Change Control Risk Assessment Checklist

# Experimental context

Change Proposal: To change from the successfully tested R&D vessel to the MICE experimental system, i.e. a thin-windowed absorber vessel housed inside the magnet beamline.

Does the proposed change:
(If 'Yes', identify if 'change intent' or how to be addressed. Record and assign any actions arising.)

**A. Safety/Environmental**

*1. Impact on the basis of safety?* ***Yes***

The R&D vessel was constructed from thick-walled stainless steel housed in a standard cylindrical cryostat. As such, the structural integrity of the whole system was high and the risk of a failure inside the system with safety-related consequences was severely limited. With the change to the experimental absorber vessel, and particularly the inclusion of thin aluminium beam windows, the risk of non-benign failure has been heightened. However, this risk is well understood and has been mitigated throughout the design and review process to an acceptable level.

Document references:

- Operational risk assessment
- HAZOP 2 (operations in an experimental context)

*2. Introduce or alter any potential cause of over/under pressurisation/vacuum or raising or lowering the temperature in the system or part of it?* ***Yes***

The absorber introduces a tangible risk of vessel wall failure. This scenario is well understood and documented.

Document references:

- Relief line change control document (link pending)

*3. Go outside the safe operating pressure/temperature limits and/or the design pressure/temperature?* ***Yes***

The beam windows installed have strict pressure differential limits in both forward and reverse directions:

- Absorber window forward pressure – 2 bar max working, 8.5 bar absolute max
- Absorber window reverse pressure – 0 bar max working, 0.9 bar absolute max
- Safety window forward pressure – 2 bar max working, 8.5 bar absolute max
- Safety window reverse pressure – 1 bar max working, 1.2 bar absolute max

The practical consequences of this are that the absorber must not be evacuated while the insulating is pressurised, and that the relief line must be designed to limit possible pressure rises to acceptable limits.

*4. Affect equipment installed to prevent or minimise over/under pressure or temperature?* ***Yes***

See A.2 – the relief line is modified to meet maximum allowable pressures for the windows

*5. Require Emergency Shutdown Trips, interlocks or alarms or affect existing ones (e.g. test frequency)?* ***Yes***

See A.3 – a reverse pressure differential across the absorber windows must be avoided.

**ACTION 1 - A new software interlock inhibiting the evacuation of the absorber if there is not a stable insulating vacuum in place should be added**

*6. Introduce new vents, or a valve or other device which may isolate or block an existing vent or relief line?* ***Yes***

See A.2

*7. Introduce the potential for leaks of material, especially flammable, toxic, corrosive and/or those onto hot surfaces?* ***Yes***

See A.1

*8. Introduce new sample points (for flammable, toxic or corrosive materials)?* ***No***

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*9. Alter the hazardous area classification (zone, gas group, temperature class)?* ***Yes***

The ATEX zone drawing will be updated to represent the change of cryostat.

*10. Affect safe access for personnel, vehicles and equipment or affect means of escape or affect access to safety showers or other key equipment?* ***Yes***

With the hydrogen cryostat now part of the MICE beamline and subsequently encased in the partial return yoke, access is severely restricted. However, excepting absorber changes and major faults, routine access is only required to the turret, which is accessible (at height) from the south mezzanine. This should only be carried out by hydrogen operators trained in working at heights.

*11. Adversely affect plant layout ie make key equipment hard to reach or operate?* ***No***

See A.10

*12. Affect the fire protection system (hydrants & sprinkler systems, etc.)?* ***No***

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*13. Affect Personnel Protective Equipment requirements?* ***No***

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*14. Affect the inspection interval of an equipment item or group of items?* ***No***

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15. *Require further Hazard Studies, HAZOP, etc?* ***No***

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**B. Process Conditions and Quality**

1. *Affect the controllability of the process? e.g. reaction, heating, cooling, agitation, etc.* ***Yes***

The control system hardware remains the same but the thermal behaviour of the system will be different. This will become evident throughout helium testing of the system and any suitable alterations to the control system sequences will be made consequently.

2. *Allow new mixing of process streams?* ***No***

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3. *Involve a change in a raw material or its specification?* ***No***

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4. *Alter the composition, physical properties or specification of any in-process materials, including recycle streams?* ***No***

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5. *Alter the composition, physical properties or specification of the finished product?* ***No***

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6. *Alter the composition, physical properties or specification of any solid, liquid or gaseous effluent stream?* ***No***

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7. *Introduce the potential for blockage of process materials?* ***No***

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8. *Involve reworking of material, not covered by the operating procedures?* ***No***

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9. *Affect shutdown, start-up or cleaning operations?* ***No***

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**C. Engineering Considerations**

1. *Require engineering design (civil, electrical, mechanical, process, instrument, systems)?* ***Yes***

Engineering design for the absorber system is well established and thoroughly reviewed. However, commissioning of the system has, and will continue to, highlight issues which require engineering solutions. Substantial issues have their own change control documents.

2. *Affect the civil & mechanical integrity (foundations, supports, vibration, etc.)?* ***No***

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3. *Affect guarding?* ***No***

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4. *Introduce new or alter existing electrical equipment?* ***Yes***

The absorber level sensor is different, comprising five pairs of Cernox temperature sensors, rather than a length of superconducting wire. The sensors are now readout by specialist cryogenic temperature readouts (Lakeshore 218) and fed into the PLC by RS232 coms. Lakeshore units can generate setpoint outputs for temperature interlocks, if necessary.

5. *Affect electrical earthing (grounding)?* ***No***

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6. *Introduce new or alter existing safety hardware?* ***Yes***

See A.2

7. *Affect process equipment upstream or downstream?* ***No***

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8. *Affect the interlinking of vessels?* ***No***

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9. *Affect any critical instrumentation, whether safety, environmental or quality related?* ***Yes***

See A.2 and C.4

10. *Use different materials of construction?* ***Yes***

The cryogenic vessel is aluminium, not stainless steel.

11. *Affect any other jobs?* ***No***

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12. *Make any facilities, equipment, alarms etc redundant?* ***No***

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**D. Operating and maintenance methods**

*1. Require change to Operating Procedures or Maintenance Records?* ***Yes***

Operating Instructions will require alteration. New safety equipment will be included in the maintenance plan.

*2. Require additional training of personnel?* ***No***

Click here to enter text.

*3. Require changed to engineering drawings or other Process Safety Information?* ***Yes***

Process and Instrumentation diagram and ATEX zoning drawing require updating.

**E. Other Considerations**

*Introduce any other hazard potential or potential impact on operations or maintenance?* ***No***

Click here to enter text.