BRIEFING NOTE FOR RAL MICE HYDROGEN SYSTEM OPERATING INSTRUCTIONS HAZOP 29-30 OCTOBER 2012

INTRODUCTION

Rutherford Appleton Laboratories (RAL) of the Science & Technology Facilities Council (STFC) is constructing an experimental physics facility which includes a liquid hydrogen system. This hydrogen delivery system is part of the first (of three) MICE (muon ionisation cooling experiment) systems.

A full HAZOP of the design of the hydrogen delivery system as a single entity was carried out in June 2006 The design is now mature, as are the surroundings, and the facility is undergoing its R&D phase.

The internal review committee gave a 'green light' for the liquid hydrogen R&D work in October 2011 but asked for a second HAZOP exercise to look at the operation of the system in the full experimental context

The aim is to complete the HAZOP in October 2012 to allow the facility to commence operation in Q1, 2013

SCOPE of HAZOP STUDY

The Study will be a procedural HAZOP based on the MICE Hydrogen Systems Operating Instructions MICEH2-TD-120417 Issue 2. The study will be broken down into the following nodes:

1. System Checks - Sec 2
2. Access Control and Work Procedures - Sec 3
3. Vac Down Procedures inc PSCL4 - Sec 4.1
4. Purge Procedures inc PSC1 (He) and PSCL2 (H_2) – Sec 4.2
5. Helium Fill – Sec 4.3
6. Helium Empty – Sec 4.4
7. Hybrid Bed Charge inc PSCL3 – Sec 4.5
8. Hydrogen Fill inc PSCL2 – Sec 4.6
9. Hydrogen Empty inc PSCL2 – Sec 4.7
10. Fault Procedures – Sec 5

This briefing note details the background and methodology applicable to a procedural HAZOP of the proposed system. Nodes and Guidewords are detailed in Appendix 1.

Procedural HAZOP

A procedure HAZOP is an examination of an existing or planned operation (work) procedure to identify hazards and causes for operational problems, quality problems, and delays.

- Can be applied to all sequences of operations
- Focus on both human errors and failures of technical systems
- Best suited for detailed assessments, but can also be used for coarse preliminary assessments
- Flexible approach with respect to use of guidewords

Procedure

- Breakdown of operation (work) procedure into suitable steps
- Define intention of each step
- Establish boundary conditions
- Apply guidewords to intention and boundary conditions for each step.

HAZOP TERMS

Various terms with special meanings are used in HAZOP studies. These are described here for reference.

Nodes or Operational Steps
The steps of the procedure are outlined and investigated for deviations as an entity. Some change in nodes may be required as a HAZOP study proceeds owing to the learning process that accompanies the study.

The Functional Intent
The functional intention defines how the plant is expected to operate in the absence of deviations at the plant items or of the operational step. It thus provides a point of reference for defining deviations.

Guidewords
Guidewords are used to qualify the intention in order to guide and stimulate the brainstorming process and so discover deviations.

Deviations
Deviations are departures from the functional intent that are discovered by systematically applying the guide words to each node in a continuous process;

It is not unusual to have more than one deviation from the application of one guideword. Not all applications of guidewords result in physically meaningful deviations

Consequences
The consequences are the results of the deviations should they occur (e.g. release of toxic materials). Trivial consequences, relative to the study objective, are noted and dropped from further consideration, i.e. causes and actions are not recorded.

Causes
The causes are the reasons why deviations may occur. Not all possible deviations are meaningful and it is the job of the HAZOP team to identify meaningful deviations with credible causes. These causes can be hardware/software failures, human errors, external disruptions (e.g. loss of power) etc. Note that often there may be more than one cause for each deviation and these must be considered individually.

Appendix 1 – NODES AND GUIDEWORDS FOR RAL MICE HYDROGEN SYSTEM OPERATING INSTRUCTIONS HAZOP

Nodes

1. System Checks - Sec 2
2. Access Control and Work Procedures - Sec 3
3. Vac Down Procedures inc PSC4 - Sec 4.1
4. Purge Procedures inc PSC1 (He) and PSC2 (H_2) – Sec 4.2
5. Helium Fill – Sec 4.3
6. Helium Empty – Sec 4.4
7. Hybrid Bed Charge inc PCS3 – Sec 4.5
8. Hydrogen Fill inc PCS2 – Sec 4.6
9. Hydrogen Empty inc PCS2 – Sec 4.7
10. Fault Procedures – Sec 5

Guidewords

Guideword	Meaning
Unclear	Procedure confusing or ambiguous
Step in wrong place	Procedure will lead to actions out of correct sequence or recovery failure
Wrong action	Procedure action specified is incorrect or not followed or different action carried out instead
Incorrect Information	Information being checked prior to action is incorrectly specified
Step Missing	Missing step, step too large requiring too much of the operator
Step unsuccessful	Step not successfully carried out due to demands on operator
Interference effects from/to others	Procedure following performance likely to be affected by other personnel carrying out simultaneous tasks (usually when co-located)
Time	Step carried out too early, too late
Procedure	Not available, not applicable or not followed
Measurement	Instrument failure, observation error
Organisation	Unclear responsibilities
Communication	Failed equipment, insufficient /incorrect information
Personnel	Lack of competence/training, too few or too many personnel
Position	Awkward placement leading to potential for error/omission
Services	Complete or partial loss
External Effect	The effect on the surrounding facilities or vice-versa