NECA SAFETY PROFESSIONALS CONFERENCE

Electrical Equipment Maintenance & Electrical Safety in the Workplace:

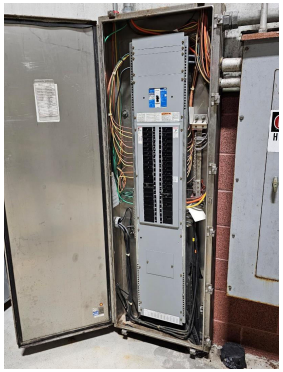
Integrating NFPA 70B & 70E Standards

Paul A. Zoubek, CSP, CIH, CESCP
Zoubek Consulting, LLC
paul@zoubekconsulting.com
619-677-8682
May 21, 2024

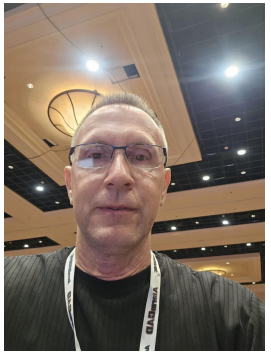
Outline

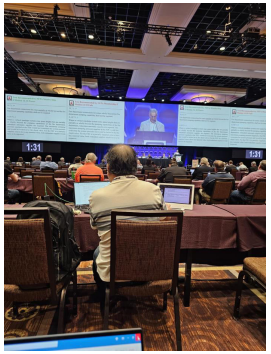
- Background on codes & standards
- Highlight overlapping standard requirements
  - 5 steps for electrical PM & safety program implementation
- Additional information & guidance
- Summary

Don't judge a book by it's cover.



Code vs. Standard





NFPA Technical Meeting 6/22/23 in Las Vegas

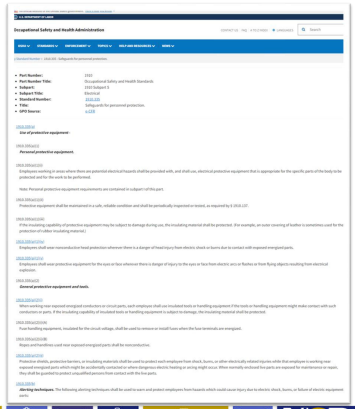
Code vs. Standard

- **Code**
  - Model
  - Set of rules recommend for others to follow.
  - Not a law but can be adopted into law.

- **Standard**
  - Detailed elaboration.
  - The nuts and bolts of meeting code requirements.
  - *AHJ* Organization responsible for enforcing requirements of code/standard.

Background

- OSHA does not enforce NFPA standards.
- OSHA may use NFPA to support citations for violations.
- Example: Requirements for personal protective equipment found in OSHA Regs.



Background

November 4, 2004

Mr.
Director of Risk Management
Inc
P.O. Box
Greensboro, NC

Dear Mr. :

Thank you for your August 23, 2004 letter to the Occupational Safety and Health Administration's (OSHA) Directorate of Enforcement Programs. You had a question regarding the relationship between OSHA standards and *National Fire Protection Association (NFPA) 70E, Standard for Electrical Safety Requirements for Employee Workplaces.* You also had questions and comments related to the application and intent of NFPA 70E as it relates to some specific work tasks. Your paraphrased inquiries and our responses follow.

Question: Is NFPA 70E a voluntary standard and not something that OSHA enforces?

Response: OSHA approaches NFPA 70E from both a standards perspective and an enforcement perspective. From a standards perspective, OSHA views NFPA 70E as the primary consensus standard addressing electrical hazards associated with electrical utilization systems (i.e. building and other premises wiring and utilization equipment). The electrical safety-related work practices in OSHA's general industry electrical standards in Subpart S - Electrical, are based on previous editions of NFPA 70E. Additionally, OSHA's proposed revision of the installation requirements in Subpart S are based on Part I of the 2000 edition of NFPA 70E. Later stages of this rulemaking project will be based on other parts of NFPA 70E.

