2009 NFPA 70E
Clearing Up Confusion

FAITH TECHNOLOGIES
ELECTRICAL CONTRACTOR

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Today's Goals:
(FPA Open Forum on NFPA 70E 2009 Changes)

- Where are we Today with NFPA 70E?
- Common Mistakes With NFPA 70E Compliance
- How to create a solid ESWP label??
- Review key code changes
- What to Ask for in a Safety Audit of Your Plant
- Review of key print needs & LOTO aids

What is Arc Flash?

February 2nd 2010 Incident

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.

NFPA 70E Overview

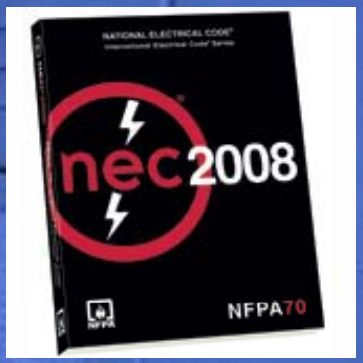
- Since roughly 2001 employers have begun to recognize there is a demand for including NFPA 70E in their ESWP programs

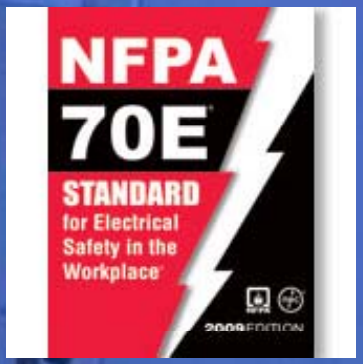
- The challenge we have as employers is how to interpret the code and create a solid approach to risk management for our staff. NFPA 70E is a performance driven code placing safety of our staff within in our policies.

- NFPA 70E will continue to be implemented throughout the country and OSHA has stepped up their internal education on what this code implies.

Code Updates

- NFPA 70E was most recently updated in September of 2008 for the 2009 code release and supersedes all previous code revisions
- Some conflicts existed between current NFPA 70E interpretations vs. OSHA requirements on definitions with energized work permits





We Can't Base Training Methods on "Common Sense"!

Top 10 Most Frequently Cited OSHA Standards:

1. Scaffolding, general requirements, construction (29 CFR 1926.451)
2. Fall protection, construction (29 CFR 1926.501)
3. Hazard communication standard, general industry (29 CFR 1910.1200)
4. Control of hazardous energy (lockout/tag out), general industry (29 CFR 1910.147)
5. Respiratory protection, general industry (29 CFR 1910.134)
6. Powered industrial trucks, general industry (29 CFR 1910.178)
7. Electrical, wiring methods, components and equipment, general industry (29 CFR 1910.305)
8. Ladders, construction (29 CFR 1926.1053)
9. Machines, general requirements, general industry (29 CFR 1910.212)
10. Electrical systems design, general requirements, general industry (29 CFR 1910.303)

70E Challenges

Common Employer Challenges:

1. First off, determining what it is that your employees do and how to qualify their tasks and knowledge.

2. Determine how you are moving forward with a program and subsequent PPE purchases.

3. Reminding your trained staff on a regular basis what is required of them and how to take ownership with safety

4. Educating non-qualified staff on how to respect the risks energized systems and how to avoid them

5. Which safety process do you chose? Either the code book or formal audit approach to determine PPE needs?

Where Is Everyone on 70E Compliance?

August 2007 Nec Digest

- **24% - Of companies used in house engineering using commercial software**
- **32% - Of companies used in house personnel and used the NFPA table 130.7C9**
- **12% - Of companies contracted outside services using commercial software programs**
- **32% - Of companies contracted personnel using the NFPA 70E table 130.7C9**

64% of employers still believe the tables in the code are a valid choice with PPE labeling. This method leads to false compliance.

Rack-In Incident

110.16 (2008) NEC Code Book

110.16 Flash Protection. **Electrical equipment such as switchboards, panel boards, industrial control panels, and motor control centers in other than dwelling occupancies, that are likely to require examination, adjustment, servicing, or maintenance while energized, shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.**

FPN No. 1: NFPA 70E-2004, ***Electrical Safety Requirements for Employee Workplaces***, provides assistance in determining severity of potential exposure, planning safe work practices, and selecting personal protective equipment.

130.3 (Equipment Labeling Needs)

- **(2009) 70E Edition:**
  Equipment shall be field marked with a label containing the available incident energy or required level of PPE.

- **The old 2004 standard of generic labeling is no longer valid**

Old Generic Arc Flash Labeling Sample:

Old Style

WARNING

Arc Flash and Shock Hazard
Appropriate PPE Required per NFPA 70E

Hazard Category 2 PPE Required for Live Work on This Equipment:

Required PPE: 8 cal/cm2 FR Shirt/FR pants, Hard Hat,
•8 cal/cm2 Face Shield, Balaclava, Safety Glasses, Hearing Prot.

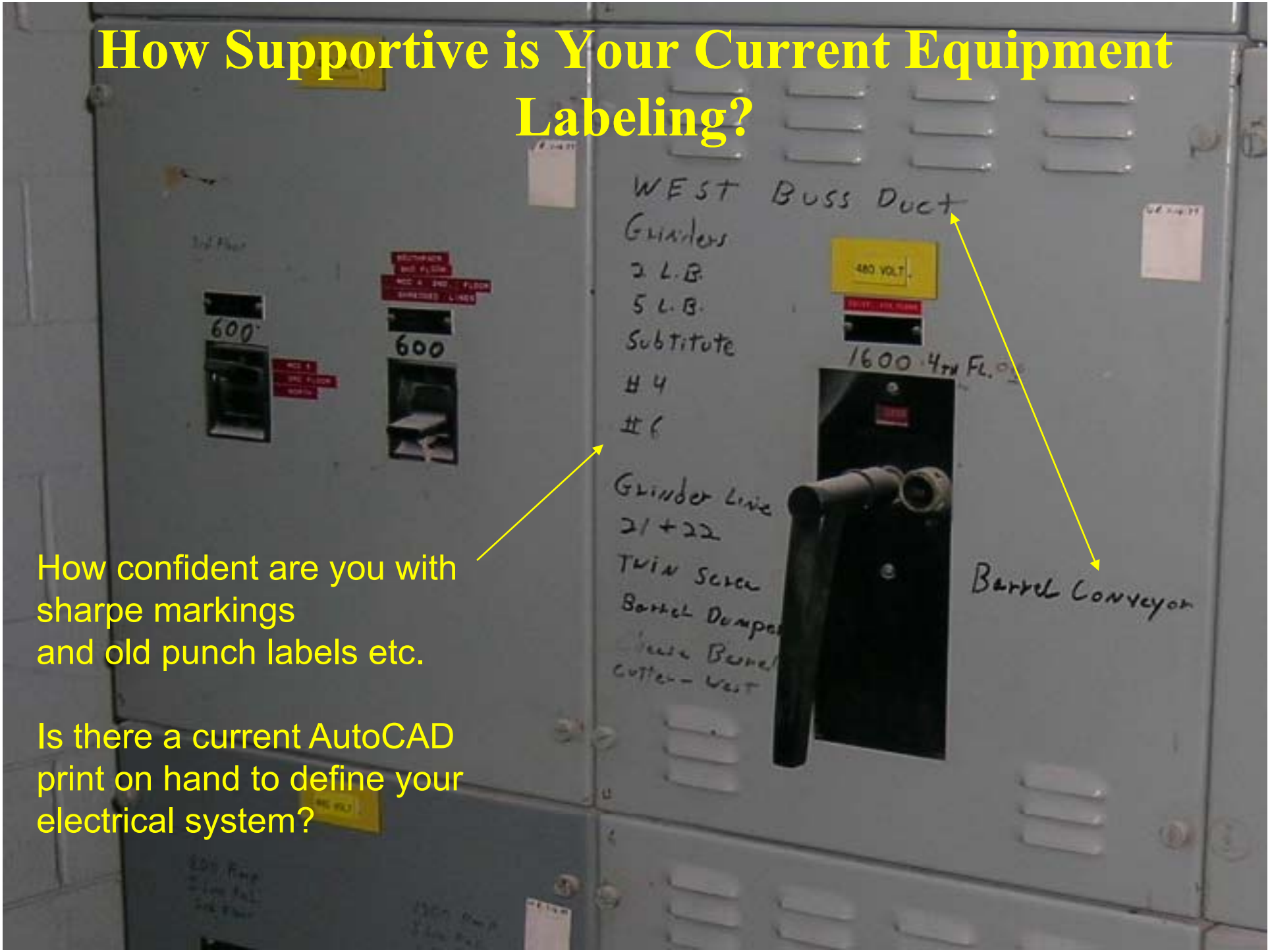
130.3(C): Equipment shall be field marked with a label containing the available Incident energy or the required level of PPE.

Labeling Goals for ESWP Programs

- Equipment Labeling should include three key components which are:

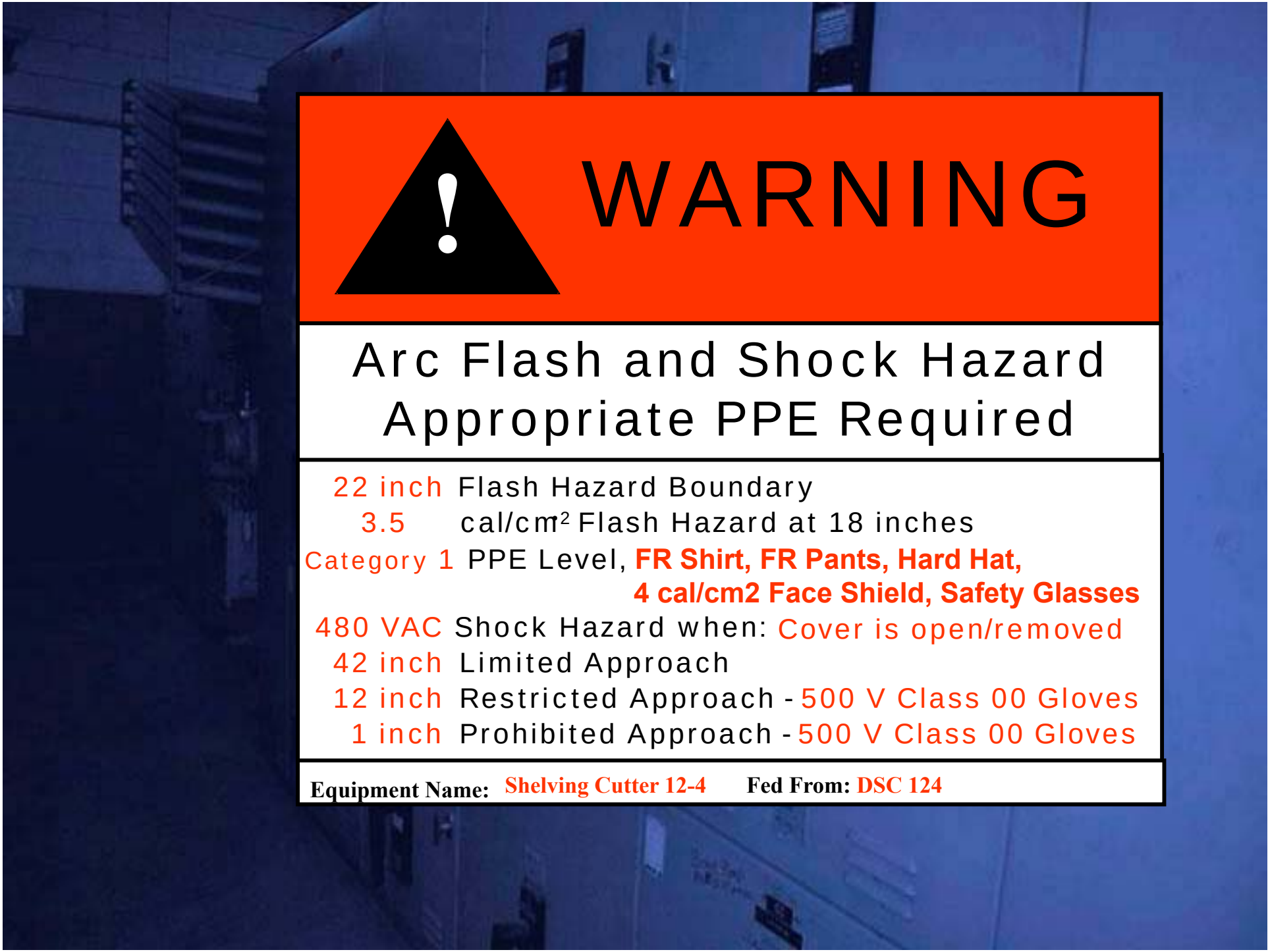
1. Complete Arc flash hazard ratings and PPE
2. Shock hazard ratings and glove needs
3. A means for identifying “what” the equipment is called and more importantly “where” it is being fed from in order to obtain a de-energized state.

