Fermilab

D0 Central Tracking Solenoid
Energization, Controls, Interlocks & Quench Protection
Initial Validation Procedures

D0 Engineering Note 3823.111-EN-525

January 27, 1998

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Date: 1/27/98
Rev Date: 3/31/98

Project: Solenoid Energization, Controls, Interlocks and Quench Protection
Doc. No: H980127A

Subject: Solenoid - Initial Checkout of Energization System Without Solenoid

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1. Introduction

This note presents the inspection and tests to be performed on the DZERO solenoid energization, controls, interlocks and quench protection system before it is energized for the first time. This test is to be performed with a 5000A jumper at the end of the bus instead of the solenoid. This system is based in DZERO room 511. A copy of this note shall be annotated, signed and dated by the person coordinating the procedure; and filed with the system maintenance records. Annotations shall include comments about any aspect of the procedure that is abnormal or unsuccessful. The following inspections and tests shall be performed by persons knowledgeable about the system[1]. Each individual test step should be reviewed and understood before proceeding with that step.

2. Administrative Requirements for Powered Testing

2.1. Reviews

2.1.1. Electrical Safety Review

2.1.1.1. Attach an annotated copy of the PPD safety committee's findings to this document. Annotations shall include responses to any deficiencies noted by the committee.

2.2. Approvals

2.2.1. PPD Division Head to operate the system

2.2.1.1. Attach a copy of the approval to this document. EMAIL is OK.

2.2.2. DZERO Department Head operate the system

2.2.2.1. Attach a copy of the approval to this document. EMAIL is OK.

3. Personnel & Equipment Required For Tests

3.1.1. Personnel Requirements

A minimum of two skilled people are required to perform the tests. No more than four people, including the testers, should be on hand to avoid distractions. List the personnel involved in the testing below.

3.1.1.1. _____

3.1.1.2. _____

3.1.1.3. _____

3.1.1.4. _____

3.1.2. Equipment Requirements

3.1.2.1. Hand tools as required
3.1.2.2. ½" drive Torque wrench (nominal setting 55 lbs-ft)
3.1.2.3. 3 ½ digit digital multimeter (volts).
3.1.2.4. Continuity indicator with test leads.
3.1.2.5. Handheld radio transceivers (walkie-talkies).
3.1.2.6. Lead box simulator (kept in room 511 equipment cabinet).
3.1.2.7. Reed switch shorting plug (kept in room 511 equipment cabinet).
3.1.2.8. ≅ 3' AWG 16 jumper wire with series 1000 Ohm ½ Watt resistor and alligator clips.
3.1.2.9. End rack jumpers as needed (3" AWG 18 with male spade connector ends).
3.1.2.10. Voltage source 0-15V (kept in room 511 equipment cabinet).
3.1.2.11. NIM extender module (amp connector type - kept in room 511 equipment cabinet).
3.1.2.12. Small can of "smoke detector tester" spray. Factory Mutual System Approved.
3.1.2.13. Small magnet (ie. magnetic document clip).
3.1.2.14. DMACS console " DZERO Solenoid Energization and Control" screen.

[1] The system is described in DZERO Engineering Note #3823-111-EN-418 which lists all related documentation. A current copy of the "as-built" specifications and documents are to be available in Room 511 at all times.

4. Lock out / Tag out (LOTO[2]) Electrical Sources

4.1.1. Disable AC to Power Supply

4.1.1.1. Disconnect switch feeding the power supply.
4.1.1.2. Verify power off.

4.1.2. Disable AC to Dump Switch/Reversing Switch

4.1.2.1. Disconnect switch feeding the reversing switch/dump switch cabinet.
4.1.2.2. Verify power off.

4.1.3. Energize Controls Cabinet

4.1.3.1. The controls cabinet remains energized through out this procedure.

5. Physical Inspection

5.1. Load and Bus

5.1.1. Inspect Load Jumper

5.1.1.1. 5000 Amp bus jumper is in place instead of solenoid and all electrical bus fasteners in place and tight.
5.1.1.2. Connection covers in place and secured to prevent inadvertent contact with conductors.

5.1.2. Inspect Bus Tray Covers

5.1.2.1. Aluminum covers in place from load end of bus to room 511 entry point and secured with sheet metal screws.

5.2. Room 511 Components

Remove bus, joint, and filter covers as necessary to conduct the following inspections and procedures. Do not replace until instructed to at the end of the "Unpowered Component Tests".

5.2.1. Inspect Room 511 Bus Electrical Connections

5.2.1.1. All ½" bolts securing mechanical connections of the 5/8" X 4" solid copper bus bars must be torqued to 55 lb-ft. Mark each fastener after torquing with a dab of paint at the nut/thread interface. Note that this torque value is to be applied to all ½" bolt/nut bus joint assemblies fitted with two Belleville spring washers. It is NOT to be applied to non-5/8" X 4" bus connections such as the 2232 mfd capacitor terminals, or the free-wheeling diode clamp bolts.
5.2.1.2. Physical security of all visible klixons and RTDs - both mechanical mounting and electrical connections.

5.2.2. Inspect LCW Connections

5.2.2.1. Verify that the LCW system is operating.
5.2.2.2. Verify the first LCW circuit intact as follows: source > solenoid valve > holec stub > bus to solenoid > jumper at solenoid > bus from solenoid > diode heat sink > diode heat sink > flow meter > flow switch > return.
5.2.2.3. Verify the second LCW circuit intact: source >solenoid valve > filter coil > other filter coil > power supply > flow meter > flow switch > return.
5.2.2.4. Verify that manual valves to "ON" position.
5.2.2.5. Verify no water leaks at hose connections.

5.2.3. Inspect Dump Resistor

5.2.3.1. Connections torqued as noted above in "Bus Electrical Connections".
5.2.3.2. Ground fault detector electrical connection secure.
5.2.3.3. Mounting hardware secure.
5.2.3.4. No foreign materials on resistor assembly or blocking airflow.

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[2] LOTO must be done by person trained in proper procedures per DZERO LOTO rules.

5.2.4. Inspect Dump Switch

5.2.4.1. Power is LOTO
5.2.4.2. No missing or loose fasteners.
5.2.4.3. No disconnected electrical leads.
5.2.4.4. Physical security of all visible klixons and RTDs - both mechanical mounting and electrical connections.
5.2.4.5. No foreign objects.

5.2.5. Inspect Reversing Switch

5.2.5.1. Power is LOTO
5.2.5.2. No missing or loose fasteners.
5.2.5.3. No disconnected electrical leads.
5.2.5.4. Physical security of all visible klixons and RTDs - both mechanical mounting and electrical connections.
5.2.5.5. No foreign objects.

5.2.6. Inspect Free Wheeling Diode

5.2.6.1. No missing or loose fasteners.
5.2.6.2. Physical security of all visible klixons and RTDs - both mechanical mounting and electrical connections.
5.2.6.3. No water leaks.
5.2.6.4. No foreign objects.

5.2.7. Inspect Filter

5.2.7.1. No missing or loose fasteners.
5.2.7.2. Physical security of all visible klixons and RTDs - both mechanical mounting and electrical connections.
5.2.7.3. No water leaks.
5.2.7.4. No foreign objects.
5.2.7.5. Verify capacitor polarities and placements; and resistor placements against schematic.

5.2.8. Inspect Power Supply

5.2.8.1. Power is LOTO
5.2.8.2. No missing or loose fasteners.
5.2.8.3. No loose electrical connections.
5.2.8.4. Physical security of all visible klixons and RTDs - both mechanical mounting and electrical connections.
5.2.8.5. No water leaks.
5.2.8.6. Doors closed and secured.

5.2.9. Inspect Controls Rack

5.2.9.1. Nim & PLC crate fans running and filters clean.
5.2.9.2. No jury rigged connections or instruments.
5.2.9.3. No disconnected leads.
5.2.9.4. Power to NIM bin, (24V ± 1V, +15V ± 0.5V, -15V ±.5V)
5.2.9.5. Power to PLC crate, (DC good light on PLC)
5.2.9.6. Power to Rack Monitor Interface chassis (indicated by illuminated displays).
5.2.9.7. Inside Rear Door - No detached cables or poorly seated power plugs. Do not plug in the "backup" NIM power supply.
5.2.9.8. Inside End Rack - No jury rigging, detached leads or loose spade connectors.

6. Unpowered Component Tests

At this point, the system components and bus connections are still uncovered and the AC power is locked off. The following component tests are intended to ascertain that the individual components of the interlocks and some systems are functional. These tests are performed in conjunction with and include the control system. Control testing is accomplished by instigating an action on the control system and observing the results on the energization system. Monitoring testing is done by manually stimulating the energization system sensors and monitoring the results on the control system.

6.1. Quench Detection Interlocks and Voltage Tap Monitoring

This test checks the eight channels of quench detectors that trigger the dump switch. A voltage is injected into each channel and verified on the DMACS system. The voltage is then increased until the channel triggers the dump switch to open. The trip level is recorded. The following events are verified: 1) The interlock signal, 2) The first fault encoded value, 3) The interlock trip to the dump switch, and 4) The removal of the power supply enable signal.

6.1.1. Establish Initial System Conditions

6.1.1.1. "Accelerator Pmt" jumper at the end rack between terminals 1063 and 1064.
6.1.1.2. "LCW Pmt" jumper at the end rack between terminals 1066 and 1067.
6.1.1.3. "Crash Pmt" jumper at the end rack between terminals 1069 and 1070.
6.1.1.4. "Steel Pmt" jumper at the end rack between terminals 1072 and 1073.
6.1.1.5. "Access Gate Pmt" jumper at the end rack between terminals 1102 and 1103.
6.1.1.6. "Cryo Pmt" jumper at the end rack between terminals 1105 and 1106.
6.1.1.7. "Dump Switch" jumper in dump switch across terminals TB2-11 and TB2-12.