From an enforcement perspective, OSHA does not enforce NFPA 70E. OSHA enforces its own standards that relate to electrical hazards. OSHA may, however, use NFPA 70E to support citations for violations relating to certain OSHA standards, such as the general requirements for personal protective equipment found in 29 CFR 1910.335. An example of this would be consulting NFPA 70E's Flash Hazard Boundary when considering citations for personal protective equipment under 1910.335.

1910.335(a)(1)(v)
Employees shall wear protective equipment for the eyes or face wherever there is danger of injury to the eyes or face from electric arcs or flashes or from flying objects resulting from electrical explosion.

Compliance may not = Acceptable Risk

1910.335(a)(1)(v)
Employees shall wear protective equipment for the eyes or face wherever there is danger of injury to the eyes or face from electric arcs or flashes or from flying objects resulting from electrical explosion.

OSHA® Occupational Safety and Health Administration

vs.

(c) *Face Protection.* Face shields shall have an arc rating suitable for the arc flash exposure. Face shields with a wrap-around guarding to protect the face, chin, forehead, ears, and neck area shall be used. Face shields without an arc rating shall not be used. Eye protection (safety glasses or goggles) shall always be worn under face shields or hoods.

Background

- **Examination of Electrical Equipment (1910.303(b)(1))**
- Electrical equipment shall be free of recognized hazards.

1910.303(b)(1)

Examination. Electric equipment shall be free from recognized hazards that are likely to cause death or serious physical harm to employees. Safety of equipment shall be determined using the following considerations:

1910.303(b)(1)(i)

Suitability for installation and use in conformity with the provisions of this subpart;

Note to paragraph (b)(1)(i) of this section: Suitability of equipment for an identified purpose may be evidenced by listing or labeling for that identified purpose.

Background

- Authority Having Jurisdiction (AHJ)
  - An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

Background

Background

- Recommended Practice for Electrical Equipment Maintenance-NFPA 70B
  - Details preventive maintenance for:
    - Electrical, electronic, and communication systems and equipment.
    - Not intended to duplicate or supersede instructions that manufacturers normally provide.

Standard Requirements

1

Maintenance Programs

- NFPA 70B lists requirements for elements of an electrical maintenance program.
- NFPA 70B, Article 4.2

Standard Requirements (Program Requirements)

NFPA 70B **Article 4.2**	NFPA 70E **Chapter 1, Article 110.3**
Responsible personnel.	
Survey of electrical equipment for maintenance requirements and priorities.	Risk Assessment & Job Planning.
Maintenance procedures & plan of servicing.	Maintenance of equipment.
Plan of inspections, servicing, and suitable tests.	Equipment inspection.
Process to implement & document corrective measures.	Procedures.

Standard Requirements

2

Equipment Condition

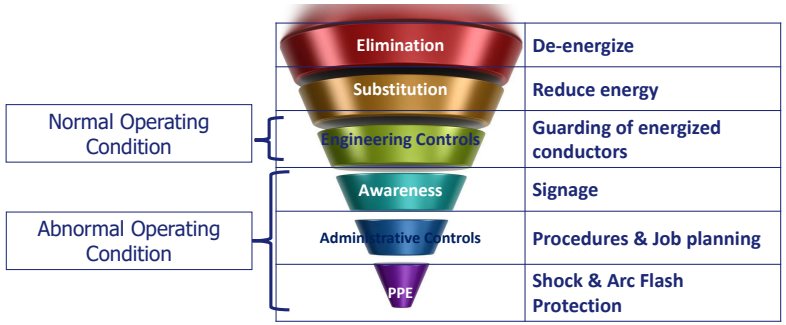
- NFPA 70B requires an equipment condition assessment.
- Determined by the equipment owner or their designee.
- NFPA 70B, Chapter 9.3

Normal vs. Abnormal Operating Condition

Standard Requirements

NFPA 70B **Article 9.3: Equipment Condition Assessment**	NFPA 70E **NFPA 70E, Chapter 1, Article 110.4(A)-(C)**
Condition 1: Properly maintained. Condition 2: Maintenance results deviate from past results. Condition 3: Equipment has missed the last 2 maintenance cycles	Defines normal operating condition. • Equipment is properly installed. • Equipment is properly maintained. • Equipment is used in accordance with instructions included in list and labeling. • Equipment doors are closed and secure. • Equipment covers are secure and in place. • No evidence of failure.

