

**NATIONAL HIGH MAGNETIC
FIELD LABORATORY**

NHMFL

FLORIDA STATE UNIVERSITY

SAFETY PROCEDURE

SP-18

CONTROLLED ACCESS PROCEDURE

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TITLE: ELECTRICAL AREA CONTROLLED ACCESS PROCEDURE

1.0 PURPOSE

- 1.1** This document establishes policy and procedure to control access to areas of this facility where electrical hazards exist from exposed electrical conductors or high voltage capacitors and to identify other controlled access areas in the facility.
- 1.2** NHMFL's policy is to provide and maintain a safe and healthful working environment. The safety and health of employees and users are the inherent responsibilities of each employee, management, and all levels of supervision.
- 1.3** This procedure defines the specific entry and exit procedures and actions required by NHMFL personnel, contractors, vendors, visitors, and users to access the Bus Tunnel, Capacitor Yard, Transformer Rooms and the Hybrid Power Supply Mezzanine. This procedure also identifies other areas of the facility that have controlled access for reasons of security and other potential hazards.

2.0 SCOPE

- 2.1** This Safety Procedure shall be used by everyone (employees, contractors, vendors, visitors, and users) at the NHMFL.
- 2.2** This procedure shall be used in conjunction with all other applicable operating and safety procedures.

3.0 RESPONSIBILITIES

3.1 Bus Tunnel and Transformer Room

The Control Room Operator is responsible for controlling access to the Bus Tunnel and Transformer Room. The key allowing access to these areas shall be kept in the Control Room.

3.2 Hybrid Areas

The Hybrid Operator is responsible for controlling access to the Hybrid power supply mezzanine, fenced area around the power supply, the fenced area around the outsert junction box, insert magnet power stabs, output busing/breaker, dump resistor and outsert supply cryostat enclosure.

3.3 Capacitor Yard

The Electrical Supervisor is responsible for controlling access to the Capacitor Yard.

3.4 Other Controlled Access Areas

The 900MHz Project Leader and NMR Director are responsible for controlling access for the 900MHz Area.

The Principal Investigator for the animal lab is responsible for controlling access to the animal lab.

The Principal Investigator of A110 and C108 is responsible for controlling access to the both of these areas.

The Computer Support Department is responsible for controlling access to the Server Rooms.

3.4 PERSONS ENTERING CONTROLLED ACCESS AREAS

Anyone requiring access to Controlled Access areas must notify the person(s) responsible for controlling access to the area prior to entry.

All visitors to these areas shall ensure that they understand and follow the guidelines presented in this procedure.

3.5 NHMFL

The NHMFL will ensure that anyone entering a Controlled Access Area is provided with the proper tools, equipment, protective clothing, training, and any other items or information necessary to provide a safe environment for the purpose of any visit in any area.

The NHMFL Safety Officer shall ensure that distribution of the keys and access cards for access to these areas is limited to authorized personnel.

4.0 BUS TUNNEL

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The Bus Tunnel is located in the OPMD building on the second floor. It is accessible from the Power Supply Rooms and from the Bus Viewing Room on the second floor at the north end of the OPMD building.



The Bus Tunnel has several hazards associated with it. The most severe is electrical shock from exposed electrical conductors. A second significant physical hazard is injury from pneumatic, remote operated, bus disconnect switches.

The Bus Tunnel contains the resistive magnets power supply bus bars. Each power supply has two (2) buses, a positive and negative bus. Each bus is made of four 1x14 inch aluminum bars. These bus bars run the length of the room. Each DC power supply is capable of 720 volts and 20,000 amps. These buses are exposed and severe injury is possible from contact with this equipment when it is energized. There are two (2) flashing red warning lights, mounted on the ceiling, at the south and north ends of the Bus Tunnel, which indicate when **any** DC Power Supply is turned on and one or more of these bus bars are energized.

There are 128 remote operated bus disconnect switches. They run the length of the Bus Tunnel and are located at floor level on either side of the room. These switches are open or exposed and severe injury is possible if an employee is in close proximity and they are opened or a body part is between the contacts of these switches while they are closed.

