

Best Practice #207

Facility: Entire DOE Complex

Best Practice Title: Identification of Look-Alike Electrical Equipment

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Brief Description of Best Practice: NFPA 70E-2015 Section 130.7(E)(4) addresses the need to alert workers when multiple units of electrical equipment in the same work area are similar in size, shape and construction. Such “look-alike” equipment can be a source of confusion for workers who may inadvertently enter energized electrical equipment instead of the intended electrical equipment that has been placed into an electrically safe work condition. This Best Practice provides recommendations for implementing the NFPA 70E-2015 Section 130.7(E)(4) requirement and to be consistent with the “Flagging” section of DOE-HDBK-1028-2009, *Human Performance Improvement Handbook*, Vol. 2.

Why the Best Practice was used: Serious accidents have occurred at multiple DOE sites in recent years because workers inadvertently entered energized equipment instead of the deenergized equipment they were intended to maintain or repair. NFPA 70E-2009 and later editions have included a requirement to protect workers against this type of hazard. Development of a Best Practice was identified by the EFCOG Electrical Safety Task Group as the best method to assist DOE contractors with implementing this NFPA 70E requirement through their electrical safety programs.

EFCOG Working Group Members Participating on Best Practice Review Team:

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What are the benefits of the Best Practice: This Best Practice provides practical guidance that DOE sites can immediately adopt to meet NFPA 70-2015 Section 130.7(E)(4).

What problems/issues were associated with the Best Practice: The various DOE sites employ different methods to implement their respective electrical safety programs, which introduced difficulty in determining the appropriate level of detail to include in the Best Practice. Some sites perform much of their own electrical maintenance work while others subcontract it. The intent of this Best Practice is to address power distribution and R&D equipment. Thus, the Best Practice is written to identify the critical issues associated with Look Alike equipment of various configurations, and provide solutions to reduce risk by preventing hazard exposure while remaining generic enough to permit its use across the DOE Complex.

How the success of the Best Practice was measured: Several DOE sites have successfully implemented – formally or informally – components of this Best Practice to reduce the likelihood that a worker would accidentally enter energized equipment instead of the intended nearby equipment that had been placed in an electrically safe working condition.

Description of process experience using the Best Practice: The known operating experience to date is limited to a few sites associated with the development of this product who have successfully employed components of this Best Practice at their respective sites.

Introduction

This document is intended to provide comprehensive and practical guidance to assist DOE sites to address the “look-alike” electrical equipment identification requirement from NFPA 70E-2015 Section 130.7(E)(4). The information in this document summarizes the collective experience and knowledge of several DOE contractors in the Energy Facility Contractor’s Group’s (EFCOG’s) Electrical Safety Task Group. It is intended for use by EFCOG contractors for general support purposes only. This information is not a formal interpretation of the NFPA 70E requirement or a binding DOE requirement.

This Best Practice is intended to address “look-alike” equipment as described in NFPA 70E.

Definitions

Terms used in this Best Practice – such as “electrically safe working condition” and “qualified worker” – are intended to have the same meaning as used in NFPA 70E-2015.

The following terms are defined for clarity or the convenience of the reader.

- **Look-Alike Equipment.** [Adapted from NFPA 790E-2015 Section 130.7(E)(4)] Equipment similar in size, shape and construction to other equipment in such a way that a worker could reasonably be expected to confuse one equipment item for another.
- **Qualified Person.** [NFPA 70E-2015] One who has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations and has received safety training to identify and avoids the hazards involved.
- **Hazardous Electrical Energy.** [Adapted from EFCOG Best Practice 120] Electrical energy that exceeds the thresholds for a shock, arc flash, or thermal hazard established in the EFCOG/DOE Electrical Severity Measurement Tool, Revision 3, dated May 1, 2013.

Permanent Labeling

A prerequisite to preventing accidents involving Look-Alike equipment is to apply permanent equipment ID labels suitable for the environment to which they will be exposed. Both power and Research and Development equipment presenting look-alike hazards should be labeled.

For example, in a switchgear lineup with similar cubicles, labels that clearly identify the equipment supplied by the cubicle (or alternately the cubicle ID) should be placed:

- On the outside of doors.
- On bolted panels that are likely to be removed for maintenance.
- Inside the cubicle or on the switchgear frame to provide identification means for the worker when the door is open or panel is removed. This will also assist with replacing a bolted panel in the correct location.

The highest voltage and/or greatest electrical hazard that could be present should be labeled on the outside of the door or removable panel.

A similar approach can be taken for other types of electrical equipment.

