EFCOG Best Practice - #254

Non-NRTL Utilization Equipment Inspection Process (NNUEIP)

Facility: DOE Complex

Best Practice Title: Non-NRTL Utilization Equipment Inspection Processes (NNUEIP)

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Brief Description of Best Practice: This best practice provides an example of a consistent and effective Non-Nationally Recognized Testing Laboratory (non-NRTL) Utilization Equipment Inspection Processes for use across the Department of Energy (DOE) Complex which is in compliance with Occupational Safety and Health Administration (OSHA) and DOE regulations and consensus standards such as: National Electrical Code (NEC), National Fire Protection Association (NFPA) 70E, NFPA 790/791, and the DOE Electrical Safety Handbook, Appendix C.

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Why the best practice was used: Presently, each DOE site has their own unique non-NRTL inspection process. This best practice incorporates lessons learned and experience from across the complex to create a standardized example for non-NRTL inspection processes.

What are the benefits of the best practice: Provides guidance regarding the implementation of Non-NRTL Utilization Equipment Inspection Processes. Building consistency among the DOE complex will also encourage reciprocity throughout the DOE and provides the safest possible equipment for our researchers.

What problems/issues were associated with the best practice: N/A (New best practice)

How the success of the Best Practice was measured: N/A (New best practice)

Description of process experience using the Best Practice: N/A (New best practice)

EFCOG Best Practice #254
Non-NRTL Utilization Equipment Inspection Process

INTRODUCTION

A survey was conducted to better understand the state of non-NRTL utilization equipment inspection processes and procedures across the Department of Energy (DOE) Complex to aid in developing these Best Practices. In this context, utilization equipment follows the NFPA 791 definition for electrical equipment such as: Any device, appliance, or machine that generates, conducts, stores, or utilizes electrical energy. This review specifically examined topics such as: safety in design, procurement, and field evaluations as they directly relate to non-Listed equipment. The purpose of the DOE Authority Having Jurisdiction (AHJ) Program is to ensure that all non-NRTL electrical equipment that is used at, by, or for the respective sites is approved, and therefore compliant with Occupational Safety and Health Agency (OSHA) and DOE regulations. Since all electrical equipment must be approved before being placed into service, it is essential to determine whether and how the equipment can be approved when said equipment is being selected for acquisition. Equipment that is "Listed" by an OSHA-accredited Nationally Recognized Testing Laboratory (NRTL) is "approved" for its "intended use". However, equipment that is "not Listed" or is being used for something other than its intended purpose may require a NRTL, Third Party Field Evaluation Body (FEB) and/or an AHJ Field Evaluation. NRTL Field Evaluations can be relatively expensive and time consuming, and the costs for modifying non-Listed equipment can only be known after the field evaluation is completed. Due to a lack of appropriate product standards for unique or custom-built equipment, programmatic schedule and/or budget constraints, it is sometimes necessary to waive the NRTL or Third-Party FEB requirement and instead perform an AHJ Field Inspection. These Best Practices describe standardized processes and procedures for AHJ Programs across the DOE Complex to follow when approving said non-NRTL listed utilization equipment.

BACKGROUND AND DISCUSSION

Procurement of Electrical Equipment

The procurement process should ensure all electrical equipment is NRTL listed (or otherwise "acceptable" per federal regulations) that may present a significant risk to persons or property whether equipment is purchased, custom-built, rented, or borrowed. Per OSHA, 29 CFR 1910.399 and 1926.403 (a), (b):

An installation or equipment is "acceptable" to the Assistant Secretary of Labor, and approved within the meaning of this Subpart S:

(1) If it is accepted, or certified, or listed, or labeled, or otherwise determined to be safe by a nationally recognized testing laboratory recognized pursuant to § 1910.7; or
(2) With respect to an installation or equipment of a kind that no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, if it is inspected or tested by another Federal agency, or by a State, municipal, or other local authority responsible for enforcing occupational safety provisions of the National Electrical Code, and found in compliance with the provisions of the National Electrical Code as applied in this subpart; or
(3) With respect to custom-made equipment or related installations that are designed, fabricated for, and intended for use by a particular customer, if it is determined to be safe for its intended use

by its manufacturer on the basis of test data which the employer keeps and makes available for inspection to the Assistant Secretary and his authorized representatives.

