

Managing Liability for Electrical Hazards

Robert E. Fuhr, P.E.

PowerStudies, Inc.

Faults, Fires, & Outages

- Faults – When insulated conductor comes in contact with a grounded conductor or another phase (Short Circuit)
- High currents flow
- A fault can cause a fire and results in an outage.
- Bolted Faults
- Arcing Faults (Arc Flash)

Faults, Fires, & Outages

- These can result in:
 - Loss on Income Revenue
 - Loss of Production
 - Personnel Injury
 - Lawsuits
 - Can be time consuming and extremely costly!!!

Outages

- Caused by:
 - Faults & Overloads (Breakers Tripping)
 - Loss of Utility
 - Equipment failure / shutdown
 - Operator Error
- Minimize the Impact using:
 - Generators
 - Automatic Transfer Switches (ATS)
 - Uninterruptible Power Supplies (UPS)

Faults, Fires, & Outages

- Reduce the Liability by:
 - Maintaining the electrical equipment
 - Reducing or Eliminating work on Energized Equipment
 - Increasing Electrician and Operator Training
 - Maintaining, Updating, Revising Electrical One Line Drawings

Faults, Fires, & Outages

- Update your One Line Drawing!!!!
- It is your road map for the electrical system
- You do not know where you are going with out it.
- You may turn off the wrong breaker!



Electrical Maintenance

- Inspection of electrical system conducted by “qualified personnel”
 - Infra-red survey
 - Visual Inspections
 - Mechanical Inspections
 - Electrical Inspections & Tests

Electrical Maintenance

- Start at power sources and work down towards load.
 - Main Service Equipment
 - Emergency Generators
 - UPS
- Concentrate on Critical & Emergency Distribution Systems

Sources and Standards

- NFPA 70B Recommended Practice for Electrical Equipment Maintenance.



- Standards
- Specifications

Other Testing Organizations

- Sigma Six - Auburn
- Advanced Electrical Testing - Sumner
- ERS (ETI) – Auburn
- Square D – Mercer Island
- Eaton Electrical
- General Electric
- Siemens

Arc Flash Faults

- Energy in the form of
 - Thermal
 - radiation
 - chemical
 - mechanical
 - Electrical

Arc Flash Faults Produce

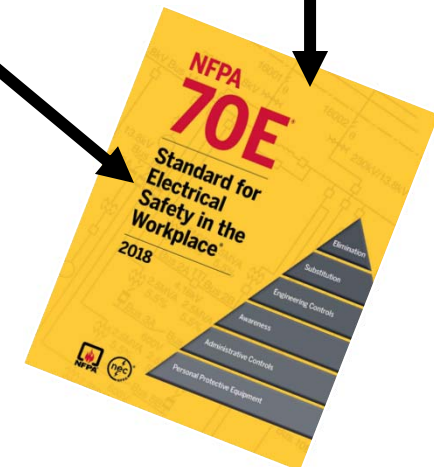
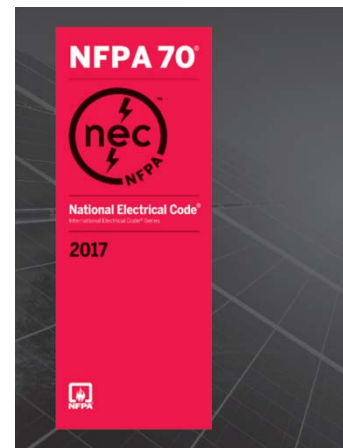
- Dangerous and potentially fatal levels of blast pressure
- Excessive sound waves
- Toxic gases & vapors,
- Heat & ultraviolet radiation
- Flying shrapnel.

Electrical Safety in the Workplace

- Reduce Electrical Accidents by:
 - Increasing Employee Training
 - Qualified & Non-Qualified
 - Installation of Arc Flash Warning Labels
 - Warns employee of the electrical hazards
 - Purchase of Personnel Protective Equipment

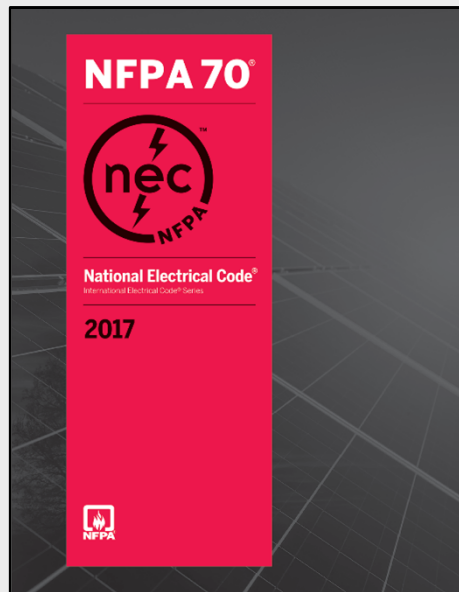
Industry standards and regulations:

- OSHA 29 CFR 1910 Subpart S
- NFPA 70 - The National Electrical Code (2017 Edition)
- NFPA 70E - Standard for Electrical Safety in the Workplace (2018 Edition)

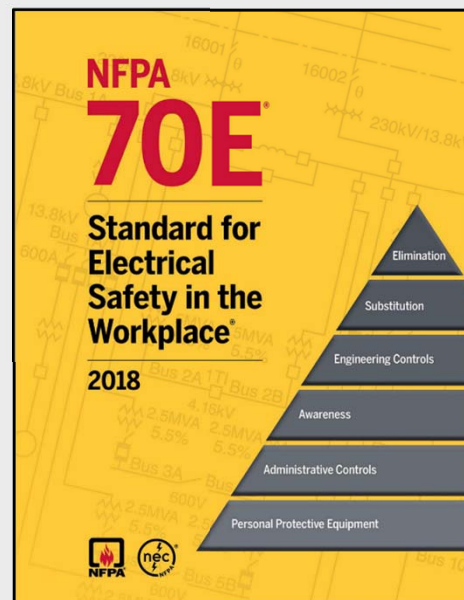
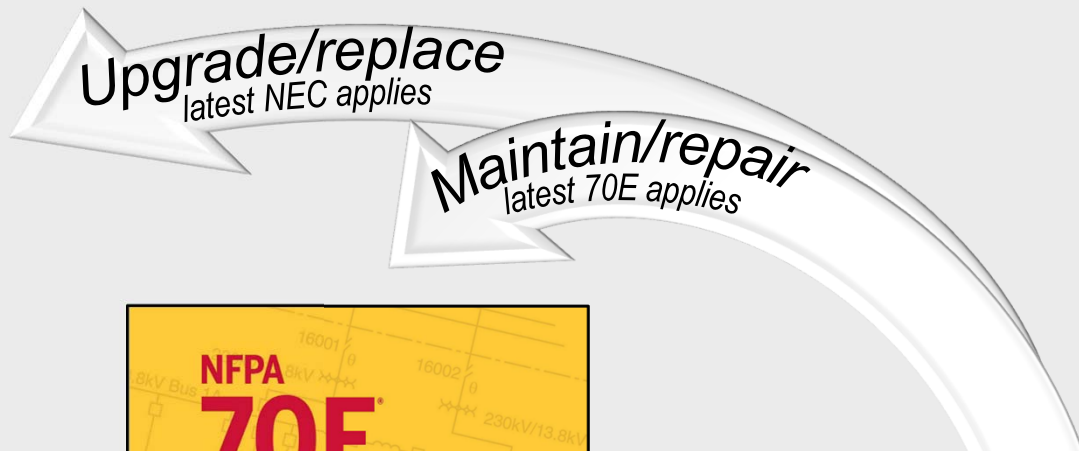


NFPA Approach to Electrical Safety

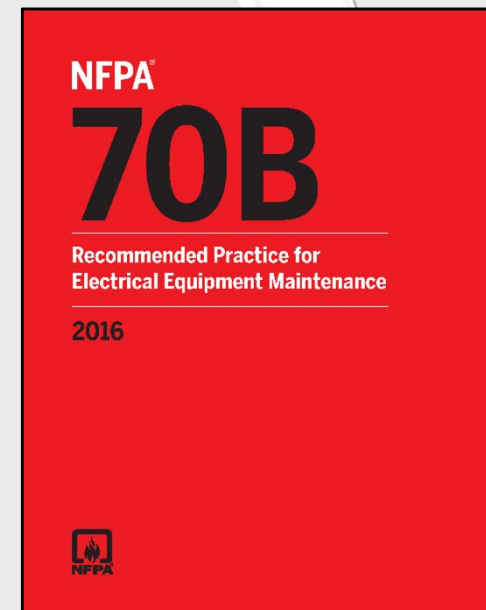
How to...



BUILD it safely



WORK on it safely



MAINTAIN it properly

OSHA & Electrical Accidents

- OSHA will Investigate Serious Accidents
- OSHA will ask for:
 - Electrical Safety Training Records
 - Arc Flash Hazard Assessment
- If you are negligent with either item:
 - Fines
 - Lawsuits filed by injured employees

OSHA enforces NFPA 70E under the “General Duty Clause”

- US Occupational Safety and Health Act of 1970
- “General Duty Clause,” requires **employers** to furnish a workplace which is **free from recognized hazards** which may cause or are likely to **cause death or serious physical harm**.

OSHA Regulations

29CFR 1910.335(a)(1)(i)

“**Employees working** in areas where there are **potential electrical hazards** shall be provided with, and shall use, **electrical protective equipment** that is appropriate for the specific **parts of the body to be protected** and for the work to be performed”. (PPE)

OSHA

- **FACT** - (OSHA) inspectors are currently enforcing National Fire Protection Association (NFPA) document NFPA 70E.