Work Planning

Work control documents should identify when Look-Alike equipment is a potential concern for specific work tasks. When Look-Alike equipment is a potential concern, a qualified person familiar with the specific equipment and the planned work activity shall walk down the equipment as part of the pre-job planning. The purpose of this walk down is to determine appropriate mitigations (a combination of signs, barricades, and/or attendants) that would be needed to prevent workers from entering Look-Alike equipment. Those mitigation actions shall be incorporated into the work plan. The work plan should also include provisions to track the installation and removal of Look-Alike signs and barricades.

Special attention is required during planning for projects that involve Look-Alike equipment when multiple work groups or multiple employers are involved in the work. Plans must ensure that supervisors and employers agree on and fully understand how Look-Alike equipment will be identified and then communicate that information to their affected workers.

Temporary Signs and Barricades for Look-Alike Equipment

Temporary signs should be used to reflect the current electrical hazard state of look-alike equipment (de-energized or energized).

Within the work area, apply signs directly on look-alike equipment or portions thereof that may contain hazardous electrical energy during the work and might be subject to accidental entry.

Sign sizes should be large enough to draw attention to the equipment status, but not inhibit work or cover permanent equipment labeling.

NFPA 70E requires that barricades shall be used in conjunction with safety signs where it is necessary to prevent or limit employee access to work areas containing energized conductors or circuit parts. Conductive barricades shall not be used where it might increase the likelihood of exposure to an electrical hazard.

However, in addition to signs, this Best Practice recommends that, when feasible, barricade tape should be applied directly to equipment or portions thereof that will continue to contain hazardous electrical energy during the work and might be subject to accidental entry. Apply the tape across doors, panels or covers so spaces behind them cannot be accessed without removing or breaking the tape.

Some examples of Wording for Look-Alike signs:

- “Notice – Look-Alike Equipment, Equipment is Under LOTO”
- “Notice – Look-Alike Equipment, Maintenance/Service in Progress”
- “Warning – Look-Alike Equipment Under Test”
- “Danger – Look-Alike Equipment, Equipment is Energized”

All signs and barricade tape will follow ANSI standards. Nonconductive signs shall be used if placed within the Limited Approach Boundary of a potential exposure.

If signs and barricades do not or cannot provide sufficient warnings and protection from electrical hazards, an attendant shall be stationed to warn workers of potential hazards. The attendant shall focus only on the task at hand.

Work Execution

A pre-job brief shall address the meaning of installed look-alike equipment barricade tape, signs, and other information related to identification of the look-alike equipment. This identification means shall also be discussed with subcontractors during host/subcontractor meetings required by NFPA 70E. Access to areas where look-alike equipment is identified using this best practice should be restricted to employees who have been briefed as detailed above.

Installation of the Look-Alike equipment barricade tape and signs shall comply with the approved work plan and be supervised by a qualified person. The Person in Charge should walk down equipment marked with temporary signs and barricade tape to ensure it is adequately fastened in place, is still intact, and its placement is consistent with the current system configuration and the lockout/tagout permit(s):

- After the tape is first applied on the equipment at the beginning of a job.
- At the start of each work shift.
- After changes to the lockout/tagout permit, work scope or any equipment configuration change.

When discrepancies are discovered, the Person in Charge shall pause work until the discrepancy is corrected.

Similarly, workers must pause work, immediately notify other workers in the vicinity, and notify the Person in Charge if they encounter barricade tape or temporary signs that has detached from the equipment, is broken, or does not appear to be correctly positioned.

After initial installation, only the Person in Charge or their designee is permitted to remove, move, or reinstall tape, signs, or other means used to identify the Look-Alike equipment.

Cones, stanchions, and similar equipment intended to “guide” the worker to the correct equipment or equipment part shall be clearly identified as to its purpose and be marked, “Do Not Move”. These items shall be placed so as to not become tripping hazards if workers are wearing darkly tinted face shields or need to quickly move away from the gear and/or exit from the area.

Closeout

At the conclusion of the work activity or release of the LOTO, temporary Look-Alike equipment signs and barricades shall be removed. Leaving Look-Alike signs or barricades in the field diminishes their impact and could increase, rather than decrease, worker confusion.

