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## SMD Operations Procedures Manual

### 8.1.1.28 OPERATION OF AUTOMATED LONG CURING PRESS

Text Pages 1 through 14  
Attachment(s) 1, 2, 3, 4

#### Hand Processed Changes

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### **8.1.1.28 Operation of Automated Long Curing Press**

#### **1. Purpose and Scope**

1.1. The purpose of this procedure is to provide instruction in the operation of the Automated Long Curing Press (Press).

1.2. The following information is contained herein:

1.2.1. State of the Press, before activating power;

1.2.2. Activating power to the Press;

1.2.3. Operating the Press;

1.2.4. Shutting down the Press;

1.2.5. Periodically testing the safety interlocks.

1.3. The following information is not contained herein:

1.3.1. Preparing the magnet coil for curing;

1.3.2. Transporting the coil to the Press;

1.3.3. Detailed curing cycle for each type of coil;

1.3.4. Storage and documentation requirements.

#### **2. Responsibilities**

2.1. The authorized operator will:

2.1.1. Operate the controls of the Press;

2.1.2. Test the safety interlocks every six months.

#### **NOTE**

**A list of authorized operators is maintained by the Cognizant Technical Supervisor.**

2.2. The authorized operator shall complete the following documentation:

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- 2.2.1. Daily log book for coil programs. Entries shall include any information that the operator deems important to pass along to the Technical Supervisor, the Cognizant Engineer, or the next work shift, including:
  - A. Work accomplished regarding coil production;
  - C. Repairs to the Press (brief description);
  - D. Lessons learned;
  - E. Irregularities during operation of the Press.
- 2.2.2. Maintenance log. Entries shall include:
  - A. Detailed description of each repair and maintenance procedure;
  - B. Detailed record of parts and material used (fittings, valves, oil,...).
- 2.2.3. Interlock Test Record (Attachment 1).

### **3. Prerequisites**

#### **3.1. Training**

- 3.1.1. The operator shall be instructed by the Coil Winding/Curing Technician Supervisor before using this Procedure.
- 3.1.2. The operator shall be trained as an "affected employee" as defined by [SBMS Lockout /Tagout \(LOTO\)](#)

#### **3.2. Equipment**

- 3.2.1. Personal protection equipment:
  - A. Hearing protection (pump room only).
  - B. Safety glasses w/side shields or goggles.

### **4. Precautions**

- 4.1. Do not reach into the Press.
- 4.2. If it is necessary to enter the Pump Room during operation, wear hearing protection.

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- 4.3. Pinch hazard when rolling “in” formblock. Use handles to move the formblock.
- 4.4. Verify all hydraulic line quick disconnects are fully seated when used.
- 4.5. Verify that all guards and shields are in place.
- 4.6. Verify that work area within the yellow border is clear of unauthorized personnel.
- 4.7. The safety interlocks shall be tested every six months. A dated "Interlock Test Record" form (Attachment 1) shall be posted near the Press and used for verification.

## **5. Procedure**

### **5.1. Overview of the Automated Long Curing Press**

During the magnet coil winding process, the superconducting cable insulation system is impregnated with either an epoxy resin or a thermoplastic adhesive. The Press provides a means of activating the epoxy or thermoplastic adhesive while holding the wound coil in the required shape. The Press applies heat and pressure to the coil in timed cycles under computer control, while the coil lays in a formblock. The result is a rigid coil pack which will produce the required magnetic field shape when excited.

The heat, pressure, and cycle times, will vary with the type of coil being cured.

The Press will accept magnet coils of up to 10 meters long.

Control of the Press is through a computer running a LabView program.

### **5.2. Before Activating Power to the Press**

- 5.2.1. Verify that machine guards and shields are in place.
- 5.2.2. Verify that the work area is clear of unauthorized personnel; put caution tape in place around the Press area.
- 5.2.3. Open the two Manually Operated Valves, MOV1 & MOV2, for the hydraulic system. Valves are located in the pump room, one on each of the main hydraulic lines.
- 5.2.4. Check for hydraulic oil leaks.

