NECA SAFETY PROFESSIONALS CONFERENCE

Human Error:

Preventing Problems through Proper Training and Job Planning

Derek Vigstol

E-Hazard, LLC

1

Key Discussion Points & Takeaways

- What do we mean?
  - "Human Error/Human Performance"
- Why is this concept so important?
- How do the standards help?
- What can we do about it?
  - Training
  - Job Planning
  - Risk Assessment

2

Human Performance? What Do We Mean?

- People are not machines, we make mistakes
- Performance can be influenced
- Error-likely situations are:
  - Predictable
  - Manageable
  - Preventable & Avoidable

3

Human Performance? What Do We Mean?

Human performance is an aspect of **risk management** that addresses **organizational**, **leader**, and **individual performance** as factors that either lead to or prevent errors and their events. The objective of human performance is to **identify and address human error** and its **negative consequences** on people, programs, processes, the work environment, an organization, or equipment.

4

Human Performance? What Do We Mean?

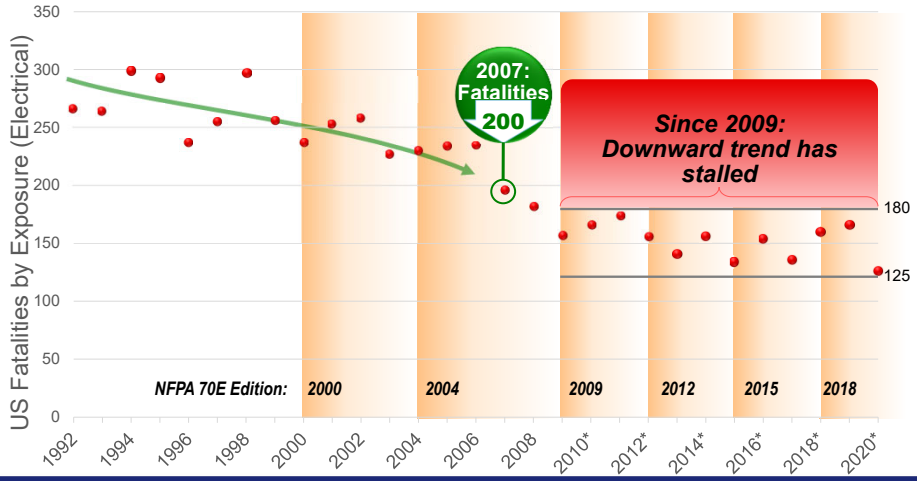
- Stages of Info Processing
  - Attention
  - Sensing
  - Encoding, Storage, Thinking
  - Retrieval, Acting
- Attention Resource Pool is shallow!
  - Attention required is inversely proportional to experience

Human Performance? What Do We Mean?

Critical points in activities when risk is higher (increased likelihood of harm or increased severity of harm, or both) require an increased allocation of attentional resources. Allocation at these critical points can be improved by training, procedures, equipment design, and teamwork.

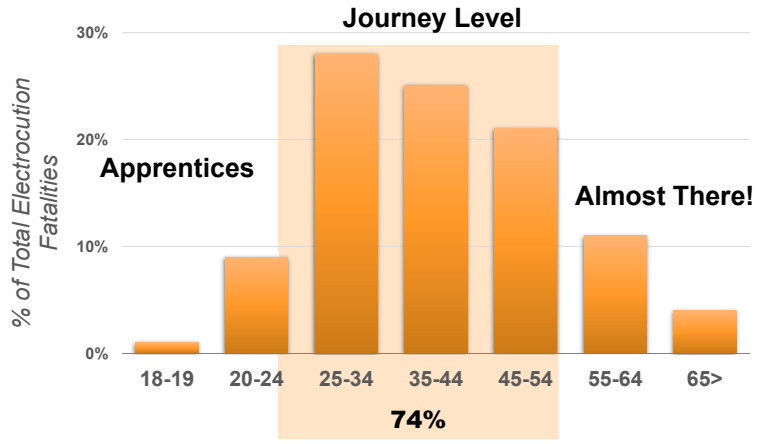
U.S. Workplace Fatalities from Exposure to Electricity

Statistics from BLS. *Due to classification/coding changes, data from 1992-2009 analyzed by "contact with electrical current" and data starting in 2010 analyzed by "exposure to electricity"



