Answers to Dave Kashy's list of issues and concerns regarding the G0 Target Neon Test

Issues Silviu Covrig, May 20, 2002

1.&2. This test was designed to take place inside the magnet, although it doesn't have much to do with the magnet itself except that it tries to simulate the in situ catastrophic boil off of the target. It has been pointed out to us very clearly by both the G0 magnet system manager and the management of JLab that no test that will break the vacuum in the magnet at a rate higher than the normal backfilling of the magnet will be approved here since it will destroy the SI in the magnet. This is one of the guidelines we will follow for this test. The target cell itself was tested statically to 85 psid at Caltech, the target cell soldered on the manifold was retested to the same pressure statically, 85 psid at JLab and it passed both tests. According to attachment [1] the pressure spike during a Neon catastrophic boil off would be less than 38 psia. We do not expect the cell to rupture, although it is not impossible. According to the literature, the effect of the pressure on thermal conductivity translates into an "S" shaped dependence of the conductivity on pressure. For most materials, including Al and superinsulation, the effect is negligible below 10^{-5} torr and develops into a plateau above 0.1 torr for Al (see attch., this graph doesn't take into account condensation). Based on G0 magnet subgroup's experience with venting the magnet, it takes less than 1 minute to bring the magnet from vacuum to 1 torr without doing any damage to the SI in the magnet. For Al we need 0.1 torr to simulate a catastrophic vacuum failure under which conditions it takes 73 s to boil off the target with Ne [1]. We will backfill the magnet vessel at the normal venting rate with dry N_2 through a KF40 port (supports 1.4"ID pipe) installed on the GV on the target service module's 4-way cross [4]. We will use regulated house N_2 and we believe that in these conditions we will simulate the most probable vacuum failure in G0 conditions without damaging the SI in the magnet.

3. Based on Sample target experience at MIT-Bates, this target was designed to run with the cell bare. The catastrophic boil off computations in [1] and [6] take into account exactly this situation.

4. The pressure of the coolant in the coolant side of the heat exchanger, I've been told, is 20 atm or 294 psia in and 3 atm or 44 psia out, during normal running. The pressure in the ballast tank before filling the loop and cooling down is 40 psia and we estimate that it will drop to about 24 psia when the loop will be full of liquid. The pressure spike during the Ne boil off is expected to be 38 psia in the target loop. All these pressures are below the pressures registered in the coolant circuit. The coolant circuit of the heat exchanger was tested statically at JLab to 500 psia or 34 atm and passed the test on the bench, in addition, the coolant circuit intrinsic to the G0 target was tested (this includes all the internal target coolant circuit, from the inlet to the outlet female bayonets that connect to outside U-tubes) to 400 psia or 27 atm and passed the test. We don't see what might be the reason for failure of the heat exchanger and under which scenario the coolant circuit might be contaminated.

Concerns

1. It is said in the TOSP that "the target system passed all the required controlled pressure tests", this one included.
2. In this TOSP there is an assessment of the ODH risk in the same manner it was done for the Test Lab TOSP for target testing, TOSP that was approved twice.
3. We'll do whatever the EH&S requires at this point.
4. This test is required by JLab. The test has to be done in such a way that it will not harm the magnet. The "philosophy of the LOV" is based on this assumption.
5. In reality the He cell exit window withstood a 1 atm negative differential pressure at Caltech with no deformations. For the test itself we will pressurize the He cell to 55 psia all the time, at least 1 atm above the computed spike in pressure for a catastrophic boil off with Neon.
6. Attch. [6] Appendix B, although obsolete in results, since it doesn't take into account the final vent line dimensions (as it is done in [2]) is based on an MIT-Bates internal report about catastrophic boil offs due to loss of vacuum. Local experts in cryogenic targets at JLab believe that it is, so far, the sole source for computing catastrophic boil offs and it is very conservative. The assumptions made for the computation are stated clearly at the beginning of the Appendix. It takes into account the most severe catastrophe and outlines the heat transfer sources.
7. There is a CV right after the RD that should prevent exposure of the RD to reverse pressures and contamination of the target system in case the disk ruptures (see the gas panel diagram attch. [8]).

Note: If anyone needs extra copies of any of the attachments please contact Silviu Covrig, pager 584 5501.