OSHA & Arc Flash Hazard Analysis

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OSHA & ARC FLASH HAZARD ANALYSIS

Impact of Revisions to the OSHA Electrical Safety Regulations

Presented by: PRAXIS Corporation

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Introduction

- *Important Definitions*
- *Understanding OSHA*
  - *Applicable standards*
  - *Integrating OSHA with Consensus standards*
  - *When to exceed minimum standards*
- *Overview of OSHA revisions…*
- *Next Steps…*

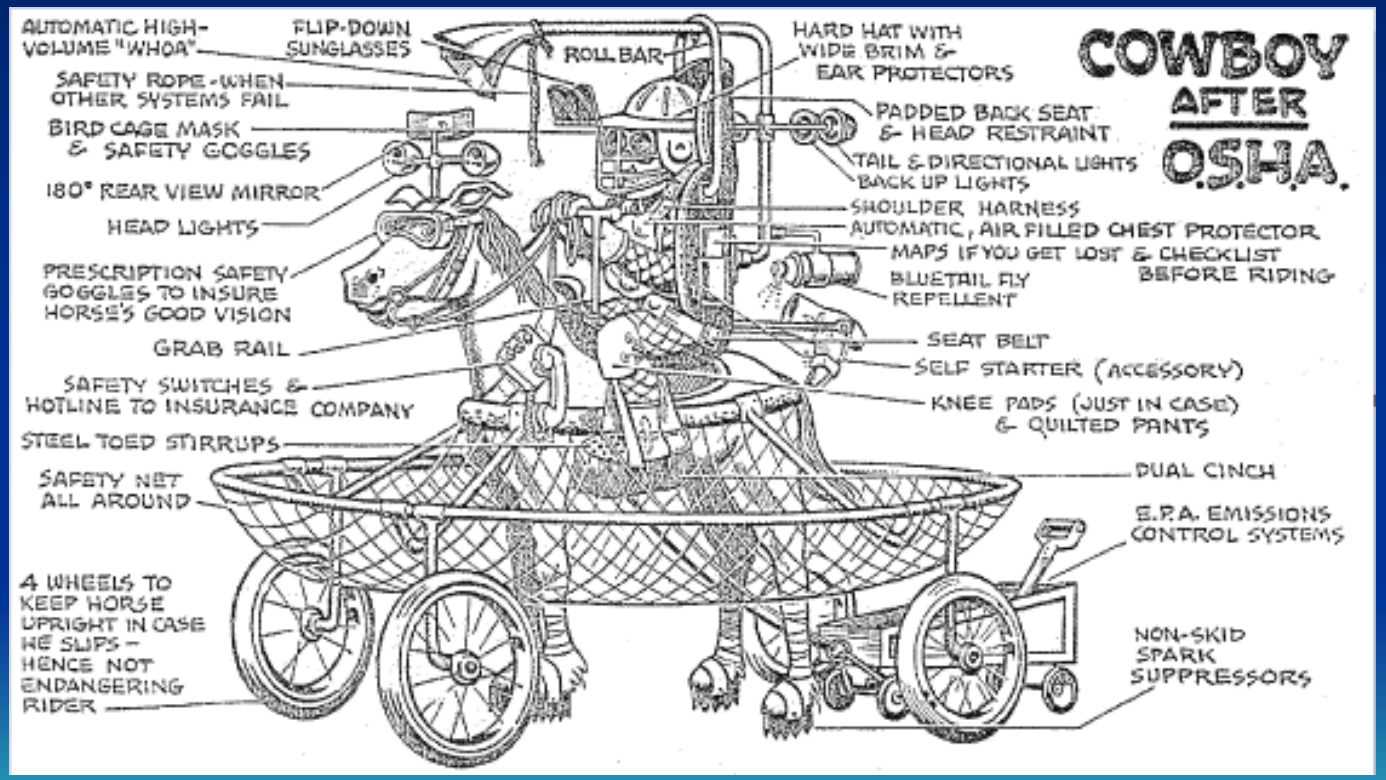
You, before this webinar…

You, after this webinar…

Important Definitions

- *Voltage (Phase to Phase vs Phase to Ground)*
  - *i.e. 120v/240v or 7,200v/12,470v*
  - *This becomes important when using Arc Flash Hazard Analysis (AFHA) software!*
- *Fault Current or Short-Circuit Current*
  - *Bolted Fault Current vs Arcing Fault Current*
- *Incident Energy (cal/cm^2)*
- *Arc Flash Hazard*
- *Flame Resistant vs Arc Rated*

