SMD Operations Procedures Manual

8.1.1.20 OPERATION OF 10 kA POWER SUPPLY FOR HORIZONTAL MAGNET TESTING (HTF PS)

Text Pages 1 through 8
Attachments 1, 2, 3

Hand Processed Changes

HPC No.	Date	Page Nos.	Initials

Revision No. 4 Approved:

Approval on File

Division Head Date

8.1.1.20 Operation of 10 kA Power Supply for Horizontal Magnet Testing

1 Purpose and Scope

1.1 The purpose of this Procedure is to provide step by step instruction in the start-up, operation, and shut-down of the HTF 10 kA power supply located in Building 902.

2 Responsibilities

2.1 The Operator will maintain a Testing log book for the magnet under test. Entries will include notes of any irregularities encountered regarding the Supply.

2.2 Authorized Operators (Operators) of the 10kA Test Facility will perform the procedure described here. A list of Operators is kept on a tag attached to the input disconnect switches of the Supply.

3 Prerequisites

3.1 The Operator shall be instructed by the following people:

3.1.1 Cognizant Engineer (CE) for the Supply, or the CE's designee.

3.1.2 Cognizant Engineer or Cognizant Scientist (CS) for magnet testing, or the CE/CS's designee.

3.2 The operator shall be trained as, a minimum "Authorized Employee" as defined by Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance Subject Area

3.3 Safety Interlocks will have been successfully tested with results posted within 6 months as required by SMD OPM 8.1.1.9, Test of Safety Interlocks of 10 kA Power Supply for Horizontal Magnet Testing.

3.4 Operator must be trained in NFPA 70E Personal Protective Equipment Requirements and Arc Flash Hazards.

3.5 Operator LOTO OJT Training on Power Supply System must be current.

4 Precautions

4.1 Personal Protective Equipment must be worn as defined in NFPA 70E for verifying LOTO, 480V is a category 2 hazard. Follow the PPE requirements according to the ARC Flash Rating on the Disconnects.

4.2 The output power of this Supply is routed through the Distribution Box (Link Box) located adjacent to the Supply. Before opening up the Link Box, the Supply shall be locked and tagged, and the Kirk keys used to open the Link Box.

4.3 When LOTO is required, verify IGBT Cabinets are locked out at Panel 902RPR18, Circuit Breaker 22

4.4 Contact the CE for the Supply if it is necessary to operate the Supply in a non-standard manner, which is defined as a manner that deviates from the procedure described below. Failure to do this could result in injury to personnel or equipment damage.

4.5 Additional precautions are noted in section 5.0 before individual steps requiring precautions.

4.6 High currents can generate static magnetic fields near cables. Ensure magnetic field strengths have been measured or calculated and the required postings are in place as per the Static Magnetic Field SBMS Subject Area (https://sbms.bnl.gov/standard/1u/1u00t011.htm).

5 Procedure

NOTE

The Horizontal Test Power Supply is a dual 5 kA supply. The 5 kA supplies are designated "PS1" and "PS2".

5.1 Verify that the safety interlocks have been tested within the past six months.

IF the test approval has expired,

THEN stop work and immediately notify the Cognizant Engineer. Do not continue performing this procedure.

NOTE

A "Safety Interlock Test Approval" form is posted on both 5 kA Supply control panels, on the HTF Distribution Box (Link Box), and in the Horizontal Control Room (HCR). The form indicates the last test date, and the expiration date.

5.2 IF the Acceptance Test Procedure (ATP) requires a different output voltage than the current configuration provides,

THEN change the voltage taps on the power transformer by performing the following steps:

WARNING

Electrical Shock Hazard

Failure to follow proper Lock Out/Tag Out procedures could lead to Death or severe injury

5.2.1 Lock and tag the two 480V Input Disconnect Switches for the Supply in the OFF position. The Switches are located on the west wall behind the Supply. They are labeled "R16-2" and "R17-1". Keep the keys in your possession.

5.2.2 Lockout IGBT Rack Breaker 902RPR18-ckt22

5.2.3 Remove the front panels (west side, nearest the wall) of PS1 and PS2.

5.2.4 Verify that the system is de-energized by using a CAT III DVM or other passive, low impedance voltage detector (per Lockout/Tagout training).

5.2.5 Using the diagram in Attachment 1, move the wires labeled "1", "2", and "3" to the desired taps of the PS1 transformer.

