Electrical Safety
ESWP and NFPA 70E
Electrical Safe Work Practice
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Today’s Goals:(Electrical Safety Awareness)

- Discuss new NFPA 70E Code Release
- Discuss Class Needs on Information You Feel is Needed to Take Back With You.
- We Will Define Electrical Safe Work Practices!
- New Code Definitions for Qualified Staff?
- Review of PPE Labeling Content and What it Means for Your Staff
- Review OSHA ties, Liability and NFPA 70E
- Break Out Sessions as Time Permits
- Review Safety Goals and PPE Discussions
- Cover OSHA Interpretations and Links with Sub Part S 331-335.
2015 NFPA 70E Discussions

The new 2015 code has been released. What do we notice in this code cycle?

- No change in definitions of what constitutes a good PPE labeling format (Again Wide Open), so it is important to maintain what the employer expects to see on effective PPE labeling content, and in many ways stick to your own path on format and structure when it meets an OSHA Sub Part S expectation!
- Code committee has eliminated the prohibited shock boundary requirement on labels.
- Code committee has eliminated hazard category 0 on a technicality stating that arc flash hazards at or below 1.2 cal/cm2 technically don’t pose an arc flash hazard, therefore it should not be classified as a “hazard”
- Changes in wording with training and AED use.
- Changes in task based approach to PPE tables 130.
- Never lose sight of how OSHA views compliance!
What Do We Normally See With Companies Implementing NFPA 70E Programs?

- It takes time to change the culture with both Management and site staff when implementing ESWP goals (Normally two years is the average).

- Support and continual reinforcement of goals with safety is vital. Encourage employees to ask questions and ask for their inputs.

- Realize there are few perfect answers in many cases with ESWP but the key topic is to always focus on some simple aspects with electricity which is “How do we work on equipment in a safe condition?”
Work Involving Electrical Hazards:

So, we are here today to examine NFPA 70E, OSHA expectations and company policies right?

What should every conversation start out like when you discuss ESWP with an employee at your facility when a question comes up?

Common Questioning Format:

- What are the task/s being performed by the employee?
- Can these tasks be performed in a de-energized condition?
- If Yes, then what is still required for PPE to confirm absence of power has been achieved and do our employees know how to do this correctly? Have they proven demonstrated skills?
- If No, then what is our justification for why work has to be performed while the equipment is energized and our attention turns to filling out work permits!
- OSHA allows very few excuses to work LIVE....
What do we Know From the OSHA Perspective When we Evaluate NFPA 70E?:

Their focus is and has always been aimed at the overall topic of:

- **Electrical Safe Work Practice!**

- What does that statement mean? Does this mean that we only focus on the “arc flash” topic or does this mean as leaders in safety we have to evaluate the entire topic and all hazards that employees are facing? Policies, PPE programs, Site Specific Programs in Place, Training, Qualification Needs etc…

- Very seldom do we see OSHA reference NFPA 70E as they have enough ammo in Sub Part S 331-335 to choke a horse with if they want to find codes to reference for citations.
Most Frequently Cited OSHA Standards 2013:

1. Fall protection, construction (29 CFR 1926.501)
3. Scaffolding, general requirements, construction (29 CFR 1926.451)
5. Electrical, wiring methods, components and equipment, general industry (29 CFR 1910.305)
7. Ladders, construction (29 CFR 1926.1053)
8. Control of hazardous energy (lockout/tag out), general industry (29 CFR 1910.147)  In the Midwest this is #1
9. Electrical systems design, general requirements, general industry (29 CFR 1910.303)
New NFPA 70E 2015 Edition:

- OSHA Can Refer to 70E for Additional Information if Needed But Rarely Do They Need To!
  - Upon review of this new standard we recommend strongly that all employers simply reference the standard to judge your safety needs and plans vs what 70E may indicate.
  - The struggle we have in any consensus code is they are often written too openly and loaded with interpretation angles.
  - Remember, OSHA has to demonstrate a risk/hazard to the employee in order for any conversation to take place.
  - Almost all citations circle back to Sub Part S 331-335 within the OSHA circles.
  - Citation totals in 2014 exceeded $10.3M between LOTO & ESWP references. This has gone up each of the past three years and continues to be a very easy topic.
We “Don’t Know What We Don’t Know”!

- Employee used wasp spray on an exterior bus. Wasps died along with major injuries to the employee when the bus faulted.
Should We Believe in “Common Sense”?

