



HSE

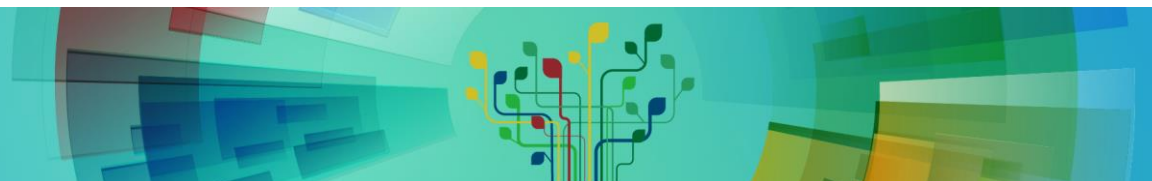
Occupational Health & Safety  
and Environmental Protection unit



# Safety at FAIR Magnet Test Station

Collaboration kick-off meeting

A. Henriques  
*HSE Unit*  
4<sup>th</sup> July 2019



# Outline

- Recap on Safety at FAIR Test Stand
  - Safety Requirements
- Design phase
  - Risk Assessment
  - Action plan
  - Safety Review
- Commissioning phase
  - Main Safety aspects
  - On-site visits
- Open points
- Summary

# Recap on Safety at FAIR Test Stand

- October 2013 – Nominated as HSE (Safety) correspondent
- Main hazards identified:



**Electrical**



**Cryogenics**



**Magnetic fields**



**Environment  
protection**



**Metallic  
structures**

- April 2014 - Launch Safety Agreement (Safety Requirements)
- 3 different project leaders / technical coordinators – good transfer of Safety in between the different interlocutors

# Safety Requirements

- Safety Requirements were established early in the project



- Launch Safety Agreement – FAIR Magnet test station [EDMS N. 1364870](#)

- Hazards Identification
- Safety Requirements applicable to the project
- Documents necessary for “Safety File”

<https://edms.cern.ch/project/FAIR-000002179>



Risk Assessment during Design phase

# Design Phase

EDMS N. 1578374

- Risk Assessment performed by the Project team with support from HSE

Risk assessment	
<p><b>Objective:</b> The purpose of this document is to evaluate all the risks to the Safety and health of workers from the installation and operation of the FAIR FRS Magnet Test Station in B180 and define control measures related to these risks according to Directive 89/391/EC and CERN SR-M.</p> <p><b>Frame:</b> High level overview of project risks to be considered for elimination, prevention or mitigation during design/installation phase to ensure safe installation and operation of the test station</p>	
<p><b>DEFINITION OF THE PERIMETER OF THE ANALYSIS OF INSTALLATION AND COMMISSIONING OF B180 FAIR MAGNET TEST STATION</b></p>	
<p><b>Start date:</b> 3/11/15</p>	<p><b>Completion date:</b> 10/01/17</p>
<p><b>Location:</b> B180 - FAIR Magnet Test Station</p>	<p><b>Department/Group:</b> TE CRG ME</p>
<p><b>DSO:</b> Thomas Otto - 73272</p>	<p><b>Activity Leader:</b> Fahim Dhalla</p>
<p><b>TSO:</b> Rodrigue Faes - 78771</p>	<p><b>EDMS number:</b> [enter a number]</p>
<p><b>Persons working on the activity/equipment/installation/project/experiment:</b>                      Cryogenics - Antonio Perin - 75422, Laura Stewart - 77294                      Electrical Power - Rene Necca - 74223, Hugues Thiesen - 75784                      Magnet Test - Giancarlo Golluccio - 62894, Gerard Willering - 62891</p>	
<p><b>Description of the activity/equipment/installation/project/experiment:</b></p> <p>The test facility is located in building 180 and connected to the adjacent building 279 for the compressor station housing.</p> <p>The facility is designed and constructed to perform the cryogenic testing of the FAIR superconducting magnets based on the CERN- GSI agreement. It makes extensive use of the existing infrastructure by refurbishing the facilities available in the two buildings and procuring new equipment.</p> <p>It shall allow performing the testing of the FAIR magnets according to their production schedule. The test station shall be able to perform the following operational activities:</p> <ol style="list-style-type: none"> <li>1. Reception, handling, installation of magnets on the test benches and connection to the relevant services (cryo, powering, utilities, data acquisition and control)</li> <li>2. Check electrical integrity of the magnets and their instrumentation as required at reception, warm and cold before testing, after powering and before shipping.</li> <li>3. Cool down of the magnets</li> <li>4. Cold powering of the magnets</li> <li>5. Magnetic field measurements of the magnets</li> <li>6. Heat loads measurements</li> <li>7. Warm up of the magnets</li> <li>8. Storage of the raw data, analysis and reporting</li> </ol>	



