



# **Mona**

***Electric Group, Inc.***

## **Arc Flash**

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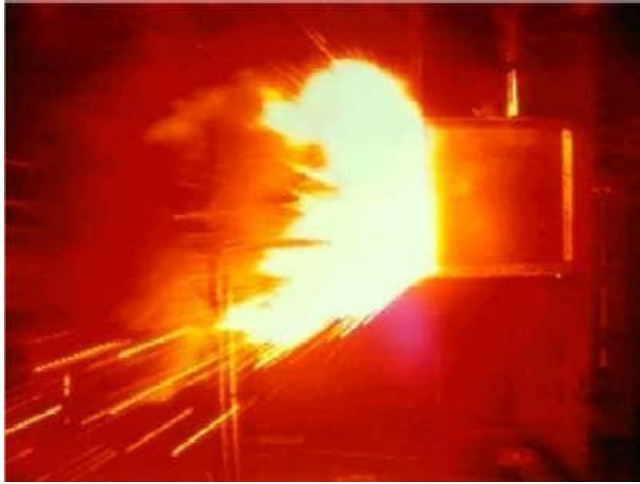
## Discussion Topics

- Definition of an Arc Flash and its Causes and Effects
- Arc Flash Risks and Mitigation
- Arc Flash and Electrical Safety Codes/Standards
- Arc Flash Analysis Basics

## What Is an Arc Flash?

- Electrical short circuit or arc—through the air
- Concentrated energy explodes outward
- High-intensity flash
- Instantaneous arc blast pressure wave
- Superheated ball of gas—melts metal, burns clothes and skin





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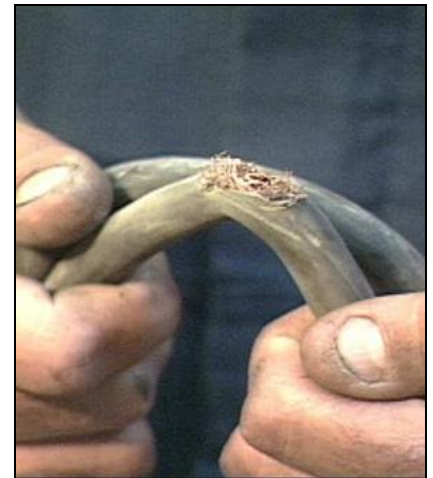
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## **Causes of Arc Flash – ENERGIZED WORK!**

- Dropped tool or conducting material
- Accidental contact with electrical conductors
- Voltage testing with inappropriate instrument
- Improper work procedures
- Incorrect installation
- Insulation failure
- Inattentiveness

## Causes of Arc Flash

- Buildup of dust, impurities, and corrosion on insulating surfaces
- Racking of breakers, replacement of fuses, and closing into faulted lines
- Birds or rodent caused insulation breakdown
- Breakdown of insulation due to age and/or environment



## Effects of an Arc Flash

- 2,000 arc flash incidents annually resulting in person admitted to a burn center
- Kill distances for arc flash up to 10 ft away
- Severe burns to skin and tissue
- Hearing Loss from explosion
- Punctures and lacerations
- Extensive damage to Equipment
- Vision damage from intense UV light



## Some Perspective

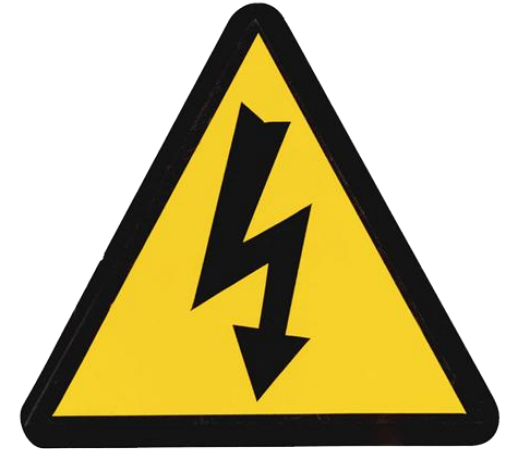
- An arc can reach 35,000 degrees F (third degree burns to skin at 205 degrees for .1 seconds)
- An arc can instantly vaporize a penny sized piece of copper into a cloud the size of a refrigerator
- Shrapnel and molten metal can be expelled 1000 ft/sec. (roughly the speed of a .45 bullet)
- The noise of an arc blast can reach 160 dB... like sitting beside the muzzle of a cannon as it fires



