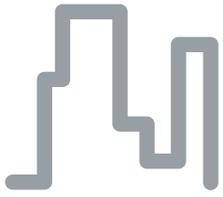


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Electric



# Compliance Solutions: NFPA 70E — 2018 Edition from Schneider Electric Services



# Industry-Leading Expertise

## to Address All of Your Power System Needs

Since 1966 Schneider Electric Engineering Services has completed over 10,000 power system assessments, studies, and designs for our customers, who include:

### Automotive

- Chrysler
- Honda of America
- Toyota Motor Manufacturing
- Ford Motor Company
- General Motors Corp.

### Chemical

- Pfizer Inc.
- Union Carbide
- INVISTA
- INEOS
- Air Products

### Commercial

- Disney® Corp.
- Home Depot
- Hyatt Regency®
- J.C. Penney
- Sears
- Kroger
- McDonald's Corp.
- Winn Dixie
- UPS® Corp.
- Food Lion
- Wal-mart

### Communications

- AT&T
- Bell Telephone
- GTE
- Pacific Bell

### Data Centers

- Lowe's
- M&T Bank
- The Hartford®
- Mayo Clinic
- Southern California Edison
- EMC®

### Educational

- Duke University®
- Harvard University
- Kansas University
- Ohio State University
- Penn State® University
- Texas A&M
- Texas Tech
- University of Illinois
- University of Kentucky
- University of South Carolina

### Educational (cont.)

- University of Texas®
- University of Washington
- Wichita State University
- Vanderbilt University

### Food & Beverage

- Coca-Cola® Company
- General Foods
- Kraft Foods
- Nabisco Foods
- Pepsi® Cola
- Sara Lee®
- Nestlé®

### Government

- Camp Pendleton
- FAA
- Ft. Campbell
- IRS
- Los Alamos National Labs
- Pentagon
- Social Security Admin.
- U.S. Federal Courthouse
- U.S. Postal Service™
- Wright Patterson AFB

### Healthcare

- VA Hospital (various facilities)
- Massachusetts General Hospital
- Barnes Jewish Hospital

### Manufacturing

- 3M™ Company
- Boeing Aircraft
- Caterpillar Inc.
- Martin Marietta
- Lockheed Martin
- Kimberly Clark Corp.
- Dell™ Computer Corp.
- IBM® Corp.
- Intel® Corp.
- Lucent Technologies
- Motorola
- Samsung
- Texas Instruments™
- Xerox® Corp.

### Oil & Gas

- ExxonMobil™
- Shell
- BP
- OXY
- Chevron

### Pharmaceutical

- AstraZeneca
- Johnson & Johnson
- Merck
- Pfizer
- GlaxoSmithKline
- Baxter Healthcare
- Wyeth
- Cordis
- DePuy

### Utility

- Commonwealth Edison
- Northern States Power
- Southern Indiana Gas and Electric
- Sunflower Electric
- TVA
- Progress Energy
- Orlando Utilities

### Water Treatment

- WWTP Columbus
- LTC WWTP Ph2
- Pelham WWTP Expansion
- Four Mile Creek WWTP

Any brand. Any industry. Any time.



Risks associated with shock and electrocution from inadvertent contact with energized parts have long been recognized as a threat to electrical workers. It has only been in recent years that awareness of the dangers of arc flash events have been incorporated into electrical safety standards.

## Over the last 10 years, more than 30,000 workers have been injured in workplace electrical accidents.\*

Regulatory agencies have recognized the severity and urgency of electrical safety. The Occupational Safety and Health Administration (OSHA) has developed laws to protect electrical workers. These laws, in essence, mandate that work on electrical equipment must be performed in a manner that does not expose the worker to undue risk of injury.

The National Fire Protection Association (NFPA) 70E: Standard for Electrical Safety in the Workplace® is the document most often referenced for electrical safety. OSHA enforces electrical workplace safety standards outlined in NFPA 70E. Enforcement can take place following an electrical accident or during the normal on-site inspection process.