ACTION PLAN			
ID	Action description	Person responsible	When?
1	Design of FAIR magnet test station operating zones	Antoine Kosmicki	01/02/2016
2	Design of FAIR magnet test station operating zones interlocks and control software	Maryline Charrondiere	01/04/2016
3	Implementation of FAIR magnet test area operating zones	Michel Arnoud	01/09/2016
4	Implement software to exclude crane operator cabin over FAIR magnet test cryo area	Helder Miguel Lourenco	01/07/2016
5	Present safety documentation for integrated cryogenics system design, build and commissioning	Antonio Perin	01/10/2016
6	Present safety documentation for integrated electrical system design, build and commissioning	Rene Necca / Hugues Thiesen	01/10/2016
-			

- ➔ Access
- ➔ Interlock
- ➔ Access
- ➔ Handling
- ➔ Design



# Action Plan

- Access to FAIR Zone – *Delimited zone vs Controlled access*



**FAIR Zone**  
Magnet test benches

**SAFETY NOTICE**  
Be AWARE of the hazards

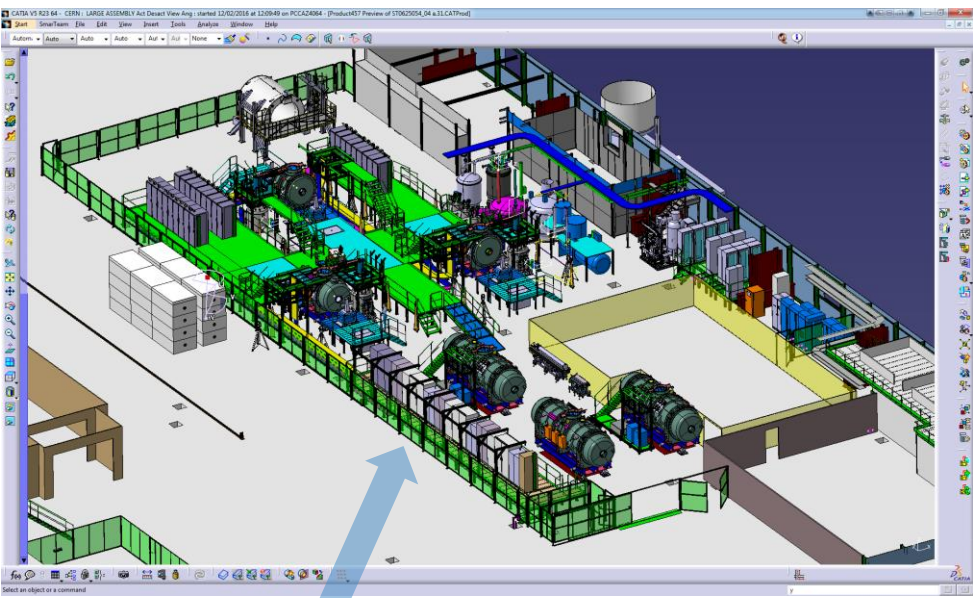
**Emergency**  
74444  
+41 2276 74444

**HAZARDS**

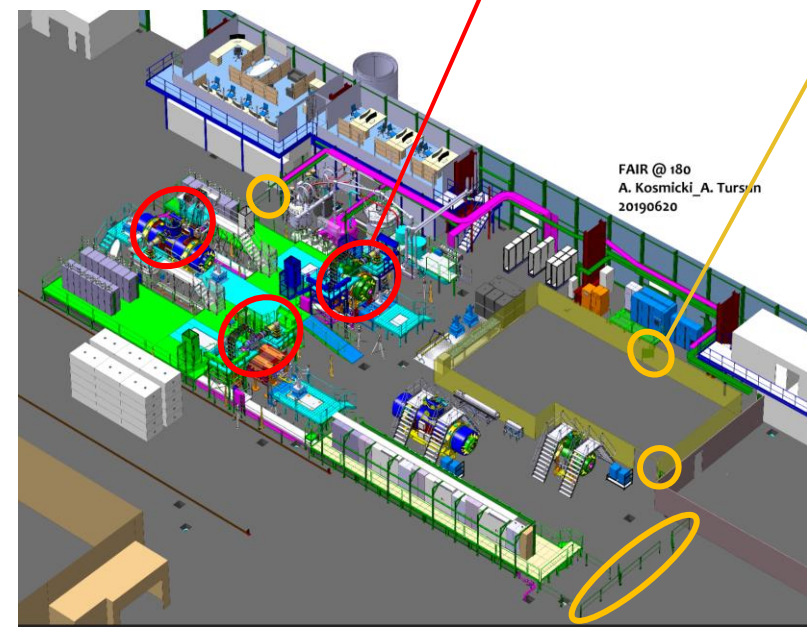
- Low temperature
- Electricity
- Laser Beam
- Overpressure relief
- Magnetic Field
- Overhead load

