Changes to the Baseline Design of the NPDGamma Liquid Hydrogen Target System

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by seppo

Below we give a list of changes that have been made to the conceptual baseline design of the NPDGamma Liquid Hydrogen (LH2) Target system. The baseline design was approved by the 2nd Hydrogen Target Safety Review and is written down in the NPDGamma Liquid Hydrogen Target Engineering Document, version 1.0, dated December 02.2004.

The Target Engineering Document states that

**"***The second hydrogen safety review defined a change control process by which formal requests for changes in the baseline design presented to the Hydrogen Safety Committee could be forwarded to the committee for response.*

*Change control is part of the larger issue of quality assurance (QA). The basis for all QA will be the Engineering Document and the assembly drawings. Any deviations from this basis, for whatever reasons, will be subject to the change control process. The Hydrogen Safety Committee recommended the following broad details be included in the change control process:*

- *When a change is identified, the Hydrogen Target Work Package Leader sends a written change request to the Project Leader. The change request will include sufficient detail to describe the change and full justification for the request.*

- *A Target Change Control Board (TCCB) consisting of J.D. Bowman (Experiment Spokesman), J. Knudson (Review Committee Chair), S. Penttilä (Project Manager), and J. Schinkel (P-23 Group Safety Officer) will review the change.*

- *The TCCB will either approve the change or recommend that it be forwarded to an appropriate level for further review and approval. The hierarchy of levels might be: TCCB, LANSCE Facility, LANL $LH_2$ Safety Committee, LANL management, DOE.*

*The TCCB will function mostly as a screening committee. The Hydrogen Work Package has adapted this change control process.*

*The changes to the base design approved through the change control process were (1) the approval of the potential use of titanium as a target vessel material, (2) the redefinition of the areas requiring external helium atmosphere to the weld joints and o-ring seals and the subsequent redesign of the vacuum system to incorporate internal channels for the introduction of the helium in the needed locations, (3) approval of the*

*use of the Cryomech pulse tube cryo-refrigerator for one of the mechanical refrigerators, (4) clarification of the nature of the radiography requirements associated with the change in design to incorporate the internal channels for helium conduction. Correspondence with the TCCB is available in the web page www.iucf.indiana.edu/U/lh2target/export-files/."*

In addition to the changes mentioned above we ask TCCB to review the following changes and modifications to the baseline conceptual design:

1. Changes to the cryostat:
    - 1.1 The target system inside the cryostat consists of the LH2 vessel and the exhaust line from the vessel outside the cryostat. The original design included total of five CF flanged joints including two Al-SST CF flanged joints and one VCR joint. The new design includes three SST CF flanged joints in the exhaust line. This change will simplify the system and increase the reliability of the cryogenics.
    - 1.2 The original two Al-SST CF flanged joints are proposed to be replaced by bi-metallic joints welded onto the LH2 vessel. The two Al-Al welds have been specified, radiographically inspected and approved.
    - 1.3 The "soft" vacuum bellow of the original design is proposed to be replaced by a stiffer bellow (MAWP 70 psia) with a stabilization system.
    - 1.4 An ½" VCR joint of the original design is proposed to be replaced by a 1 1/3" CF flanged joint with bolts of 0.25-28 (a standard 1 1/3" flange uses 0.16-30 bolts) which allows higher axial sealing force.
    - 1.5 The cryo testing has shown that we need more cooling power during the hydrogen gas condensation. We propose to have a precooler/ortho-para converter system locating around the exhaust line inside the cryostat as shown in attached drawing. The precooler/OPC will speed up the condensation time significantly and thus also increase safety.
    - 1.6 We propose to add an extra instrumentation feedthrough the top flange of the cryostat. This is a high internal pressure instrumentation feedthrough.

2. Changes to the original University Indiana gas handling system
    - 2.1 We propose to remove the Pd membrane purifier which is not needed because of the new precooler/OPC. This will decrease the hydrogen source pressure in the supply and gas handling system (GHS) from 250 psi to 100 psi.
    - 2.2 We propose to remove two mechanical and two turbo pumps out from the GHS. We propose to remove any possible source of sparks from the GHS. This was proposed of LANL Hydrogen Safety Committee.
    - 2.3 We propose to remove other sources of sparks out from the GHS like microswitches, power strips, extra pressure gauges, and pneumatic valve drive coils.
    - 2.4 We propose to replace in the GHS the original normal mechanical pump used to pump hydrogen by a hydrogen proofed pump.
    - 2.5 We propose to remove the ortho-para converter (OPC) from the GHS. The new precooler/OPC in the cryostat will its job.

2.6 We propose to lower the cracking pressure of the relief valves RV102 and RV103 in the GHS to 100 psid.

2. We propose to use an integrated relief chamber unit which include the two rupture disks of the cryostat vacuum and one rupture disk and main relief valve of the hydrogen vent line.
3. We propose to use fixed flow restrictors of 20 SLPM on the hydrogen gas bottle regulators.