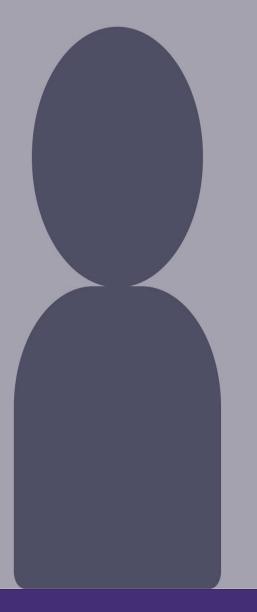
NFPA 70E and Electrical Safe Work Practices



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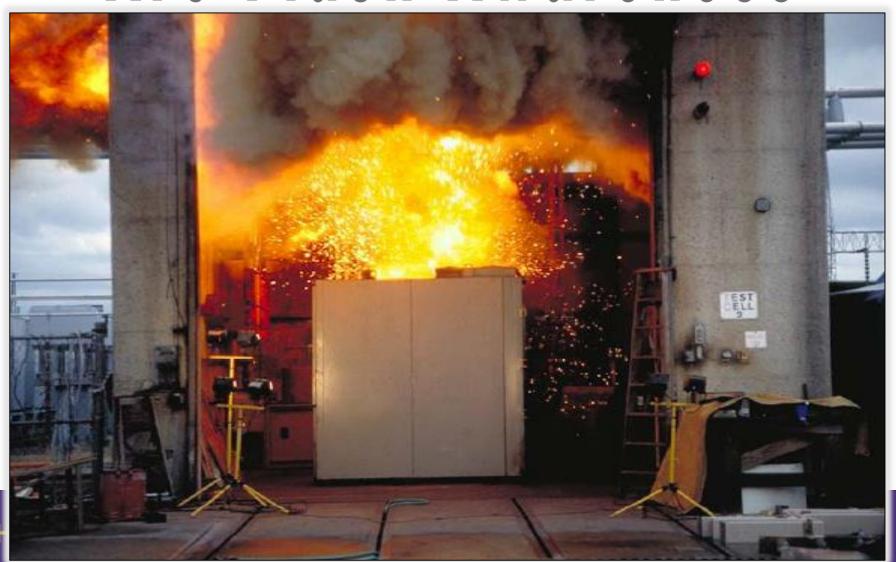
A FRIENDLY REMINDER

- Please turn off your cell phones
- Please do not enter or exit sessions after five minutes past the start time
- In case of an emergency

If you already hold a credential from GEAPS / K-State, earn CEUs towards maintaining your credential!

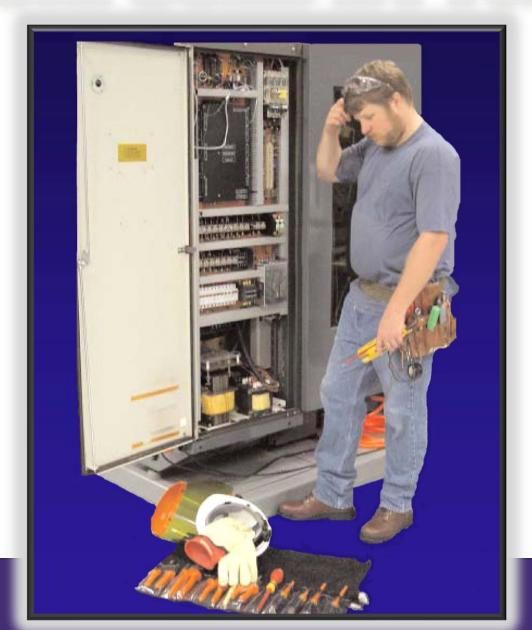
- Sign-in and provide your email address at CEU-approved sessions
- Within 24 hours you will receive an online quiz link
- Take the quiz within 30 days
- Take the quiz up to three times within 30 days
- Earn a passing score of 80% to receive credit

Arc Flash Awareness





CONFUSED BY 70E?



Where did <u>70E</u> come from and how Long has it been around?

Parts of 70E have been around since 1979/1981. OSHA actually adopted new regulations on safe electrical work practices in 1990 based on 70E. However, the reason we're just now talking about 70E is because the NEC (National Electrical Code) and OSHA (Occupational Safety and Health Administration) have both started referring to it in their documents, and citations are now

being written on 70E.

