



PPD / EED / Infrastructure Group / D0

D0 Procedure / Hazard Analysis Document
D0_ELE_CAL_002

Remove and Replace Calorimeter Pre-amp Power Supply

Date: 19-Jun-07

Latest revision: 28-Jun-07

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Personal Protective Equipment: (Check protective equipment required for the job.)

- | | | |
|--|---------------------------------------|---|
| <input type="checkbox"/> Safety glasses | <input type="checkbox"/> Side shields | <input type="checkbox"/> Chemical splash goggles |
| <input type="checkbox"/> Hearing Protection | | ● Hard Hats |
| <input type="checkbox"/> 3.0 Braising goggles | | <input type="checkbox"/> Impact goggles |
| <input type="checkbox"/> Face shield | | <input type="checkbox"/> Rubber apron |
| <input type="checkbox"/> Leather gloves | | <input type="checkbox"/> Hot/Cold thermal protective gloves |
| <input type="checkbox"/> Chemical resistant gloves (specify type): | | <input type="checkbox"/> Respirators |
| <input type="checkbox"/> Other required PPE (specify): | | <input type="checkbox"/> Fall protection equipment (specify): |

Proper radiation dosimetry required for collision hall access.

Log survey meter (LSM) required during controlled access to D0 collision hall.

Work Plan History Information: (List any lessons learned accidents from this job, tips from previous jobs)

The Calorimeter Power Supplies are water-cooled. Water drips on the printed circuit boards within the volume of the Power Supply have mixed with flux residue left on the printed circuits and resulted in corrosive action that damages the printed circuit board traces.

Overview:

Calorimeter Pre-amp Power Supplies are located in the east and west upper cathedral regions of the D0 Detector. Access to these regions is limited to those times when the appropriate Muon Toroid is opened and only after a temporary platform has been erected by the D0 Mechanical Support Group.