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### 5.3. **Activating Power to the Press and Starting the Control Software**

- 5.3.1. Press the “Hydraulics Enable” push button on the control cabinet. The red indicator light on the control cabinet will illuminate to indicate that the hydraulic have been enabled.
- 5.3.2. Press the “Heater Enable” push button on the control cabinet. The red indicator light on the control cabinet will illuminate to indicate that the heaters have been enabled.
- 5.3.2.1 Switch the “Control Power” switch located under load cabinet to “On”.
- 5.3.3. Turn on and log in to the computer.
- 5.3.4. Perform Program Initiation:
  - a) Open project “BNL\_CURINGPRESS.LVPROJ” from desktop shortcut
  - b) Expand CFP (compact field point) target 192.168.0.1
  - c) Select and run “BNL\_FPHEATERTARGET.VI”
  - d) Expand RTCOMPACTR10 Target 192.168.0.2
  - e) Select and run “POWER MONITOR RT(N).VI”
  - f) Expand “MY COMPUTER” Tab
  - g) Select and run “BNL\_CURINGPRESS\_MAIN.VI”

### 5.4. **Operating the Press**

#### **CAUTION**

**The computer control program has several operator controls which are intended for manual control of the Press. Before using these controls, read the section headed, "Manual Operation". Using manual controls without fully understanding how they function could result in unexpected operation of motors, pumps, etc, possibly resulting in equipment or product damage.**

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- 5.4.1. Roll the formblock into the press to stop. Mount non-lead end stop bar to hold formblock in place. Connect the heaters, thermocouples, and the end cylinders following the instructions in the applicable traveler. Mount end cylinder covers/guards.
- 5.4.2. In “BNL\_CURINGPRESS\_MAIN”, Open / Enter a recipe on the “Profile” tab as per traveler, then click “Load Profile”.
- 5.4.3. Click the “Hydraulic Pump” button. The red indicator light on the control cabinet will illuminate to indicate that the hydraulic pumps are on.
- 5.4.4. Click the “Main Contactor” button. The red indicator light on the control cabinet will illuminate to indicate that the heater power is on.
- 5.4.5. Verify that the system indicator lights at the bottom of the monitor tab are illuminated.
- 5.4.6. Click the "Start/Resume" button to start the automatic cycle.
- 5.4.7. Verify that the temperature of the mandrel and formblock is increasing by observing both the thermocouple readouts and the plot of temperature vs. time.

#### **NOTE**

**The temperatures are plotted for only the six selected thermocouples.**

- 5.4.8. The automatic cycle may include steps where the cycle pauses and waits for operator input. When ready, click the “Next” button to advance to the next step and then click “Start/Resume”.
- 5.4.9. The Press will continue to apply heat and pressure in varying amounts under computer control. Monitor progress by observing the temperature and pressure readouts.
- 5.4.10. When the cycle is complete and the temperature has cooled down to the value entered for the “Cutoff point for pressure cycling”, the top hat will rise.
- 5.4.11. Click the “Hydraulics Pump” button. The red indicator light on the control cabinet will extinguish to indicate that the hydraulic pumps are off.
- 5.4.12. Click the “Main Contactor” button. The red indicator light on the control cabinet will extinguish to indicate that the heater power is off.

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5.4.13. Disconnect the heaters and thermocouples. Disconnect the end cylinders and remove stop bar. Roll the formblock out of the press following the instructions in the applicable traveler.

5.5. **Manual Operation**

**NOTE 1**

**Press Can Be Operated In Manual Mode In Two Ways:**

- 1. When “BNL\_CURINGPRESS\_MAIN.VI” is started, program is in manual mode by default.**
- 2. Once the profile is started, clicking “PAUSE PROFILE” button on the interface screen will put the program in Manual Mode. Clicking “START /RESUME PROFILE” button will return the program in Auto Run Mode.**

**NOTE 2**

**A description of the controls and readouts can be found with a view of the computer screen in Attachment 2, "Computer Control Panel Reference".**

5.5.1. The target temperature can be changed in manual mode by entering a value in the “Temperature Setpoint” box in the manual mode area of the monitor screen.