7

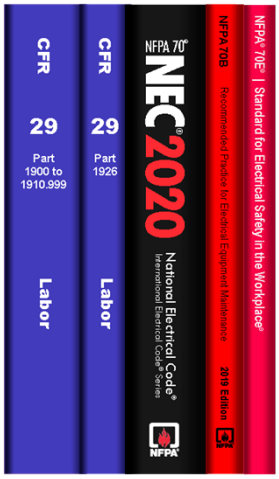
Electrocution by Age (2011 – 2020)



ESFI, Workplace Electrical Injury & Fatality Statistics Report 2020
Table 4 Fatal Work Electrical Injuries by Selected Worker Characteristics, 2011– 2020 (Data source: BLS)

8

Regulations and Standards



- OSHA 29 CFR 1910 Subpart S
- OSHA 29 CFR 1926 Subpart K
- NFPA 70E / CSA Z462
- NEC/ CEC
- NESC/ CAN/ULC S801

Support Standards

- IEEE
- ASTM
- NETA MTS
- ANSI
- IEC
- NFPA 70B

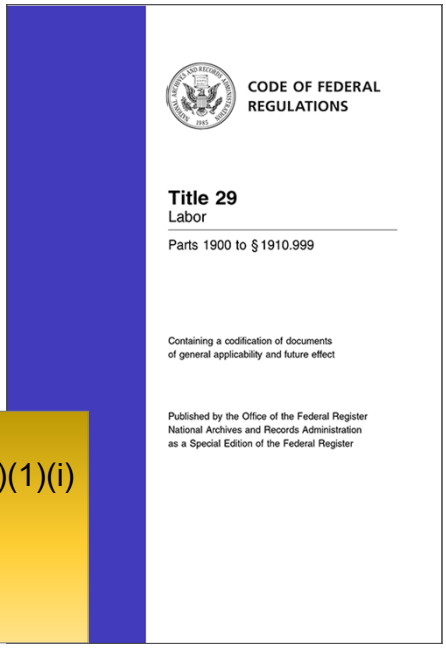
9

OSHA Requirements

- The general duty clause requires workplaces to be **free from recognized hazards**
- Specific duty clauses require employers to comply with OSHA standards

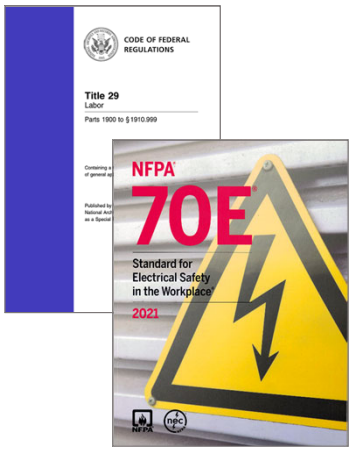
OSHA Specific Duty Clauses: Look it Up

- Electrical Protective Equipment in 1910.335(a)(1)(i)
  - *Is this Arc Flash clothing?*
  - *Check definitions*
- Eye and Face Protection in 1910.335(a)(1)(v)
- Insulated Tools in 1910.335(a)(2)(i)



10

Best Practice Compliance Strategies



- Training
- Job Safety Planning
- Risk Assessment
- Engineering
- Electrically safe work condition
- PPE & Tools
- Annex Q

11

Training Required for All Personnel

- Unqualified
- Task Qualified
- Qualified
- Management

- Electrical hazard awareness
- LO/TO/V if applicable
- Sufficient for worker safety
- Adequate for tasks involved

NFPA 70E ***110.6***

12

What Makes a Person Qualified…

NFPA 70E defines it as a two-part process:

"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 the hazards and reduce the associated risk."

NFPA 70E, Article 100, pg. 13

A person may be "task qualified" – qualified to perform a certain task or qualified to use certain equipment – but not be low voltage qualified.

Only the employer can determine if someone is qualified. *NFPA 70E **110.6**(A)(1)(b) and (f)*

13

Skills & Knowledge Required to be a Qualified Person

- Precautionary techniques used for working around the hazards,
- Applicable electrical policies and procedures,
- Proper use of PPE, including arc flash, insulating, and shielding materials,
- Proper use of insulating tools and test equipment,
- Distinguish exposed, energized conductors and circuits from other parts of equipment,
- Determine nominal voltage.

