PALISADES NUCLEAR PLANT
FUNCTIONAL DESCRIPTION
Facility Change

UFI No. 02530 (System) 50016 (Equipment) Plant System Code RPS FC: 888

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Attach detailed Function Description

| Processing Sequence | | REVISION 0 Sign & Date | REVISION 1 Sign & Date | REVISION 2 Sign & Date | REVISION 3 Sign & Date |
|---|---|---|---|---|---|
| FD.DIC Reviewed* Conceptual Design Approved | OPS | 5-23-91 | | | |
| FD.DIC Reviewed* Conceptual Design Approved | Sys Engr | 5/31/91 | | | |
| FD. DIC Reviewed Approved | ISI | N/A | | | |
| Conceptual Design Complete | RE | 5/31/91 | | | |
| Scope Control Team Reviewed | SCT | 6/6/91 | | | |
| Q Classification ☒ Yes ☐ No | Proj Supt | 6/6/91 | | | |
| PRC Reviewed | RE, PRC Chairman, or PS&L Member | Paul F. Bruce 91-0511 5-28-91 | | | |
| Detailed Design Complete | RE | | | | |
| Modifications Reviewed/Approved | Proj Supt | | | | |
| QE Review | QE | | | | |
| Authorization to Install | E&M Mgr | | | | |
| Departments Notified (Including SCT) | RE | | | | |
| Drawing Stamping Initiated | RE | | | | |
| Design Documents Transmitted | RE | | | | |
| Installation & Testing Complete | RE | | | | |
| Critical Document Update | RE | | | | |
| Walkdown & Inspection Complete | RE & QA | | | | |
| Operability Authorized | OPS Supt | | | | |
| Documents Updated | RE | | | | |
| FC Packaged Reviewed | Proj Supt | | | | |

*Functional Description, Design Input Checklist

This Functional Description covers the replacement of all four channels of the Reactor Protection System (RPS) Power Supply Assemblies, Trip Unit Assemblies, Interconnection Modules, Bistable Trip Units and Auxiliary Trip Units. This description also covers the incorporation of Trip Tester functions into the Power Supply Assemblies. This RPS modification is required to address obsolescence concerns. The upgrade will improve RPS performance while reducing testing time and maintenance costs.

