Cold Test of Tevatron Spool TSM001

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Summary

On 25-Oct-2006 TSM001 was "cold leak tested" on test stand two in the Magnet Test Facility. This entailed cooing the magnet down to ~ 4.9°K and then cycling the helium pressure to look for a leak signal. The result is that no leak was detected up to a pressure of 50 psia. This test was successful due to the excellent cooperation between the Test & Instrumentation, Material Control and Magnet Systems departments.

Background

TSM001 was installed at Tevatron lattice location B17-1A on 14-Feb-1991. It contains weak corrector DSQI-177 and strong corrector S5-001. A massive quench in November 2005 resulted in TSM001 developing a substantial leak. In January 2006 it was reported that an inspection revealed that a piece of a nearby Kautzky valve had broken off and become lodged in such a fashion that the valve could not open when required. As a result the brunt of the quench pressure was felt by the TSM spool which came out with a massive leak.

An incoming inspection was done on the magnet, and the leak was confirmed (see DR 4315); the single phase relief tube is the suspect. Fortunately the correction coils appeared to be fine. It was determined that we should open the magnet up and see if it could be repaired. This indeed took place, and the magnet was repaired during the summer of 2006 (see pictures at \\tdserver1\project\proeng\MagnetPhotos\TSM\TSM001).

During final leak checking in October 2006 some odd things were seen. While pressurizing the internal systems a leak signal was seen by the MSLD, which subsequently cleaned up. This "signal" was seen numerous times, and it always cleaned up. The magnet was even left at 40 psig for two days and no real leak was identified. But in order to make sure that we were not missing something it was decided to run a cold leak test on an MTF test stand.

Test Setup

The spool was installed on test stand 2 in the Magnet Test Facility. We used an IB2 leak detector (Dupont 120SSA, tag number 29904) and an IB4 data logger (Omega model RD8800). James Williams provided the support for the data logger, including the configuration file. The leak detector was connected to the exhaust port of the test stand blower, in parallel with the blowers' backing pump.

Test Operations

The test began after it was confirmed that the leak detector had stabilized, which was by about 10am on 25-Oct-2006, at which point the cool-down was initiated. By about 2pm the spool was stable at ~4.9°K, and so the pressure increase began at around 2:30pm. The plan was to increase the pressure by increments of 5 psi and then hold for about 10 minutes at each plateau of 30, 35, 40, 45 and 50 psia. If there was a leak that opened at a certain pressure we would expect to see a signal on the MSLD that coincided with the pressure change of the single-phase helium. The MTF operator believed they could go up to about 50 psia without blowing any relief valves.

The test went very successfully. The pressure was pushed to about 50 psia for two cycles, and all data were adequately logged.

Test Conclusions

After the data were extracted from their respective systems, we were able to combine them to look for any signals of leaks. It is worth noting that the extraction and integration of the two sets of data was a little tricky. One issue is that the MTF data logging system uses a time-stamp that needs to be converted into “real” time by a special algorithm (Joe DiMarco has an algorithm “jul2greg” that should work on a Unix machine; I ended up doing the conversion manually by choosing a datum and giving it a real timestamp based on the print-out provided by Mike Tartaglia, and then having MS-Excel calculate all the other timestamps). The other issue was that the data logging frequency between the two data sets was quite different; MTF was at ~ 0.091 Hz (about once every 11 seconds) and the MSLD was at 4 Hz. This resulted in a couple of problems, which were overcome by hand. The first was that the number of MSLD data points exceeded MS-Excel’s limit (which is somewhere around 65k rows), and the fix was to export the data in segments of 60 minutes. The other issue was that it was difficult to put both data sets onto one graph in MS-Excel due to the data point frequency. One needed to be able to have MS-Excel calculate a moving average (i.e. average 88 rows at a time), but the MS-Excel operator did not know how to do that. The fix was to plot the instantaneous reading of every 88th row instead of a moving average. Doing this “by hand” in MS-Excel was quite tedious.

The result of all of this is seen in figures 1, 2 and 3 below, which are the data plots for the 2pm, 3pm, and 4pm hours. The plot of most interest is figure 2, which shows an interesting bump starting around 15:28 and ending around 15:47. It seems to start around the time the pressure was increased from 40 to 45 psia, and then cleans up around when the magnet hits 50 psia. Since it cleaned up, this is not interpreted as a leak, although it does appear to be a similar signal to what was seen when leak checking the spool warm in IB2. None of our experts are overly concerned with this bump, and so we give TSM001 a clean bill of health.

