



Conformity approach for Pressure Equipment for the High Luminosity LHC Project

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CERN Mechanical Safety Rules

- In accordance with its intergovernmental status, CERN establishes and updates Safety Rules to implement its Safety Policy
- Mechanical Safety Regulation SR-M (2015) and associated General Safety Instructions
 - Define the minimum safety requirements related to the life cycle of pressure equipment
 - Valid for all new equipment and equipment brought onto the CERN site from elsewhere
 - Aligned, as far as possible, to existing standards

CERN Mechanical Safety Rules

- Design, manufacture and procurement
 - Primarily based on European Directives for pressure equipment and transportable pressure equipment
 - Use of harmonised European standards (EN and IEC)
 - Use of other technical standards is subject to approval by HSE Unit
 - CE marking
 - Declaration of conformity
 - Factory acceptance tests, where applicable
 - Instruction manual

CERN Safety Rules for Pressure Equipment

- Baseline approach
 - Design, manufacturing and testing as per EN harmonised standards
 - Compliance with **Pressure Equipment Directive (PED)** 2014/68/EU
 - CE marking
- Exceptional Approach
 - Equipment that does not readily fit into the context of European harmonised standards (e.g. due to equipment type, materials, area of application, geographical origin, etc.)
 - Classification as equipment with “major Safety implications”(mSi), at the discretion of the HSE Unit, who defines the Safety requirements
 - HSE Unit performs the conformity assessment, for all equipment categories (substitutes itself for the notified body)

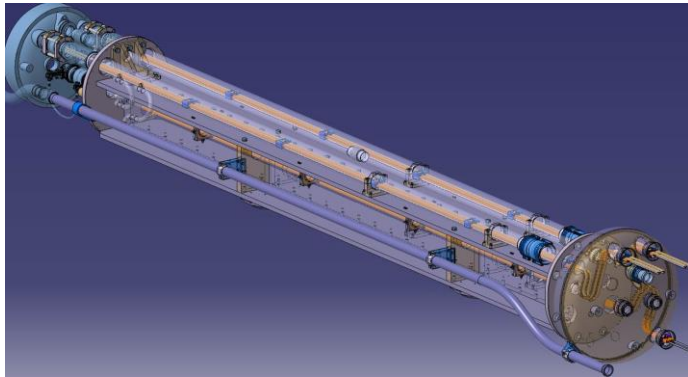
Pressure Equipment Directive (PED)

- Conformity assessment
 - Conformity assessment modules: the higher the category, the more demanding the requirements (increase of supervision from Notified body over the whole fabrication process).
- Notified bodies
 - Organisations appointed by EU states to assess conformity of a product to the ESRs before being put in the market.
 - Categories II-IV require conformity to be assessed by external independent Notified bodies.
- CE marking
 - Affixed to equipment by the manufacturer.
 - Statement that the equipment meets requirements of all relevant Directives – *Declaration of conformity*.
 - Permitted only after Notified body attests full conformity to the Directive(s), when the Notified body involvement is required.