In other words, and in order of preference,

(1) If a NRTL listed product for the intended purpose/location is available, then it is accepted and should be procured/used
(2) If NRTL listed equipment does not exist, but applicable product standards are available, the equipment should be inspected by an NRTL Field Evaluation Body (FEB), preferably at the source/factory if possible. The NRTL field evaluation should be included in the procurement requirements (i.e. statement of work, purchase order, contract, etc.) prior to placing order.
(3) If equipment is not NRTL listed and a field evaluation is not possible, then contact the electrical AHJ representative for resolution. Equipment should be approved by the AHJ representative prior to procurement using NFPA 791 4.1 - Pre-site Information, as a guide. Note: When local expertise is not available to evaluate the equipment, the inspections should be subcontracted to other relevant subject matter experts.

Training should be implemented for all personnel requesting the purchase of and procuring of electrical equipment to recognize the acceptability requirements per federal regulations. In addition to the initial training, periodic training should also be employed as a refresher course for all requestors/purchasers and as a remedial activity for personnel not following proper procurement processes and procedures. The procurement processes and procedures should clearly guide the requestors/purchasers to implement the required controls for the procurement of electrical equipment (i.e. computerized automated system, checkboxes, flow charts, etc.)

Receipt Inspections

In addition to other receipt inspection processes, electrical equipment arriving at the facility should be verified as NRTL listed. If equipment arrives that is not NRTL listed, contact AHJ representative for resolution prior to releasing from receiving department. Additional inspections such as verification of part numbers and suspect/counterfeit identifiers should also be considered.

Standardized Non-NRTL Approval Checklist

Provided in Attachment A is an example of a "Standardized Non-NRTL Approval Checklist Form." Instructions and definitions for the form can be found in Appendix C of the DOE Electrical Safety Handbook.

The following bulleted list are suggestions for improving this form:

- General
    - Bold Borders to separate sections

  - Align checkboxes
  - Checkboxes need labels
  - Rename to Non-NRTL listed/modified equipment approval form
  - Remove facility and equipment non-NRTL forms from DOE Electrical Safety Handbook

- Identify Equipment Status
  - Modified NRTL
  - Modified non-NRTL

- Foreign Power Supplies
  - Document color coding, check for fused neutrals
- Marking
  - Verify Short Circuit Current Rating
  - Document Fuse Replacement Info and operating temperature
  - Identify available drawings and manuals from manufacturer
- Secondary Hazards
  - Add Radiation, Noise, Other
- Internal Wiring
  - Recalled Components
  - Suspect/Counterfeit
  - Proper guarding as required for >=50V
  - Intrinsically safe wiring separated
  - NRTL listed components should be used for >=50V
  - Non-NRTL or recognized components should be evaluated for use case.
  - Non-NRTL components should be protected by NRTL fuse.
- Tests Performed
  - Ground Bond Test
  - Hipot and GFCI testing/leakage current when applicable

System Non-NRTL Approval Checklist

For inspection of electrical systems, a systems-level approval form should be used. Attachment B provides an example of a "Standardized Non-NRTL System Approval Checklist Form." Again, Instructions and definitions for the form can be found in Appendix C of the DOE Electrical Safety Handbook (2013).

The following bulleted list are suggestions for improving this form:

- General
  - Add N/A Column
  - Add mechanical/seismic restraint

Performing modifications to existing listed equipment

If modifications to existing NRTL listed equipment are:

- Performed by the original manufacturer and included in their NRTL listing, then no additional inspections are needed
- Performed by an entity other than the original manufacturer and modification is outside NRTL listing, then a re-evaluation should be performed by a NRTL Field Evaluation Body
    - If a NRTL field evaluation is not possible, then an AHJ inspection should be performed using a Standardized Non-NRTL Approval Checklist form
        - Modifications should be approved based on site specific requirements
        - Components should be NRTL Listed/Recognized

Temporary equipment brought on-site from other entities

Often visitors and/or subcontractors bring their own non-NRTL electrical equipment for use onsite. Below are recommended non-NRTL equipment inspection processes with respect to specific situations:

- Visitors (Users)
    - From another DOE Site:
        - Review visitor site's non-NRTL inspection results
            - If reciprocity is in place, then
                - Accept or re-inspect using graded approach
            - If no previous inspection or no reciprocity is in place, then
                - Perform full inspection at AHJ's discretion
    - From public/private companies and universities:
        - Follow site requirements for NRTL or acceptance inspection of non-NRTL
        - Inspect for potential impacts of equipment failure on facility/personnel
- Subcontractors
    - NRTL site requirements should be included in the subcontract
    - Equipment should be NRTL listed, or approved by the AHJ, or by an AHJ approved inspection program performed by the outside entity
    - Subcontractor is responsible to follow site specific electrical requirements

