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# **Safety Framework for HL-LHC - First experience**

# HL-LHC Safety Challenge

- High-technology accelerator hardware
- Produced at CERN, in partner institutes and industry
- Need to function in the CERN environment
- Numerous laboratories, workshops and testing areas
- **Our goal: Produce and procure Safe equipment in a Safe way**

# Two flavours of Safety

- **Conformity:**
- **Occupational Health and Safety (OHS) at the workplace:**



# Outline of the approaches

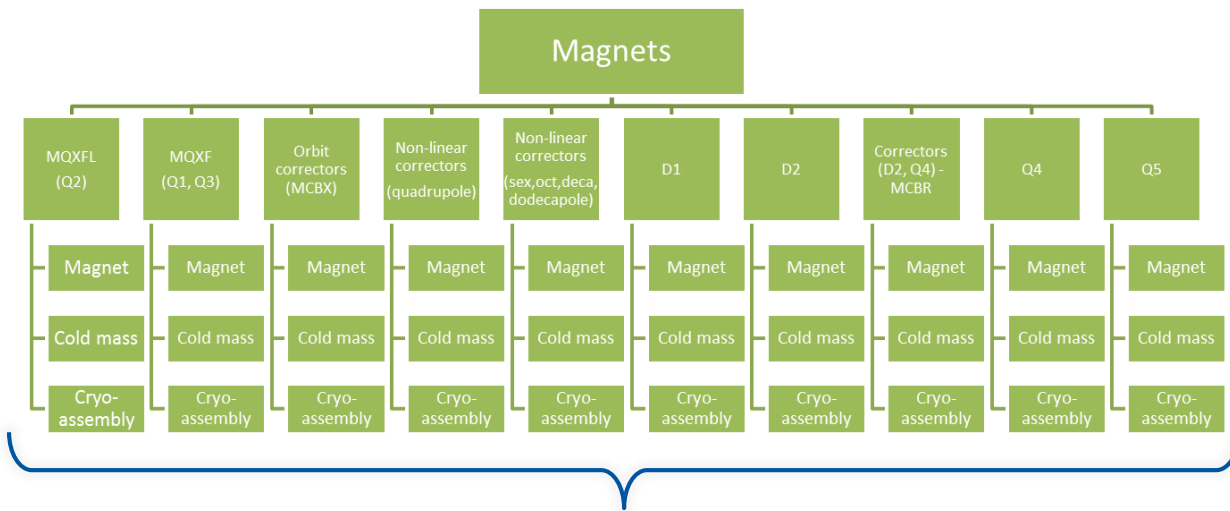
- **Conformity:**
- Functional analysis
  - **Hazard Register**
- Launch Safety Agreement
  - applicable rules and deliverable documents, certificates etc.
- HSE Safety clearance
- LHC Safety File
- **OHS at Workplace:**
- Process analysis
  - **Hazard Register**
  - (Risk analysis)
- Safety Recommendations
  - based on CERN rules and external recommendations
- Implementation and Follow-up
- Departmental Safety Plan

# How-To in HL-LHC

- **Asset / “Equipment”**
  - Conformity-branch
  - E.g. 11T-Dipole
  - Documented evidence
  - Receives Safety Clearance
  - Documentation to LHC Safety File
- **Process / “Production”**
  - OHS Branch
  - E.g. Workshops in Bld. 180
  - Work process analysis
  - Recommendations
  - Documentation to Dept. Safety Plan

# System Identification

- From the Safety viewpoint, all s.c. magnets are similar



Numerous different magnets,  
produced at CERN and elsewhere


## Safety assessment distinguishes only

- Magnet coil and yoke
- Cold-mass
- Cryostat

**Launch Safety Agreement:**  
for full magnet system

# Hazard Identification step

- For each “Safety Subsystem”:



EDMS NO. 0000000    REV. 1.0    VALIDITY DRAFT  
REFERENCE : [OTHER REFERENCES]

**HAZARDS TABLE**

The following table below provides a list of broadly defined hazards usually present in accelerator equipment. It serves to generate the Launch Safety Agreement, defining the applicable Safety regulations and deliverable conformity or other Safety documents. These will demonstrate that the Safety risks generated by the equipment are adequately controlled.