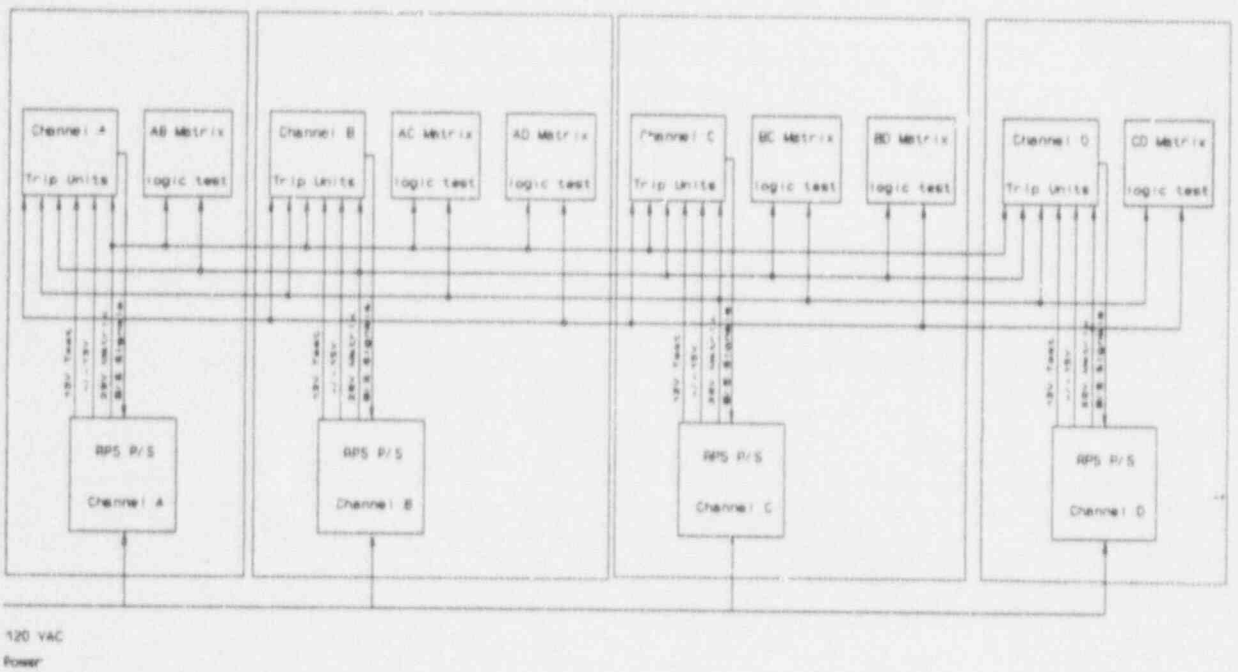


Figure 1
RPS UPGRADE BLOCK DIAGRAM

Figure 1 shows the RPS Upgrade Block Diagram. All items provided for this upgrade will be form-fit-function replacements of installed equipment with the exception of the Power Supply Assembly front panel. This panel will combine the functions that were previously contained in the Trip Tester Unit with the indications currently found on the Power Supply Assembly front panel. This

combination will eliminate the need for the Trip Tester Unit. All equipment will be installed in the same location as the item being replaced.

As shown in Figure 1, there will be four (4) complete sets of equipment as described below, one for each channel of the RPS. Each P/S assembly will supply a 12 VDC Test voltage, ±15 VDC power for Trip Unit operation and 28 VDC Matrix Power. Inputs to the P/S Assembly will be the signal input to the Trip Unit, and the trip and pre-trip point voltages.

Figure 2 shows the RPS P/S Assembly Block Diagram for Channel A. This figure corresponds to the RPS P/S Channel A block shown in Figure 1. Five discrete power supplies, two (2) +300V VDC Bulk and three (3) 28 VDC Matrix, are powered off a common AC bus. The output of each of the 28 VDC Matrix Power Supplies is diode auctioneered to specific logic matrix loads as shown. The Bulk 300 VDC power supplies are diode auctioneered and supply twelve (12) ±15 VDC converter/isolators that power each individual Trip Unit. A 12 VDC Test Voltage converter/isolator is also powered off of the +300V bulk volt supply. This supplies isolated power to the test functions in each Power Supply Assembly.

The test functions that were previously on the Trip Unit are implemented in a manner similar to that used earlier. Changes made to the former design include the rewiring of, and the addition of four (4) decks to the Trip Unit Select Switch; rewiring the TMLP Select Switch, removing unnecessary resistors and potentiometers, and adding three (3) decks and three (3) positions to the DVM Input Select Switch. The test signals are brought into the Power Supply Assembly from the Interconnection Module by MS type connectors.

The Setpoint Trip and Setpoint Pre-trip decks on the Trip Unit Select Switch are rewired to direct the signals from each of the twelve possible Trip Units to the to the DVM Input Select Switch. The location of the Trip Test Switch Connection to the Setpoint Trip deck is changed to the center pole This is required in order to maintain proper function after the switch deck is

