

OSHA & Arc Flash Hazard Analysis

Presented by
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Praxis Corporation

EasyPower
Webinar Series



OSHA & ARC FLASH HAZARD ANALYSIS

*Impact of Revisions to the OSHA
Electrical Safety Regulations*



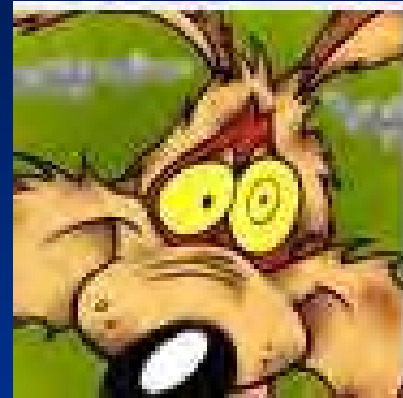
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Introduction

- *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...



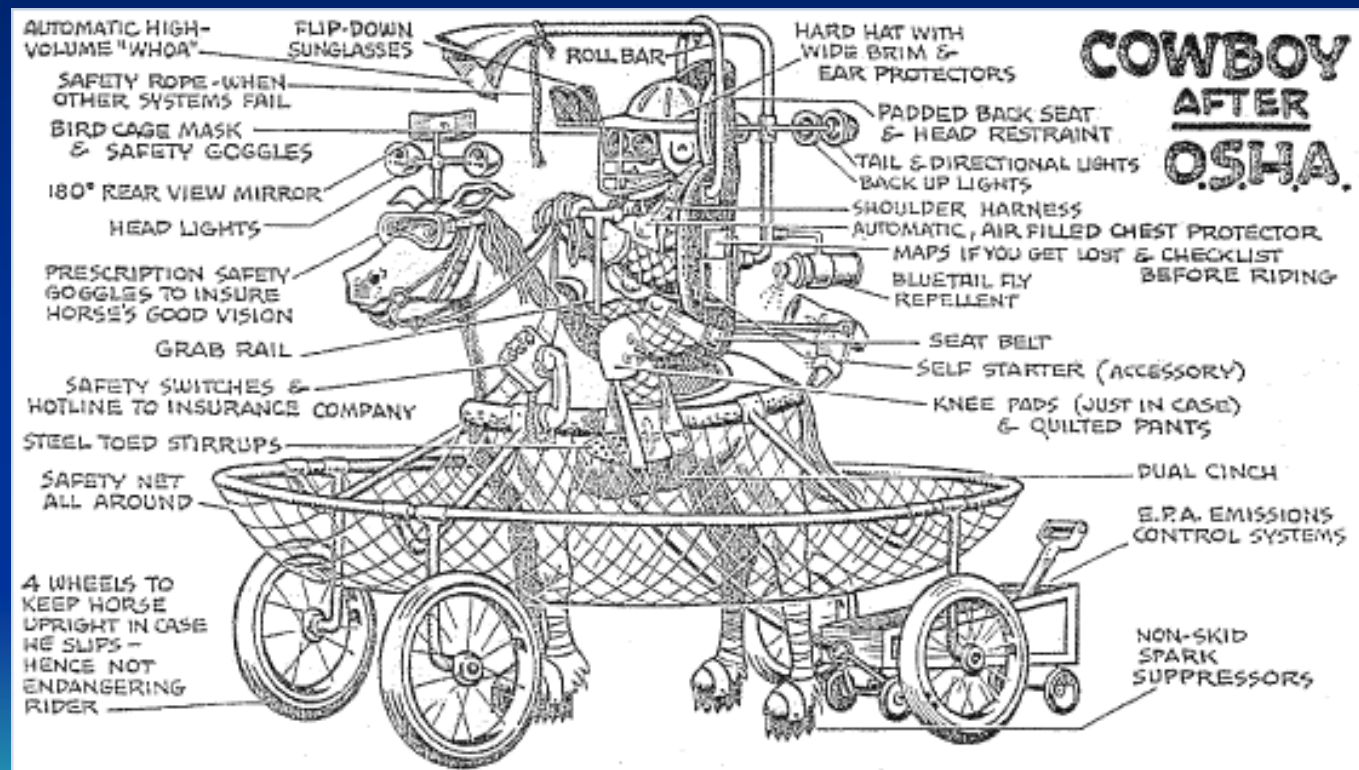
You, after this webinar...