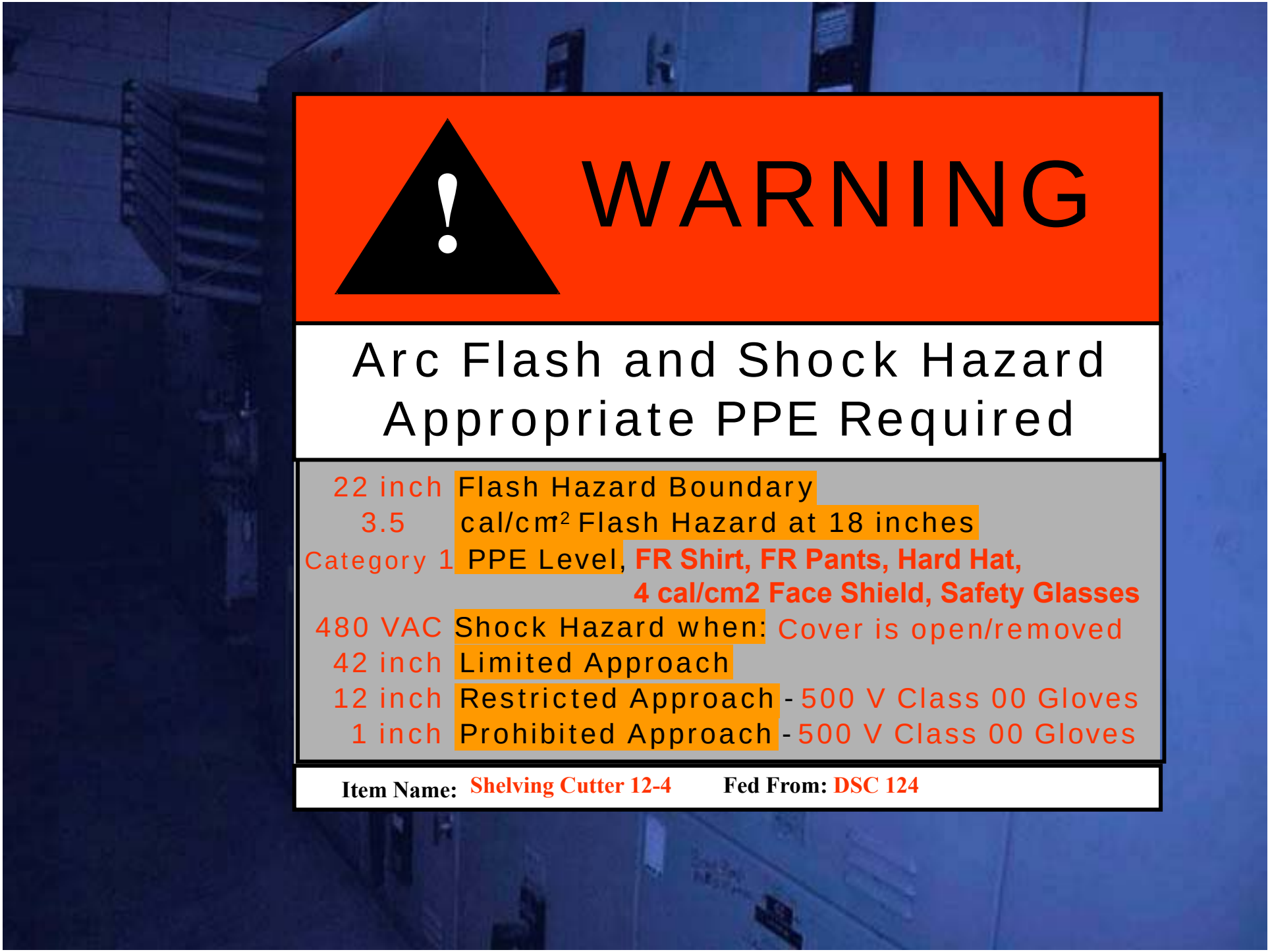
How Supportive is Your Current Equipment Labeling?



How confident are you with sharpe markings and old punch labels etc.

Is there a current AutoCAD print on hand to define your electrical system?


WARNING
Arc Flash and Shock Hazard
Appropriate PPE Required
22 inch Flash Hazard Boundary
3.5 cal/cm² Flash Hazard at 18 inches
Category 1 PPE Level, FR Shirt, FR Pants, Hard Hat,
4 cal/cm2 Face Shield, Safety Glasses
480 VAC Shock Hazard when: Cover is open/removed
42 inch Limited Approach
12 inch Restricted Approach - 500 V Class 00 Gloves
1 inch Prohibited Approach - 500 V Class 00 Gloves
Equipment Name: Shelving Cutter 12-4 Fed From: DSC 124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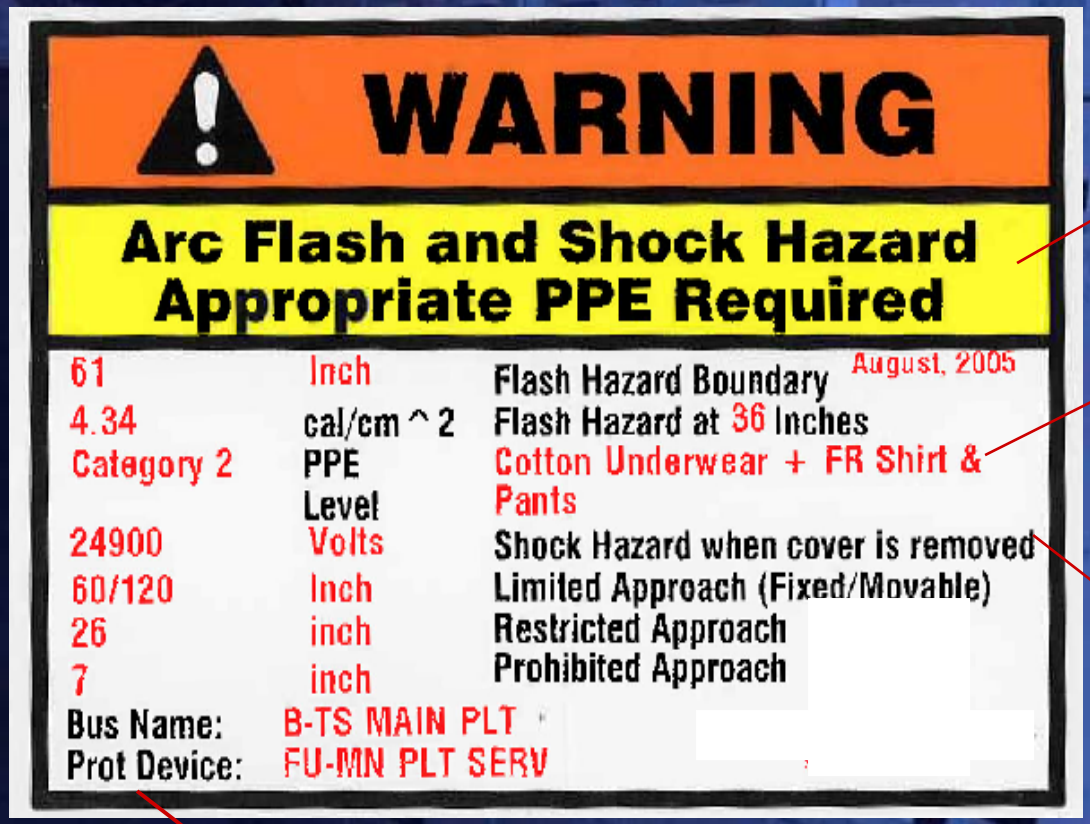
12 inch Restricted Approach - 500 V Class 00 Gloves
1 inch Prohibited Approach - 500 V Class 00 Gloves
Item Name: Shelving Cutter 12-4 Fed From: DSC 124

Labeling Currently Represent a Large Problem in the NFPA 70E Market Today:

- The following label examples and formats have been obtained over the past several years for use in classroom discussions
- The new code book does require that a calorie rating be posted on a label but yet does not specifically reference a “sample or design” so it is again up to the employer to know and understand the goals of their safety plan.

Incomplete Label Example:



Color coding is not recommended nor required

Labeling lacked PPE details

No Mention of insulated glove needs in old labels

Bus Names and Protective Device references may not be the ideal references to use for LOTO goals?

Common Labeling Errors:

1. **Improper PPE listings. Employers will be at risk if employees do not have the tools needed to remember what is expected of them.**

2. **Insulated glove class not present or at the appropriate location within the label.**

3. **Incomplete or ineffective LOTO references. If you embark on arc flash audits, you must tie in LOTO to your overall goals for de-energized work practices.**

Minimum FR PPE Content For Labels:

Category	Required Protection FR Clothing
Category 0	Untreated Cotton Long Sleeve Shirt, Pants, Safety Glasses
Category 1	FR Shirt, FR Pants, Hard Hat, 4 cal/cm^2 Face Shield, Safety Glasses
Category 2	FR Shirt, FR Pants, Hard Hat, Balaclava/Hood, 8 cal/cm^2 Face Shield, Safety Glasses
Category 3	FR Shirt & Pant + FR Coverall, Switching Hood, Safety Glasses
Category 4	FR Shirt & Pant + FR Coverall, Double Layer Switching Coat and Hood, Safety Glasses

(130.7C10) Protective Equipment Table (Category 1) PPE Listing

Table 130.7(C)(10) Protective Clothing and Personal Protective Equipment (PPE)

Hazard/Risk Category 1	Protective Clothing and PPE
FR Clothing, Minimum Arc Rating of 4 (Note 1)	Arc-rated long-sleeve shirt (Note 3)
	Arc-rated pants (Note 3)
	Arc-rated coverall (Note 4)
	Arc-rated face shield or arc flash suit hood (Note 7)
	Arc-rated jacket, parka, or rainwear (AN)
FR Protective Equipment	Hard hat
	Safety glasses or safety goggles (SR)
	Hearing protection (ear canal inserts)
	Leather gloves (Note 2)
	Leather work shoes (AN)

Labeling Summary:

- The bottom line on labeling is your employees will benefit from a simple yet complete label
- If any key aspects are missing from a label the employees won't have the time or remember to go look up what is needed for PPE.
- If you have multiple sites, it is recommended to be consistent with labeling format and designs. As a company you typically have one common safety policy to train from.

1910.333(a)(1) De-energized parts.

"Live parts to which an employee may be exposed shall be de-energized before the employee works on or near them, unless the employer can demonstrate that de-energizing introduces additional or increased hazards or is infeasible due to equipment design or operational limitations."