Does everyone have the same history or experience with electrical systems?
Qualified Employees?
Are we Ever Really Sure what is Behind Closed Doors? Constant Awareness of Electrical Risks.
An arc flash event can be described as the release of heat energy, blast energy and projectiles that can injure employees when electrical equipment experiences a fault or failure.

Shock hazards are still our main concern! 4 to 1 over arc flash incidents so maintain focus on electrocution prevention and glove use!

Daily, 6-10 major incidents occur Nationally!
What is Arc Flash? Which Electrical Hazard is Most Significant to Our Staff? Shock or Flash?

ARG workers injured by ‘electrical arc flash’ at the plant

Posted: Thursday, January 29, 2015 10:00 am

By KATE DAY SAGER Era Reporter
kdsager@bradfordera.com | 0 comments

Two American Refining Group (ARG) employees were injured early Wednesday when an electrical arc flash occurred as they were working on electrical equipment at the plant.

Sara Furlong, executive communications coordinator at ARG, said information released by Don Keck, senior vice president of operations, stated the incident occurred about 6:30 a.m. in the motor control center, or MCC, of the crude unit. Furlong said two male employees, who were not identified, were working in the facility, which is undergoing expansion due to expanding electrical requirements at the refinery. The crude unit is located in the plant between North Kendall Avenue and Mill Street in Bradford. The incident did not disrupt operations at the plant.
Rack-In Incident
Typical Incident Exposure:
Both NFPA and OSHA Rely on IEEE for their Technical Knowledge in the Engineering topic:

- Upon review of this new standard we recommend if you need to draft a plan for NFPA 70E assessments, do not use this document as your only resource, and again is important to focus your attention with OSHA Sub Part S 301-335 standards as your focal point!

  - IEEE and most people we encounter Nationally will automatically lean towards the engineering aspects of the “arc-flash study”.
  - This standard makes many references to “data-collection” and it is clear that the owner (You as the Employer) hold the accountability based on what you accept in scope.
  - Do not assume any resource you find will take on any roles with LOTO confirmations. Remember many of us fight with costs and juggling that battle internally with upper management? This takes time to do correctly with plant systems confirmation & LOTO.
IEEE 1584.1 Standards on Arc Flash Studies

• Assumptions will be the end of us all!

  – 5.1 – Determination of which party(s) is to be responsible for verification of one-lines, creating one-lines, and other site data collection must be determined prior to the quoting of the arc-flash hazard study.

  – If the facility owner does not provide data to the engineer, the owner should provide qualified personnel to guide those responsible for the site data collection and assist as required.

  – Should you be cautious of these concepts in consideration of LOTO value for equipment labeling at the end of a standard engineering study?
IEEE 1584.1 Topic of Electrical One-Lines

- A Functional Electrical Drawing is the Backbone of your ESWP Program!
  - IEEE also has no good definition of the electrical one-line diagrams.
    - They do say one-lines offer the best source of management for your electrical management needs but fail to define a good one-line or how that process should take place.
    - Most programs Nationally we have seen since 2005 rely entirely on Engineering Software systems only.
    - Those normally fail to support day to day use and are far too vanilla in nature.
NEC 110.24 Fault Current Markings on Equipment:

Article 110 – Requirements for Electrical Installations 110.24 Available Fault Current

(A) Field Marking.

1. Service equipment in other than dwelling units shall be legibly marked in the field with the maximum available fault current.

2. 110.24A added compliance with 110.9 & 110.10. The maximum available fault current is not intended to be used for incident energy analysis!
2014 NEC 110.16 Arc-Flash Warning:

Article 110.16

1. The words “or factory” and “switchgear” have been added to this requirement. The revision clarifies that the marking applies also to switchgear, and it can be either field applied or factory applied. (Be cautious of Contractors or Electrical Inspectors forcing this issue)

2. The words “meet the requirements in 110.21(B)” have been added to guide design structures of labels.

3. If labeling is applied at your site by outside sources and you don’t have an effective program in place to address ESWP, it might put you in a state of compliance issue with OSHA.
2014 NEC 110.26(C)(3) Personnel Doors:

Article 110.26(C)(3)

The value “1,200 Amps has been lowered to 800Amps” expanding requirements for panic hardware on egress doors. The words panic bars, pressure plates, or other devices that are normally latched but open under simple pressure have been replaced with “listed panic hardware”.
(2) First, Aid, Emergency Response, and Resuscitation.