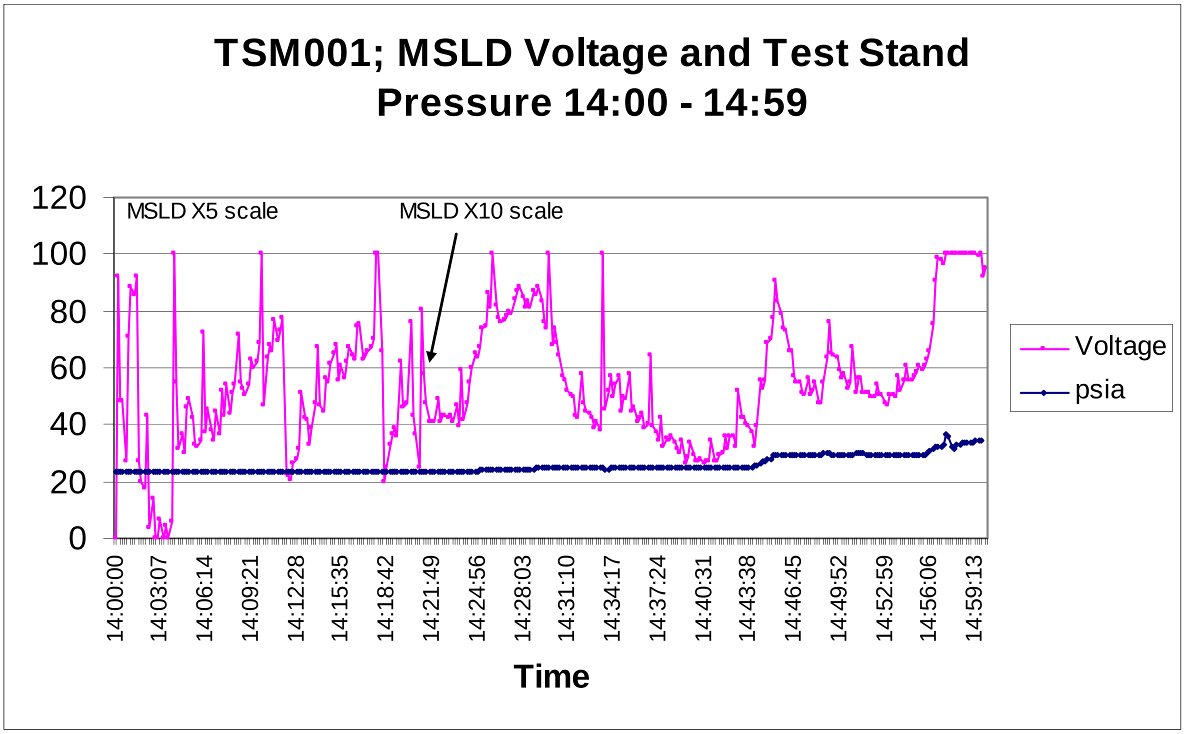

Figure 1, 2:00pm – 3:59pm

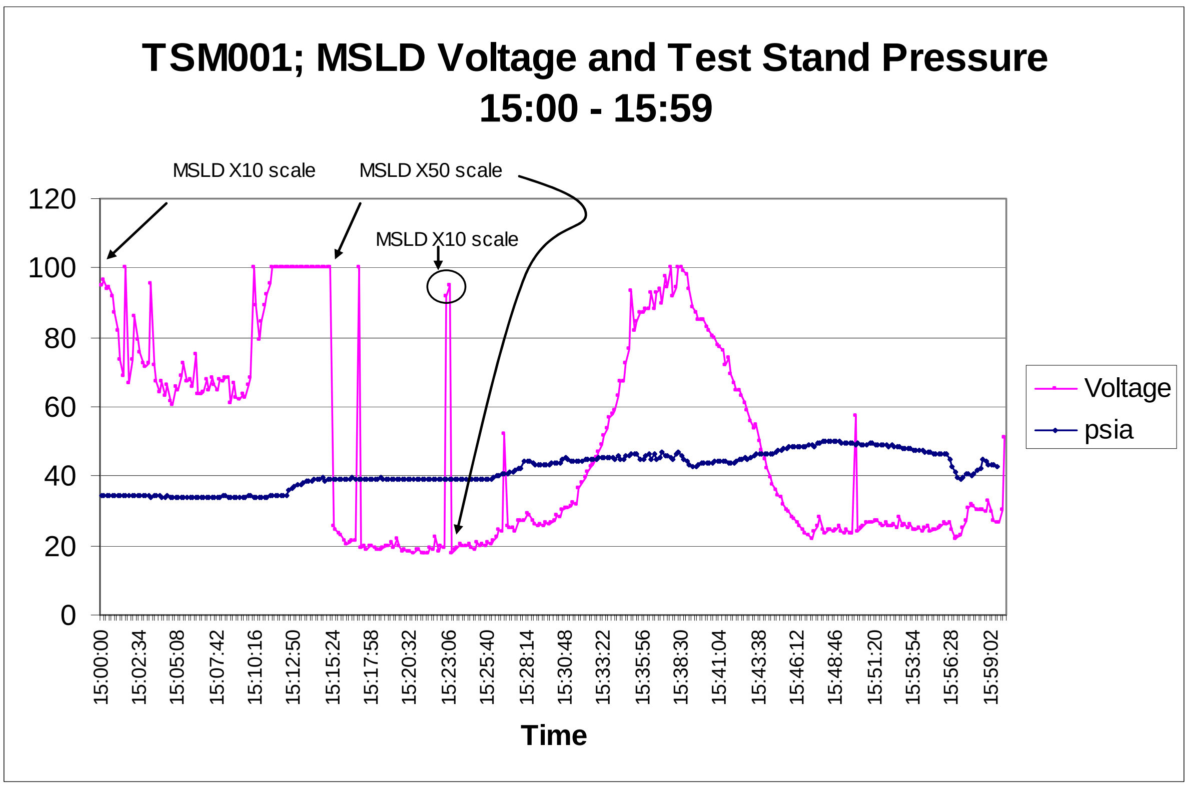