**PPE**

**Access**



2016 – fenced area with card reader; based on conservative assumptions  
 ➤ PL requested to study alternatives



2017 – **Delimited zone** with physical barriers + **interlock fenced areas** to the test platforms  
 ➤ Detailed / optimized Safety analysis  
 ➤ Proposal agreed by the PL

# Action Plan

- Safety Interlock System – Test benches

CERN  
CH-1211 Geneva 23  
Switzerland

TE Technology Department

TE/MS-C/TF  
EDMS Document No. 1753728 v2.1

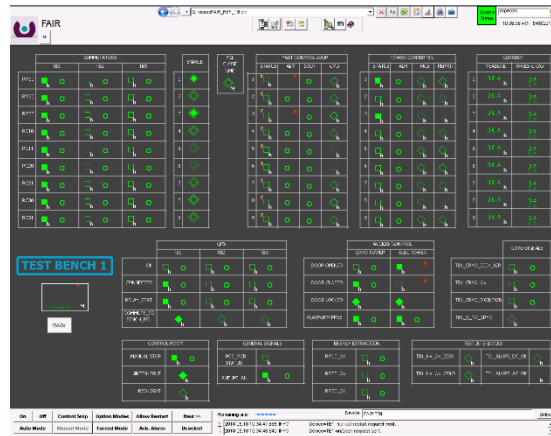
Date: 20 FEBRUARY 2017

**Technical specifications**

**INTERLOCKS and CONTROL for Super-FRS Magnets**

Following functional specifications [1], Quench protection & interlock logic diagram has been discussed within CERN experts of the different systems interacting with the interlock and quench protection chain. Discussions have also clarified the control part. This document, being technical specifications, is the outcome of these discussions and other thoughts.

<b>Prepared by :</b> M. Charrondiere B. Fernandez Adiego	<b>Checked by :</b> M. Bajko, C. Giloux, E. Willeling, O. Ditsch, J. Blanco Vizueta, J. Oriola Vidal, R. Spornoni, A. Rijlaert, H. Raymond, F. Gomez De La Cruz, F. Rodriguez Mateos, R. Benz, O. Galkonen, J. Mourao, H. Thiesen, V. Inglese, E. Rogez, A. Henriques, T. Otto	<b>Approved by :</b> L. Serio (CERN) L. Van Den Broegaard (CERN) E. Cho (GSI) H. Muller (GSI)
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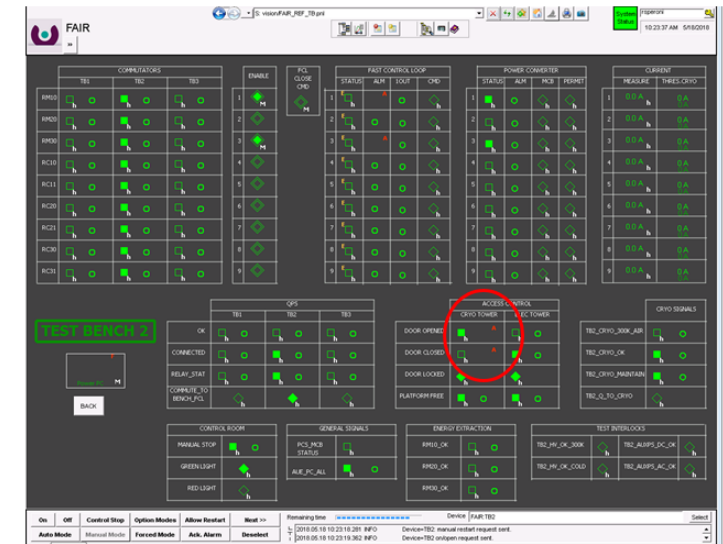
➔

**Safety Test:  
EDMS N. 1982411**

### 3.4 Door interlock switch

Time	10:23
Test Bench #	2
Result	OK
Comments	<ul style="list-style-type: none"> <li>• Door opened from inside and it cuts the power</li> <li>• Can't power if the door is open</li> </ul>

Screenshot:



Interlock system (incl. risk assessment)  
performed by TE-MS-C and BE-ICS

HSE proposed a interlock test ('dry run')  
➤ Participation of TE DSO, TE-MS-C and BE-ICS



# Action Plan

- Acceptance of the Magnet from GSI

Documents to be delivered at CERN (for each magnet) before unloading :

- Declaration of Conformity
- Pressure test reports from manufacturer
- Acceleration measurements during transport
- Instruction Manual

Avoid additional pressure tests on CERN-site  
 ➤ Agreed upon with CERN / GSI Technical Coordinators & HSE