The new code book has revised wording in this section!

It used to read as defined below:
110.3 Host and Contract Employer Responsibility:

This is becoming a very easy target for OSHA compliance. Rarely do we take the time to document what outside contractors are on site to do for us.

(C) Documentation. Where the host employer has knowledge of hazards covered by this standard that are related to the contract employer’s work, there shall be a documented meeting between the host employer and the contract employer.
110.2 Training Requirements.

(A) Training Requirements

The training requirements contained in this section shall apply to employees exposed to an electrical hazard when the risk associated with that hazard is not reduced to a safe level by the applicable electrical installation requirements. Such employees shall be trained to understand the specific hazards associated with electrical energy.

(B)- The training required by this section shall be classroom or on the job or a combination of the two. The type and extent of the training provided shall be determined by the risk to the employee.

- The 2015 NFPA 70E code requires evidence of the content of your training and has added a dedicated section on First Aid, Emergency Response, and Resuscitation.

- Focus on skills demonstration concepts of training programs! The “Show Me” concept for in house training is what OSHA is seeking.
Article 110.2 Training Requirements

110.2 1 (a) Qualified Person:

D1(b)(4):
Persons permitted to work within the limited approach boundary shall, at a minimum, be additionally trained in all of the following:

a. Perform the job safety planning
b. Identify electrical hazards
c. Assess the associated risks
d. Select the appropriate risk control methods from the hierarchy of controls identified in 110.1G, including personal protective equipment
Article 110.1G Risk Assessment Procedure

110.1 (G):

Risk Assessment Procedure:

Informational Note: The hierarchy of risk control methods specified in ANSI/AIHA Z10, American National Standard for Occupational Health and Safety Management Systems, is as follows:

1. Elimination
2. Substitution
3. Engineering Controls
4. Awareness
5. Administrative Controls
6. PPE
110.2 D Qualified Person:

(1) Qualified Person:

(c) An employee who is undergoing on-the-job training for the purpose of obtaining the skills and knowledge necessary to be considered a qualified person and who in the course of such training demonstrates an ability to perform specific duties safely at his or her level or training and who is under the direct supervision of a qualified person shall be considered to be a qualified person for the performance of those specific duties.
Connecting OSHA & NFPA 70E - LOTO

Citation and Notification of Penalty

Company Name: 
Inspection Site: 

Citation 1  Item 7  Type of Violation: Serious

29 CFR 1910.335(a)(1)(i): Employees working in areas where there were potential electrical hazards were not provided with electrical protective equipment that was appropriate for the specific parts of the body that needed to be protected and for the work being performed:

(a) Drill bank; Unqualified employees, accessing drill speed controls in 480-volt cabinets with exposed live parts, were not provided with personal protective equipment.

ABATEMENT DOCUMENTATION REQUIRED FOR THIS ITEM

Date by which Violation must be Abated: 2012 
Proposed Penalty: $7000.00
(B) Source of Supply:

All switchboards and panel boards supplied by a feeder in other than one-or two-family dwellings shall be marked to indicate the device or equipment where the power supply originates.

- This code doesn’t read very well but the intent here is to get involved with electrical work done in your facilities.
- Electrical Contractors and Maintenance Staff alike are not overly creative on labeling and often we don’t think in terms of LOTO needs!!!!!

Common General Labeling Lacking Good Upstream LOTO information.
Article 130.2(A)(4) Normal Operation

(4) Normal Operation. Normal operation of electrical equipment shall be permitted where all of the following conditions are satisfied:

1. The equipment is properly installed.
2. The equipment is properly maintained.
3. The equipment doors are closed and secured.
4. All equipment covers are in place and secured.
5. There is no evidence of impending failure.

Informational Note: The phrase *properly installed* means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer’s recommendations. The phrase *properly maintained* means that the equipment has been maintained in accordance with the manufacturer’s recommendations and applicable industry codes and standards. The phrase *evidence of impending failure* means that there is evidence such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.

