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|  | **TITLE:** | **ES&H Manual** |
|  |
| **DOCUMENT ID:** | **(rough draft – update to OSP 3310)** **Operational Safety Procedure Form** |
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|  | X | **OSP** |  | **TOSP** |  |  |  |
|  | **\*Attach the Task Hazard Analysis (THA) related to this procedure** |
|  |  |  |  |  |  |
|  | Issue Date: | May 1, 2017 | Expiration Date: | **May 1, 2020** |  |
|  | (No more than three years from Issue Date except TOSP which is three months from issue date) |  |
|  | Title: | **Hall A Room Temperature Septum (update to OSP 3310)** |  |
|  | Location: | Hall A |  |
|  | Risk classification(See [*ESH&Q Manual Chapter 3210 Appendix T3 Risk Code Assignment*](http://www.jlab.org/ehs/ehsmanual/3210T3.htm).) | Without mitigation measures (3 or 4): | 3 (M+M) |  |
|  | With mitigation measures in place (0, 1, or 2): | 1 (M+EL) |  |
|  | Document Owner(s): | Robert Michaels | Date: |  |  |
|  |  |  |  |  |  |
| Supplemental Technical Validations: |
|  | Hazard Reviewed (per [ES&H Manual 2410-T1](https://www.jlab.org/ehs/ehsmanual/2410T1.htm)): | Subject Matter Experts Signature: | Date: |  |
|  | Electrical |  | To be assigned |  |  |  |
|  | Magnetic Fields |  | To be assigned |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |
| Approval Signatures: | Print Signature | Date: |
|  | Division Safety Officer: | Ed Folts |  |  |  |
|  | Department or Group Head: | Cynthia Keppel |  |  |  |
|  | **Safety Warden of Area:** | Javier Gomez |  |  |  |
|  | Other Approval(s): |  |  |  |  |
|  |  |  |  |  |
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**After expiration:** Forward original and log sheet of trained personnel to ESH&Q Document Control.

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|  | 1. **Purpose of the Procedure**
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| The PREX septum in 3-coil configuration will be used for the PREX-II and C-REX experiments. These experiments will run back-to-back, the only change is to insert a different target. . The purpose of this document is to describe the hazards and safety procedures for operating this magnet. The BigBox power supply was being used during PREX-I. (This document is still a work in progress.) |
| 1. **Scope –** include operations, people, and/or areas where procedure applies
 |
| These procedures include running the magnet during an experiment in Hall A and making field measurements.  |
| 1. **Description of the Facility: (**include floor plans and layout of a typical experiment or operation)
 |
| 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 PREX-I, g2p, APEX, and the Hall A RCS experiment (E99-114). The control software of the supply runs from the HAC computer with the BigBox GUI. The operating conditions for C-REX are 780 Amps, 250 kW for a field integral of 0.93 T-m. For PREX it is 430 A, 75 kW, 0.49 T-m. These are within the operating envelope of what was used during previous experiments and commissioning tests. |
| 1. **Authority and Responsibility:**
 |
|  | **4.1 Who has authority to implement/terminate** |
| System Owner |
|  | **4.2 Who is responsible for key tasks** |
| Only authorized personnel may enable the power supply as per the operating guidelines described in Section 11. To become authorized one must:* Read and understand this document.
* Read and understand Chapter 6440 of the Jefferson Lab  ES&H 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, at the end of this document.
 |
| 1. **Who analyzes the special or unusual hazards (See** [**ES&H Manual Chapter 3210 Appendix T1 Work Planning, Control, and Authorization Procedure**](http://www.jlab.org/ehs/ehsmanual/3210T1.htm)**)**
 |
| N/A |
| 1. **Personal and environmental hazard controls including:**
 |
|  | **6.1 Shielding** |
| * Protective covers as needed during work around the magnet over the target windows and the spectrometer sieve slit
* Covers on energized conductors on the magnet
* 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 than500 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.
* Before being energized, the magnet's exposed current bus must be covered to mitigate the shock hazard.
* All power supply doors must be secured.
 |
|  | **6.2 Interlocks** |
| * 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.
* The over-current circuit in the BigBox power supply shall be set to no more than 800 A
 |
|  | * 1. **Other**
 |
| * **Magnetic fields:** 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.
* **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  ES&H 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  ES&H 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.
 |
| 1. **Monitoring systems**
 |
| 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.  |
| 1. **Ventilation**
 |
| N/A |
| 1. **List of safety equipment (i.e: personal protective equipment or special tools)**
 |
| N/A  |
| 1. **Associated administrative procedures**
 |
| **Testing the PREX septum After Installation:** Once the PREX septum has been installed and connected to the BigBox power supply, which should have been locked out during the connection, **i.e.** an administrative lock was placed on the power supply disconnect switch, 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-clearzone. 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 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  ES&H 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 Jack Segal.
* 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 and verify that the magnet exit water temperature is ≤90°C.
* Restore the administrative lock on the power supply disconnect switch.
* Enter record of the successful test into a Hall A electronic log book.

