



To: Patrizia Rossi  
From: Christopher Keith and Tim Whitlatch  
Cc: Ed Daly, Steve Christo, Dave Kashy, JP Chen, Dave Kausch, Eugene Chudakov, Javier Gomez, Tom Carstens  
Subject: Hall D Hydrogen Target Safety Review  
Date: June 11, 2014

This document replies to the Review Committee's comments and recommendations, given as result of the review.

Review Committee:

Ed Daly (chair)	JLab
Dave Kashy	JLab
JP Chen	JLab
Steve Christo	JLab
Dave Kausch	JLab

The Review Committee put forth the following recommendations:

1. Recommend further testing on the glue joint, such as repeated cold shock cycles, or as part of the current integrated test plan. The design team may consider Torlon as viable alternative if further testing is unsuccessful. (Note: Gluing of aluminum-to-stainless did not work for Hall B targets and were subsequently changed to Torlon. Although tests on the Hall B targets showed that the aluminum-to-stainless glue joint was problematic, that target had a different geometry and interface length.)
2. Complete engineering calculations associated with system design prior to commencement of Neon testing.
3. Add relief set point values to the Hazard Analysis prior to Neon testing.
4. Purchase a spare PTR and compressor (~\$60K) to improve target system availability. The timeframe for completion is dependent upon agreement for funding of components and balanced against the potential reduction in target availability.
5. Develop procedures for system shutdown including considerations for target warm-up, occupied vs. empty hall and automatic detection of hydrogen within FSD. (Work with D. Kausch to complete prior to operations readiness)
6. Define the location of hydrogen cylinders in the OSP. (Work with D. Kausch to complete prior to operations readiness)
7. Draft version of the trouble-shooting guide should be developed prior to Neon testing.

8. The schematic should include EPICs tags and labels for flammable gases. It should be reviewed and approved prior to hot-check out in the Hall. Due consideration should be given to appropriate definitions, testing configurations of the gas panel and full system, testing pressures and which parts are isolated during testing.
9. The P&ID should be reviewed and approved prior to hot-check out in the Hall. Due consideration should be given to appropriate definitions, testing configurations of the gas panel and full system, testing pressures and which parts are isolated during testing.
10. Define the performance requirements and limitations of the current design. Reference to this should be included in the Hall D Operational Procedure so this should be completed prior to hot-check out in the Hall.

**Our replies to the recommendations are as follows:**

- 1. The existing design, consisting of an aluminum base, kapton cell, and stainless entrance/exit tubing was successfully utilized at 28 K during the previous tests with liquid neon and will experience additional multiple thermal cycles during the upcoming tests, both in the EEL and in Hall D. If this design proves problematic during these tests, replacing the aluminum base with torlon will be a priority.**
- 2. All calculations will be completed and reviewed by a 2<sup>nd</sup> DA prior to commencement of neon testing.**
- 3. Relief set point values will be added to the Hazard Analysis prior to testing.**
- 4. Hall D and the Target Group will pursue the procurement of a 2<sup>nd</sup> PTR with the 12 GeV project and Physics division.**
- 5. Work installing the Flammable Gas Detection System is well along at this point. We are working with Dave Kausch to install alarms in the Counting Room. A flashing alarm will be mounted above the target in the hall. Procedures are being developed for operators and personnel in the Hall. If it is deemed necessary, the flammable gas monitor can be interlocked with the target refrigerator to warm the system automatically.**
- 6. Locations for the hydrogen/helium cylinders have been defined and installation will begin shortly.**
- 7. A trouble-shooting guide will be developed as experience with the target is accumulated.**
- 8. The target system has been appropriately marked for its flammable gas content. The control GUI/schematic is currently in progress and will display appropriate EPICs tags.**
- 9. The PI&D will be reviewed and approved prior to hot check out in the Hall. A detailed set of instructions for preparing and operating the system was provided prior to the review. These instructions will be updated as experience with the target is accumulated.**
- 10. The performance of the target will be ascertained during its testing phase in Hall D this summer, and the results communicated to the GlueX collaboration. The Hall D Operational Procedure will be updated to include a section on the target prior to hot-check out.**

In addition to these formal recommendations, comments were also written as follows:

1. Consider changing VCR fittings to Conflat fittings for better reliability. Welding is also a viable option.
2. Consider an over-pressure test that mimics a loss-of-vacuum incident.
3. Consider destructive testing at the end-of-life of the target to improve understanding of target performance limits.

**Our replies to the comments are as follows:**

- 1. The Target Group has extensive experience utilizing Swagelock VCR fittings at cryogenic temperatures and found them to be reliable. They have used these fittings multiple times on existing cryotargets at 19 K, on polarized targets at 1 K, and below 1 K on the frozen spin target. We will therefore proceed with the current design, but will keep the panel's comments in mind if problems arise.**
- 2. Design and construction of the target system was made in full compliance with all relevant ASME and NSFP codes, which we believe obviates the need for such a test. Furthermore, these codes do not require loss-of-vacuum testing, nor are such tests currently part of JLab's standard practice for cryogenic systems.**
- 3. This will become part of the plan for future operations. At least the first cell will be tested when usage is completed.**

**In conclusion, we feel that the review committee's concerns have been addressed adequately, and we can commence cooling and condensing hydrogen when all systems are ready.**