
SAND2015-8429C

# Physical Asset Management, Track 6 Application of the NFPA 70E Standard in the Maintenance Arena

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An industrial electrician by trade, Wes has worked in the maintenance arena as a craftsman, supervisor, inspector, planner, designer, engineer, consultant, and trainer for over 35 years.

# NFPA 70E Standard for Electrical Safety in the Workplace

- Frequently thought of as a standard for electricians or electrical maintenance workers only
- Standard makes it quite clear that it applies to anyone who may be exposed to an electrical hazard
- This would include mechanical and other maintenance workers who may be exposed to an electrical system in the performance of their work duties

# Qualified Person – 110.2 (D) (1)

Shall be trained and knowledgeable in the construction and operation of the equipment or a specific work method and be trained to identify and avoid the electrical hazards that might be present with respect to that equipment or work method

# Qualified Person - Definition

One who has demonstrated skills 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

# Unqualified Person

- Definition – A person who is not a qualified person
- 110.2 (D) (2) – Shall be trained in, and familiar with, any electrical safety-related practices necessary for their safety

# History of the NFPA 70E

- Developed at the request of OSHA
- Industry consensus standard under the ANSI consensus standard process
- Can be referenced by OSHA under the Section 5(a)(1) (General Duty Clause) of the OSH Act.
- Updated every three years

# Do We Have to Implement the 70E?

- Consensus standard – not a law
- As a consensus standard it is a baseline for industry best practices
- Implementation will go far with respect to electrical injuries on the job
- OSHA can reference for citations

# Do We Have to Implement the 70E?

- If an electrical incident resulting in injury or death occurs on the job, this is the standard by which the aftermath will be evaluated
- The question that will be asked is, ‘Could this injury or fatality have been prevented if 70E had been implemented?’

# Implementation of 70E

- A process – doesn't happen overnight
- For many companies and workers it presents a radical change in the way electrical work is performed
- Management needs to commit to a long process at significant cost or implementation will not be successful

# Implementation of 70E

- Implementation will be most successful if workforce buy-in is received.  Will be less successful if perceived as a management edict
- Workforce needs to be educated as to why they want the NFPA 70E to be implemented in their workplace

# Electrical Shock

- There are approximately 1000 electrical contact fatalities each year making electrocution the fourth leading cause of industrial fatalities after traffic, homicide and construction accidents
- Approximately 30,000 non-fatal shock incidents occur annually

# Arc Flash

- There are actually more hospital admissions due to arc flash incidents rather than shock
- The temperature generated by an arc flash can exceed 30,000º F

# Arc Blast

- An arc flash can sometimes involve the metal in the arc path leading to a catastrophic event
- Explosion can generate a tremendous percussive blast sending shrapnel flying in addition to the arc itself
- Each year there are more than 2000 hospital admissions from this type of incident

# Non-Fatal Shock Incidents

- Frequently looked on as minor
- ‘Shake it off’ attitude – even bragging rights
- Typically any residual pain from an electrical shock dissipates in a day or two and people assume they are okay
- Lack of education in industry as to the long term effect of electrical shock on the human body

# Effect of Electrical Shock on the Human Body

- Nervous system
  - Muscle Contraction
    - Tearing of muscle fibers
    - Causing the heart to beat out of sequence
    - Stopping the heart
    - Breaking the back
  - Heat damage to the nerve
    - Loss of function
    - Loss of sensation
  - Organs and endocrine system

# Effect of Electrical Shock on the Human Body

- Circulatory system
  - Blood clots
- Muscle and Tissue
  - Burned Tissue
  - Premature organ failure
- Bones
  - Marrow

# A Change of Attitude

- A little education can go a long way
- Historically electrical injuries have been accepted in the workplace – especially as long as they happen to the other guy
- Because it hasn't happened to us – yet – we assume it won't

# A Change of Attitude

- The industry attitude is changing
  - Electrical shock incidents are not acceptable
  - Many arcing incidents are preventable
  - Injuries from arcing incidents that do occur are preventable or at least can be significantly mitigated with proper PPE

# NFPA 70E

- Arranged in the same format as all NFPA documents
- Consists of Article 90 Introduction, 3 chapters and 16 Annexes
- Bulk of the implementation pertinent to the implementation of the Standard will be found in Chapter 1 and the Annexes

# Chapter 1

- Defines our safety related work practices
- Begins with Article 100 – four pages of definition of terms used in the Standard – a valuable resource as one gets into the Standard and wants to clarify terminology

# Article 105

- Discusses the application of safety-related work practices
- Employer has the responsibility to provide the safety-related work practices and train to them
- Employee has the responsibility to implement the safety-related work practices

# Article 110.1 – Electrical Safety Program

- Developing the safety program
  - Additional information in Annex E
  - Special emphasis on developing employee awareness and self-discipline with respect to safety
  - Condition of maintenance also needs to be a consideration