NOTE 1

DO NOT remove the wires labeled "L1", "L2", "L3" from tap number 5.

NOTE 2

Wires labeled "1", "2", "3" should be connected subsequently to taps on the left, middle, and right sides of the transformer to maintain proper phase.

5.2.6 Repeat 5.2.5 for PS2. PS1 and PS2 must have the same configuration.

5.2.7 Tighten all bolts.

5.2.8 Remove all tools from inside the PS enclosures.

5.2.9 Double check work.

5.2.10 Replace covers.

5.3 Configure the Link Box, which is labeled " DISTRIBUTION BOX", by performing the following steps:

5.3.1 Perform Lockout/Tagout. Lock and tag the 480V input disconnect switches for the Supply, located on the west wall behind the supplies and marked R16-2 and R17-1.

5.3.2 Lockout IGBT Rack. Breaker 902RPR18-ckt 22

5.3.3 Remove Kirk lock keys #29 and #30 from the input disconnect switches.

5.3.4 Open the Link Box by unlocking Kirk locks RE11384 (key #29) and RE11534 (key #30).

Warning

Electrical Shock Hazard

Verify that the meter is operating properly by testing it on a similar voltage (same range) prior to and after checking Link Box

5.3.5 Make sure that the system is de-energized by using a CAT III DVM or other passive, low impedance voltage detector (per Lockout/Tagout training).

5.3.6 Verify that all mating surfaces are clean and free of debris.

5.3.7 Configure link box such that the test stand with the magnet under test is connected.

WARNING

High Current/Arc Flash Hazard

Ensure all connections are secured and all tools, hardware and Foreign objects are removed prior to installing panels. Failure could result in Arc Flash and fire

5.3.8 Close the Link Box. Lock the Kirk Locks. Install and secure all cover panels.

5.3.9 Fill out a "Warning" sheet, describing the supply configuration (Attachment 2). Affix it to the outside of the Link Box.

5.4 Check the Remote-Control Rack, located adjacent to the Supply, by performing the following steps:

5.4.1 Verify that control power is applied to the components of the Remote Control Rack.

5.4.2 In 10kA LabVIEW control program: Using attachment 3 “LabView Control Software Startup Procedure”, make sure all LabView programs are running properly.

A. Reset faults

B. Check for cooling water flow and for any faults

C. Check Dewar 6 area is secure and locked with Kirk Lock.

CAUTION

Failure to start the control software before activating power to the Supply could cause equipment or product damage.

5.5 Start the control software in the Electrical Systems Control Area, use attachment # 3 “LabView Control software Start-up Procedure.

CAUTION

Failure to perform step 5.6 could result in equipment or product damage.

5.6 Before activating power to the Supply, verify that ALL of the following are true:

A. Check liquid Helium level is appropriate to the test plan

B. Gas-cooled lead flow is on.

C. Cooling water is flowing to the Supply and 10kA bus line.

5.7 Activate power to the Supply locally by performing the following steps:

5.7.1 Turn the LOCAL/REMOTE selector switch of PS1, located on the control

panel on the outside of PS1, to LOCAL.

5.7.2 Repeat 5.7.1 for PS2.

5.7.3 Remove locks and tags from the input disconnect switches labeled "R16-2" and "R17-1".

5.7.4 Unlock the Kirk Locks on the switches.

5.7.5 Place both switches in the ON position. Verify that the red POWER ON lights, located on the control panels of PS1 and PS2, illuminate.

5.7.6 If the ON/OFF breaker switches, located on the control panels of PS1 and PS2, are not in the ON position, then place them in the ON position.

5.7.7 Depress the black STANDBY/RESET push buttons. Verify the following:

A. No white FAULT lights are lit.

B. The amber STANDBY/READY light is illuminated.

C. The D.C. voltmeters and D.C. current meters on the Supply read zero.

D. Set “DC over-current limit device” to a value specified in the magnet test “Run Plan”

5.8 Before leaving the Supply area, perform the following steps:

5.8.1 Alert cryogenic personnel and other affected personnel that the Supply is about to be operated.

5.9 Operate the Supply from the Power Supply control panel by performing the following steps:

5.9.1 Verify all faults are clear.

5.9.2 Turn Supply on.

5.9.3 Verify that warning lights on the Link Box, the Supply, the magnet under test, are flashing.

5.9.4 Operate Supply normally per instructions in the Run Plan for the particular test being conducted.

5.9.5 Confirm that the software is running per step 5.5.

5.10 Shut down the Supply by performing the following steps:

5.10.1 Ramp Supply to zero.

5.10.2 Issue a Power Supply OFF command from the power supply control panel. Verify that D.C. indicators show zero voltage and zero current.