UNDERSTANDING OSHA…



Why OSHA Was Created

1. *The development and enforcement of Health and Safety standards*
   - *Consensus Standards*
   - *How CFR's and Consensus Standards Relate…*
2. *Establishing both employer and employee responsibilities regarding safety*
   - *General Duty Clause {section 5(a)(1)} of the OSHact…*
3. *Establishing record keeping requirements*

Supply vs Utilization Regulations…

OSHA Standards

Utilization Standards

- ***29 CFR 1910.302 - .308 Design Standards***
- ***29 CFR 1910.331 - .399 Safe Work Practices***
- ***29 CFR 1926.400-.449 Construction***

Supply Standards

- ***29 CFR 1910.269 Utility Maintenance. Std***
- ***29 CFR 1926.950-.959 Construction Industry T&D standards***

Consensus Standards

Utilization Standards

- National Electrical Code (NFPA 70)
- NFPA 70E
- NFPA 70B

Supply Standards

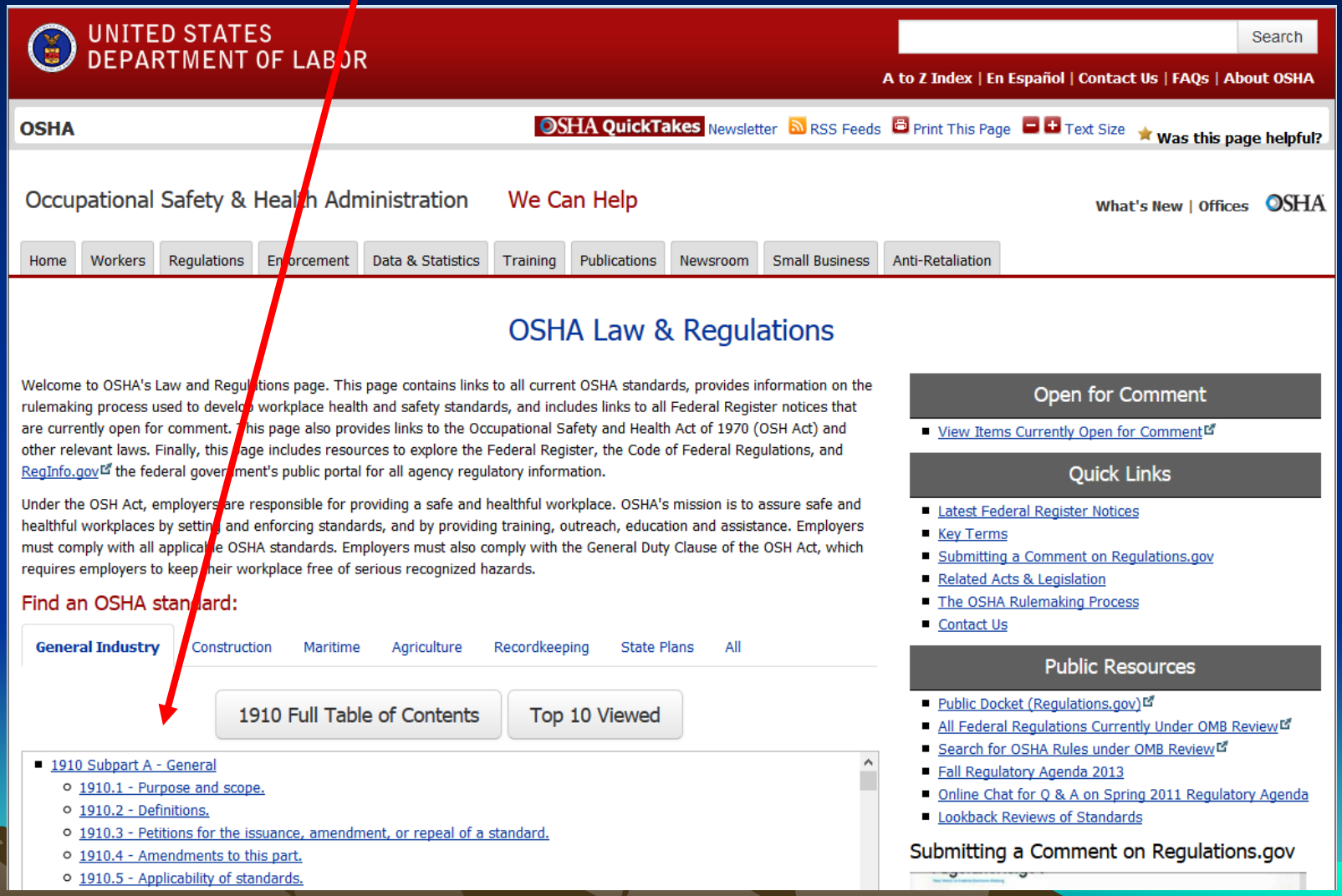
- National Electrical Safety Code (ANSI C2)