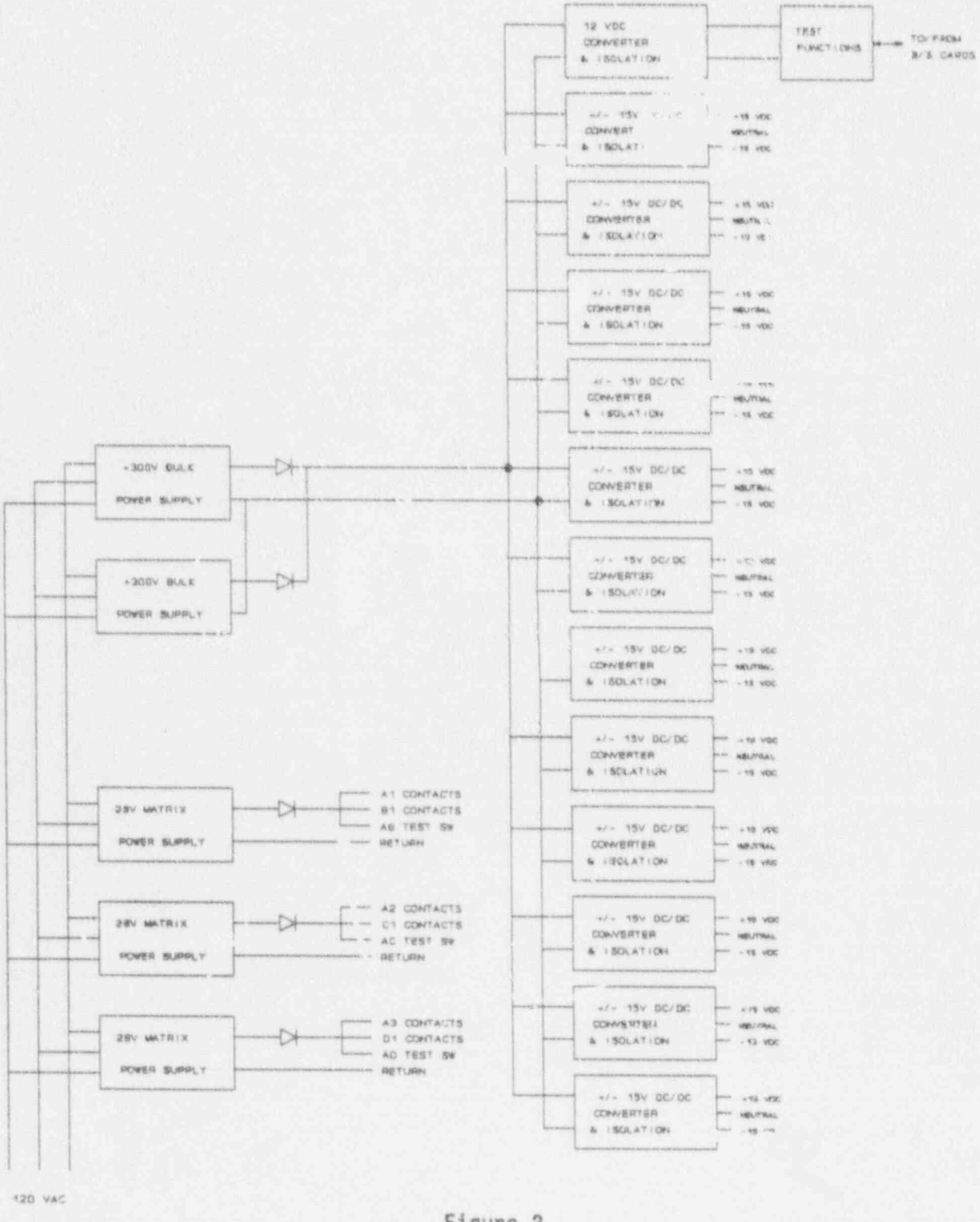


Figure 2
CHANNEL A RPS ASSEMBLY BLOCK DIAGRAM

rewired. The change in location has no affect on the circuit operation.

Two (2) of the decks added to the Trip Unit Select Switch are used to replace the dedicated signal and floating ground lines in the Trip Unit connection cable. Additionally, one (1) deck is added for each polarity of the 15 Volts used to power the Trip Units.