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"...



The screenshot shows the OSHA Home Page with a red arrow pointing to the "Regulations" link in the navigation menu. The page features a red header with the OSHA logo and the text "UNITED STATES DEPARTMENT OF LABOR". A search bar is located in the top right corner. Below the header, there is a navigation bar with links for "Home", "Workers", "Regulations", "Enforcement", "Data & Statistics", "Training", "Publications", "Newsroom", "Small Business", and "Anti-Retaliation". The "Regulations" link is highlighted with a red arrow. To the right of the navigation bar, there are links for "A to Z Index", "En Español", "Contact Us", "FAQs", and "About OSHA". Below the navigation bar, there is a section titled "Highlights" with a large image of healthcare workers and a banner for "Worker Safety In Hospitals: Caring for our Caregivers". To the right of the highlights, there are two banners: "National Severe Weather Preparedness Week March 2-8" and "Protecting Temporary Workers". At the bottom right, there is a banner for "WINTER WEATHER Plan. Equip. Train." with the text "To prevent injuries, illnesses and fatalities during winter storms."

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Highlights

Worker Safety In Hospitals
Caring for our Caregivers

Worker Safety in Hospitals: Caring for Caregivers
Web page | News Release | Assistant Secretary's Statement
Press Call Audio *

National Severe Weather Preparedness Week
March 2-8
OSHA Tornado Preparedness | NOAA Severe Weather Page

Protecting Temporary Workers

WINTER WEATHER
Plan. Equip. Train.
To prevent injuries, illnesses and fatalities during winter storms.

Regulations Page...

The List of Standards Appears Here...

The screenshot shows the OSHA website's 'Law & Regulations' page. At the top is the United States Department of Labor header with a search bar and navigation links. Below this is the OSHA logo and a row of links including 'OSHA QuickTakes', 'Newsletter', 'RSS Feeds', 'Print This Page', 'Text Size', and a feedback link. The main navigation bar includes 'Occupational Safety & Health Administration', 'We Can Help', and 'What's New | Offices | OSHA'. A secondary navigation bar lists various topics: Home, Workers, Regulations, Enforcement, Data & Statistics, Training, Publications, Newsroom, Small Business, and Anti-Retaliation. The main heading is 'OSHA Law & Regulations'. The introductory text explains the page's purpose and provides links to the Federal Register, Code of Federal Regulations, and RegInfo.gov. A paragraph describes the OSH Act and employer responsibilities. Below this is a 'Find an OSHA standard:' section with tabs for 'General Industry', 'Construction', 'Maritime', 'Agriculture', 'Recordkeeping', 'State Plans', and 'All'. A red arrow points from the text 'The List of Standards Appears Here...' to the '1910 Full Table of Contents' button. To the right of this button is a 'Top 10 Viewed' button. Below these buttons is a list of standards under the heading '1910 Subpart A - General', including links for Purpose and scope, Definitions, Petitions for the issuance, amendment, or repeal of a standard, Amendments to this part, and Applicability of standards. On the right side of the page, there are three sections: 'Open for Comment' with a link to 'View Items Currently Open for Comment', 'Quick Links' with links to 'Latest Federal Register Notices', 'Key Terms', 'Submitting a Comment on Regulations.gov', 'Related Acts & Legislation', 'The OSHA Rulemaking Process', and 'Contact Us'; and 'Public Resources' with links to 'Public Docket (Regulations.gov)', 'All Federal Regulations Currently Under OMB Review', 'Search for OSHA Rules under OMB Review', 'Fall Regulatory Agenda 2013', 'Online Chat for Q & A on Spring 2011 Regulatory Agenda', and 'Lookback Reviews of Standards'. At the bottom right, there is a section for 'Submitting a Comment on Regulations.gov'.

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OSHA Law & Regulations

Welcome to OSHA's Law and Regulations page. This page contains links to all current OSHA standards, provides information on the rulemaking process used to develop workplace health and safety standards, and includes links to all Federal Register notices that are currently open for comment. This page also provides links to the Occupational Safety and Health Act of 1970 (OSH Act) and other relevant laws. Finally, this page includes resources to explore the Federal Register, the Code of Federal Regulations, and [RegInfo.gov](#) the federal government's public portal for all agency regulatory information.