5.5.2. Main hydraulic pressure can be set by toggling the “Top Hat” Up/ Down switch and entering a value in the “Pressure” box in the manual mode area of the monitor screen.

5.5.3. End hydraulic pressure can be set by toggling the “End Cylinder” In / Out switch and entering a value in the “Pressure” box in the manual mode area of the monitor screen.

5.6. **Shutting Down the Press**

5.6.1. Press the “Hydraulics Disable” push button on the control cabinet. The red indicator light on the control cabinet will extinguish to indicate that the hydraulic have been disabled.

5.6.2. Press the “Heater Disable” push button on the control cabinet. The red indicator light on the control cabinet will extinguish to indicate that the heaters have been disabled.

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5.6.3. Exit the program by clicking "STOP" on the target screen.

**NOTE**

**Click only the rectangular "STOP" button. Stopping the program any other way will cause set point values to be lost.**

5.6.4. Close LabView and turn off the computer.

5.6.5. Close the two Manually Operated Valves for the hydraulic system. Valves are located in the pump room, one on each of the main hydraulic lines.

**NOTE**

**The valves close off the hydraulic lines to prevent fluid from draining down and overflowing the pump reservoir.**

5.7. **Test of Safety Interlocks**

**NOTE**

**The test shall be completed at an interval not to exceed six months.**

Test Procedure

5.7.1. IF a failure occurs at any step of the procedure, THEN stop work, write "fail" on the form, and immediately notify the cognizant engineer and the ES&H Coordinator.

5.7.2. Perform all of the steps in Section 5.3 - **Activating Power to the Press and Starting the Control Software**

5.7.3. Depress one of the four Emergency Stop push buttons on the press.

5.7.4. Verify that all of the following occur:

5.7.4.1. The red indicator light labeled "Hydraulics On" on the control cabinet extinguishes to indicate that the hydraulic pumps have been turned off.

5.7.4.2. The red indicator light labeled the "Heaters On" on the control cabinet extinguishes to indicate that the heaters have been turned off.

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- 5.7.4.3. The red indicator light labeled “Hydraulics Enable” on the control cabinet extinguishes to indicate that the hydraulic have been disabled.
- 5.7.4.4. The red indicator light labeled the “Heater Enable” on the control cabinet extinguishes to indicate that the heaters have been disabled.
- 5.7.5. Enable and turn on the hydraulic pumps and the heaters. The four indicator lights on the control cabinet should illuminate.
- 5.7.6. Repeat steps 5.7.3 through 5.7.5 for the other three Emergency Stop push buttons on the Press.
- 5.7.7. Check off, date, and initial the Interlock Test Record (Attachment 1) and post it on the Control Cabinet. Note in the daily log that the test was completed successfully.

5.8. **Calibration of the Temperature Monitoring System**

**NOTE 1**

**The Calibration Technician is responsible for performing the main actions of the calibration procedure.**

**The Operator is responsible for those parts of the procedure involving manipulation of the controls of the Curing Press**

**The Division Quality Assurance Group is responsible for:**

- **Notifying responsible persons when calibrations are due**
- **Affixing appropriate labels and stickers indicating calibration status**
- **Maintaining a file for all documents related to calibrations**

**NOTE 2**

**You must be listed as an Authorized Operator for the Curing Press before performing the sections of the Calibration Procedure designated to be performed by the "Operator". A current list is available from the Cognizant Technical Supervisor for the Curing Press. All applicable steps and precautions in this OPM regarding operation of the Curing Press shall be followed during calibration.**

**NOTE 3**

**Required Tools & Equipment:**

- **Safety glasses with side shields, or goggles.**

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- **Calibrated Metrology Well (300°C Capable)**
- **Calibrated Thermometer**

#### NOTE 4

In this section, the tasks designated to be performed by the Authorized Operator, the Calibration Technician, and the Quality Assurance Representative are indicated by the headings "Operator", "Calibration Technician", and "Quality Assurance Representative".