*NFPA 70E **110.6**(A)(1)*

14

Skills & Knowledge Required to be a Qualified Person

- Understand the approach distances and determining factors for shock and arc boundaries
- Understand decision making process necessary to be able to:
  - Perform job safety planning
  - Identify electrical hazards
  - Assess the associated risk
  - Select the appropriate risk control methods, including PPE

*NFPA 70E **110.6**(A)(1)*

15

Skills & Knowledge Required to be a Qualified Person

- Human performance modes
  - Rules-based performance
  - Knowledge-based performance
  - Skills-based performance
- Errors happen based on mode
  - Misinterpretation
  - Inaccurate picture of situation
  - Inattention & complacency

*NFPA 70E **Annex Q***

16

What are 3 safety habits you believe are most critical to electrical safety?

17

Job Safety Planning Requirements

Must be completed by qualified person, documented and include:

- Job description with individual tasks,
- Identify hazards associated with tasks,
- Shock risk assessment,
- Arc flash risk assessment,
- Work procedures, special precautions, energy source controls:
  - Energized repair work requires an Energized Electrical Work Permit (EEWP).

Guidelines

- Identify
- Ask
- Check
- Know
- Think
- Prepare for emergencies

NFPA 70E Annex I

NFPA 70E ***110.5****(I)(1)*

18

Addressing Human Error Before It Happens

To be useful, job plan and briefing should:

- Include impact of improperly performing or skimming over steps related to key tasks,
- Discuss remedies for issues that commonly precede errors:
  - Repetitive steps, time pressure, distractions, unexpected conditions, complacency, assumptions, etc.
- Evaluate contingency plans to prevent and/or recover from errors to reduce consequences,
- Incorporate lessons learned from prior experiences.

NFPA 70E Annex Q

Tools for Minimizing the Effects

Utilize methods that reduce likelihood of error:

- Job Planning and Briefing tool
  - Paraphrase and Parrot
  - Talk about the back-up plan
  - Review a previous mistake
- Employee-in-charge role
- Develop a step-by-step plan
- Read and repeat

Required: Jobs Safety Planning

Remember STAR…

- Stop!
- Think!
- Act!
- Review!

It's

OK

to talk to yourself!

21

The Best Way to Reduce Hazard Exposure Is…

- Identify hazards
- Assess risks
  - Likelihood of occurrence
  - Potential severity
- Implement risk control methods
  - Remove or reduce possibility of contact through engineering controls
  - Establish mandatory safe work practices

*NFPA 70E **110.5**(H)(1)*

22

Risk Assessment Musts

- Establish shock protection boundary
- Establish arc flash boundary
- Select appropriate PPE
- NFPA 70E Annex F provides guidelines for risk assessment

23

Methods for Arc Flash Risk Assessment

1st Assess likelihood of arc flash incident using NFPA 70E Table 130.5(C)*

2nd

NFPA 70E Table Method	*OR*	Calculations Method
Follow guidelines in Tables 130.7(C)(15)(a)/(b) when equipment meets requirements		Perform arc flash study to estimate incident energy (IE) • Methods listed in NFPA 70E Annex D (IEEE 1584, etc.)

*IEEE 1584-2002 was not concerned with 208 volt "circuits fed by transformers <125 kVA"

- 2018 Update: *"Sustainable arcs are possible but less likely in three-phase systems operating at 240V nominal or less with an available short-circuit current of less than 2000A"*
- **Best Practice:** Equipment fed from transformers rated ³45 kVA should be "remodeled" using new IEEE 1584-2018 equations

24

Required Label Information

Nominal system voltage

AND

Arc Flash boundary

AND at least 1 of the following:

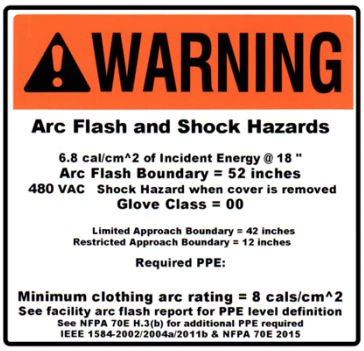
a) Incident energy and working distance*
OR
required PPE Category, based on tables*