Maintenance:

Define “Normal Operation”? What is clear, is the code is expressing the need to make sure we address Maintenance of equipment to ensure we realize the ties between risk levels and equipment condition.
This New Code Article Will Inevitably Bring Up the Age Old Question of “Closed Door Switching PPE Needs”:  

- Some people interpret closed door switching of breaker or disconnects as if we should dress up to the same PPE levels as determined by “OPEN” door levels  
- Others have united with a somewhat universal “Best Practice” scenario of what represents a reasonable approach to this topic.  
- OSHA and NFPA 70E are unable to truly define what our exact exposure levels may be and to what extent covers can contain faults but an employer can only be held accountable to defined expectations of risk.
This Article Will Inevitably Bring Up the Age Old Question of “Closed Door Switching PPE Needs”:

- Here is what has commonly been used to define closed door risk management and PPE needs.
  - For known (calculated) HRC Levels of 0, 1 or 2
    - Recommended HRC Level 0 PPE for switching procedures
  - For known (calculated) HRC Levels of 3, 4 or Dangerous
    - Recommended HRC Level 2 PPE for switching procedures

Remember the maintenance component discussed earlier and work with employees to understand the importance of shedding load on a system before we re-engage breaker disconnects.
Evaluating NFPA 70E Interpretations:
How Faults Can Carry Between Sections:

Enclosure:

Note: When you consider electrical exposure you must consider the entire enclosure. Article 130.2 (2)
Article 130 Work Involving Electrical Hazards:

130.2 Electrically Safe Working Conditions

Energized electrical conductors and circuit parts shall be put into an *electrically safe work condition* before an employee performs work if *any* of the following conditions exist:

1. The employee is within the Limited Approach Boundary
2. **The employee interacts with equipment where conductors or circuit parts are not exposed, but an increased likelihood of injury from an exposure to an arc flash hazard exists**

Note: Our struggle with interpretation on definitions with enclosures and what constitutes an “electrically safe enclosure” is the real issue with cabinet designs and engineering arc flash ratings to the enclosures. Normal construction methods and OEM’s alike are not accustomed to these new concepts with installations.
There are no good defined statements in the OSHA circles to rely on but between NFPA 70E article 130.2 and IEEE comments above, both are saying that we can’t rely on the breaker alone to lower downstream energy levels if we have no isolation/separation of equipment sections. Arc Flash ratings then apply to the entire enclosures!!
The “New-Normal” Installation Method:

Customer made a decision to separate the new service sections. The resulting arc flash outcome was a dangerous no live entry on the left incoming section and a HRC 1 on the right load center. No compliance interpretation issues are possible in this installation concept!
130.5 (D) Equipment Labeling Codes for 2015 Edition: (Arc Flash Portion) D(3)

At least one of the following:
- Available incident energy and the corresponding working distance, or the arc flash PPE category in table 130.7(C)(15)(A)(b) or table 130.7(C)(15)(B) for the equipment, but not both.
- Minimum arc rating of clothing
- Site-Specific level of PPE

Employers are being confused by this first portion of article 130.5 and vendors nationally are not helping the cause!
130.5 (D) Equipment Labeling Codes for 2015 Edition: (Cont)

(1) Nominal system voltage

(2) Arc flash boundary

• Exception: Labels applied prior to September 30, 2011 are acceptable if they contain the available incident energy or required level of PPE. (This exception reads poorly)
The method of calculating and the data to support the information for the label shall be documented.

Where the review of the arc flash hazard risk assessment identifies a change that renders the label inaccurate, the label shall be updated.

The owner of the electrical equipment shall be responsible for documentation, installation, and maintenance of the field marked label.
Overview of Informative 2015 PPE Label Format:

- Complete Statements in PPE listings
- Shows When Gloves are needed. Prohibited Approach Boundary was eliminated for 2015
- Supports Electrical LOTO Needs
- Date Optional for 70E
- Shows Fault Current Levels to Aid in Breaker Applications
## Minimum AR PPE Content For Labels:

<table>
<thead>
<tr>
<th>Category</th>
<th>Required Protection FR Clothing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Category 0</strong>*</td>
<td>Untreated Cotton Long Sleeve Shirt, Pants, Safety Glasses, Hearing Protection</td>
</tr>
<tr>
<td><strong>Category 1</strong></td>
<td>AR Shirt, AR Pants, Hard Hat, 4 cal/cm² Face Shield, Safety Glasses, Hearing Protection</td>
</tr>
<tr>
<td><strong>Category 2</strong></td>
<td>AR Shirt, AR Pants, Hard Hat, Balaclava/Hood, 8 cal/cm² Face Shield, Safety Glasses, Hearing Protection</td>
</tr>
<tr>
<td><strong>Category 3</strong></td>
<td>AR Shirt &amp; Pant + AR Coverall, Switching Hood, Safety Glasses, Hearing Protection</td>
</tr>
<tr>
<td><strong>Category 4</strong></td>
<td>AR Shirt &amp; Pant + AR Coverall, Double Layer Switching Coat and Hood, Safety Glasses, Hearing Protection</td>
</tr>
</tbody>
</table>

2015 Code no longer formally recognizes Category 0 as an “Arc Flash” Category. *The need for natural fibered garments and general PPE however has not changed!!*
Clarification on Category 0:

- The NFPA Code based on a technical evaluation of incident energy exposures to the body has eliminated “Category 0” from table 130.7(C)(16).

