ACCEPTANCE SUMMARY FOR LHC MAGNETS BUILT AT BNL

Magnets D2L101, D2L102

Date of this summary: 30 December 2003.

This document contains a short summary of the acceptance status (in italics, just below), the minutes of the acceptance meeting, and actions taken after the acceptance meeting [in square brackets with the text of the minutes, or as footnotes].

Acceptance status:

The BNL committee has approved the magnets for shipment to CERN, assuming satisfactory completion of several items:

- *Survey of the pipe positions [completed-see [1]]*
- *Sign "BNL acceptance" certificate –[signed 17 December 2003]*
- *Make official nameplate – [completed as of 29 Dec.]*
- *Apply "BNL" decal – [completed as of 29 Dec.]*

The following items are needed for MEB acceptance:

- *·Review and acceptance of the survey data by CERN – see [4]*
- *Review and acceptance of field quality data by CERN – see [5]*
- *Acceptance of waiver on pipe positions (if any)*
- *Acceptance of waiver for defective level probe--done (see [2])*

MINUTES OF ACCEPTANCE MEETING

Date of acceptance meeting: 25 November 2003

Present at acceptance meeting: Durnan, Escallier, Jain, Muratore, Pilat, Plate, Porretto, Schmalzle, Wanderer

Quench Data: Muratore showed the quench performance of all nine D2's. These two magnets are located in IR8 and operate in liquid helium. Their operating current is 6505A at 7.54 TeV. D2L101 was the first magnet tested on this test stand (Magcool Bay C). The magnet exceeded 6.6 kA (the quench performance goal in the final version of the acceptance specification) in both liquid and supercritical modes. Its erratic performance was attributed to heat leaking in via the cold bore tubes, which were poorly shielded at the magnet ends. The quench performance in forced flow was better than that in liquid, as would be expected for quenching induced by heating, since heat is removed more slowly with liquid cooling than with forced flow cooling.

Prior to the test of the next magnet, D2L102, superinsulation was added to the cold bore tubes in these regions. The quench performance of D2L102 and D2L103 was excellent. These results are consistent with the discussion of heat as the source of quenching in D2L101. (Note that the warm bore tubes were not installed in D2 L101-L103 during quench tests, whereas they were installed during quench tests of the remaining six D2 magnets.) The quench plot and tabulation are available on the Web at http://www.bnl.gov/magnets/LHC_Acceptance/default.asp

Field Quality: Jain showed the warm data (from all nine D2's) and the cold data (from the last six D2's). The field quality of D2L101 and D2L102 was generally similar to that of the other D2 magnets. Jain noted that the cold transfer function (TF) data near 3 kA (the middle of the excitation curve) fall into two groups, D2L104-L106 and D2L107-109, with TF's in the first group being ~ 0.1% higher than those in the second group. This spread is much larger than that observed in RHIC ($\sigma \sim 0.03\%$) and the grouping suggests a systematic problem. No such grouping is observed in the sextupole data. A review of the magnet construction data did not uncover any significant changes made between the construction of magnets D2L106 and D2L107. However, the magnet test control system was changed from a VAX-based system to a PC-based system between these two magnets. At the same time, the system (DVM plus buffer) used to read the DCCT's was changed. It was decided to make a careful investigation of the relative normalization of the two meters. (This question has been resolved. See [3]]

Pilat reviewed the data as shown by Jain. She stated that the field quality was acceptable for the LHC, but wished to draw attention to the following items:

- b_6 at full field: check that the corrector strength is sufficient.
- Transfer function (assuming the data shown are correct): not a problem since the magnets are independently powered.
- b_2 at 3 kA: note that the harmonics are of opposite sign.

Engineering: Escallier reviewed the electrical test results. D2L101 meets the electrical specifications. D2L102 also meets the electrical specifications, except for one wire of a level probe at the non-lead end of the magnet. The resistance of this wire has increased significantly, to ~ 30 Ω, for an unknown reason. This level probe is one of two level probes at the non-lead end of the magnet. Should the good probe fail, it is possible to circumvent the problem with the wire by building a special circuit for reading the level probe.

Schmalzle said that the magnet met specifications, except that survey data for the pipe positions at the end of the magnets was not yet available. [survey completed – see [4]].

QA: Porretto reported that the only issue beyond those listed by the engineering staff was the application of a decal.

Safety: Durnan stated that the magnet satisfied the safety requirements (specifically, pressure and electrical) established for it. (J. Durnan has replaced M. Gaffney on the committee.)

Survey: The final survey of the magnets has not yet been made. (Survey completed and reviewed – see [1].)

These notes written by P. Wanderer

FOOTNOTES

[1] From: Plate, Stephen
Sent: Tuesday, December 09, 2003 1:54 PM
To: Wanderer, Peter
Cc: Porretto, Chris; Anerella, Michael D
Subject: Closure of BNL Acceptance of D2L101 & 102

Peter,
I have reviewed the survey data for the two subject magnets and find that we can accept these magnets based on that data.
Steve

[2] Email from R. Ostojic to H. Hocker, December 17, 2003:
Henry,

Thank you for the additional information on the level gauges.

We have reviewed the non-conformity and agree with your proposal that the magnet is used as is.

In order to prepare for the eventuality of operating the gauge in a three wire configuration, it would be useful to have one of the gauges shipped to us separately. Could you please find if you have any available.

Thanks,

Ranko

[3] Email from Jain to Wanderer et al., 10 December 2003:

“We measured today the intercalibration of various buffers and voltmeters in the horizontal system. A reference voltage was fed to the buffers (in place of the DCCT signal), and various outputs noted. The reference signal, as well as the two buffer outputs, were also measured with HP3458 voltmeters, which were used as the "true" values.

“The INTRINSIC calibrations of both HP3456 in the power supply rack, and the HP34401 in the measurement rack, are both quite good. The HP3456 shows a gain error of +37 ppm and a DC offset of -21 microvolt relative to a HP3458. The HP34401 shows a gain error of only -2 ppm and a DC offset of +13 microvolt.

“The parameters of the two buffers, however, differ considerably. The buffer that feeds to the HP3456 in the power supply rack has a gain error of -210 ppm and a DC offset of +265 microvolts. The buffer that feeds to the 34401 has a gain error of +756 ppm and a DC offset of +162 microvolts.

“The above results imply that the current read outs from the two measurement systems differ by 966 ppm or ~0.1%. This is also roughly the amount of change seen in the transfer functions between the two groups of magnets. Also, from these results, the OLDER current readout is more accurate.”

Based on this calibration, the transfer function data from the cold tests of the D2’s have been corrected.

[4] The survey data were emailed by S. Plate to J.-.P Quesnel and D. Missiaen on 26 December. Steve thinks that Henry has submitted the deviation waiver to CERN for approval.

[5] The field quality data were emailed to L. Deniau by A. Jain in late December, after Jain was unable to gain access to the LHC FQ database.