6.1.2. Test Quench Detector Channels

6.1.2.1. If any step of this procedure fails to produce the proper results, then troubleshoot and repair before proceeding with the tests.
6.1.2.2. Plug the lead box simulator into JB-2 which is the voltage tap patch panel located at the bus entry point in room 511.
6.1.2.3. Check continuity of the "Quench Detector" dump signal (Dump1) in dump switch across TB2-7, TB2-8. The circuit should be closed.
6.1.2.4. Check continuity of the "Interlock System" dump signal (Dump2) in dump switch across TB2-5, TB2-6. The circuit should be closed.
6.1.2.5. Check the DMACS "Interlocks" screen and verify that the "Lead, Trans, Chimney, and Imbal" interlocks all read OK.
6.1.2.6. Check continuity of the power supply enable signal at the power supply by disconnecting and checking across P3-A and P3-B (cable #C426). The circuit should be closed.
6.1.2.7. For the first signal group on the lead box simulator (Vapor lead A), inject 2.50 Volts with the voltage source. The controls readout on the corresponding quench detector channel on the DMACS control system "Quench Detector" screen should be as follows: leads 25.0 mV (±3.0 mV), CT 50.0 mV (±5.0 mV), QT 100.0 mV (±10.0 mV). Record the reading in the "forward polarity" table below.
6.1.2.8. Increase the voltage source until the quench detector channel trips as indicated by open Dump1 signal across TB2-7 and TB2-8 in the dump switch. Record the "trip point input Volts", and the "DMACS readout". Record in table the "Dump1 status".
6.1.2.9. Check the DMACS control system "Interlocks" screen and verify that the corresponding "Interlocks Status" readout has changed to "Not OK".
6.1.2.10. Select the DMACS "First Fault" button and verify that the first fault is properly identified.
6.1.2.11. Check continuity of the "Dump2 status" at dump switch TB2-5 and TB2-6. Circuit should be open. Indicate in table the "Dump2 status".
6.1.2.12. Check "interlock status LED" on interlock module channel corresponding to signal group under test. LED should be RED. Record in table the "Interlock status LED" color.
6.1.2.13. Check continuity of the "PS enable status" at the power supply cable #C426 P3-

A and P3-B. Circuit should be open. Record table "PS enable status".

6.1.2.14. Set the voltage source to zero, and reset the interlocks locally or by DMACS.

6.1.2.15. Repeat the "Quench Detector Channel" test for each remaining signal group.

6.1.2.16. Reverse the polarity of the voltage source and repeat the "Quench Detector Channel" test for each signal group.

Quench Detector Channel Tests with Forward Polarity Reference Voltage

	Vapor Lead A	Transition Lead A	Chimney Lead A	Chimney Lead B	Transition Lead B	Vapor Lead B	CT Imbal	QT Imbal
DMACS readout at 2.50V input								
Trip point input Volts								
DMACS readout at trip								
DMACS Interlock status								
Dump1 status at trip								
Dump2 status at trip								
Interlock status LED at trip								
PS enable status at trip								

Quench Detector Channel Tests with Reverse Polarity Reference Voltage

	Vapor Lead A	Transition Lead A	Chimney Lead A	Chimney Lead B	Transition Lead B	Vapor Lead B	CT Imbal	QT Imbal
DMACS readout at 2.50V input								
Trip point input Volts								
DMACS readout at trip								
DMACS Interlock status								
Dump1 status at trip								
Dump2 status at trip								
Interlock status LED at trip								
PS enable status at trip								

6.1.3. Test Inner and Outer Coil Voltage Tap Monitoring

6.1.3.1. Complete the previous test before proceeding.
6.1.3.2. Inject 2.50 V into the "Inner Coil" signal group on the lead box simulator. The controls readout on the "Inner Coil Volts" channel on the DMACS control system "Quench Detector" screen should be 2.5 Volts (±0.05 Volts).
6.1.3.3. Reverse the polarity of the voltage source and verify the DMACS readout.
6.1.3.4. Inject 2.50 V into the "Outer Coil" signal group on the lead box simulator. The controls readout on the "Outer Coil Volts" channel on the DMACS control system "Quench Detector" screen should be 2.5 Volts (±0.05 Volts).
6.1.3.5. Reverse the polarity of the voltage source and verify the DMACS readout.

6.2. Miscellaneous Interlocks

Perform each interlock test as described below. Initial each interlock as it is tested. If any step of this procedure fails to produce the proper results, then troubleshoot and repair before proceeding with the tests. Endrack jumpers will be used as necessary to temporarily complete specific interlocks during testing.

6.2.1. Test Controls Pmt

6.2.1.1. At the DMACS "Interlocks Control" screen, select "Ctrl Pmt On" followed by " Reset Interlocks".
6.2.1.2. Verify that DMACS indicates "OK" for the "Ctrl Pmt" interlock status.
6.2.1.3. Verify that the "Bit 7" LED on NIM slot 8 interlock is green.
6.2.1.4. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be closed.
6.2.1.5. At the DMACS "Interlocks Control" screen, select "Ctrl Pmt Off".
6.2.1.6. Verify that DMACS indicates "Not OK" for the "Ctrl Pmt" interlock status.
6.2.1.7. Select the DMACS "First Fault" button and verify that the first fault is properly identified.
6.2.1.8. Verify that "Bit 7" LED on NIM slot 8 interlock module has changed to red.
6.2.1.9. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be open.
6.2.1.10. At the DMACS "Interlocks Control" screen, select "Ctrl Pmt On".

6.2.2. Test Accelerator Pmt

6.2.2.1. At the DMACS "Interlocks Control" screen, select " Reset Interlocks".
6.2.2.2. Verify that DMACS indicates "OK" for the "Accel" interlock status.
6.2.2.3. Verify that the "Bit 6" LED on NIM slot 8 interlock module is green.
6.2.2.4. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be closed.
6.2.2.5. Remove the "Accelerator Pmt" jumper from end rack terminals 1063-1064.
6.2.2.6. Verify that DMACS indicates "Not OK" for the "Accel" interlock status.
6.2.2.7. Select the DMACS "First Fault" button and verify that the first fault is properly identified.
6.2.2.8. Verify that "Bit 6" LED on NIM slot 8 interlock module has changed to red.
6.2.2.9. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be open.
6.2.2.10. Re-install the "Accelerator Pmt" jumper at end rack terminals 1063 and 1064.

6.2.3. Test LCW Pmt

6.2.3.1. Requires helper with radio, at Beckman LCW meter in north west corner of room 604.
6.2.3.2. Remove the "LCW Pmt" jumper at end rack terminals 1066 and 1067.
6.2.3.3. Adjust set point of LCW meter counter-clockwise until "Above Set point" light illuminates.
6.2.3.4. At the DMACS "Interlocks Control" screen, select " Reset Interlocks".
6.2.3.5. Verify that DMACS indicates "OK" for the "LCW Res" interlock status.
6.2.3.6. Verify that the "Bit 5" LED on NIM slot 8 interlock is green.
6.2.3.7. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-

A and P3-B. Circuit should be closed.

6.2.3.8. Adjust set point of LCW meter clockwise until "Below Set point" light illuminates.

6.2.3.9. Verify that DMACS indicates "Not OK" for the "LCW Res" interlock status.

6.2.3.10. Select the DMACS "First Fault" button and verify that the first fault is properly identified.

6.2.3.11. Verify that "Bit 5" LED on NIM slot 8 interlock module has changed to red.

6.2.3.12. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be open.

6.2.3.13. Re-install the "LCW Pmt" jumper at end rack terminals 1066 and 1067.

6.2.4. Test Crash Pmt

6.2.4.1. At the DMACS "Interlocks Control" screen, select " Reset Interlocks".

6.2.4.2. Verify that DMACS indicates "OK" for the "Crash Button" interlock status.

6.2.4.3. Verify that the "Bit 4" LED on NIM slot 8 interlock module is green.

6.2.4.4. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be closed.

6.2.4.5. Remove the "Crash Pmt" jumper from end rack terminals 1069-1070.

6.2.4.6. Verify that DMACS indicates "Not OK" for the "Crash Button" interlock status.

6.2.4.7. Select the DMACS "First Fault" button and verify that the first fault is properly identified.

6.2.4.8. Verify that "Bit 4" LED on NIM slot 8 interlock module has changed to red.

6.2.4.9. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be open.

6.2.4.10. Re-install the "Crash Pmt" jumper at end rack terminals 1069 and 1070.

6.2.5. Test Steel Pmt

6.2.5.1. At the DMACS "Interlocks Control" screen, select " Reset Interlocks".

6.2.5.2. Verify that DMACS indicates "OK" for the "Steel Position" interlock status.

6.2.5.3. Verify that the "Bit 3" LED on NIM slot 8 interlock module is green.

6.2.5.4. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be closed.

6.2.5.5. Remove the "Steel Pmt" jumper from end rack terminals 1072-1073.

6.2.5.6. Verify that DMACS indicates "Not OK" for the "Steel Position" interlock status.

6.2.5.7. Select the DMACS "First Fault" button and verify that the first fault is properly identified.

6.2.5.8. Verify that "Bit 3" LED on NIM slot 8 interlock module has changed to red.

6.2.5.9. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be open.