Standard Requirements



Standard Requirements

3

Field Testing

- Field testing shall be conducted to assess the overall condition of electrical equipment.
- NFPA 70B, Chapter 8
- Type of test depends on electrical equipment.

Standard Requirements

Field tests are outlined according to equipment type.

Table 13.3.5 Panelboard and Switchboard Electrical Testing

No.	Task	Test Type*
1	Check electrical hardware connections	NA
2	Measure insulation resistance of the main bus	2
3	Measure insulation resistance of control wiring	2A
4	Test protective devices and systems	2
5	Perform system operational tests	1 or 2
6	Test control power transformers, instrument transformers, and metering to ensure correct operation	2
7	For individual components, refer to the appropriate chapter(s) of this standard	NA
8	Where environmental controls are provided, check for correct operating condition	1 or 2

Example: Panelboards (configuration for circuit breakers) are one of the most common types of electrical equipment

Standard Requirements

Table 13.3.5 Panelboard and Switchboard Electrical Testing

No.	Task	Test Type*
1	Check electrical hardware connections	NA
2	Measure insulation resistance of the main bus	2
3	Measure insulation resistance of control wiring	2A
4	Test protective devices and systems	2
5	Perform system operational tests	1 or 2
6	Test control power transformers, instrument transformers, and metering to ensure correct operation	2
7	For individual components, refer to the appropriate chapter(s) of this standard	NA
8	Where environmental controls are provided, check for correct operating condition	1 or 2

Some testing operations my need to be performed with equipment energized.

Background

NFPA 70B	NFPA 70E
Article 8.3 Chapter 10-38 (Specific Equipment)	**Article 110.5(I)** **Article 110.5(H)(1)** **Article 130.5** **Article 130.4** **Article 130.7** **Article 110.6(A)(1))** **Article 120** **Article 110.6(A)(1)(e)** **Article 110.8(A)**
1 – Online standard test 1A – Online enhanced test 2 – Offline standard test 2A – Offline enhanced test	Job Safety Planning & Job Briefing Risk Assessment Procedure Arc Flash Boundaries Shock Boundaries PPE Training Lockout/Tagout Test Instruments

Standard Requirements

4

Maintenance Intervals

- NFPA 70B provides maintenance intervals by equipment type and condition.
- NFPA 70B, Article 9.2

Example: Panelboards

Standard Requirements
Scope of Work (Panelboard Example)

NFPA 70B	NFPA 70E
Article/Table 9.2.2	**Article 120 (LOTO)** **Chapter 1 (Safety Related Work Practices)**
Visual inspection	May or may not be done energized.
Cleaning	Done de-energized.
Lubrication	Done de-energized.
Mechanical inspections	May be energized or de-energized.
Electrical testing	Done Energized.

Standard Requirements
Scope of Work (All Equipment Example)

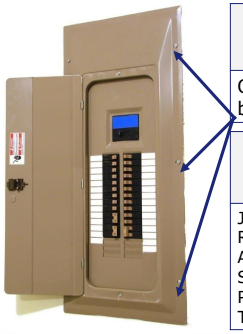
Table 9.2.2 Maintenance Intervals

Product	Scope of Work	Equipment Condition Assessment		
		Condition 1	Condition 2	Condition 3
All equipment	Infrared thermography	12 months	12 months	6 months

NFPA 70B	NFPA 70E
Table 9.2.2	**Table 130.5(C)**
IR Thermography	Done Energized.