Under the OSH Act, employers are responsible for providing a safe and healthful workplace. OSHA's mission is to assure safe and healthful workplaces by setting and enforcing standards, and by providing training, outreach, education and assistance. Employers must comply with all applicable OSHA standards. Employers must also comply with the General Duty Clause of the OSH Act, which requires employers to keep their workplace free of serious recognized hazards.

Find an OSHA standard:

General Industry Construction Maritime Agriculture Recordkeeping State Plans All

1910 Full Table of Contents Top 10 Viewed

- 1910 Subpart A - General
 - 1910.1 - Purpose and scope.
 - 1910.2 - Definitions.
 - 1910.3 - Petitions for the issuance, amendment, or repeal of a standard.
 - 1910.4 - Amendments to this part.
 - 1910.5 - Applicability of standards.

Open for Comment

- [View Items Currently Open for Comment](#)

Quick Links

- [Latest Federal Register Notices](#)
- [Key Terms](#)
- [Submitting a Comment on Regulations.gov](#)
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Public Resources

- [Public Docket \(Regulations.gov\)](#)
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Submitting a Comment on Regulations.gov

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.](#)

[1910.270 - Grounding and Bonding.](#)

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/cm² vs 1.2 cal/cm²)*



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 $>2 \text{ cal/cm}^2$
- Hand protection not needed if wearing rubber gloves & arc exposures $<14 \text{ cal/cm}^2$ (Let's talk about what to do if $> 14 \text{ cal/cm}^2$)
- Head protection need not be AR if $<5 \text{ cal/cm}^2$, 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 wear 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.

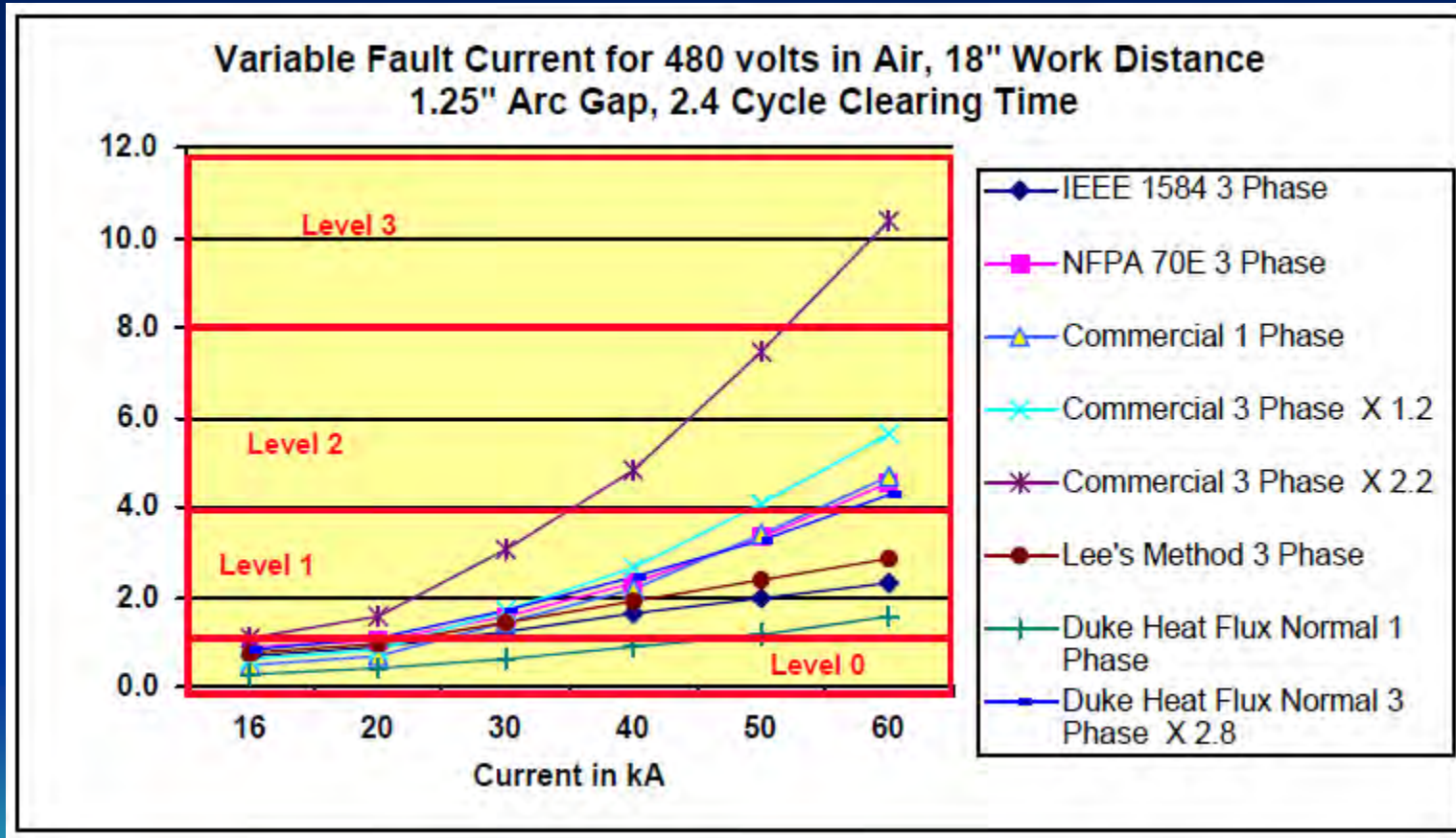
3Φb: Three-phase arc in an enclosure (box).