6.2.5.10. Re-install the "Steel Pmt" jumper at the end rack between terminals 1072 and 1073.

6.2.6. Test Flow Pmt

6.2.6.1. Verify that the LCW supply valves are closed.

6.2.6.2. At the DMACS "Interlocks Control" screen, select " Reset Interlocks".

6.2.6.3. Verify that DMACS indicates "OK" for the "LCW Flow" interlock status.

6.2.6.4. Verify that the "Bit 2" LED on NIM slot 8 interlock module is green.

6.2.6.5. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be closed.

6.2.6.6. Disconnect the RTD connector on the free-wheeling diode (cable #RTD05).

6.2.6.7. Verify that DMACS indicates "Not OK" for the "LCW Flow" interlock status.

6.2.6.8. Select the DMACS "First Fault" button and verify that the first fault is properly identified.

6.2.6.9. Verify that "Bit 2" LED on NIM slot 8 interlock module has changed to red.

6.2.6.10. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be open.

6.2.6.11. Reconnect the RTD connector on the free-wheeling diode.

6.2.6.12. At the DMACS "Interlocks Control" screen, select " Reset Interlocks".
6.2.6.13. Verify that DMACS indicates "OK" for the "LCW Flow" interlock status.
6.2.6.14. Disconnect the RTD connector on the power supply interphase transformer (inside PS left front door, above transductor chassis -- cable #RTD01).
6.2.6.15. Verify that DMACS indicates "Not OK" for the "LCW Flow" interlock status.
6.2.6.16. Reconnect the RTD connector on the power supply interphase transformer.
6.2.6.17. At the DMACS "Interlocks Control" screen, select " Reset Interlocks".
6.2.6.18. Verify that DMACS indicates "OK" for the "LCW Flow" interlock status.

6.2.7. Test Temperature Pmt

6.2.7.1. Verify that all klixon cables inside the junction box (JB1) are connected in series as per sheet 15 of the system schematic (3823-111-ED-330052).
6.2.7.2. At the DMACS "Interlocks Control" screen, select " Reset Interlocks".
6.2.7.3. Verify that DMACS indicates "OK" for the "Temp String" interlock status.
6.2.7.4. Verify that the "Bit 1" LED on NIM slot 8 interlock module is green.
6.2.7.5. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be closed.
6.2.7.6. Disconnect the klixon molex connector on the free-wheeling diode (cable #TS206).
6.2.7.7. Verify that DMACS indicates "Not OK" for the "Temp String" interlock status.
6.2.7.8. Select the DMACS "First Fault" button and verify that the first fault is properly identified.
6.2.7.9. Verify that "Bit 1" LED on NIM slot 8 interlock module has changed to red.
6.2.7.10. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be open.
6.2.7.11. Reconnect the klixon molex connector on the free-wheeling diode.
6.2.7.12. At the DMACS "Interlocks Control" screen, select " Reset Interlocks".
6.2.7.13. Verify that DMACS indicates "OK" for the "Temp String" interlock status.

6.2.8. Test Filter Pmt

6.2.8.1. Verify that the filter hi-pot knife switch is in the down positon.
6.2.8.2. At the DMACS "Interlocks Control" screen, select " Reset Interlocks".
6.2.8.3. Verify that DMACS indicates "OK" for the "Filter" interlock status.
6.2.8.4. Verify that the "Bit 0" LED on NIM slot 8 interlock module is green.
6.2.8.5. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be closed.
6.2.8.6. Actuate the filter hi-pot switch to its up position.
6.2.8.7. Verify that DMACS indicates "Not OK" for the "Filter" interlock status.
6.2.8.8. Select the DMACS "First Fault" button and verify that the first fault is properly identified.
6.2.8.9. Verify that "Bit 0" LED on NIM slot 8 interlock module has changed to red.
6.2.8.10. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be open.
6.2.8.11. Return the filter hi-pot switch to the down position.

6.2.9. Test Dump Switch Pmt

The dump switch interlock test includes the circuits from the dump switch terminal block through the control system and including the power supply. To avoid powering the dump switch at this time, it does not test the actual operation of the dump switch. The complete path including the operation of the dump switch will be validated in the later tests.

6.2.9.1. At the DMACS "Interlocks Control" screen, select " Reset Interlocks".
6.2.9.2. Verify that DMACS indicates "OK" for the "Dump Switch" interlock status.
6.2.9.3. Verify that the "Bit 7" LED on NIM slot 9 interlock module is green.
6.2.9.4. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be closed.
6.2.9.5. Remove the "Dump Switch" jumper at the dump switch TB2-11 and TB2-12 .
6.2.9.6. Verify that DMACS indicates "Not OK" for the "Dump Switch" interlock status.
6.2.9.7. Select the DMACS "First Fault" button and verify that the first fault is properly identified.
6.2.9.8. Verify that the "Bit 7" LED on NIM slot 9 interlock module has changed to red.
6.2.9.9. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be open.
6.2.9.10. Install a jumper between end rack terminals 1084 and 1085 to override operation of the dump switch interlock.

6.2.10. Test Gnd Fault Pmt

6.2.10.1. Temporarily remove relay KT from its socket inside the dump switch cabinet on the far left side. This overrides the ground fault detector "disable" signal.
6.2.10.2. At the DMACS "Interlocks Control" screen, select " Reset Interlocks".
6.2.10.3. Verify that DMACS indicates "OK" for the "Gnd Fault" interlock status.
6.2.10.4. Verify that the "Bit 6" LED on NIM slot 9 interlock module is green.
6.2.10.5. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be closed.
6.2.10.6. Use the 3' resistive jumper to momentarily connect a power bus element to ground via 1000 Ohms ie. between a free-wheeling diode connection and a frame ground.
6.2.10.7. Verify that DMACS indicates "Not OK" for the "Gnd Fault" interlock status.
6.2.10.8. Select the DMACS "First Fault" button and verify that the first fault is properly identified.
6.2.10.9. Verify that the "Bit 6" LED on NIM slot 9 interlock module has changed to red.
6.2.10.10. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be open.
6.2.10.11. Reinstall relay KT into its socket inside the dump switch cabinet.

6.2.11. Test Rev Switch Pmt

The reversing switch interlock test includes the circuits from the reversing switch terminal block through the control system and including the power supply. To avoid powering the reversing switch at this time, it does not test the actual operation of the reversing switch. The complete path including the operation of the reversing switch will be validated in the operational tests.

6.2.11.1. At the DMACS "Interlocks Control" screen, select " Reset Interlocks".
6.2.11.2. Verify that DMACS indicates "OK" for the "Rev Switch" interlock status.
6.2.11.3. Verify that the "Bit 5" LED on NIM slot 9 interlock module is green.
6.2.11.4. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be closed.
6.2.11.5. Temporarily remove relay KPMT from its socket inside the reversing switch cabinet toward the center of the cabinet. This removes the reversing switch interlock permit signal.
6.2.11.6. Verify that DMACS indicates "Not OK" for the "Rev Switch" interlock status.
6.2.11.7. Select the DMACS "First Fault" button and verify that the first fault is properly identified.
6.2.11.8. Verify that "Bit 5" LED on NIM slot 9 interlock module has changed to red.
6.2.11.9. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be open.
6.2.11.10. Reinstall relay KPMT into its socket inside the reversing switch cabinet.

6.2.12. Test Absolute Value Circuit Xducer Valid Pmt

6.2.12.1. At the DMACS "Interlocks Control" screen, select " Reset Interlocks".
6.2.12.2. Verify that DMACS indicates "OK" for the "Xducer Valid" interlock status.
6.2.12.3. Verify that the "Bit 4" LED on NIM slot 9 interlock module is green.
6.2.12.4. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be closed.
6.2.12.5. Temporarily disconnect P1, power supply readout cable (C421) at the supply.
6.2.12.6. Momentarily inject 1V into P1, + to P1-C, - to P1-D.
6.2.12.7. Verify that DMACS indicates "Not OK" for the "Xducer Valid" interlock status.
6.2.12.8. Select the DMACS "First Fault" button and verify that the first fault is properly identified.
6.2.12.9. Verify that "Bit 4" LED on NIM slot 9 interlock module has changed to red.
6.2.12.10. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be open.
6.2.12.11. Reconnect P1, the power supply readout cable (C421) at the power supply.

6.2.13. Test Absolute Value Circuit DC Over Current Pmt

6.2.13.1. Open the LCW solenoid valves.
6.2.13.2. Temporarily disconnect connector X4 (cable C413) at the rear of the Holec chassis in the controls rack.
6.2.13.3. Connect voltage source set to 0.00 V to end rack terminals 0120 and 0121 (polarity not important).
6.2.13.4. At the DMACS "Interlocks Control" screen, select " Reset Interlocks".
6.2.13.5. Verify that DMACS indicates "OK" for the "DC Over Curr" interlock status.
6.2.13.6. Verify that the "Bit 3" LED on NIM slot 9 interlock module is green.
6.2.13.7. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be closed.
6.2.13.8. Set the voltage source to 11.0 V.
6.2.13.9. Verify DMACS indicates "Not OK" for the "DC Over Curr" interlock status.
6.2.13.10. Select the DMACS "First Fault" button and verify that the first fault is properly identified.
6.2.13.11. Verify that "Bit 3" LED on NIM slot 9 interlock module has changed to red.
6.2.13.12. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be open.
6.2.13.13. Remove the voltage source and reconnect connector X4 (cable C413) at the

rear of the Holec chassis in the controls rack.

