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1. Purpose:

1.1 A procedure is defined for control of Measurement and Test Equipment (M&TE) in the possession of the Magnet Division. Areas covered include:

1.1.1 Identification and labeling;

1.1.2 Calibration system;

1.1.3 Records.

1.2 This procedure is expected to be fully implemented by Sept. 30, 1992.

2. Scope:

2.1 The procedure defined here is intended to be used during the production phase for RHIC magnets. This procedure will also be applied to other Magnet Division projects. It is based on the knowledge of measurements needed for high quality magnets derived from the R&D program. It will apply to all Magnet Division-owned M&TE, including BNL designed and fabricated equipment (commonly called Special Test Equipment). The method of identifying items of M&TE requiring calibration is described, as is the methodology of assuring calibration of these items.

3. Objective:

3.1 The goal of the Magnet Division is the production of magnets that meet Project requirements for quench performance, magnetic field quality, and magnet reliability. In furtherance of this goal, this procedure follows the RHIC policy of using a graded approach that places the most emphasis upon and allocates proper resources to those items that could have the greatest effect on Collider performance, cost, and schedule.

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- 3.2 Equipment to be calibrated should meet one or more of the following criteria:
- a) required for receiving inspection/ product acceptance of component parts and materials;
 - b) affect magnet quality in ways not detectable with other calibrated instruments and procedures in place, or affect magnet quality in a way that would unacceptably raise production costs;
 - c) designated by Division/Section Heads.
- 3.3 The Division recognizes that there is a potential for incorrect or substandard parts being incorporated into magnets. Ongoing tests at each step of construction that include use of calibrated measuring devices, cross checks, consistency analysis, and an awareness of quality throughout the construction process, will minimize this potential. The Division considers the control and calibration procedure discussed here to be part of a balanced approach to meeting objectives for high quality magnets and believes this approach is the most advantageous one for the Project.
4. References:
- 4.1 BNL-QAG-901: Requirements for the Control and Calibration of Measuring and Test Equipment.
 - 4.2 RHIC-QAP-802: Control of Measuring and Test Equipment.
 - 4.3 RHIC Design Manual
5. Identification and Tracking of Controlled Equipment:
- 5.1 A computerized database of all Magnet Division M&TE will be developed and maintained, containing such information as:
 - a) make, model, and serial number of instrument
 - b) description of instrument
 - c) location
 - d) test or measurement with which the instrument is associated (or "general use")
 - e) cognizant engineer/scientist
 - f) calibration status
 - 5.2 A sticker will be affixed identifying the item as Magnet Division property (exhibit B).

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6.0 Identification of Calibrated Equipment:

6.1 The Division Head, in consultation with the Division Section Heads, will identify those systems and that equipment that need to be part of the calibration system. The decisions will be based on the criteria set forth in Section 3.0.

6.2 A list of this equipment, and the processes or measurements with which the equipment is associated, will be developed and maintained. Magnet Division staff may nominate equipment for inclusion on the list at any time using a standard form (exhibit D); a cogent discussion of how an uncalibrated instrument could lead to a failure to meet the Project objectives as given in Section 3.0 must be presented. Approval for inclusion will be given by the Division head or his designee.

7. Calibration Procedure:

7.1 A calibration procedure will be established for the equipment specified in 6.0. This will be a written procedure and will describe:

7.1.1 the parameter(s) to be calibrated;

7.1.2 the tolerance of the parameter(s), and who establishes this tolerance (i.e., mfr's recommendation, CE/CS based on intended use);

7.1.3 the frequency of calibration;

7.1.4 the calibration method;

7.1.5 the standards to be used.

7.2 The individual responsible for establishing the calibration procedure will be appointed by the Division Head or his designee.

7.3 In the case of an outside calibration, the supplier is required to have a written calibration procedure on file and to reference the procedure number on the calibration certificate.

7.4 Standard Test Equipment:

7.4.1 For Standard Test Equipment, which is defined as equipment that is designed and manufactured by a recognized company and is part of that company's standard product line, the calibration procedure will normally follow the manufacturer's recommended procedure.

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7.4.2 Conditional Calibration: if equipment usage permits, a conditional calibration may be performed wherein the full range and function of the instrument is not calibrated; in this case the instrument must be labeled to indicate conditional status.

7.5 Specialized Test Equipment:

7.5.1 For BNL designed and fabricated equipment, the Division Head will appoint an individual to be responsible for establishing the calibration procedure.

7.6 Systems:

7.6.1 Systems may consist of a combination of standard and specialized equipment; the Division head will appoint an individual responsible for establishing the calibration procedure; if it is calibrated as a system, then the individual components will not be considered calibrated and will not be labeled as such.

8. Calibration Requirements:

8.1 All formal calibrations performed will meet the following minimum requirements:

- a) calibration should be performed with standards that are traceable to NIST or other recognized standard; if this is not possible for a particular instrument or system, the CE/CS will document a calibration method and provide a supporting rationale; the method will provide assurance that the instrument or system is calibrated for its intended use and will be defensible under peer review;
- b) a list of standards used, stating their calibration date and date due, must be kept on file for each calibration;
- c) standards used for calibrations should have an accuracy of at least 4 times, and preferably 10 times, the accuracy of the instrument, when feasible;
- d) before-calibration data and after-calibration data should be noted and kept on file;
- e) a label stating the date of calibration, the due date of next calibration, and the calibration supplier must be affixed to the instrument; if an instrument must be calibrated before each use, the label will state that;
- f) outside calibration suppliers must meet all of the above requirements plus provide the following: a certificate stating traceability of the calibration to the NIST and noting the calibration procedure number.