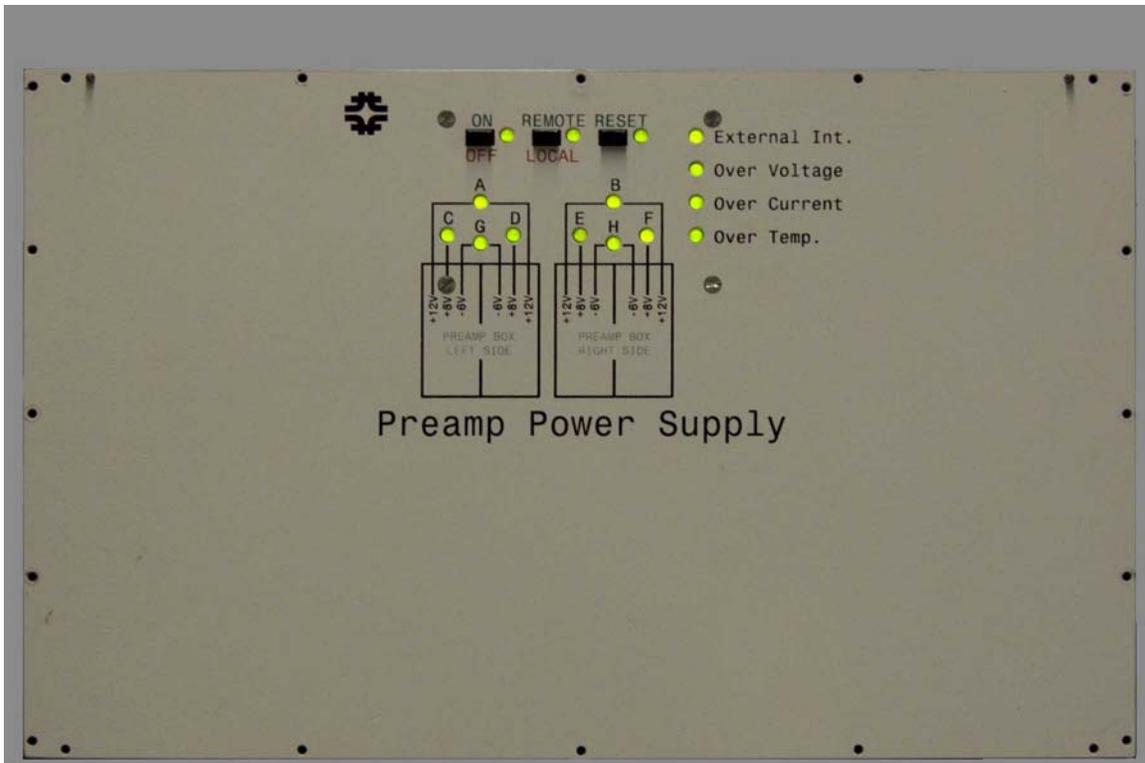


Figure 1. Front Panel of Calorimeter Pre-amp Power Supply.

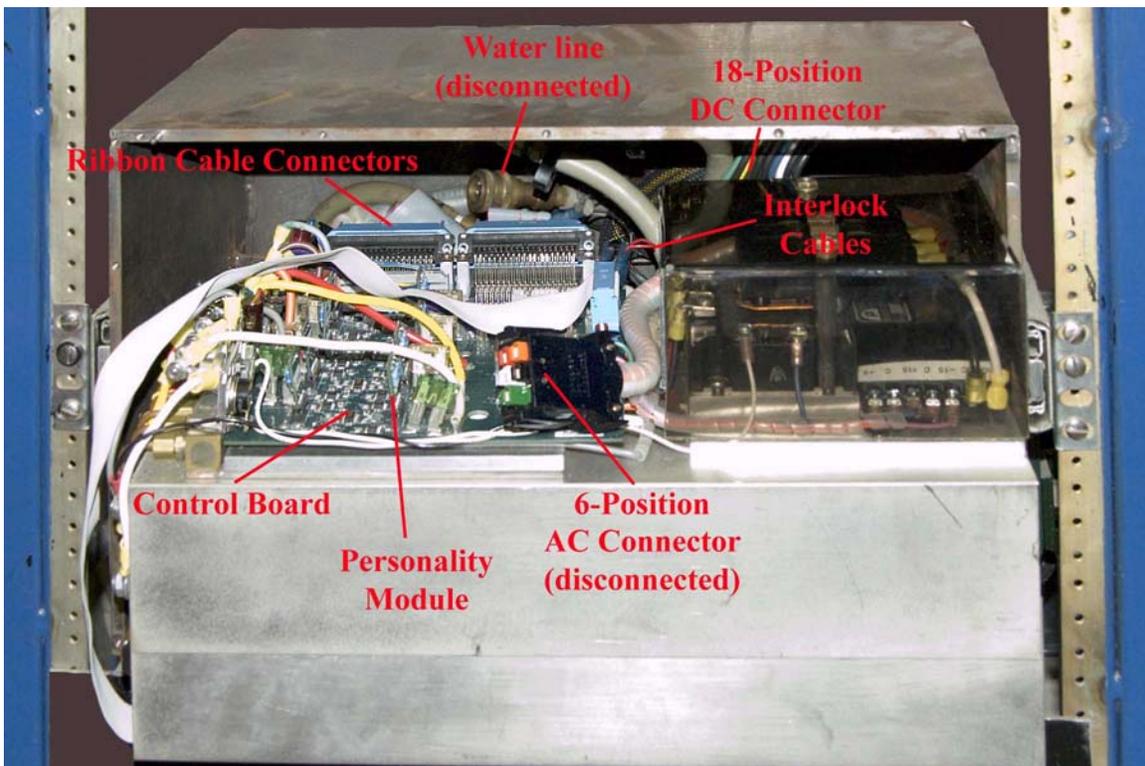


Figure 2. Major components of Calorimeter Pre-amp Power Supply

Training Requirements:

DO_ELE_CAL_002
 Expiration Date: 21-Oct-09

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- Appropriate training to be issued a key to the D0 Collision Hall.
- Basic Electrical Safety (minimum).
- D0 Hazard Awareness.
- D0 Electrical Support Group Power Supply Backpack Training.