6.2.14. Test Smoke Det Pmt

6.2.14.1. At the DMACS "Interlocks Control" screen, select " Reset Interlocks".
6.2.14.2. Verify that DMACS indicates "OK" for the "Smoke Det" interlock status.
6.2.14.3. Verify that the "Bit 2" LED on NIM slot 9 interlock module is green.
6.2.14.4. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be closed.
6.2.14.5. Spray a small amount of "smoke detector tester" toward the smoke detector sensor located at the inside top of the controls rack.
6.2.14.6. Verify that DMACS indicates "Not OK" for the "Smoke Det" interlock status.
6.2.14.7. Select the DMACS "First Fault" button and verify that the first fault is properly identified.
6.2.14.8. Verify that "Bit 2" LED on NIM slot 9 interlock module has changed to red.
6.2.14.9. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be open.

6.2.15. Test Access Gate Pmt

6.2.15.1. Remove access gate pmt jumper from end rack terminals 1102-1103.
6.2.15.2. Close the access gate.
6.2.15.3. At the DMACS "Interlocks Control" screen, select " Reset Interlocks".
6.2.15.4. Verify that DMACS indicates "OK" for the "Access Gate" interlock status.
6.2.15.5. Verify that the "Bit 1" LED on NIM slot 9 interlock module is green.
6.2.15.6. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be closed.
6.2.15.7. Open the access gate.
6.2.15.8. Verify that DMACS indicates "Not OK" for the "Access Gate" interlock status.
6.2.15.9. Select the DMACS "First Fault" button and verify that the first fault is properly identified.
6.2.15.10. Verify that "Bit 1" LED on NIM slot 9 interlock module has changed to red.
6.2.15.11. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be open.

6.2.16. Test Cryo Pmt

6.2.16.1. Reinstall access gate pmt jumper at endrack terminals 1102-1103.
6.2.16.2. At the DMACS "Interlocks Control" screen, select " Reset Interlocks".
6.2.16.3. Verify that DMACS indicates "OK" for the "Cryo Pmt" interlock status.
6.2.16.4. Verify that the "Bit 0" LED on NIM slot 9 interlock module is green.
6.2.16.5. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be closed.
6.2.16.6. Remove the "Cryo Pmt" jumper from end rack terminals 1105 and 1106.
6.2.16.7. Verify that DMACS indicates "Not OK" for the "Cryo Pmt" interlock status.
6.2.16.8. Select the DMACS "First Fault" button and verify that the first fault is properly identified.
6.2.16.9. Verify that the "Bit 0" LED on NIM slot 9 interlock module has changed from grn to red.
6.2.16.10. Verify continuity of the "PS enable status" at the power supply cable #C426 P3-A and P3-B. Circuit should be open.
6.2.16.11. Re-install the "Cryo Pmt" jumper at end rack terminals 1105 and 1106.
6.2.16.12. Reconnect power supply cable C426 at P3.

6.3. Low Conductivity Cooling Water (LCW)

6.3.1. Test Power supply and filter cooling circuit

6.3.1.1. At the DMACS "LCW" screen, verify that the "PS & Filter LCW Sol Valve" is "Off" and the "PS & Filter LCW Flow Switch" reads "No Flow".

6.3.1.2. Disconnect the RTD connector on the power supply interphase transformer (inside PS left front door, above transductor chassis -- cable #RTD01).

6.3.1.3. At the DMACS "LCW" screen, verify that the "PS & Filter LCW Sol Valve" is "On" and the "PS & Filter LCW Flow Switch" reads "Flowing".

6.3.1.4. Re-connect the RTD connector on the power supply interphase transformer.

6.3.2. Test Solenoid bus and free-wheeling diode cooling circuit

6.3.2.1. At the DMACS "LCW" screen, verify that the "Sol Bus & Diode LCW Sol Valve" is "Off" and the "Sol Bus & Diode LCW Flow Switch" reads "No Flow".

6.3.2.2. Disconnect the RTD connector on the free-wheeling diode (cable #RTD05).

6.3.2.3. At the DMACS "LCW" screen, verify that the "Sol Bus & Diode LCW Sol Valve" is "On" and the "Sol Bus & Diode LCW Flow Switch" reads "Flowing".

6.3.2.4. Re-connect the RTD connector on the free-wheeling diode (cable #RTD05).

6.4. Ground Fault Detector Operation

6.4.1. Test low resistance to ground condition.

6.4.1.1. Temporarily remove relay KT from its socket inside the dump switch cabinet on the far left side. This overrides the ground fault detector "disable" signal.

6.4.1.2. Verify that the DMACS "GFD" screen indicates "Enable" for "GFD Enable/Disabled"; and "OK" for "Gnd Res < HiLim" and "Gnd Res > LoLim"

6.4.1.3. Use the 3' resistive jumper to momentarily short circuit a power bus element to ground ie. between a free-wheeling diode connection and a frame ground.

6.4.1.4. Verify that the DMACS "GFD" screen indicates " Not OK" for "Gnd Res > LoLim"

6.4.1.5. Verify that the DMACS "GFD" screen indicates "Actual Gnd Resistance" less than 1500 Ohms.

6.4.1.6. Remove the 3' resistive jumper.

6.4.2. Test high resistance to ground condition.

6.4.2.1. Verify that the DMACS "GFD" screen indicates "OK" for "Gnd Res < HiLim" and "Gnd Res > LoLim"

6.4.2.2. Switch the toggle switch on the front panel of the Ground Fault Detector Module in slot 11 of the NIM bin to the "UP" position. This disconnects the GFD module from the bus.

6.4.2.3. Verify that the DMACS "GFD" screen indicates " Not OK" for "Gnd Res < HiLim".

6.4.2.4. Return the toggle switch on the front panel of the Ground Fault Detector Module in slot 11 of the NIM bin to the "down" position. This re-connects the GFD module to the bus.

6.4.2.5. Reinstall relay KT into its socket inside the dump switch cabinet.

6.4.2.6. Verify that the DMACS "GFD" screen indicates "OK" for "Gnd Res < HiLim" and "Gnd Res > LoLim"

6.5. Reversing Switch Static Tests

6.5.1. Verify initial state

6.5.1.1. Connect an ohm meter set to the 2000 Ohm (10X) scale as follows: Positive lead to TB3-4 and negative lead to TB3-1. TB3 is located on the reversing switch controller inside the cabinet.

6.5.1.2. Verify that the Ohm meter reads ≈ 0 Ohms. This indicates that the following internal interlocks are intact: Holec I<0.1%, Absolute value I<25A, and bus reed switch I<200A.

6.5.2. Test Holec I<0.1% interlock.

6.5.2.1. Unplug the Holec chassis AC line cord inside the controls rack.

6.5.2.2. Verify that the Ohm meter reads 200 Ohms or greater (Holec I<0.1% relay opens).

6.5.2.3. Re-connect the Holec chassis AC line cord.

6.5.2.4. Verify that the Ohm meter reads approximately 0 Ohms. This indicates that the internal interlocks are once again intact.

6.5.3. Test NIM absolute value module I<25A interlock.

6.5.3.1. Unplug the NIM bin power supply chassis AC line cord inside the controls rack.

6.5.3.2. Verify that the Ohm meter reads 200 Ohms or greater (Abs value I<25A relay opens).

6.5.3.3. Re-connect the NIM bin power supply chassis AC line cord.

6.5.3.4. Verify that the Ohm meter reads approximately 0 Ohms. This indicates that the internal interlocks are once again intact.

6.5.4. Test bus current sensing switch interlock.

6.5.4.1. Place the test magnet in contact with the Hamlin reed switch located adjacent to the Holec transducer head. This should open the Hamlin reed switch contacts which are used as a current sensing switch interlock to the reversing switch.

6.5.4.2. Verify that the Ohm meter reads 200 Ohms or greater (reed switch opens).

6.5.4.3. Remove the test magnet.

6.5.4.4. Verify that the Ohm meter reads approximately 0 Ohms. This indicates that the internal interlocks are once again intact.

6.5.4.5. Remove Ohm meter from TB3-1 & TB3-4.

6.5.5. Test contact temperature transducer.

6.5.5.1. On the DMACS "Reversing Switch" screen, verify that "+Input Temp and –Input Temp" indicates ambient room temperature (≅ 23 degrees Celsius).

6.5.5.2. Unplug the RTD06 connector located on the positive input bus of the reversing switch.

6.5.5.3. On the DMACS "Reversing Switch" screen, verify that "+Input Temp" indicates greater than 800 degrees and "-Input Temp" has not changed.

6.5.5.4. Re-connect the RTD06 connector.

6.5.5.5. Unplug the RTD07 connector located on the negative input bus of the reversing switch.

6.5.5.6. On the DMACS "Reversing Switch" screen, verify that "-Input Temp" indicates greater than 800 degrees and "+Input Temp" is normal again.

6.5.5.7. Re-connect the RTD07 connector.

6.5.5.8. On the DMACS "Reversing Switch" screen, verify that "+Input Temp and –Input Temp" indicates ambient room temperature (≅ 23 degrees Celsius).

6.6. Dump Switch Static Tests

6.6.1. Test PLC "Dump3" control

6.6.1.1. At the DMACS "Dump Switch Control" screen, select "Open DS" while observing the continuity across TB2-3 and TB2-4 inside the dump switch cabinet. The circuit should open momentarily.

