Fermilab

PPD / EED / Infrastructure Group
Technical Note: IG_ 20100001
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Smoke Detection and AC Power Distribution / Interruption for NOvA Near Detector Surface Building Electronics Racks

Overview:

Four equipment racks (two each of two different configurations) have been assembled for use in the NOvA Near Detector Surface Building (NDSB). It has been deemed beneficial to provide the ability to turn off AC power to most of the equipment installed in these racks in the event that smoke is ever detected within the rack. This document details the implementation of the smoke detection / interlock system as well as a description of the AC power distribution associated with a rack. Though there are two different rack configurations, the implementation of the smoke detection / power distribution system is the same for both.

Power Requirements:

The two rack configurations can be described as the rack with the Control Station and the rack with the High Voltage crate. Both types will require multiple (but the same) AC power connections; two 240V / 20A and one 120V / 20A. These connections are available for each rack location in a wire raceway installed on the railing in the upper level platform at the NDSB.

The power requirements by rack type are listed below.

For the Control Station rack:

Device	Voltage	Current
Wiener PL506 power supply (2)	240V	11A each
Field Point monitoring system	120V	1.5A
DCS computer	120V	2.5A
Terminal	120V	0.3A
DCS switch	120V	0.6A
DAQ switch	120V	0.6A
Fan tray (3)	120V	1A each
D0 Rack Monitor Interface	120V	1A

For the High Voltage rack:

Device	Voltage	Current
Wiener PL506 power supply (2)	240V	11A each
Field Point monitoring system	120V	1.5A
Wiener MPOD ISEG high voltage power supply	120V	5A
DCS switch	120V	0.6A
DAQ switch	120V	0.6A
Fan tray (4)	120V	1A each
D0 Rack Monitor Interface	120V	1A

Total anticipated current drawn from the 240V and 120V sources, by rack configuration, is 22A and 9.5A for the Control Station rack and 22A and 12.7A for the High Voltage rack, respectively.

The D0 Rack Monitor Interface monitors the smoke detector installed in each rack and generates the Interlock signal that permits the delivery of AC power to equipment in the rack when the smoke detector is not tripped. This device will be connected to AC power that is always on.

The Field Point monitoring system can provide operating conditions such as operating voltage levels to remote locations. This device will be connected to AC power that is always on.

All other equipment in the racks will lose their AC power in the event of a smoke detector trip.

Available Power:

According to the NOVA NDSB OUTFITTING – Upper Level Build-Out drawing (Cordogan, Clark & Associates, Inc drawing number 6-7-15B), each rack located on the upper platform has two 240V/20A and one 120V/20A receptacles available to it, implemented as L6-20R and L5-20R receptacles respectively. These receptacles are fed by similarly rated breakers (two-phase for 240V and single-phase for 120V) in power panel PP-NDSB-1-B1.

Power Distribution / Interruption for 240V:

Each of the two Wiener PL506 power supplies in a rack will be connected to one of the L6-20R receptacles. To implement power interruption capabilities, we've constructed a 240V Power Distribution panel that will mount below the PL506 on the front face of the rack. Details for this panel can be found in the drawing in the Appendix. A short length (< 10 feet) of 12AWG / 3-conductor power cable (appropriately phase-taped for indicating two un-grounded connections) is terminated in an L6-20P plug. The other end

is strain-relieved to the back-side of the panel (inside the volume of the rack) and connected to an input terminal strip. Each of the two un-grounded connections is connected to a fuse holder. The fuse for both installations is a 15A 3AG style. After the fuses, the two un-grounded connections pass through a Crydom D2425D two-pole, normally-open solid state relay (rated at 250V / 25A) and then onto an output terminal strip along with the grounding connection. The three conductor power cord delivered with the Wiener power supplies (with a proprietary plug) will be cut to appropriate length, passed through the front of the 240V distribution panel (secured with a cord-grip) and appropriately connected to the output terminal strip. The estimated gauge of the conductors in the Wiener power cord is 16AWG, driving the choice of the rating of the fuses in the two phase connections. A Lexan cover prevents incidental contact with the power connections.