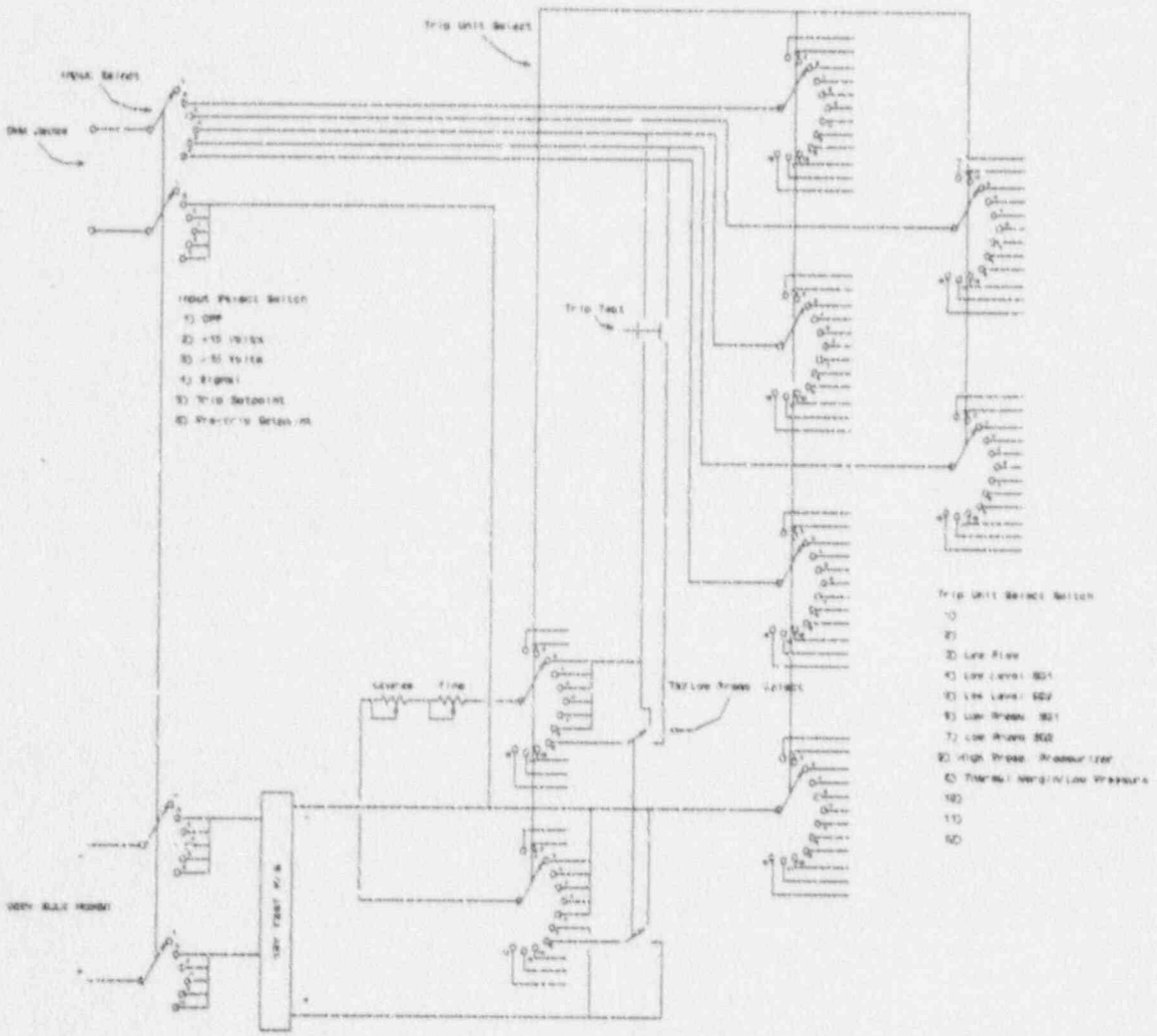

Figure 3
TEST FUNCTIONS SCHEMATIC DIAGRAM

The two (2) decks on the Trip Unit Select switch that provide the proper polarity and attenuation of test voltage are rewired to provide polarity selection on one deck and power routing on the other deck. This results in the use of only one set of potentiometers and simplifies the circuit. The TMLP Switch is rewired to support the power polarity selection on one deck and the output on the other.

The three (3) decks added to the DVM Input Select Switch allow the test functions to be completely disconnected from both the DVM Jacks and the Bulk 300 VDC power. The first of the added positions is an OFF position. This is an open contact which performs the disconnect function described above. The other two added positions allow the measurement of the ±15 Volt Power supplied to each Trip Unit. Figure 3 shows the implementation of the test functions.

Figure 4 shows the component blocks required to implement the 28V Matrix Power

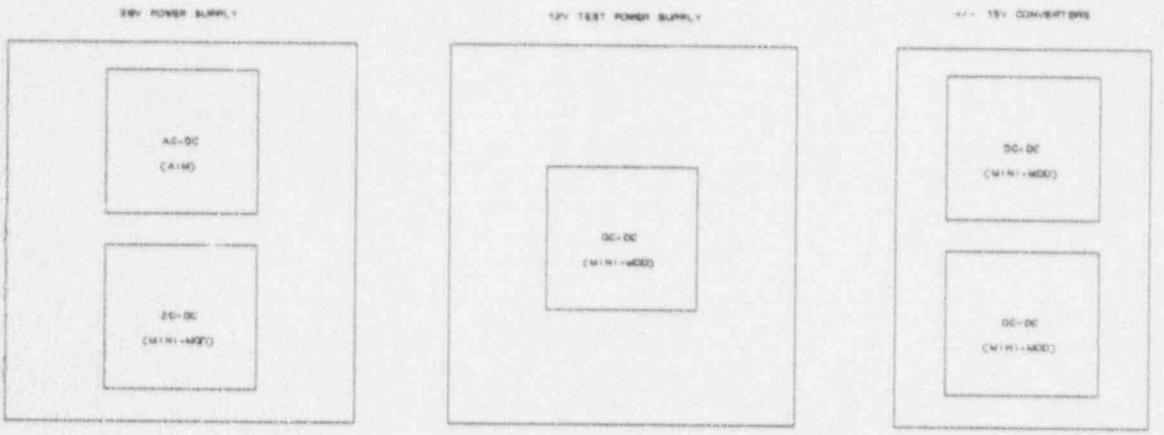

Figure 4
P/S PC CARD BLOCK DIAGRAM

Supplies and the Converter/Isolators shown in Figure 2. Each block in Figure 4 has a corresponding block in Figure 2 except for the +300V Volt Bulk Power Supplies. The +300V Volt Bulk Power Supplies are chassis mounted supplies.