Key References in NEC ® -2017

- 110.16 Flash Protection. 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.

NEC 110.16 (continued)

- The marking shall meet the requirements in 110.21(B) and shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

NEC 110.16 (continued)

- (B) - In other than dwelling units, in addition to the requirements in (A), a permanent label shall be field or factory applied to service equipment rated 1200 amps or more. The label shall meet the requirements of 110.21(B) and contain the following information:

NEC 110.16 (continued)

- (1) Nominal system voltage
- (2) Available fault current at the service overcurrent protective devices
- (3) The clearing time of service overcurrent protective devices based on the available fault current at the service
- (4) The date the label was applied

Exception: Service equipment labeling shall not be required if an arc flash label is applied in accordance with acceptable industry practice.

NEC 110.16 (continued)

Informational Notes No. 1 & 3 Point to NFPA-70E for guidance as to how to determine the values & information to put on the labels.

NFPA 70E -Flash Hazard Analysis

- **130.5(A) General.** An arc flash risk assessment shall be performed:
 - (1) To identify arc flash hazards
 - (2) To estimate the likelihood of occurrence of injury or damage to health and the potential severity of injury or damage to health
 - (3) To determine if additional protective measures are required, including the use of PPE

NFPA 70E -Flash Hazard Analysis

- **130.5(F) Arc Flash PPE.** One of the following methods shall be used for the selection of arc flash PPE:
 - (1) The incident energy analysis method in accordance with 130.5(G)
 - (2) The arc flash PPE category method in accordance with 130.7(C)(15)*
- * - Use with extreme caution!!!

Arc Flash Hazard Analysis Key Steps

- Determine
 - Incident energy levels
 - Arc Flash hazard distance
 - Hazard/Risk Category
 - Required PPE
 - Install Arc Flash Labels



NFPA 70E –Arc Flash Labeling

- (1) Nominal system voltage
- (2) Arc flash boundary
- (3) At least one of the following:
 - a. 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.
 - b. Minimum arc rating of clothing
 - c. Site-specific level of PPE

NFPA 70E –Arc Flash Labeling

- The data shall be reviewed for accuracy at intervals not to exceed 5 years.
 - (Arc Flash Refresher Study)
- The **owner** of the electrical equipment shall be responsible for the documentation, installation, and maintenance of the marked label.

Generic Labels not Acceptable!

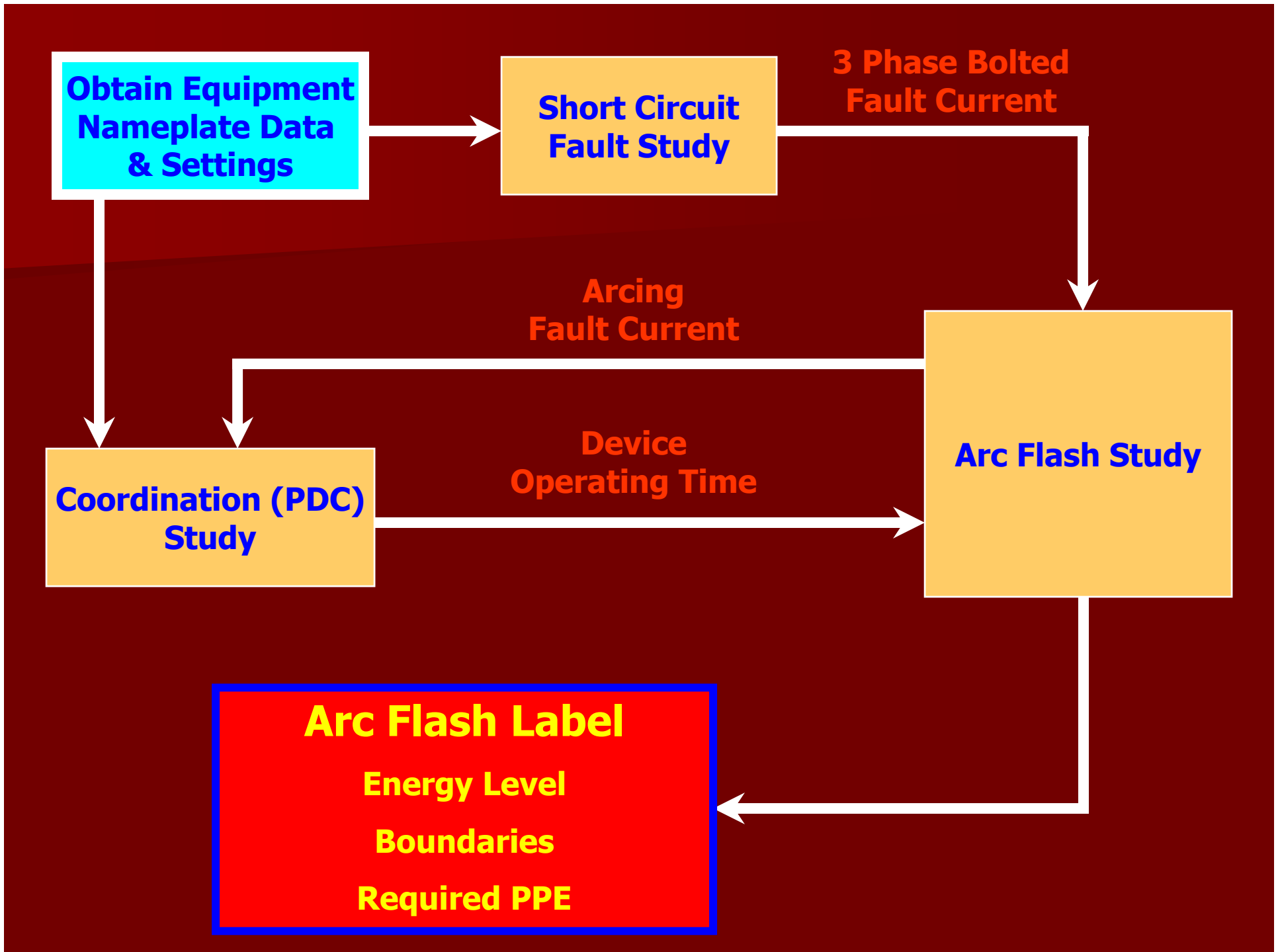
- May meet the NEC Requirements
- Do not meet the intent of NFPA 70E