OSHA Home Page…

Select “Regulations”…

Regulations Page…

The List of Standards Appears Here…



Important Standards…

- 1910.147 - The control of hazardous energy (lockout/tagout).
  - 1910.147 App A - Typical minimal lockout procedures

1910 Subpart S - Electrical

- 1910.301 - Introduction.
- 1910.302 - Electric utilization systems.
- 1910.303 - General.
- 1910.304 - Wiring design and protection.
- 1910.305 - Wiring methods, components, and equipment for general use.
- 1910.306 - Specific purpose equipment and installations.
- 1910.307 - Hazardous (classified) locations.
- 1910.308 - Special systems

1910.269 - Electric Power Generation, Transmission, and Distribution.

- 1910.269 App A - Flow Charts.
- 1910.269 App B - Working on Exposed Energized Parts.
- 1910.269 App C - Protection from Step and Touch Potentials.
- 1910.269 App D - Methods of Inspecting and Testing Wood Poles.
- 1910.269 App E - Reference Documents.

OSHA & Arc Flash Safety…

- *There have been no substantial changes to Subpart S related to Arc Flash Hazards (AFH)…*
- *The Utility Maintenance Standard (29 CFR 1910.269) included the most substantive changes…*
  - *1910.269 (g)(8): Personal Protective Equipment (Fall Arrest systems)*
  - *1910.269 (l): Work On Energized Parts*
  - *Appendix E: Protection From Flames & Electric Arcs*
- *The most significant changes relate to High Voltage (>600v) systems (this can be Supply OR Utilization systems)*
- *The changes to OSHA do not precisely align with some of the Consensus standards (i.e. 2.0 cal/cm^2 vs 1.2 cal/cm^2)*

1910.269(l)(8): Work On Energized Parts

- All PPE must also meet the requirements of Subpart I (1910.132)…
- 1910.269(l)(8): Employers must assess the workplace for arc hazards…
  - Identify tasks that expose workers to arc flash hazards
  - Estimate Incident Energy
- Ensure employees don't wear clothing that will melt…
- The outermost layer must be FR at a minimum & Arc Rated (AR) if exposed to electrical arcs…
- Workers must wear AR clothing if exposed to >2 cal/cm^2
- Hand protection not needed if wearing rubber gloves & arc exposures <14 cal/cm^2 (Let's talk about what to do if > 14 cal/cm^2)
- Head protection need not be AR if <5cal/cm^2, 3-phase
- Foot protection need not be AR (if they are constructed of heavy leather) for any IE level
- The requirement to ensure employees exposed to arc hazards we AR clothing commences in April 1, 2015