In September 1999 a major U.S. corporation experienced an electrical accident that resulted in serious burn injuries to an electrical apprentice employee. OSHA (Occupational Safety and Health Administration) investigated the accident and issued a number of citations. The employer challenged the citations and the disagreement ended up before the Occupational Safety and Health Review Commission.

As a part of the citation OSHA contended that the employer violated a federal regulation because it did not provide or require that its electricians wear appropriate flame-resistant or retardant personal protection, specifically, flameresistant coveralls and insulated gloves. OSHA also contended that the employer violated a regulation when I did not provide or require that its electricians wear appropriate face protection.

In the settlement the employer agreed to develop hazard analyses in accordance with the personal protective equipment provisions contained in NFPA (National Fire Protection Association) 70E. OSHA agreed that given the present state of its standards and regulations, the hazard analyses would achieve compliance with their requirements.

OSHA has not adopted NFPA 70E, and does not mandate 70E compliance, yet you can be cited for non-compliance!!

How is this possible?

TOE By definition NFPA 70E is: A "National Consensus Standard".

In 29 CFR 1910.2(g) a National Consensus Standard is defined as a standard that is developed by the same persons it affects and then is adopted by a nationally recognized organization.

Some examples of organizations that publish national consensus standards include:

NFPA, ASTM and ANSI

General Duty Clause

Before attempting to address the questions concerning compliance, it is important to understand what is the

"General Duty Clause" -

Section 5.(a)(1) within the ACT: Occupational Safety and Health Act of 1970

- 5. Duties
 - (a) Each employer

(1) Shall furnish to each of his employees and place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees;

General Duty Clause

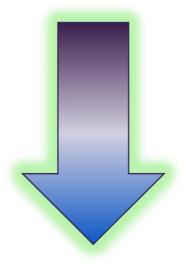
Section 5(a)(1) has become known as "The General Duty Clause".

It is a catch all for citations if OSHA identifies unsafe conditions to which a regulation does not exist. In practice, OSHA, court precedent, and the review commission have established that if the following elements are present, a "general duty clause" citation may be issued.

General Duty Clause

- 1) The employers failed to keep the workplace free of a hazard to which employees of that Employer were exposed.
- 2) The hazard was recognized. (Examples might include: through your safety personnel, employees, organization, trade organization or industry customs).
- 3) The hazard was causing or was likely to cause death or serious physical harm.
- 4) There was a feasible and useful method to correct the hazard.

Arc Flash Incident





















































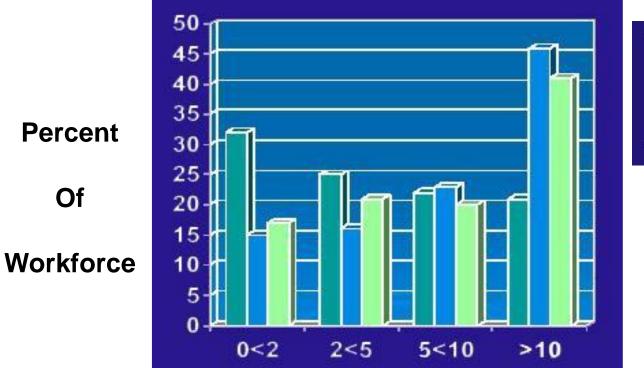






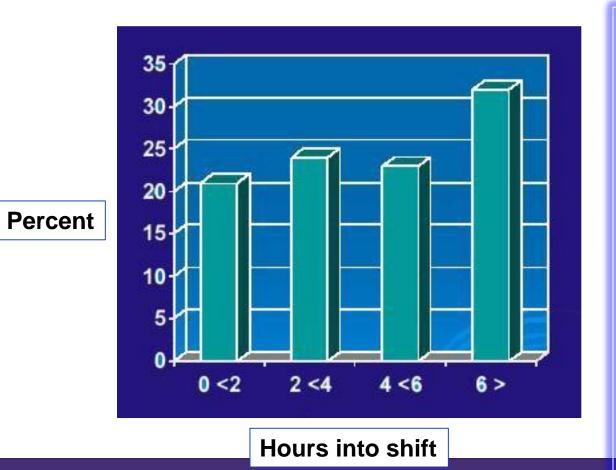
Injury Statistics Experienced maintenance personnel and

Experienced maintenance personnel and Supervisors had a larger proportion of injuries; Less experienced laborers had more injuries





