Dune-ND: ArgonCube 2x2

Linda Bagby

Light Readout Meeting

ORC Process

February 17, 2022

What is an ORC Review?

- Prior to operation, experiments, projects, and R&D (Research and Development) efforts may require an ES&H (Environment, Safety, and Health) review depending on the hazards or risks involved. The ES&H review may consist of multiple reviews by subject matter experts (SME's) from a variety of committees depending upon the hazards involved. The ES&H review procedure is designed to review these projects and to ensure proper documentation and reviews have been conducted. The **Operational Readiness Clearance** (ORC) process is used to capture the recommendations, findings, and ultimate recommendation to operate from these various committees.

http://esh-docdb.fnal.gov/cgi-bin/ShowDocument?docid=3311

ORC or NOT????

- **All** equipment, temporary or 'production', requires a review at some level.

> Divisions have the discretion to require ORCs per internal policies or at any time for any type of activity. Activities that have undergone an ORC review that cease operations for greater than 60 days or have been modified may require another ORC at the discretion of the DSO.

> **4.0 PROGRAM DESCRIPTION**
>
> The Operational Readiness Clearance process must be completed prior to commencement of operation for all experiments, tests or R&D activities that utilize any equipment or materials that have the potential to cause harm to personnel, property or the environment. For example, use of:
>
> - Non-Nationally Recognized Testing Laboratory (NRTL) or modified listed electrical equipment including electronics.
> - Materials that are potentially harmful to the environment or human health.
> - Flammable materials.
> - Moving components, unexpected startup of equipment.
> - Lasers (class 3b or 4).
> - Cryogens (in some cases, the ORC may consist solely of the cryogenic safety panel review).
> - Pressure vessels and piping or vacuum vessels.
> - Materials/processes capable of emitting radiation.

- Angela Aparicio and the responsible engineer for the various disciplines looks at each case to determine the level of the review.
  - Electrical/Electronics equipment: Linda Bagby

Custom vs Commercial Equipment

- Custom electrical equipment is defined as electronics that are not commercially available.
  - Printed circuit boards designed by anyone other than a commercial company (engineer, collaborator, physicist, post doc, grad student).
  - Chassis containing a collection of commercial parts with internal wiring completed by the user.
  - Modified commercial equipment.
    - Extending a power cord.
  - Equipment that does not contain a Nationally Recognized Testing Laboratory (NRTL) seal.
- Commercial electrical equipment typically has a NRTL seal.

Guidance Sources

All experiments within the Neutrino Division (ND) follow the Particle Physics Division (PPD) guidelines for Operational Readiness Clearance (ORC) reviews and utilize the Fermilab Office of Program Planning TSW (Technical Scope of Work) and ORC webpage.

- Link to the Particle Physics Division Operational Readiness Clearance (PPD ORC)

http://www-ppd.fnal.gov/ESHBMGOffice/orc.html

- Office of Program Planning

http://programplanning.fnal.gov/tsw_orc/

- Link to the Fermilab Environment, Safety and Health Manual (FESHM)

http://eshq.fnal.gov/manuals/feshm/

Where does one start??

- Use the PPD ORC page to determine the hazards for a given subsystem
  - http://www-ppd.fnal.gov/ESHBMGOffice/orc.html
- Hazard Checklist
  - http://www-ppd.fnal.gov/eshbmgOffice/SafetyPDFs/HazardIDChecklist.pdf
- Hazards include:
  - Flammable (Gases or Liquids)
  - Gases
  - Chemicals
  - Radioactive Sources
  - Target Materials
  - Nuclear Materials
  - **Class 3b or Class 4 Lasers**
  - **Electrical Equipment**
  - **Mechanical Structures**
  - **Vacuum Vessels**
  - **Pressure Vessels and Pressure Piping**
  - **Fire and Life Safety**
  - Radiation Safety
  - **Trip, Fall, and Strain relief considerations**

