

## **MINUTES –ACCEPTANCE MEETING FOR LHC MAGNETS BUILT AT BNL**

Magnet: D1L105

Date of meeting: 29 March 2002

Date of these minutes: 5 November 2002

Present: Cozzolino, Escallier, Fischer, Ghosh, Hocker, Jackson, Jain, McChesney, Muratore, Pilat, Plate, Soika, Thomas, Wanderer, Willen

[Information added after the acceptance meeting is in square brackets or has been added as footnotes.]

**Quench Data:** Muratore showed the quench behavior of the magnet. During the first two cooldowns, all quenches originated in the lower half of the magnet, a location consistent with the interpretation that the source of the quenching was heat leaking from the warm bore tube. The quench performance during the third cooldown, with the warm bore tube removed, met the acceptance criteria. The last three quench currents were higher than 6919A. (6919A is 10% higher than 6290A, the current needed for 7.56 Tev.) The quench plot and tabulation are available on the Web at

[http://www.bnl.gov/magnets/LHC\\_Acceptance/default.htm](http://www.bnl.gov/magnets/LHC_Acceptance/default.htm).

[Test results from the first four of the D1's were reported in a paper presented at EPAC 2002.]

**Field Quality:** Jain showed the cold data from D1L105 and all the warm measurements to date. Fischer has compared this magnet's data to the table of accepted values (allowing for the warm-cold difference). The harmonics are within the range of expected values from the reference table with two exceptions: the normal quad and the skew sextupole at the lead end (not the integral) at injection. They were judged to be of minor consequence.

The normal sextupole at injection is within the range of expected values but outside the value in the reference table because the table was prepared before data from the prototype were available. Jain showed a table summarizing this. (Jain's table is available via the Web reference given above.) The sextupole is outside the range of expected values only at injection. BNL AP will study this. [On May 10, BNL AP approved the field quality – see footnote 1]

The integral field measurement of the dipole field with the 10m non-rotating coil is not yet analyzed because there has not yet been time to change some of the program constants from RHIC values to D1 values. This will happen in the near future. [The program has been updated, the data analyzed, and transmitted to CERN.]

The field angle measurements are ok. However, the D1 magnets need a warm-cold comparison, and there is some uncertainty in the calibration of the gravity sensor for the cold measurements in D1L105. This is being checked. [Checks were completed before the data were transmitted to CERN. Luca Bottura has agreed that the magnet can be shipped, and work to match the field angle to the survey data was completed in the fall – see footnote 3.]

**Engineering, QA:** Escallier reported that one yoke temperature sensor has problems. [A replacement thermometer was installed inside the instrumentation line in the interconnect, and the wires routed along with the rest of the instrumentation bundle.] The magnet passed all other final electrical tests.

Plate and Cozzolino reported that the magnet had passed all mechanical tests, except that the analysis of the pipe positions awaits analysis of data from the survey group.

[Subsequently, most pipe positions were corrected where necessary by adding offset extensions to the existing pipes, and in a few cases by indicating position discrepancies that, although out-of-tolerance, were deemed to be acceptable. See note [4]]

Hocker reported that there were no issues beyond those reported by the engineering staff.

**Survey:** The survey data have just been made available to the AP group, which will handle the interface with CERN. RHIC staff will assist in evaluating the data. Plate will contact CERN to establish a contact person. [The survey data have been transmitted to CERN and reviewed by Jean-Pierre Quesnel. Quesnel has given approval to ship the magnet – see note [2] A deviation waiver on the positions of the ends of the pipes was approved by the US LHC PO on Nov. 5<sup>th</sup> – see [3].]

Minutes written by P. Wanderer

## FOOTNOTES

### [1] Email from F. Pilat, May 10, 2002:

Dear Peter,

Here is our (AP) summary concerning acceptance of D105, cold measurements of D103, and alignment acceptance.

We reviewed the warm data that Animesh presented for D105 and see no outstanding problem, as far as the field harmonics are concerned.

About cold measurements of D103, the measured b3 at injection of -18 units is slightly outside the reference table window of (-16.8, -5.7). This is a very small effect. We calculated via an Excel spreadsheet the effect on LHC chromaticity at injection with the following results:

b3 = -11 (reference) chromH 0.352 chromY -0.368

b3 = -18 (measured) chromH 0.577 chromY -0.601

As a comparison, the lattice chromaticity of the LHC at injection is ~80 units and the persistent current induced chromaticity is ~450 units, and a strong sextupole correction system exist at injection to correct for that. The D1L contribution appears negligible on this scale.

On the alignment acceptance, AP suggested the following alignment acceptance procedure, that was eventually agreed upon by all parties. I include here for completeness.

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1. For every magnet, we fill a table that contains the following information: straightness, twist, sag, beam tube positioning. The measurements for a specific D1 are compared to reference quantities. John Cozzolino is responsible for filling this table, checking that the individual measurements meet the reference specs, and signing off.
  2. Field angle data are checked (and if necessary signed off) by Animesh.
  3. The deliverables to CERN are: a drawing for each D1 that includes printed data and the description of data. Also individual D1 data will be shipped in the form of a Excel spreadsheet. (If they require another format, we can change that of course).
  4. Alignment data for LHC dipoles will also be loaded in the uslhMag database, in tables

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I checked today with John Cozzolino and he will make the alignment information for D105 described above available shortly, in time for the May 21 deadline.

Sincerely,  
Fulvia

**[2] Email from Jean-Pierre Quesnel to Steve Plate, August 1, 2002.**

Steve,  
I don't understand perfectly with respect to what points are given your data and we will have to discuss about that next time you come here. But in any case, you can send the magnet as it is.  
I think there is not missing data in what you have sent, but perhaps some uncertainties on the definitions.  
I hope this answer is ok for you for this moment.  
regards,  
Jean-Pierre

**[3] Email from Luca Bottura to Peter Wanderer, September 5, 2002**

This email was sent after Luca read the above email from J.-P. Quesnel to S. Plate. (Luca also proposed that CERN staff visit BNL later in the fall so that the matching of survey and field angle measurements could be done as thoroughly as possible.)

Hi Peter,

then I think that the data is complete. Luca

**[3] Email from Phil Fund to Peter Wanderer, November 5, 2002**

The pipe position deviations reported in DWR No. M0286, 28 October 2002 for magnet D1L103 are acceptable.

This is based on my analysis of the reported deviations and discussed with Tom Peterson, Joseph Rasson, Jon Zbasnik and Daryl Oshatz. To accommodate the reported conditions we modified the clearances in the DFBX pipe support plate and the installed lengths of the DFBX pipes. The changes will also accommodate the preliminary report of similar deviations in D1L105. When you report the deviations for D1L105 I will quickly check them, and if your final survey data has not changed, they will also be acceptable.

**[4] Email from Henry Hocker to Peter Wanderer, February 13, 2003.**

From: Hocker, Henry M  
Sent: Thursday, February 13, 2003 11:02 AM  
To: Wanderer, Peter  
Cc: Plate, Stephen; Porretto, Christopher J  
Subject: D1 #5 Waiver on Pipe Locations  
Waiver M0290 was approved internally and also reviewed by Phil Pfund. The waiver has been formally closed out in our system.