Larger components are required for the +300V Bulk Power Supply due to the high power requirements. Using these larger components means implementing the +300V Volt Bulk Power Supplys with off the shelf components. The diode auctioneering is performed with chassis mounted auctioneering diodes. Indication that both each of the +300V Bulk Power Supplies is operating properly is provided by a front panel LED. This LED is connected to the +300V Bulk Power Supply upstream of the auctioneering diode.

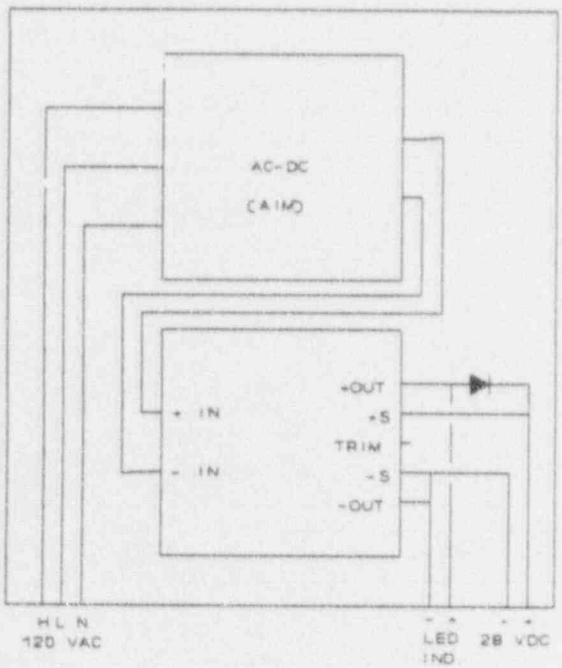


Figure 5
28V MATRIX POWER SUPPLY

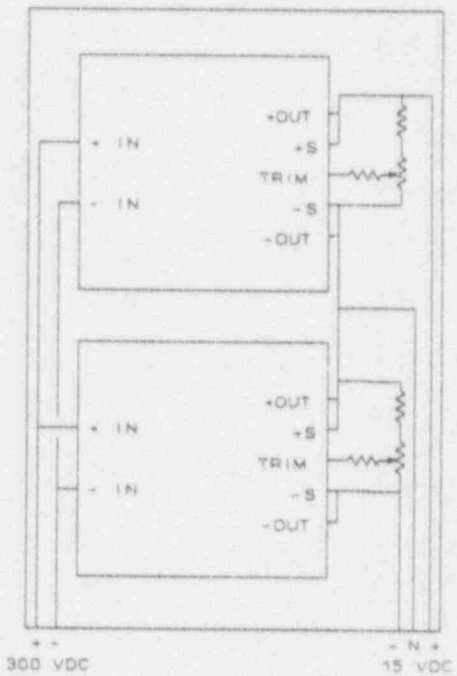


Figure 6
±15 V CONVERTERS

The lower power requirements of the 28 Volt Matrix Power Supplies allows the entire conversion process to be done on one card. Figure 5 shows the card layout. The diode auctioneering is performed on the PC Card. LED indication is provided to show proper operation of the power supplies in the same manner as the +300V Bulk Power Supplies.

Figure 6 shows the ±15V Converter Card Layout. The card converts the +300V Bulk power to the required ±15 VDC, isolated power required by the Trip Units.

The trim pots required for the ±5% trim are onboard the PC Card. The converter modules are protected by fuses mounted on the PC Card.

The +12V test power is supplied by a single converter/isolator card. This card, shown in Figure 7, provides power to the test function potentiometers found on the front panel of the RPS Power Supply Assembly. Onboard trim and protection are provided for in the same manner as the ±15V converter cards.

The RPS Power Supply Assembly Front Panel is shown in Figure 8. The panel incorporates the Matrix Power Supply indication found on the present system with the Trip Tester Unit functions.

Indications found on the front panel are LEDs for each of the three (3) 28V Matrix Power Supplies, both of the 300V Bulk Power Supplies and the 12V Test Power. A dual banana jack is provided for DVM connection to the test functions. Controls on the front panel are the Trip Unit Select Switch, Meter Output Select Switch, TMLP Switch, Trip Test Switch, and Course and Fine Potentiometers.