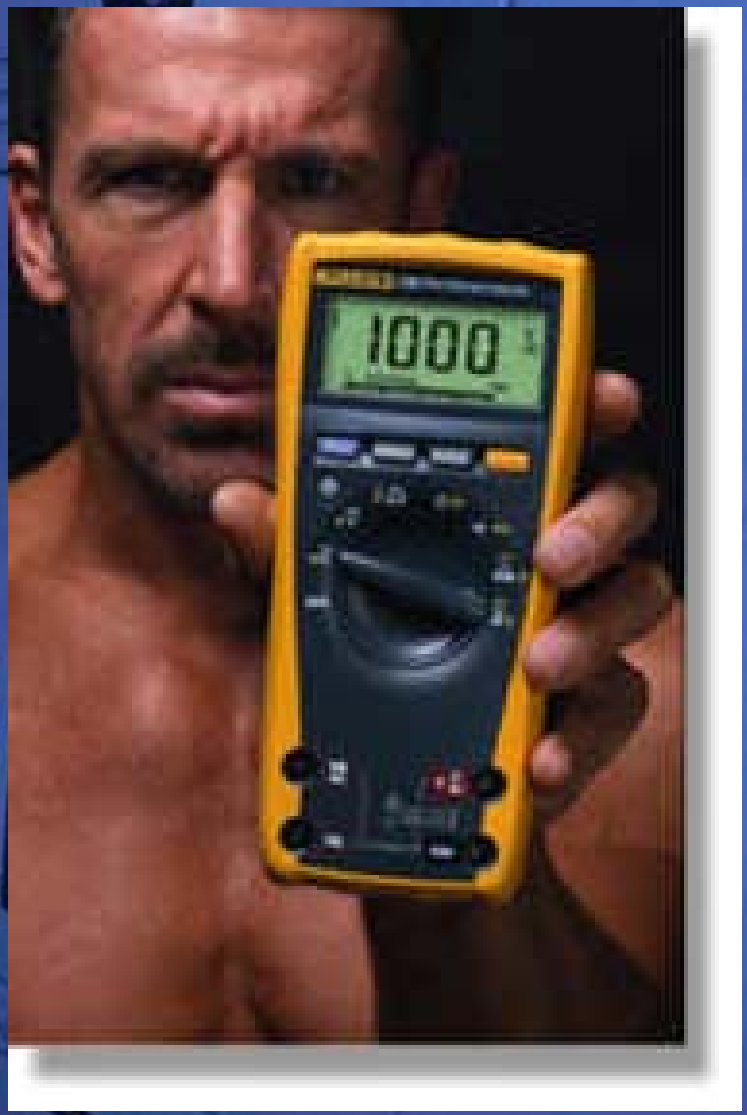
Does OSHA need NFPA 70E in order to issue citations??

Voltage Testing Can Be Fatal!

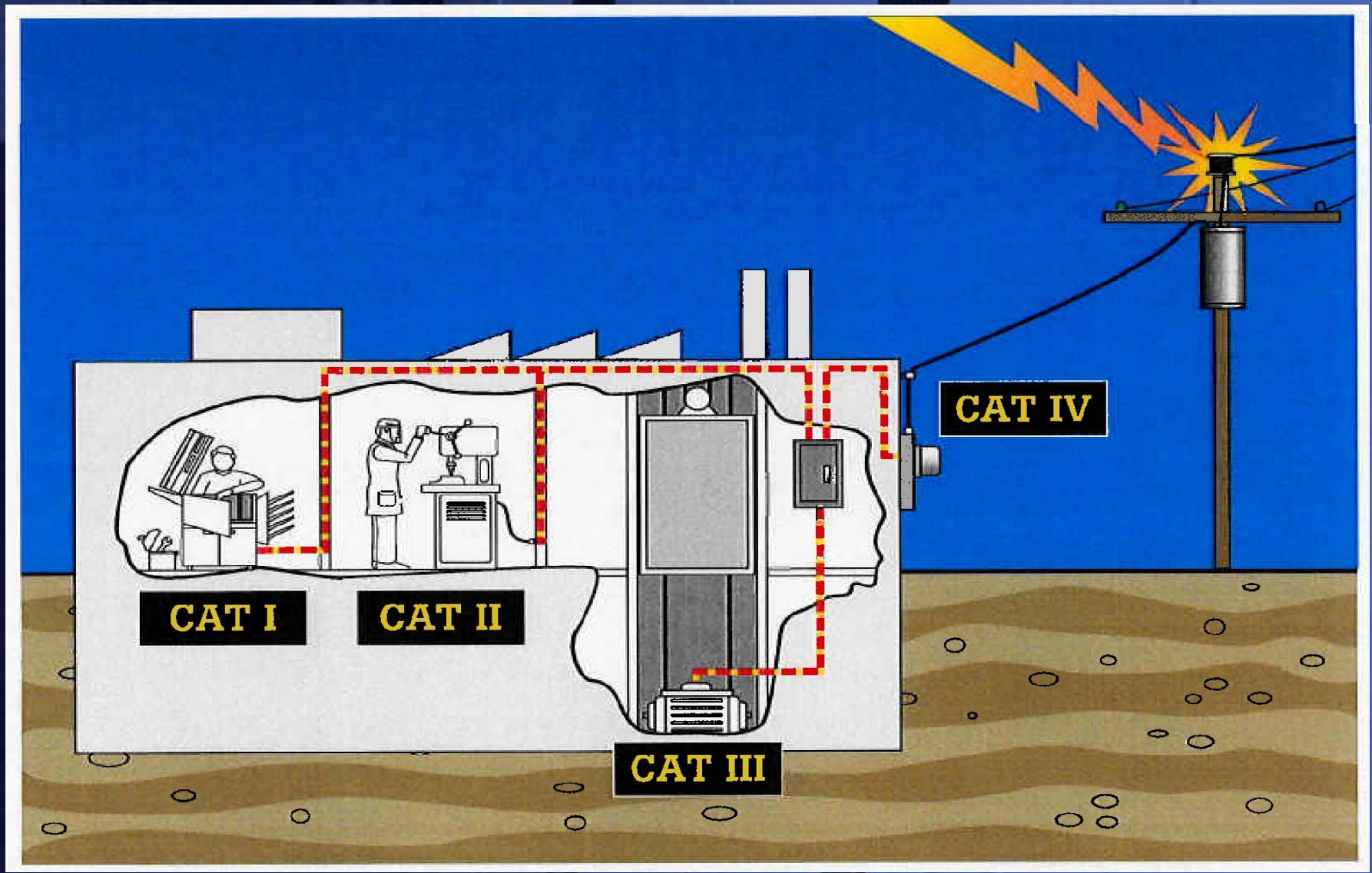
Incorrect fuse used in multi-meter

Top Causes of Meter Incidents

1. Using the wrong meter for the job (i.e. using a 600 V meter on a 4160 V source)
2. Leads connected to wrong inputs on meter (i.e. leads in Current input while performing a voltage test)
3. Incorrect fuse installed in meter (replaced w/ substandard fuse)

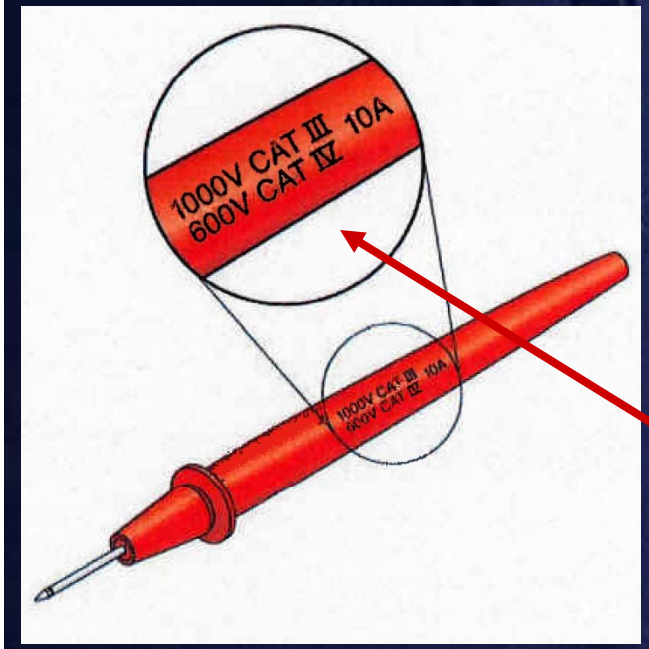


Meter Needs:



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

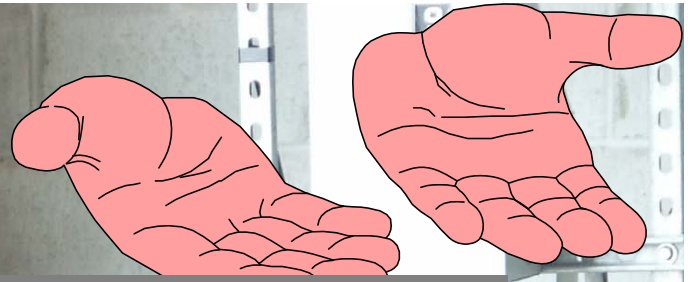
Do not use meters without proper CAT markings on 480 V circuits

Please make sure your meter leads are correct

Use Appropriate Levels of Protection

- Every Product has a Specific Purpose
- Do not Assume They are Rated for the Task
- Recommend Oberon face shields and Insulated tools with two layers of insulation
- Watch for ASTM ratings, not IEC!

Glove Ratings Table:



Class	Max Use Voltage	AC Test Voltage
00 Beige	500v	2.5Kv
0 Red	1Kv	5Kv
1 White	7.5Kv	10Kv
2 Yellow	17Kv	20Kv
3 Green	26.5Kv	30Kv
4 Orange	36Kv	40Kv

Table 130.7(C)(6)(c) Rubber Insulating Equipment, Maximum Test Intervals

Table 130.7(C)(6)(c) Rubber Insulating Equipment, Maximum Test Intervals		
Rubber Insulating Equipment	**When to test**	**Governing Standard* for Test Voltage**
Blankets	Before first issue; every 12 months thereafter	ASTM F 479
Covers	If insulating value is suspect	ASTM F 478
Gloves	Before first issue; every 6 months thereafter	ASTM F 496
Line hose	If insulating value is suspect	ASTM F 478
Sleeves	Before first issue; every 12 months thereafter	ASTM F 496

Multi-Employer Language

➢ 110.5 Relationships with Contractors

1. A **Creating Employer** – One who caused the hazardous condition to exist
2. An **Exposing Employer** – One who assigns a work task to workers knowing that a hazardous condition exists
3. A **Correcting Employer** – One who is responsible for correcting the hazardous condition
4. A **Controlling Employer** – One who has the authority to correct the hazardous condition

110.6 Training Requirements.

- **(E) Training Documentation**

  The employer shall document that each employee has received the training required by paragraph 110.6(D). This documentation shall be made when the employee demonstrates proficiency in the work practices involved and shall be maintained for the duration of the employee's employment. The documentation shall contain each employee's name and dates of training.

110.6 Training Requirements.

- **(D)(e) Employee Training**

  Employees shall be trained to select an appropriate voltage detector and shall demonstrate how to use a device to verify the absence of voltage, including interpreting indications provided by the device. The training shall include information that enables the employee to understand all limitations of each specific voltage detector that may be used.

- **Tic tracers or other audible devices should not be used as a sole source of voltage measurement or verification.**

110.9 Test Instruments and Equipment.

- **(A)(4) Operation Verification.**
  When test instruments are used for the testing for absence of voltage on conductors or circuit parts operating at 50 volts or more, the operation of the test equipment shall be verified before and after an absence of voltage test is performed.

- **This is the old "Live Dead Live" application that has been taught over the years and now it is written in clear code reference for all of us to implement correctly**

130.1(B)1
Energized Electrical Work Permit (Where Required)

(1) Where Required.

When working on energized electrical conductors or circuit parts that are not placed in an electrically safe work condition (i.e.., for the reasons of increased or additional hazards or infeasibility per 130.1), work to be performed shall be considered energized work and shall be performed by written permit only.

130.1(A)(3)
Energized Electrical Work Permit
(Exemptions to Work Permit)

- Work performed within the Limited Approach Boundary of energized electrical conductors or circuit parts by qualified persons related to tasks such as testing, troubleshooting, voltage measuring, etc. shall be permitted to be performed without an energized electrical work permit, provided appropriate safe work practices and personal protective equipment in accordance with Chapter 1 are provided and used. If the purpose of crossing the Limited Approach Boundary is only for visual inspection and the Restricted Approach Boundary will not be crossed, then an energized electrical permit shall not be required.

ENERGIZED WORK SPECIFICATIONS FORM 12.1

Requesting Competent Person_____ Division_____

Job/W.O. Number_____ Job Name_____

Equipment/Machine to be Locked Out and Tagged Out_____

Equipment and/or Circuits to be worked on energized_____

Statement of why equipment cannot be de-energized_____

Is it possible to reschedule work at a later date when equipment may be de-energized?_____

Hazards (risk to electrical property/) _____

_____

Date(s) of work to be performance _____

Work to be performed _____

Energy Source and Location _____

Employees who will be performing the energized work_____

Have employees been properly trained? Yes ☐ No ☐

Have effective employees been notified of procedures and hazards? Yes ☐ No ☐

Date of Notification _____ Competent person assigned _____

Energized Work Category: **≤50v** ☐ **50–250v** ☐ **250–600v** ☐ **≥600v** ☐

List personal protective equipment_____

Date equipment last tested _____ Tested by: _____

Has (JSA) written plan been completed for energized work? _____, attach copy.