HSE validation  
 EDMS N. 2089849

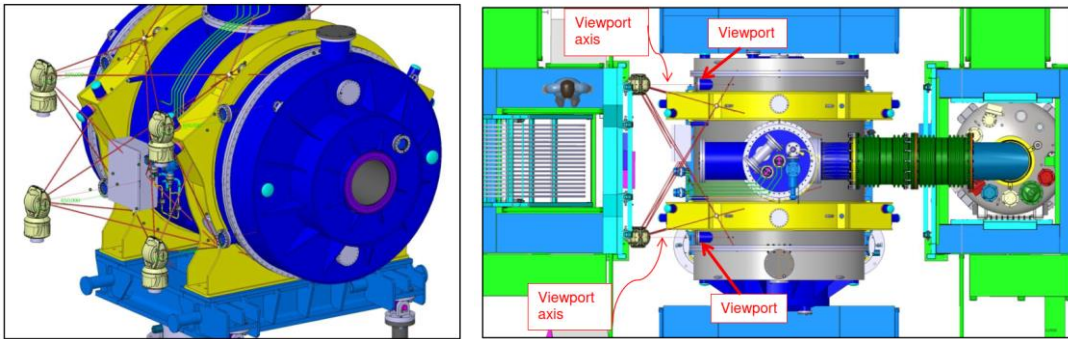
Magnet ID  
 #FPF2YMQ12



Validation of Safety documents			
FAIR magnet test bench project			
<i>Installation, equipment or project</i> : Short Multiplet #FPF2YMQ12		<i>Technical supervisor</i> : G. Golluccio, A. Chiuchiolo TE-MSC	
<i>Department/group requester</i> : TE-MSC		<i>Location</i> : Bldg. 180	
<i>List of documents submitted for validation</i>			
Type	Identification	EDMS	Date
EC Declaration of Conformity	FAIR Magnet	<a href="#">EDMS N. 2038480</a>	20-Feb-19
EC Declaration of Conformity	Safety Valves	<a href="#">EDMS N. 2038480</a>	20-Feb-19
Pressure test report	FAIR Magnet	<a href="#">EDMS N. 2038480</a>	20-Feb-19
User Manual	FAIR Magnet	<a href="#">EDMS N. 2038480</a>	20-Feb-19
Acceleration monitoring during transport	FAIR Magnet	<a href="#">EDMS N. 2038480</a>	20-Feb-19

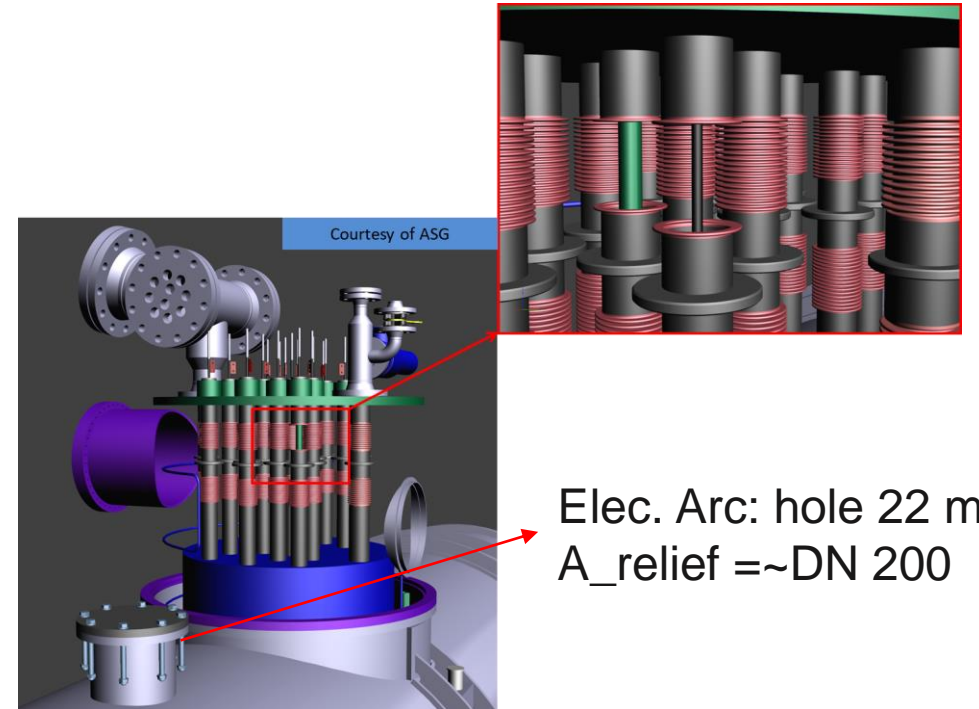
# Safety Review at GSI

- General overview of Safety aspects
- Specific topics:



## Survey & cold mass measurements (warm and cold):

- Risk assessment and procedure approved
- Engineering Specification of viewports approved

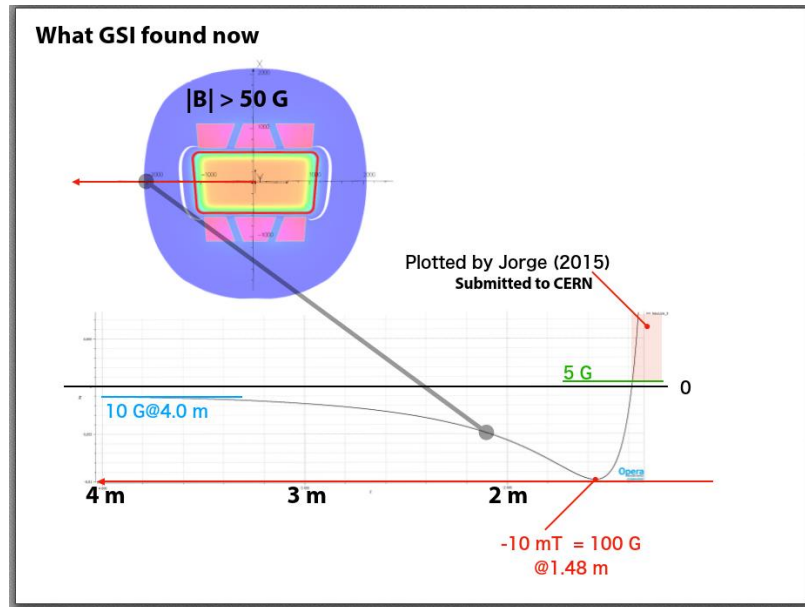


## Assumptions made by GSI on the dimensioning of relief plate:

- Analysis accepted (few comments)
- Assumptions were conservative – room for optimization