# Article 110.1 – Electrical Safety Program

- Risk analysis
  - Additional information in Annex F
  - OSHA hierarchy of controls
- Job briefing
- Auditing of the electrical safety program

# Article 110.2 - Training

- Employees must be trained to the level of the hazard they face
- Qualified person
- Unqualified person – how do we train an unqualified person to be a qualified person
- Use of test instruments – employee must demonstrate
- Documentation

# Article 110.3 – Host and Contract Employers

- Emphasis on communication so all personnel on a jobsite are aware of all hazards, regardless of who their employer is
- Documentation of communication is emphasized

# Article 110.4 – Use of Electrical Equipment

- Test instruments
  - Used only by qualified personnel
  - Rated for the application
  - Visual inspection
  - Operation verification
- Portable electrical equipment
  - Includes tools and cord sets
- GFCIs

# Article 120 – Establishing an Electrically Safe Work Condition

Definition – A state in which an electrical conductor or circuit part has been disconnected from energized parts, locked/tagged in accordance with established standards, tested to ensure the absence of voltage, and grounded if determined necessary

# Article 120 – Establishing an Electrically Safe Work Condition

- Six steps to establish and verify an electrically safe work condition
- Four pages of information on establishing a lockout/tagout program with Annex G for additional information
- Discussion of temporary protective grounding equipment

# Article 130 – Work Involving Electrical Hazards

- Finally – the article that tells us how we can work it hot
- 130.2 – Electrically Safe Work Condition
  - The “work it hot” chapter starts off by telling us we shouldn’t work it hot, but rather establish an electrically safe work condition

# Energized Work is Permitted

- When employer can demonstrate that de-energizing introduces additional hazards or increased risk
- When the employer can demonstrate infeasibility due to equipment design or operational limitations
- When the system is less than 50 volts

# Key Words

EMPLOYER CAN DEMONSTRATE

# Energized Electrical Work Permit

- 8 Elements
  - Description of the circuit and equipment to be worked on
  - Justification of why the work must be performed in an energized condition
  - Description of the safe work practices to be employed
  - Shock risk assessment – Tables 130.4 (D)

# Energized Electrical Work Permit

- 8 Elements – continued
  - Arc flash risk assessment
  - Means employed to restrict access of unqualified persons from the work area
  - Evidence of a job briefing
  - Approval signatures

# Exemptions to Work Permit Requirement

- Testing
- Troubleshooting
- Voltage measuring
- Thermography
- Visual inspections
- General Housekeeping in the area

# Arc Flash Risk Assessment

- Significant part of the implementation of the NFPA 70E Standard
- Term used in the industry is Modeling
- Complex calculations covered in Annex D
- Calculations are complex enough most engineers use software for the calculations and modeling process

# Equipment Labeling 130.5 (D)

- Switchboards, panelboards, industrial control panels, meter socket enclosures, motor control centers
- May want to go down as far as disconnects and utilization equipment in certain facilities

# Equipment Labeling 130.5 (D)

- Label must include
  - Nominal system voltage
  - Arc flash boundary
  - Information to allow the worker to select the appropriate level of PPE

# 130.6 – Other Precautions

- Alertness
- Not working while impaired
- Awareness of changes in scope
- Adequate illumination
- Not wearing conductive articles
- Anticipating failure
- Housekeeping

# 130.7 Personal and Other Protective Equipment

- Defines all PPE requirements
- Information on standards governing PPE selection
- Care and maintenance of PPE
- Tables to assist in determining when PPE is appropriate
- Tables to assist in determining what level of PPE is necessary

# Other Energized Work Requirements

- 130.8 – Work near overhead lines
- 130.9 - Work near underground lines
- 130.10 – Cutting or Drilling – Employer shall perform a risk assessment to spot potential utilities prior to an employee drilling into a wall or floor

# Balance of Standard

- Chapter 2 – Several short articles concerning Safety-Related Maintenance Requirements
- Chapter 3 – Safety Requirements for Special Equipment such as electrolytic cells, lasers, battery rooms and power electronic equipment not commonly found in a production facility

# Conclusion

- NFPA 70E applies to all facilities where electrical equipment is located.
- The process of implementing the 70E standard takes time and commitment
- It won't happen in a week, or a month, or even a year – the implementation process and the culture change that accompanies it will take time

# Conclusion

- As we learn more about electrical safety and the Standard is updated every three years there will be new areas for us to address to improve the safety of our workers
- Implementation of 70E best thought of as a journey, not a destination

# The Payoff

- Better overall safety for our workers
- Comfort in the knowledge that our workers are going home at the end of every shift healthy and uninjured
- Knowing that the costs we have invested in electrical safety will pay off a thousand fold with the prevention of just one electrical accident

???? QUESTIONS ????