5.10.3 Place the input disconnect switches in the OFF position. Lock the Kirk Locks.

5.11 Complete logbook. If any irregularities regarding the start-up, operation, or shut-down of the Supply occurred, then provide a detailed description in the log book.

6 Documentation

6.1 Link Box warning sheet.

6.2 Horizontal testing logbook (Electronic).

7 References

7.1 Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance Subject Area

7.2 SMD OPM 8.1.1.9, "Test of Safety Interlocks of HTF 10 kA Power Supply."

7.3 NFPA 70E, Standard for Electrical Safety in the Workplace.

7.4 System Specific SMD LOTO Training.

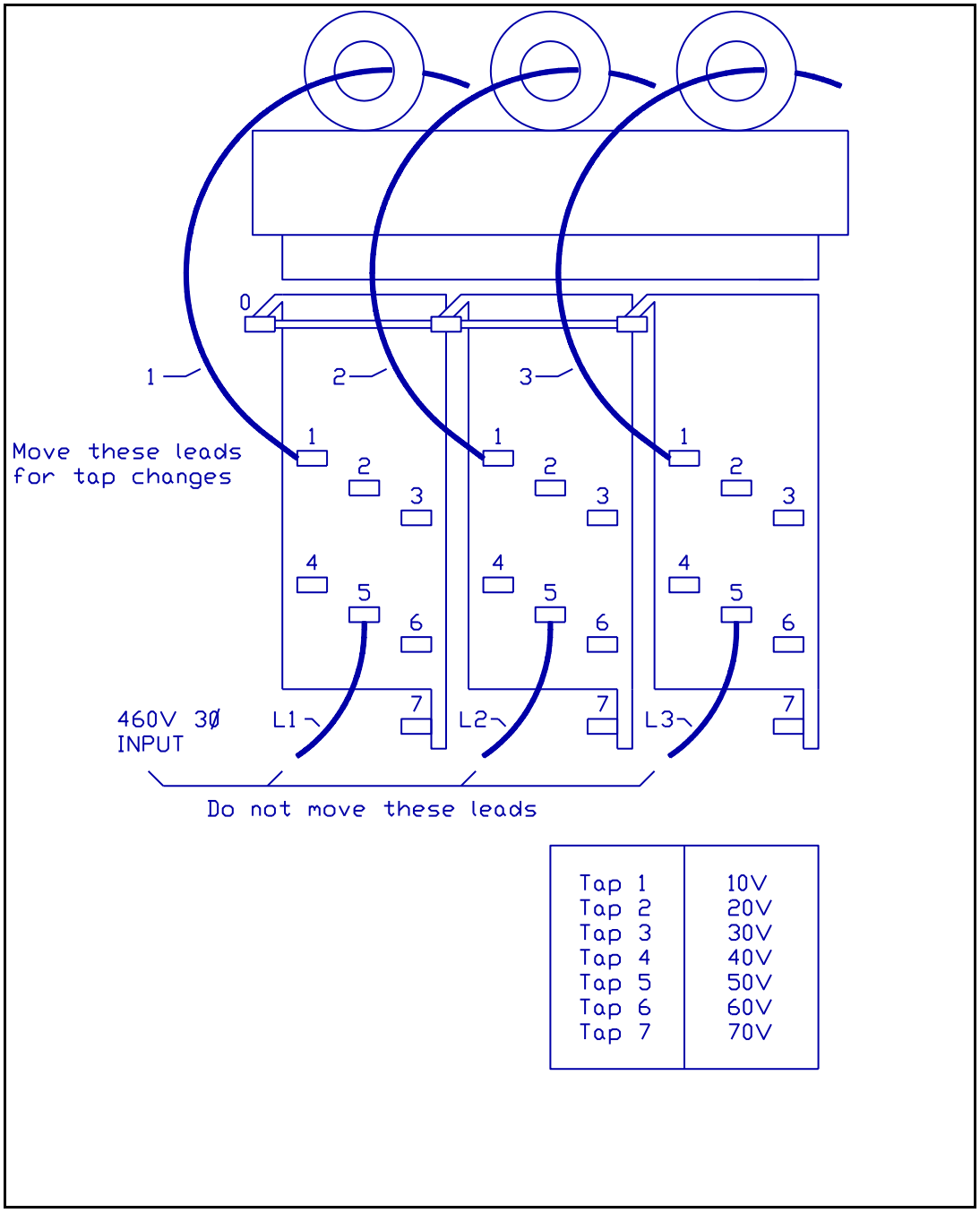
8 Attachments

1. Voltage Tap Change Diagram
2. Link Box Warning Sheet
3. LabView Control Software Start Up Procedure.

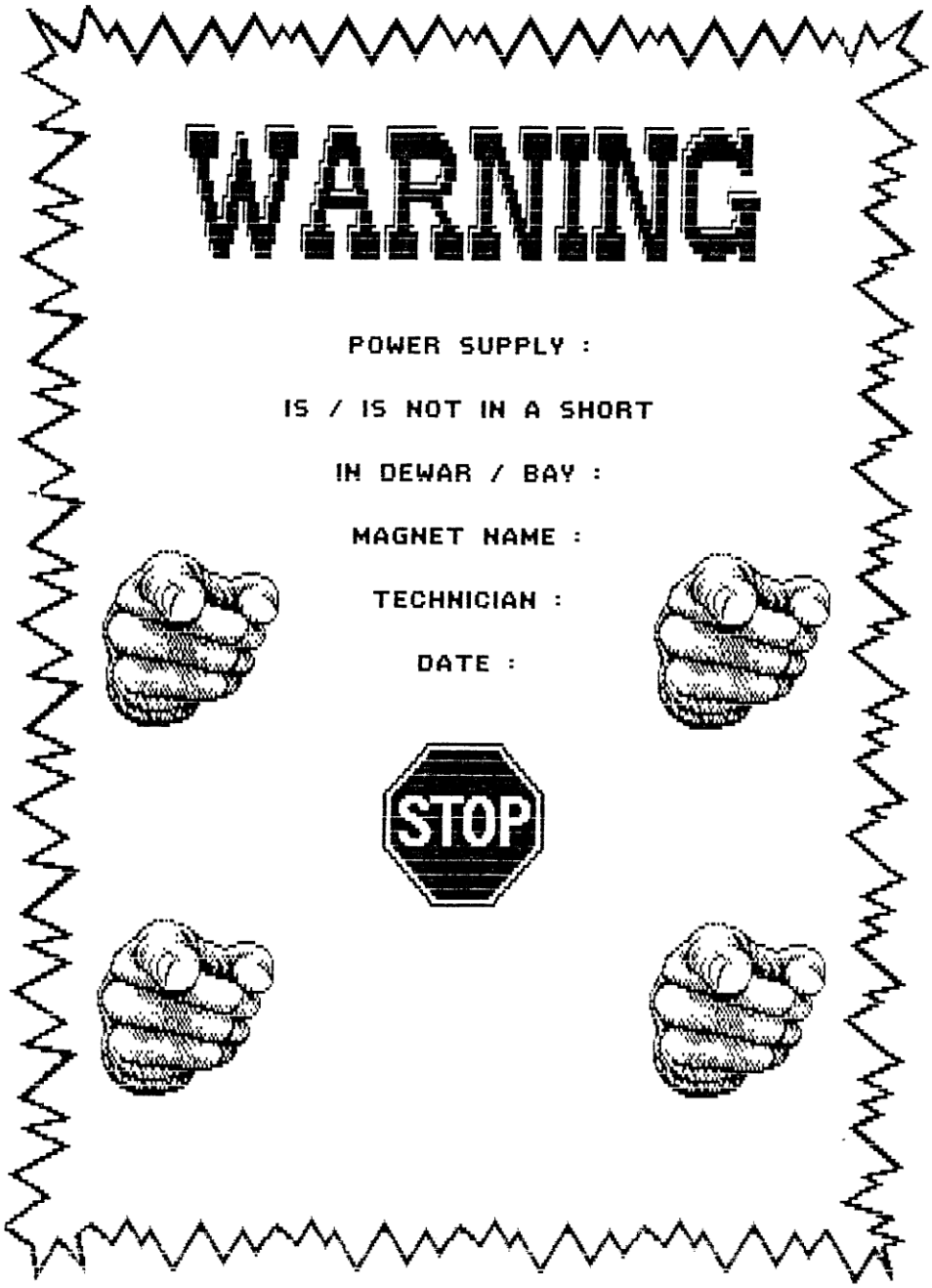
9 Version History Log

Revision	Description of Changes	Reviewers	Effective Date
04	• Implemented Version History Log • Updated to reflect Power Supply Hardware Reconfiguration