Conclusion

A study of the electrical equipment approval processes across the DOE Complex was conducted at our 2022 annual Energy Facility Contractors Group (EFCOG) Electrical Safety Task Team (ESTT) Summer Workshop. Our NNUEIP Working Group consisted of twenty-one participants from eighteen DOE sites. This review primarily focused on the non-NRTL utilization equipment procurement, receipt inspection and AHJ evaluation methods for initial equipment acceptance along with criteria for the approval of modified and temporary-use equipment scenarios. We recommend creating electronic versions of the equipment-level and system-level approval checklist forms with searchable fields, automatically resizable input

sections along with drop down menus. These best practices provide consistent, effective, and standardized processes and procedures for AHJ Programs across the DOE Complex to follow when procuring and inspecting non-NRTL listed utilization equipment for compliance with OSHA and DOE regulations.

References

[1] *DOE Handbook: Electrical Safety*, DOE-HDBK-1092-2013, U.S. Department of Energy, Washington D.C. 20585

[2] *Occupational Safety and Health Standards*, 29 CFR 1910 and 1926, Occupational Safety and Health Administration, Washington, D.C. 20210

[3] *National Electrical Code (NEC),* NFPA 70, National Fire Protection Association, Quincy, MA 02169

[4] *Standard for Electrical Safety in the Workplace*, NFPA 70E, National Fire Protection Association, Quincy, MA 02169

[5] *Standard for Competency of Third-Party Field Evaluation Bodies*, NFPA 790, National Fire Protection Association, Quincy, MA 02169

[6] *Recommended Practice and Procedures for Unlabeled Electrical Equipment Evaluation*, NFPA 791, National Fire Protection Association, Quincy, MA 02169

Non-NRTL Utilization Equipment Inspection Process

ATTACHMENT A: Standardized Non-NRTL Approval Checklist Form

SECTION 1 – Information		
Site Inspector Tracking Number (i.e. LLNL-#########):		
Group:	Responsible Person:	Employee#:
Equipment Name:		
☐ Multiple ☐ Single		
Manufacturer:		
Model Number:		
Serial number of piece of equipment actually evaluated (see attached form for additional serial numbers of identical equipment):		
Property number of piece of equipment actually evaluated (see attached form for additional property numbers of identical equipment):		
Location Site:	Bld:	Room:
Identify Equipment Status: ☐ New ☐ Used ☐ Modified ☐ Not Previously Approved ☐ In Use		
Equipment Type: ☐ Stand-alone custom built ☐ System ☐ Powered rack		
☐ Appliance/electrical tools ☐ Powered workbench ☐ Extension cord/relocatable power taps ☐ Other		
Function and Use (duty cycle):		
Operating Environment:		
☐ Indoor/dry ☐ Outdoor/wet/damp ☐ Flammable vapor/dust/flyings ☐ Explosive gas/powder/solid		

SECTION 2 – External Inspection			
Enclosure:		**Foreign Power Supplies and Equipment:**	
☐ Operator not exposed to any hazard	☐ NA	☐ Appropriate power adapters & check for fused neutrals	☐ NA
☐ Not damaged	☐ NA	☐ Correct voltage, frequency, and phasing	☐ NA
☐ Appropriate Material	☐ NA	☐ Correct wire color & ampacity for U.S. use	☐ NA
☐ Protects contents from operating environment	☐ NA	**Overcurrent Protection:**	
☐ Will contain any arcs, sparks, electrical explosions	☐ NA	☐ Overcurrent protection ☐ Equipment Branch Circuit	☐ NA
Power Source – Cord and plugs:		**Marking Requirements:**	
☐ Proper voltage and ampacity rating for plug and cord	☐ NA	☐ Hazards, including stored energy	☐ NA
☐ Grounding conductor included if required	☐ NA	☐ Power requirements (voltage, current, frequency)	☐ NA
☐ Not frayed or damaged	☐ NA	☐ Restriction and limitations of use	☐ NA
☐ Proper wiring of plug	☐ NA	☐ Make/Model/Drawing Numbers & Manuf. Manuals	☐ NA
☐ Strain relief on cord	☐ NA	☐ Verify SCC rating and document fuse/operating info	☐ NA
Power Source – Direct wired into facility		**Other Requirements:**	
☐ Proper voltage and ampacity rating for wiring method	☐ NA	☐ Documentation adequate	☐ NA
☐ Installation according to NEC	☐ NA	☐ Procedures to use (IWD)	☐ NA
☐ Proper loading and overcurrent protection in branch circuit	☐ NA	☐ Training and qualification to use	☐ NA
Grounding:		**Secondary Hazards:**	
☐ Ground from cord or other is properly terminated	☐ NA	☐ RF hazards	☐ NA
☐ All non-current carrying exposed metal is properly bonded	☐ NA	☐ DC electric or magnetic fields	☐ NA
☐ All non-current carrying internal subsystems are properly bonded	☐ NA	☐ Non-Ionizing Radiation (IR, Visible, or UV)	☐ NA
☐ Equipment ground is run with circuit conductors	☐ NA	☐ Ionizing Radiation (Neutrons, X-rays, Gamma, etc.)	☐ NA
☐ Auxiliary ground permitted: Check Termination	☐ NA	☐ Fire, electrical explosion ☐ Noise ☐ Other	☐ NA