- This shift in clarification was an attempt to use the code tables to define “actual” arc flash levels so the code felt that having a category in the tables for level “0” was not needed.

- We as employers are still required to post a PPE label however and still required to inform staff of what clothing and general PPE is required to be used.

- This PPE label represents Faith Technologies official position on recommended PPE label formats on exposure levels 1.2cal/cm² or less.

Note: (*) While the 2015 NFPA 70E Edition no longer recognizes Category 0 as an “arc flash” hazard, the need for proper personal protective equipment (PPE) remains unchanged.
Incomplete Label?? Is This Still Correct per NFPA 70E Code?? (Yes) But….

<table>
<thead>
<tr>
<th>Category 3</th>
<th>PPE - Category Appropriate</th>
</tr>
</thead>
<tbody>
<tr>
<td>64 inch</td>
<td>Flash Hazard Boundary</td>
</tr>
<tr>
<td>9.67</td>
<td>cal/cm^2 Flash Hazard at 18 inches</td>
</tr>
<tr>
<td>480 VAC</td>
<td>Shock Hazard when cover is removed</td>
</tr>
<tr>
<td>00</td>
<td>Glove Class</td>
</tr>
<tr>
<td>42 inch</td>
<td>Limited Approach (Fixed Circuit)</td>
</tr>
<tr>
<td>12 inch</td>
<td>Restricted Approach</td>
</tr>
<tr>
<td>1 inch</td>
<td>Prohibited Approach</td>
</tr>
</tbody>
</table>

Many PPE label formats don’t fully disclose valuable PPE Information

Protective Device Names will often not represent true LOTO points in a system so be careful on what you reference here..
The alleged violations below have been grouped because they involve similar or related hazards that may increase the potential for injury or illness.

Citation 1  Item 4 a  Type of Violation: **Serious**

Markings were not provided on electrical equipment giving voltage, current, wattage, and other ratings as necessary:

(a) Drill bank; Two electrical panels were not marked with applicable ratings.

Date by which Violation must be Abated: /2012

Proposed Penalty: $4400.00
### 130.7C16 New Protective Clothing and PPE Equipment Table

| Hazard/Risk Category 1          | Arc-Rated clothing, minimum Arc Rating of 4 cal/cm². *(See Note 3)* | Arc-rated long-sleeve shirt and pants or arc-rated coverall  
Arc-rated face shield *(see Note 2)* or arc flash suit hood  
Arc-rated jacket, parka, rainwear, or hard hat liner (AN)  
Protective Equipment | Hard hat  
Safety glasses or goggles (SR)  
Hearing protection (ear canal inserts)  
Heavy duty leather gloves *(See Note 1.)*  
Leather work shoes (AN) |

• Remember this table no longer defines PPE Category 0 however we are still enforcing the minimal PPE expectations on labeling such as Cotton Clothing, Safety Glasses and hearing protection etc.!
### New 2015 Task Based Table:

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Arc Flash PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Normal operation of a circuit breaker (CB), switch, contactor or starter</td>
<td>All of the following:</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>The equipment is properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All equipment doors are closed and secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All equipment covers are in place and secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>One or more of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly installed</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equipment doors are open or not secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equipment covers are off or not secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing</td>
<td>Any</td>
<td>Yes</td>
</tr>
</tbody>
</table>
### New 2015 Table to Define Parameters:

**Table 130.7(C)(15)(A)(b) Arc-Flash Hazard PPE Categories for Alternating Current (ac) Systems**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panelboards or other equipment rated 240V and below</td>
<td>1</td>
<td>485 mm (19 in.)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;240V and up to 600V</td>
<td>2</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>1.5 m</td>
<td></td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum</td>
<td>2</td>
<td>(5 ft)</td>
</tr>
<tr>
<td>of 0.03 sec (2 cycles) fault clearing time; working distance 455 (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>4</td>
<td>4.3 m (14 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 42 kA short-circuit current available; maximum</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class switchgear (with power circuit breakers or fused switches)</td>
<td>6 m</td>
<td></td>
</tr>
<tr>
<td>and 600 V class switchboards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum</td>
<td>4</td>
<td>(20 ft)</td>
</tr>
<tr>
<td>up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class (277V through 600V nominal) equipment</td>
<td></td>
<td>1.5 m (5 ft)</td>
</tr>
</tbody>
</table>
Skills Sheet:

• Training for qualified employee status is largely based on the concepts of “show me”.