Application of CERN Mechanical Safety Rules – High Luminosity LHC Project



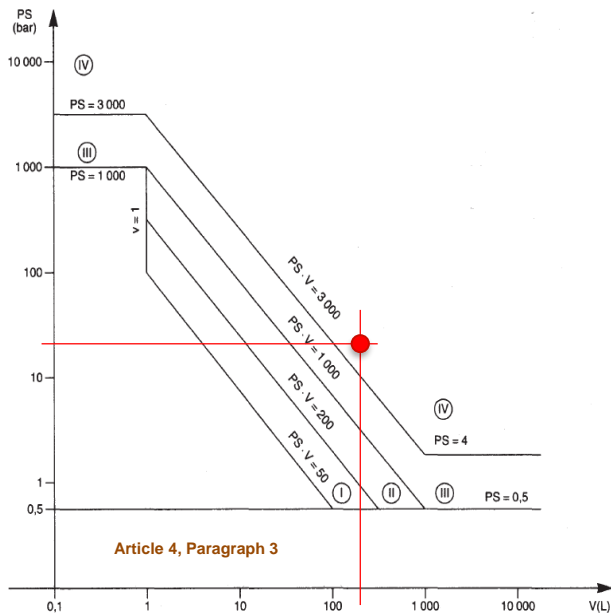
WP 4: crab cavity cryostat



WP 11: 11T Dipole

WP 3: Inner triplet magnets

11T dipole cold mass



Annex II Table 2

PS = 20 bar

V = 183 L

PS * V = 3630 bar L > 3000 bar L

Category:

IV

The following module(s) are at least available for the above mentioned category:

B+D, B+F, G, H1

WP 3: same criteria (PED Cat. IV) apply

WP 4: Niobium not officially qualified for mechanical properties at liquid Helium temperature

Conformity assessment by HSE

- Requirements for HSE Safety clearance:
 - Full compliance with the applicable Essential Safety Requirements (ESRs) in the PED
 - Use of harmonised European standards **wherever applicable** (presumption of conformity) for design, manufacturing and testing, e.g.
 - EN 13445 – Unfired pressure vessels;
 - EN 13458 – Cryogenic vessels – static vacuum-insulated vessels;
 - EN 10028 – Flat products made of steels for pressure purposes;
 - ...
 - **Other (inter)national standards may be used provided compliance with the ESRs is fully demonstrated**
 - Eventual non-compliances to be assessed individually. The Project shall propose compensatory measures to ensure a commensurate level of Safety
 - **Assessment of conformity to the ESRs is carried out by the HSE Unit acting as an 'independent' party**

Conformity assessment by HSE

- Design examination
 - HSE Unit will validate the design of the equipment prior to the commencement of fabrication
 - **Manufacturer must produce technical documentation** as to enable an assessment of the conformity of the equipment with the ESRs
- Production quality assurance
 - **HSE Unit and Project to agree on the Inspection and Test Plan**, including Safety-relevant Hold Points
 - Manufacturer to provide quality records for the manufacturing part of the QA system, such as inspection reports and test data, qualifications of personnel concerned, etc.
 - Documentation to ensure full traceability of components and processes

Conformity assessment by HSE

- Provided Safety requirements are met and Safety clearance is achieved, CE marking is not compulsory as per the Safety Rules
- HSE acts as *de facto* Notified body
 - Involvement of external Notified body not required
- Safety accessories (e.g. relief valves, rupture discs) have to be, however, fully compliant with the Pressure Equipment Directive and harmonised standards

Current status

- Project has made a formal request to follow the '*Exceptions to the baseline approach*' for 21 superconducting magnet and connection cryostat variants (concerning 191 pieces of equipment, including spares)
- WP 3, WP 11 and HSE Unit work out the Inspection and Test Plan
- Currently following same approach for the Crab Cavity prototype test facility, so expectation is that this will be requested for the series production



Thank you for your attention



Spare Slides

Pressure Equipment Directive (PED) 2014/68/EU – Annex I

- Essential Safety Requirements - pressure equipment must be:

- Designed
- Manufactured
- Verified
- Equipped and installed (if applicable)

As to
ensure
its safety
when

- Put into service as per manufacturer's instructions
- Other foreseeable conditions (including potential misuse)

- And they qualitatively cover:

Design

- Adequate strength
- Appropriate Safety factors
- Calculation/experimental method
- Provisions for safe handling/operation
- Safety accessories against overpressure

Manufacturing

- WPS and welding personnel to be approved by NoBo or recognised third party
- NDT
- Operating instructions
- Final proof test (normally hydrostatic, other tests allowed with additional measures, such as NDT)

Materials

- Appropriate properties
- Covered by EN, EAM or PMA
- Compulsory declaration from material supplier affirming compliance with a specification.
- Traceability of material from receipt of material through final testing