Schneider Electric™ Services advocates compliance to NFPA 70E: Standard for Electrical Safety in the Workplace not only for worker safety, but also equipment productivity. An arc flash accident can render equipment unusable and place the facility in a costly downtime mode, which could last hours or days.

**While not the leading cause of on-the-job injuries and accidents, electrical accidents are disproportionately fatal and costly.\***



The Liberty Mutual Research Institute for Safety reports that electrical injuries are the second-most costly worker's compensation claim.

\*Electrical Safety Foundation International (ESFI)

# What a Facility Can Do to Comply with NFPA 70E — 2018 Edition

NFPA 70E requires the development and enforcement of an Electrical Safe Work Practices (ESWP) policy. It also defines the requirements for safe work practices, and requires audits and revisions to keep the safety policy up-to-date. Compliance to NFPA 70E requirements can be achieved through a six-step process, providing safety and operability of facility power systems.

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Step 1	Develop and Audit Electrical Safe Work Practices Policy
Step 2	Conduct an Arc Flash Risk Assessment to Evaluate the Likelihood of Occurrence and Severity of Arc Flash Hazards
Step 3	Follow Strategies to Mitigate and Control Arc Flash Hazards
Step 4	Conduct Regularly Scheduled Safety Training and Audits for All Electrical Workers
Step 5	Maintain All Electrical Distribution System Components
Step 6	Ensure Adequate Supply of Personal Protective Equipment (PPE) and Proper Tools

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## Did you know?

NFPA 70E 2018, Section 110.3(A) states that hiring contractors to perform electrical work does not absolve the owner of the facility (host employer) from assuring compliance to safe work practices.

The facility owner is ultimately responsible for safety at their site and must document and communicate known hazards covered by NFPA 70E to the contracted worker(s).

The owner (host employer) must hold a documented meeting with the contractor outlining hazards at the facility.

### Step 1

## Develop and Audit Electrical Safe Work Practices (ESWP) Policy

This is a written document created by the employer that covers all areas of the company's electrical safety practices. It includes such things as lock out/tag out procedures, method of qualifying the workers, selection and application of PPE, methods of establishing a safe work area, risk assessment procedure, equipment labeling, and worker audit procedures.

An audit of the safety policy must be performed on a three-year cycle to assure continued compliance of the policies and procedures to the standard. When the auditing determines that the principles and procedures of the electrical safety program are not being followed, appropriate revisions to the training program and/or revisions to the procedures shall be made. In addition, workers must be evaluated for compliance to the standards and the policy, and any deviations must be documented.



The safety policy is a **living document** that must be audited over time.



### Step 2

## Conduct an Arc Flash Risk Assessment to Evaluate the Likelihood of Occurrence and Severity of Arc Flash Hazards

NFPA 70E-2018 Section 130.5 states an arc flash risk assessment shall be performed to identify arc flash hazards, estimate the likelihood of occurrence of injury or damage to health, and assess the potential severity of injury or damage to health; and to determine if additional protective measures are required, including the use of PPE. Arc flash PPE may be selected either by the incident energy analysis method, or by the PPE category method.

The incident energy analysis method is a study that is overseen by professional engineers who are familiar with the power distribution and control equipment, and

the calculation methods required. The methodology for conducting an incident energy analysis is outlined in *IEEE 1584™ Guide for Performing Arc-Flash Hazard Calculations*.

The incident energy analysis must be updated when changes occur in the electrical distribution system that could affect the results of the analysis. At a minimum, the incident energy analysis should be reviewed every five years because changes in the electrical distribution system could affect the results of the analysis.



Schneider Electric can assist with **data collection, analysis, and label installation** to help you comply with the requirements of NFPA 70E.



