If you are using a printed copy of this procedure, and not the on-screen version, then you MUST make sure the dates at the bottom of the printed copy and the on-screen version match. The on-screen version of the Collider-Accelerator Department Procedure is the Official Version. Hard copies of all signed, official, C-A Operating Procedures are available by contacting the ESSHQ Procedures Coordinator, Bldg. 911A

C-A OPERATIONS PROCEDURES MANUAL

11.4.3 STAR Power Supply Operating Procedure

Text Pages 2 through 7

Attachments

Hand Processed Changes

HPC No.	Date	Page Nos.	Initials

Approved: _____***Signature on File***_____ _____
Collider-Accelerator Department Chairman Date

P. Rosas

1. Purpose and Scope

This procedure defines the operation of the STAR Main Magnet Power Supply along with the Pole Tip Trim East, Pole Tip Trim West, Space Trim East, and the Space Trim West Power Supplies. The purpose of this procedure is to ensure the safe operation of all the Power Supplies.

2. Responsibilities

2.1 The authorized **STAR Power Supply Operators** are responsible for the operation of the Star Magnet Power Supplies and the sweeping of the magnet area prior to unlocking the power supplies and insuring that all aspects of this procedure are implemented.

2.2 The authorized Collider-Accelerator Support Group (CAS) Watch is responsible for the start-up, shut-down, polarity change, and tap change of the Star Magnet Power Supplies.

2.3 The STAR Power Supply Operator and the Collider-Accelerator Support Group Watch are responsible for the enabling and disabling of the power supplies through the insertion or removal of their Kirk Lock Control Keys in the 'A' and 'B' transfer locks located in the power supply area.

3. Prerequisites

3.1 Operation of the power supplies shall be coordinated with the STAR Operation Leader, STAR Run Coordinator or their designee.

3.2 The authorized CAS Watch Technicians shall be experienced with high power Silicon Control Rectifier (SCR) controlled power supplies and shall be trained and authorized in the lockout and operation of the STAR Magnet Power Supplies. The CAS Watch Technicians shall be familiar with power supply schematic diagrams and operations manuals.

3.3 The **STAR Power Supply Operator** and the **Collider Accelerator Support Group (CAS) Watch** shall be trained in the operation of the power supplies using the graphics control page, PET page and the Allen Bradley monitoring system and shall also be familiar with the power supply block diagram.

3.4 Routine access to the power supply equipment room shall be restricted to **(CAS)** and Pump Room personnel. Authorization to enter the power supply equipment room may only be given by the **STAR Operation Leader**, **STAR Run Coordinator or their designee**.

3.5 All the STAR Power Supply check off sheets shall be followed and signed. Completed check off sheets shall be kept in a binder in the STAR Control Room.

3.6 Training:

3..1	CAS Watch:	Electrical Safety – 1
3..2	CAS Watch:	Lockout / Tagout, Authorized
3..3	CAS Watch and STAR Operator:	C-AD Access Training and Collider User Training
3..4	CAS Watch and STAR Operator:	Noise and Hearing Conservation
3..5	CAS Watch and STAR Operator:	Static Magnetic Fields
3..6	CAS Watch and STAR Operator:	STAR Power Supply Check Off Lists
3..7	CAS Watch and STAR Operator:	Remote operations of the STAR power system.

4. Precautions

4.1 All sets of magnet coils are coupled together either galvanically (main-trims) or magnetically (main-pole tip trims). It is therefore required that all power supplies (the Main Magnet supply, the two PTT's and the two Space-Trim power supplies) be locked out before entering the high power sections of any of the power supplies. The Kirk Lock scheme has been designed to prevent entry into any power supply unless all power supplies are locked out.

4.2 Main Magnet Power Supply:

4.2.1 This is a 4.3 MW AC to DC converter capable of delivering 5300 amperes at approximately 1000 volts. The STAR solenoid represents an inductive load of 1.6 Henries. At full load the magnet stores 22.5 MJ of energy. The nature of this extremely high power system dictates caution and diligence.

4.2.2 The system is protected with automatic interlocks such as:

Over currents
Over voltages
Over temperatures
Ground Faults
Water Flow

The system should not be operated if any system interlocks are suspect.

4.2.3 All power supplies have been built with dead front construction and are secured with KIRK type locks that prevent access to the energized components while connected to the AC electrical line. The Main Magnet power supply will be locked out by racking the 13.8 KV circuit breaker to the test position and locking out the circuit breaker with a Kirk Lock.

Warning:

Current can flow for approximately one minute after the power supply is turned off due to the stored energy in the magnet. In addition to the energy stored in the magnet the power supply contains filter capacitors which decay with a 1-minute time constant. Entrance into the power supply enclosure shall be delayed for at least five (5) minutes after de-energizing the power supply.

4.3 Pole Tip Trim Power Supplies:

4.3.1 The Pole Tip Trims are 225 kW AC to DC converters capable of delivering 1600 amperes at approximately 140 volts. The pole tip windings represents an inductive load of 0.05 Henries. At full load the coils stores 64 KJ of energy. The nature of this extremely high power system dictates caution and diligence.

4.3.2 Other precautions are identical to 4.2.2.

Warning:

Current can flow after the power supply is turned off due to the stored energy in the magnet. In addition to the energy stored in the magnet the power supply contains filter capacitors which decay with a 1-minute time constant. Entrance into the power supply enclosure shall be delayed for at least 5 minutes after de-energizing the power supply.

4.4 Space Trim Power Supplies:

4.4.1 The Space Trim supplies are 30 kW AC to DC converters capable of delivering 600 amperes at 50 volts. The load inductance could be as high as 0.05 Henries and the stored energy at full load is 9 KJ.