Injury Statistics

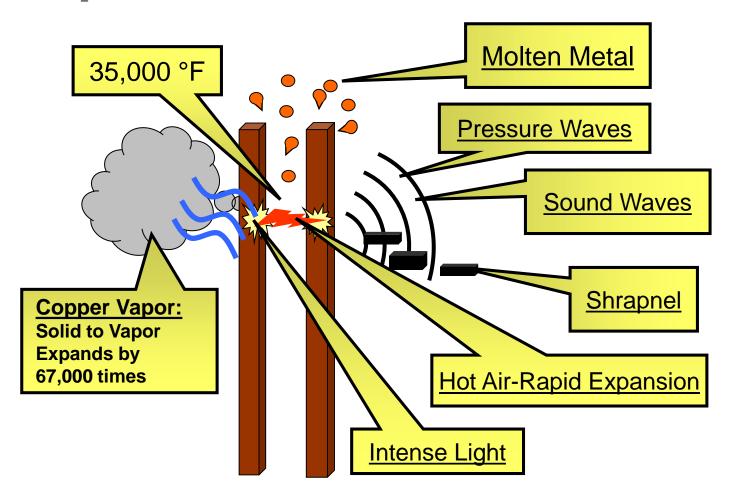


greater proportion of injuries occurred six or more hours into shift (32%)

Electrical Hazards

- □ Electrical Shock
 - Electrocution
 - Internal and external burns
- □ Arc Flash
 - ☐ Potentially severe external burns
- ■Arc Blast
 - Pressure and sound waves
 - ☐ Shrapnel (in excess of 700 MPH)

Components of Electrical Arcs



Electrical Arcs

- □One of the hottest things on earth
- ☐ Size of arc is independent of voltage
- □ Amount of short circuit current available determines size of arc
- □ Responsible for about 75% of all industrial electrical injuries
- □Arcs on low voltage systems can be just as dangerous as arcs on medium & high voltage systems

"Qualified" Person - OSHA Expanded

- ☐ Trained and knowledgeable in the construction and operation of equipment or specific work method
- □ Able to recognize and avoid electrical hazards

☐ May be qualified with respect to certain equipment and methods but unqualified for others.

"Qualified" Person - OSHA Expanded

To work within the

Limited Approach Boundary

You must be trained to:

- □ Distinguish exposed energized parts from other parts
- ■Determine nominal voltage
- □ Determine approach distances
- ■Determine degree and extent of hazard and PPE required.

Can the staff employees effectively identify and avoid hazards and get equipment to a "Safe Condition".

Only the Host Employer ultimately can deem the employee "Qualified". No external resource can do that for us officially.

How Do We Qualify Employees???:

- (4) Decision-making process necessary to be able to do the following:
 - a. Perform the job safety planning
 - b. Identify electrical hazards
 - c. Assess the associated risk
 - d. Select the appropriate risk control methods from the hierarchy of controls identified in 110.1(G), including personal protective equipment
- (d) 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 of 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.

Different Ways to Qualify Employees:

ELECTRICAL (QUALI	FIED WORKER	₹			
PRACTICAL COMPE	TENCY	CHECKLIST S	AMPLE			
Employee Name		Hire Date				
Facility						
Competency Categories	N/A	Inspector	Date	ок	Needs Work - State	Follow Up
(To be completed within 60 days of hire date)	(v)	(√) Initials		(√)	Corrective Actions	Date
Preparation						
Ability to read and understand arc flash labeling - specifically approach zones, arc flash boundaries and PPE requirements	ch					
Ability to read, understand and update one-line and ladder diagrams or schematics as necessary to keep current programs up to date	ì		//			
Ability to understand and follow plant-wide electrical LOTO and machine specific LOTO procedures. Confirm the employee knows the difference between both types.	,		, ,			
Use of required PPE, insulated tools and shielding materials including any test requirements			/ /			
Understanding and appropriate use of the energized work permit process			1 /			

• Testing / Troubleshooting





 Qualified electrician was asked to troubleshoot a breaker disconnect after a forklift had bumped the cabinet because the lights had gone out.

In the process of turning off the breaker, the internal components failed and the fault came out the handle.

Could a Risk Assessment possibly have helped the employee recognize the need for minimally leather gloves to help with potential burn protection when he already knew something wasn't right on the inside of that cabinet?

EXCHANGE 2019



Article 130.2 Normal Operations (Maintenance):

- Maintenance:
- Define "Normal Operation"?
- What is clear, is the code is expressing the need to address Maintenance of equipment. There are direct ties to our arc flash outcomes based on how breakers react when called upon to trip etc.