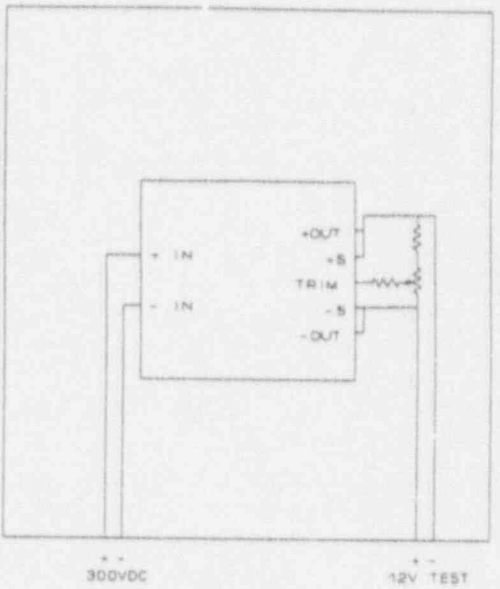


Figure 7
12V TEST POWER

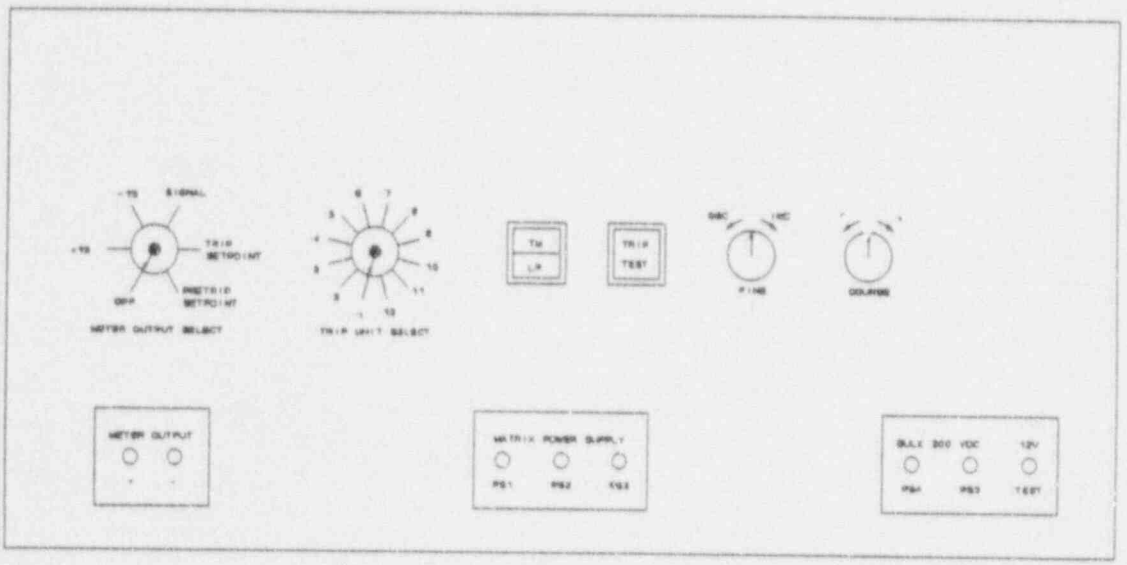

Figure 8
POWER SUPPLY FRONT PANEL LAYOUT

The Trip Unit Select Switch has two functions. The first is to connect the signals to be measured in the selected Trip Unit to the Meter Output Select Switch. The second is to supply the power polarity voltage to the selected Trip Unit through the Course and Fine potentiometers. The Trip Units which correspond to the Trip Unit Select Switch positions are listed in Figure 1.

The Meter Output Select switch connects the signals from the Trip Unit Select Switch to the DVM Jacks on the front panel. Figure 1 lists the switch positions and corresponding signals.

The TMLP Switch and Trip Test switch are functionally unchanged. The wiring of the TMLP Switch was changed to accommodate the rewire of the Trip Unit Select Switch. This change allows the use of only one set of Potentiometers for upscale or downscale trip testing.

A power switch located on the top of the power supply drawer will remove all AC power to the PC Cards.

This is done because of the high voltage and large current capacities on some of the card connectors. The power switch allows cards to be changed with the voltage removed from the cards.