3 Step Process: Step 1

- Safety Engineering Design Review (SEDR)
  - Performed on custom designed or modified commercial equipment.
  - Requirements (chassis level)
    - A SEDR Request document containing:
      - General description of the chassis.
      - Simplified (block) electrical diagram of the chassis, including commercial components, with special emphasis on power handling issues. These must be of sufficient detail that reviewers can verify the experimenters have observed good systems engineering practices and have used proper fusing, wire sizes, insulation, termination, etc.
      - Schematics, Artwork, Bill of Materials, of custom manufactured circuitry or modifications of commercial components of similar detail.
      - Sample of the equipment to be reviewed.
      - An Engineering Note is useful.

  - Should be done during the PRE-PRODUCTION phase of a design to allow time to complete any ‘required’ findings before going into production.

3 Step Process: Step 2

- partial Operational Readiness Clearance (pORC)
  - A mechanism for powering up one subsystem while others are being installed or assembled.
  - Performed on a subsystem's fully populated electronics racks or a subsystem's collection of equipment which will be operated at a test stand, experimental building, or in a beamline enclosure.
  - Includes all intra AND inter rack connections, including external AC Distribution.
  - Requirements (rack or subsystem level)
    - Simplified (block) electrical diagram of entire installation, including commercial components, with special emphasis on power handling issues. These must be of sufficient detail that reviewers can verify the experimenters have observed good systems engineering practices and have used proper fusing, wire sizes, insulation, termination, etc.
    - Line diagrams of custom manufactured circuitry or modifications of commercial components of similar detail.
    - Fully populated rack.
  - Can be done at experiment's enclosure or other site before racks are moved to enclosure.
  - Includes SEDR Findings report, subsequent actions, and final approval.

3 Step Process: Step 3

- Final Operational Readiness Clearance Walkthrough (ORC)
  - Documentation consists of a ‘wrapper’ around all of the subsystem partial Operational Readiness Clearance review Findings and Responses.
  - This is a final walkthrough by safety to ensure the installation is complete and ready to be energized.

Electrical Equipment Support

On the Particle Physics Division Operational Readiness Clearance webpage, under Electrical Equipment, there are 2 useful links to use as guidance.

- http://www-ppd.fnal.gov/ESHBMGOffice/orc.html
- Electrical Safety ORC Review Guidelines
  - http://esh-docdb.fnal.gov/cgi-bin/ShowDocument?docid=3270
- Electrical Design Standards
  - http://esh-docdb.fnal.gov/cgi-bin/ShowDocument?docid=2781

To assist in the preparation of electronics rack builds and a method of organizing documentation for reviews, operations, and maintenance.