Attachments

Figure 1 – Look-Alike Equipment



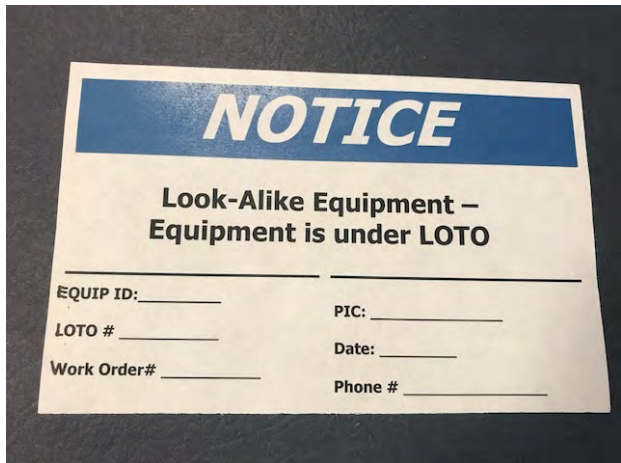
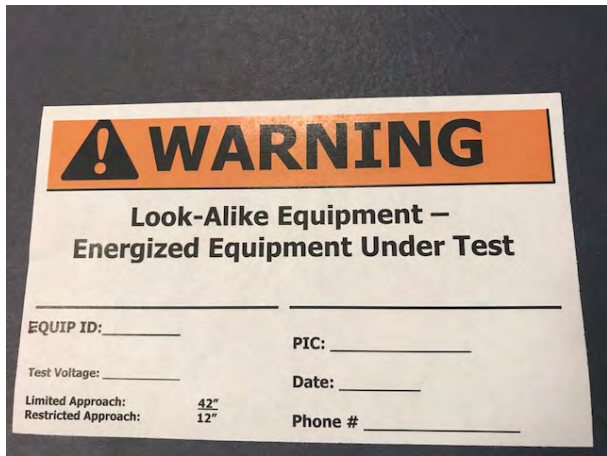
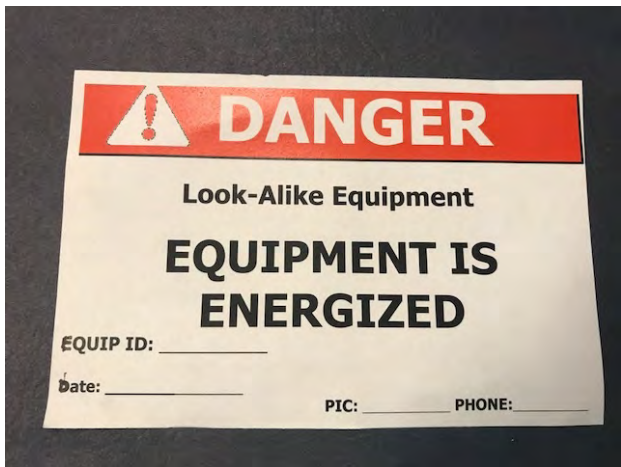
Example of permanent equipment ID labels and labeling of “blank” unused compartments

Figure 2 – Look-Alike Equipment



Example of side-by-side look-alike equipment with permanent equipment ID labels

Figure 3 – Examples of Look-Alike Equipment Status Signs



Examples of Look-Alike Equipment Signs using ANSI standards
Figure 4A (Top) – Look-Alike Equipment



Example of side-by-side look-alike equipment indicating which ones are de-energized and under LOTO and which ones are energized

Figure 4B – Energized Equipment Marking



Addition of barricade tape to provide enhanced warning of energized look-alike equipment

Figure 4C – Equipment to be Worked On



Notice sign on unit to be accessed, indicating LOTO and Work Authorization documents needed

Figure 5A – Unit Substation during Maintenance, Front



Example of marking sections workers are to stay clear of using barricade tape

Figure 5B – Unit Substation during Maintenance, Rear



Using barricade tape on both the front and back of the energized equipment, to minimize human error when counting cubicles or when equipment identification is not prominent.

Figure 6 – Switchboards Prior to Maintenance on Switchboard on Left



Example of barricade tape in use

Figure 7A – One line drawing delineating LOTO isolations, grounding device locations and work scope located at work site



A centralized point close to the work should be established to perform pre-job briefings and serve as a common point where questions or concerns about the work can be addressed. One line drawings of the equipment must be available and printed large enough to follow the scope of work and verify lockout points before the work starts and as the work progresses. Each worker may also be provided with a smaller one line drawing for quick reference as needed.