** Either acceptable, but not both*

b) Min. arc rating of clothing

c) Site Specific PPE Level

Method of calculating and support data for labels shall be documented



Best Practice:
Separate LARGE Label with upstream device information "fed from…"

*NFPA 70E 130.5**(H)***

25

More Guidelines in Determining Arc Flash Risk

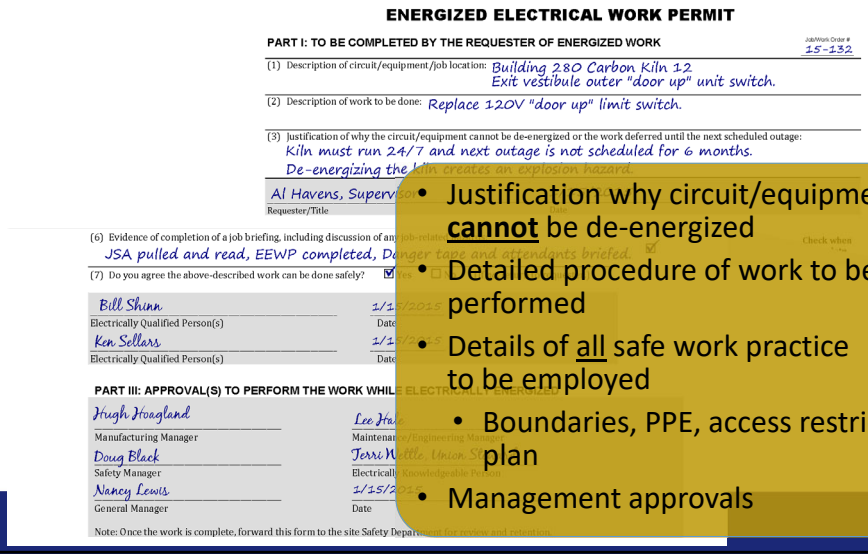
- May use combination of the two methods within a facility, but not on individual equipment
- Must be reviewed a minimum of every five years
- Updates required if major modifications or renovations
- Must consider effects of overcurrent protective devices and opening times

NFPA 70E 130.5

26

NECA SAFETY PROFESSIONALS CONFERENCE

Energized Electrical Work Permit (EEWP)



ENERGIZED ELECTRICAL WORK PERMIT

PART I: TO BE COMPLETED BY THE REQUESTER OF ENERGIZED WORK

Job/Work Order # 15-132

(1) Description of circuit/equipment/job location: Building 280 Carbon Kiln 12
Exit vestibule outer "door up" unit switch.

(2) Description of work to be done: Replace 120V "door up" limit switch.

(3) Justification of why the circuit/equipment cannot be de-energized or the work deferred until the next scheduled outage:
Kiln must run 24/7 and next outage is not scheduled for 6 months.
De-energizing the kiln creates an explosion hazard.

Al Havens, Supervi...
Requester/Title

(6) Evidence of completion of a job briefing, including discussion of any job-related ...
JSA pulled and read, EEWP completed, Danger tags and attendants briefed.

(7) Do you agree the above-described work can be done safely? ☑ Yes

Bill Shinn — 1/15/2015
Electrically Qualified Person(s) — Date

Ken Sellars — 1/15/2015
Electrically Qualified Person(s) — Date

PART III: APPROVAL(S) TO PERFORM THE WORK WHILE ELECTRICALLY ENERGIZED

Hugh Hoagland — Lee Ha...
Manufacturing Manager — Maintenance/Engineering Manager

Doug Black — Jerri M... Little, Union S...
Safety Manager — Electrically Knowledgeable Person

Nancy Lewis — 1/15/2...
General Manager — Date

Note: Once the work is complete, forward this form to the site Safety Department for review and retention.

- Justification why circuit/equipment **cannot** be de-energized
- Detailed procedure of work to be performed
- Details of all safe work practice to be employed
  - Boundaries, PPE, access restriction plan
- Management approvals

Questions?
Want More Information?

"Like" us: **ehazardsafety**

Follow us: **@nfpa70e**

Phone: **(502) 716-7073**
Email: **questions@e-hazard.com**
www.e-hazard.com

Complete the Online Evaluation

29