Presence of Hazards	Short description	Production/ Equipment	
		P	E
<b>Mechanical Safety</b>			
Pressure equipment [pressure][bar]; [volume][l]	P: bladders for yoking E: He @ < 20 bar	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Vacuum		<input type="checkbox"/>	<input type="checkbox"/>
Lifting/handling equipment	Spreader beams, "chariots"	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Machinery/machine Tools	Standard workshops in Bld. 927 and 183	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Mechanical energy (moving parts)		<input type="checkbox"/>	<input type="checkbox"/>
Mechanical properties (sharp, rough, slippery)		<input checked="" type="checkbox"/>	<input type="checkbox"/>
Industrial Vehicles		<input type="checkbox"/>	<input type="checkbox"/>
Hot Work (e.g. welding, grinding)	Brazing, curing, Nb <sub>3</sub> Sn reaction	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Hot/cold surfaces	After curing and reaction	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Vibration		<input type="checkbox"/>	<input type="checkbox"/>
<b>Cryogenic Safety</b>			
Cryogenic fluids	Superfluid Helium, 2 K	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Structural Safety</b>			
Shielding walls		<input type="checkbox"/>	<input type="checkbox"/>
Earthworks, drainage (excavation, underground networks etc.)		<input type="checkbox"/>	<input type="checkbox"/>
Bearing structures		<input type="checkbox"/>	<input type="checkbox"/>
Platforms, walkways, guards rails, stairs and ladders		<input type="checkbox"/>	<input type="checkbox"/>
Other		<input type="checkbox"/>	<input type="checkbox"/>
<b>Electrical and Electromagnetic Safety</b>			
Electrical equipment / installation	Up to 16.5 kA	<input type="checkbox"/>	<input checked="" type="checkbox"/>
High voltage equipment	5 kV Megger	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Magnetic field [magnetic field] [T]	P: during tests E: nominal condition in HL-LHC: 11.5 T	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Equipment in potentially explosive atmospheres		<input type="checkbox"/>	<input type="checkbox"/>

Page 2 of 5    Template EDMS No. : 1361970 v.3



Hazards identified for Production Process: **OHS Branch**



Hazards identified for Equipment: **Conformity Branch**



# Conformity: Launch Safety Agreement



HSE  
Occupational Health & Safety  
and Environmental Protection Unit

## Launch Safety Agreement (Conventional aspects)

Superconducting Dipoles (WP11) –HL-LHC Project

Following the Launch Safety discussion held on: 21/10/2014

From: DGS/SEE group of HSE Unit – J. Gascon

To: L. Rossi, I. Bejar-Alonso DG/DI, F. Savary TE/MSC

CC: T. Otto TE/HDO

Date: 03/02/2015

EDMS: 1472317

Subject: Launch Safety Agreement (Conventional aspects) of the Superconducting Dipoles (WP11)

### PURPOSE & SCOPE

This document, entitled **Launch Safety Agreement (Conventional aspects)**, provides an overview of the conventional (non-radiological) Safety requirements applicable to the Superconducting Dipoles and its related Safety documentation. After the **Launch Safety discussion**, it is the 2<sup>nd</sup> Step of the editorial process in the **Safety Documentation Management** procedure ([EDMS 1177755](#)).

This document is an integral part of the Safety documentation<sup>1</sup> for the Superconducting Dipoles that the HL-LHC Project Leader with the Project Safety Officer (PSO) shall:

- maintain and keep it updated during the life cycle of the HL-LHC project in order to demonstrate compliance with the Safety requirements stated in this document;
- make available to the HSE Unit upon request and before any periodic inspection.

The scope of the document includes superconducting magnets production (the cold mass assembly), the magnet models (2m long), the cryostat of the magnet, the cable, the power converter associated. The installation and commissioning in the tunnel are excluded.

<sup>1</sup>  
- Safety File: set of documents and data relating to the assessment of the Safety, at all stages of their life cycle, of Installations, projects, facilities or CERN Experiments and the corresponding implementation measures and procedures as well as lessons learned.  
- Safety Folder: a set of Safety Files relating to a Complex

- Established by HSE
- Applicable rules and regulations
- Deliverable documentation and certification
- Mutual Engagement

# OHS:

## Safety Analysis of Workplaces

- Following an established method
  - (Swiss professional accident insurance SUVA)
- Establishment of hazard register by Departmental Safety (Support) Officers
- Comparison of status-quo with rules, standards and best practice
- Recommendations for continuous improvement
- Integrated in the Department's Safety Objective to update it's Safety Plan

# Roles in the Process

## Hazard Identification

Start	PSO
Hazard Register	WPE, PSO, HSE link
Review	WP Leader
Approve	PSO

## Conformity Branch

LSA edit	HSE link and experts
LSA Review	WPL, WPE and PSO
Safety Clearance	HSE
Safety File Contrib.	WPE, WPL & PSO

## OHS Branch

Machine conformity	DEKRA via HSE
Workplace analysis	WPE with PSO, DSO and SSOs
Recommendations	PSO / DSO to Resp. of Workshop
Dept. Safety Plan	PSO / DSO

# Open Questions

- Safety Analysis for Workplaces
  - Ok for TE
  - Other departments ?
    - To be cleared in a DSO meeting of the participating departments
- Workplaces outside of CERN (Institutes / Industry) are nor in the scope

# Open questions

- Scope of LSA



- The project needs planning certainty also about the RP aspects of equipment and work

# Status May 2015

	Hazard Identification		Launch Safety Agreement	
	In Work	to HSE	In work	Received
WP 03	X			
WP 04 (SPS test)	X	X	X	
WP 11	X	X	X	X
WP 14	X	X	X	

Process to be started for remaining work packages at a rate of approx. 2/month