to have IGBT protection instead of SCRs. • Updated to reflect Software side updated to IGBT protection and LabVIEW controls rather than an analog hardware control rack. • Rewrite of Attachment 3 to update to current process and for clarity	T. Tallerico P. Joshi H. Hocker M. Anerella M. Samms A. Volk	1/16/24

Attachment 1 - Voltage Tap Change Diagram



Attachment 2 - Link Box Warning Sheet



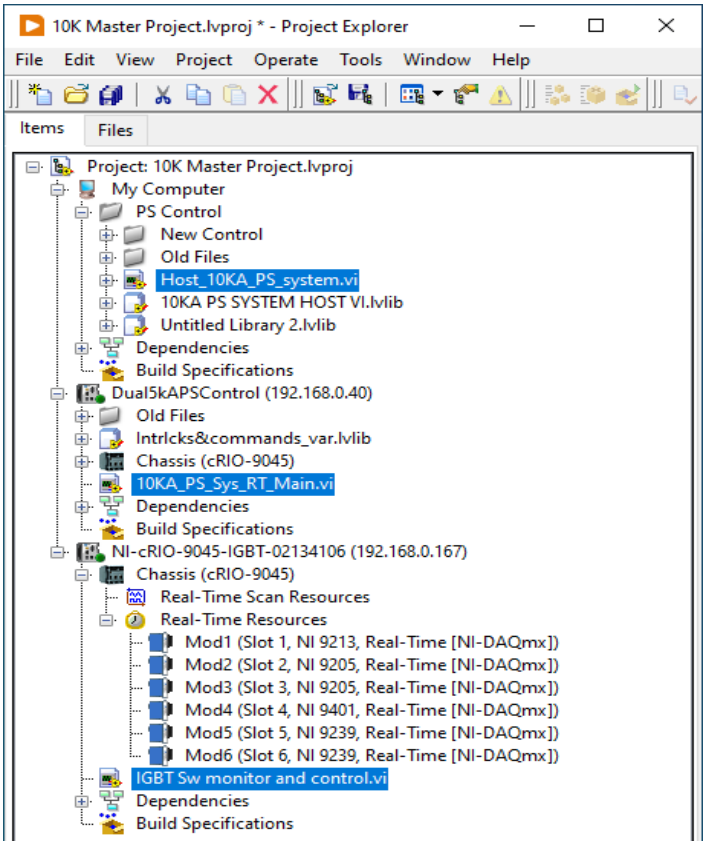
Attachment 3 - LabView Control Software Start Up Procedure.