Authorized Customer representative approval_____ Date _____
Customer representative understands/assumes all risks/damages to property and lost of production (Required for all energized work)

Job Supervisor _____ Date _____
(Required for all Energized work)

PM/PCM _____ Date_____
(Required for energized work, ≥600v, (nominal))

VP Construction / Branch Manager _____ Date _____
(Required for energized work, ≥600v)

Remember you can add to this form but don’t subtract topics!

130.3 Arc Flash Hazard Analysis

- **(2009) Edition-** An arc flash hazard analysis shall determine the Arc Flash Protection Boundary and the personal protective equipment people within the Arc Flash Boundary shall use.

  - The arc flash hazard analysis shall be updated when a major modification or renovation takes place. It shall be reviewed periodically, not to exceed 5 years, to account for changes in the electrical distribution system that could affect the results of the arc flash hazard analysis.

130.3 Arc Flash Hazard Analysis

- **(2009) Edition-** **An arc flash hazard analysis shall determine the Arc Flash Protection Boundary and the personal protective equipment people within the Arc Flash Boundary shall use.**

  - **The arc flash hazard analysis shall take into consideration the design of the over current protective device and its opening time, including its condition of maintenance.**

130.7(C)(3) Head, Face, Neck, and Chin Protection

(3). Employees shall wear nonconductive head protection wherever there is danger of head injury from electrical shock or burns due to contact with energized electrical conductors or circuit parts or from flying objects resulting from electrical explosion. Employees shall wear nonconductive protective equipment for the face, neck, and chin whenever there is a danger of injury from exposure to electric arcs or flashes or from flying objects resulting from electrical explosion. If employees use hairnets and/or beard nets, these items must be non-melting and flame resistant.

Options With NFPA 70E

There two options available for NFPA 70E Compliance Goals:

Safety Audit Process:

#1 Recommendation is to do your homework and complete a full safety audit. This includes a full evaluation of existing LOTO labeling and current one-line print use in your facility.

Code Book Approach:

#2 You can use the table approach to PPE in order to get a program started. Must use caution if you use this as your sole source of protection as the code book has numerous open ended notes associated with the tables.

Is Table 130.7(C)(9) a Good Choice for Your Program and Policy Implementation Goals?

- Where selected in lieu of the incident energy analysis of 130.3B1, table 130.7C9 shall be used to determine the hazard/risk category and shock prevention needs.
- The assumed maximum short circuit current capacities and maximum fault clearing times are listed for various tasks and must be considered.

130.7(C)(9) Selection of PPE When Required of Various Tasks:

- For tasks not listed, or for power systems with greater than assumed maximum short circuit capacity or with longer than assumed trip clearing times, an arc flash analysis shall be required in accordance with 130.3

(130.7C9) PPE Task Based Table

Electrical Safety Matrix Task (Assumes Equipment Is Energized, and Work, Is Done Within the Flash Protection Boundary) Refer to Notes 1 and 3	Hazard Risk Category	V-rated Gloves	V-rated Tools
Panel boards 240 V (nominal) and below			
Circuit breaker (CB) or fused switch (FS) operation with covers on	0		
Opening hinged covers (to expose bare, energized parts)	0		
CB or FS operation with covers off	0		
Work on energized parts, including all testing	1	•	•
Remove/install CBs or fused switches	1	•	•
Removal of bolted covers (to expose bare, energized parts)	1		

Note 1 - >25kAIC and a no more than .03 sec fault clearing time
Note 3 - <10kAIC then you can reduce the category by one #

(130.7C10) Protective Equipment Table (Category 1) PPE Listing

Table 130.7(C)(10) Protective Clothing and Personal Protective Equipment (PPE)

Hazard/Risk Category 1	Protective Clothing and PPE
FR Clothing, Minimum Arc Rating of 4 (Note 1)	Arc-rated long-sleeve shirt (Note 3)
	Arc-rated pants (Note 3)
	Arc-rated coverall (Note 4)
	Arc-rated face shield or arc flash suit hood (Note 7)
	Arc-rated jacket, parka, or rainwear (AN)
FR Protective Equipment	Hard hat
	Safety glasses or safety goggles (SR)
	Hearing protection (ear canal inserts)
	Leather gloves (Note 2)
	Leather work shoes (AN)

(130.7C10) Protective Equipment Table Changes in the 2009 Code:

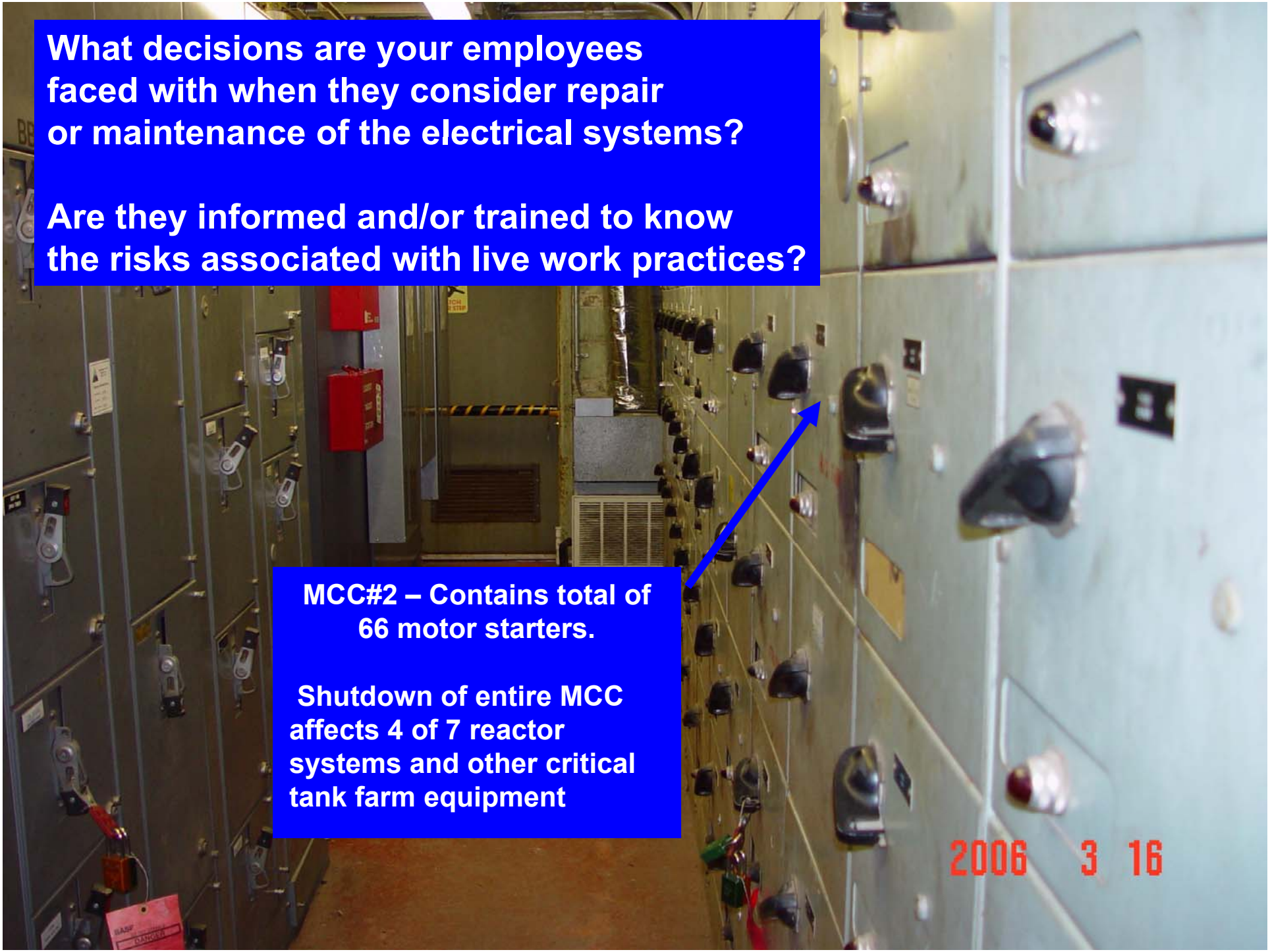
Table 130.7(C)(10) Protective Clothing and Personal Protective Equipment (PPE)

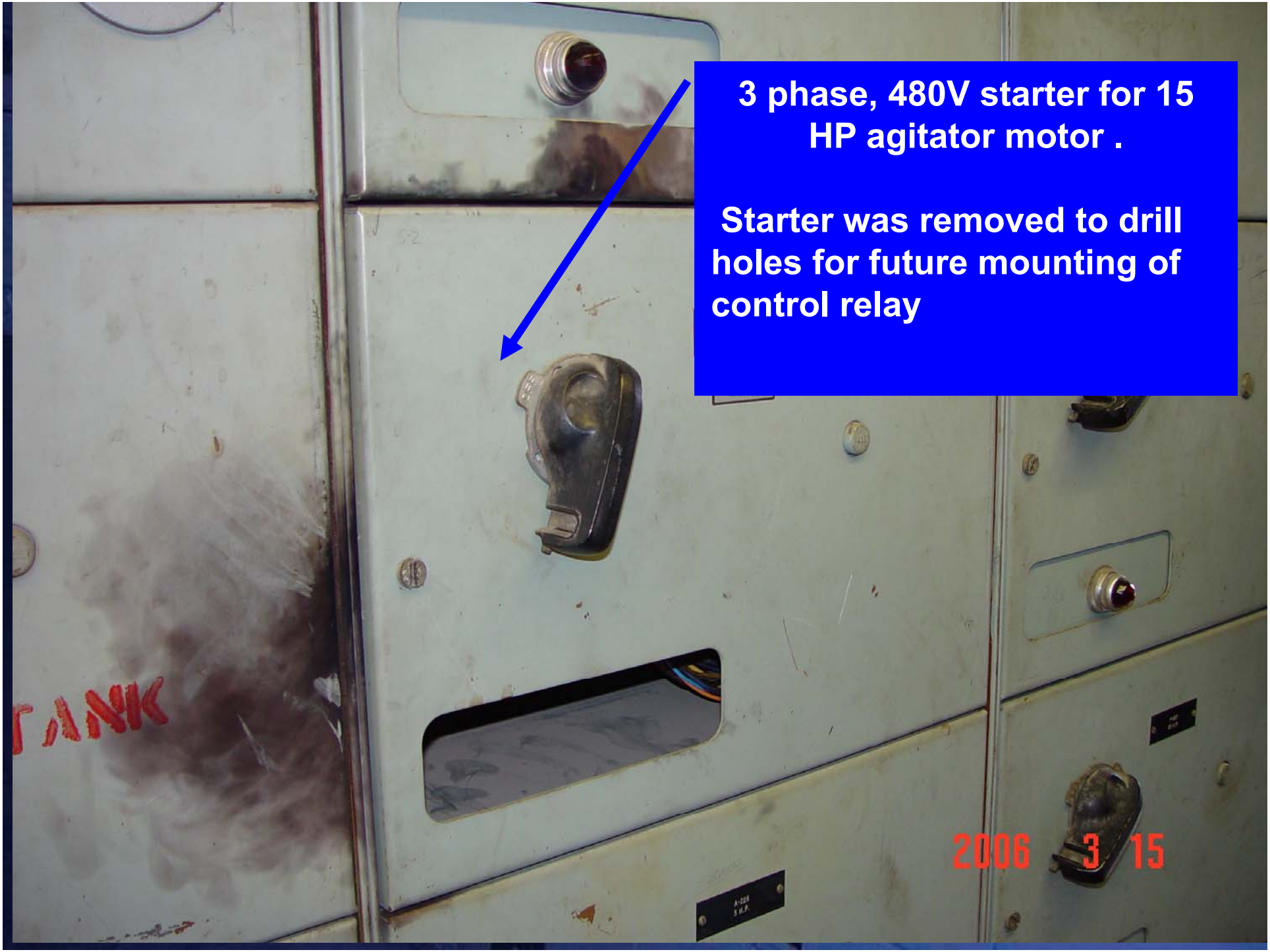
- Hearing protection required for all hazard risk categories
- 4 cal/cm^2 Face shield protection for HRC #1
- The code has lowered the cal/cm^2 rating for HRC #0 from 2.0 to 1.2. This means any PPE labeling done prior to September 2008 must be evaluated.
- Cotton T-shirts are no longer required under HRC clothing