## Apply Warning Labels to Equipment

NFPA 70E-2018, Section 130.5(H) requires that equipment that is likely to be examined, adjusted, serviced, or maintained while energized shall be field-marked with a label containing all of the following information:

- 1) At least **one** of the following:
  - Available incident energy or required PPE Category, but not both
  - Minimum arc rating of clothing
  - Site-specific level of PPE
- 2) Nominal system voltage
- 3) Arc flash boundary

In addition, the calculation method and data to support the information for the label shall be documented.

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## Understanding the Different Types of Arc Flash Labels

Arc flash labels shall always be applied to equipment per the company's ESWP policy. Custom labels or site-specific PPE labels that comply with the ESWP policy are allowed by NFPA 70E. Schneider Electric offers three predefined label formats that address the majority of arc-flash labeling scenarios. We can also provide custom labels for unique situations.

**Schneider Electric recommends simplified arc flash labels because they:**

- Reduce the opportunity for PPE selection errors due to the two-tiered system for “energized work”
- Standardize PPE purchases and reduce supply chain complexity
- Eliminate time and costs associated with label changes due to small incident energy changes

## Understanding the Different Types of Arc Flash Labels (continued)

1) **Simplified Labeling** is based upon a two-tiered PPE system, reporting the maximum arc flash boundary for each case:

- Level 1:  $\leq 8 \text{ cal/cm}^2$  OR
- Level 2:  $> 8 \text{ cal/cm}^2$  and  $\leq 40 \text{ cal/cm}^2$

Using this labeling method results in fewer arc flash boundaries to observe. Therefore, the PPE that employers must provide for workers is simplified and standardized.

In some cases, this method requires more PPE than necessary as it assumes a minimum work wear rated to  $8 \text{ cal/cm}^2$ . However, showing the maximum IE and arc flash boundary may indicate that minor system changes do not invalidate the labels of the PPE category. This results in simpler label installation and records management.

Arc Flash Information	
Use this information in accordance with applicable OSHA standards, NFPA 70E and other required safe electrical work practices.	
8 cal/cm <sup>2</sup> Incident Energy at a Working Distance of 1 ft 6 in. 4 ft 9 in. Arc Flash Boundary	
208V Shock hazard when cover is open 3 ft 6 in. Limited Approach 1 ft 0 in. Restricted Approach	
Job: 12345678	Date: 09/10/14
Values produced by a Schneider Electric engineering analysis. Any system modification, adjustment of protective device settings, or failure to properly maintain equipment will invalidate this label. For more information, contact Schneider Electric at 1-888-778-2733. Copyright©2017 Schneider Electric. All Rights Reserved.	

2) **Actual Incident Energy (IE) Levels (Individual) labels** reflect the precise IE and arc flash boundary with the equipment name.

- Having unique labels for each location complicates the installation process.
- Requires workers to interpret discrete IE values to select proper PPE.
- Reflect many different arc flash boundaries within the same power system.
- Any changes in the power system can easily invalidate the label values.

Arc Flash Information	
PPE LEVEL - Site-Specific <b>2</b>	Use this information in accordance with applicable OSHA standards, NFPA 70E and other required safe electrical work practices.
4.28 cal/cm <sup>2</sup> Incident Energy at a Working Distance of 1 ft 6 in. 3 ft 3 in. Arc Flash Boundary	
480V Shock hazard when cover is open 3 ft 6 in. Limited Approach 1 ft 0 in. Restricted Approach	
Eqpt Name: VFD-N110-1 INPUT	Job: 33119983 Date: 02/03/15
Values produced by a Schneider Electric engineering analysis. Any system modification, adjustment of protective device settings, or failure to properly maintain equipment will invalidate this label. For more information, contact Schneider Electric at 1-888-778-2733. Copyright©2017 Schneider Electric. All Rights Reserved.	

3) **Site-Specific (Standard) labels** group pieces of equipment within a given range, based upon IE levels. The same label is used for all equipment within a given range and aligns with ESWP policies that indicate site-specific PPE levels.