There are 4 Emergency Power Off (EPO) button switches in the bus tunnel. There is one at each end of the tunnel and one on each side of the tunnel. These buttons will simultaneously trip all 4 power supplies off line, de-energizing the DC buses.

The north bus tunnel doors in each power supply room have micro switches in series with the power supply room EPO circuit, such that when the door is opened, the EPO circuit is activated, opening all four power supply breakers. There is a key activated normal/bypass switch located in each power supply room next to the north bus tunnel doors that has the ability to bypass the EPO interlock. The position for this switch is in the Normal Position.

4.1 BUS TUNNEL ACCESS

The control room operators are responsible for controlling access to the Bus Tunnel.

4.1.1 Bus Tunnel Access with Energized Power Supplies

Access to this area is forbidden when any of the DC Power Supplies are energized.

Exceptions can be made for qualified personnel with just cause.

Just Cause is defined as demonstrating that work on or near the exposed electrical conductors is necessary because de-energizing them introduces additional or increased hazards or is infeasible due to equipment design or operational limitations.

Examples of increased hazards are interruption of life support equipment, deactivation of emergency alarm systems, or removal of illumination for a work area.

Examples of unfeasibility due to equipment design or operational limitations are testing of electrical circuits which may only be done with the circuit energized or work on circuits which form an integral part of a continuous industrial process that would otherwise have to be completely shut down in order to perform the work.

When access is granted to the Bus Tunnel and any DC Power Supplies are energized, safety related work practices shall be used to protect employees who may be exposed to the electrical hazards present. Employees shall be protected against contacting any energized circuit parts directly with any part of their body or indirectly through some other conductive object. These employees must be qualified and capable of working on energized circuits and shall take special precautionary measures such as personal protective equipment (insulating clothing i.e.: flash apron, insulating gloves, face shield or eye protection), insulating and shielding materials, and insulated tools.

A two person rule applies at all times when access is granted for any reason and any DC Power Supply is energized.

A red placard with white lettering stating "Personnel in Bus Tunnel" shall be prominently placed on the operating console of the Distributed Control System operator interface units for the period of time the Bus Tunnel is

occupied.

The bus tunnel bypass switch must be placed in the bypass position in order to enter the bus tunnel with power supplies energized. The key for this switch must be obtained from the control room operator.

4.1.2 Bus Tunnel Access for Maintenance

When access is granted for maintenance on or near the DC buses, and the conditions for working on or near exposed energized electrical circuits in sec 4.2.1 of this procedure cannot be demonstrated, all four DC Power Supply feeder breakers shall be racked to disconnect, tagged and locked out in accordance with the NHMFL Safety Procedure, SP-1, Safety Clearance Procedure.

Other equipment will be disabled and tagged out as appropriate for the work in progress and the hazards present.

Static electrical charges may be present within the DC Power Supply buses and must be shorted to ground prior to commencing any work on or about the DC buses.

A red placard with white lettering stating "Personnel in Bus Tunnel" shall be prominently placed on the operating console of the Distributed Control System operator interface units for the period of time the Bus Tunnel is occupied.

4.1.3 Bus Tunnel Access for Visual Inspection

When access is granted for a **HANDS OFF** visual inspection of Bus Tunnel equipment, the Control Room EPO button shall be pushed and activated.

The DC Power Supply feeder breakers tripped position shall be verified by remote indications on the Distributed Control System by a Control Room Operator.

The bus tunnel EPO bypass switch shall be in the normal, or un-bypassed position, and at least one bus tunnel door shall remain opened while personnel are in the bus tunnel.

A red placard with white lettering stating "Personnel in Bus Tunnel" shall be prominently placed on the operating consoles of the Distributed Control System operator interface units for the period of time the Bus Tunnel is occupied.

4.1.4 Bus Tunnel Access To Verify Lockout

During lockout, it is necessary to verify the position of the stabs in the Bus Tunnel. This visual, hands off inspection must be done without activating the EPO. This inspection requires the use of a two man rule.

Only the following personnel may perform the inspection: Head of Facilities, Electrical Supervisor and Head of Magnet Operations.