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.

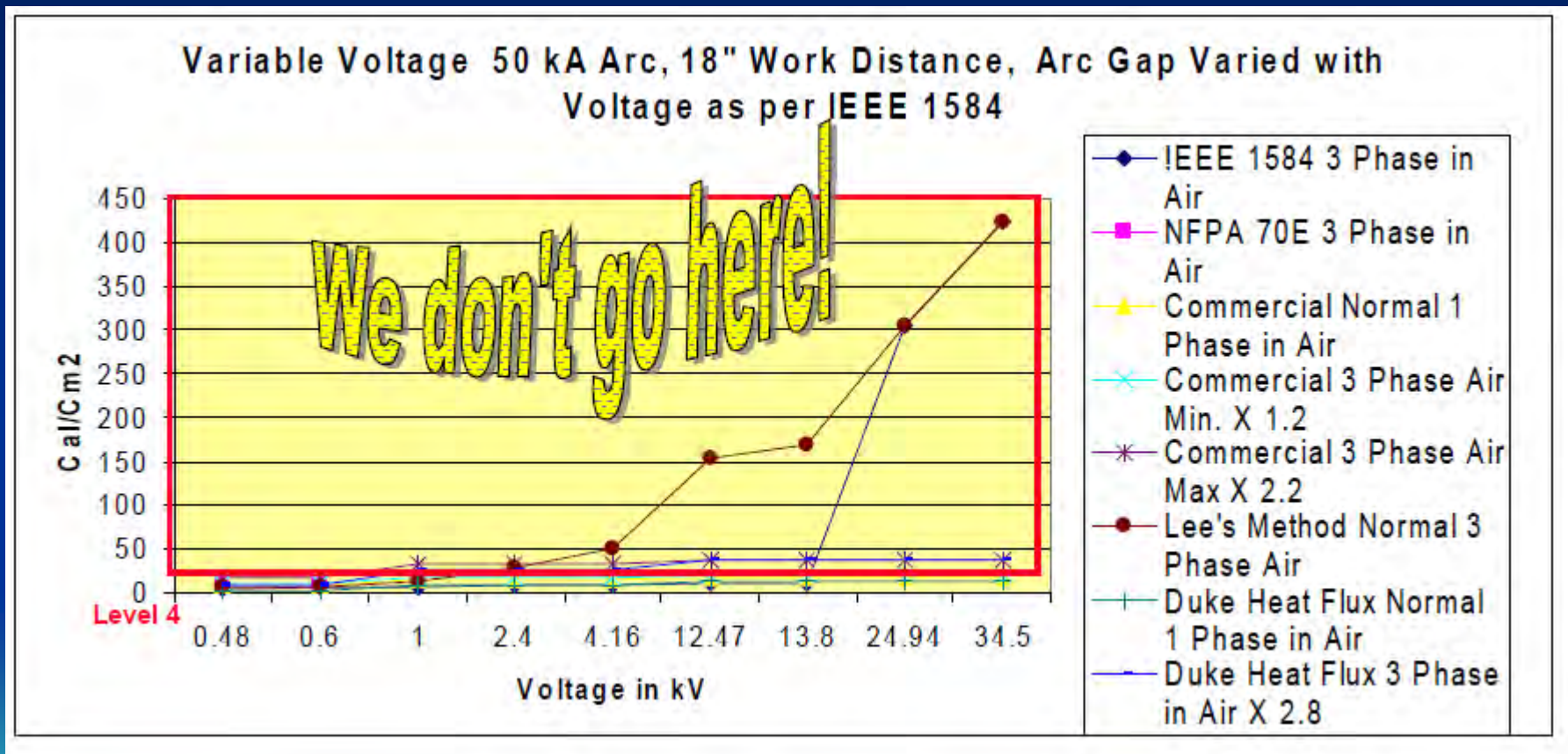
Y-C: Acceptable; produces a reasonable, but conservative, estimate of incident heat energy from this type of electric arc.