6.6.2. Test PLC "Close Dump Switch" control

6.6.2.1. Connect an Ohm meter positive lead to TB2-1 and negative lead to TB2-2. The resistance should be > 500 Ohms.

6.6.2.2. At the DMACS "Dump Switch Control" screen, select "Close DS" while observing the Ohm meter. The circuit resistance should go to approximately 0 Ohms momentarily.

6.6.3. Test Contact Temperature Transducers

6.6.3.1. On the DMACS "Dump Switch" screen, verify that "In Pole 1, In Pole 2, Out Pole 1, and Out Pole 2" temperatures all indicate ambient room temperature (≅ 23 degrees Celsius).

6.6.3.2. Unplug the RTD08 connector located on the input bus of the dump switch.

6.6.3.3. On the DMACS "Dump Switch" screen, verify that "In Pole 1 Temp" indicates greater than 800 degrees and the other "Temps" indicate ambient temperature.

6.6.3.4. Re-connect the RTD08 connector.

6.6.3.5. Unplug the RTD09 connector located on the input bus of the dump switch.

6.6.3.6. On the DMACS "Dump Switch" screen, verify that "In Pole 2 Temp" indicates greater than 800 degrees and the other "Temps" indicate ambient temperature.

6.6.3.7. Re-connect the RTD09 connector.

6.6.3.8. Unplug the RTD10 connector located on the output bus of the dump switch.

6.6.3.9. On the DMACS "Dump Switch" screen, verify that "Out Pole 1 Temp" indicates greater than 800 degrees and the other "Temps" indicate ambient temperature.

6.6.3.10. Re-connect the RTD10 connector.

6.6.3.11. Unplug the RTD11 connector located on the output bus of the dump switch.

6.6.3.12. On the DMACS "Dump Switch" screen, verify that "Out Pole 2 Temp" indicates greater than 800 degrees and the other "Temps" indicate ambient temperature.

6.6.3.13. Re-connect the RTD11 connector.

6.6.3.14. On the DMACS "Dump Switch" screen, verify that all "Temps" indicate ambient room temperature.

6.7. Dump Resistor Static Tests

6.7.1. Test Dump Resistor Temperature transducer

6.7.1.1. On the DMACS "Dump Resistor" screen, verify that "Temperature" indicates ambient room temperature (≅ 23 degrees Celsius).

6.7.1.2. Unplug the RTD12 connector located in the middle of the dump resistor on the bottom.

6.7.1.3. On the DMACS "Dump Resistor" screen, verify that "Temperature" indicates greater than 800 degrees.

6.7.1.4. Re-connect the RTD12 connector.

6.7.1.5. On the DMACS "Dump Resistor" screen, verify that "Temperature" indicates ambient room temperature (≅ 23 degrees Celsius).

7. Powered Component Tests

These tests are necessary to validate some aspects of component operation that require power to test. The previous "Individual Component Tests" must have been completed prior to this system test. Once these "Powered Component" tests are completed successfully, the system is ready for operational testing.

7.1. Secure System for Powered Tests

7.1.1. Replace Mechanical Covers

7.1.1.1. Replace and secure all bus, joint, and filter covers. Close and secure doors on reversing switch, dump switch, and power supply.

7.1.2. Test for Electrical Leakage (Hi-Pot)

7.1.2.1. Open the right rear door of the power supply and verify that the grounding switch is in the "off" position. Then close the door.
7.1.2.2. Remove the regulator module from the power supply NIM bin.
7.1.2.3. On the ground fault detector module in the controls rack, place the front panel switch in the "Megger" position.
7.1.2.4. At the filter assembly inside the caged area, place the grounding knife switch in the "UP" position.
7.1.2.5. Connect the megger instrument to the "Megger Test Point" and the large flat copper filter ground return bus next to the knife switch.
7.1.2.6. Set the megger instrument to the "500V" range and activate the instrument.
7.1.2.7. Verify that the resistance to ground stabilizes within ≈ 5 seconds to > 1 meg Ohms.
7.1.2.8. Set the megger instrument to "Discharge" and wait 5 seconds for any stored charge to discharge.
7.1.2.9. Remove the megger instrument from the "Megger Test Point".
7.1.2.10. Place the grounding knife switch in the "down" position.
7.1.2.11. On the ground fault detector module in the controls rack, place the front panel switch in the "Run" position.
7.1.2.12. Reinstall the regulator module in the power supply NIM bin.

7.2. Reversing Switch Operational Tests

7.2.1. Apply AC Power to DS/RS Cabinet

7.2.1.1. Remove the LOTO on the disconnect switch to restore power to the dump switch and reversing switch. Do not remove the LOTO for the power supply yet.

7.2.2. Test Cabinet door interlocks

7.2.2.1. Open the left door of the dump & reversing switch cabinet.
7.2.2.2. Verify that the DMACS "Reversing Switch" screen indicates that the "RS & DS Door" is "Open".
7.2.2.3. Verify that the all lights of the reversing switch controller at the center of the cabinet are OFF (indicates control power circuit is open).
7.2.2.4. Close the left door and open the right door.
7.2.2.5. Again verify that the DMACS "Reversing Switch" screen indicates that the "RS & DS Door" is "Open".
7.2.2.6. Again verify that the all lights of the reversing switch controller at the center of the cabinet are OFF (indicates control power circuit is open).
7.2.2.7. Momentarily depress the top most door switch plunger and verify that the "Control Power" light on the reversing switch controller illuminates.
7.2.2.8. Close the door. Both doors should now be closed.
7.2.2.9. Verify that the DMACS "Reversing Switch" screen indicates that the "RS & DS Door" is "Closed".

7.2.3. Test Reversing Switch Control and Status

These test verify various circuits involved in the operation of the reversing switch. The following operations are verified: 1) DMACS control and monitoring, 2) Power supply gate inhibit, 3) Reversing switch permit.

7.2.3.1. Verify that the DMACS "Reversing Switch" screen indicates that the "Operator Polarity Command, Relay Contact to Rev. Sw., and Status From Rev. Sw." are in the same state.

7.2.3.2. Connect a continuity tester across the PS Clamp signal located at relay K_{aux} inside the right door of the power supply. Positive continuity probe to terminal 11 and negative probe to 14. The circuit should be closed at this time.

7.2.3.3. On the DMACS "Reversing Switch" screen, "Control" sub-screen, select "Proceed" to start the change of polarity cycle.

7.2.3.4. Verify that the following occurs:

7.2.3.4.1. DMACS "Operator Polarity Command" changes state.

7.2.3.4.2. DMACS "Relay Contact to Rev. Sw." changes state.

7.2.3.4.3. Continuity tester across the PS Clamp signal indicates "open circuit" within a few seconds.

7.2.3.4.4. DMACS "Status From Rev. Sw. changes to "Cycling" during reversing switch timing cycle, and changes state at the end of the cycle. The reversing switch will audibly cycle during this step.

7.2.3.4.5. DMACS "Reversing Switch Interlock" changes to "Not OK" and stays that way until system interlocks are subsequently RESET.

7.2.3.4.6. At the end of the cycle, the continuity tester across the PS Clamp signal indicates "closed circuit".

7.2.3.5. On the DMACS "Interlocks Control" screen, select "Reset Intlks" to clear the system interlocks.

7.2.3.6. On the DMACS "Reversing Switch" screen, "Control" sub-screen, select "Proceed" to start the change of polarity cycle again.

7.2.3.7. Verify that the following occurs:

7.2.3.7.1. DMACS "Operator Polarity Command" changes state.

7.2.3.7.2. DMACS "Relay Contact to Rev. Sw." changes state.

7.2.3.7.3. Continuity tester across the PS Clamp signal indicates "open circuit" within a few seconds.

7.2.3.7.4. DMACS "Status From Rev. Sw. changes to "Cycling" during reversing switch timing cycle, and changes state at the end of the cycle. The reversing switch will audibly cycle during this step.

7.2.3.7.5. DMACS "Reversing Switch Interlock" changes to "Not OK" and stays that way until system interlocks are subsequently RESET.

7.2.3.7.6. At the end of the cycle, the continuity tester across the PS Clamp signal indicates "closed circuit".

7.2.3.8. Remove the continuity tester across the PS Clamp signal.

7.3. Dump Switch Operational Tests

7.3.1. Verify Control & Status

7.3.1.1. Verify that the dump switch "Control Power" lamp is illuminated. The lamp is located inside the cabinet on the far left hand side. Close the dump switch doors.

7.3.1.2. On the DMACS "Dump Switch" screen, verify that "DS AC Power" indicates "OK".

7.3.1.3. On the DMACS "Dump Switch" screen, "Control" sub-screen, select "Close DS" to close the dump switch.

7.3.1.4. On the DMACS "Interlocks Control" screen, select "Reset Intlks" to clear the system interlocks.

7.3.1.5. On the DMACS "Dump Switch Control" screen, verify that "DS Status" indicates "Closed" and "DS Interlock" indicates "OK".

7.3.1.6. On the DMACS "GFD" screen, verify that the "GFD Enabled/Disabled" indicates "Enable".

7.3.2. Test Quench Detector Dump Control (Dump1)

7.3.2.1. Remove Dump Switch Pmt override jumper from end rack terminals 1084-1085.
7.3.2.2. Install a jumper between end rack terminals 1135 and 1136 to disable the "Dump2" signal.
7.3.2.3. On the DMACS "Quench Detector Control" screen, select "Trigger" to force a Dump1 signal from the quench detector.
7.3.2.4. Verify audibly that the dump switch opens.
7.3.2.5. On the DMACS "Dump Switch" screen, verify that "DS Status" indicates "Open!" and "DS Interlock" indicates "Not OK".
7.3.2.6. On the DMACS "GFD" screen, verify that the "GFD Enabled/Disabled" indicates "Disable".
7.3.2.7. Remove the Dump2 override jumper between end rack terminals 1135 and 1136.

