Change Control Risk Assessment Checklist

Hydrogen supply

Change Proposal: To change from hydrogen being stored locally in a hydride bed and controlled via a heater-chiller in a closed loop, to storage in standard pressurised bottles and vented during an empty cycle.

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***

This change fundamentally alters the closed system philosophy on which the hydrogen safety case was previously based. With the hydride bed being used as the primary storage device, hydrogen merely moved between the bed and the cryostat along the jacketed transfer line. This kept the number of manual operations to a minimum when multiple cryogenic cycles were anticipated. With removal of the bed, hydrogen must be liquefied direct from a bottle and then vented to atmosphere at the end of each cryogenic cycle.

To remove the risk associated with multiple manual operations, the hydrogen will be stored in an individually-valved, manifolded bottle pack situated external to the experimental hall and piped in along a nitrogen-jacketed charge line. When hydrogen is to be vented from the system, it will be released through the nitrogen-purged vent line and out through the stacks on the roof.

Removing the hydride bed reduces the complexity of the system and increases the speed of the standard empty cycle. It removes the glycol circuit and cooling water circuit associated with the bed heater-chiller unit. It also removes the risk associated with a charged bed subject to an external fire in the MICE Hall.

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***

As the hydrogen bottle pack will be stored external to the Hall, the regulator valve is not protected by the MICE PPS system. To mitigate the risk of overpressure due to tampering or sabotage, the bottle pack and regulator will be stored in a locked cage enclosure, with the key held in the hydrogen control room.

It should be noted that the system still has its pressure relief valve of 0.5 bar.g.

The enclosure will be protected against vehicle collisions by strategically-placed bollards and barriers.

3. Go outside the safe operating pressure/temperature limits and/or the design pressure/temperature? ***No***

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

The hydride bed relief valves of 30 and 60 bar are now redundant. The rest of the system remains protected by the 0.5 bar.g relief valve.

5. Require Emergency Shutdown Trips, interlocks or alarms or affect existing ones (e.g. test frequency)? ***No***

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

The nitrogen-jacketed transfer line will vent into the gas panel in a similar fashion to the main transfer line.

7. Introduce the potential for leaks of material, especially flammable, toxic, corrosive and/or those onto hot surfaces? ***No***

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

Click here to enter text.

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

The new bottle enclosure and transfer line will be included in the ATEX zoning drawing.

10. Affect safe access for personnel, vehicles and equipment or affect means of escape or affect access to safety showers or other key equipment? ***No***

Click here to enter text.

11. Adversely affect plant layout ie make key equipment hard to reach or operate? ***Yes***

The hydrogen bottle isolation valve will be within the locked enclosure, meaning a key is required to isolate the system from the supply.

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

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

Click here to enter text.

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

Click here to enter text.

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 system will be much quicker to respond without the hydride bed, which had a delay associated with its thermal mass.

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***

Click here to enter text.

9. *Affect shutdown, start-up or cleaning operations?* ***Yes***

Ending a cryogenic cycle will now involve switching the absorber heater on and opening the vent line valve until all liquid has boiled off. The system can then be purged as normal.

C. Engineering Considerations

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

Requires engineering design of the bottle enclosure and transfer line.

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? ***No***

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

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6. Introduce new or alter existing safety hardware? ***No***

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

Click here to enter text.

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

Click here to enter text.

9. Affect any critical instrumentation, whether safety, environmental or quality related? ***No***

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10. Use different materials of construction? ***No***

Click here to enter text.

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

Click here to enter text.

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

Click here to enter text.

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***

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

Process and Instrumentation Diagram requires modification to represent new charging line.

E. Other Considerations

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

Click here to enter text.