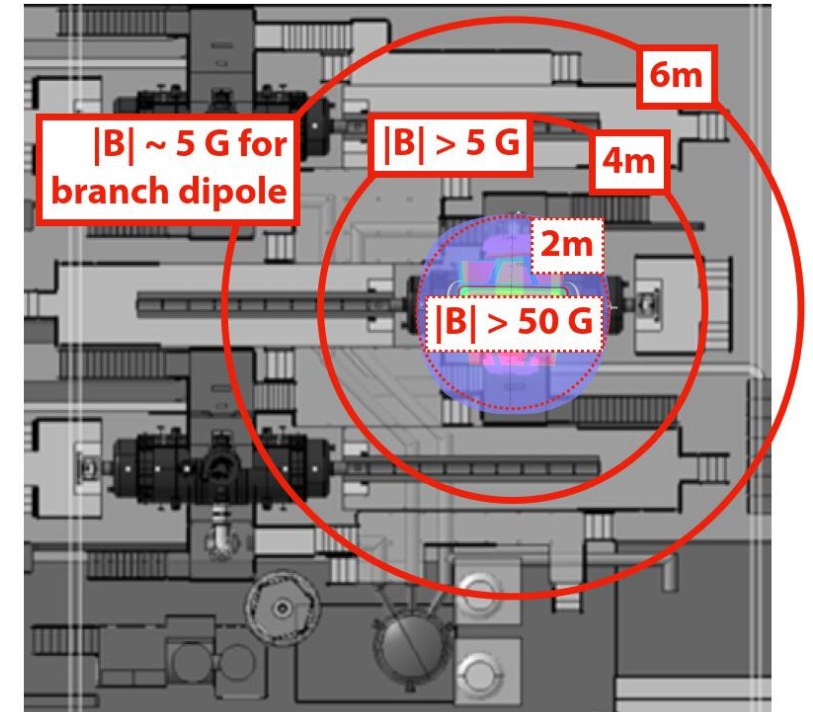
# Other Safety aspects

- Magnet stray field of Dipole



*Impact on Safety controls, PLCs ?!*

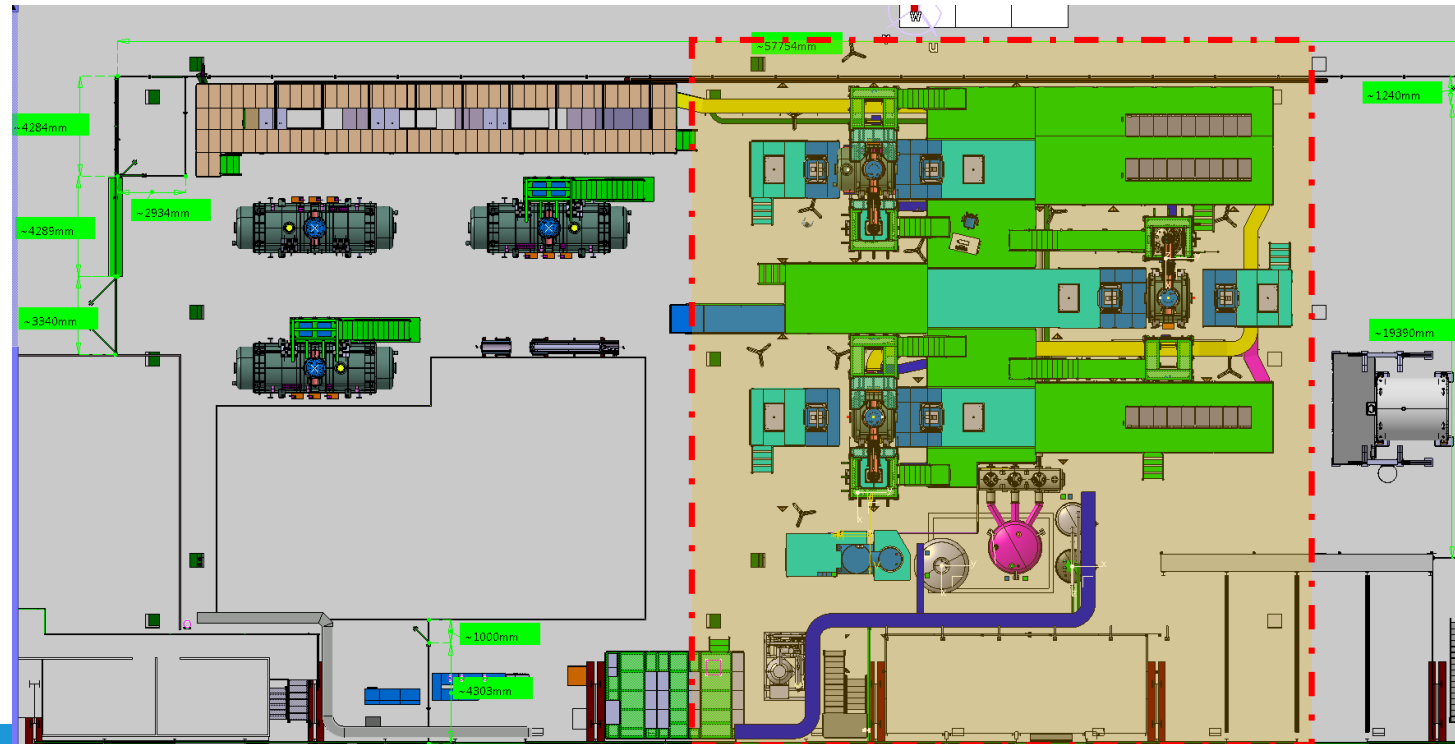
- Initial stray field estimation – 5 G
- New stray field estimation – **100 G**
  - Only for ‘branched’ dipole



- 10mT (100 G) at platform and near the cryo valve-box
  - Impact still to be seen (Safety and operational)

