

Calibration Dipole Magnet

6.8.84.1 Rev. B

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REVISION HISTORY

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1.0 INTRODUCTION

1.1 SUMMARY

A calibration dipole magnet is needed to calibrate the Hall elements in the 3-dimensional Hall probes used to measure the magnetic flux density components in different kinds of insertion devices and other magnets. The magnet shall have good field quality and be able to reach a maximum field of 2 T using an existing power supply.

1.2 SCOPE

The deliverables are:

- A dipole magnet fulfilling the specified field quality.
- QA/QC documents.
- Field measurements showing that the field quality is obtained.
- User's manual.
- Maintenance manual.

1.3 BACKGROUND

The Canadian Light Source is a national facility under construction at the campus of University of Saskatchewan in Saskatoon. The facility is a 2.9 GeV, 3rd generation synchrotron light source, which will produce high intensity beams of infrared, visible, ultraviolet and x-ray radiation.

The most intense beams will be produced by insertion devices (IDs), which are made of permanent magnets and iron poles. The magnetic field of the IDs must be very accurately measured and tuned to maximize the photon flux. The magnetic field components are measured using specially made Hall probes mounted on a measuring bench. However, the Hall probes must be calibrated to accuracy better than 10^{-4} , and planar Hall effect and misalignment of the Hall elements must be determined so they can be eliminated from the field measurements.

For the calibration we need a dipole magnet with good field quality that can be powered by an existing power supply. The field in the dipole will be measured by a set of NMR-probes.

2.0 REQUIREMENTS

2.1 FUNCTIONAL

- 2.1.1 The dipole shall have a variable air gap from 30 mm to at least 80 mm.
- 2.1.2 The dipole shall reach a field of at least 2 T at 30 mm gap and a field of at least 1.2 T at 80 mm gap.
- 2.1.3 The dipole shall be powered by an existing power supply. The power supply ratings are:
- | | |
|------------------|--------|
| Maximum Current: | 265 A |
| Maximum Voltage: | 75 V |
| Stability Class: | 10 PPM |

- 2.1.4 Inside a cylindrical volume with a diameter of 25 mm and a height of 30 mm centered at the middle of the dipole the field quality shall meet the following specifications:

$$|\mathbf{B}| < 1.2 \text{ T: } \quad \Delta\mathbf{B}/|\mathbf{B}| < 5 \times 10^{-5}$$

$$|\mathbf{B}| < 2 \text{ T: } \quad \Delta\mathbf{B}/|\mathbf{B}| < 1 \times 10^{-4}$$

- 2.1.5 The inlet pressure of the cooling water at CLS is 6 bar. The allowable pressure drop is 3 bar and the flow rate 20 l/min. The inlet temperature is (26 +/- 1)°C, and the temperature increase shall be maximum 20 °C.
- 2.1.6 The dipole shall have over-temperature and water flow interlocks. The interlocks shall be normally closed. The temperature switches shall be Microtherm L01, and the flow meter of the ELETTA AF1 series with stainless steel body.
- 2.1.7 The dipole shall be able to be transported with the 10-ton overhead crane in the beam line hall at CLS.
- 2.1.8 The dipole shall be certified by CSA or other prescribed testing laboratory acceptable to the Chief Electrical Inspector of Saskatchewan.

3.0 SAFETY AND ENVIRONMENTAL

Not applicable.

4.0 QUALITY ASSURANCE

The Proponent shall maintain and apply a quality assurance program compliant with ISO-9001 for the design, manufacture and testing of all components in the magnet.

5.0 INSPECTION, TESTING AND COMMISSIONING

- 5.1 The field quality requirement listed in section 2.1.5 for a field of 2 T shall be demonstrated at 30 mm gap.
- 5.2 The field quality requirement listed in section 2.1.5 for a field of 1.2 T shall be demonstrated for 50 and 80 mm gap.

6.0 RELIABILITY AND MAINTAINABILITY

The Proponent shall provide a maintenance manual for the dipole magnet.

7.0 APPLICABLE CODES, STANDARDS AND PROCEDURES

None

8.0 VIBRATION AND ACOUSTIC NOISE

Not applicable

9.0 OTHER REQUIREMENT AND CONSTRAINTS

None