NOTE: THE NORTH BUS TUNNEL DOORS IN EACH POWER SUPPLY ROOM HAVE MICRO SWITCHES IN SERIES WITH THE POWER SUPPLY ROOM EPO CIRCUIT, SUCH THAT WHEN THE DOOR IS OPENED, THE EPO CIRCUIT IS ACTIVATED, OPENING ALL FOUR POWER SUPPLY BREAKERS. THERE IS A NORMAL/BYPASS SWITCH LOCATED IN EACH POWER SUPPLY ROOM NEXT TO THE NORTH BUS TUNNEL DOORS THAT HAS THE ABILITY TO BYPASS THE EPO INTERLOCK. THE POSITION FOR THIS SWITCH IS IN THE NORMAL POSITION, EXCEPTIONS ARE FOR ACCESS WITH POWER SUPPLIES ENERGIZED PER SECTION 4.2.1 OF THIS PROCEDURE.

5.0 CAPACITOR YARD

The Capacitor Yard is located at the south east wing of the facility, between the front parking lot and Cooling Tower. It is a locked, fenced enclosure. There are four (4) banks of high voltage, single phase, power capacitors. The electrical voltage present is 12.4 kV.

The capacitor banks are exposed to the elements and personnel. They are highly charged and close proximity or direct contact could result in a discharge of electrical energy resulting in severe injury or death. No one may enter the Capacitor Yard while energized.



5.1 CAPACITOR YARD ACCESS FOR INSPECTION OR MAINTENANCE

When access is granted to the Capacitor Yard area for inspection or maintenance on or near the capacitor banks, all four capacitor bank feeder isolation breakers shall be opened, racked to disconnect, and tagged out in accordance with NHMFL Safety Procedure, SP-1, Safety Clearance Procedure.

The capacitor bank grounding switches shall be closed in accordance with the NHMFL Operating Procedure, OP-8, Capacitor Bank Operation.

No personnel are allowed access to this area except those necessary to fulfill the requirements of this procedure and the NHMFL Operating Procedure, OP-8, Capacitor Bank Operation until the above steps have been completed in accordance with the NHMFL Operating Procedure, OP-8, Capacitor Bank Operation.

6.0 HYBRID POWER SUPPLY MEZZANINE

The Hybrid Power Supply Mezzanine is located in the OPMD building on the third floor. It is accessible from the stairs outside at the north end of the OPMD building.



The Hybrid Magnet Power Supply is located in a fenced area on the Hybrid Power Supply Mezzanine. This is a low voltage DC power supply however, it is capable of high current levels. It is rated at 25 VDC, 15,000 amps.

The Hybrid Magnet super conducting coils are energized via the Hybrid Magnet Power Supply positive and negative buses. These buses are two (2) inches thick and five (5) inches wide and are made of two 1x5 inch thick copper bars. The buses are exposed and injury is possible from contact with this equipment when it is energized.

There are two load interrupting disconnect switches on the Hybrid Power Supply Mezzanine. These switches are open or exposed to personnel and injury is possible from contact with this equipment when it is energized. Electrical arcs during operation of this equipment are possible. This equipment is automatically

operated at any time.

There is a high current dump resistor located on the Hybrid Power Supply Mezzanine. This is open or exposed to personnel and injury is possible from contact with this equipment when it is energized. Electrical energy is discharged to this dump resistor during a magnet dump and high temperatures are generated in the resistor as a result of this electrical energy. Care should be taken to keep personnel and equipment clear of it at all times. This equipment is automatically operated at any time.

Under certain conditions the two load interrupting disconnect switches and the high current dump resistor can experience voltages as high as 7.5 kV. Therefore all exposed electrical equipment shall be treated as energized, 7.5 kV gear.

6.1 HYBRID POWER SUPPLY MEZZANINE ACCESS

No one should access Hybrid Power Supply Mezzanine without notifying the Hybrid Operator prior to access. Only authorized personnel (electricians and operators) have keys to the fenced area of the Hybrid Power Supply Mezzanine Fenced Area.

6.1.1 Hybrid Power Supply Mezzanine Fenced Area Access When Energized

Access to this area is forbidden when the Hybrid Magnet DC Power Supply is energized.

The hybrid operator may allow exceptions for qualified personnel with just cause.