NOTE

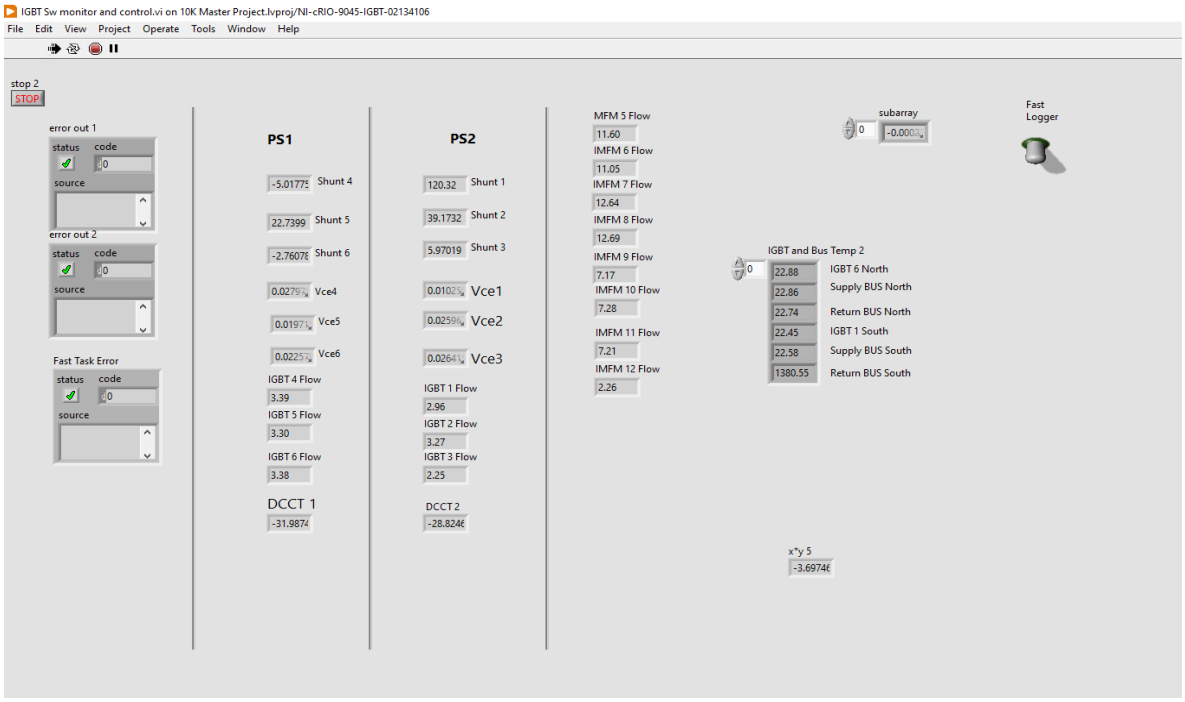
Before starting this procedure, the OPM 8.1.1.20 must be completed up to step 5.4.2 After this procedure is done, continue with step 5.6.

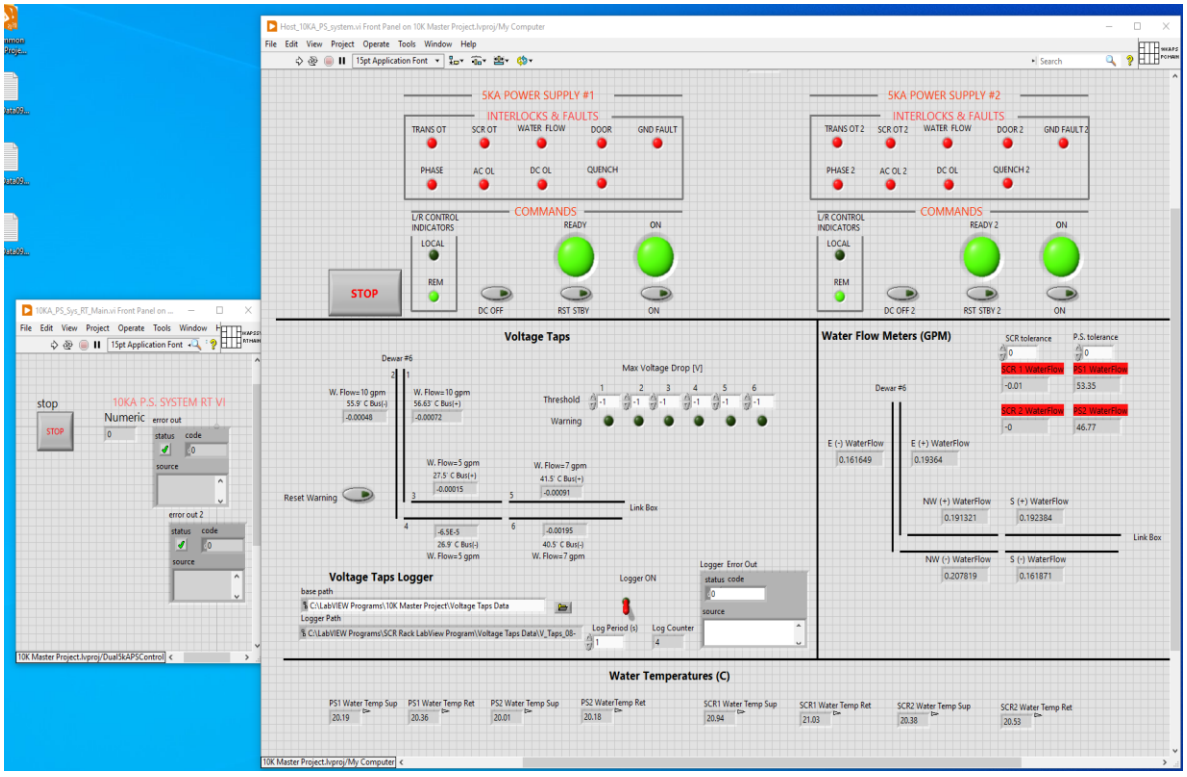
1. From Desktop AM-043322, located in Control table, run: C/LabView Programs/10K Master Project/10K Master Project.lvproj.