#### NOTE 6

**Calibration frequency is one year. The Thermocouples and the Temperature Indicators are not adjustable**

##### *Operator*

- 5.8.1. Verify that the Temperature Indicators on the Display Panel are energized. The Indicators should display room temperature.

##### *Calibration Technician:*

- 5.8.2. Record the following ID #'s on the Calibration Report (Attachment 3).
- A) Temperature Reference (Metrology Well).
  - B) Thermometer
- 5.8.3. Set up the Metrology Well on a rolling cart.
- 5.8.4. Roll the cart to the thermocouple to be tested.
- 5.8.5. Detach the thermocouple from the formblock/mandrel.
- 5.8.6. Find the correct row on the Calibration Report that matches the thermocouple ID number.
- 5.8.7. Using a calibrated thermometer, measure and record the ambient temperature. Record in the Calibration Report.
- 5.8.8. Record the Display Panel temperature reading in the Calibration Report.

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- 5.8.9. Insert the thermocouple in the Metrology Well.
- 5.8.10. Set the Metrology Well to the test temperature specified on the Calibration Report. Allow the Well to reach the desired temperature.
- 5.8.11. Record the temperature reading from the Display Panel in the "Read" column.
- 5.8.12. Repeat steps 5.8.10 to 5.8.11 for the remaining test temperatures.
- 5.8.13. Place a "\*" in the "Fail" column if a reading is outside of the Specified Tolerance of  $\pm 2^{\circ}\text{C}$  of the "Actual" (Ref) temperature.
- 5.8.14. Reattach the thermocouple to the formblock/mandrel.
- 5.8.15. Repeat steps 5.8.6 to 5.8.14 for each of the remaining thermocouples
- 5.8.16. Dismantle the test set-up.
- 5.8.17. If all of the readings are within the Specified Tolerance of  $\pm 2^{\circ}\text{C}$ , then the Quality Assurance Representative shall place a calibration sticker on the Display Panel.
- 5.8.18. If one or more readings are outside the Specified Tolerance of  $\pm 2^{\circ}\text{C}$ , then the Calibration Technician shall notify the Cognizant Technical Supervisor and the Cognizant Engineer immediately. Also perform the following two steps A & B:

*Quality Assurance Representative*

- A) Place a "DEFECTIVE" Label on the Temperature Indicator or on the Display Panel in a prominent location.
- B) Take appropriate steps to resolve the problem and restore the system to working order.

*Calibration Technician*

- 5.8.19. Complete, date, and sign the Calibration Report. Provide a copy to the Quality Assurance Representative.

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5.9. Calibration of the Curing Press Pressure Measurement System

**NOTE 1**

The section describes the procedure to be used in calibrating the pressure transducers located throughout the press. The procedure described in this section shall be used to perform these calibrations.

**NOTE 2**

The Calibration Technician is responsible for performing the main actions of the calibration procedure.

The Operator is responsible for those parts of the procedure involving manipulation of the controls of the Curing Press and operations to the hydraulic pressure lines.

The Division Quality Assurance Representative is responsible for:

- Notifying responsible persons when calibrations are due
- Affixing appropriate labels and stickers indicating calibration status
- Maintaining a file for all documents related to calibrations

**NOTE 3**

You must be listed as an Authorized Operator for the Curing Press before performing the sections of the Calibration Procedure designated to be performed by the "Operator". A current list is available from the Cognizant Technical Supervisor for the Curing Press. All applicable steps and precautions in this OPM regarding operation of the Curing Press shall be followed during calibration.