(2009) 130.7C11 Hazard Selection Table

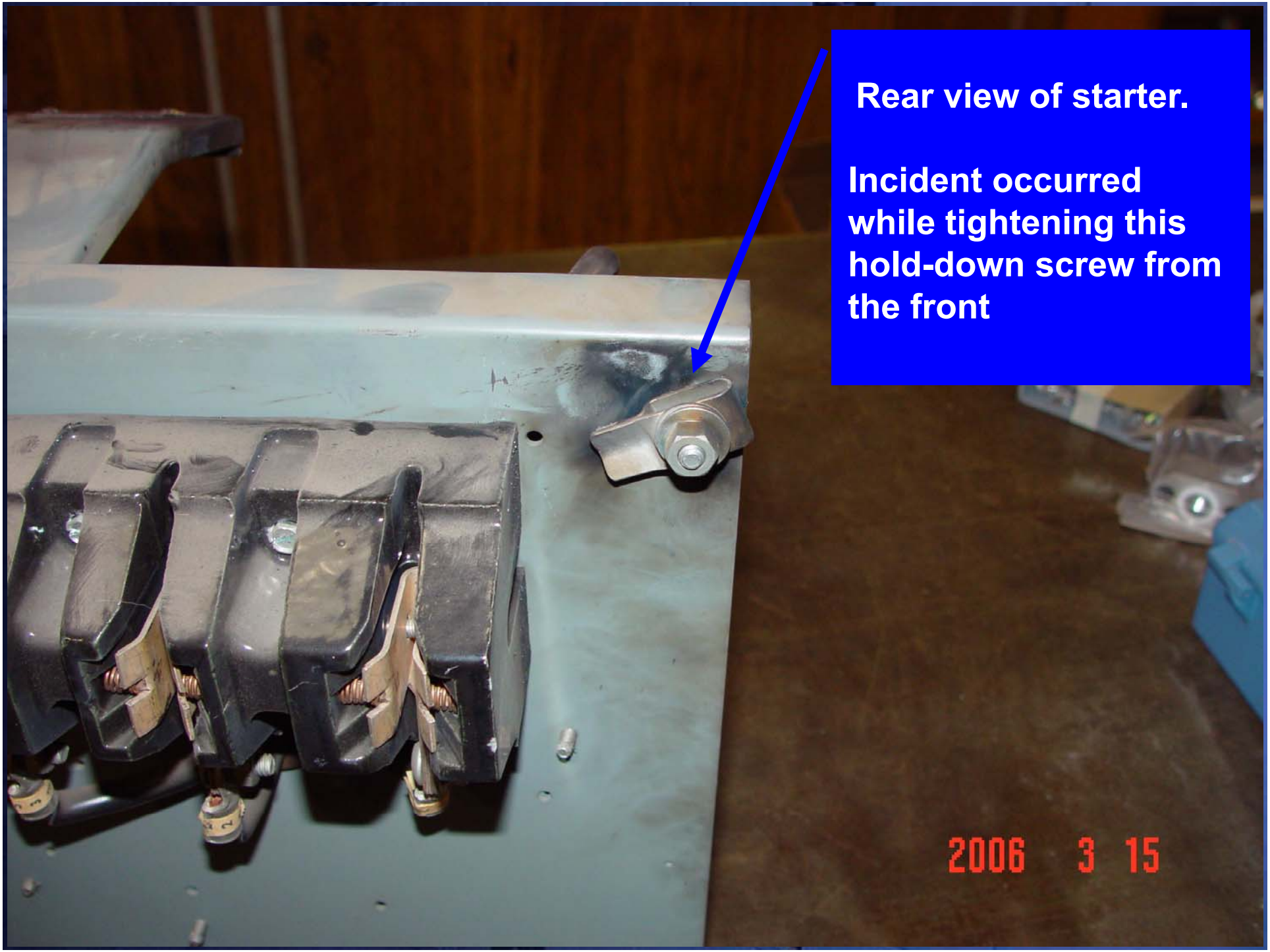
Hazard Risk Category	Clothing Description	Minimum ATPV (cal/cm^2)
0	Non-melting, flammable materials (i.e.; untreated cotton, wool, rayon, or silk, or blends of these materials) with a fabric weight of 4.5 oz/yd^2	N/A
1	Arc-rated shirt and FR Pants or FR Coverall	4
2	Arc-rated shirt and FR Pants or FR Coverall	8
3	Arc-rated FR Shirt and pants or FR coverall, and arc flash suit selected so that the system arc rating meets the required minimum	25
4	Arc-rated FR Shirt and pants or FR coverall, and arc flash suit selected so that the system arc rating meets the required minimum	40

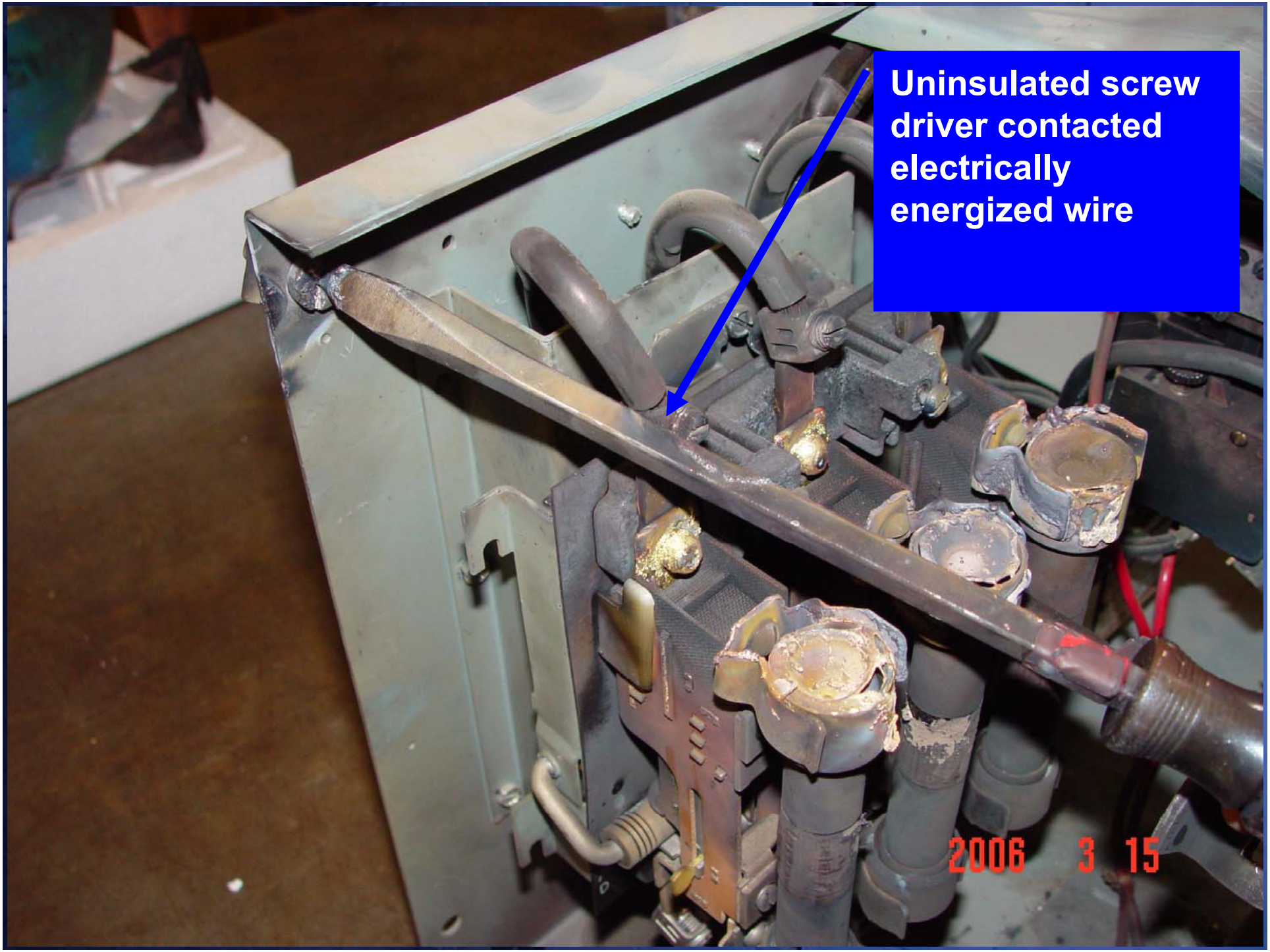
Do not rely on this table for anything other than the ATPV levels.
Table 130.7C10 is the table you must be using for PPE needs.


What decisions are your employees faced with when they consider repair or maintenance of the electrical systems?
Are they informed and/or trained to know the risks associated with live work practices?
MCC#2 – Contains total of 66 motor starters.
Shutdown of entire MCC affects 4 of 7 reactor systems and other critical tank farm equipment
2006 3 16

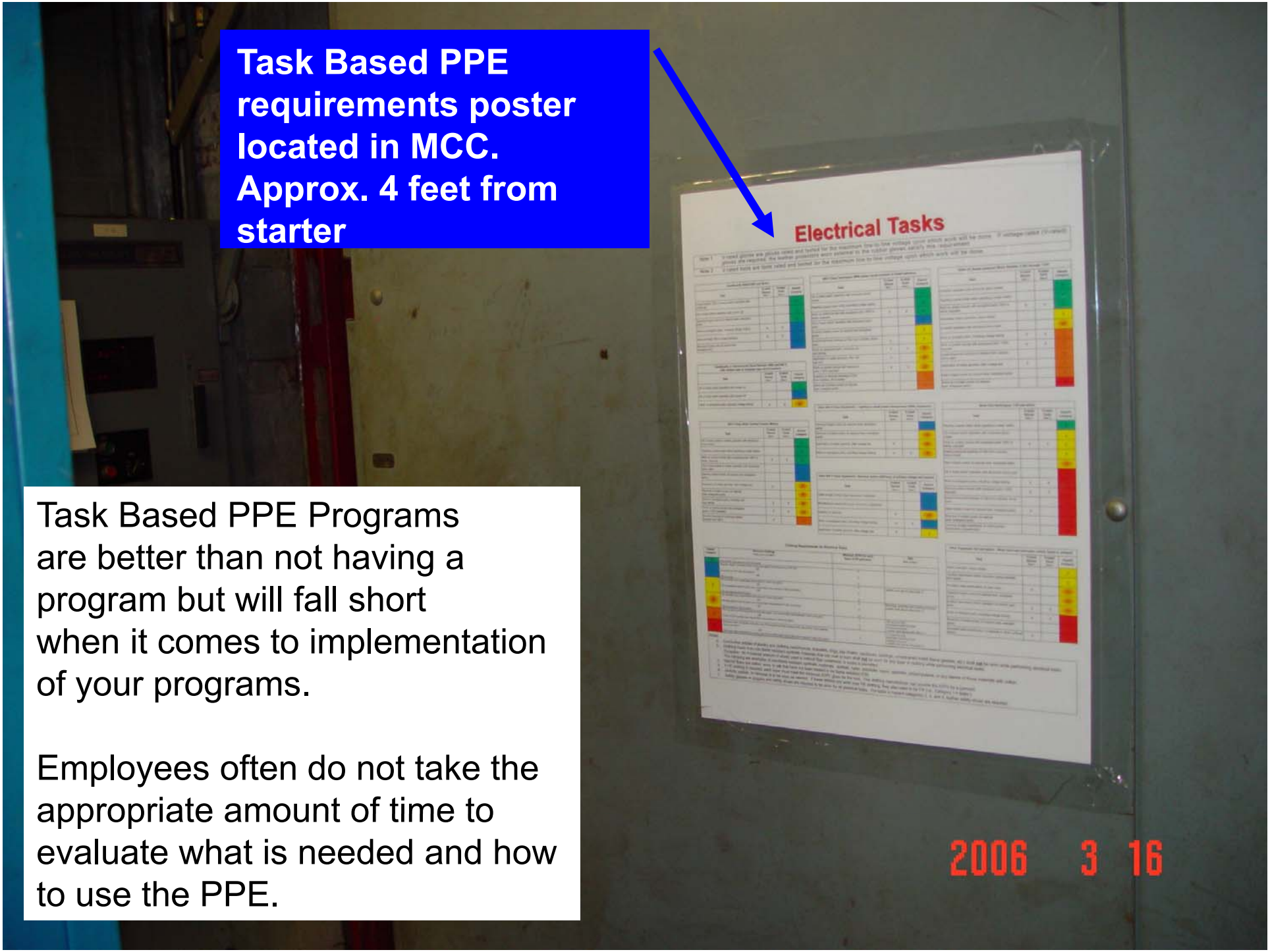

3 phase, 480V starter for 15 HP agitator motor .
Starter was removed to drill holes for future mounting of control relay
2006 3 15


Exposed 480 V buss bar
with starter removed
2006 3 15


Rear view of starter.
Incident occurred while tightening this hold-down screw from the front
2006 3 15


Uninsulated screw driver contacted electrically energized wire
2006 3 15


Soot residue on helmet and safety glasses
BASF
2006 3 16



Task Based PPE Programs are better than not having a program but will fall short when it comes to implementation of your programs.