7.3.3. Test Interlock Dump Control (Dump2)

7.3.3.1. On the DMACS "Interlocks Control screen", select "Reset Interlocks".
7.3.3.2. Install a jumper between end rack terminals 1133 and 1134 to disable the "Dump1" signal.
7.3.3.3. On the DMACS "Dump Switch" screen, "Control" sub-screen, select "Close DS" to close the dump switch.
7.3.3.4. On the DMACS "Interlocks Control" screen, select "Reset Intlks" to clear the system interlocks.
7.3.3.5. On the DMACS "Dump Switch Control" screen, verify that "DS Status" indicates "Closed" and "DS Interlock" indicates "OK".
7.3.3.6. On the DMACS "Quench Detector" screen, "Control" sub-screen, select "Trigger" to force a Dump2 signal from the interlock modules.
7.3.3.7. Verify audibly that the dump switch opens.
7.3.3.8. On the DMACS "Dump Switch" screen, verify that "DS Status" indicates "Open!" and "DS Interlock" indicates "Not OK".
7.3.3.9. Remove the jumper between end rack terminals 1133 and 1134.

7.3.4. Test PLC Dump Control (Dump3)

7.3.4.1. On the DMACS "Interlocks Control screen", select "Reset Interlocks".
7.3.4.2. On the DMACS "Dump Switch Control" screen, select "Close DS" to close the dump switch.
7.3.4.3. On the DMACS "Interlocks Control" screen, select "Reset Intlks" to clear the system interlocks.
7.3.4.4. On the DMACS "Dump Switch Control" screen, verify that "DS Status" indicates "Closed" and "DS Interlock" indicates "OK".
7.3.4.5. On the DMACS "Dumps Switch" screen, "Control" sub-screen, select "Open DS" to force a Dump3 signal from the PLC.
7.3.4.6. Verify audibly that the dump switch opens.
7.3.4.7. On the DMACS "Dump Switch" screen, verify that "DS Status" indicates "Open!" and "DS Interlock" indicates "Not OK".

7.3.5. Lock Out AC Power to DS/RS Cabinet

7.3.5.1. Lock off (LOTO) the disconnect switch feeding the reversing switch/dump switch cabinet. Verify power off.

7.4. Power Supply Preliminary Operational Tests

7.4.1. Test Low Conductivity Water (LCW) Cooling System

7.4.1.1. Verify that LCW system is operating.
7.4.1.2. **Remove** - "LCW Pmt" jumper at the end rack between terminals 1066 and 1067.
7.4.1.3. LCW permit will not reset until conductivity is ≥ the set point on the LCW meter in room 604. Verify that the set point is 4 Meg Ohms per square centimeter.

7.4.2. Secure Power Supply Doors and Side Covers.

7.4.2.1. Verify that top and bottom latches of front and rear doors are secured.
7.4.2.2. Verify that both side covers are secured.

7.4.3. Disable Power Supply DC Output

7.4.3.1. Unscrew and remove the four "Firing Modules" from the power supply NIM bin.

7.4.4. Apply AC Power to Power Supply

7.4.4.1. Remove the lock out on the power supply disconnect switch to restore AC power to the power supply.
7.4.4.2. Turn on the main circuit breaker on the power supply.

7.4.5. Set Power Supply for Remote Operation

7.4.5.1. On the power supply front panel, set the "Local/Remote" switch to "Remote".
7.4.5.2. On the power supply reference module, set the "Reference" switch to "External".

7.4.6. Override Dump Switch Interlock

7.4.6.1. Install a jumper between end rack terminals 1084 and 1085 to force the dump switch permit "DS Pmt".

7.4.7. Verify Internal Interlock Circuits

7.4.7.1. Push "RESET" button on power supply and verify that all fault lamps on the power supply are extinguished except perhaps the "External 1".
7.4.7.2. Open left front door of the supply and verify that the "Door Interlock" fault lamp illuminates. Close and secure the door and "RESET" the power supply again.
7.4.7.3. Open right back door of the supply and verify that the "Door Interlock" fault lamp illuminates. Close and secure the door.

7.4.8. Enable Controls Permit

7.4.8.1. At the DMACS "Interlocks Control" screen, select "Control Pmt On".

7.4.9. Reset External Interlocks

7.4.9.1. At the DMACS "Interlocks Control" screen, select "Reset Intlks".
7.4.9.2. Verify that all DMACS "Interlocks Status" indicators read "Ok".
7.4.9.3. At the DMACS "Power Supply Control" screen, select "Reset".
7.4.9.4. Verify that the power supply resets ie. all supply fault lamps extinguish.

7.4.10. Test Power Supply On Command

7.4.10.1. At the DMACS "Power Supply Control" screen, select "On".
7.4.10.2. Verify that the "On/Off Status" switches to "On".

7.4.11. Test External Current Reference

7.4.11.1. At the DMACS "Power Supply Control" screen, set the "Sol Target Amps" to 2500.
7.4.11.2. Select "Proceed to Target".
7.4.11.3. Verify that the center pin of the BNC "Reference" test point on the power supply reference module is 5.00 Volts with respect to chassis ground.
7.4.11.4. At the DMACS "Power Supply Control" screen, set the "Sol Target Amps" to 0.
7.4.11.5. Select "Proceed to Target".

7.4.12. Test External Phase Back Command

7.4.12.1. Install a jumper between end rack terminals 3013 and 3014 to override the remote power supply "DC OFF" command.
7.4.12.2. Verify that the "Gate Inhibit" LED on the regulator module in the power supply NIM bin is extinguished.
7.4.12.3. At the DMACS "Power Supply Control" screen, select the "Off" command.
7.4.12.4. Verify that the "Gate Inhibit" LED is now illuminated.
7.4.12.5. Remove the "DC OFF" jumper between end rack terminals 3013 and 3014.

7.4.13. Test Power Supply Off Command

7.4.13.1. At the DMACS "Power Supply Control" screen, select "Off".
7.4.13.2. Verify that the "On/Off Status" switches to "Off".

7.4.14. Disable AC to Power Supply

7.4.14.1. Turn off the main circuit breaker on the power supply.

7.4.15. Re-enable Power Supply DC Output

7.4.15.1. Replace and secure the four "Firing Modules" in the power supply NIM bin.

8. Powered System Tests

8.1. System Preparation

8.1.1. Secure Department Head Approval

8.1.1.1. Department Head must be notified and approval received prior to operating the power supply since the DC bus extends into the assembly hall work area. Attach EMAIL or written authorization correspondence to this record.

8.1.2. Re-inspect Load Jumper

8.1.2.1. 5000 Amp bus jumper is in place instead of solenoid and all electrical bus fasteners in place and tight.
8.1.2.2. Connection covers in place and secured to prevent inadvertent contact with conductors.

8.1.3. Secure Room 511 Hardware

8.1.3.1. All bus connections secured.
8.1.3.2. All covers in place and secured.
8.1.3.3. Dump/Reversing switch cabinet doors are closed.
8.1.3.4. Power supply doors are closed.
8.1.3.5. Access gate is closed.

8.1.4. Install Interlock Jumpers Required for Tests:

8.1.4.1. "Accelerator Pmt" override jumper at the end rack between terminals 1063 and 1064.
8.1.4.2. **Removed** - "LCW Pmt" override jumper at the end rack between terminals 1066 and 1067.
8.1.4.3. "Crash Pmt" override jumper at the end rack between terminals 1069 and 1070.
8.1.4.4. "Steel Pmt" override jumper at the end rack between terminals 1072 and 1073.
8.1.4.5. "Cryo Pmt" override jumper at the end rack between terminals 1105 and 1106.
8.1.4.6. "Dump Switch Pmt" override jumper at the end rack between terminals 1084 and 1085.

8.1.5. Enable AC Power to All Devices

8.1.5.1. Remove the lock out on the power supply disconnect switch to restore AC power to the Dump Switch/Reversing Switch.
8.1.5.2. Remove the lock out on the power supply disconnect switch to restore AC power to the power supply.
8.1.5.3. Turn on the main circuit breaker on the power supply.

8.1.6. Set Power Supply Operational Mode

8.1.6.1. On the power supply front panel, set the "Local/Remote" switch to "Remote".
8.1.6.2. On the power supply reference module, set the "Reference" switch to "External".
8.1.6.3. On the power supply regulator module, set the "Mode" switch to "Current Regulate".

8.1.7. Initialize Control System

8.1.7.1. At the DMACS "Power Supply Control" screen, set the "PS Voltage Limit" to 0.
8.1.7.2. At the DMACS "Interlocks Control" screen, select "Control Pmt On".
8.1.7.3. At the DMACS "Interlocks Control" screen, select "Reset Intlks".
8.1.7.4. Verify that the DMACS "Interlocks Status" are all "Ok".