**NOTE 4**

**Required Tools & Equipment:**

- Calibrated dead weight tester capable of applying 3000 PSI.
- Safety glasses with side shields, or goggles.

**NOTE 5**

In this section, the tasks designated to be performed by the Authorized Operator, the Calibration Technician, and the Quality Assurance Representative are

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**indicated by the headings "Operator", "Calibration Technician", and "Quality Assurance Representative".**

**NOTE 6**

**Calibration frequency is one year.**

**WARNING**

**Disturbing a hydraulic line while it is pressurized could cause injury.**

*Operator*

- 5.9.1. Lower the Tophat
- 5.9.2. Verify that all hydraulic lines on the Press are depressurized.
- 5.9.3. Listed below are the transducers to be calibrated:
  - 1) Top Hat – Down (North)
  - 2) Top Hat – Down (South)
  - 3) Top Hat – Up
  - 4) End Cylinders (Both Ends)
  - 5) Main Pump Pressure
  - 6) Low Pressure Main
  - 7) End Cylinder Pump Pressure
- 5.9.4. Disconnect the 1st Pressure Transducer to be calibrated from the hydraulic line. Install a temporary cap on the hydraulic line pressure fitting.

**WARNING**

**Pressures up to 3000 PSI are applied to the transducers during the procedure. Failure to use proper high-pressure fittings could result in severe injury.**

- 5.9.5. Attach the Pressure Reference (Dead Weight Tester) to the Pressure Transducer input.

**WARNING**

**Use caution when energizing the control console. Failure to follow this step could result in injury or equipment damage.**

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5.9.6. Verify that energizing the Display Console will not result in energizing of pumps, heaters or other equipment not intended to be energized.

5.9.7. Energize the Display Console by following the applicable steps in this procedure.

*Calibration Technician*

5.9.8. Record the following ID #'s on the Calibration Report (Attachment 4):

A) Hydraulic Pressure Transducer.

B) Pressure Reference.

5.9.9. Use the dead weight tester to apply the test pressures called out in the "Applied Input" column of the Calibration Report (Attachment 4) to the pressure transducer input. In the Calibration Report, at each test point, record the pressure indicator reading from the Display Console.

5.9.10. If all readings for the transducer under test are within tolerance, then the following actions shall be taken:

*Quality Assurance Representative* - Place a calibration sticker on the Pressure Transducer. Complete, date, and sign the Calibration Report. Provide a copy to the Quality Assurance Representative.

*Operator* - Remove the Pressure Transducer from the Pressure Reference and re-install it onto the Main Pressure hydraulic line.

5.9.11. If any of the readings are out of the prescribed tolerance, complete the following steps:

*Calibration Technician* - Place a "\*" in the "Fail" column next to the reading(s) that are outside the Specified Tolerance. Complete, date, and sign the Calibration Report. The Calibration Technician shall notify the Quality Assurance Representative immediately & provide them a copy of the report.

*Quality Assurance Representative* - Place a "DEFECTIVE" label in a prominent location on the system. Take appropriate steps to resolve the problem and restore the system to working order.

5.9.12. Repeat 5.9.4 to 5.9.11 for the remaining transducers.

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**6.        Documentation**

- 6.1.      Daily Logbook
- 6.2.      Maintenance Log
- 6.3.      Interlock Test Record

**7.        References**

- 7.1.      [SBMS Subject Area: Lockout/Tagout \(LOTO\)](#)

**8.        Attachments**

- a) Interlock Test Record
- b) Computer Control Panel Reference
- c) Thermocouple Calibration Report
- d) Pressure Transducer Calibration Report

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Attachment 1

Automated Long Curing Press Interlock Test Record

| <b>Date</b> | <b>North<br/>West</b> | <b>North<br/>East</b> | <b>South<br/>West</b> | <b>South<br/>East</b> | <b>Initials</b> |
|-------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------|
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Attachment 2 - Computer Control Panel Reference