Employees often do not take the appropriate amount of time to evaluate what is needed and how to use the PPE.


Duffle bags containing required PPE: V-rated gloves, FR coveralls, flash suit hood, etc.
Located in MCC. Approx. 10 feet from starter
PUMP
2006 3 16

Which program would you prefer to use with your site staff?

One program is asking staff to stop and dig into PPE needs while the other is taking that step out and is clearly telling them what they need.

Incident Overview (photos)

This door was latched, top and bottom, and exploded outwards

Position of electrician when switching. Note the flash-suit worn during operation.

Incident Overview (Photos)

Relays housed in this unit

Breakers in this unit, submerged in oil. Note blast damage to steel casing.

Bank of OCB's. The unit second from right exploded. The rest were damaged by the blast and ensuing fire.

Incident Overview (photos)

Above: Position of front doors. They were blown towards the camera position, and though a chain-link fence, the remains of which can be seen in the foreground.

Left: Doors behind which electrician sheltered during switching. Note the cracks in the brickwork. Supports were installed after the event.

Starting Out:

- So, as a company you decide that it is time to address NFPA 70E needs and “arc flash”
- What should you ask for from a vendor or contracting source and more importantly how do you know what you are going to get in your final end products???

What to ask for in NFPA 70E Studies????

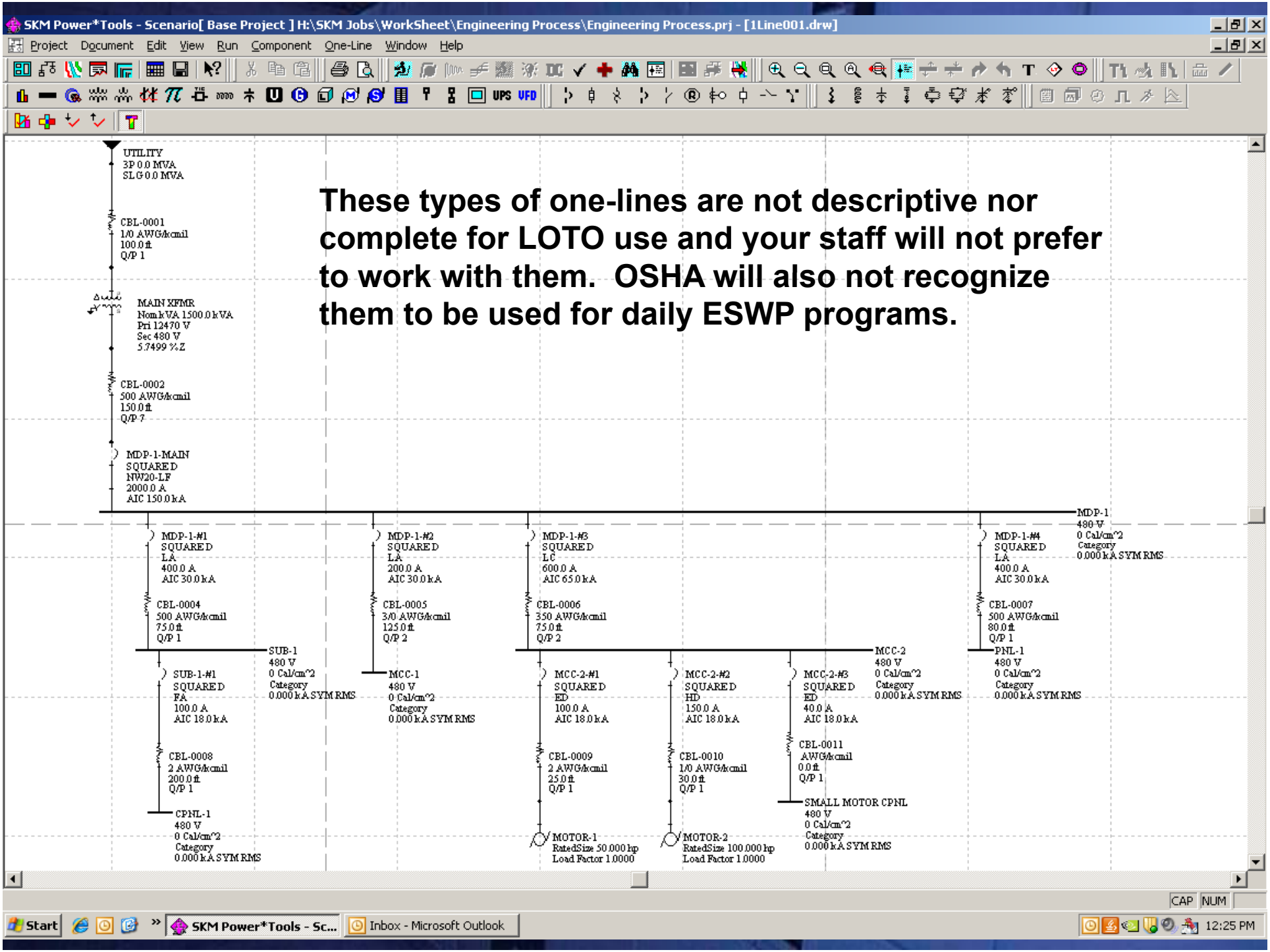
1. Most current “Arc flash studies” performed lack end user value due to a poorly defined process. Vendors often provide a level of service based on what you are asking for.

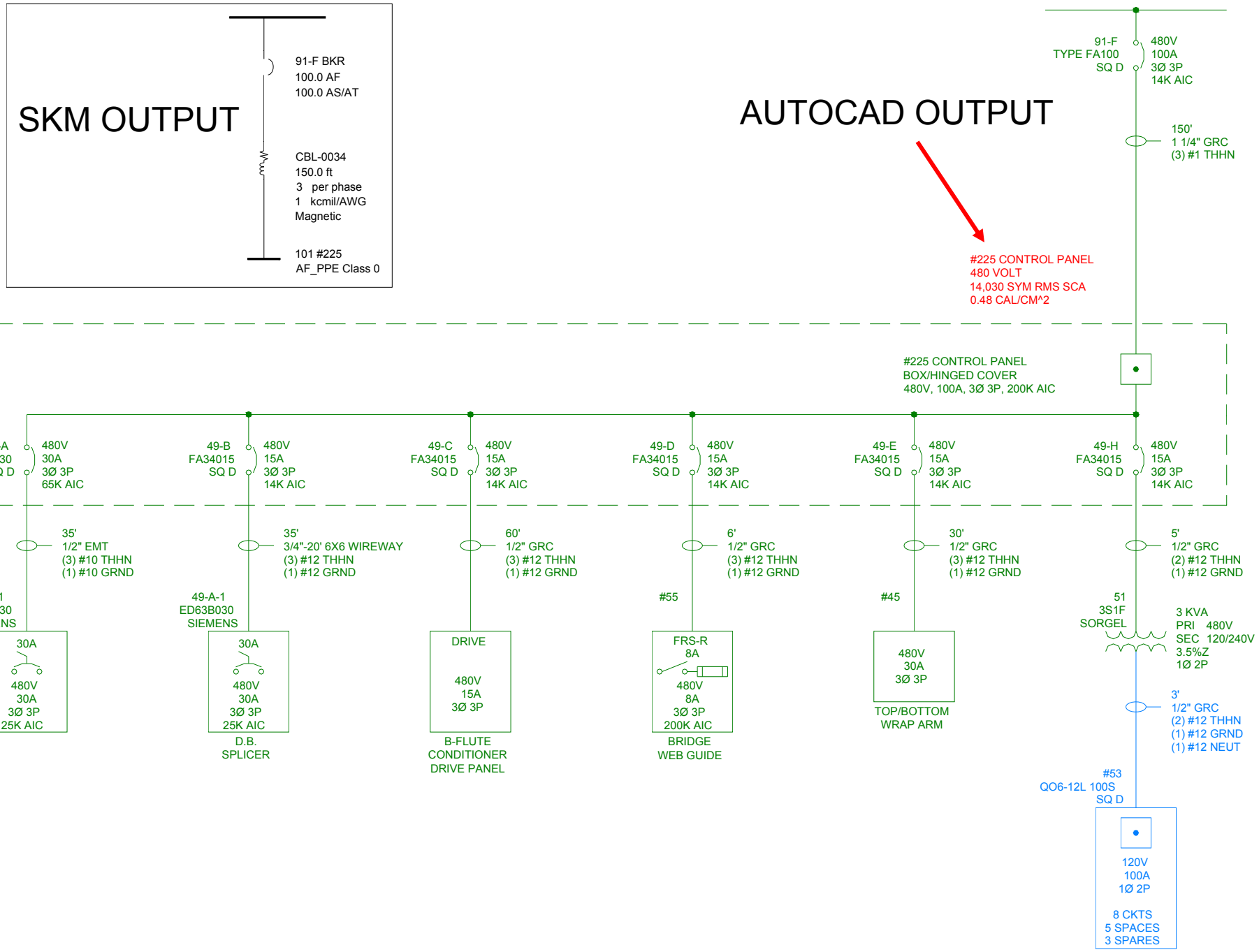
2. The process used for your audits on site has to be based on the most important set of facts in our daily work methods. How accurate is your existing equipment labeling in your site?? (De-Energized / LOTO)

What to ask for in NFPA 70E Studies????