- Δ (4) Normal Operating Condition. Normal operation of electric equipment shall be permitted where a normal operating condition exists. A normal operating condition exists when all of the following conditions are satisfied:
 - (1) The equipment is properly installed.
 - (2) The equipment is properly maintained.
 - (3) The equipment is used in accordance with instructions included in the listing and labeling and in accordance with manufacturer's instructions.
 - (4) The equipment doors are closed and secured.
 - (5) All equipment covers are in place and secured.
 - (6) 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.

This Article Will Inevitably Bring Up the Age Old Question of "Closed Door Switching PPE Needs" and is a key topic when the code committee decides what the "likelihood" of an exposure might be etc.

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) <u>HRC Levels of 3, 4 or Dangerous</u>
- 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.

Arc Flash Risk Assessment

Based on Maintained Equipment!! (70E-130.5)

- Determines Trip Time for Each Protective Device based on Arcing Fault Current
- Calculates Incident Energy at Working Distance
- Calculates Arc Flash Boundary
- Determines Required PPE
- Is Used to Generate Warning Labels

Process and Steps of performing an Assessment

- Initial Site Verification and Data Collection of Electrical System
- One-line Electrical Print Development
- Engineering Review
- Final Site PPE Labeling and Training

Initial Site Verification and Data Collection of Electrical System

- Field verification of any electrical system is the primary aspect to a
 worthwhile NFPA 70E audit project and this involves physically tracing out
 and verifying electrical circuits where required or signal tracing as required
 in order to confirm the accuracy of the existing equipment labeling at any
 facility location.
- A sound safety program focuses on LOTO first and validated electrical feeds being the cornerstone of successful arc flash and NFPA 70E program development.
- The one-line diagram of your electrical systems is a key cornerstone of the ESWP program for safety and annually each plant will be looking to update changes made throughout the calendar year as a minimal expectation.

One-Line Electrical Print Development

- The one-line diagram of your electrical systems is a key cornerstone of the ESWP program for safety.
- With a complete safety audit, one-line diagrams will be provided to each plant. Any recommended changes to improve safety or to help make the electrical systems more code compliant will be clouded for ease of reference.

Engineering Review Arc Flash/ESWP:

- Engineering reports will come with recommendations to lower arc flash levels of hazard category 2 or higher that exists in the facilities.
- All short circuit issues should help be called out by being noted on the report along with any over current issues found.
- Each recommendation made in all original reports and continued yearly updates will have the corresponding AutoCAD sheet number listed for quick cross reference to the drawing files so personnel can identify where in the facility those items are and what is affected by planning the repair/modifications shut down process etc.

Engineering Review Arc Flash/ESWP(cont.):

Example of how reports read for recommendations and cross references to the AutoCAD drawings:

Arc Flash Mitigation Table

Location (Sheet #)	Protective Device	Initial Setting or Device	Present Cal/cm^2 and Category	Recommended Change	Coordination for Engineering Recommendations	New Cal/cm^2 and Category
DP5A (EE101)	DP5-11	Sq-D type LA 300-amp breaker set at: INST=2000	11.7 Category 3	Install new isolated fused disconnect before DP5A using Bussmann type KTS-R 225-amp fuses	There is no simple way to create coordination with the new fuses.	0.9 Category 0*

What is the OSHA Focus on "Safe Work Practice"?

Their focus is and <u>has always been</u> aimed at the overall topic of: "Electrical Safe Work Practice!"

What does this statement mean?

- Many of us refer to NFPA 70E as the reference guide for safety and it is a good starting point.
- OSHA on the other hand has one main goal. The main question is how are we managing ourselves and can we get equipment to a "safe condition" before work is performed.
- OSHA Sub Part S 331-335 references are often used. On Maintenance of systems, 1910-303 is the primary source OSHA can refer to on maintaining site equipment for operational safety.
- OSHA will rarely if ever come in and ask "How are you managing "arc flash"... They want you to prove you can get equipment deenergized and safe.