Acceptable & Informative Labels

| | | | |
|--|---------------------------------------|---|---|
| ! DANGER | | | |
| Arc Flash & Shock Hazard Appropriate PPE Required | | | |
| Flash Hazard Category _____ | Flash Protection Boundary _____ | | |
| Min. Arc Rating (cal/cm ²) _____ | Limited Approach Boundary _____ | | |
| _____ VAC Shock Hazard When _____ | Restricted Approach Boundary _____ | | |
| _____ | Prohibited Approach Boundary _____ | | |
| FLASH PPE | <input type="checkbox"/> FR shirt | <input type="checkbox"/> Hard hat | <input type="checkbox"/> Leather gloves |
| <input type="checkbox"/> Cotton underwear | <input type="checkbox"/> FR pants | <input type="checkbox"/> Face shield | <input type="checkbox"/> Leather shoes |
| <input type="checkbox"/> T-shirt | <input type="checkbox"/> FR coveralls | <input type="checkbox"/> Ear protection | <input type="checkbox"/> Class _____ |
| <input type="checkbox"/> Long-sleeve shirt | <input type="checkbox"/> Flash suit | <input type="checkbox"/> Safety glasses | <input type="checkbox"/> Voltage _____ |
| <input type="checkbox"/> Long pants | <input type="checkbox"/> Flash hood | <input type="checkbox"/> Safety goggles | <input type="checkbox"/> |
| SHOCK PPE | | | |
| Equipment ID: _____ | | | |
| <small>MSB2CV - CATALOG NO. 99459</small> | | | |

| | |
|--|---|
| ! WARNING | |
| Arc Flash and Shock Hazard | |
| 11 Ft 5 In | Flash Hazard Boundary |
| 33.0 | cal/cm ² Flash Hazard at 1 Ft 6 In |
| | Arc Rated Clothing Required (See NFPA 70E-2018 Table 130.5(G) for additional PPE) |
| 208 VAC | Shock Hazard when cover is removed |
| 00 | Glove Class |
| 3 Ft 6 In | Limited Approach (Fixed Circuit) |
| 1 Ft 0 In | Restricted Approach |
| 11/15/2018 | IEEE 1584-2018 & NFPA 70E-2018 |
| Equipment: | SWBD MSB2 |
| Device: | MSB2 MAIN |
| Scenario 2 - 50% UTILITY | Max Fault Current: 20.0 kA |
| Study Performed By PowerStudies, Inc. (253) 639-8535 | |



Reduce Liability of Electrical Hazards - Summary

- Maintain the Electrical System
- Document & Revise the Electrical Drawings
- Train the Employees Using NFPA 70E as a guide.
- Perform an Arc Flash Hazard Assessment
- Install Arc Flash Warning Labels on Electrical Equipment

Need more Information

- www.powerstudies.com
 - Articles
 - Links
 - Specifications for Power System Studies
 - Short Circuit
 - Protective Device Coordination
 - Arc Flash Hazard
- Phone: 253-639-8535
- Email: fuhr@powerstudies.com

Thank you for your time!

- Questions?????

Who are we?

- We Specialize in performing Power System Studies
- Established in 1986
- 95% of our business is in performing Power System Studies