2. Then Run:
   a. 10KA_PS_sys_RT_Main.vi
   b. Host_10KA_PS_system.vi.
      - This monitors the interlocks, status of PS1 and PS2 and waterflow readings of the power supplies and 10kA cables.
   c. IGBT SW monitor and control.VI

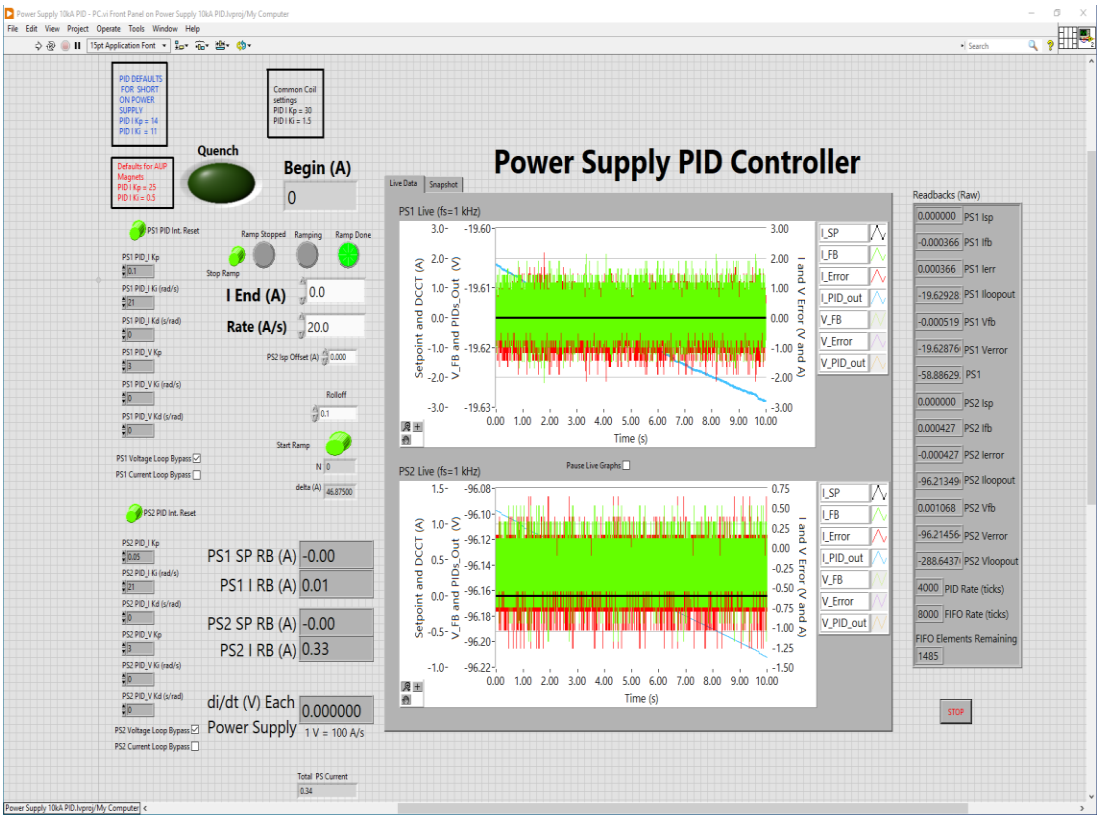


3. After running the VI's, the windows below should appear. This is a monitor only; it does not need any settings.





4. Initiate Power Supply PID Controller
   a. Go to "C:\Magnet Test Labview Programs and Data\10k PID\Power Supply 30000 A PID LV2014 9066 SMD with Ramp Gen and Done Lights 9215-021119\Power Supply 10kAPID.lvproj"
   b. Run Power Supply 10kA PID - PC.vi
   c. This VI:
      - Controls the Power Supply,
      - Controls the PID,
      - Generates a ramp as a current reference.
      - Generates a manual Quench