Important Information:

- A minimum of two people are necessary to perform this procedure.
- The Calorimeter Pre-amp Power Supply weighs approximately 37 pounds.
- There is a backpack structure used to transport the Power Supply up and down ladders. When loaded with a Power Supply and protective cover, the backpack weighs approximately 50 pounds.
- Wearing the loaded Power Supply Backpack, one will notice that the motion of the Power Supply amplifies natural body motions. In some areas, this motion might cause damage to delicate Detector Equipment should the Power Supply make contact.
- Disconnecting and reconnecting Calorimeter Pre-amp Power Supplies is done on platforms located in the East or West cathedrals of the D0 Detector. These platforms are approximately 12 feet above the local floor and have railings to mitigate the possibility of falling. Access to the platform is made by climbing a ladder through an access door in the floor of the platform.
- Power is supplied to Calorimeter Pre-amp Crates using two Power Supplies. Nominally identified as “Primary” and “Secondary”, both are capable of providing all of the required power. The two are wired to the crate in parallel, with diodes preventing current flow from one into the other. Generally, only one of the two Power Supplies will be on at a time.
- Calorimeter Power Supplies are housed in boxes that are on rails. These boxes are capable of being moved away from the rack into which they are mounted. This feature does not enhance Power Supply disconnection / reconnection, but permits some access to the wiring behind the box. If the Power Supply box is not completely closed, interference with closing of the D0 Detector may result. To keep this from happening, the boxes are secured to the rack with various type of restraining devices. These devices must be removed before the Power Supply can be disconnected and re-installed after reconnection.
- Many of the connections to / from the Power Supply will be opened and made “blindly” as the wiring harness is situated behind the Power Supply and the Power Supply is housed in a box not much bigger than the supply itself.
- The Power Supplies are water cooled. Hoses on the Power Supply utilize quick disconnect type connectors.
- There are 8 Personality Modules located in sockets on the Power Supply Control Board. The sockets are notoriously unreliable. If the Personality Modules are not fully inserted into the sockets (perhaps bumped in the installation process), the Power Supply may appear to function incorrectly. This may require an additional access to correct.

Required Tools:

With the exception of the small stool, Digital Voltmeter, Electrical Support Group Laptop and Power Supply Backpack, the following tools should be found in a backpack labeled Cal. Pre-amp PS.

- 7/64 inch Allen wrench.
- Flat blade screwdriver.
- 3/8 inch combination wrench or pliers.
- Paper and writing utensil.
- Collection of Failure Indication Tags.
- Digital Voltmeter (DVM)
- Kimwipes.
- Length of rope at least 15 feet long. This rope should be capable of lifting ~ 10 pounds.
- A small stool. Several small stools are located in the D0 Collision Hall, typically located near the stairway in the North-East corner.
- D0 Electrical Support Group Laptop (optional, may be useful in diagnosing problems while in the cathedral).
- Backpack designed to carry Calorimeter Pre-amp and SMT Power Supplies.

Procedure:

This procedure assumes that a working spare Calorimeter Pre-amp Power Supply is available in either the D0 Electrical Support Group Spares area or in the technical area located in the D0 Assembly Building. As such, the procedure describes the process of bringing the spare to the cathedral area, disconnecting then removing the failed power supply, installing the spare, then returning with the failed power supply.

This procedure can be appropriately reorganized if the decision is made to remove the failed power supply from the cathedral area, have it repaired and then re-install it in the same location.

- Collect the Cal. Pre-amp PS tool backpack and Power Supply Backpack. If bringing the laptop, it must be carried in the tool backpack.
- Attach and secure the Power Supply to the Power Supply Backpack. Place on rolling cart.
- Ensure that D0 Control Room personnel responsible for Calorimeter Detector operation are aware of replacement plans prior to entering D0 Collision Hall.

Accessing the Cathedral Platform:

- Only proceed after the D0 Mechanical Support Group has indicated that the cathedral platform is properly erected.