Figure 7B – Signage Installation on back of substation cubicles



Example of signs used in conjunction to indicate look-alike equipment and equipment status

Figure 7C – Close up of the sign shown posted in Figure 7B

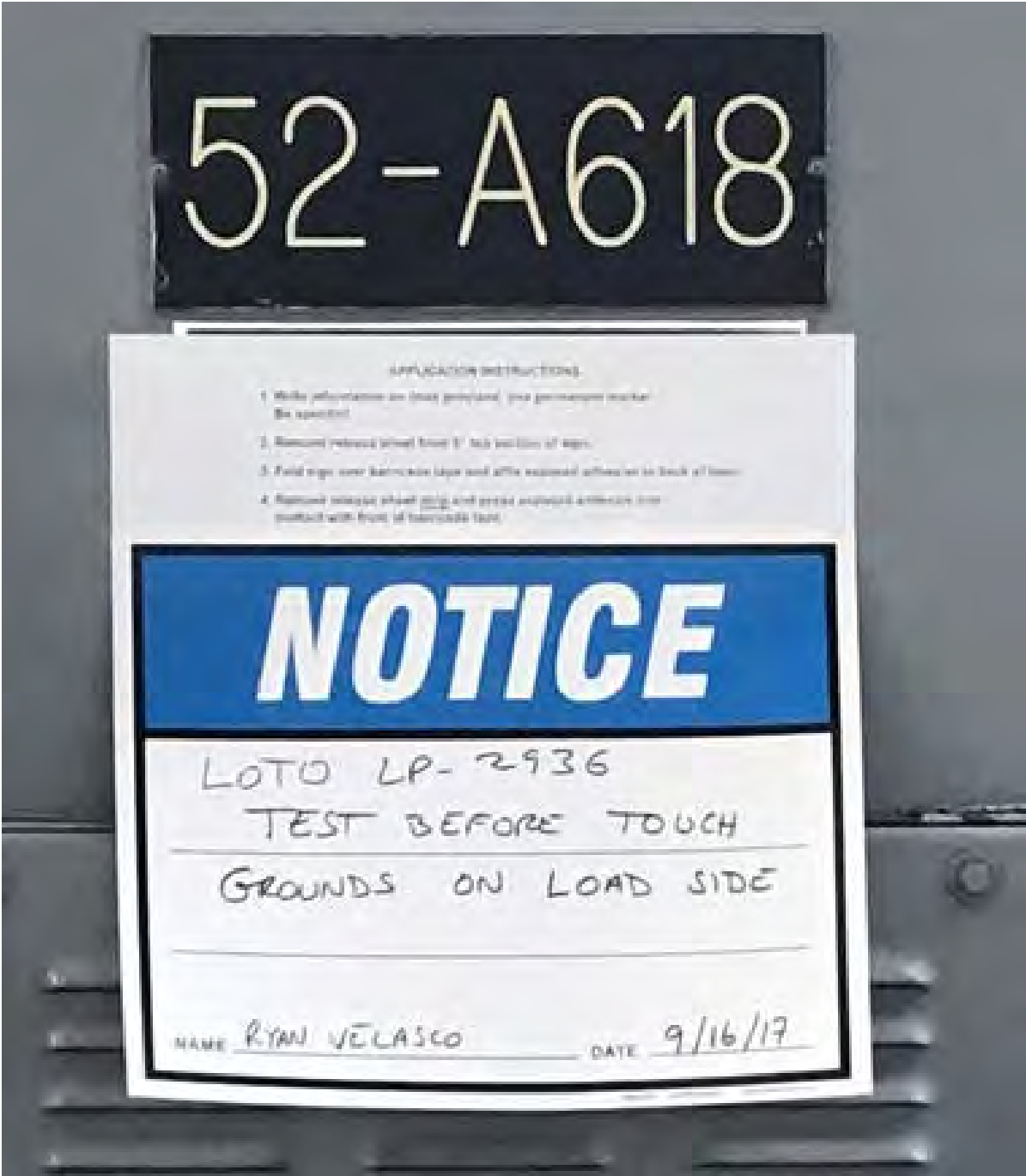


Figure 7D – Substation view once all signs and barricade tape installed



Figure 7E – Zero Voltage Verification



Figure 8A – Magnetic Signs used on energized cubicles



NOTE: The signage used in this best practice are for example only and were used to demonstrate how the best practice can be applied and do not necessarily represent ANSI standards. ANSI standards for signage must be used accordingly.

Figure 8B – Magnetic Signs Installed (front view)



Example of installed magnetic signs sized appropriately for the equipment

Figure 8C – Magnetic Signs Installed (horizontal opening)



Example of installed magnetic signs sized appropriately for the equipment

Figure 8D – Magnetic Signs Installed (vertical opening)



Magnetic signs can be placed in such a way as to warn workers attempting to access energized equipment. Bridging the enclosure door openings may alert workers if the signage falls to the ground when one of the enclosure doors is opened. Protruding signs stuck on the opened or unopened door may also serve as a warning catching the workers attention.

Figure 8E – Magnetic Signs Installed



Example of a magnetic sign warning that the Look-Alike equipment is not part of an established Lockout.