PREX Septum Magnet OSP

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1 Overview

The PREX septum, the key component to several Hall A approved experiments, was commissioned to 800 A under TOSP PHY-10-001-TOSP (Physics Division) and PHY-10008.100-T (ESH&Q). The purpose of this document is to describe the hazards and safety procedures for operating this magnet. These procedures include running the magnet during an experiment and making field measurements. The BigBox power supply being used with the PREX septum was commissioned during Hall A experiment E99-114 (TSOP PHY-02-003) using the BigBite magnet and this document presents the same procedures for safely operating the supply. This document does not attempt to describe the function or operation of the dipole or power supply.

2 Description of Magnet

Hall A PREX and associated experiments will make use of a room temperature coil septum magnet to deflect charged particles into the Hall A HRS's. The BigBox power supply will be used to energize this magnet. The power supply has previously been tested and was successfully used during the Hall A RCS experiment (E99-114). The control software of the supply runs from the HAC computer with the BigBox GUI. The first BigBite experiment (E01-015) ran the magnet at an excitation of 0.92 T which required 518 A with the maximum current limited to 550 A. Subsequently, after the successful completion of a high current commissioning under TOSP PHY-05-015, the limited was raised to 800 A.

3 Authority and Responsibility

3.1 BigBox Power Supply

Only authorized personnel may enable the power supply as per the operating guidelines described in Section 7.1. To become authorized one must:

- Read and understand this document.

- Read and understand Chapter 6440 of the Jefferson Lab EH&S Manual on Static Magnet Fields.
- Complete JLab Lock and Tag Training (SAF104)
- Complete NFPA-70E Electrical Safety Training (SAF603)
- Complete training on power supply operation by authorized Hall A technical staff.
- Obtain an authorizing signature from the PREX-septum magnet contact person, John LeRose, on the attached signature sheet.

3.2 Energizing the PREX septum

Once the BigBox power supply has been enabled, the PREX septum can either be controlled locally or with the BigBox GUI. Shift workers will only be allowed to control the magnet via the BigBox GUI and only after they have read and signed the COO of the experiment for which they are taking shift. One shall immedately turn off the magnet via the BigBox GUI or locally at the BigBox supply if someone unauthorized and/or unknown is seen entering the magnet area or any hazard, e.g. leaking low conductivity water, is identified.

3.3 Magnetic Field Measurements

With the written permission of the Hall A work coordinator, physics users may make field measurements of the area around the magnet. The guidelines for safely performing these measurements can be found in Section 7.3. During these measurements, the current to the magnet may be changed using the BigBox GUI. Once the measurements have been completed, authorized personnel secure the system as per Section 7.4.

4 Location of Equipment

All required equipment is located in Hall A. During operation, the PREX septum will be located near the pivot area and the BigBox power supply is located near the Hall A control racks.

5 Hazard Analysis

The hazards associated with the magnet and power supply are electrical, magnetic, and fire.
Electrical: The power supply has a maximum output current of 1050 A at a voltage of 250 V and thus presents a potentially lethal hazard. A hazard also arises from the power bus on the magnet itself.

Magnetic: The magnet produces a central field of 0.45 T at 500 A. As the magnet has a return yoke, the external field is much smaller than the central field. Although the magnetic field is primarily confined to the magnet gap, fringe fields are strong enough to accelerate unsecured metal objects in the vicinity of the magnet. In addition these fields may present a particularly large hazard to individuals using a pacemaker. An additional hazard arises due to the close proximity of the magnet to the target area where an unsecured metal object could destroy the scattering chamber.
Fire: There exists a potential fire hazard with high current power supplies.

6 Hazard Mitigation

Electrical: Access to the power supply or magnet can only be made after following "Lockout/Tagout Procedures" as described in Chapter 6110 of the Jefferson Lab EH&S manual and the *Hall A power supply test and maintenance* safety procedure. When working on the power supply, the responsible people will follow the guidelines in the electrical safety chapter of the EH&S manual. Before being energized, the magnet's exposed current bus must be covered to mitigate the shock hazard. The power supply bus must be covered and all doors secured. Also, to keep the current of the PREX septum within operational limits, the over-current circuit in the BigBox power supply should be set to no more than 800 A.
Magnetic: The possible presence of high magnetic fields will be indicated by standard Jefferson Lab signs and by a flashing beacon. The area surrounding the magnet will be roped off whenever it is possible that the magnet will be energized. The ropes will be at a distance from the magnet such that the fringe fields are less than 500 μT (5 G) at the maximum allowed current of 800 A. This should be roughly one meter, but should be checked as soon as possible once the magnet has been energized. Personnel with ferromagnetic implants and those wearing electronic medical devices are not allowed inside the roped off area. Due to the large magnet gap size, personnel working inside the roped-off area should be aware of the possible presence of a magnetic fringe field, as well as a high field in the magnet gap.
Fire: The magnet coils are protected from over-heating by Klixon devices installed on the magnet and interlocked to the power supply that will shut off the power supply in case of the coil over-heating.