Detail	Hazard	Precautions / Safety Procedures
Access to the D0 Detector cathedral platforms requires climbing a ladder. The height of the platforms above the local floor is approximately 12 feet. A gas spring assisted door in the platform needs to be opened to gain access to the platform.	The cathedral platforms are temporary structures, repositioned when the D0 Detector is closed. Required tools and equipment must be brought up and down the ladder. Ascending or descending ladders is only safely done while maintaining a minimum of three points of contact with the ladder. Carrying anything in one hand makes this impossible.	The tools are contained in a backpack. The Power Supply is carried on a backpack. The backpacks must be worn anytime tools or Power Supplies are transported up or down the ladder. Only one person is allowed on the ladder at a time. Others in the area should stay clear of the ladder while someone is ascending or descending.
With platform door open, the height above the local floor is approximately 12 feet.	Falling from this height can result in bodily injury.	The platform door must remain closed when ever the platform is not being accessed or exited.

- Roll cart with Loaded Power Supply Backpack to and through D0 Collision Hall access door. Two people carefully carry the cart and load down the 3 stairs near the door. Once past the access door, continue to roll the cart to the Collision Hall north wall.
- With assistance, one person dons and secures the Power Supply Backpack. The other person dons and secures the tool backpack.
- In a two person team, walk carefully to bottom of ladder in the lower cathedral. The person wearing the Power Supply Backpack leads the way. The second person walking behind, one hand holding the bottom of the Power Supply to ensure that it doesn't swing into any detector equipment or structures. There is one short ladder to ascend to reach the lower cathedral area. The person wearing the Power Supply Backpack should ascend first. The second person should continue to guard against the Power Supply coming in contact with Muon Detector Equipment until the person wearing the Power Supply Backpack is actually climbing the ladder, at which point the second person stands clear.
- With both people in the lower cathedral, the second person packs all remaining tools (ie. the LSM) into the tool backpack and ascends the ladder to the platform. Three points of contact with the ladder must be maintained at all times. Once on the platform, they wait at the opening on the side opposite that to which the ladder is secured.
- The person with wearing the Power Supply Backpack ascends the ladder, maintaining a minimum of three points of contact, climbs onto the platform and proceeds along the platform without turning. It may be helpful for the second person to guide the Power Supply as it passes through the platform opening. The second person closes the access door, then walks over to the first person and assists in the removal of the Power Supply Backpack. The tool backpack can be removed.
- With one person on the platform and one person on the local floor - lower one end of the rope through the platform door opening, to the local floor. Tie the rope

securely to the small stool. Using a hand-over-hand motion the person on the platform raises the small stool up to and over the railing. The person below stands clear to insure that they will not be hit by the stool if it falls.

- Disconnect the Calorimeter Pre-amp Power Supply from Backpack and set in a convenient and safe location. Tools and equipment should be placed so they are not in the way.

Disconnection Procedure:

- Place the replacement Calorimeter Power Supply on the platform near the location of the Power Supply to be replaced. Note that sufficient room needs to be left to place the Power Supply that’s being removed. Sitting on the small stool can facilitate the disconnection / reconnection process by positioning the arms at a convenient working height.
- Initial and date the front side of the Failure Indication Tag (see example in Figure 3). Examine the Status Indicators on the Front Panel of the Power Supply to be replaced. Red status indicators indicate a fault. Check the appropriate boxes on the back side of the Failure Indication Tag to record the fault condition. Additional notes regarding the problems associated with the Power Supply should also be added to the Tag as appropriate.