U.S. Department of Labor

Occupational Safety and Health Administration

Inspection Number: Inspection Date(s):

Issuance Date:

/2012 -

/2012

2012





Citation and Notification of Penalty

Company Name: Inspection Site:

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

29 CFR 1910.303(e)(1)(ii): 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:

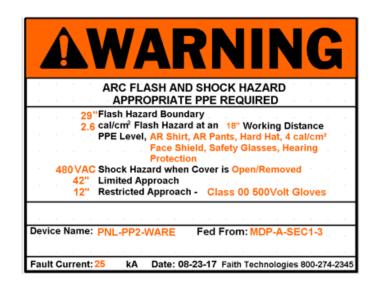
Proposed Penalty:

/2012

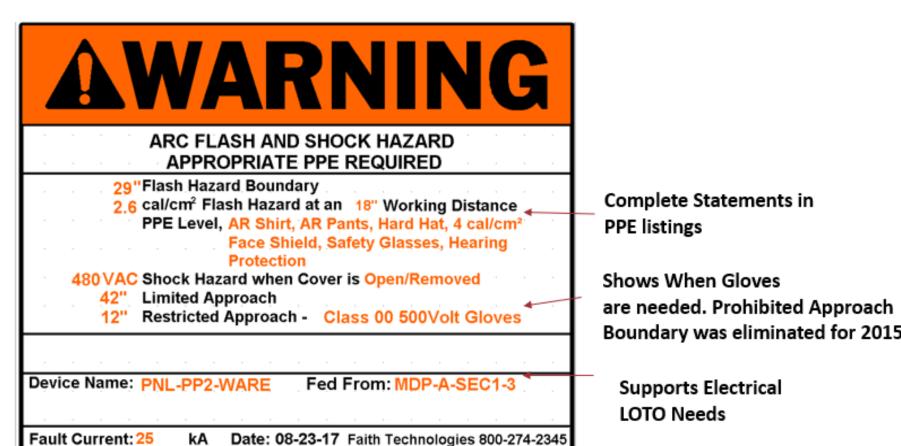
\$4400.00

130.5 (H)Equipment Labeling Codes for 2018 Edition:

- (1) Nominal system voltage
- (2) Arc flash boundary
- (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) or table 130.7(C)(15)(b) for the equipment, but not both.
 - Minimum arc rating of clothing
 - Site-Specific level of PPE



Overview of Informative 2018 PPE Label Format:



Supports Electrical

LOTO Needs

Date Optional for 70E

Shows Fault Current Levels to Aid in Breaker Applications

General PPE Levels:

Category

Category 0*

Category 1

Category 2

Category 3

Category 4

Required Protection FR Clothing

Untreated Cotton Long Sleeve Shirt, Pants, Safety Glasses, Hearing Protection

AR Shirt, AR Pants, Hard Hat, 4 cal/cm² Face Shield, Safety Glasses, Hearing Protection

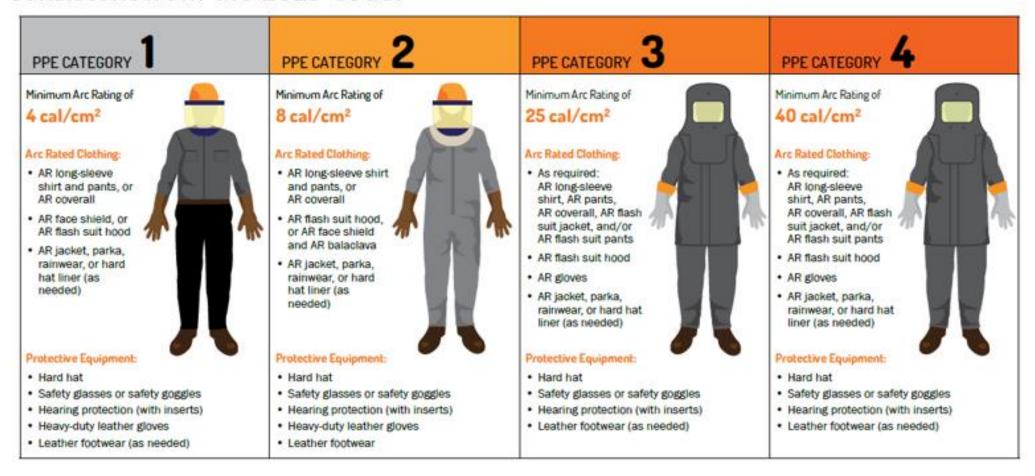
AR Shirt, AR Pants, Hard Hat, Balaclava/Hood, 8 cal/cm² Face Shield, Safety Glasses, Hearing Protection

AR Shirt & Pant + AR Coverall, Switching Hood, Safety Glasses, Hearing Protection

AR Shirt & Pant + AR Coverall, Double Layer Switching Coat and Hood, Safety Glasses, Hearing Protection 2018 Code again does not discuss what we used to recognize as Category 0

*The need for natural fibered garments and general PPE however has not changed!!