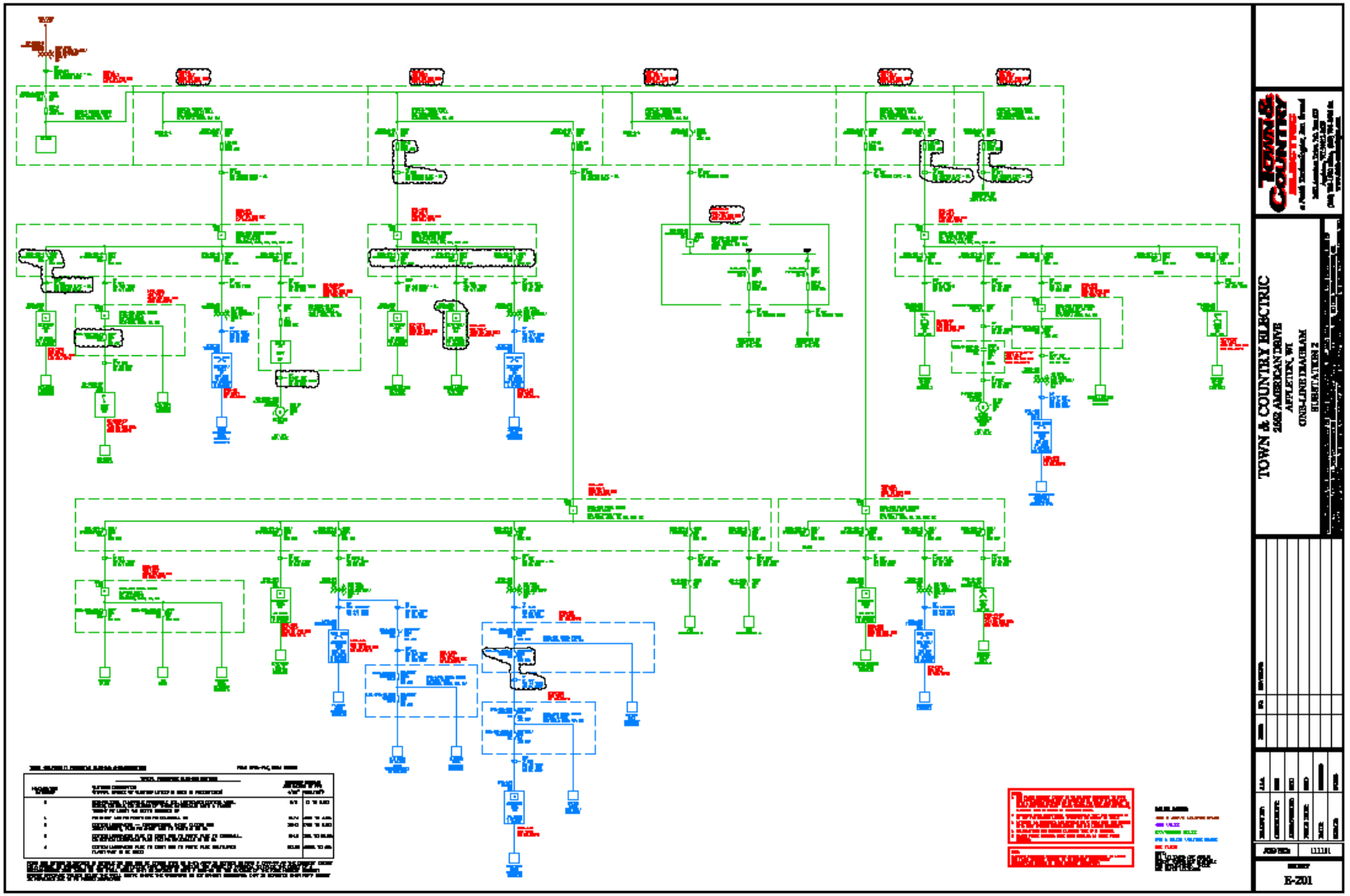
3. Request to review and edit a custom AutoCAD print PRIOR to any engineering work performed in your evaluation.

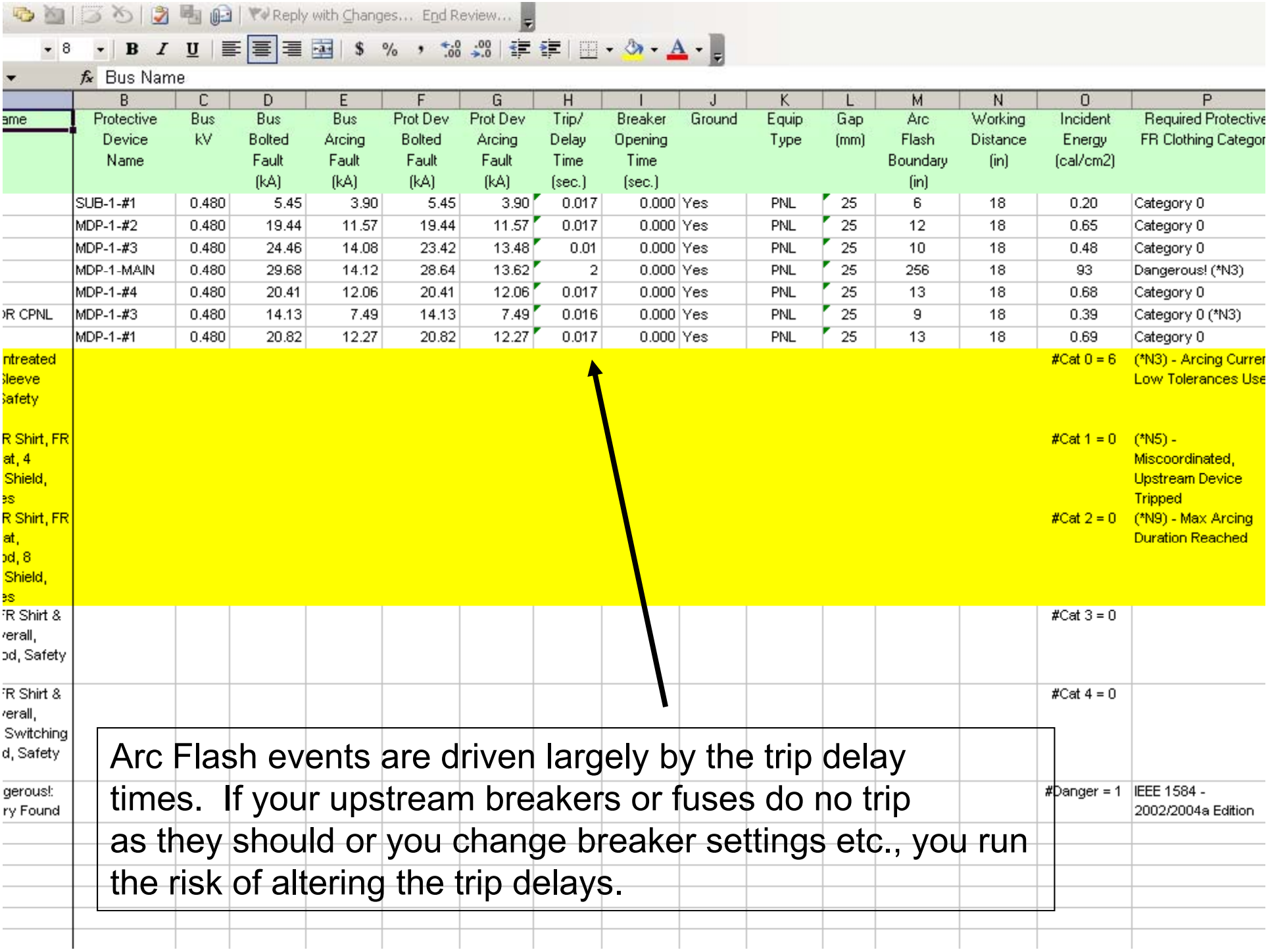
4. Get involved in your final labeling program and know what is being printed for your staff to follow. Ensure it matches with your policy goals and follows table 130.7C10.


SKM Power*Tools - Scenario[Base Project] H:\SKM Jobs\WorkSheet\Engineering Process\Engineering Process.prj - [1Line001.drw]
Project Document Edit View Run Component One-Line Window Help
UTILITY
3P 0.0 MVA
SLG 0.0 MVA
CBL-0001
1/0 AWG/kcmil
100.0 ft
Q/P 1
MAIN XFMR
Nom kVA 1500.0 kVA
Pri 12470 V
Sec 480 V
5.7499 %Z
CBL-0002
500 AWG/kcmil
150.0 ft
Q/P 7
MDP-1-MAIN
SQUARE D
NW20-LF
2000.0 A
AIC 150.0 kA
These types of one-lines are not descriptive nor complete for LOTO use and your staff will not prefer to work with them. OSHA will also not recognize them to be used for daily ESWP programs.
MDP-1-#1
SQUARE D
LA
400.0 A
AIC 30.0 kA
CBL-0004
500 AWG/kcmil
75.0 ft
Q/P 1
SUB-1
480 V
0 Cal/cm^2
Category
0.000 kA SYM RMS
SUB-1-#1
SQUARE D
FA
100.0 A
AIC 18.0 kA
CBL-0008
2 AWG/kcmil
200.0 ft
Q/P 1
CPNL-1
480 V
0 Cal/cm^2
Category
0.000 kA SYM RMS
MDP-1-#2
SQUARE D
LA
200.0 A
AIC 30.0 kA
CBL-0005
3/0 AWG/kcmil
125.0 ft
Q/P 2
MCC-1
480 V
0 Cal/cm^2
Category
0.000 kA SYM RMS
MDP-1-#3
SQUARE D
LC
600.0 A
AIC 65.0 kA
CBL-0006
350 AWG/kcmil
75.0 ft
Q/P 2
MCC-2
480 V
0 Cal/cm^2
Category
0.000 kA SYM RMS
MCC-2-#1
SQUARE D
ED
100.0 A
AIC 18.0 kA
CBL-0009
2 AWG/kcmil
25.0 ft
Q/P 1
MOTOR-1
RatedSize 50.000 hp
Load Factor 1.0000
MCC-2-#2
SQUARE D
HD
150.0 A
AIC 18.0 kA
CBL-0010
1/0 AWG/kcmil
30.0 ft
Q/P 1
MOTOR-2
RatedSize 100.000 hp
Load Factor 1.0000
MCC-2-#3
SQUARE D
ED
40.0 A
AIC 18.0 kA
CBL-0011
AWG/kcmil
0.0 ft
Q/P 1
SMALL MOTOR CPNL
480 V
0 Cal/cm^2
Category
0.000 kA SYM RMS
MDP-1-#4
SQUARE D
LA
400.0 A
AIC 30.0 kA
CBL-0007
500 AWG/kcmil
80.0 ft
Q/P 1
PNL-1
480 V
0 Cal/cm^2
Category
0.000 kA SYM RMS
MDP-1
480 V
0 Cal/cm^2
Category
0.000 kA SYM RMS
CAP NUM
Start
SKM Power*Tools - Sc...
Inbox - Microsoft Outlook
12:25 PM


SKM OUTPUT
91-F BKR
100.0 AF
100.0 AS/AT
CBL-0034
150.0 ft
3 per phase
1 kcmil/AWG
Magnetic
101 #225
AF_PPE Class 0
AUTOCAD OUTPUT
91-F
TYPE FA100
SQ D
480V
100A
3Ø 3P
14K AIC
150'
1 1/4" GRC
(3) #1 THHN
#225 CONTROL PANEL
480 VOLT
14,030 SYM RMS SCA
0.48 CAL/CM^2
#225 CONTROL PANEL
BOX/HINGED COVER
480V, 100A, 3Ø 3P, 200K AIC
49-A
FC34030
SQ D
480V
30A
3Ø 3P
65K AIC
49-B
FA34015
SQ D
480V
15A
3Ø 3P
14K AIC
49-C
FA34015
SQ D
480V
15A
3Ø 3P
14K AIC
49-D
FA34015
SQ D
480V
15A
3Ø 3P
14K AIC
49-E
FA34015
SQ D
480V
15A
3Ø 3P
14K AIC
49-H
FA34015
SQ D
480V
15A
3Ø 3P
14K AIC
35'
1/2" EMT
(3) #10 THHN
(1) #10 GRND
35'
3/4"-20' 6X6 WIREWAY
(3) #12 THHN
(1) #12 GRND
60'
1/2" GRC
(3) #12 THHN
(1) #12 GRND
6'
1/2" GRC
(3) #12 THHN
(1) #12 GRND
30'
1/2" GRC
(3) #12 THHN
(1) #12 GRND
5'
1/2" GRC
(2) #12 THHN
(1) #12 GRND
49-A-1
ED63B030
SIEMENS
30A
480V
30A
3Ø 3P
25K AIC
49-A-1
ED63B030
SIEMENS
30A
480V
30A
3Ø 3P
25K AIC
D.B.
SPLICER
DRIVE
480V
15A
3Ø 3P
B-FLUTE
CONDITIONER
DRIVE PANEL
#55
FRS-R
8A
480V
8A
3Ø 3P
200K AIC
BRIDGE
WEB GUIDE
#45
480V
30A
3Ø 3P
TOP/BOTTOM
WRAP ARM
51
3S1F
SORGEL
3 KVA
PRI 480V
SEC 120/240V
3.5%Z
1Ø 2P
3'
1/2" GRC
(2) #12 THHN
(1) #12 GRND
(1) #12 NEUT
#53
QO6-12L 100S
SQ D
120V
100A
1Ø 2P
8 CKTS
5 SPACES
3 SPARES

Arc Flash Hazard Analysis – What should be in a One-Line diagram?