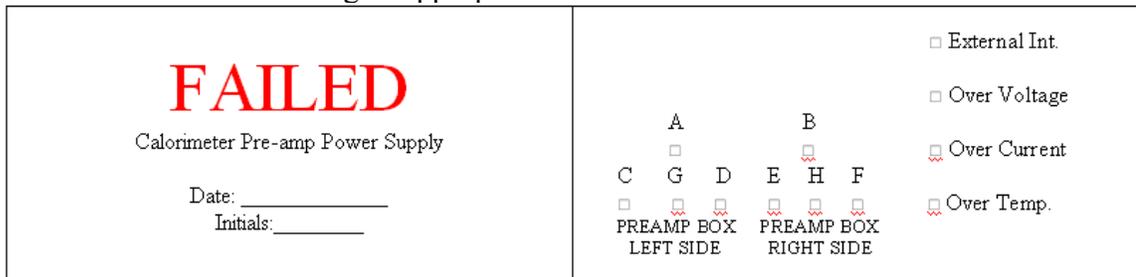


Figure 3. Front and rear sides of Failure Indication Tag

- Press the “Local / Remote” button for both the Power Supply to be disconnected and it’s partner (Primary and Secondary Power Supplies can each provide power to the Pre-amp Crate.) until the status indicator to the right of the button is illuminated Red, indicating the power supply is under “Local” control. Press the “On / Off” button for both the Power Supply to be replaced and it’s partner until the status indicator to the right of the button is illuminated Red, indicating at the Power Supply is Off. (See picture of front panel in Figure 1.)
- Locate and remove the Power Supply box restraining washer using screwdriver. Place washer and screw in secure location as these will be re-installed.
- Loosen and remove all Allen Head screws that secure the front panel using Allen wrench. Place screws in secure location as these screws will be re-installed.
- The Front Panel of the Calorimeter Pre-amp Power Supply contains status indicators and buttons. These devices are connected to the Power Supply via a cable. The Front Panel is typically located to the box using two pins mounted into the edge of the box. Carefully remove the Front Panel being careful not to break off these locating pins. Disconnect the cable from the Power Supply connector on

the Control Board. (See Figure 2 for locations of main components within the volume of the Power Supply box.) Set the Front Panel aside in a secure location.

- A spacer is placed on the right side the Power Supply Box to ensure that a minimum space is maintained between the Power Supply and the side of the box. This ensures that the cooling fan on the Power Supply has an adequate volume of air in which to operate. Locate and note the position of this spacer. Remove the spacer and set aside in a secure and convenient location. This spacer will be re-installed.
- Slowly and carefully slide the Power Supply out of the box a few inches.
- Locate and disconnect the 6-position Anderson PowerPole connector (note only 5 positions have connectors installed) that delivers 208VAC three-phase power to the Power Supply. Note that the two halves of the connector are locked together, requiring manipulation of the latch to perform the disconnection.
- Note the location and polarity of the two spade connectors that form the Interlock Cable connection to the Power Supply Control Board. Carefully disconnect the two connectors by pulling on the connectors. Care should be taken to not short out the red-wire connector to avoid turning off all Calorimeter Pre-amp Power Supplies on a given cathedral area.
- Locate and disconnect the two cooling water “quick-connects” connected to the Power Supply. This action is preferentially performed with the “quick-connects” located in the space vacated by the Power Supply to avoid dripping onto the printed circuits of the Power Supply. Wipe up any drips / spills immediately with Kimwipe.
- Slowly and carefully slide the Power Supply out of the box a few more inches, making sure that the Power Supply still rests on the box. There are still cables connected to the Power Supply that need to be disconnected. Check for interference. Be aware of tightness in the cables so that damage to the cables and connectors can be avoided. As necessary, reach behind the Power Supply and manipulate cables to provide slack in cables. One may consider resting the Power Supply on the knee(s) to provide support.
- Locate the 4 ribbon cables that are connected to 37-pin connectors at the back of the Power Supply. The cables should be labeled. If they are not, note the location of the cables. Disconnect all 4 connectors. ***Do not pull on the cables.*** Use fingernails or a small screwdriver to gently lever the connector end away from the supply. Pulling on the cable will damage the connector and force subsequent accesses.
- Located and disconnect the 18-position DC power connector. Note that this connector may be tight and require significant manipulation to disconnect. It is also difficult to grasp. In this case, pulling on the cables is acceptable and may provide additional grasping area and leverage.
- Carefully slide the Power Supply completely out of the box and lower onto the platform. Caution should be exercised to avoid pinching fingers or hands.
- Attached the completed Failure Indication Tag to the removed Power Supply.