Figure 2, 3:00pm – 3:59pm

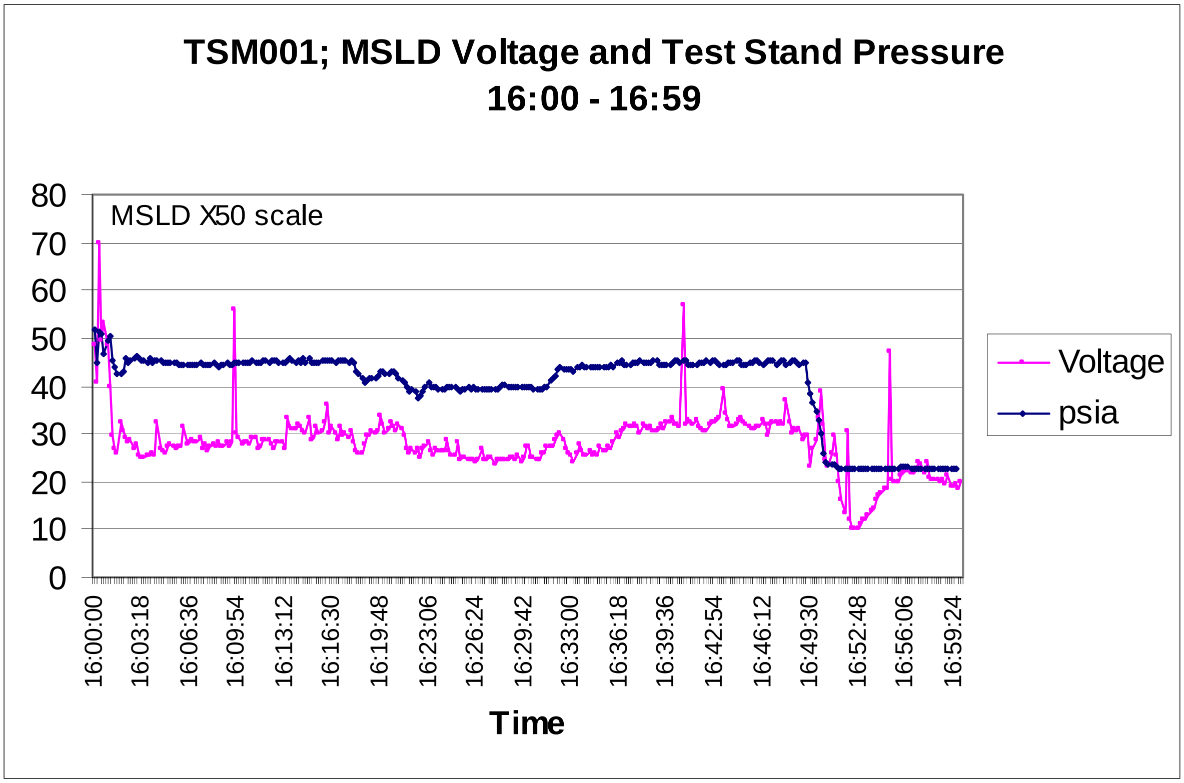

Figure 3, 4:00pm – 4:59pm