TOSP for RCS Dipole Magnet and Power Supply

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1 Description of the Magnet

The RCS experiment (E99-114) will use a specially designed dipole magnet as a charged particle deflection magnet. The Bigbite power supply will be used to energize this magnet. The power supply, which is located in Hall A, was commissioned in the past few months. The control software runs from the HAC computer under GUI BIGBOX. The maximum current energizing the magnet is approximately 600 A. The magnet components are at JLab and are currently being assembled in the Test Lab. The magnet will be tested up to 300 A and roughly field mapped in the Test Lab prior to Dec. 21, 2001 to check the field calculations. It is expected that the magnet will be installed in Hall A during the first week of January, 2002 and energized there on or about January 10.

2 Purpose of this Document

The purpose of this document is to describe safe handling practices for the dipole magnet and associated power supply during commissioning, field mapping, and running in Hall A. It evaluates the hazards and identifies what measures have been implemented in order to mitigate them. This document does not attempt to describe the function or operation of the dipole or power supply.

3 Authority and Responsibility

3.1 During Commissioning in Hall A

During commissioning of the magnet in Hall A, only authorized personnel may energize the power supply, according to the guidelines in Sec. 7. To become authorized, an individual must:

- Read and understand this document.
- Read and understand Chapter 6440 of the Jefferson Lab EH&S Manual, "Static Magnetic Fields"
- Complete JLab Lock and Tag training (SAF104).
- Complete training on power supply operation by Mark Stevens of the Hall A technical staff.
- Obtain an authorizing signature from the RCS contact person, Bogdan Wojtsekhowski, on the attached signature sheet.

3.2 After Commissioning in Hall A

After commissioning in Hall A, and after passing the appropriate safety review, the magnet may be energized by the shift leaders and the run coordinators, the Hall A technical staff, and any other people so designated by Bogdan Wojtsekhowski, according to the guidelines in Sec. 8.

4 Location of the Equipment

The RCS dipole is located in Hall A adjacent to the target chamber on the right side of the beam. The power supply is also in Hall A adjacent to 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 buss on the magnet itself.

Magnetic: The magnet produces a maximum central field of 10 kG. 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 hazard to individuals using a pacemaker. Fields may also corrupt magnetic recording media or interfere with the operation of mechanical devices with metallic parts. An additional hazard arises due to the close proximity of the magnet to the cryogenic target, which could accelerate unsecured metal objects into the thin windows of the scattering chamber, causing destruction of the cyrogenic target.

Fire: There exists a potential fire hazard associated with high current power supplies. A failure of the coil cooling system may lead to a fire in the coils.

6 Hazard Mitigation

Electrical: Access to the power supply or magnet can only be made after following "Lock and Tag Procedures" as described in Chapter 6110 of the Jefferson Lab EH&S Manual for the power supply. Before the magnet is connected to the power supply, the over-current protection circuit in the BIGBOX power supply should be preset to 600 A, which is the maximum current that the magnet was designed to operate safely. When working on the power supply, the responsible people will follow the guidelines in the electrical safety chapter of the EH&S manual. A Kevlar sheet will cover the entrance and exit apertures to the magnet to limit access to the exposed current buss, at which the voltage is $\leq$50 volts.

Magnetic: The possible presence of high magnetic fields will be indicated by standard JLab 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 full current (600 A). This is roughly one meter. 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 (30 cm), 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. A Kevlar sheet of thickness 0.02 mm will cover the entrance and exit to the pole region to prevent objects from being attracted into the field. Finally, to mitigate against the hazard due to the close proximitiy of the magnet to the cryogenic target, a protective cover must be installed on the window of the scattering chamber prior to work being done on the magnet.

Fire: The magnet coils are protected from over-heating (and hence fire) by the cooling water system in the Hall. There are 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 during Commissioning

7.1 Before Applying Power to Power Supply

1. At least two persons must be working on the task together.
2. Rope off the area around the magnet.
3. Install protective cover over the scattering chamber window.
4. 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 material must be removed and placed outside of the ropes.
5. Make sure all protective barricades, signs, *etc.* are in place to warn of possible exposure to magnetic and electrical hazards.
6. Verify all covers on energized conductors on the magnet are securely in place.
7. Verify all power supply doors and cabinets are closed and locked.
8. Check that the cooling water is turned on. Valves on the magnet and on individual cooling paths must all be open.
9. Verify that water flow is present—feel the hoses and look at flow switches.
10. Turn on the flashing beacons.

11. Remove the administrative lock on the power supply disconnect switch. Make sure that Jefferson Lab's Lock and Tag procedures, as described in Chapter 6110 of the Jefferson Lab EH&S Manual, are followed throughout the following procedures:
    (a) Up-to-date Lock and Tag training.
    (b) Training on the operation of the power supply and magnet.
    (c) Authorization by B. Wojtsekhowski
12. Enable main power on the power supply and ramp output current at the rate of approximately 10 A per second to 50 A. At 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 maxiumum current of 500 A.

7.2 When Magnet Is Energized

All work in the vicinity of the magnet must conform to the practices described in Chapter 6440 of the Jefferson Lab EH&S Manual. In particular, all workers must respect the limits shown in Table 1, "Exposure Limits for Static Magnetic Fields," of that chapter, reproduced here:

	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 (6,000 G)	Whole body: 2 T (20,000 G) Limbs: 5 T (50,000 G)

7.3 Before Leaving the Area

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

8 Operating Guidelines during Running Conditions

8.1 Preparing to Close the Hall

The Hall A technical staff will be responsible for doing the following things during the transition from restricted access:

1. Rope off the area around the magnet.

2. 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 material must be removed and placed outside of the ropes.
3. Make sure all protective barricades, signs, *etc.* are in place to warn of possible exposure to magnetic and electrical hazards.
4. Verify all covers on energized conductors on the magnet are securely in place.
5. Verify all power supply doors and cabinets are closed and locked.
6. Check that the cooling water is turned on. Valves on the magnet and on individual cooling paths must all be open.
7. Verify that water flow is present—feel the hoses.
8. Turn on the flashing beacons.
9. Remove the administrative lock on the power supply disconnect switch.
10. Enable main power on the power supply and ramp output current according to standard procedures.

8.2 While the Hall is Closed

Under normal running conditions, the shift leader has sole authority to energize or de-energize the magnet, according to the run plan.

8.3 Controlled Access

For controlled access during the experiment, it is the responsibility of the shift leader to ramp the current to zero prior to personnel entering the hall.

8.4 Returning to Restricted Access

If the hall returns to restricted access, the shift leader is responsible for ramping the current to zero. Upon accomplishing this, the shift leader informs the Hall A technical staff, who is then responsible for turning off the main power at the power supply, applying the administrative lock to the power supply, and turning off the flashing beacons. As a part of standard Hall A procedure, the Hall A technical staff will install a protective cover on the scattering chamber window. All this needs to be done before the hall is open for restricted access.

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 for access. Names may be added to the list by Bogdan Wojtsekhowski.

I have read and understood the attached document titled "TOSP for RCS Dipole Magnet and Power Supply: Commissioning and Field Mapping"

Personnel from JLab

Name	Signature	Date	Authorization
Bogdan Wojtsekhowski			

Personnel from the RCS collaboration

Name	Signature	Date	Authorization