Power Distribution / Interruption for 120V:

All 120V power for a rack will be provided from the L5-20R receptacle. To implement power interruption capabilities, we've constructed a 120V Power Distribution panel that will mount to the rear face of the rack. Details for this panel can be found in the drawing in the Appendix. A short length (< 10 feet) of 12AWG / 3-conductor power cable is terminated in an L5-20P plug. The other end is strain-relieved to the back-side of the panel (inside the volume of the rack) and connected to an input terminal strip. Here, the un-grounded connection is split into two. Each of these subsequent un-grounded connections is connected to a panel-mount fuse holder (accessible from the front of the distribution panel) containing a 15A 3AG fuse. One of the two subsequent un-grounded connections is connected to the un-switched output terminal strip, along with the grounded and non-grounded power connections. The other subsequent un-grounded connection is connected to a Crydom D2425 single-pole, normally-open solid state relay (rated at 250V / 25A) and then onto the switched output terminal strip, along with the grounded and grounding power connections. A Lexan cover prevents incidental contact with the power connections.

The two output power strips are connected to lengths of rack-mounted utility strips with short lengths (< 4 feet) of 14AWG / 3-conductor power cable. The power cable is strain-relieved to the back-side of the distribution panel and held to the entrance box of the utility strip with a compression cord-grip. There are 4 outlets in the un-switched utility strip and 8 outlets in the switched utility strip.

Smoke Detection / Power Interruption:

The small number of racks and limited duration for the NDSB installation allowed us to use the rack-mountable D0 Rack Monitor Interface (RMI) to control the three solid state relays used in the Power Distribution panels. The RMI has a proven and well understood interface for the smoke detectors (Siemens PE-11 photo-electric) we've installed in the top of each rack. If the smoke detector "trips", a relay on the smoke detector closes, circuitry inside the RMI detects this closure and latches a Smoke Trip. In response, the RMI drops the potential of the Interlock signal (TTL) to a low value, causing the solid

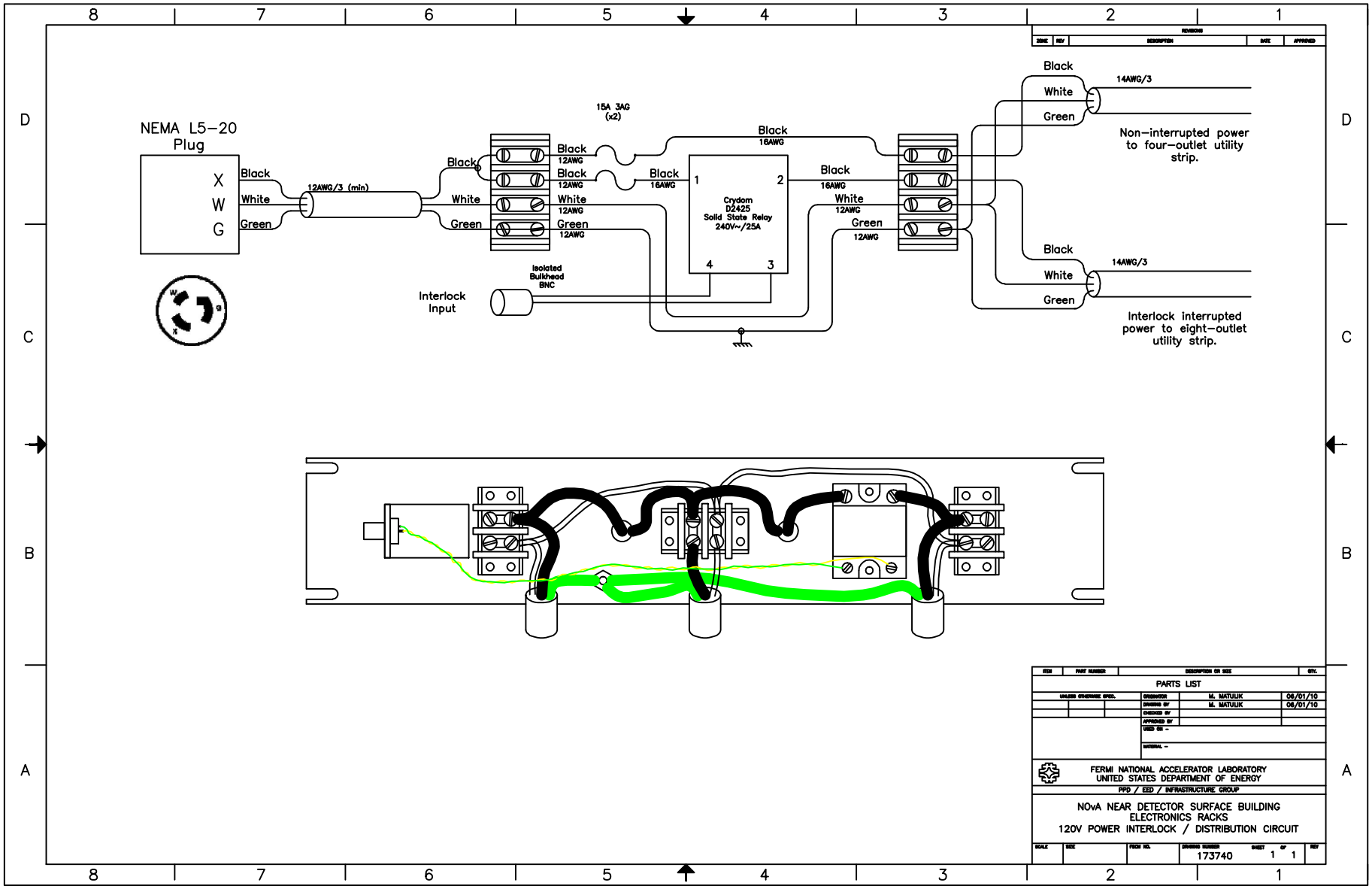
state relays to open – interrupting power to subsequent devices. Additionally, an LED on the front-panel of the RMI changes color from green to red to indicate the tripped condition. A reset button on the front-panel of the RMI is used to reset the smoke detector and to clear the trip indication and re-establish the Interlock signal level.