1910.269 Appendix E: Protection From Flames & Electric Arcs

- **Employer requirements:**
  1. **Assess flame & arc hazards**
  2. **Estimate IE exposures**
  3. **Ensure employees don't wear clothing that will melt**
  4. **Ensure employees wear properly-rated FR or AR clothing**
- **Identify sources of flame & arc exposures**
- **Determine the Probability that an arc will occur**
- **READ THE FOOTNOTES to the Tables!**
  - **Things like "rubber glove approach distances or Live-Line work distances" don't apply to most locations…**
  - **Single-phase vs Three-phase faults**
- **OSHA allows broad-estimates of IE exposures (be careful here…)**
- **Remember what an Arc Thermal Protective Rating (ATPV) rating means…**

Selecting An AF Calculation Method…

TABLE 3-SELECTING A REASONABLE INCIDENT-ENERGY CALCULATION METHOD [1]

Incident-energy calculation method	600 V and Less [2]			601 V to 15 kV [2]			More than 15 kV		
	1Φ	3Φa	3Φb	1Φ	3Φa	3Φb	1Φ	3Φa	3Φb
NFPA 70E-2012 Annex D (Lee equation) ...	Y-C	Y	N	Y-C	Y-C	N	N[3]	N[3]	N[3]
Doughty, Neal, and Floyd	Y-C	Y	Y	N	N	N	N	N	N
IEEE Std 1584b-2011	Y	Y	Y	Y	Y	Y	N	N	N
ARCPRO	y	N	N	Y	N	N	Y	Y[4]	Y[4]

Key:

1Φ: Single-phase arc in open air.

3Φa: Three-phase arc in open air.

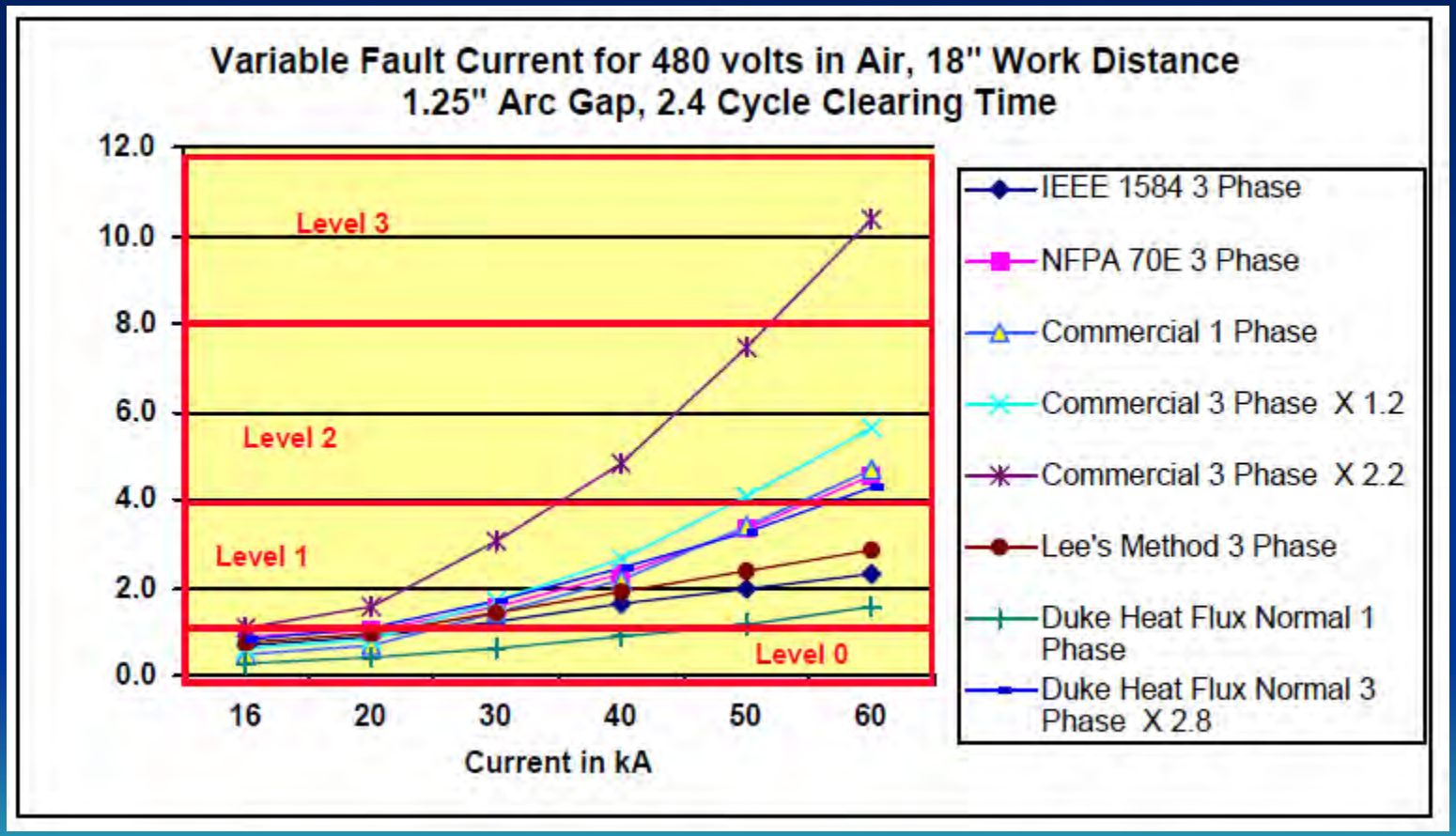
3Φb: Three-phase arc in an enclosure (box).