ATTACHMENT A: Standardized Non-NRTL Approval Checklist Form (Continued)

PART 2 – Internal Inspection			
Internal Wiring		**Tests Performed**	
☐ Recalled/Suspect/Counterfeit Components	☐ NA	☐ Ground bond test	☐ NA
☐ Proper guarding as required for >=50V	☐ NA	☐ HiPot and GFCI test/leakage current	☐ NA
☐ Intrinsically safe wiring separated	☐ NA	☐ Ground continuity (less than 1 ohm)	☐ NA
☐ NRTL-listed components used for >=50V	☐ NA	☐ Polarization of cord and plug	☐ NA
☐ Non-NRTL or Recognized components evaluated for use case	☐ NA	☐ Auto discharge of high voltage capacitor	☐ NA
☐ Non-NRTL components protected by NRTL fuse	☐ NA	☐ Functional test (e.g., GFCI, emergency shut-off)	☐ NA
☐ Polarity correct	☐ NA	☐ Others	☐ NA
☐ Phasing correct	☐ NA		
☐ Landing of ground correct	☐ NA	**Failure Analysis:**	
☐ Separated – line voltage and high voltage from low voltage	☐ NA	☐ Effect of ground fault	☐ NA
☐ Wiring terminals and leads	☐ NA	☐ Effect of short circuit	☐ NA
☐ Wire sizes adequate	☐ NA	☐ Effect of interlock failure	☐ NA
☐ Proper dielectric	☐ NA	☐ Effect of overload	☐ NA
☐ Clearance/creepage distances for high voltage	☐ NA	☐ Effect of incorrect setting	☐ NA
☐ Listed conductors	☐ NA	☐ Others	☐ NA
Other Internal Issues:		**Maintenance:**	
☐ Neat workmanship	☐ NA	Any safety issues with access and maintenance: ☐ Yes ☐ No	
☐ Listed components used	☐ NA	Explain:	
☐ Proper management of conductors	☐ NA	**Comments:**	
☐ Free of sharp edges	☐ NA		
☐ Proper cooling	☐ NA		
☐ Automatic discharge of high voltage capacitor	☐ NA		

NOTE: APPROVED EQUIPMENT WILL BE INSTALLED AND USED IN ACCORDANCE WITH THE INSTRUCTIONS PROVIDED BY THE DESIGNER/BUILDER AND AHJ.

Condition of Usage/comments: (Include all designer/builder instructions, drawings, or information that is relevant to the safe installation and use of this equipment. Attach additional sheets as necessary.):

This equipment is **APPROVED** for installation and use at *YOUR INSTITUTION*. IF THIS EQUIPMENT IS MODIFIED, DAMAGED, OR UTILIZED FOR OTHER THAN THE INTENDED USE STATED ABOVE, THIS APPROVAL IS VOID, PENDING RE-EXAMINATION.

DATE:	AHJ / Electrical inspector Printed Name:	AHJ / Electrical Inspector Signature:
Summary/Comments:		

This equipment is **REJECTED** for use at *YOUR INSTITUTION* (see comments above).