# Other Safety aspects

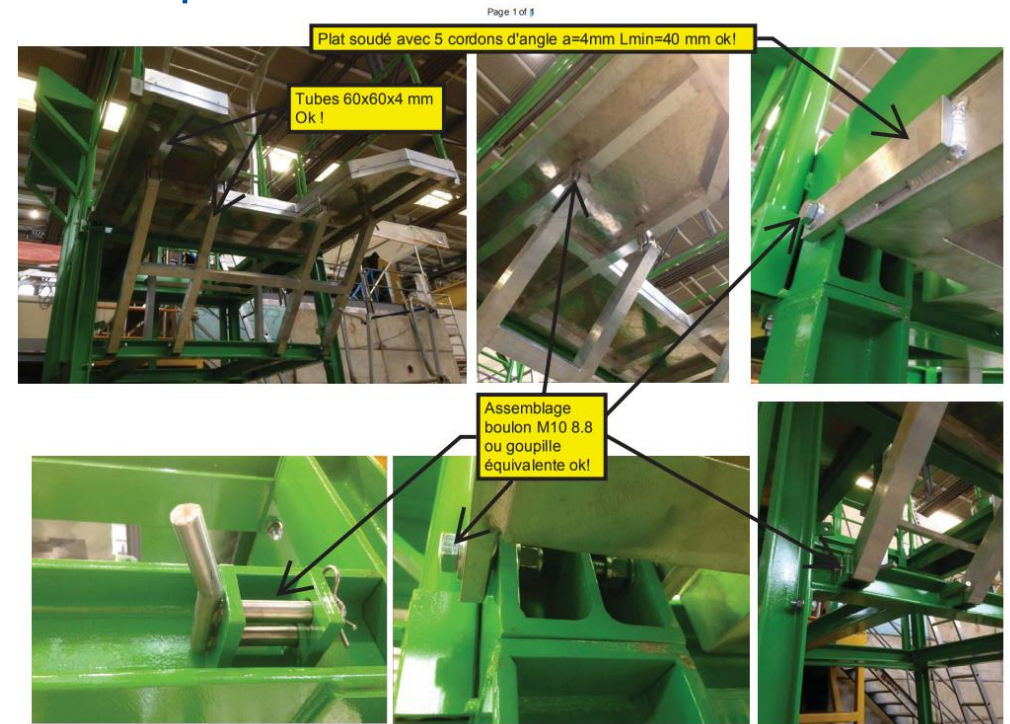
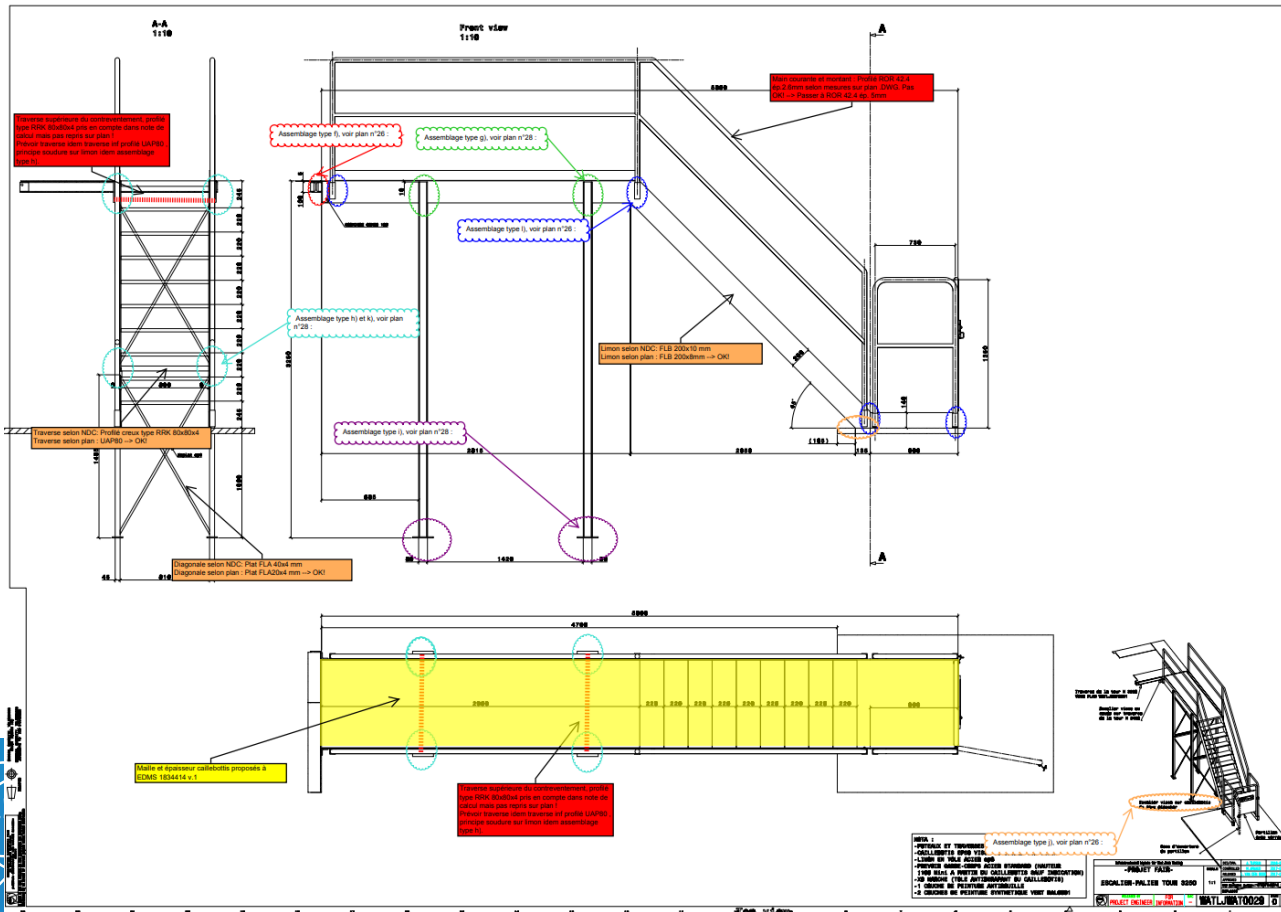
- ODH Assessment in Bldg. 180
  - Implement a 'zoning' in the crane's software
    - Avoid passing on top of the cryogenic systems





# Other Safety aspects

- Metallic structures
  - HSE consultant to verify the structures according to the ECs (incl. EC 8)
  - Minor modifications were proposed to cope with the requirements





# Commissioning phase

## ➤ Main Safety aspects

- Works & Services – Preparation, VICs
- Interaction between GSI and CERN installations
- On-site Safety visits 



Barrier missing

Activities from CERN / GSI Staff, ENTC, COAS, etc...



