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GENERAL SAFETY & HYGIENE GROUP
MECHANICAL SAFETY SECTION

MEMORANDUM

MERIT CRYOGENICS PROJECT REVIEW

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1. INTRODUCTION

This memorandum concerns the MERIT magnet cryostat project review. It contains recommendations to be put in practice by the MERIT collaboration either in matter of mechanical and cryogenics aspects of the magnet and its feeding system design. The recommendations shall be fulfilled prior to the use of the MERIT cryostat magnet at CERN.

2. CRYOSTAT MECHANICAL DESIGN

In the framework of the MERIT cryostat magnet project review, SC/GS Mechanical Safety (MS) section here lists its remarks concerning design and commissioning of the magnet.
According to CERN D2 safety code an engineering file shall be provided to SC/GS/MS containing all documents and design parameters necessary for acceptance of the cryostat magnet at CERN. We expect the MERIT collaboration to provide CERN the engineering report before shippping of the cryostat magnet to CERN.
The document shall in particular contain:

1. Base material and filler material certificates
2. User's notice
3. Complete set of drawings
4. A list and all results of planned safety inspections, safety checks and quality controls

5. Results of non-destructive test (x-rays of welds)
6. Welding procedures and welding qualification according to ASME standards
7. Welder qualification according to ASME standards
8. Buckling FEA calculation referring to the effective design layout (5 mm shell thickness without stiffners). Previously provided results only show the 1 mm thikness scenario. Notice that a buckling eigenvalue of 3 is considered as minimum admissible value
9. Maximum operating pressure value. Consider that the vessel must have a design pressure identical to the maximum operating pressure forecast during operation. Such a value must be specified
10. Resistance of the bolts used for the head closure must be proved by calculations to withstand a 1.25* design pressure test scenario.
11. Description, drawings and calculations relative to the cryostat magnet overall base supporting structure, interconnections between the cryostat magnet and the overall supporting structure and interconnections between the overall base supporting structure and the ground.
12. Specifications concerning transportation precautions (such as admissible accelerations, packing and handling in general)

The MERIT collaboration shall explain the reason why the equipment shall not be delivered at CERN stamped.

3. CRYOGENIC DESIGN

In the framework of the MERIT cryostat magnet project review, SC/GS Safety Inspections and Ergonomy (SI) section here list its remarks concerning the design of the cryostat and the cryogenic supply system.

3.1 Cryostat

1. Prove with calculations that each of the two safety valves is capable to protect against over pressure in the cryostat in the event of a sudden vacuum loss, short cut in the magnet or other heat inleak. The protection by the safety devices shall garuantee that the maximum pressure in the cryostat never shall exceed 110 % of the design pressure.
2. What is the maxiumum heat inleak in the event of a sudden vacuum loss? We are concidering the worst case scenario to be liquid nitrogen entering the vacuum jacket.

3. What is the maximum heat inleak to the cryostat in the event of a short cut of the magnet?
4. The safety valves shall be CE marked according to the European Directive 97/23/CE category IV (tested by notified body) or equivalent if the safety valves are bought in USA.
5. The safety valves shall be conform with the European standard EN13648-1 or equivalent if the safety valves are bought in USA.
6. The two safety devices shall preferably be installed at different locations (different pipes)
7. Pressure relief devices shall be installed so as to remain at room temperature under normal working conditions.
8. Liquid discharge of the safety relief devices shall be avoided as far as possible by placing the exhaust line at the highest possible level on the cryostat and by preventing overfilling.

We are happy to see that no intermediate shut off valve is installed between the cryostat, the relief device and the point of discharge

3.2 Vacuum jacket

1. It was understood that the existing protection of the vacuum jacket is too small against over pressurisation. Provide calculations showing the necessary size for the pressure protection in order to not exceed the 0.5 bar above atmospheric pressure in the event of a big nitrogen leak in to the vacuum.
2. Implement a protection against over pressurisation of the vacuum jacket fulfilling the criteria mentioned in the point above.
3. The protection against over pressure of the vacuum jacket shall not fly away with the risk of hitting somebody or something. Show how this is avoided.

3.3 Other

1. There shall be no condensation or ice on the vessel or adjacent pipes due to poor insulation.
2. MERIT shall provide information to CERN about the thermal efficiency of the cryostats insulation during tests carried out in the US.
3. Install temperature sensor(s) on the vent line to detect if safety valves are blowing or failure of the 20kW heater
4. A list showing the setting of all safety valves shall be provided to CERN
5. Provide a PFD (Process Flow Diagram) including all the operating modes (filling, emptying etc).
6. CV101 & CV201 shall automatically be closed if the temperature on the vent line decreases or if the ventilation in TT10 stops.

7. Show that no shortcircuit can occur in the magnet due to the thermal stresses during the tests at CERN.
8. Provide the tecnical specification of the valve box.

4. RECOMMENDATIONS FOR LIFTING AND HANDLING TOOLS

All lifting tools used during handling and installation procedure shall be designed according to CERN safety code D1. All lifting tools must be veryfied and approved by CERN's Safety Commission prior to their construction. A lifting test has to be performed at CERN prior to use.
Procedures for the installation shall be described and submitted to CERN for approval before shipping.

5. PRESSURE TEST

A pressure test shall be carried out at CERN once the equipment will be delivered to the laboratory. The test will be performed with a pneumatic test, applying a pressure value of 1.25* P_{design}.
The MERIT collaboration will be invited to participate in the test.

SC/GS/MS

Andrea Astone

NB: For tests and inspections, please contact SC-GS-MS Staff

NB: These remarks are based on the specific items(s) actually presented.
Further remarks may be forthcoming during the development of the project

NB : Le projet sus mentionné a été étudié en fonction des données actuelles.
D'autres remarques peuvent encore être faites en cours d'évolution du projet.