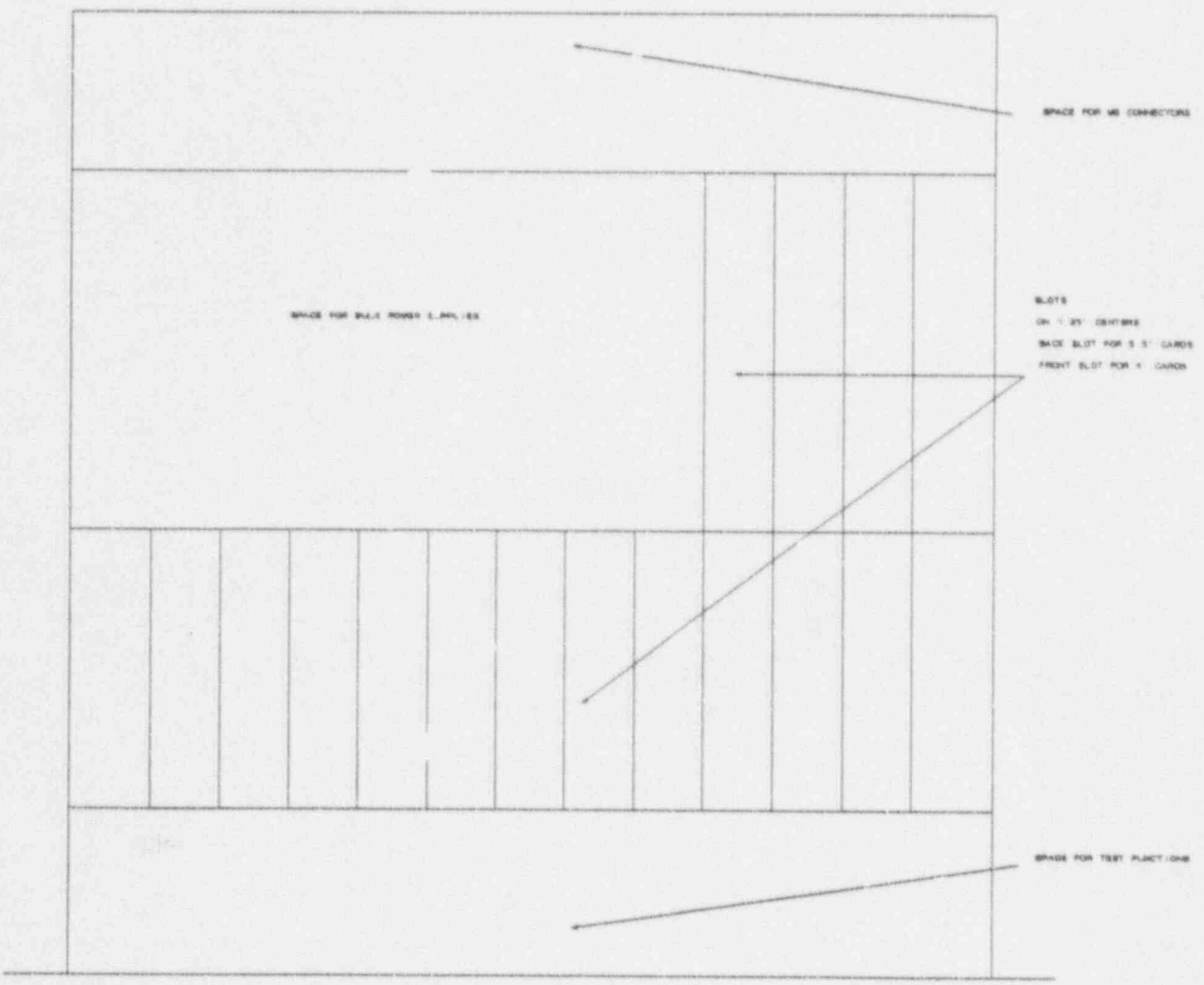

Figure 9
RPS POWER SUPPLY ASSEMBLY LAYOUT

The general layout of the RPS Power Supply Assembly is shown in Figure 9. The Assembly is divided into three parts. The rear of the Assembly holds the 28V Matrix Power Supply cards, the +300V Bulk Power Supplies and the 12V Test

Power Supply card. The middle area of the Assembly holds the ±15V converter/isolators. Each card type has a specific pin configuration to ensure that each type will operate only in it's respected location. The front area provides space behind the front panel for the individual components required for the test and indication functions.