Y: Acceptable; produces a reasonable estimate of incident heat energy from this type of electric arc.

N: Not acceptable; does not produce a reasonable estimate of incident heat energy from this type of electric arc.

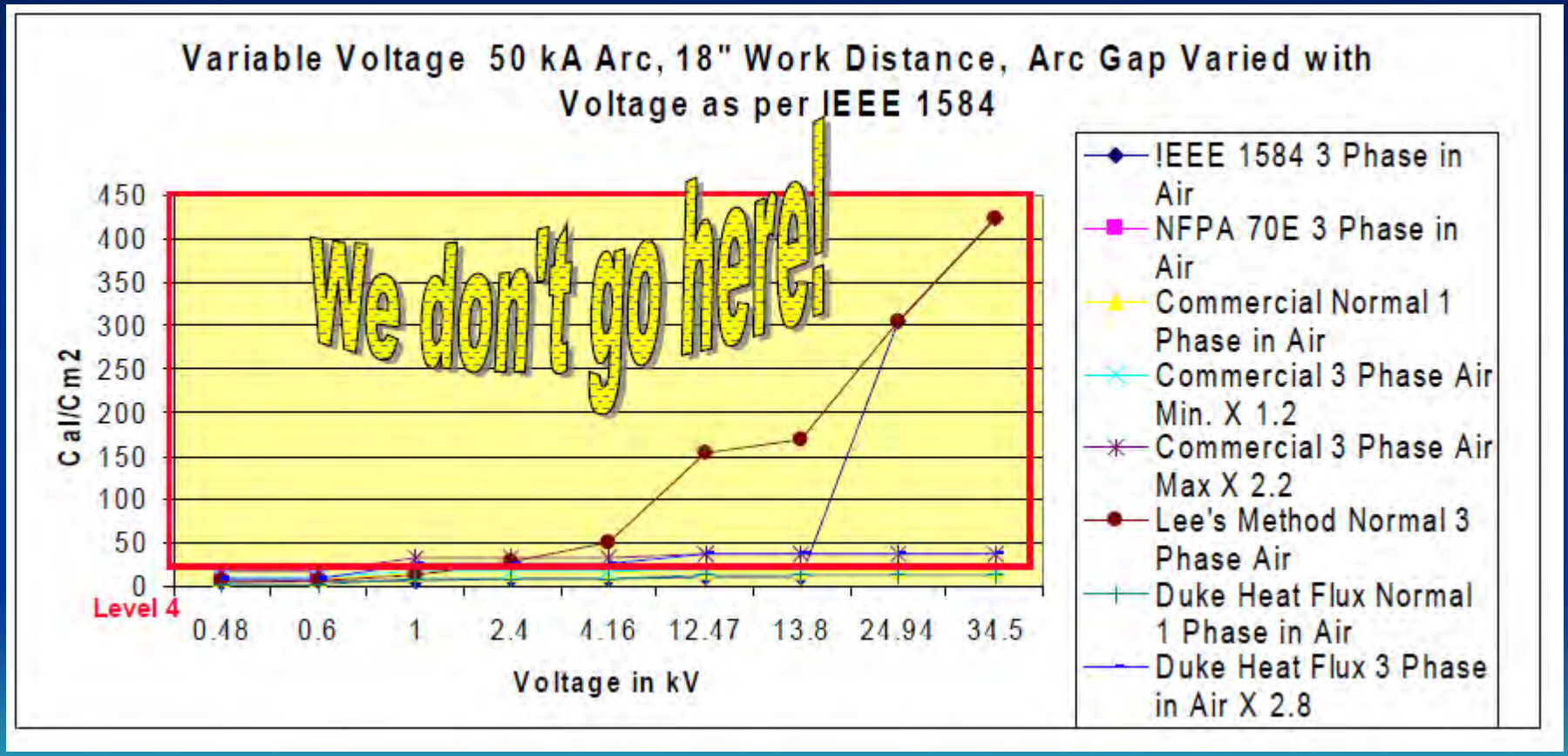
Y-C: Acceptable; produces a reasonable, but conservative, estimate of incident heat energy from this type of electric arc.

Arc Flash Calculation Methods on Low Voltage Systems…



Van Geem, N. & Blackley, W., 2005

Arc Flash Calculation Methods On High Voltage Systems



Van Geem, N. & Blackley, W., 2005

Flash Hazard Approach Distances

TABLE 4-SELECTING A REASONABLE DISTANCE FROM THE EMPLOYEE TO THE ELECTRIC ARC

Class of equipment	Single-phase arc mm (inches)	Three-phase arc mm (inches)
Cable	*NA	455 (18)
Low voltage MCCs and panelboards	NA	455 (18)
Low-voltage switchgear	NA	610 (24)
5-kV switchgear	NA	910 (36)
15-kV switchgear	NA	910 (36)
Single conductors in air (up to 46 kilovolts), work with rubber insulating gloves ..	380 (15)	NA
Single conductors in air, work with live-line tools and live-line barehand work	*MAD* - (2 × *kV* × 2.54)	NA
	(*MAD* - (2 × *kV*/10)) †	

IMPORTANT: IE can be calculated at different distances than listed in this table…

TABLE 6-INCIDENT HEAT ENERGY FOR VARIOUS FAULT CURRENTS, CLEARING TIMES, AND VOLTAGES ARCS IN OPEN AIR ONLY * † ‡ RUBBER INSULATING GLOVE EXPOSURES INVOLVING PHASE-TO-GROUND

Voltage range (kV) **	Fault current (kA)	Maximum clearing time (cycles)			
		4 cal/cm^2	5 cal/cm^2	8 cal/cm^2	12 cal/cm^2
4.0 to 15.0	5	46	58	92	138
	10	18	22	36	54
	15	10	12	20	30
	20	6	8	13	19
15.1 to 25.0	5	28	34	55	83
	10	11	14	23	34