CAUTION

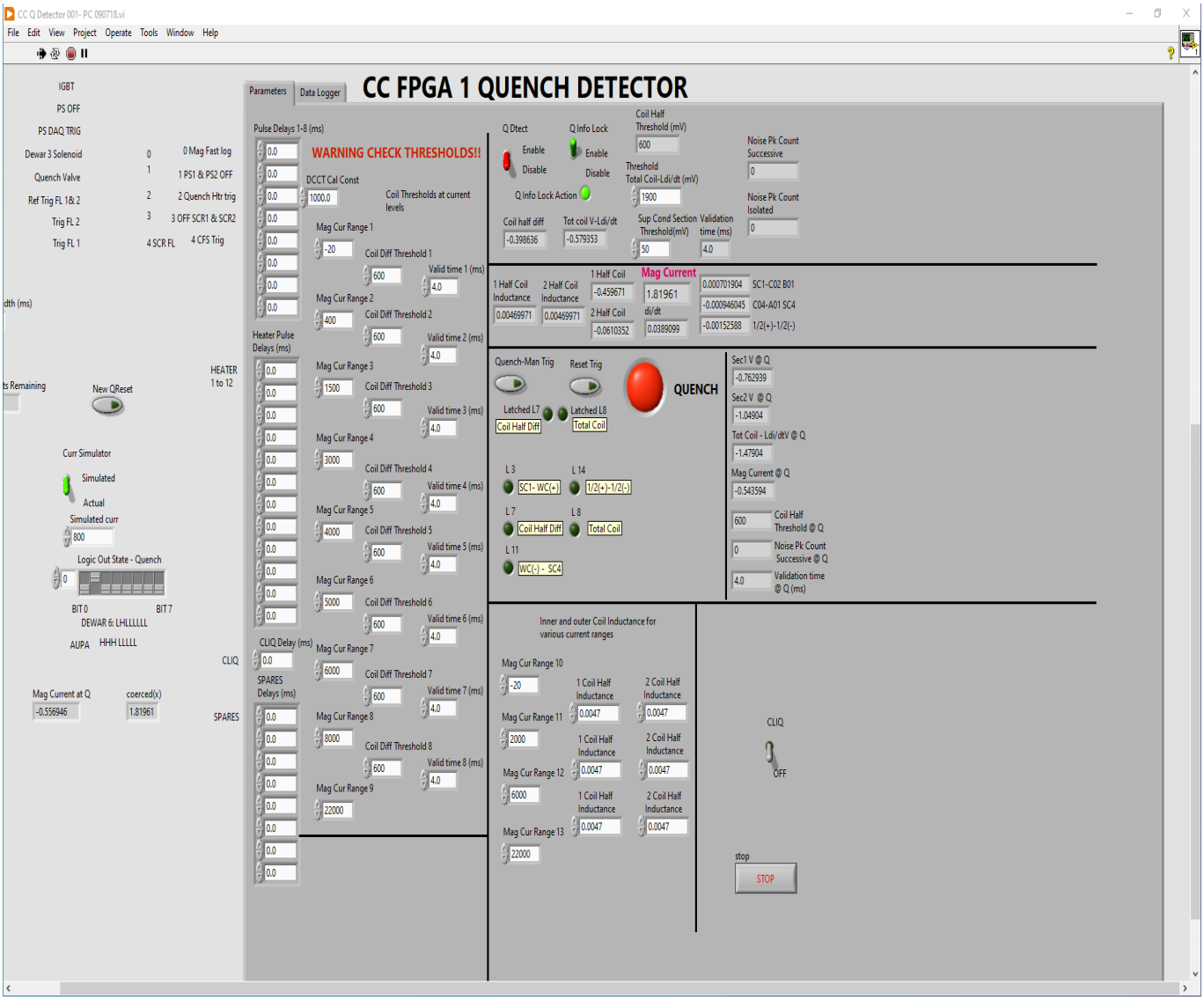
Before turning ON the power supplies, make sure "Begin (A)" and "I END (A)" are set with "Zero"

5. Initiate Quench Detector
   a. Go to "C:\Magnet Test Labview Programs and Data\Dewar 6 Quench Detector\dewar-6-quench-detector\Backup Quench Detector 1-

FPGA.lvproj"

b. Run CC Quad Q detector 001-PC 090718.vi,

c. In the left bottom corner of the panel, click “Main Application instance” and run it.



d. Double check that “Logic OUT State -Quench” settings look like the highlighted area.

6. Continue to Step 5.6 of OPM 8.1.1.20