Reconnection Process:

- Carefully lift the replacement Power Supply and insert into box opening.
- Carefully slide the Power Supply into the box a couple of inches. One may consider resting the Power Supply against the knee(s) to provide support.
- Connect the 18-position DC power connector. Note that this connector is keyed and cannot be inserted backward. ***However, the connector can be mated but not properly aligned.*** During and after the connection process, feel the ends of both halves of the connector to ensure alignment. Also verify that the connection is fully made by ensuring that the two halves of the connector are flush.
- Install the 4 ribbon cable connectors. Ensure they connect to the same connectors on the Power Supply as they were originally. When closing the connectors, do not press on the exposed metal contacts of the connectors on the Power Supply. They can bend / break under this pressure. Instead, use two hands and squeeze the connectors together at the outside edges.
- Slowly and carefully slide the Power Supply into the box a few more inches. Manipulate cables as necessary to ensure they don't get pinched in the process.
- Connect the two cooling water "quick-connects". This action should be preferentially performed in the open space just behind the Power Supply. Wipe up and drips / spills with a Kimwipe.
- Connect the two Interlock Cable connections. The spades on the Control Board are partially obscured. Ensure that proper connections are made. The terminal connected to the Red wire must be located on the spade closest to the Lexan covered AC solid state relay / fuse assembly. Care should be taken to not short out the red-wire connector to avoid turning off all Calorimeter Pre-amp Power Supplies on a given cathedral area.
- Connect the 6-position Anderson PowerPole AC connector. This connector cannot be incorrectly mated. The connector halves must be pushed together far enough to ensure the latching mechanism operates.
- Slowly and carefully slide the Power Supply into the box the rest of the way. Manipulate cables as necessary.
- Locate and install the spacer.
- Manipulate the Personality Modules to ensure that they are fully inserted into their sockets. The Personality Modules should be nearly vertical when properly inserted.
- Lift the Front Panel and position (properly oriented) near the Power Supply. Connect the ribbon cable from the Front Panel Monitor Board to the connector on the Control Board.
- Place the Front Panel onto the two locating pins and press against the box. Secure the Allen Head screws.
- Install and secure the Power Supply box restraining washer.
- Press the "Reset" button for the replaced Power Supply and it's partner. The status indicator to the right of the Reset should illuminate Green. Press the "On / Off" button for the replaced Power Supply and it's partner. The status indicator to the right of the On / Off button should illuminate Green. All four trip indicators and all 8 voltage indicators should illuminate Green.

- Press the “Remote / Local” button for the replaced Power Supply and it’s partner. The status indicator to the right of the Remote / Local button *must* illuminate Green.
- Verify that all status indicator are illuminated Green.

Platform exit procedure:

- Collect tools and laptop into tool backpack.
- Securely attach failed Power Supply to Calorimeter Pre-amp and SMT Power Supply backpack.
- With one person on the platform and the other on the lower cathedral level, the small stool (tied to the rope) is lowered through the platform door opening. After the stool is untied and set out of the way, the upper end of the rope is dropped to the lower cathedral where it is coiled and placed out of the way.
- With both people on the platform one person, with assistance, dons and secures the Power Supply backpack.
- The person wearing the Power Supply Backpack descends the ladder maintaining a minimum of three points of contact at all times. It may be helpful for the second person to guide the Power Supply through the platform door opening. Wearing the tool backpack, the remaining person descends the ladder maintaining a minimum of three points of contact at all times.
- Walking as a two-person team, the person wearing the Power Supply Backpack leads the way back to the cart. The second person holds onto the Power Supply to ensure that it doesn’t make contact with detector equipment and structures.
- The second person assists as the Power Supply Backpack is removed and places it onto the cart for transport out of the collision hall.
- After leaving the cathedral area, contact the D0 Control Room personnel responsible for Calorimeter Detector operation and verify the correct operation of all Calorimeter Pre-amp Power Supplies.

