2013WWOA Conference
Technical Conference Program

Understanding Arc-Flash Hazards, Its Implications on Operations and Solutions that Mitigate Such Exposure

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Arc-Resistant Program

- **Lets Take the mystery out of Arc Flash**
- **Lets Identify Potential Solutions**
- **Lets Develop A Practical Approach**

What is an Arc Flash?

An Arc flash is a short circuit through air that flashes over from one exposed live conductor to another conductor or to ground.

What is an Arc Flash Hazard?

Ionized air (gas) creates an electrically conductive superheated plasma that can reach temperatures of 35,000°F.

This event is an explosion that produces:

- **A brilliant flash**
- **Intense heat**
- **A pressure blast**
- **Electrocution**

A Quick Overview of Regulations

OSHA 29 Code of Federal Regulations (CFR) Part 1910, Subpart S

States, in part: **"Safety related work practices shall be employed to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts… ."**

OSHA Addresses:

- The **qualification of workers** exposed to electrical shock hazards
- The **provision for protective equipment** appropriate for the work to be performed.

OSHA Enforces

- **Safety practices** and cites to the NFPA requirements.
- **NFPA 70-2002, National Electrical Code Section 110.16**
  - **--Requires a label** on equipment if an arc flash can occur
  - **--Label** criteria is loosely specified
  - **--Revisions** of NEC may become more detailed on label criteria.

A Quick Overview of Regulations -- continued

NFPA 70E-2002, Standard for Electrical Safety Requirements for Employee Workplaces

--NFPA 70E is the "how to" standard behind OSHA enforcement.

--Provides detailed actions required to be in compliance.

Specifically:

--Requires **a Safety Program** with defined responsibilities

--Requires **Calculations of the degree of arc flash hazard**

--Specifies **Personal Protective Equipment (PPE)** for workers

--Requires **Training** for Workers

--Requires **Tools** for safe work

--Requires **Warning Labels** on equipment

A Quick Overview of Regulations -- continued

IEEE Standard 1584-2002, Guide for Arc Flash Hazard Analysis

-- Need a **Short-Circuit Study**

-- Need a **Coordination Study**

-- Required to provide accurate information on the arc flash hazard

-- Required to develop accurate information for the warning labels

-- Required to establish the danger zone for arc flash conditions

The area **only qualified workers** should enter

The **arc-flash protection boundary**.

-- Provides a method to **calculate the incident energy exposure**

-- Specifies the **level of PPE required** based on the incident energy exposure

NEMA Guides Provide Some Direction

1. **NEMA SG10 – 2008**

   Guide to OSHA and NFPA 70E Safety Requirements when Servicing and Maintaining Medium-Voltage Switchgear and Circuit Breakers Rated above 1000 Volts

   This guide is in the ballot stage and will probably be issued by the end of this year or spring 2014

2. **NEMA SG11 – 2009**

   Guide for Handling and Maintenance of AC Outdoor High Voltage Circuit Breakers

   This guide has been reaffirmed in 2013

Three possible ways to address arc flash hazard:

1. **Design Arc-Resistant Switchgear**

2. **Wear Suitable Personal Protective Equipment**
   Applicable to the Degree of Exposure Based on the Energy Available

3. **Utilize Arc-Flash Mitigation Schemes**
   To Minimize or Eliminate the Degree of Exposure By:
   a. Operating the Gear Remotely
   b. Rapidly Removing the Fault Current/Voltage Source

Option #1: Design Arc-Resistant Gear

Arc Resistant Gear- Passing Test **(NOT FP)**

Arc-Resistant Switchgear

To be called Arc-Resistant Switchgear equipment must meet the requirements of IEEE Guide C37.20.7

Note: C37.20.7 is presently under revision. More products are being added with an Appendix Provided to cover the testing method requirements for each product

Option #1: Design Arc-Resistant Switchgear

In summary:

Specifies Tests to Verify That Cotton Indicators Placed Adjacent to the Switchgear Do NOT Ignite and NO Debris is Expelled When a Short-Circuit is Initiated Inside the Switchgear.

Arc-Resistant Switchgear

Pro

Eliminates Need to Wear Arc-Flash Clothing

Con

Expensive to Qualify

Expensive to Manufacture

Option #2 - Wear Protective Clothing

Arc-Flash Clothing Required When Working On Switchgear

Categories, Exposure and PPE Described in NFPA 70E		
Category	**Exposure Cal/cm^2**	**Clothing Required**
0	1.2	Untreated Cotton
1	5	Flame Retardant (FR) Shirt and FR Pants
2	8	Cotton Underwear FR Shirt and FR Pants
3	25	Cotton Underwear FR Shirt, FR Pants and FR Coveralls
4	40	Cotton Underwear FR Shirt, FR Pants and Double Layer Switching Coat and Pants