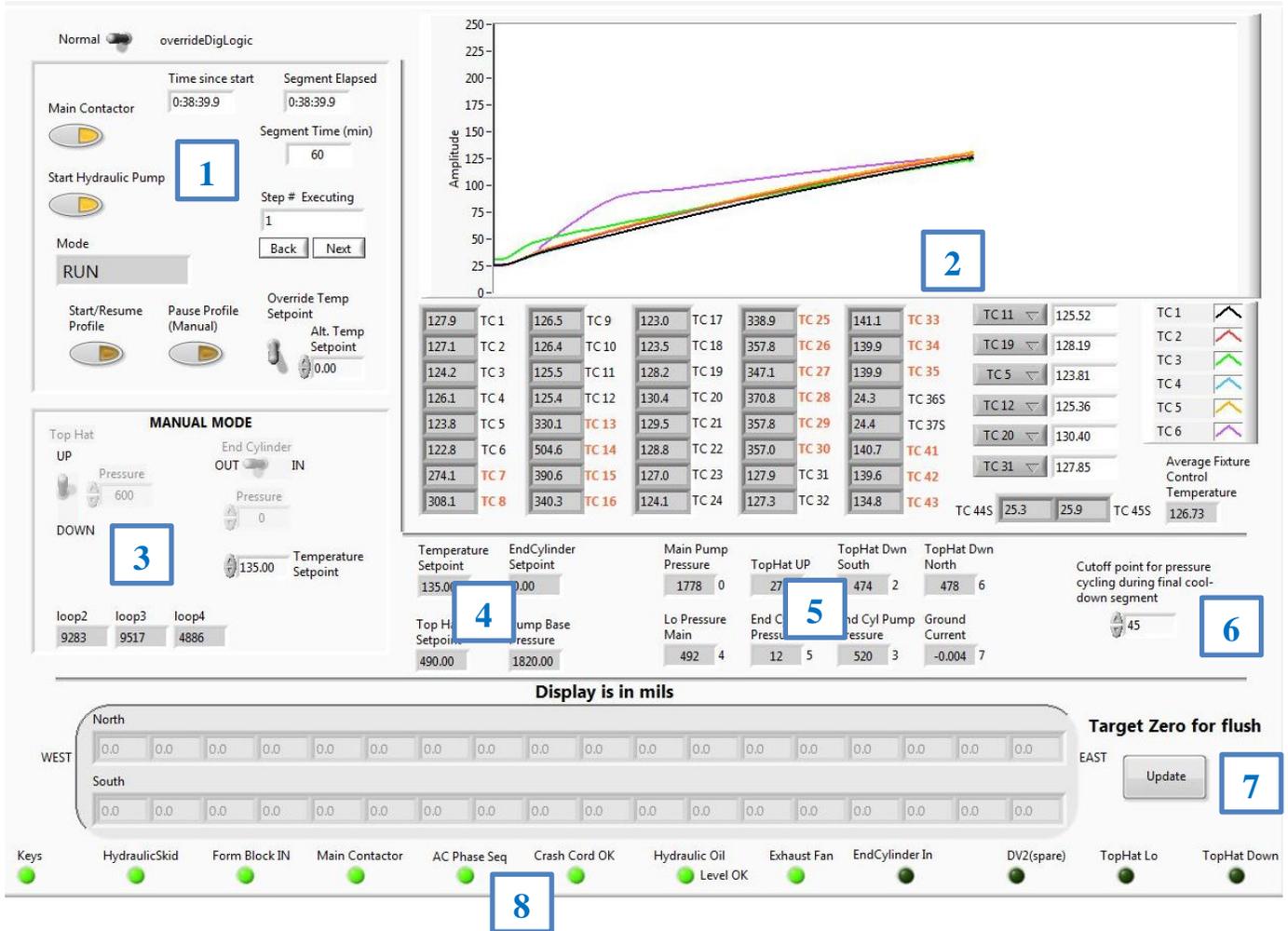


Figure 1 - Computer Control Panel

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Attachment 2 (Cont'd)  
Figure 2 - Description of Operator Controls and Indicators