- An update to 2004-2012 Schneider Electric legacy labels.
- Easier to install than actual IE & arc flash boundary labels.

Arc Flash Information	
Use this information in accordance with applicable OSHA standards, NFPA 70E and other required safe electrical work practices.	
8 cal/cm <sup>2</sup> Max Incident Energy at a Working Distance of 1 ft 6 in. 4 ft 9 in. Arc Flash Boundary	
480V Shock hazard when cover is open 3 ft 6 in. Limited Approach 1 ft 0 in. Restricted Approach	
Eqpt Name: UPS-80kW	Job: 34926396 Date: 02/26/15
Values produced by a Schneider Electric engineering analysis. Any system modification, adjustment of protective device settings, or failure to properly maintain equipment will invalidate this label. For more information, contact Schneider Electric at 1-888-778-2733. Copyright©2017 Schneider Electric. All Rights Reserved.	

Step 3

## Implement Strategies to Mitigate and Control the Risk Associated with Arc Flash

In 2018, NFPA 70E mandated the use of the hierarchy of risk control methods when conducting task risk assessments for electrical work. The hierarchy of risk control implements preventative and protective risk control methods in the following order:

1	<b>Elimination</b> ( <i>physically remove the hazard</i> )	More effective
2	<b>Substitution</b> ( <i>replace the hazard</i> )	
3	<b>Engineering Controls</b> ( <i>isolate the hazard</i> )	
4	<b>Administrative Controls</b> ( <i>change work habits</i> )	Less effective
5	<b>PPE</b> ( <i>protect workers from the hazard</i> )	

Placing a worker in PPE is the least effective means of risk control and is essentially the last line of defense to worker protection.

Providing effective arc flash mitigation through substitution and engineering controls should always be conducted prior to placing workers in PPE. The goal of arc flash mitigation is to reduce the incident energy, and thus the PPE, to a level that permits normal tasks to be performed on equipment. Arc flash mitigation has been a rapidly developing area of research and development for Schneider Electric. We are constantly working on new mitigation strategies to promote electrical workplace safety.

Step 4

## Conduct Regularly Scheduled Safety Training and Audits for All Electrical Workers

NFPA 70E-2018 defines a qualified person as “one who has demonstrated skill and knowledge related to the construction and operation of electrical equipment and installations and has received safety training to identify and avoid the hazards involved.”

This training requirement means that the employee must have received safety training specified to identify the hazards and reduce the associated risk. Electrical workers are not considered to be qualified by OSHA until they have received this specific training.

Further, the employer must verify, through regular supervision or through inspection conducted on at least an annual basis, that each worker is complying with the safety-related work practices required by NFPA 70E-2018.



Step 5

## Maintain All Electrical Distribution System Components

The “active” components in electrical distribution systems consist of fuses, circuit breakers, and protective relays that help protect the system in the event of an electrical fault. These over-current protective devices have a critical role in controlling the arc flash energy. Therefore, it is crucial to keep these devices in proper operating condition with a regular maintenance program. Without proper over-current protection, sustained arcing can subject electrical workers to much higher levels of energy. On the other hand, modern, properly adjusted over-current protective devices that have been well maintained are able to detect an arcing fault condition and clear the fault quickly.

Unless adequate maintenance is performed, the electrical system study and the arc flash analysis will not be a correct representation of the potential performance of the power system. Therefore, in addition to compliance with NFPA 70E, Schneider Electric recommends that facilities adopt NFPA 70B: Recommended Practice for Electrical Equipment Maintenance. Our qualified field services personnel perform on-site preventive and predictive maintenance services for any manufacturer’s electrical equipment. Upon completion, a detailed report is provided that identifies potential issues along with corrective recommendations.

### Did you know?

**NFPA 70E-2018 states:** “Electrical Equipment shall be maintained in accordance with manufacturer’s 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 maintenance of the electrical equipment and documentation.”



Equipment must be in an electrically-safe condition during maintenance, testing, and repair.