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	$MAD - (2 \times kV \times 2.54)$	NA
	$(MAD - (2 \times kV/10)) \dagger$	

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
	5	28	34	55	83
15.1 to 25.0	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!



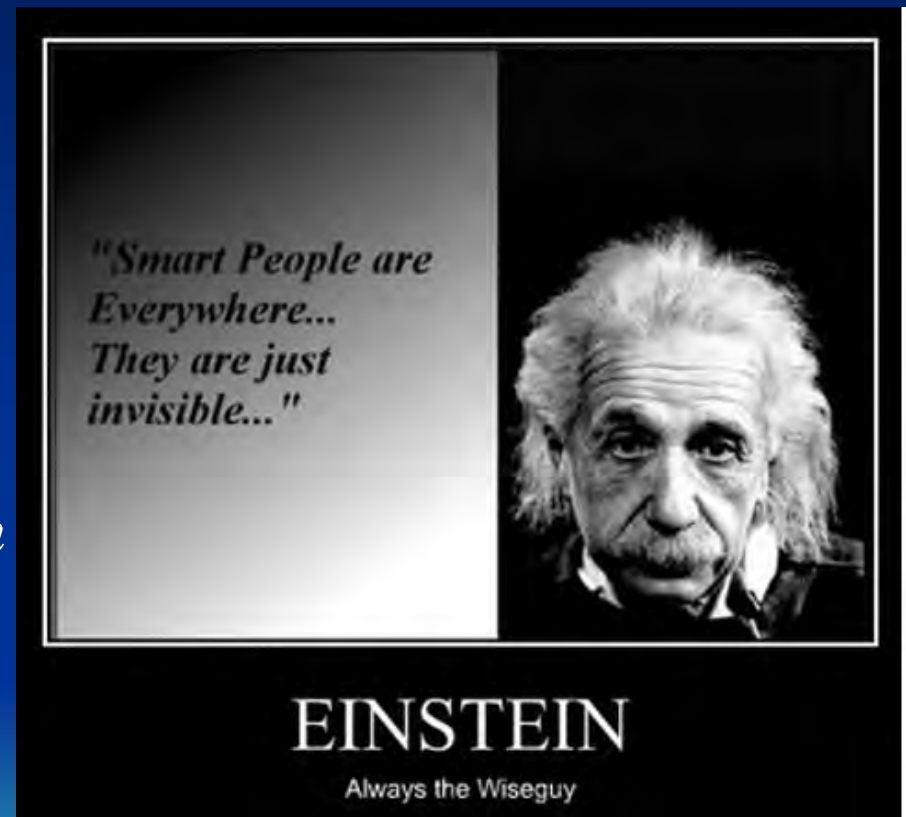
Next Steps For Those w/Utilization Systems

- 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?