The levels of PPE in concept when we talk about "categories" has remained consistent from the 2015 Code.



Voltage Rated Glove Use:

- First line of defense
- Choose the right size
- Leather protectors must be worn over the rubber gloves
- Gloves must be dielectrically tested
 - Before first issue and every 6 months
 - If tested, but not issued for service, glove may not be put into service unless tested within previous 12 months.
- Checked before use
 - Roll-up test
 - Inflator test





Obtaining a De-Energized State Correctly is our Primary Goal with ESWP and OSHA:

 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?
- OSHA Question: If you had to change a fuse in this disconnect, explain to me how you would do that????



120.5 Process for Establishing and Verifying an Electrically Safe Work Condition. Establishing and verifying an electrically safe work condition shall include all of the following steps, which shall be performed in the order presented, if feasible:

- 1. Determine al sources of electrical supply or energy to the equipment. Check up to date drawings as required
- 2. Open the upstream disconnecting sources for each source of power.
- 3. Release stored electrical energy if present
- 4. Release or block stored mechanical energy
- 5. Apply Lockout/Tagout devices in accordance with established procedures
- 6. Determine expected PPE needs for the piece of equipment you intend to power down. Obtain correct arc flash and shock hazard protection including the appropriate voltage meter for upcoming steps.
- 7. Use an adequately rated portable test instrument to test all aspects of the power supply to verify upstream power has been eliminated. Meter shall be tested on a known 120V power supply before and after LOTO verification steps to ensure the meter works properly

2018 Article 130.2 on Work Permits:

130.2(B): Energized Work Permit. Some Changes in Wording But Not in Concept from the 2015 Code.

- (B) Energized Electrical Work Permit.
- Δ (1) When Required. When work is performed as permitted in accordance with 130.2(A), an energized electrical work permit shall be required and documented under the any of 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 exists

130.2 Exemptions to Work Permits:

• 130.2(B): Exemptions to Work Permit. Some Wording Changes in 2018

- Δ (3) Exemptions to Work Permit. Electrical work shall be permitted without an energized electrical work permit 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, or voltage measuring
 - (2) Thermography, ultrasound, or 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 Example

• It is more important to learn how to fill these out and what they mean so you can help others and also manage expectations with staff on being complete in documentation!

PART I TO BE COMPLETED BY THE REQUESTER:

ELECTRICAL WORK PERMIT WORK ORDER NO.

							·	
Work site location	on:							
Planned start da					d date/time:			
Description of the work to be performed: (must be specific on the project description)								
Requested by:	Signature:		Title:				Date:	
PART II. TO BE	COMPLETED BY E	ECTRICA	ALLY QUAL	IFIED PERS	ONS <u>DOING</u> TH	HE WOR	к	
Lii Resti Proh	Approach Boundar mited approach bour ricted approach bour ibited approach bour ash hazard analysis	rom Table 130.4(D)(b)) ft in t in						
Calculation results:ftin						el posted on the equipment)		
Uvoltage-rated t Uvoltage-rated t Safety glasses Hearing protec Leather gloves Leather work s Hard hat	gloves tion hoes	Hard h	nat AR liner sleeve shirt sleeve shirt pants (natur sleeve AR s AR pants (A	(ATPV) (nat fiber) (nat fiber) al fiber) hirt (ATPV)	□AR coverall: □AR jacket/ra □Multi-layer A	s (ATPV) ainwear (AR flash : AR flash : ce shield	ATPV) suit jacket (ATPV) suit pants (ATPV) I (ATPV)	
unqualified pers	d to restrict the acc ons from the work	area:	_Signs/tag	s Barricad	es Attendan	ts		
	ed job briefing witl ires been conducte		Yes, see	attached []No			
Justification for the energized electrical work request: Shut down creates an increased/additional hazard (detailed explanation required): Shut down is infeasible due to design or operational limitations (detailed explanation required):								
Do you agree the above can be do	at the work describ one safely?	ed Elec	ctrically Qua	lified Person	(s):	Date:		
PART III. APPRO	OVALS							
Supervisor: (Print)			Signature:			[Date:	
Program Manager: (Print)			Signature:			ı	Date:	
Safety Manager/Coordinator: (Print)			Signature:				Date:	

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Questions and Answers

Open Dialogue



Quiz Time!

WE WANT YOUR

FEEDBACK!

- Open the App store
- Search GEAPS
- Download 2019 Exchange Mobile App
- Open app and click Schedule
- Find correct session date and time
- Select the session
- Click evaluation link