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9. Calibration Records:

9.1 A paper file for each piece of calibrated equipment will be maintained for three years; the file will contain all paper records, such as:

9.1.1 certificate of traceability

9.1.2 calibration data

9.1.3 calibration summary sheet (exhibit C)

- a) history of calibration
- b) calibration date, interval, and date due
- c) pass/fail on first run with details
- d) any limitations on use

10. Magnet Division Calibration Group:

10.1 The Division Head will establish a Calibration Group within the Division to assist in implementing the control and calibration system. The Group will consist of one or more calibration technicians and a calibration engineer. The calibration engineer will monitor the work of the calibration technician and will provide such professional assistance and advice as may be required

10.2 Duties and responsibilities of calibration technician:

10.2.1 Procedure Control: will keep a binder of all calibration procedures; will assign a number and rev to each procedure and will see that each procedure has been checked and signed off by the cognizant engineer/scientist and by the calibration engineer.

10.2.2 Equipment Database: will maintain M&TE database.

10.2.3 Calibrations: may perform formal calibrations himself or with the help of other in-house personnel, or send the equipment out to an approved calibration supplier, or have an approved calibration supplier come on-site to perform the calibration; will recommend outside suppliers from a list of suppliers surveyed and approved by the BNL Quality Assurance Office.

10.2.4 Calibration Schedule: will develop a written schedule of calibrations, subject to Division approval.

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10.2.5 Recall: will notify cognizant personnel of required calibrations, and work with them to meet the calibration schedule; notification will be in the form of a memo or personal visit 30-60 days before calibration is due.

10.2.6 Notification of Out Of Tolerance Condition: will notify cognizant personnel, including the Division Head, if an instrument fails calibration on the first run; notification will be in the form of a written "Notification of Out of Tolerance" document (see exhibit A) and one copy will be kept on file; the document will precisely describe the failure in order to aid Division personnel in determining the impact (if any) on magnet production and testing.

10.2.7 Records: will maintain a paper file on calibrated equipment as per 9.0.

10.2.8 Labels: will update labels on instruments as required.

10.2.9 Repairs: will arrange repair of instruments that fail or that malfunction in use; such instruments are to be withdrawn from service and routed to the Calibration Group office where they will be properly tagged and repaired before further use; the necessity for formal recalibration will be determined by intended usage.

11. Deviations from Calibration Schedule:

11.1 A two week window around the due date will be permitted for items on a 6 month or longer calibration interval; for instance, if the due date falls on Jan. 31, the item will be calibrated during the last week of January or the first week of February. This flexibility should minimize the impact on production schedules. Items on an interval of less than 6 months will not be permitted a window. No provision is made in this procedure for any other deviation from schedule.

12. Labeling Methodology:

12.1 Individual instruments

12.1.1 Each individual instrument that is part of the calibration system and that is calibrated individually will be labeled in one of the following ways (exhibit B):

- a) a calibration sticker stating the date of calibration, the calibration technician or supplier, and the date due for re-calibration;
- b) a sticker stating "Calibrate Before Each Use";
- c) a sticker indicating conditional calibration for limited use.

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12.1.2 Instruments not in the calibration system will have a sticker stating "Not In Calibration System".

12.1.3 Instruments that fail, malfunction, or are suspect, and cannot be withdrawn from service immediately, will be labeled "DEFECTIVE". Such devices may not be used.

12.2 Systems

12.2.1 Systems that are calibrated as a system will be labeled as follows:

- a) a calibration sticker stating the date of calibration, the calibration technician or supplier, and the date due for re-calibration, and containing the statement "Components not Calibrated Unless Indicated".
- b) each system will be assigned a unique identification code; this code will be written on small stickers and, where possible, affixed to the individual components of the system; it will then be possible to know if a component has been switched, thus making the calibration suspect; the CE\CS will be notified and a decision made whether re-calibration is warranted.

13. Training on Calibration Procedure:

The Division will conduct a training program for professionals and/or technicians at the working level to introduce them to the control and calibration system. The program will consist of a series of meetings on the floor between a "program coordinator" and groups of workers.

The Division Head will appoint an individual to set up, document, and run the training program.

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Exhibit A
Notification of Out of Tolerance Form

BNL MAGNET DIVISION
CALIBRATION GROUP (EXT 2971)

**NOTIFICATION OF
OUT-OF-TOLERANCE CONDITION**

Date: _____

To: _____ **Bldg.** _____

The following equipment from your area was found to be in an out-of-tolerance condition as noted below. In accordance with BNL Quality Assurance Guide No.

BNL-QAG-901 and BNL RHIC-QAP-802, we ask that you determine the impact of this out-of-tolerance condition on data taken with this equipment since the last calibration date.

Cal Group ID No. _____

Manufacturer _____

Model No. _____

Serial No. _____

Description _____

Location _____

Last Calibration Date _____

Deficiency:

Calibration Group Rep.

Copy to Division Chairman _____ ✓

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Exhibit B
Labels

MAGNET DIV.
ID#

CALIBRATION
Date
By
Due

**CALIBRATE
BEFORE
EACH USE**

**NOT IN
CALIBRATION
SYSTEM**

**CONDITIONAL
CALIBRATION
FOR LIMITED USE**
DATE
BY
DUE
Conditions:

**SYSTEM
CALIBRATION**
COMPONENTS NOT CALIBRATED
UNLESS INDICATED
DATE
BY
DUE

DEFECTIVE
BNL Magnet Division
Calibration Group X2971