*Note: Location numbers refer to those called out on Figure 1, "Computer Control Panel."*

| Loc# | Designation               | Device Type | Function  |
|------|---------------------------|-------------|---|
| 1    | Main Contactor            | Button      | Activates / Deactivates power to the heaters.                             |
| 1    | Hydraulic Pump            | Button      | Activates / Deactivates power to the hydraulic pumps.                     |
| 1    | Mode                      | Display     | Displays program mode.  |
| 1    | Back / Next               | Buttons     | Increments step number.   |
| 1    | Start / Resume            | Button      | Starts or resumes the program at the current step.                        |
| 1    | Pause Profile             | Button      | Pauses the program and activates manual mode.                             |
| 2    | Thermocouple display area | Display     | Displays thermocouple data, plots the six selected Thermocouple readings. |
| 3    | Top Hat Up / Down         | Toggle      | Selects Top Hat up or down in manual mode.                                |
| 3    | Top Hat Pressure          | Entry       | Enter desired pressure for Top Hat in manual mode.                        |
| 3    | End Cylinder In/Out       | Toggle      | Selects End Cylinder In or Out in manual mode.                            |
| 3    | End Cylinder Pressure     | Entry       | Enter desired pressure for end cylinders in manual mode.                  |
| 3    | Temperature Setpoint      | Entry       | Enter desired target temperature in manual mode.                          |
| 4    | Temperature Setpoint      | Display     | Displays the temperature set point.                                       |
| 4    | EndCylinder Setpoint      | Display     | Displays end cylinder setpoint.   |
| 4    | TopHat Lo Setpoint        | Display     | Displays top hat low pressure setpoint.                                   |
| 4    | Pump Base Pressure        | Display     | Displays top hat high pressure setpoint.                                  |
| 5    | Main Pump Pressure        | Display     | Displays pressure at the main hydraulic pump.                             |
| 5    | TopHat Up                 | Display     | Displays top hat up pressure.   |
| 5    | TopHat Dwn South          | Display     | Displays top hat down pressure on south side of press.                    |
| 5    | TopHat Dwn North          | Display     | Displays top hat down pressure on north side of press.                    |
| 5    | Lo Pressure Main          | Display     | Displays pressure on the low pressure branch of the main hydraulic line.  |
| 5    | EndCyl Pressure           | Display     | Displays end cylinder pressure at the press.                              |
| 5    | EndCyl Pump Pressure.     | Display     | Displays pressure at the end cylinder pump.                               |
| 6    | Cutoff point              | Entry       | Enter pressure at which to stop cycling pressure during final cool-down.  |
| 7    | Update                    | Button      | Reads all LVDT's and records data to file.                                |
| 8    | Keys                      | Indicator   | Lights when all heater connectors are plugged in correctly.               |
| 8    | HydraulicSkid             | Indicator   | Lights when hydraulic pumps are on.                                       |
| 8    | Formblock IN              | Indicator   | Light when formblock limit switch is engaged.                             |
| 8    | Main Contactor            | Indicator   | Light when heater power is on.  |
| 8    | AC Phase Seq              | Indicator   | Light when AC power is on.  |
| 8    | Crash Cord OK             | Indicator   | Light when safety stops are ready.  |
| 8    | Hydraulic Oil             | Indicator   | Lights when hydraulic oil level is adequate.                              |
| 8    | Exhaust Fan               | Indicator   | Light when exhaust fan is on.   |
| 8    | End Cylinder In           | Indicator   | Light when end cylinders are extended..                                   |
| 8    | TopHat Lo                 | Indicator   | Light when main hydraulics are in low pressure mode                       |
| 8    | TopHat Down               | Indicator   | Lights when pressure is in top hat down mode.                             |