One of the two 240V Power Distribution Panels in the rack has a resistor-isolated copy of the Interlock signal available for the Field Point monitoring system. The connection for this signal is available through a front-panel mounted Lemo connector.

Appendix:

NOvA NDSB Electronics Rack 120V Power Interlock / Distribution Drawing (number 173740).

NOvA NDSB Electronics Rack 240V Power Interlock / Distribution Drawing (number 173741).


NEMA L5-20
Plug
X
W
G
Black
White
Green
12AWG/3 (min)
15A 3AG
(x2)
Black
12AWG
White
12AWG
Green
12AWG
Black
16AWG
Crydom
D2425
Solid State Relay
240V~/25A
1
2
3
4
Isolated
Bulkhead
BNC
Interlock
Input
14AWG/3
Non-interrupted power
to four-outlet utility
strip.
Interlock interrupted
power to eight-outlet
utility strip.
PARTS LIST
FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY
PPD / EED / INFRASTRUCTURE GROUP
NOvA NEAR DETECTOR SURFACE BUILDING
ELECTRONICS RACKS
120V POWER INTERLOCK / DISTRIBUTION CIRCUIT
M. MATULIK
06/01/10
173740
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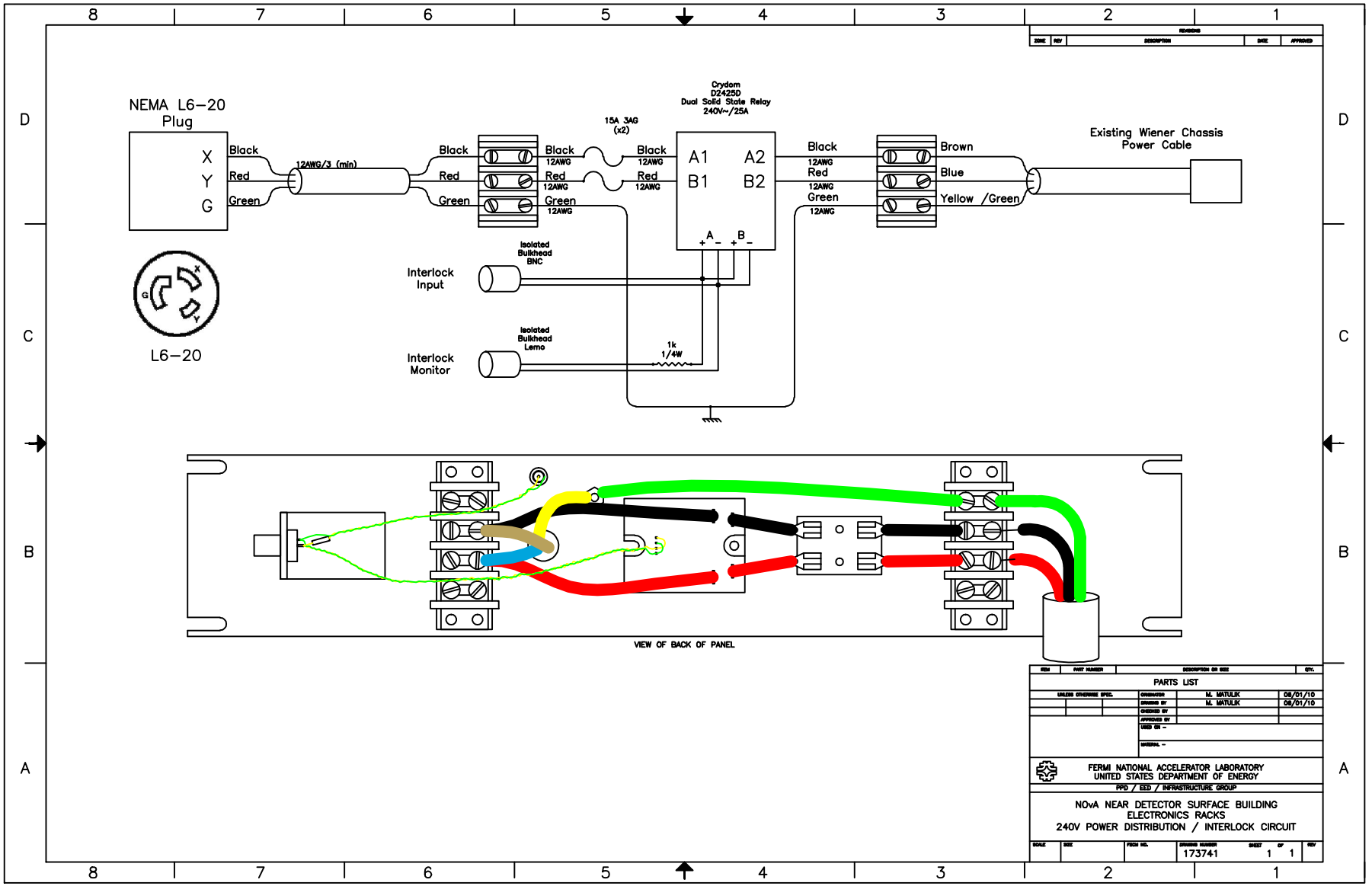
NEMA L6-20
Plug
X
Y
G
Black
Red
Green
12AWG/3 (min)
Black
Red
Green
Black 12AWG
Red 12AWG
Green 12AWG
15A 3AG
(x2)
Black 12AWG
Red 12AWG
Crydom
D2425D
Dual Solid State Relay
240V~/25A
A1
A2
B1
B2
A + -
B + -
Black 12AWG
Red 12AWG
Green 12AWG
Brown
Blue
Yellow /Green
Existing Wiener Chassis
Power Cable
L6-20
Isolated
Bulkhead
BNC
Interlock
Input
Isolated
Bulkhead
Lemo
Interlock
Monitor
1k
1/4W
VIEW OF BACK OF PANEL
PARTS LIST
M. MATULIK
08/01/10
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NOvA NEAR DETECTOR SURFACE BUILDING
ELECTRONICS RACKS
240V POWER DISTRIBUTION / INTERLOCK CIRCUIT
173741
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