Just Cause is defined as demonstrating that work on or near the exposed electrical conductors in the Hybrid Power Supply Mezzanine is necessary because de-energizing them introduces additional or increased hazards or is infeasible due to equipment design or operational limitations.

When access is granted to the Hybrid Power Supply Mezzanine and the Hybrid Magnet DC Power Supply is energized safety related work practices shall be used to protect employees who may be exposed to the electrical hazards present. These employees must be qualified and capable of working on energized circuits and shall take special precautionary measures such as personal protective equipment (insulating clothing i.e.: flash apron, insulating gloves, face shield or eye protection), insulating and shielding materials, and insulated tools as appropriate for

the work in progress.

A two person rule applies at all times when access is granted while the Hybrid Magnet Power Supply is energized.

6.1.2 Hybrid Power Supply Mezzanine Access for Maintenance

When access is granted for maintenance on or near the Hybrid Magnet Power Supply DC bus, and just cause as defined in section 6.1.1 of this procedure cannot be demonstrated, the Hybrid Magnet Power Supply feeder disconnect shall be opened, tagged and locked out in accordance with the NHMFL Safety Procedure, SP-1, Safety Clearance Procedure.

Other equipment will be disabled and tagged out as appropriate for the work in progress and the hazards present.

Static electrical charges may be present within the DC Power Supply bus and must be shorted to ground prior to commencing any work on or about the DC bus.

7.0 TRANSFORMER ROOM

The Transformer rooms are located on both sides of the cell bays. OP 127 is the first door on the right side where the even cells are located. OP 123 is the first door on the left side where the even cells are located. The doors are always locked. The electrical voltage present is 12.4 kVAC and 720 VAC.



7.1 Transformer Room Access for Maintenance

When access is granted for maintenance activities that require any object or body part to reach above an 8ft. level in the transformer room, and just cause as defined in section 4.2.1 of this procedure cannot be demonstrated, the Power Supply breakers must be tagged and locked out

in accordance with the NHMFL Safety Procedure, SP-1, Safety Clearance Procedure. Access to these rooms when energized shall only be by the following personnel: Operators, Facilities Personnel and Electronic Shop Personnel.

8.0 OTHER CONTROLLED ACCESS AREAS

8.1 900MHz Area

This is a controlled access area due to the potential hazard associated with a critical event resulting from a magnet quench or oxygen deficient atmosphere. Only personnel that have received the 900MHz safety training and demonstrate a need for access are allowed in this area after obtaining approval from the 900MHz Project Leader or NMR Director. Refer to SP-28 Ultra-Wide Bore 900MHz Safety Procedure for more detailed information on access to this area.

8.2 Other Areas

A110, C108, Animal Lab and Server Room are controlled access areas due to security concerns. These areas can only be accessed by individuals with badges that have been programmed to allow entrance. The Principal Investigator or the supervisor of these areas must authorized access.

7.0 PROCEDURE REFERENCES

- 7.1 OSHA CFR 1910.333, "Subpart S", sec.a.1-2, b.1-2, c.1-3,
- 7.2 Gilbert Power Factor Correction Capacitors and Harmonic Filters, NHMFL Technical Library, January '93 edition;
 - 7.2.1 McGraw-Edison Company, Capacitors, Block Banks, Installation and Service Manual, March '78 revision.
 - 7.2.3 Cooper Power Systems, Power Capacitors, High Voltage, Single Phase, Installation and Maintenance Instructions, February '90 revision.

Revisions

Date	Revision #	Section	Description
2/20/07	1	Cover	Names changed to reflect current management
2/20/07	1	3.1	Appropriate responsibilities assigned to Control Room, Hybrid Operator and Electrical Supervisor
2/20/07	1	3.1	Removal of statement regarding loaning of keys a verifying familiarity with procedures.
2/20/07	1	4.2.3	Remove statement regarding bus tunnel access by tour groups
3/22/07	1	5.0	Addition of statement "No one may enter capacitor yard while energized"
3/22/07	1	7.1	Addition of multiple statements in section 7.1
3/28/07	1	3.0 & 8.0	Addition of other controlled access areas
4/2/07	1	4.0, 5.0, 6.0, 7.0	Addition of photos