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**PPD / EED / Infrastructure Group**

Technical Note: IG\_ 20120004

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**NOvA Far Detector Low Voltage Rack Temperature Test Stand**

**Overview:**

To gauge the effectiveness of the air cooling system the NOvA experiment has designed for their Low Voltage Racks, the Infrastructure and Support Group has assembled a rack that mimics the Low Voltage Rack in terms of size and population of applicable components. A second rack has been provided to house resistive loads required to operate the power supplies at expected temperatures. Smoke detection and power interruption capabilities are provided. The Temperature Test Stand is located in the High Bay of the D0 Assembly Building (DAB).

**Test Stand Configuration:**

The Temperature Test Stand rack is a standard 19 inch wide, 45U high, 30 inch? deep equipment rack. The rack is configured with two side panels and a rear door. All front panel space (except for the lowest 1U) will be covered in a manner consistent with the population of Low Voltage Racks installed in the Far Detector Building in Ash River (Ash River). Four Wiener PL560 power supply / circuit breaker chassis are installed at locations identical to those in a Low Voltage Rack at Ash River. Five 9-fan fan trays are installed at locations identical to those in a Low Voltage Rack. These power supply / circuit breaker chassis and fan trays, provided by University of Virginia (UVa), are identical to those installed in Low Voltage Racks in Ash River. The power supply / circuit breaker chassis have already been subject to and passed a Fermilab Particle Physics Division Operational Readiness Clearance (ORC) review. Four 240V Power Distribution Chassis and one 120V Power Distribution Chassis are installed in the rack. These power distribution chassis, provided by NOvA to facilitate test stand assembly, are identical to those installed in Low Voltage Racks and have already been subject to and passed an ORC review. A smoke detection system consisting of a Siemens PD-11 photoelectric smoke detector and a D0 “Cook” Rack Monitor Interface (RMI) generates the 24Vdc interlock signal that the normally-open solid state relays on the power distribution chassis require to operate.

To draw currents comparable to those expected in Ash River, UVa provided two resistive Load Modules. The Load Modules are installed in the second rack. Two fan trays are installed to cool the Load Modules. Cables of the type used in Ash River and terminated to plug into connectors on the power supply / circuit breaker chassis have also been supplied by UVa. These cables will exit the Temperature Test Stand rack through the bottom, in same manner they do in the Low Voltage Rack in Ash River. They will enter the second rack through the bottom to be connected to the Load Module.

**AC Power for the Temperature Test Stand:**

At Ash River, each Wiener power supply is connected to the secondary of a 480/240Vac transformer. DAB does not have a ready source of 4 receptacles providing ~240Vac in close proximity. To remedy this situation, we utilize a Fermilab “power cart.” The power cart is primarily a 480Vac primary to 208/120Vac secondary transformer with a 150A panelboard connected to the secondary. The panelboard is connected to a number of utility boxes via chase nipples along it’s periphery. Each utility box contains receptacles that provide either single or three-phase connections and are protected by appropriately rated circuit breakers inside the panel. The transformer’s primary winding is connected to a 480V / 60A welding plug terminating 6AWG 4C SOOW cable through a 60A fused disconnect. See Figure 1 for a single line electrical drawing.

Figure 1. Power cart SLED.

We utilize four 120V five-terminal 20A receptacles located in utility boxes mounted to the panelboard to approximate 240V connections to the 240V Power Distribution Chassis in the test stand rack One end of a 12AWG 3C SOOW cable is terminated in 5 terminal 20A plug that mates with the receptacle. The equipment grounding connection and two of the three phase connections in the plug are utilized. The other end of the cable is terminated in an L6-20R receptacle that mates with the L6-20 inlet on the 240V Power Distribution Chassis.

120V single phase power for the test stand is obtained from one of the 120V 15A/20A receptacles on the panelboard. One end of a 12AWG 3C SOOW cable is terminated in NEMA 5-15P plug that mates with the receptacle. The other end of the cable is terminated in an L5-20R receptacle that mates with an L5-20 inlet on the 120V Power Distribution Chassis.

**DC Power Distribution:**

The configuration of the Wiener power supplies used in Low Voltage Racks in Ash River results in 6 outputs. Three of the outputs are ~4.5Vdc, each capable of delivering 100A, the other three are ~24Vdc, each capable of delivering 60A. These outputs are routed in pairs to power distribution chassis located in Ash River.

Each output of each Wiener power supply / circuit breaker chassis is connected to a resistive load in one of the Load Modules by approximately 10 feet of the same cable used to connect to distribution chassis in Ash River. Each 4.5V output will be loaded with a total resistance of 0.05Ω and supply 90A (405W) over 2AWG cable. A circuit breaker in series with the cable limits the total current to 100A. Each 24V output will be loaded with a total resistance of 1.25Ω and supply 19.2A (461W) over 6AWG cable. A circuit breaker in series with the cable limits the total current to 60A.

The total heat dissipated by the Load Modules is the sum of all 24 loads:

$$P\_{T}=12\left(405W\right)+ 12\left(461W\right)$$