- Rack Build tool

https://docs.dunescience.org/cgi-bin/sso/ShowDocument?docid=20490

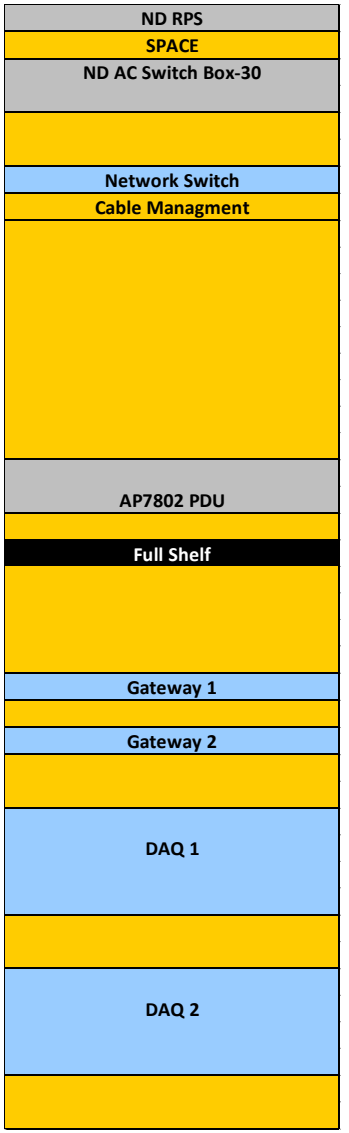
- Electronics Documentation Links

https://docs.dunescience.org/cgi-bin/sso/ShowDocument?docid=21955

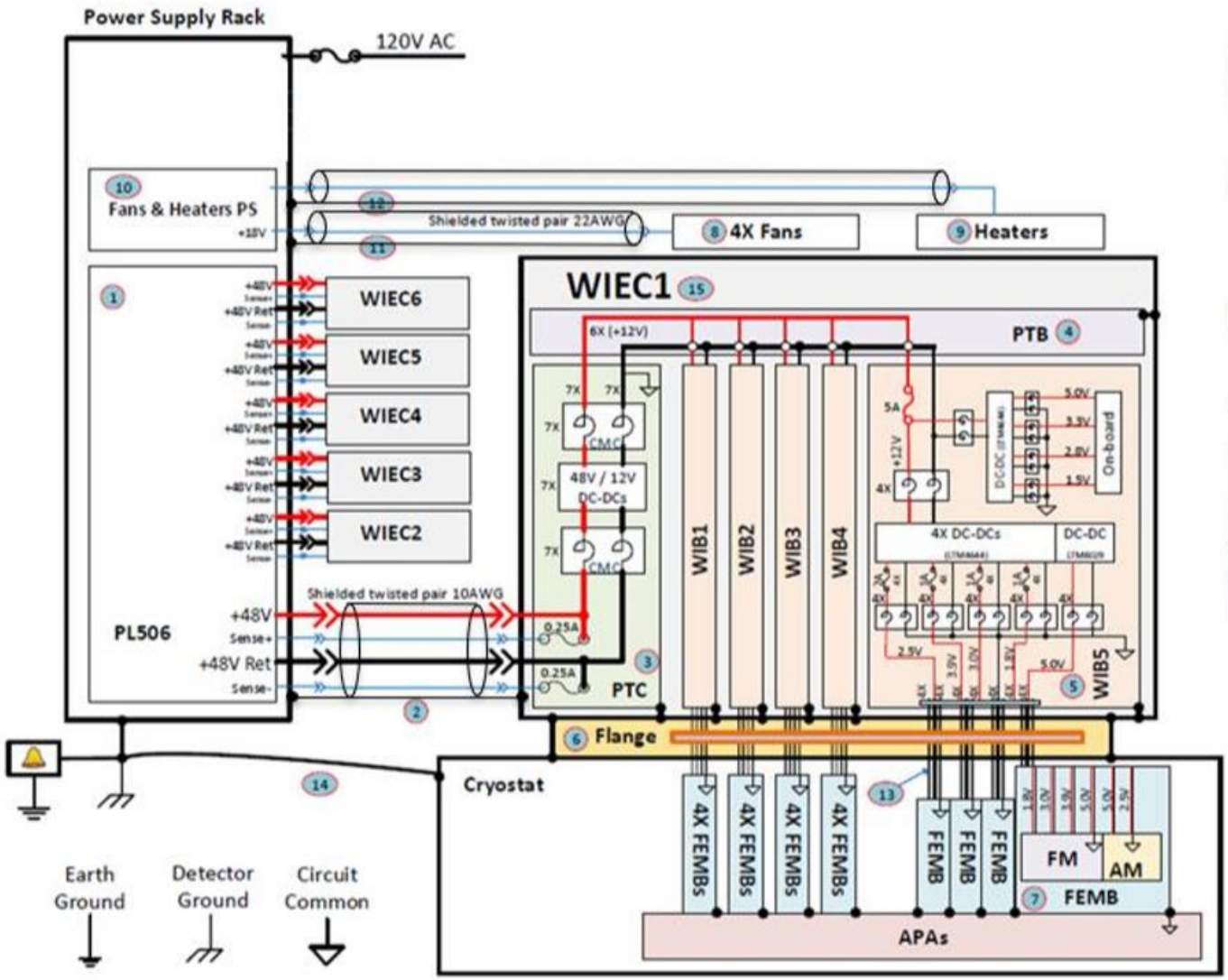
Rack Build Example

- List all rack equipment
- Useful to have a system block diagram

		Server Rack									
# of racks	Location	Rack Name	Rack Components	Network	Voltage (V)	Current (A)	Power (VA)	Space (U)	120V/15A	120V/20A	120V/30A
1	Under catwalk	Server	ND RPS		120	1	120	1	1		
			Space					1			
			Switch Box-30					2			1
			Space					4			
			network switch		120	5	600	1	1		
			cable management					1			
			space					6			
			gateway computer	2	120	2	240	1	2		
			space					1			
			gateway computer	2	120	2	240	1	2		
			Space					2			
			DAQ computer	2	120	3	360	4	1		
			Space					2			
			DAQ computer	2	120	3	360	4	1		
			Space					2			
			Total	**8**		**16**	**1920**	**33**	**8**	**0**	**1**



System DC distribution example



1: Weiner PL506 Power Supply
2: 48V power cable
3: PTC (Power and Timing Card)
0.25A Fuse P/N: 3404.0006.11
Choke P/N: PLT10HH501100PNL
4. PTB (Power and Timing Backplane)
5: WIB (Warm Interface Board)
5A Fuse P/N: 3404.0017.11
2A Fuse P/N: 0468002.NR
1A Fuse P/N: 0468001.NR
Choke P/N: PLT5BPH5013R1SNL
6: Flange Board
7: FEMB (Front End Motherboard)
FM: FPGA Mezzanine
AM: Analog Motherboard
8: Fans box
Fans are electrical isolated from WIEC
9: Heater
Heater is electrical isolated from WIEC
10: Fans & Heater power supply
11: Fans power cable (shielded)
12: Heater power cable
13: 7m cold power cable
14: Grounding cable
15: Warm Interface Electronics Crate (WIEC)

Notes
(1) Fans and heaters are isolated from WIEC
(2) PTB is mounted with the brass standoffs as a grounding connection
(3) The grounding connection between WIBs and WIEC is through front panels and side bars
(4) The grounding connection between PTB and WIEC is through front panels and side bars
(5) Flange (and flange board) is the place that the FEMB circuit common is referenced to the cryostat (detector ground)