4.4.2 The Space Trim power supplies are connected directly across windings of the main solenoid magnet that can be energized by the 4.3 MW Main Power Supply.

4.4.3 Other precautions are identical to 4.2.2.

4.5 Each of the power supplies has a free wheeling diode across its output. Each supply has polarity reversing links or a manual switch.

Caution:

If the Main Power Supply and the Space Trim Power Supplies have reversed polarities, the Space Trim Free Wheeling diodes may be destroyed due to over-current.

4.6 All sets of magnet coils are coupled together either galvanically (Main Magnet-Space Trims) or magnetically (Main Magnet-Pole Tip Trims). It is therefore required that all power supplies (the Main Magnet, the two Pole Tip Trims and the two Space-Trim) be locked out before entering the high power sections of **any** of the power supplies. The Kirk Lock scheme has been designed to prevent entry into any power supply unless all power supplies are locked out.

5. Procedure

5.1 Power Supply Start Up :

5.1.1 Inform all affected personnel that the Magnets will be energized.

5.1.2 The location of crash buttons, telephones, and fire extinguishers shall be noted in the power supply building and the magnet areas.

5.1.3 The power supply transformer yard shall remain locked at all times with UEB-19 locks.

5.1.4 The STAR Power Supply Operator shall ensure that all barriers; warning signs and lights are in place before energizing the magnet. See C-A OPM 11.4.2 Procedure for Preparing the STAR Magnet for Operations.

5.1.5 The STAR Power Supply Operator shall provide the operating parameters for the power supplies, such as polarity, operating current and ramp rate. Transformer tap settings shall be set based on the maximum operating current.

5.1.6 Start the STAR Graphic control page. Start The STAR Pet Page and, Start the power supply magnet monitor program (rsVIEW).

5.1.7 Verify that the Magnet Monitor Rack is running. Reset the magnet monitor system if needed.

5.1.8 The STAR Power Supplies shall be energized in accordance with the "STAR Power Supply Start-UP Check Off List." (C-A-OPM 11.4.3.b) All completed check off sheets shall be signed and kept in a binder in the STAR Control Room.

5.1.9 All of the STAR power supplies have polarity reversing links or a manual switch. Verify that all power supplies polarity indicator lights show the correct polarity as specified by the STAR Power Supply Operator.

5.1.10 The STAR Power Supply Operator shall enable the turn-on of the power supplies by inserting his Control Key, 8A, into the 'A' Transfer Lock. The 9A key will also need to be inserted into the 'A' Transfer Lock. This completes the Power Supply Start-Up section of this procedure.

5.1.11 The STAR Power Supply Operator shall review the power supply logbook for any changes or modifications done to any system required to run the power supply. Verify that if any system was tagged or locked, these tags or locks have been properly removed from these systems.

5.2 Power Supply Shut Down:

5.2.1 The STAR Power Supplies shall be shut down in accordance with the "STAR Power Supply SHUT-DOWN Check Off List." (C-A-OPM-ATT 11.4.3.a) All completed check off sheets shall be signed and kept in a binder in the STAR Control Room.

5.3 Power Supply Polarity Change:

5.3.1 Verify the polarity status of each power supply before beginning the Star Power Supply SHUT-DOWN Check Off List.

5.3.2 The STAR Power Supplies shall be shut down in accordance with the "STAR Power Supply SHUT-DOWN Check Off List." (C-A-OPM-ATT 11.4.3.a) All completed check off sheets shall be signed by the CAS Watch and kept in a binder in the STAR Control Room.

5.3.3 Upon completing the "STAR Power Supply Polarity Change Check Off List." (C-A-OPM-ATT 11.4.3.c) notify the STAR Power Supply Operator. All completed check off sheets shall be signed and kept in a binder in the STAR Control Room. This completes the Power Supply Polarity Change section of this procedure.

5.4 Power Supply Tap Change:

5.4.1 The STAR Power Supplies shall be shut down in accordance with the "STAR Power Supply SHUT-DOWN Check Off List." (C-A-OPM-ATT 11.4.3.a) All completed check off sheets shall be signed and kept in a binder in the STAR Control Room.

5.4.2 Upon completing the "STAR Power Supply Tap Change Check Off List." (C-A-OPM-ATT 11.4.3.d) notify the STAR Power Supply Operator. All completed check off sheets shall be signed and kept in a binder in the STAR Control Room. This completes the Power Supply Tap Change section of this procedure.

6. Documentation

6.1 The CAS Watch shall maintain a power supply Log Book to record all activities related to the power supplies such as start up, shut down, lock out, tap change, polarity changes, faults and modifications.

6.2 The CAS Watch shall keep all completed Shut-Down Check Off List's in the CAS Power Supply Operation's Binder located in the STAR Control Room.

6.3 The CAS Watch shall keep all completed Start-Up Check Off List's in the CAS Power Supply Operation's Binder located in the STAR Control Room.

6.4 The CAS WATCH shall keep all completed Polarity Change Check Off List's in the CAS Power Supply Operations Binder located in the STAR Control Room.

6.5 The CAS WATCH shall keep all completed Transformer Tap Change Check Off List's in the CAS Power Supply Operations Binder located in the STAR Control Room.

7. References

7.1 C-A OPM 11.4.2 "Procedure for Preparing the STAR Magnet for Operation"

8. Attachments

8.1 C-A OPM 11.4.3.a "STAR Power Supply SHUT-DOWN Check Off List"

8.2 C-A OPM 11.4.3.b "STAR Power Supply START-UP Check Off List"

8.3 C-A OPM 11.4.3.c "STAR Power Supply Polarity Change Check Off List"

8.4 C-A OPM 11.4.3.d "STAR Power Supply TAP Change Check Off List"