8.2. Power Supply Operation

8.2.1. Test Power Supply Voltage Limiter

8.2.1.1. At the DMACS "Power Supply Control" screen, select "Reset" to reset the power supply
8.2.1.2. At the DMACS "Power Supply Control" screen, select "On" to turn on the power supply
8.2.1.3. At the DMACS "Power Supply Control" screen, set the "Sol Target Amps" to 100.
8.2.1.4. At the DMACS "Power Supply Control" screen, select "Proceed to Target".
8.2.1.5. Verify that the DMACS "PS Voltage" and "PS Current" remain at "0".
8.2.1.6. Verify on the power supply front panel that "DC Output Voltage" remains "0".
8.2.1.7. At the DMACS "Power Supply Control" screen, set the "PS Voltage Limit" to "5.0".
8.2.1.8. At the DMACS "Power Supply Control" screen, select "Proceed to Target".
8.2.1.9. Verify that the DMACS "PS Voltage" indicates "5.0".
8.2.1.10. Verify on the power supply front panel that the "DC Output Voltage" indicates "5.0".
8.2.1.11. At the DMACS "Power Supply Control" screen, set the "Sol Target Amps" to "0".
8.2.1.12. At the DMACS "Power Supply Control" screen, select "Proceed to Target".
8.2.1.13. At the DMACS "Power Supply Control" screen, select "Off" to turn off the power supply
8.2.1.14. Remove the jumper between end rack terminals 1084 and 1085 to restore operation of the dump switch interlock.

8.3. Reversing Switch Operation

The first test verifies that the reversing switch in operation will clamp the output of the power supply to zero. The interlocks that prevent the reversing from cycling under power are first defeated. The controls software that prevents the reversing switch from cycling under power is defeated. Then the reversing switch is toggled with a safe current in the system and the power supply is observed to ascertain that its output is clamped to zero by the reversing switch during the switch cycle.

The next set of tests verifies that the reversing switch cannot be cycled when high currents are flowing in the bus. Three levels of safety exist: 5A, 25A and 200A. The test first checks that the Hamlin reed switch on the water cooled bus locks out the reversing switch at currents >≈200A. The test next checks that the Absolute Value module locks out the reversing switch at currents >≈25A as determined from three sources: 1) Holec chassis output, 2) PEI current transducer output, 3) PEI Voltage readout. The test then checks that Holec chassis locks out the reversing switch at currents >≈5A.

8.3.1. Test Reversing Switch Clamp of PS

8.3.1.1. "Holec I<0.1%" override jumper at the end rack between terminals 1130 and 1131.
8.3.1.2. "Absolute Value I<25A-1" override jumper at the end rack between terminals 1124 and 1125.
8.3.1.3. "Absolute Value I<25A-2" override jumper at the end rack between terminals 2100 and 2101.
8.3.1.4. "Reversing Switch Permit" override jumper at the end rack between terminals 1090 and 1091.
8.3.1.5. "Gnd Fault Pmt" override jumper at the end rack between terminals 1087-1088.
8.3.1.6. At the DMACS "Dump Switch Control" screen, select "Close DS" to close the dump switch.
8.3.1.7. At the DMACS "Interlocks Control" screen, select "Reset Intlks".
8.3.1.8. At the DMACS "Power Supply Control" screen, select "Reset" to reset the power supply
8.3.1.9. At the DMACS "Power Supply Control" screen, set the "PS Voltage Limit" to 1.0 Volt.
8.3.1.10. At the DMACS "Power Supply Control" screen, select "Proceed to Target".
8.3.1.11. At the Power Supply, set the "Local/Remote" switch to "Local"
8.3.1.12. At the Power Supply, set the "Internal/External Reference" switch to "Internal"
8.3.1.13. At the Power Supply, set the "Local Reference" potentiometer to "000"
8.3.1.14. At the Power Supply, momentarily depress the "On" button.
8.3.1.15. At the Power Supply, set the "Local Reference" potentiometer to "020"
8.3.1.16. At the DMACS "Power Supply Control" screen, Verify that the "Solenoid Current" reads ≈ 100 Amps.
8.3.1.17. At the DMACS "Reversing Switch Control" screen, select "Proceed" to initiate a reversing switch cycle.
8.3.1.18. Watch the "Gate Inhibit LED" on the power supply regulator module. Verify that the LED illuminates shortly before the reversing switch audibly cycles. The LED will remain on during the cycle and extinguish at the end of the cycle. The current readout, as viewed on the DMACS will indicate 0 Amps during the entire time that the LED is illuminated.

8.3.2. Test Bus Reed Switch Reversing Switch Lockout

8.3.2.1. Complete the previous test before proceeding.
8.3.2.2. At the Power Supply, set the "Local Reference" potentiometer to "068".
8.3.2.3. At the DMACS "Power Supply Control" screen, Verify that the "Solenoid Current" reads ≈ 350 Amps.
8.3.2.4. At the DMACS "Reversing Switch Control" screen, select "Proceed" to initiate a reversing switch cycle.
8.3.2.5. Observe the DMACS "Reversing Switch Control" screen. If the "Status From Rev. Sw." does not indicate "Cycling" within 2 minutes, then select "Cancel" to abort the operation. Test has passed if reversing switch refuses to cycle (Hamlin

reed switch on bus is detecting current and locking out Rev. Sw. operation).

8.3.2.6. At the Power Supply, set the "Local Reference" potentiometer to "000".

8.3.2.7. At the Power Supply, momentarily depress the "Off" button.

8.3.2.8. Enter the fenced area. Entering through the gate will interrupt the interlock string. Unplug the Hamlin reed switch Molex connector and install the reed switch shorting plug on the cable end.

8.3.2.9. Secure the access gate.

8.3.2.10. Remove the I<25A-1 jumper at end rack terminals 1124 and 1125.

8.3.3. Test Holec I>25A-1 Reversing Switch Lockout

8.3.3.1. Complete the previous test before proceeding.

8.3.3.2. At the power supply, disconnect the P1 connector (cable C421) to disable the power supply voltage readout to the absolute value module and the PLC.

8.3.3.3. Install a jumper between end rack terminals 0084 and 0085 to disable the PS transductor signal to the absolute value module and the PLC.

8.3.3.4. At the DMACS "Interlocks Control" screen, select "Reset Intlks".

8.3.3.5. At the Power Supply, momentarily depress the "Reset" button.

8.3.3.6. At the Power Supply, momentarily depress the "On" button.

8.3.3.7. At the Power Supply, set the "Local Reference" potentiometer to "010"

8.3.3.8. At the DMACS "Power Supply Control" screen, Verify that the "Solenoid Current" reads ≈ 50 Amps.

8.3.3.9. At the DMACS "Reversing Switch Control" screen, select "Proceed" to initiate a reversing switch cycle.

8.3.3.10. Observe the DMACS "Reversing Switch Control" screen. If the "Status From Rev. Sw." does not indicate "Cycling" within 2 minutes, then select "Cancel" to abort the operation. Test has passed if reversing switch refuses to cycle (The Holec transductor head via the absolute value module is detecting current and locking out Rev. Sw. operation).

8.3.3.11. At the Power Supply, set the "Local Reference" potentiometer to "000".

8.3.3.12. At the Power Supply, momentarily depress the "Off" button.

8.3.3.13. Remove the jumper between end rack terminals 0084 and 0085 to re-enable the PS transductor signal to the absolute value module and the PLC.

8.3.4. Test PS Xducer Contribution to I>25A Reversing Switch Lockout

8.3.4.1. Complete the previous test before proceeding.

8.3.4.2. Place the NIM bin "Absolute Value Module" on an extender, remove its side panel, and temporarily install the following clip lead jumper: From the top of the ½ W 2.2 KΩ resistor adjacent to IC11-7, to frame ground. This disables the Holec I>25A signal.

8.3.4.3. At the DMACS "Interlocks Control" screen, select "Reset Intlks".

8.3.4.4. At the Power Supply, momentarily depress the "Reset" button.

8.3.4.5. At the Power Supply, momentarily depress the "On" button.

8.3.4.6. At the Power Supply, set the "Local Reference" potentiometer to "010"

8.3.4.7. At the DMACS "Power Supply Control" screen, Verify that the "Solenoid Current" reads ≈ 50 Amps.

8.3.4.8. At the DMACS "Reversing Switch Control" screen, select "Proceed" to initiate a reversing switch cycle.

8.3.4.9. Observe the DMACS "Reversing Switch Control" screen. If the "Status From Rev. Sw." does not indicate "Cycling" within 2 minutes, then select "Cancel" to abort the operation. Test has passed if reversing switch refuses to cycle (The power supply transductor via the absolute value module is detecting current and locking out Rev. Sw. operation).

8.3.4.10. At the Power Supply, set the "Local Reference" potentiometer to "000".

8.3.4.11. At the Power Supply, momentarily depress the "Off" button.

8.3.5. Test PS Voltage Contribution to I>25A Reversing Switch Lockout

8.3.5.1. Complete the previous test before proceeding.

8.3.5.2. At the power supply, re-connect the P1 connector (cable C421) to re-enable the power supply voltage readout to the absolute value module and the PLC.
8.3.5.3. Install a jumper between end rack terminals 0084 and 0085 to disable the PS transductor signal to the absolute value module and the PLC.
8.3.5.4. At the DMACS "Interlocks Control" screen, select "Reset Intlks".
8.3.5.5. At the Power Supply, momentarily depress the "Reset" button.
8.3.5.6. At the Power Supply, momentarily depress the "On" button.
8.3.5.7. At the Power Supply, set the "Local Reference" potentiometer to "020"
8.3.5.8. At the DMACS "Power Supply Control" screen, Verify that the "Solenoid Current" reads ≈ 200 Amps.
8.3.5.9. At the DMACS "Reversing Switch Control" screen, select "Proceed" to initiate a reversing switch cycle.
8.3.5.10. Observe the DMACS "Reversing Switch Control" screen. If the "Status From Rev. Sw." does not indicate "Cycling" within 2 minutes, then select "Cancel" to abort the operation. Test has passed if reversing switch refuses to cycle (The power supply voltage readout via the absolute value module is detecting voltage and locking out Rev. Sw. operation).
8.3.5.11. At the Power Supply, set the "Local Reference" potentiometer to "000".
8.3.5.12. At the Power Supply, momentarily depress the "Off" button.
8.3.5.13. Remove the jumper between end rack terminals 0084 and 0085 to re-enable the PS transductor signal to the absolute value module and the PLC.
8.3.5.14. Remove the clip lead jumper from the "Absolute Value Module", replace its side panel, and reinsert it in the NIM bin without the extender card.