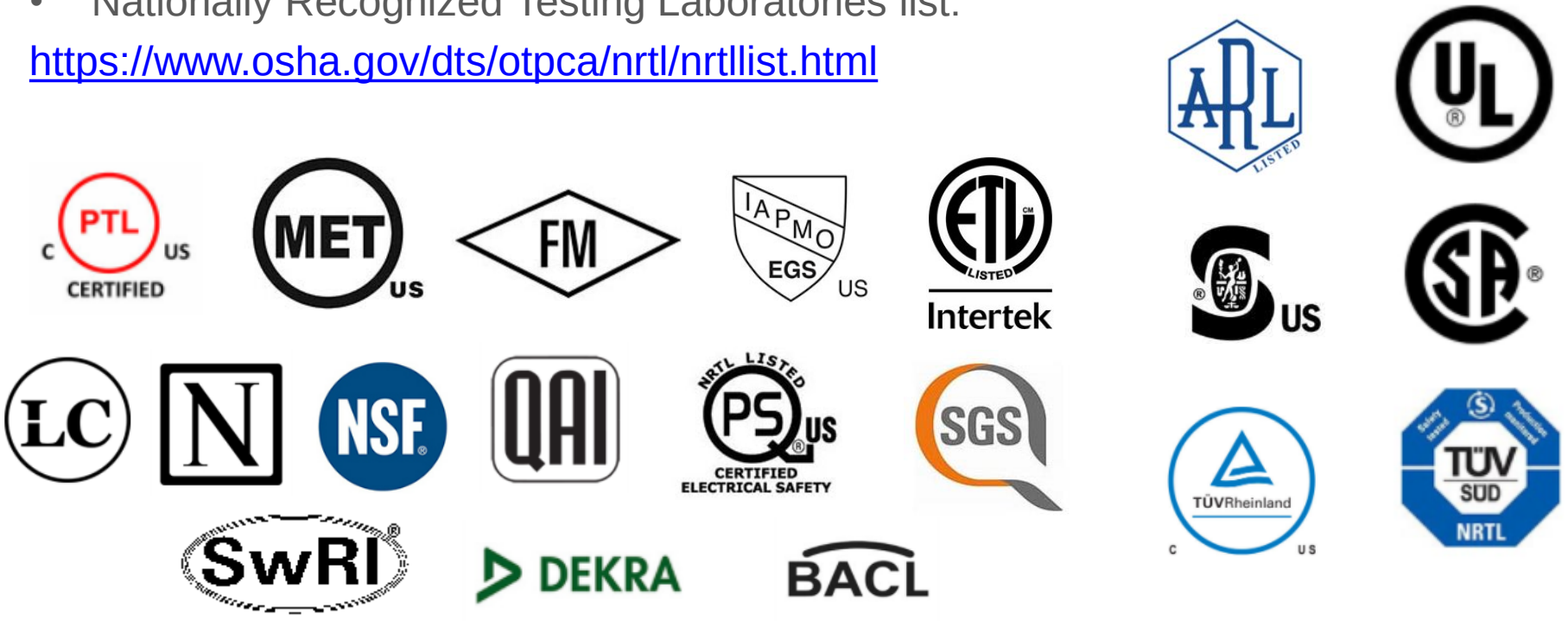
S. Gao

NRTL Seal and CE Mark

Electrical Equipment Approvals

- Per the Department of Energy's prime directive to Fermilab, Fermilab is required to follow the National Electrical Codes (NEC) and Occupational Health and Safety Administration (OSHA) guidelines.
- OSHA requires all commercial equipment to be approved by the electrical Authority Having Jurisdiction (AHJ).
  - The AHJ for Fermilab is David Mertz.
- Nationally Recognized Testing Laboratories list:

https://www.osha.gov/dts/otpca/nrtl/nrtllist.html



CE Mark

- OSHA requires Nationally Recognized Testing Laboratories (NRTLs) to be independent from the manufacturer.
- The CE mark is a manufacturer's self-certification, therefore, the mark does not meet OSHA requirements.
- https://www.osha.gov/dts/otpca/nrtl/nrtl_faq.html

The CE mark is unrelated to the requirements for product safety in the United States. It is a generic mark used in the European Union (EU) to indicate that a manufacturer has declared that the product meets regulatory requirements in the EU that may or may not include product safety. In the United States, under OSHA's NRTL requirements, the product must have the specific mark of one of the NRTLs recognized to test and certify this type of product.

Similarly, ATEX Certification is a certification of equipment intended for use in potentially explosive atmospheres in the European Union. Equipment intended for use in potentially explosive atmospheres in the United States must have the specific mark of one of the NRTLs recognized to test and certify this type of equipment.

- For custom designs or CE marked equipment, there are 3 solutions:
  - Safety Engineering Design Review (SEDR).
  - Have vendor obtain a Nationally Recognized Testing Laboratory (NRTL) listing so the equipment bears a NRTL seal.
  - Have a Nationally Recognized Testing Laboratory (NRTL) representative perform a field inspection of the equipment on site.

Summary

- Equipment must operate at voltages/frequency readily available on the US power grid.
- All set-ups must have a safety review. Level of the review is based on hazards.
- Generate block diagrams of all systems.
- Power requirements (voltage/current) must be provided for all equipment.
  - Identify building or detector power.
  - Use the Rack Build tool to itemize equipment.