## Arc Flash Exposure Risk

Workers are at higher risk when:

- PPE is lacking or insufficient
- Poor or no specific training
- Poor or broken concentration
- Often exposed to energized parts
- Equipment is not maintained in good condition
- Required to perform multiple tasks during live work



## **Codes/Standards for Energized Work**

- OSHA requires all hazards be mitigated, including when working on energized electrical equipment
- NFPA 70 (National Electric Code) details how to construct electrical systems
- NFPA 70E (Standard for Electrical Safety in the Workplace) details how to construct or maintain electrical systems in a safe manner

## Is an Arc Flash Analysis Code Required?

- No state, city, or municipality has a requirement that an Arc Flash Analysis be performed on a building
- However, OSHA requires that risk be mitigated
  
- OWNER RISK MITIGATION

## Arc Flash Risk Mitigation

- When Energized Work is a Must
  - Preventative Maintenance
  - Troubleshooting
  - Life Safety
- Analyze the Risk
  - NFPA70E Tables
  - Arc Flash Analysis
- Proper PPE



## **NFPA70E Tables**

- Identifies energized work activities, and whether PPE is required
- Specifies PPE levels for particular tasks in specific types of electrical equipment under specific conditions
- Based on assumptions that cannot be field verified
- **THIS SHOULD BE THE SAFETY MINIMUM!**

## **Arc Flash Analysis**

- Provides energy levels at each piece of equipment (cal/cm<sup>2</sup>)
- Survey electrical system
- Results driven by the following:
  - Available fault current - based on utility, resistance in system
  - Upstream overcurrent protection device
  - Distance from the worker to the equipment
  - Voltage and Equipment construction

## Arc Flash Analysis Contents

- Summary Write-Up
- One Line Diagrams
- Input Data
- Short Circuit One Line Diagrams and Results
- Over Current Device Time Current Curves
- Device Trip Settings
- Arc Flash One Line Diagrams and Results
- Labels

# Arc Flash Analysis Label



## WARNING

**Arc Flash and Shock Hazard Present  
Appropriate PPE Required**

**Arc Flash Protection**

**Incident Energy @ 18 in**    **0.4**    cal/cm<sup>2</sup>  
**Arc Flash Hazard Boundary**    **0.77**    ft  
**Available Fault Current**    **29.4**    kA

**Shock Protection**

**Limited Approach Boundary**    **3.5**    ft  
**Restricted Approach Boundary**    **1**    ft  
**Shock Hazard Exposure**    **480**    VAC  
**Glove V-rating**    **500**

**Equipment ID: P-H10**

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Arc Flash Survey Date: **11/2016**

Incident Energy was calculated based on equipment operated and maintained as per MFR instructions. Changes in equipment settings, system configuration, or utility available fault current after the Arc Flash Survey Date will invalidate the calculated values and may result in a hazardous condition. This analysis shall be used as a tool in forming a hazard assessment to determine proper PPE, as required by OSHA and recommended by NFPA 70E.



## **Arc Flash Analysis RFP/Specification**

- Include equipment list if available (IR)
- Include updated electrical single line or Riser diagram
- Arc Flash specification - standard specifications can be obtained from various software analysis software manufacturers (ETAP, SKM, EasyPower), equipment vendors, or Arc Flash engineers

## Arc Flash Analysis Budgeting

- Best to contact Arc Flash Analysis providers for estimates
- Ballpark ROM Budgets per Sq Ft
  - Commercial, Mixed Use - 6-10¢ per SF
  - Healthcare/Light Industrial - 8-12¢ per SF
  - Heavy Industrial/Mission Critical -10-14¢ per SF

## **General Electrical Safety**

- Follow the Guidelines in NFPA 70E
- No Exposed Energized Work Unless Absolutely Necessary
- Be Qualified
- Be Alert
- Use Proper PPE
- Properly Maintain Equipment



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