• In summary, we can have great safety policies and good equipment labeling in place BUT if employees do not demonstrate effective practice of our safety needs, this represents a problem with compliance.
Obtaining a De-Energized State Correctly is our Primary Goal with ESWP and NFPA 70E:

De-Energized Work Practices  
(Supportive PPE Labeling/Process)

- This example shows a standard disconnect with ideal labeling in place which in turn supports the fundamental goal for any safety program.

- If an employee was asked this question, how would they be able to respond now?

- **OSHA Question:** If you had to change a fuse in this disconnect, explain to me how you would do that?
130.2 Electrically Safe Working Conditions:

130.2(B)(1): Energized Work Permit.

(1) When Required.

- When energized work is permitted in accordance with 130.2(A), an energized work permit shall be required under the following conditions.
  1. When work is performed within the restricted approach boundary.
  2. When the employee interacts with the equipment when conductors or circuit parts are not exposed but an increased likelihood of injury from an exposure to an arc flash hazard exits.

- This reads very similar to 130.2!! The only difference is in #1 where they reference limited vs. restricted boundaries.
130.2 Electrically Safe Working Conditions:

- 130.2(B)(3): Energized Work Permit.

(3) Exemptions to Work Permit.

- An energized work permit shall not be required if a qualified person is provided with and uses appropriate safe work practices and PPE in accordance with Chapter 1 under any of the following conditions.
  1. Testing, troubleshooting, and voltage measuring.
  2. Thermography and visual inspections if the restricted approach boundary is not crossed.
  3. Access to and egress from an area with energized electrical equipment if no electrical work is performed and the restricted approach boundary is not crossed.
  4. General housekeeping and miscellaneous non-electrical tasks if the restricted approach boundary is not crossed.
What Constitutes Valid Reasons to Work on Energized Equipment??

1. **Additional hazards or Increased risk:** Employer must demonstrate that de-energizing introduces additional hazards or increased risks to the employee.

2. **Infeasibility:** Employer must demonstrate that the task to be performed is infeasible in a de-energized state due to the equipment design or operational limitations. (Be very cautious of discussing costs or money in any way if you chose to use this)

3. **Less than 50 volts:** Self explanatory…
Work Permit Break Out Session:

This break out session is challenging but brings up great discussions!

- Many of you won’t support any energized work as a rule but there may come a day when one of these meetings does happen and are you prepared to fill one of these out?

- As groups of two or three, role play to fill out the work permit the best you can.
  - The person who is doing the work fills out the permit
  - The person responsible for authorization (Safety) would be the one who signs off on the permit or denies the permit!!
WORK PERMIT EXAMPLE:

- Your goal is to use the work permit sheet to discuss a project you have in mind.
- Be Creative and...
- BE REALISTIC on what you likely have taking place in some instances now.
- It is more important to learn how to fill these out and what they mean so you can help others and also manage contractors!
Required Meter Safety Items

Double check your meter to ensure it is current

New

1000 V CAT III and 600 V CAT IV meters designed to withstand 8000 V transients

Use meters with these markings: 1000 V CAT III or 600 V CAT IV

Old

Fluke Meters designed to older standards do not show category rating on front of instrument

Do not use meters without proper CAT markings on 480 V circuits

Please make sure your meter leads are correct
Voltage Testing Represents our Greatest Daily Exposures!

Incorrect fuse used in multi-meter
Not Approved!

Look for this symbol to indicate approved tools but be careful the tool is still ASTM registered:

(Hint: these tools don’t have it!)

Once the screw is set in the holder, you don’t have to touch it again. Both the handle and shanks are insulated against up to 1000 volts, only the chrome vanadium tips are exposed.