Step 6

## Ensure Adequate Supply of Personal Protective Equipment (PPE) and Proper Tools

Employees working in areas where there are potential electrical hazards shall be provided with personal protective equipment (PPE) that is appropriate for the specific parts of the body to be protected. This can include an arc-resistant shirt, pants or coveralls, or a multi-layer flash suit. Additional PPE requirements consist of flash hoods, voltage rated gloves, EH-rated safety shoes, safety glasses, and hard hats. Employees working within the arc flash boundary also are required to wear hearing protection.

Properly-rated equipment is needed to test voltages. Insulated tools are required for workers who are to perform testing and troubleshooting on energized equipment.



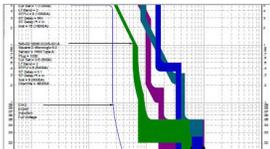
# Arc Flash Mitigation Solutions

Schneider Electric Services provides a variety of arc flash mitigation solutions for any brand of electrical equipment.

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## Solution Group 1

Lowers arc flash energy by reducing the arcing time.



### Over-Current Protective Device (OCPD) Coordination Study

An OCPD coordination study optimizes circuit breaker and relay settings, and can be specified as a component of the arc flash study. The speed of operation of the OCPD determines the duration of an arc flash event.



### Specialized Relaying, Such as Light Sensing Technology

Strategically-placed light sensors in switchgear compartments makes it possible to sense the arc within a millisecond. Modern relays can sense this condition and trip the appropriate circuit breaker. Other relaying technologies are zone-selective interlocking and differential protection.



### Virtual Main Relay

Low-voltage switchgear and switchboards can be subjected to dangerous levels of arc flash incident energy when fed directly from a power transformer. Upgrading switchgear with a virtual main relay adds over-current sensing to the low-voltage side of the service transformer and is designed to trip an existing upstream fault-breaking device.

## Solution Group 2

Removes worker from location or places a barrier between worker and exposed energized parts.



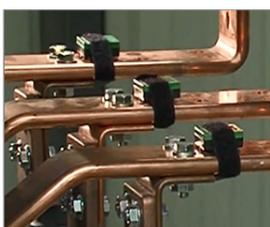
### Infrared (IR) Windows

IR windows allow you to obtain condition and status information of electrical equipment without the need to remove equipment panels. The complete unit is permanently fitted into electrical equipment and enables infrared inspections to be performed without downtime.



### Remote Racking System (RRS)

An RRS allows low-voltage circuit breaker racking operations to be performed via a control panel located away from the cell, removing the operator from manual contact with the circuit breaker. In addition, an RRS may reduce the PPE Hazard Risk category because the worker is removed from the flash protection boundary.



### Asset Connect

Asset Connect offers wireless sensors that can be installed into low- and medium-voltage equipment as well as transformers and busway. Sensors can be placed in locations usually not accessible with an infrared camera. They can be installed on equipment with high arc flash ratings, allowing equipment condition to be monitored without a risk of danger to personnel or equipment.

# Why Choose Schneider Electric Engineering Services for NFPA 70E Compliance Solutions?

Since 1966, Schneider Electric Engineering Services has been proactively engaged in electrical workplace safety and compliance since arc flash requirements were first introduced.

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Many of our engineers are leaders in IEEE, NFPA, and other power system standard-making organizations. Specifically, we:

- Have over 150 strategically located professional engineers who are collectively registered in every state of the U.S. to meet state licensing requirements
- Are professional engineers who have in-depth knowledge of power distribution and control equipment and expertise of the calculation methods required for arc flash analyses
- Provide full-scope NFPA 70E compliance support and solutions
- Offer arc flash mitigation solutions through a variety of engineering and electrical distribution services
- Established a standardized methodology to complete arc flash analyses along with uniform reporting standards nationwide
- Provide generic arc flash analysis specifications to assist customers with specification development
- Have the capabilities to perform the arc flash analysis, as well as make recommendations for corrective action(s)

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