Standard Requirements
Estimate of Likelihood of Occurrence of Arc Flash

NFPA 70E-Table 130.5(C), page 27



TASK	Equipment Condition	Likelihood of Occurrence of arc flash
Opening of hinged doors or covers or removal of bolted covers to exposed electrical conductors.	*Any*	*Yes*

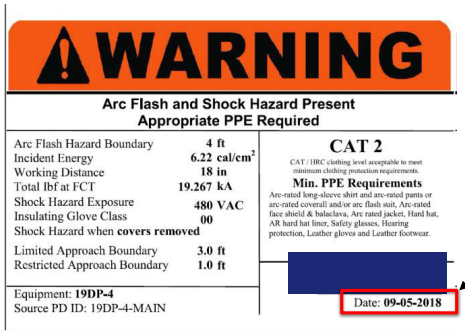
Applicable Standards

Job Safety Planning & Job Briefing (**NFPA 70E-Article 110.5(I)**)
Risk Assessment Procedure **(NFPA 70E-Article 110.5(H)(1))**
Arc Flash Boundaries **(NFPA 70E, Article 130.5)**
Shock Boundaries **(NFPA 70E, Article 130.4)**
PPE **(NFPA 70E, Article 130.7)**
Training **(NFPA 70E-Article 110.6(A)(1))**

Standard Requirements
Frequency of maintenance is based on condition of equipment (panelboard example).

Condition	Assessment Results	Maintenance Frequency
1	Maintained at required intervals.	60 months
2	Previous maintenance cycle revealed issues requiring the repair or replacement of major equipment components.	36 months
3	Equipment has missed the last two successive maintenance cycles.	12 months

Maintenance Intervals/Tip



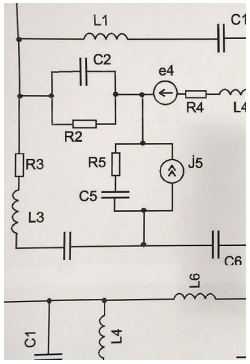
Indication equipment may not be serviced on required intervals

Standard Requirements

5

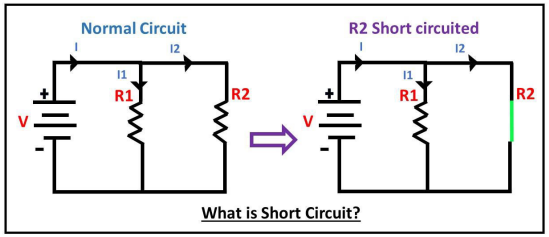
System Study Intervals

- NFPA 70B Chapter 6 provides
  - Detailed requirements for system studies,
  - Include up-to-date single-line diagrams and short-circuit studies.



Standard Requirements

- Section 6.3 – Short-circuit studies
  - Determine the available short circuit current at each point in the system.

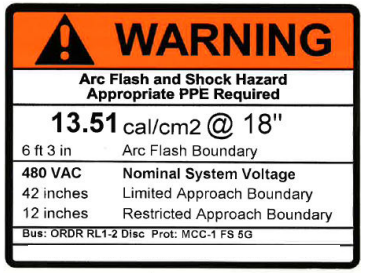


Standard Requirements

- Section 6.4 – Coordination studies
  - Evaluation of faults in an electrical system/analysis of circuit interrupting devices to ensure functionality.
  - e.g.: Is a circuit breaker used as a light switch?

Standard Requirements

- Section 6.7 – Incident Energy Analyses
- Determine the risk of an arc flash boundary.



Standard Requirements
System Study Intervals

NFPA 70B	NFPA 70E
Article 6.3, 6.4, 6.7	**Article 130.5(E)(1)** **Article 130.5(F)** **Article 130.5(G)/(H)**
• Short-circuit studies • Coordination studies • Incident Energy Analyses	Requires incident energy analysis be performed for administrative and PPE controls.
Performed every 5-years	

Additional Information/Guidance
Guidance on Equipment Maintenance*

NFPA 70B	NFPA 70E
Chapter 10-38*	**Chapter 2-3***
Hazardous Locations	Safety Related Maintenance Requirements
Panelboards & Switchboards	Special Equipment
Circuit Breakers	
Ground Fault Protection Systems	
Motor Control Equipment	
Photovoltaic Systems	

***Not intended to supersede manufacturer instructions for equipment maintenance**

Contractors

- What does your contractor safety program say about energized electrical work?
- Typical energized electrical work that is outsourced:
  (1) Field Testing
  (2) IR Thermography
  (3) System Interval Studies:
    (a) Short circuit current studies
    (b) Coordination studies
    (c) Incident energy analysis

Contractors

- **NFPA 70E, Article 110.5(A), Page 19**
- Host Employer
  - Communicate known hazards
  - Report contractor violations of NFPA 70E to contract employer
  - Documented meeting host employer and the contract employer.