**The only official copy of this file is the one on-line on the Superconducting Magnet Division website. Before using a printed copy, verify that this is the most current version by checking the document issue date on the website.**

**Attachment 3 - Superconductor Magnet Division - Curing Press Temperature Monitoring System Calibration Report**

Service Date: \_\_\_\_\_ By: \_\_\_\_\_ Next Calibration Due: \_\_\_\_\_

Temperature Reference (Ref): ID# \_\_\_\_\_  
 Thermometer: ID# \_\_\_\_\_

*Specified Tolerance:  $\pm 2$  °C of "Actual" temperature (all readings)*

| T/C# | Room Temp (Ref) | Room Temp (Read) | 100°C (Ref) | 100°C (Read) | 200°C (Ref) | 200°C (Read) | 300°C (Ref) | 300°C (Read) | Fail (*) |
|------|-----------------|------------------|-------------|--------------|-------------|--------------|-------------|--------------|----------|
| 1    |                 |                  |             |              |             |              |             |              |          |
| 2    |                 |                  |             |              |             |              |             |              |          |
| 3    |                 |                  |             |              |             |              |             |              |          |
| 4    |                 |                  |             |              |             |              |             |              |          |
| 5    |                 |                  |             |              |             |              |             |              |          |
| 6    |                 |                  |             |              |             |              |             |              |          |
| 7    |                 |                  |             |              |             |              |             |              |          |
| 8    |                 |                  |             |              |             |              |             |              |          |
| 9    |                 |                  |             |              |             |              |             |              |          |
| 10   |                 |                  |             |              |             |              |             |              |          |
| 11   |                 |                  |             |              |             |              |             |              |          |
| 12   |                 |                  |             |              |             |              |             |              |          |
| 13   |                 |                  |             |              |             |              |             |              |          |
| 14   |                 |                  |             |              |             |              |             |              |          |
| 15   |                 |                  |             |              |             |              |             |              |          |
| 16   |                 |                  |             |              |             |              |             |              |          |
| 17   |                 |                  |             |              |             |              |             |              |          |
| 18   |                 |                  |             |              |             |              |             |              |          |
| 19   |                 |                  |             |              |             |              |             |              |          |
| 20   |                 |                  |             |              |             |              |             |              |          |
| 21   |                 |                  |             |              |             |              |             |              |          |
| 22   |                 |                  |             |              |             |              |             |              |          |
| 23   |                 |                  |             |              |             |              |             |              |          |
| 24   |                 |                  |             |              |             |              |             |              |          |
| 25   |                 |                  |             |              |             |              |             |              |          |
| 26   |                 |                  |             |              |             |              |             |              |          |
| 27   |                 |                  |             |              |             |              |             |              |          |
| 28   |                 |                  |             |              |             |              |             |              |          |
| 29   |                 |                  |             |              |             |              |             |              |          |
| 30   |                 |                  |             |              |             |              |             |              |          |

West

*ID's 1-8 & 29-30 are in the mandrel*

East



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**Appendix 4 - Superconductor Magnet Division – Curing Press Pressure Measurement System Calibration Report**

Service Date \_\_\_\_\_ By \_\_\_\_\_ Next Calibration Due: \_\_\_\_\_

Pressure Transducer: ID# \_\_\_\_\_

Pressure Test Reference: ID# \_\_\_\_\_

Specified Tolerance  $\pm 50$  psi (all readings)

| Applied Input (psi) | Display Console Reading | Fail(*) |
|---------------------|-------------------------|---------|
| 0                   |                         |         |
| 500                 |                         |         |
| 1000                |                         |         |
| 1500                |                         |         |
| 2000                |                         |         |
| 2500                |                         |         |
| 3000                |                         |         |
| 2500                |                         |         |
| 2000                |                         |         |
| 1500                |                         |         |
| 1000                |                         |         |
| 500                 |                         |         |
| 0                   |                         |         |