- Pieces: 5
- Design: flat and cross point
- Description: 5 x 150, 4 x 125, and 3 x 125mm flat points, 6 x 175 No. 2, and 4 x 125 No. 1 cross points
- Shipping weight: 1 lb.
Study of Electrocutions

Frequencies of Electrocution Incidents Identified by FACE

- 110-120V: 16
- 220-240V: 12
- 277V: 6
- 440-480V: 15
- 600V: 25
Defining One-Line Diagrams?? What do we Look For?:

- One-Line Diagrams are the building blocks for sound electrical safety programs including project discussions and safe work practices!
It is important to realize that in an engineering study, the “data collection” in the field is simply taken using existing equipment naming and is re-entered in software programs back at the office. Educate your clients that these types of one-lines are not descriptive nor complete for LOTO use and their staff will not prefer to work with them. Normally they are not received well by OSHA.
Value Based Engineering Reports: Seek Simplicity and Universal Ties with your One-Line Diagrams.

<table>
<thead>
<tr>
<th>Item #</th>
<th>Location (Sheet #)</th>
<th>Protective Device</th>
<th>Initial Setting or Device</th>
<th>Present Cal/cm^2</th>
<th>Hazard Class</th>
<th>Recommended Change</th>
<th>New Cal/cm^2</th>
<th>Hazard Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TURB-SWGR (E-002)</td>
<td>GEN-1, GEN-2 &amp; RESER-SWGR-CAB-1B</td>
<td>CO-6 Relay set at: 1200A, Tap=5.0, Time=4.0, GEN-1 and GEN-2</td>
<td>49</td>
<td>Dangerous!</td>
<td>Remove utility feed at RESERVIOR-SWGR-CAB-1B</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>CP-44-PKR-B (E-101)</td>
<td>CP-44-PKR</td>
<td>Shawmut type AJT 250 amp fuses</td>
<td>1.7</td>
<td>1</td>
<td>Replace CP-44PKR fuses with Bussmann type LPS-RK 250 amp fuses</td>
<td>0.44</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>CP-45A-1 (E-109)</td>
<td>MCC-Z45C-6E</td>
<td>Sq-D 60 amp breaker</td>
<td>3.3</td>
<td>1</td>
<td>Install a fused disconnect before CP-45A-1 using Bussmann type LPS-RK 60 amp fuses</td>
<td>0.05</td>
<td>0</td>
</tr>
</tbody>
</table>
2015 Additions for Maintenance

• **205.3 General Maintenance Requirements:**

  Electrical equipment shall be maintained in accordance with manufacturers’ instructions or industry consensus standards to reduce the risk associated with failure. The equipment owner or the owner’s designated representative shall be responsible for the maintenance of the electrical equipment and documentation.
205.3 General Maintenance Recommendations

- **205.3 General Maintenance Requirements:**
  - Commonly, many companies focus primary attention on breakers or loads 400 amps or larger considering smaller loads are common or considered “off the shelf” items.
  - Focus on some “high maintenance” items or those equipment types that may pose a greater level of maintenance such as bolted pressure switches. These types of equipment have many moving parts and require special lubricants and exercising regularly.
Know How to Read Arc Flash Scope Content:

• #1 Assumption made with 90% of all Arc Flash Studies we see Nationally Today: (Direct word quotes):
  – Field Technicians will visit your facility to collect the necessary electrical data to perform an Arc Flash Hazard Analysis. Who in this room can define what “Data Collection” means?
  – Direct Quote: “Your facility’s panel boards, bus ducts, motor control centers, disconnects, switchgear, etc, should be properly labeled per the National Electrical Code prior to our arrival.” What does this imply?
You will go back to your Plant: (Need Three Volunteers).

• **Safety Director** to maintenance electrician
  – “I just learned about arc flash and blast, it scared the **bleep** out of me.”
  – “Do you work energized?”

• **Electrician** to Safety director
  – “I always turn it off”
  – **Safety Director** response: Thank You!!
Now we have an OSHA inspection

- **CSHO** to safety director
- What do you have for an ESWP program?
- **Safety Director to CSHO**- “We never work energized we lock it out all the time”.
- **CSHO** to SD That’s good, well let’s get started and go out to do the walk around inspection of your facility.
CSHO to Maintenance Electrician

• What kind of testing devices do you have?
• Electrician to CSHO, I have an ammeter, phase tester, a Volt Ohm Meter (VOM) from *****, a solenoid tester, an electrical field tester, and a few others.
• CSHO - What do you have to for PPE?
• Electrician to CSHO, Safety glasses and a hard hat with muffs
• CSHO response….HMMMMMMMMMMMMMM??
CSHO to Maint Electrician

- **CSHO** How old is this place?
- **CSHO** What kind of a system do you have to maintain?
- **Sparky** to CSHO - This place is 40 years old and we have added a lot of new equipment. The only new stuff is the buss bar on the new line.
- **CSHO**, do you have any of those old 70s breakers?
- **Sparky** yes, We replace them when they fail.
CSHO to Maintenance Electrician

• Do you have a one line diagram?