NOTE: Convert cycles to seconds by dividing the "Clearing Time" cycles by 60

Next Steps For Those w/Supply Systems…

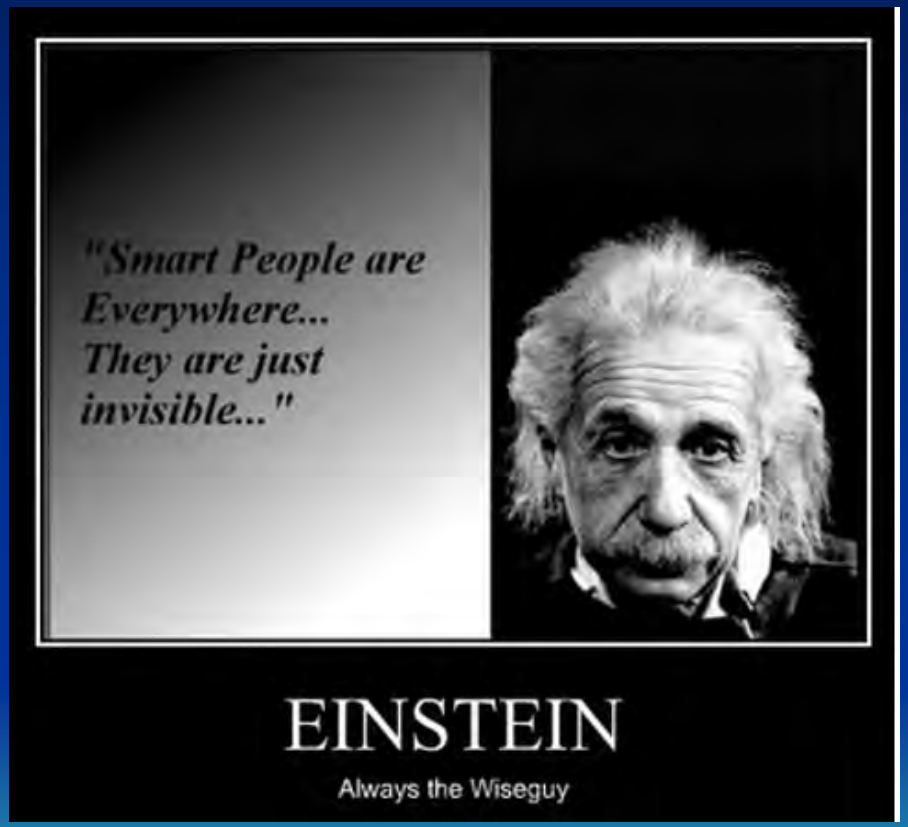
- **Consult the National Electrical Safety Code as well as the NFPA 70E**
- **Carefully consider whether arcing faults will likely result in phase-to-phase or phase-to-ground faults. Then, ensure the software you use will accurately-evaluate that type of fault…**
- **High Voltage work requires the use of insulated sticks which results in greater Working Distances than listed in the 1910.269 tables…**
- **Know & understand the limitations of whichever type of Arc Flash Hazard Analysis software you use!**
- **EXCEED minimum standards when non-standard conditions exist!**

Next Steps For Those w/Utilization Systems

- If you have High Voltage systems, follow the 1910.269 guidelines for those systems
- If you have “Utility type equipment” *, follow the 1910.269 guidelines
- KNOW the requirements of Supply AND Utilization systems & follow the most protective standard…
- Following the requirements in the NFPA 70E-2015 will usually result in the best protection…
- Know & understand the limitations of whichever type of Arc Flash Hazard Analysis software you use!
- EXCEED minimum standards when non-standard conditions exist!

Closing Thoughts...

- *Remember that OSHA or Consensus standards are only MINIMUM requirements!*
- *Know ALL the standards that relate to your location & follow the most protective one…*
- *Become intimately-familiar with your arc flash software…*
- *Use AFHA to MITIGATE arc exposures, not just to select AR PPE!*



Questions?