8.3.6. Test Holec I>0.1% Reversing Switch Lockout

8.3.6.1. Remove the Holec I< 0.1% override jumper from endrack terminals 1130-1131.
8.3.6.2. Install a jumper between end rack terminals 1124 and 1125 to disable the I>25A reversing switch interlock from the "Absolute Value Module".
8.3.6.3. At the DMACS "Interlocks Control" screen, select "Reset Intlks".
8.3.6.4. At the Power Supply, momentarily depress the "Reset" button.
8.3.6.5. At the Power Supply, momentarily depress the "On" button.
8.3.6.6. At the Power Supply, set the "Local Reference" potentiometer to "005"
8.3.6.7. At the DMACS "Power Supply Control" screen, Verify that the "Solenoid Current" reads ≈ 25 Amps.
8.3.6.8. At the DMACS "Reversing Switch Control" screen, select "Proceed" to initiate a reversing switch cycle.
8.3.6.9. Observe the DMACS "Reversing Switch Control" screen. If the "Status From Rev. Sw." does not indicate "Cycling" within 2 minutes, then select "Cancel" to abort the operation. Test has passed if reversing switch refuses to cycle (Holec chassis is detecting current >0.1% of full scale and is locking out Rev. Sw. operation).
8.3.6.10. At the Power Supply, set the "Local Reference" potentiometer to "0.0".
8.3.6.11. At the Power Supply, momentarily depress the "Off" button.
8.3.6.12. Remove the jumper between end rack terminals 1124 and 1125 to re-enable the I>25A reversing switch interlock from the "Absolute Value Module".
8.3.6.13. Enter the fenced area. Entering through the gate will interrupt the interlock string. Unplug the Hamlin reed switch shorting plug and reconnect the cable end to the reed switch.
8.3.6.14. Secure the access gate.
8.3.6.15. Remove the I<25A jumper from 2100-2101.
8.3.6.16. Remove the Gnd Fault pmt override jumper from 1087-1088.
8.3.6.17. Remove the Rev Switch pmt override jumper from 1090-1091.

8.4. High Current Operation

8.4.1. Set Power Supply Operational Mode

8.4.1.1. On the power supply front panel, set the "Local/Remote" switch to "Remote".
8.4.1.2. On the power supply reference module, set the "Reference" switch to "External".

8.4.1.3. On the power supply regulator module, set the "Mode" switch to "Current Regulate".

8.4.2. Initialize Control System

8.4.2.1. At the DMACS "Interlocks Control" screen, select "Control Pmt On".
8.4.2.2. At the DMACS "Interlocks Control" screen, select "Reset Intlks".
8.4.2.3. Verify that the DMACS "Interlocks Status" are all "Ok".
8.4.2.4. At the DMACS "Power Supply Control" screen, set "PS Voltage Limit" to 7.5.

8.4.3. Test Current Calibration in Forward Polarity

8.4.3.1. At the DMACS "Power Supply Control" screen, select "Reset" to reset the power supply.
8.4.3.2. At the DMACS "Power Supply Control" screen, select "On" to turn on the power supply.
8.4.3.3. At the DMACS "Power Supply Control" screen, set the "Sol Target Amps" to setting from table below.
8.4.3.4. At the DMACS "Power Supply Control" screen, select "Proceed to Target".
8.4.3.5. At the DMACS Record the DMACS table readings as indicated.
8.4.3.6. Record the Direct Holec output voltage as taken with a DVM at end rack terminals 0120 and 0121.
8.4.3.7. Record the absolute value Holec output voltage as taken with a DVM at end rack terminals 0081 and 0082.
8.4.3.8. Record the PS transductor output voltage as taken with a DVM at end rack terminals 0084 and 0085.
8.4.3.9. Record the buffered PS output voltage as taken with a DVM at end rack terminals 0087 and 0088.
8.4.3.10. Using the next forward current setting from the table, repeat the steps of this test until the 5000A data has been recorded.
8.4.3.11. At the DMACS "Power Supply Control" screen, set "Sol Target Amps" to "0".
8.4.3.12. At the DMACS "Power Supply Control" screen, select "Proceed to Target".

8.4.4. Test Current Calibration in Reverse Polarity

8.4.4.1. At the DMACS "Reversing Switch Control" screen, select "Proceed" to initiate a reversing switch cycle. Wait for the reversing switch to cycle to the opposite polarity.
8.4.4.2. At the DMACS "Interlocks Control" screen, select "Reset Intlks".
8.4.4.3. Verify that the DMACS "Interlocks Status" are all "Ok".
8.4.4.4. At the DMACS "Power Supply Control" screen, select "Reset" to reset the power supply.
8.4.4.5. At the DMACS "Power Supply Control" screen, select "On" to turn on the power supply.
8.4.4.6. At the DMACS "Power Supply Control" screen, set the "Sol Target Amps" to setting from table below.
8.4.4.7. At the DMACS "Power Supply Control" screen, select "Proceed to Target".
8.4.4.8. At the DMACS Record the DMACS table readings as indicated.
8.4.4.9. Record the Direct Holec output voltage as taken with a DVM at end rack terminals 0120 and 0121.
8.4.4.10. Record the absolute value Holec output voltage as taken with a DVM at end rack terminals 0081 and 0082.
8.4.4.11. Record the PS transductor output voltage as taken with a DVM at end rack terminals 0084 and 0085.
8.4.4.12. Record the buffered PS output voltage as taken with a DVM at end rack terminals 0087 and 0088.
8.4.4.13. Using the next reverse current setting from the table, repeat the steps of this test until the 5000A data has been recorded.
8.4.4.14. At the DMACS "Power Supply Control" screen, set "Sol Target Amps" to "0".
8.4.4.15. At the DMACS "Power Supply Control" screen, select "Proceed to Target".

8.4.5. Test Current Calibration Table

Current	Holec output Mag Curr-2		ABS Val ABS I-2		PEI Xducer		PEI Buffered V		Dump Resistor Temp
	DMACS	DVM	DMACS	DVM	DMACS	DVM	DMACS	DVM	DMACS
Fwd 0000 A									
Fwd 1000 A									
Fwd 2000 A									
Fwd 3000 A									
Fwd 4000 A									
Fwd 5000 A									
Rev 0000 A									
Rev 1000 A									
Rev 2000 A									
Rev 3000 A									
Rev 4000 A									
Rev 5000 A									

8.5. Continuous Current Operation

8.5.1. Prepare System for Test

8.5.1.1. On the DMACS "Interlocks Control" screen, verify that all "Interlocks Status" indicators are "Ok".

8.5.1.2. On the DMACS "Power Supply Control" screen, verify that the "PS Interlocks Status" indicates "Ok".

8.5.1.3. At the DMACS "Power Supply Control" screen, select "On" to turn on the power supply.

8.5.1.4. At the DMACS "Power Supply Control" screen, increase the power supply current to 5000 A in 1000 A steps by entering the entering values into "Sol Target (Amps)" and selecting "Proceed to Target".

8.5.1.5. Monitor the system operation for at least one hour at the DMACS alternating between the "Diagnostics Access / Temperatures" screen and the "Power Supply Control" screen. Turn off the power supply if any abnormal conditions occur. Abnormal conditions include any temperatures exceeding 40 degrees Celsius or current fluctuations exceeding 5 Amps.

8.6. Dump Switch Operation at High Current

8.6.1. Execute Fast Dump from 5000 A

8.6.1.1. At the DMACS "Quench Detector Control" screen, select "Trigger" to initiate a fast dump. Advise bystanders that dump switch will make considerable noise as it opens.

8.6.1.2. At the DMACS without changing screens, verify that the Dump Switch indicates "Open!"

8.6.1.3. At the DMACS without changing screens, verify that the Power Supply indicates "Off"

8.7. Secure System

8.7.1. Disable AC to Power Supply

8.7.1.1. LOTO the disconnect switch feeding the power supply.
8.7.1.2. Verify power off.

8.7.2. Disable AC to Dump Switch/Reversing Switch

8.7.2.1. LOTO the disconnect switch feeding the reversing switch/dump switch cabinet.
8.7.2.2. Verify power off.

8.7.3. Remove Remaining Interlock Jumpers

8.7.3.1. "Accelerator Pmt" jumper at the end rack between terminals 1063 and 1064.
8.7.3.2. "Crash Pmt" jumper at the end rack between terminals 1069 and 1070.
8.7.3.3. "Steel Pmt" jumper at the end rack between terminals 1072 and 1073.
8.7.3.4. "Cryo Pmt" jumper at the end rack between terminals 1105 and 1106.

8.7.4. Enter Test Results in Maintenance Log

8.7.4.1. Make a notation in the maintenance log that this test was performed.
8.7.4.2. Enter the Dump Switch counter reading in the log.
8.7.4.3. Photocopy this test record and insert the copy into the maintenance log binder.

Signed_____ Date _____