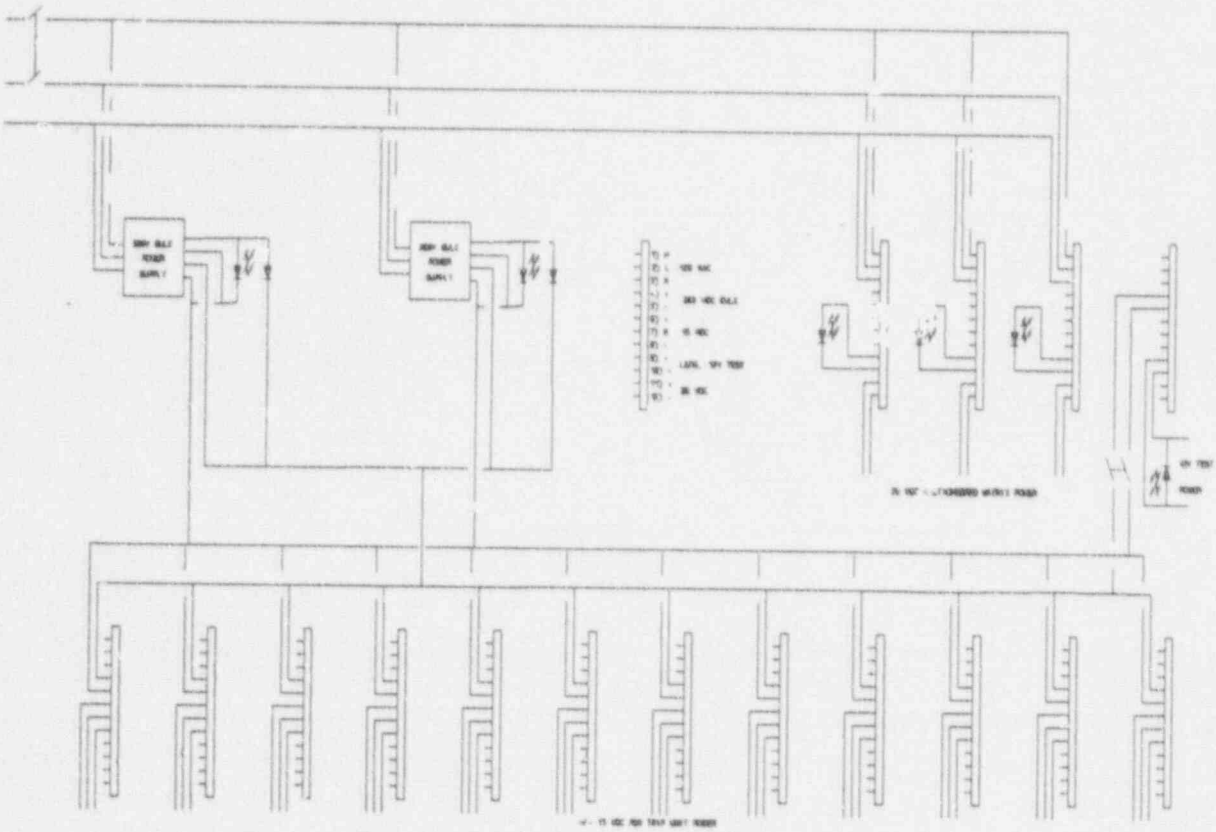

Figure 10
CARD CONNECTOR INTERCONNECTION DIAGRAM

A simplified diagram of the interconnection of these card connectors is shown in Figure 10. The top row shows the connections for the 300 and 28 volt power supplies and the 12 volt test converter/isolator. The bottom row shows the ±15V converter/isolators. The power switch controls AC power to each of the power supplies. The external LED indication is also shown. A simplified picture of the 2 decks of the DVM Input Select Switch is shown connecting the

300V bus to the 12V Test Power. MS type connecters are used to connect the ±15V and the 28V Matrix Power to the Interconnection Module.

The interconnection modules function remains unchanged. The design remains the same as the original with the exception of the number and location of the connectors. The added connectors are required to implement the test functions in the PRS Power Supply Assembly. Connections are made within existng connectors where possible.

The only changes made in the Bistable and Auxiliary Trip Units are to remove obsolete components and to remove the test jack and associated components from the front panel. A new circuit design results from using updated components in the Trip Units. Some pin connections on the Trip Units are changed. These changes are accomodated in the redesign of the interconnection module. These physical changes to the trip units do not change the function of the Trip Units.

The RPS is a QListed system. All components not currently in the EDB must be added.

The EEQ is unaffected. There are no harsh environmental factors to be considered since the equipment to be installed is entirely within the control room.

Upon the request of the Palisades engineering personnel, the RPS Flow Trip Setpoint Selector (FTSS) switch shall be removed as part of the upgrade. This modification has limited impact upon the upgraded auxiliary and bistable trip unit assembly design.