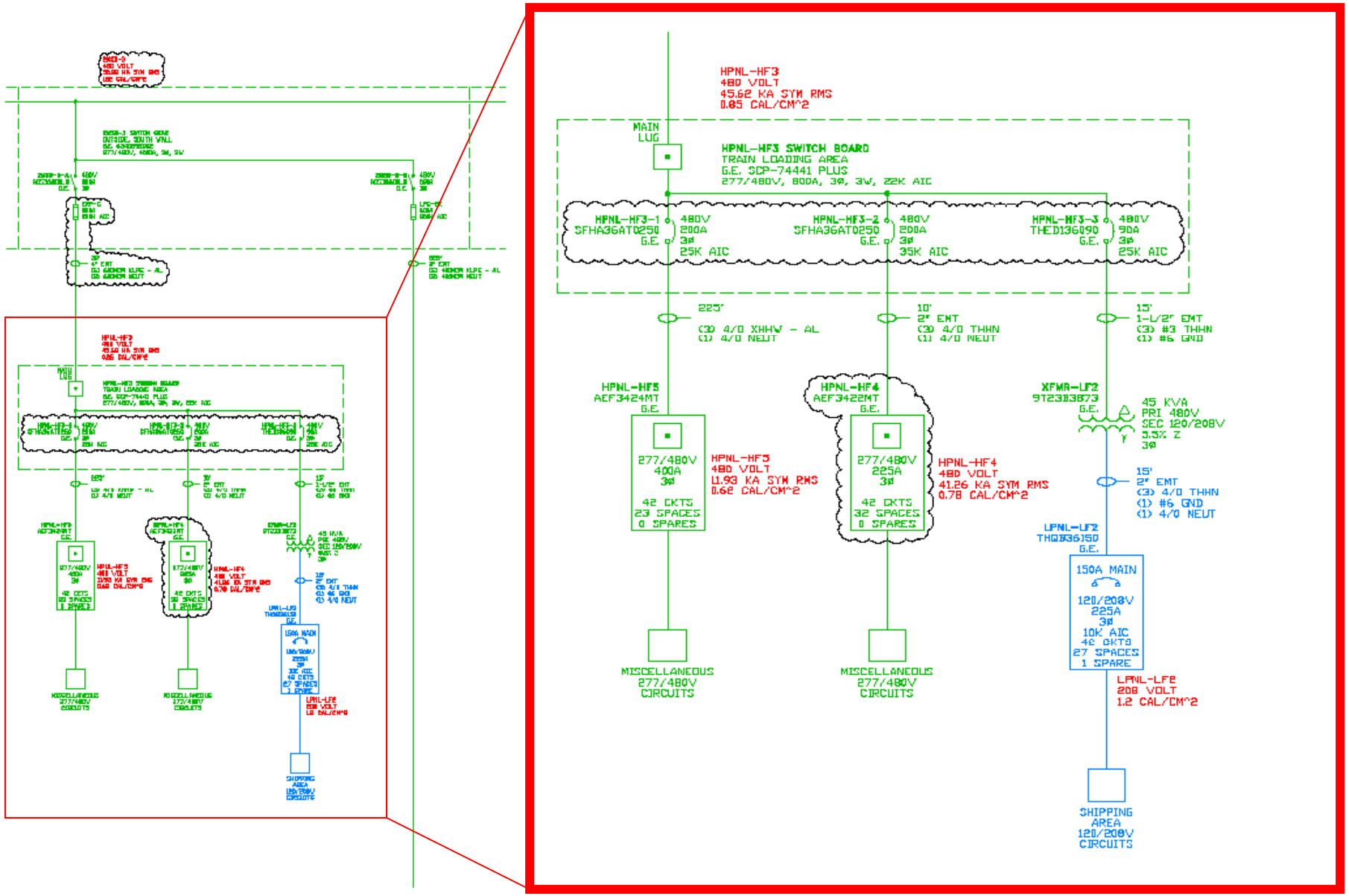
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
ame	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Bus Arcing Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/ Delay Time (sec.)	Breaker Opening Time (sec.)	Ground	Equip Type	Gap (mm)	Arc Flash Boundary (in)	Working Distance (in)	Incident Energy (cal/cm2)	Required Protective FR Clothing Categor
	SUB-1-#1	0.480	5.45	3.90	5.45	3.90	0.017	0.000	Yes	PNL	25	6	18	0.20	Category 0
	MDP-1-#2	0.480	19.44	11.57	19.44	11.57	0.017	0.000	Yes	PNL	25	12	18	0.65	Category 0
	MDP-1-#3	0.480	24.46	14.08	23.42	13.48	0.01	0.000	Yes	PNL	25	10	18	0.48	Category 0
	MDP-1-MAIN	0.480	29.68	14.12	28.64	13.62	2	0.000	Yes	PNL	25	256	18	93	Dangerous! (*N3)
	MDP-1-#4	0.480	20.41	12.06	20.41	12.06	0.017	0.000	Yes	PNL	25	13	18	0.68	Category 0
R CPNL	MDP-1-#3	0.480	14.13	7.49	14.13	7.49	0.016	0.000	Yes	PNL	25	9	18	0.39	Category 0 (*N3)
	MDP-1-#1	0.480	20.82	12.27	20.82	12.27	0.017	0.000	Yes	PNL	25	13	18	0.69	Category 0
ntreated leeve afety														#Cat 0 = 6	(*N3) - Arcing Curren Low Tolerances Use
R Shirt, FR at, 4 Shield, es														#Cat 1 = 0	(*N5) - Miscoordinated, Upstream Device Tripped
R Shirt, FR at, od, 8 Shield, es														#Cat 2 = 0	(*N9) - Max Arcing Duration Reached
R Shirt & verall, od, Safety														#Cat 3 = 0	
R Shirt & verall, Switching d, Safety														#Cat 4 = 0	
gerous!: ry Found														#Danger = 1	IEEE 1584 - 2002/2004a Edition

Arc Flash events are driven largely by the trip delay times. If your upstream breakers or fuses do no trip as they should or you change breaker settings etc., you run the risk of altering the trip delays.

Spreadsheet Recommendations Example

Location (Sheet #)	Protective Device	Initial Setting or Device	Present Cal/cm^2	Hazard Class	Recommended Change	New Cal/cm^2	Hazard Class
LMPA (E-103)	Panel Board HMDPA/11	LA 400 A BREAKER	34	4	Install fused disconnect using JKS 600 A fuse	1.7	1
LPA (E-103)	Panel Board LMDPA/14	Q2 225 A BREAKER	14.8	3	Install fused disconnect using FRS-R 225 A fuse	3.6	1
LMPA1 (E-103)	Panel Board HMDPA/11	LA 400 A BREAKER	34	4	Install fused disconnect using JKS 600 A fuse	1.7	1
L5COPL (E-105)	Fused Disconnect DSL5N	FRN-R 300 A FUSE	8.43	3	Replace FRN-R fuse with FRS-R 300 A fuse	0.43	0
L5COPR (E-105)	Fused Disconnect DSL5N	FRN-R 300 A FUSE	13.77	3	Replace FRN-R fuse with FRS-R 300 A fuse	0.33	0
L5N/1-42 (E-105)	Fused Disconnect DSL5N	FRN-R 300 A FUSE	12.84	3	Replace FRN-R fuse with FRS-R 300 A fuse	0.39	0

Arc Flash Hazard Analysis – AIC Issues



110.9 Interrupting Ratings:

- Equipment intended to interrupt current at fault levels shall have an interrupting rating sufficient for the nominal circuit voltage and the current that is available at the line terminals of the equipment.
- Equipment intended to interrupt current at other than fault levels shall have an interrupting rating at nominal circuit voltage sufficient for the current that must be interrupted.

OSHA 1910.303(b)(5)...

**Adds requirements for the coordination of over current protection for circuits and equipment.

This is a separate presentation in itself

2009 Additions for Maintenance

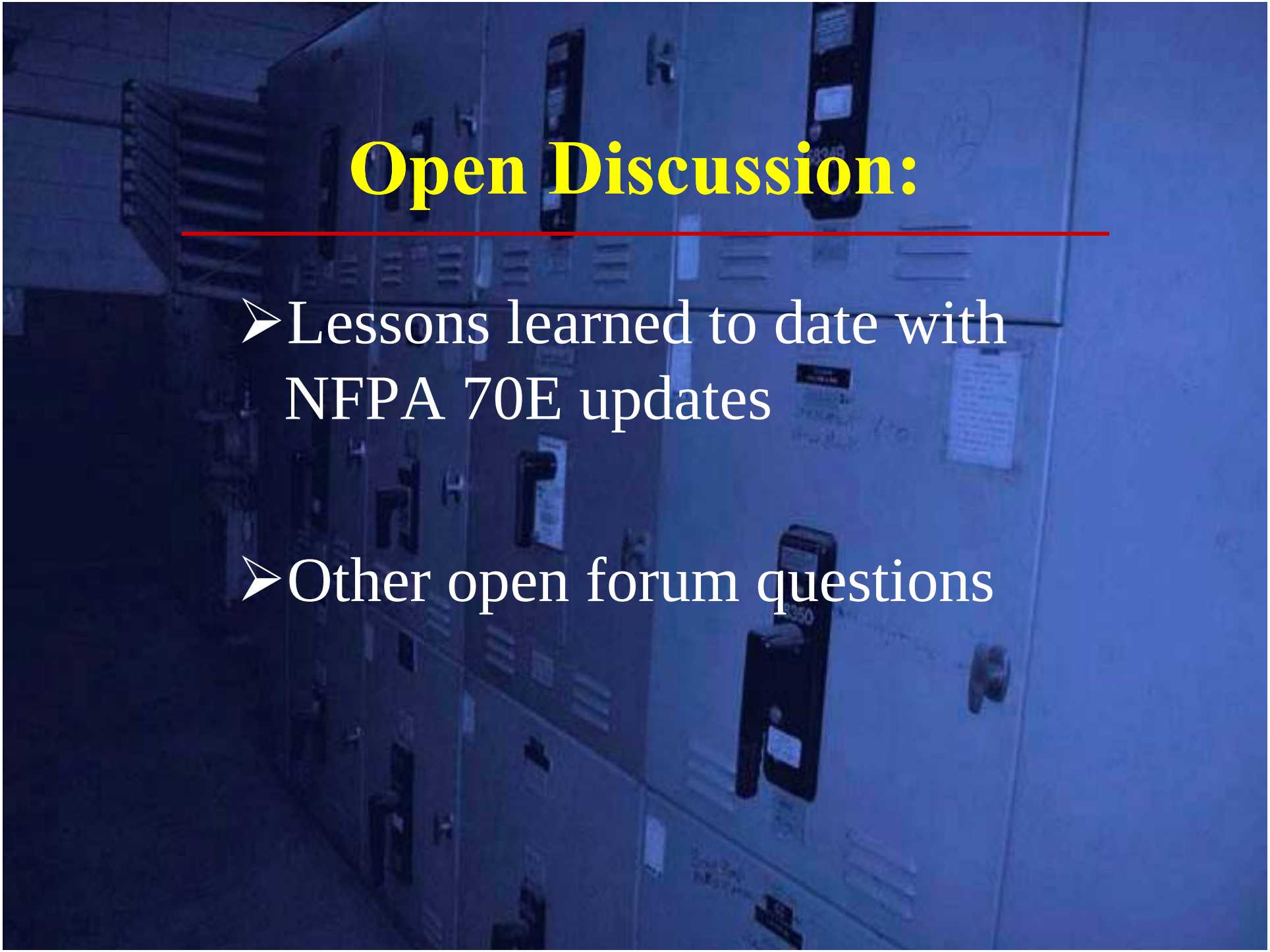
- **205.3 General Maintenance Requirements:**

  Over current protective devices shall be maintained in accordance with the manufacture's instructions or industry consensus standards.

Scope Clarification Goals:

General Rules:

- ✓ Be very specific in what you are asking for
- ✓ Remember the goal with any program is to achieve a state of zero energy so focus efforts on LOTO and verification of labeling
- ✓ Seek help in creating a solid scope of work from reputable vendors or other Safety Directors etc.
- ✓ Ask for very specific deliverable samples and pay very close attention to one-line diagram quality. Software one-lines do not comply with OSHA



Open Discussion:

- Lessons learned to date with NFPA 70E updates
- Other open forum questions