**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 possibleexposure 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  ES&H 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 Jack Segal..
* 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.

**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 immediately 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.**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  ES&H 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 canbe made as long as the limits in the table are adhered to and a description of the planned measurement points has been presented to Robert Michaels for approval. A hand-held Lake Shore field measurement device can be used for establishing the 5 G perimeter and making measurements to 0.1 G precision.  |
| 1. **Operating guidelines**
 |
| **This is the same as 10. Associated Administrative Procedures.****Testing the PREX septum After Installation:** Once the PREX septum has been installed and connected to the BigBox power supply, which should have been locked out during the connection, **i.e.** an administrative lock was placed on the power supply disconnect switch, 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-clearzone. 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 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  ES&H 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 Jack Segal..
* 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 and verify that the magnet exit water temperature is ≤90°C.
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**Enabling the PREX septum For Physics**:* At least two persons must be working on the task together.
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| 1. **Notification of Affected Personnel (How and Who)**
 |
| N/A  |
| 1. **List of steps required to execute the procedure from start to finish.**
 |
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| 1. **Back out procedures, i.e., steps necessary to restore the equipment/area to a safe level.**
 |
| **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. |
| 1. **Special environmental control requirements:**
 |
| N/A |
| 1. **Environmental Impacts (See** [**EMP-04 Project/Activity/Experiment Environmental Review**](https://jlabdoc.jlab.org/docushare/dsweb/View/Collection-1349)
 |
| N/A |
| 1. **Abatement Steps – Secondary Containment, or Special Packaging requirements**
 |
| N/A  |
| 1. **Training requirements**
 |
| Shift workers must have standard Hall A/ JLab user required safety training and have read and signed the COO for the experiment for which they are taking shifts.People authorized to energize the power supply either for testing or for Physics operation must also:* Read and understand this document.
* Read and understand Chapter 6440 of the Jefferson Lab  ES&H 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, Robert Michaels, at the end of this document.
 |
| 1. **Unusual/Emergency procedures e.g., Injury, Fire, Loss of power**
 |
| N/A  |
| 1. **Instrument calibration requirements, e.g., safety system/device recertification, RF probe calibration**
 |
| N/A |
| 1. **Inspection schedules**
 |
| N/A  |
| 1. **References/Associated Documentation**
 |
| JLab  ES&H manual * Chapter 6440 (Static Magnet Fields)
* Chapter 6110 (Jefferson Lab's Lockout/Tagout procedures)
 |
| 1. **List of Records Generated (Include Location / Review and Approved procedure)**
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|   |
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**Authorized/Trained Individuals**

| **Print Name/Signature** | **Date** |
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|  | **ISSUING AUTHORITY** | **APPENDIX AUTHOR** | **APPROVAL DATE** | **EFFECTIVE DATE** | **EXPIRATION DATE** | **REV.** |  |  |
|  | ESH&Q Division | Harry Fanning | 10/05/09 | 01/01/10 | 10/05012 | 0 |  |

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