RA Test bench ✓  
RA SC Magnet ✓



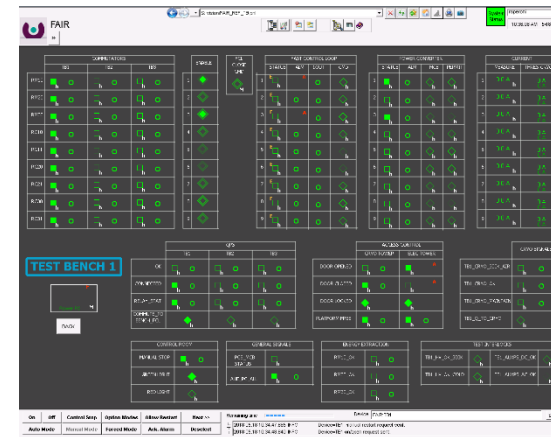
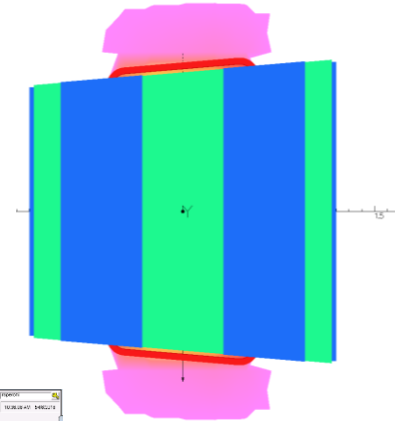
RA Control cabinet ✓

RA of the assembly 

- *Importance of On-site visits*
- *Additional measures implemented*

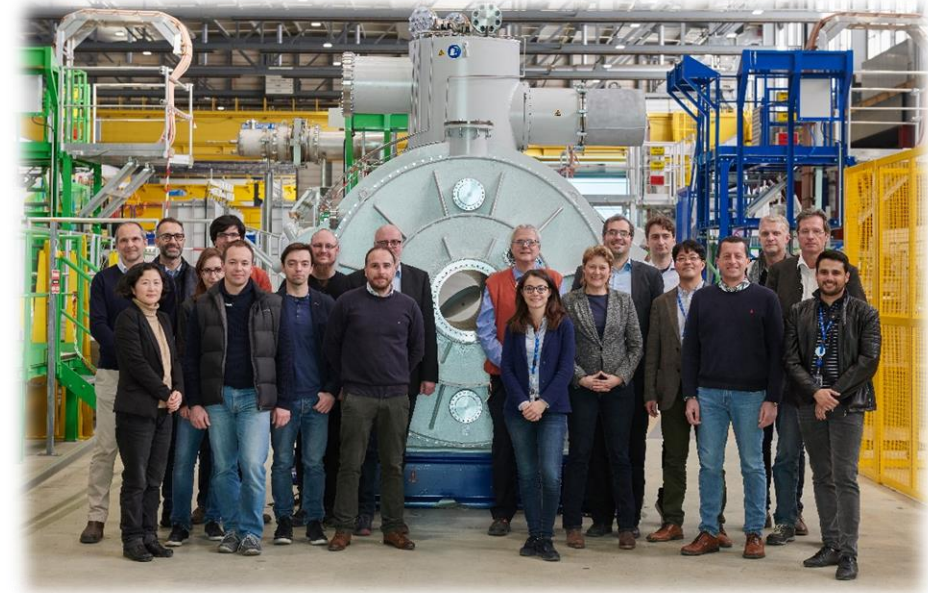
# Open points

- **Nominate a Coordinator for the test bench** – incl. Safety (i.e. contact person)
  - More and more activities, VICs, etc...
  - Juan Perez (TE DDSO) is assisting the project team for Safety aspects
- Impact to the sensors/equipment to the 10mT stray field
- TE-MSC training on the interlock system to the operators
  - During commissioning: Test the interlocks and associated actions on the technical systems (i.e. power converters, QPS, cryogenics...)
- Complete and adapt the operational procedures during commissioning phase



# Summary

- Very good collaboration with the project team(s)
- Safety requirements introduced in the study/conceptual phase
- Several interactions, on-site visits, inspections, etc...
- Safety Review at GSI – March 2016
- 'Test Bench' coordinator is important for the daily safety tasks and coordinate activities
  - In the meantime HSE correspondent is allocated until the end of the project phase



*CERN/GSI group photo  
Courtesy of S. Russenschuck*



[www.cern.ch](http://www.cern.ch)