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memorandum

LANSCE Division
Accelerator Operations and Technical Support

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Phone/Fax: 7-2927/Fax 5-4049
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Report of the November 2, 2005 meeting of the np → dγ LH_2 target change control board

The Target Change Control Board (TCCB) for the np → dγ experiment liquid hydrogen target (Jeff Schinkel, P-DO; David Bowman, P-23 (absent); James Knudson, LANSCE-OPS; Seppo Penttila, P-23) met on November 2, 2005 to discuss the changes that have been made or are being proposed for the target. A summary of the changes, discussion and recommendations are listed below.

Changes to the cryostat:

Description: a number of changes are proposed which collectively serve to improve the leak-tight integrity of the target vessel and to provide additional strength to the internal components. These changes were motivated by deficiencies detected during the first pressure tests of the cryostat and the first attempted cool down of the system. The specific changes are:

1. Elimination of several mechanical joints in the hydrogen exhaust line.
2. Replacement of two aluminum-to-stainless-steel Conflat joints on the target vessel with bi-metallic joints.
3. Replace a bellows section with a stiffer bellow and mechanical stabilization.
4. Replace a cold VCR joint with a Conflat joint with upgraded bolts.
5. Increase the cooling capacity of the system by adding a combined precooler and ortho-para converter.
6. Provide for additional instrumentation with a high-pressure feedthrough.

Discussion: the TCCB views items 1 through 3 as generally improving the reliability of the cryostat by reducing the number of points where leaks can develop. These four changes reflect cryogenic best practice and the TCCB therefore grants its approval.

Item 4 arises from a lack of information regarding the performance of VCR fittings when they are thermally cycled relative to experience with Conflats. Item 6 will allow the operators to more closely monitor the operation of the target. The TCCB concurs with the experiment team that these two changes will not increase the risk of operating this target and therefore grants its approval.

Item 5 is proposed to overcome the slow cooling rate that was observed during the first cold tests of the target with neon gas. This test resulted in a calculated cool down time of two weeks for a full charge of hydrogen. The TCCB agrees that this is clearly excessive and would expose the entire system to additional vulnerabilities. Clearly, more cooling capacity is required. The change proposed by item 5 is to add passive cooling capacity during the condensation phase of cool down in the form of a tube-in-tube heat exchanger where cold helium gas cools the incoming stream of hydrogen. The addition of

catalyst material for ortho-para conversion as part of this precooler will permit the extraction of the heat of conversion by the helium gas, thus removing this heat load from the existing cryo-coolers. The TCCB approves this change.

Changes to the gas handling system:

Description: several changes are proposed to the gas handling system (GHS). These reflect evolving experimental requirements as well as safety code considerations. The specific changes are:

1. Remove the palladium membrane purifier.
2. Remove vacuum pumps from the GHS.
3. Remove other sources of electrical energy.
4. Replace a standard vacuum pump with an explosion-proof vacuum pump.
5. Remove the ortho-para converter from the GHS.
6. Lower the cracking pressure of relief valves RV102 and RV103 to 100 psid.

Discussion: items 1 and 5 above may be considered as changes arising from evolving requirements. The palladium purifier will not serve any useful service as the experiment plans to fill the target with very high purity hydrogen. Its elimination will allow the team to operate the hydrogen fill line and the GHS at a much lower pressure (100 psi vs. 250 psi). The TCCB concurs with this idea and approves this change.

Items 2, 3 and 4 are all designed to remove sparking sources from the GHS as recommended by the LANL Hydrogen Safety Committee. We note that the "explosion-proof" pump of item 4 refers to a unit wherein the electric motor is sealed, thus isolating sparks from any hydrogen atmosphere that might surround the motor during an accident. The TCCB agrees and approves these changes.

Item 6 results from the lowering of system pressures noted above. As the pressure vessels were originally rated for the higher pressures, the lowered relief valve pressures will serve to increase the margin of safety for the pressure system. Therefore, the TCCB approves this change.

Integrated relief chamber:

Description: a 10" diameter section of pipe with several flanges will be fabricated. The various relief valves and rupture disks from the vacuum space and the hydrogen vent will be piped into this chamber, which will then be connected to the primary 4-inch vent line to the outside.

Discussion: this chamber is intended to collect the system relief valves and rupture disks in a clean manner. There is some concern over the weight of this item. The TCCB recommends that a suitable support structure be designed for this chamber, but otherwise approves the change.

Flow restrictors:

Description: the experiment proposes to install flow restrictors between the hydrogen supply bottles and their regulators. Flow would be limited to a maximum of 20 SLPM.

Discussion: this change is seen to effectively protect the GHS and the balance of the target system from a regulator failure that would expose the system to full bottle pressure and volume. This change is consistent with best hydrogen practice, and is therefore approved by the TCCB.

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