DATE:	AHJ / Electrical inspector Printed Name:	AHJ / Electrical Inspector Signature:
Summary/Comments:		

ATTACHMENT B: Standardized System Non-NRTL Approval Checklist Form

SECTION 1 – Information		
Site Inspector Tracking Number (i.e. LLNL-#########):		
Group:	Responsible Person:	Employee #:
System Name:		
System Description:		
Manufacturer, if any:	# of pieces of equipment in system:	
Model Number, if any:		
Serial Number of System Actually Evaluated (see attached for additional serial numbers of identical equipment):		
Date Built:	Date Last Modified:	
Location Site:	Bld:	Room:
Identify Equipment Status: ☐ New ☐ Used ☐ Modified ☐ Not Previously Approved ☐ In Use		
Function and List of Subsystems:		

SECTION 2 – Hazard Assessment

Determine all electrical and non-electrical hazards that could injure an employee, including operation and maintenance workers.

Hazard Classification		Hazard Characteristics
☐ Stored electrical energy in capacitors (E and V)	☐ NA	
☐ Batteries, including UPSs	☐ NA	
☐ Electromagnetic fields produced (dc to 300 GHz, pulsed)	☐ NA	
☐ Non-Ionizing Radiation (IR, optical, or UV)	☐ NA	
☐ Ionizing Radition (Neutrons, X-rays, Gamma, etc.)	☐ NA	
☐ Heat and sparks	☐ NA	
☐ Acoustic energy	☐ NA	
☐ Fire, Explosion	☐ NA	
☐ Other (chemical, high pressure, cryogen, etc.)	☐ NA	

ATTACHMENT B: Standardized System Non-NRTL Approval Checklist Form (Continued)

SECTION 3 – Evaluation for Operation: Determine that engineering controls adequately protect the operators and users during system operation.	**APPROVE**	**REJECT**	**NA**
Enclosure, isolation. No exposed hazardous energized conductors, no unused openings.	☐	☐	☐
Grounding. All conductive enclosures exposed to personnel properly grounded.	☐	☐	☐
Overcurrent protection. Provision for overload, ground fault, and short circuit	☐	☐	☐
Failure analysis. Adequate electrical and fire protection systems for failure modes.	☐	☐	☐
Operation safety analysis and controls documented where? E.g., IWD	☐	☐	☐
System is labeled as approved, how?	☐	☐	☐
Other, explain.	☐	☐	☐
SECTION 4 – Evaluation for Working on System: Determine that engineering controls are implemented, in conjunction with work control to safely enter into and work on the system.	**APPROVE**	**REJECT**	**NA**
Method(s) of energy isolation (e.g., plug control, LOTO, Kirk key)	☐	☐	☐
Automatic methods of stored energy removal, if necessary	☐	☐	☐
Proper design for the manual removal and/or verification of capacitively stored energy	☐	☐	☐
Documentation for entry and work on system where? E.g., IWD	☐	☐	☐

NOTE: System will be installed and used in accordance with the instructions provided by the designer/builder and AHJ approval.

Comments/conditions of use: (Include all designer/builder instructions, restrictions on use, drawings or information that is relevant to the safe installation and use of this equipment. Attach additional sheets as necessary)

☐ This system and its associated electrical equipment is **APPROVED** for installation and use at *YOUR INSTITUTION*. IF THIS SYSTEM IS MODIFIED, DAMAGED, OR REPAIRED IN A MANNER THAT AFFECTS SAFETY, THIS APPROVAL IS VOID, PENDING RE- EXAMINATION BY AN

☐ This system is **REJECTED** for use at *YOUR INSTITUTION*. (See comments above.)

Note: The following signatures indicate that these electrical inspector(s) have reviewed some or all parts of this system for safety. In some cases, an electrical inspector inspects only sections of the system for which their group is responsible. The head electrical inspector (if any) ensures that all components have been reviewed by one or more group electrical inspectors.

ATTACHMENT B: Standardized System Non-NRTL Approval Checklist Form (Continued)

SECTION 5 – Approval Signatures			
Division/Group	Date:	Head Equipment Inspector Printed Name	Head Electrical Inspector Signature:
Division/Group	Date:	Equip. Insp Printed Name	Equip. Inspector Signature:
Division/Group	Date:	Equip. Insp Printed Name	Equip. Inspector Signature:
Division/Group	Date:	Equip. Insp Printed Name	Equip. Inspector Signature:
Division/Group	Date:	Equip. Insp Printed Name	Equip. Inspector Signature:

	SECTION 6 – Specific Tests Performed for Approval List tests performed relevant to safety.	**Date**	**Who**
1			
2			
3			
4			
5			
6			
7			

	SECTION 7 – Immediate Improvements List required modifications (with a due date) and compensatory measures taken to ensure safety if system is operated before modifications.	**Date**	**Who**
1			
2			
3			
4			
5			
6			
7			