• Sparky, somewhere I think

• So when you have to trouble shoot a problem in this old plant what do you use.

• Sparky, I’ve been in this plant for 29 years.

• Any new guys like you?

• Sparky, yea Curly and Mo retired so they hired Larry We are training him.
What is your up time goal?

Sparky, 90%

So when you troubleshoot and find the problem, you always turn the power off?

Sparky, Wellllllllllll. Sometimes we can’t

When can’t you?

Sparky, The new line has one main disconnect, that kills the program if you turn it off. We did it once and the production supervisor had a fit.
CSHO to Maintenance Electrician

• Any other times that you can’t turn it off?
• Sparky, No

• You mean you know where every thing is fed from?
• Sparky, Welllllllllll, most of the time

• What about your new guy Larry
• Sparky, Oh he is just learning
• So he guesses??
CSHO to Maintenance Electrician

• Could I look in your tool box?
Electricians’ Tools

- Electrical Tape as Insulation
- Gouge – Weld Mark
CSHO to Maint Electrician

• So you do work energized,
• Your tools are not rated,
• You have no idea of the calorie levels to which you are exposed,
• You have no arc PPE and you work hot swapping buss plugs from a ladder.
• You don’t have any live work procedures.
• Sparky Yea, but I am careful!
CSHO to Safety Director

• You were made aware of Arc Flash and Blast at ABC Company.

• You have ignored all of the hazards

• You will be receiving correspondence from us in the future. Now let us discuss some abatement dates.
OR

• You have the example of a VPP company that did their homework, and protected their people.
Tuesday, Wood River experienced a significant electrical arc flash incident in one of the substations. ... there were ___injuries and it looks as though they will have the substation back in service in the next 3 or 4 days.
What does a new hood look like?
The Arc?

• They speculate that the initiating event occurred when the metal edge on one of the voltage meter probes touched the edge of the grounded steel shutter.

• The arc occurred and……..
The Employee was Protected

• You can see in *next slide* how the hood looked after being exposed to the arc flash but what you can’t see is that the inside of the hood looks like new. A few years ago they upgraded their electrical safe work practices and their electrical PPE to state of the art gear.
• PPE is Designed to Create Survivable Outcomes.  This PPE Did it’s Job!
Remember What the “Before” Looked Like?
The restricted approach boundary for a 480 volt nominal system is?

a. Not specified  
b. 1.07 m (3 ft 6 in.)  
c. 25.4 mm (0 ft 1 in.)  
d. 304.8 mm (1 ft 0 in.)
The restricted approach boundary for a 480 volt nominal system is?

**d. 304.8 mm (1 ft 0 in.)**
Qualified persons shall be able to show demonstrated skills in order to be considered qualified for working on or near energized equipment? 

True or False
Only qualified persons capable of demonstrating the ability to recognize and avoid electrical hazards are allowed to interact on systems of 50 volts or more.
What Might OSHA Look For?:

• Will look for PPE labeling
• Will seek inspection of tools and PPE use
• Will seek supporting data on training efforts to show evidence of qualified staff
• Will seek evidence of the process used for risk assessments (What was the written scope of work for the arc flash process?)
• Will review and quantify your use of energized work permits and job briefings
• Bottom Line, How do we manage de-energized work methods
Ending Summary:

• The new 2015 NFPA 70E code book has some interesting new revisions but don’t get distracted from the basic fundamental goals of electrical safety and your role as an employer!!! This code is not written well and is very minimal in design.
  – Focus on great equipment labeling (accurate) that supports fundamental needs for “electrical LOTO” goals!
  – Focus on good informational One-Line Diagram development that will help staff grow in LOTO and safety planning needs!
  – Get solid PPE labeling in place to make it clear to your staff on their exposures
  – Train & Keep Training Employees!
Ending Thoughts?:

• Questions??