

CRATE 2 : WIC GENERIC "POWER CONVERTERS"
CRATE 3 : WIC GENERIC "POWER CONVERTERS"
CRATE 4 : WIC GENERIC "POWER CONVERTERS"
PATCH 1 : WIC GENERIC "POWER CONVERTERS" 1xB48P & 6xB8P & 24xB12P
PATCH 2 : WIC GENERIC "POWER CONVERTERS" 1xB48P & 6xB8P & 24xB12P
PATCH 3 : WIC GENERIC "POWER CONVERTERS" 1xB48P & 6xB8P & 24xB12P

10.5.4 TARGET (370)

The « AD TARGET » might be renovated before the others part of the installation. So we might use temporarily one generic controller in place of the generic magnets for the SCADA communication in waiting of the completion of the installation.

RACK AD - TARGET

CRATE 1 : WIC GENERIC "POWER SUPPLY"
CRATE 2 : WIC GENERIC "MAGNETS"
CRATE 3 : WIC GENERIC "POWER CONVERTERS"
PATCH 1 : WIC GENERIC "POWER CONVERTERS" 1xB48P & 6xB8P & 24xB12P

10.6 CABLING

For reducing the amount of cables (and so the cost) that have to be pulled by EN-EL, the decision has been taken to transmit the magnets statuses via 4P/8P Burndy connectors (depending on whether we use one/two or four way interlock boxes) to local patch panels located in the ring. Then those patches, will be connected to the control crates on the surface using 48P Burndy copper cable.

The estimate number of patches is al follows:

- 4 patches for "AD-Target & Injection/Extraction"
- 9 patches for "AD-Ring"
- 5 patches for "AD-Experiments"

The exact location hasn't been decided, as it is not a final conceptual study, the power converters & the magnets might incur changes.

10.6.1.1 MAGNETS TO PATCH

Depending on whether, the magnet requires a one way or two way interlock boxes (regarding if there is a flow-meters or not and if they are in series), the cabling convention for the connection between the magnet interlock boxes and the patch-panel is mapped as follow.

Burndy NE4:

Name	NE04 cable (right)
ST_MAG_OVERTEMP1 +	1
ST_MAG_OVERTEMP1 -	2
CMD_MAG_OVERTEMP1_TEST +	3
CMD_MAG_OVERTEMP1_TEST -	4

Burndy NE8:

Name	NE08 cable (right)
ST_MAG_OVERTEMP1 +	1
ST_MAG_OVERTEMP1 -	2
CMD_MAG_OVERTEMP1_TEST +	3
CMD_MAG_OVERTEMP1_TEST -	4
ST_MAG_OVERTEMP2 +	5
ST_MAG_OVERTEMP2 -	6
CMD_MAG_OVERTEMP2_TEST +	7
CMD_MAG_OVERTEMP2_TEST -	8

10.6.1.2 PATCH TO WIC

Those patches, gather the magnet statuses and the magnet remote control using the NE4, NE8 or NE18 "Burndy" connector listed above and will then, bring and pack them up using 48Pins Burndy connectors for bringing it to the controller on the surface.

10.6.1.3 WIC TO POWER CONVERTERS

The connection between the WIC and the power converter (for both P.C permit and P.C status) is done using patch panels (located directly in the rack) and NE10 copper cable with twelve pins Burndy connectors (following the EN-EL convention MCI13).

Name	PC side or WIC side	NE 10 cable
ST_FAILURE_WIC +	Pin 1	1
ST_FAILURE_WIC -	Pin 2	2
Spare	Pin 5	3
Spare	Pin 6	4
CMD_FABORT_WIC +	Pin 7	5
CMD_FABORT_WIC -	Pin 8	6
Spare	Pin 9	7
Spare	Pin 10	8
Spare	Pin 11	9
Spare	Pin 12	10

10.6.1.4 WIC TO BIS

As it is not enough to cut the power in case of thermal failure, we also have to request a beam dump/inhibit. A redundant connection with the beam interlock system, is done using a Burndy NE8 cable and is mapped as follow. With the latest version of the generic firmware, it's now possible to connect four BIS to one WIC controller crate for independent dumps request.

Burndy NE8:

Name	NE 8 cable (right)
GROUND	1
USER_PERMIT_A +	2
USER_PERMIT_A -	3
USER_PERMIT_B +	4
USER_PERMIT_B –	5
GROUND	6
Spare	7
Spare	8

11. APPENDIX – HYPERLINK

11.1 VISIT REPORT – 27022013

- G:\Projects\MagnetInterlocks\WIC AD\Documentation\OLD\AD_Visit__27022013.docx

11.2 MAGNETS & POWER CONVERTERS

- G:\Projects\MagnetInterlocks\WIC AD\Documentation\AD DATAS.xlsx
- G:\Projects\MagnetInterlocks\WIC AD\Documentation\AD P.C DATA.xlsx

11.3 BUDGET

- G:\Projects\MagnetInterlocks\WIC AD\Documentation\AD BUDGET.xlsx

11.4 SCHEDULE

- This section has been left empty, as the consolidation hasn't been fully accepted and is foreseen for LS3, no detailed planning are currently available.

11.5 WIC DESIGN

- G:\Projects\MagnetInterlocks\WIC AD\Documentation\WIC Generic\WIC Generic Crates.vsd

11.6 RACK CONFIGURATION

- G:\Projects\MagnetInterlocks\WIC AD\Documentation\AD CONFIG.vsd
- G:\Projects\MagnetInterlocks\WIC AD\Documentation\AD IO ESTIMATION.xlsx

11.7 DEC

- G:\Projects\MagnetInterlocks\WIC AD\Documentation\AD DEC.xlsx

11.8 DIC

- G:\Projects\MagnetInterlocks\WIC AD\Documentation\AD DIC.xlsx

12. REFERENCES - HYPERLINK

12.1 MAGNETS - DATABASE

- https://norma-db.web.cern.ch/

12.2 POWER CONVERTERS - DATABASE

- https://te-dep-epc-databases.web.cern.ch/Default.aspx

12.3 INFRASTRUCTURE / LAYOUT

- https://layout.web.cern.ch/default.aspx?version=study&navigator=machine&id=&name=
- http://gs-dep.web.cern.ch/en/content/isp