7 Operating Guidelines

7.1 Testing the PREX septum After Installation

Once the PREX septum has been installed and connected to the BigBox power supply, it should be tested to ensure that it is working properly.

- At least two qualified persons must be working on the task together.

- Rope off the area around the magnet.
- Install protective covers as needed over the target windows and the spectrometer sieve slit. Check with the Hall A work coordinator to ensure proper covers are used.
- Sweep the area inside the ropes for magnetic material. Make sure that the area is clean, and that no foreign objects are in or near the aperture of the magnet or the inside of the stay-clear zone. All such materials must be removed and placed outside of the ropes.
- Make sure all protective barricades, signs and beacons are in place to warn of possible exposure to magnetic and electrical hazards.
- Verify all covers on energized conductors on the magnet are securely in place.
- Verify all power supply doors and cabinets are closed and locked.
- Check that the cooling water is turned on. Valves on the magnet and on individual cooling paths must all be open.
- Verify that water flow is present. The flow switches on the supply and return lines must be open and the the supply pressure must be verified to be 50 psi greater than the return pressure.
- Turn on the flashing beacons.
- Remove the administrative lock on the power supply disconnect switch. Make sure the Jefferson Lab's Lockout/Tagout procedures, as described in Chapter 6110 of the Jefferson Lab EH&S manual are followed. Make sure your Lockout/Tagout training is up-to-date, you have been trained on the operation of the power supply and magnet and that you have been authorized by John LeRose.
- Enable main power on the power supply and ramp output current at the rate of approximately 10 A per second to 50 A. Check that all controls and safety features are operational then continue to ramp at the rate of 10 A per second to the maximum current.
- Enter record of the successful test into a Hall A electronic log book.

7.2 Enabling the PREX septum For Physics

- At least two persons must be working on the task together.
- Rope off the area around the magnet.

- Sweep the area inside the ropes for magnetic material. Make sure that the area is clean, and that no foreign objects are in or near the aperture of the magnet or the inside of the stay-clear zone. All such materials must be removed and placed outside of the ropes.
- Make sure all protective barricades, signs and beacons are in place to warn of possible exposure to magnetic and electrical hazards.
- Verify all covers on energized conductors on the magnet are securely in place.
- Verify all power supply doors and cabinets are closed and locked.
- Check that the cooling water is turned on. Valves on the magnet and on individual cooling paths must all be open.
- Verify that water flow is present — checking that the differential pressure is greater than 50 psi and look at flow switches (inlet pressure should be greater than 100 psi).
- Turn on the flashing beacons.
- Remove the administrative lock on the power supply disconnect switch. Make sure the Jefferson Lab's Lockout/Tagout procedures, as described in Chapter 6110 of the Jefferson Lab EH&S manual are followed. Make sure your Lockout/Tagout training is up-to-date, you have been trained on the operation of the power supply and magnet and that you have been authorized by John LeRose.
- Enable main power on the power supply and check the current can be set with the BigBox GUI by ramping the magnet to 50 A.
- Set the magnet to 0 A and submit a electronic log entry that magnet is ready and that Hall A shift workers now can control the magnet via the BigBox GUI.

7.3 Magnetic Field Measurements

With the Hall A work coordinator's written authorization, a map of the magnet's fringe field can be made. During magnetic field measurements, the covers should be on the scattering chamber. All work in the vicinity of the magnet must conform to the practice described in Chapter 6440 of the Jefferson Lab EH&S manual. In particular all workers must respect the limits shown in the table "exposure limits for static magnetic fields" of that chapter and reproduced below.

	Routine 8 Hour Average	Maximum Allowable
Ferromagnetic implant and electronic medical device wearers	Routine Exposure Not Recommended	0.5 mT (5 G) or as determined by a physician
Regular Employees	Whole Body: 60 mT (600 G) Limbs: 600 mT (6000 G)	Whole Body: 2 T (20,000 G) Limbs: 5 T (50,000 G)

The first field measurements should be made around the 1 meter perimeter to make sure the fringe is less than 5 G at this location. Measurements closer to the magnet and in the gap of the magnet can be made as long as the limits in the table are adhered to and a description of the planned measurement points has been presented to John LeRose for approval. A hand-held Lake Shore field measurement device is avaliable from John LeRose for establishing the 5 G perimeter and making measurements to 0.1 G precision.

7.4 Turning Off The BigBox Supply

The magnet power supply should always be locked out when the magnet is not going to be used for any extended period.

- Ramp output current to zero and turn off main power at the power supply.
- Apply the administrative lock to the power supply.
- Turn off the flashing beacons.

8 Authorized Personnel

Access to the magnet area when energized and control of the power supply is limited to the following personnel. A signature is required. Name may be added to the list by John LeRose.

Personnel Authorized to Enable BigBox Power Supply

Name	Signature	Date	Authorization

Personnel Authorized to make Field Measurements

Name	Signature	Date	Authorization