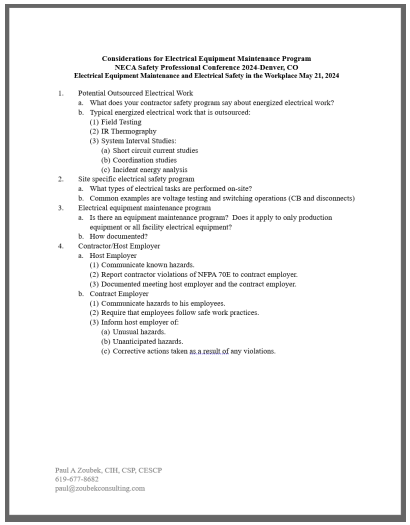
Contractors

- **NFPA 70E, Article 110.5(A), Page 19**
- Contract Employer
  - Communicate hazards to his employees
  - Require that employees follow safe work practices
  - Inform host employer of:
    - Unusual hazards
    - Unanticipated hazards
    - Corrective actions taken as a result of any violations

Summary

Step	Action		
1	Establish Maintenance Program	Overall Electrical Safety Program	
2	Determine Equipment Condition	Normal vs. Abnormal Condition	
3	Perform Field Testing	Based on equipment with worker safety	
4	Determine Maintenance Intervals		
5	Implement System Study Intervals	Studies every 5 years	

Summary



Considerations for Electrical Equipment Maintenance Program
NECA Safety Professional Conference 2024-Denver, CO
Electrical Equipment Maintenance and Electrical Safety in the Workplace May 21, 2024

1. Potential Outsourced Electrical Work
   a. What does your contractor safety program say about energized electrical work?
   b. Typical energized electrical work that is outsourced:
      (1) Field Testing
      (2) IR Thermography
      (3) System Interval Studies:
         (a) Short circuit current studies
         (b) Coordination studies
         (c) Incident energy analysis
2. Site specific electrical safety program
   a. What types of electrical tasks are performed on-site?
   b. Common examples are voltage testing and switching operations (CB and disconnects)
3. Electrical equipment maintenance program
   a. Is there an equipment maintenance program? Does it apply to only production equipment or all facility electrical equipment?
   b. How documented?
4. Contractor/Host Employer
   a. Host Employer
      (1) Communicate known hazards.
      (2) Report contractor violations of NFPA 70E to contract employer.
      (3) Documented meeting host employer and the contract employer.
   b. Contract Employer
      (1) Communicate hazards to his employees.
      (2) Require that employees follow safe work practices.
      (3) Inform host employer of:
         (a) Unusual hazards.
         (b) Unanticipated hazards.
         (c) Corrective actions taken as a result of any violations.

Paul A Zoubek, CIH, CSP, CESCP
619-677-8682
paul@zoubekconsulting.com

Summary
Business Case for Safety

- An effective electrical safety program, along with an electrical maintenance program, will lead to
  - Higher reliability
  - Longer life of equipment
  - Lower cost

Summary

- NFPA C&E (Orlando), June 18
  - **The NFPA 70E Risk Factor: Concepts for Risk Assessment and Reduction in Electrical Safety**
    - 4-hour workshop using NFPA LiNK®
- ASSP PDC (Denver), August 5-6
  - **Electrical Safe Work Practices with Application of NFPA 70E (2024 Edition)**
    - 2-day hands-on course focusing on NFPA 70E hard copy standard

Please complete the Online Evaluation

https://www.surveymonkey.com/r/2024NationalSafetyProfessionalsConference