Crab Cavity
Technical Coordination meeting: overview of safety related activities of the SPS Cryomodule (concerning EN-MME)

DISCLAIMER:

I don't know exactly how the Safety for the entire facility (including cryomodule) is managed

The content of this presentation has not yet been discussed with HSE unit, neither with responsible for SPS installation

"SPS installation facility"

- Cryomodule
- Table
- Cryogenic supply
- Electronics
- RF components
- Vacuum
- Safety valves
- …

- Dressed cavity
- HOMs
- Cryogenic lines
- Thermal shield
- Inter-cavity connections
- Tuner system
- Vacuum vessel
- Safety valve on vacuum v.
- Feet
- Lifting accessories

Final inspection report
HSE for SPS installation

According to PED Annex 2, the cryomodule belong to risk category I
Prototype for SPS: equipment liable to have major Safety implications (EDMS 1541969 + 1494776) according to definition in GSI-M-4)
WARNING: not clear definition of cryomodule "boundaries"

GSI-M4:
Pursuant to Safety Regulation "Mechanical equipment" (SR-M), the approval of the HSE Unit is required for each stage in the life cycle of an item of cryogenic equipment liable to have major Safety implications.

"SPS installation facility"

- Cryomodule
- Table
- Cryogenic supply
- Electronics
- RF components
- vacuum
- …

Safety file:

- Risk assessment
- Engineering specifications (EDMS 1608964 - DRAFT)
- Safety files of all sub components
- EC certificates for components
- Specific documentation for the cryomodule

Validated by HSE

- Record of welding operation during assembly
- Process and instrumentation diagrams
- Operating procedures and instructions
- Maintenance and inspection plan
- Record of non conformities
- Certificate of commissioning and authorization to put equipment into service?
- …

HSE final inspection report for cryomodule ?

- Dressed cavity
- HOMs
- Cryogenic lines
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- Inter-cavity connections

- Tuner system

- Vacuum vessel
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For each component a safety file:

- (Risk assessment)
- Engineering specification
- Design calculation report
- Drawings

Validated by HSE before manufacturing

- Materials
  - Mechanical test of materials reports
  - CERN material specifications
  - Material certificates Particular Material Appraisals (PMA)
- Welding documentation reports
  - manufacturing(WPQR, WQ, WPS)
  - testing (VT, Xray, …)

Validated by HSE

- (Pressure test report???)

Done in collaboration with HSE

- Dressed cavity
- HOMs
- Cryogenic lines
- Thermal shield

- Inter-cavity connections

- Tuner system

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? After Risk analysis.
At least documentation about manufacturing

Safety file:
- (Risk assessment)
- instruction manual
- all documentation relating to the use of the machinery
- the acceptance report
- the declaration of commissioning

Validated by HSE

Safety file:
- (Risk assessment)
- Engineering specification
- Design calculation report
- Calculation for Safety Valve
- Drawings
- Materials
- Welding documentation reports

Validated by HSE

- Dressed cavity
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"Safety" file ?

Do we need something for RF lines and for FPC? (no pressure equipment, depends on risk analysis)

Components to be pressure tested:

- Dressed cavity (2x)
- HOMs (2x(3x))
- Cyogenic lines (main and minor)
- Cooling circuit for thermal shield
- (Service module – not considered as part of the cryomodule)

EDMS 1541969 + 1494776: pneumatic pressure test at 1.8 bara at 300 K is accepted by HSE.
This is already a derogation!
No clear definition of the pressure test procedure!

Practical issues

- Final pressure test together with service module? Is it possible (what about PID)?
- Amount of gas (N2?) required to perform the pressure test in case of final pressure test to be available (cryomodule volume 200 l?)
- After clean room, cavities are with N2 gas in beam vacuum at 1 bara (Δp = 1.8 bar required)

- Final pressure test could be replaced by intermediate ones, assuming that the connecting welded joint can be fully inspected with NDT, preferably X-ray. (TO BE CONFIRMED by HSE)

Problems on cavities

- Risk of plastic deformation even with 1.8 bara at 300 K: info gained during leak test and vertical test

Other options:

- Before tuning? Best option!
- Cold test in vertical test station? Not a real pressure test: I don't like this solution!
- Cold pressure test? If yes, how to correlate it with the design case (p=1.8 bara at 300K)?
- «first operation» -> first cool-down to be carefully followed, measuring pressure peaks and T Not a real pressure test: I don't like this solution!

Impact on the schedule/planning/workflow is really important: to be studied, once the strategy is defined.
Actions should be added consequently in the workflow (including HSE actions)

HIE-ISOLDE cryom. (Category II equipment) example: it seems they did only one at the end of the assembly (TO BE CONFIRMED)

Open points

Risk analysis: how to deal with it? One for the installation + one for each component? Deadline? Responsibilities?

Pressure tests: intermediate (on cavities, on cryolines) + final? If yes, at which point of the assembly? Only final? A FEA on pressure test loading conditions (i.e. with real material properties) could help?

Validation of documentation by HSE: who is the main contact? Which procedure? Responsibilities? How many intermediate steps?

Safety devices:

- Safety valves on cryogenic lines are not included in the SPS CRAB cryomodule
- Safety valves on vacuum vessel included in the SPS CRAB cryomodule