Option #2 - Wear Protective Clothing

All Electrical Equipment Must Be Labeled with Required PPE

--User (**NOT FP**) Must Perform an Arc-Flash Survey

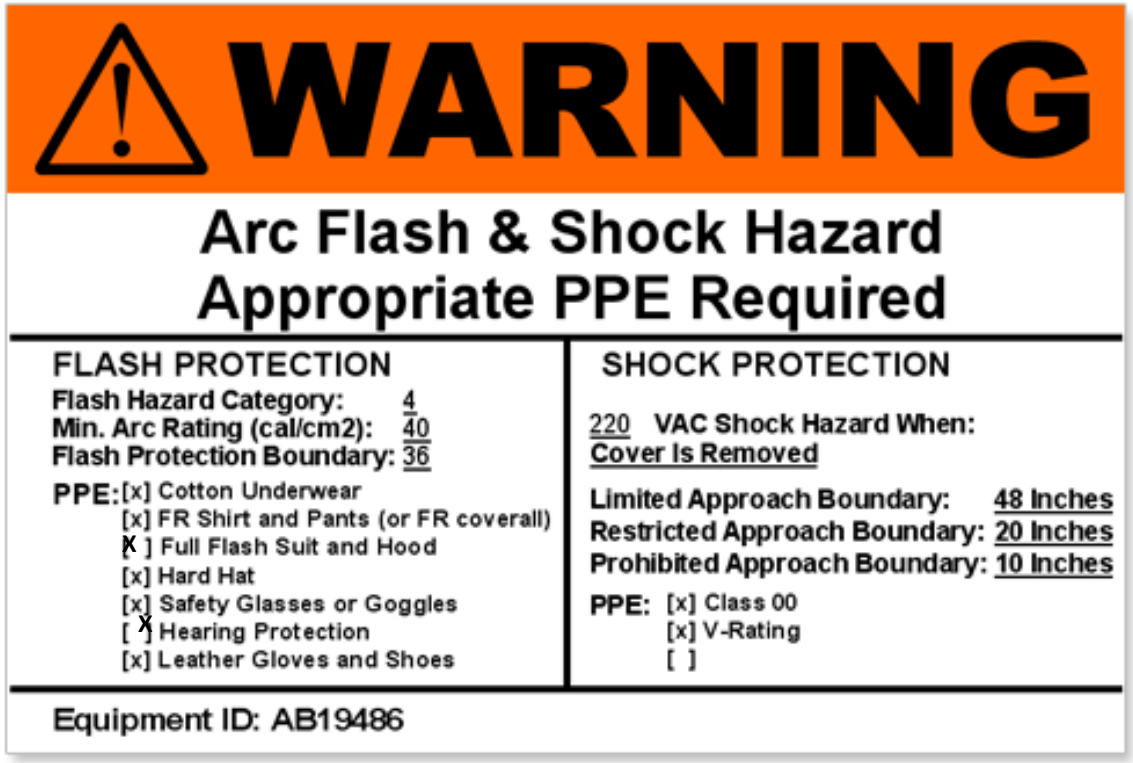
--User (**NOT FP**) Confirms Actual Data Established

By A System Short-Circuit Study

By A System Coordination Study

--User (**NOT FP**) Applies Label

A Typical Arc-Flash Label



Arc-Flash Boundary

Hard Fact:
Not Adequate To Simply Make Worst Case Assumptions and Label Switchgear Accordingly.

Simpler To Require Equipment To Be Operated
De-Energized and
Do Not Operate the Switchgear At Any Level of
Arc-Flash PPE.

Option #2- Wear Protective Gear

Pro

Use With Existing Equipment

Con

Requirements are Confusing: Difficult to Define and Comprehend

It May Not Always Be Possible to Operate Equipment in Compliance

Option #3- Operate our Gear Remotely

Product Line Extensions

- **Simple, Hand-Held Control Unit for Remote Operation of In-Line or Run-and-Trip Motor Operators**
- **Suitable for Arc-Flash Mitigation Applications To Minimize Exposure of Operating Personnel**
- **Available with 50-foot Cable**

Option #3- Operate our Gear Remotely

A Retrofit Arrangement for Metal Enclosed and Padmount

Attach an air operator to the handle or hex drive

Walk outside the arc flash zone

Open a valve on an air cylinder.

Advantages:

- **Simple**
- **Relatively inexpensive**
- **No electrical conductors going to the operator**
- **No control power required**

Option #3- Operate our Gear Remotely

Pro

-- Eliminates PPE by operating outside the zone (Arc Flash Boundary)
-- Relatively inexpensive
-- Easy to comprehend by field personnel
-- Easy to produce
-- Available as a Retrofit Kit for existing gear
-- Available with provisions on new switchgear
-- Portable Equipment Moves from Unit to Unit--

Con

--Attaches Portable Remote Operator on Exterior of unit
--Initial Installation Requires Unit to be De-Energized

Option #4- Incorporate Fast Response Components

Pro

-- Reduces PPE requirement by operating fast and keeping the caloric exposure lower

-- Relatively inexpensive for the result

-- Easy to comprehend by field personnel

-- Available as add-on components for existing gear

-- Available an add-on separate stand alone system to integrate into the power system

Con

--Space may not be available for retrofit into existing equipment

--Available space for addition of a stand alone system may be limited

What is available today?

1. Obtain a line of portable (not intended to be left in place), remote operators suitable for installation on existing manual-operating handles that allow operation of the switchgear from a location outside the arc-flash zone without requiring any PPE .

2. Promote portable, remote controls for use with motor-operated switchgear that allow operation of the switchgear from a location outside the arc-flash zone without requiring any PPE.

What is available today?

3. Integrate Components Capable of Operating Fast Enough to Minimize the Arc Flash Hazard

4. Maintain Awareness of Market Developments, Continue Benefit Analysis and Evaluate Requirements for Design of Suitable Arc-Resistant Switchgear.

Recommendation

1. Have someone in your organization a responsible authority
2. Make sure the responsible authority attends industry meetings necessary to stay abreast of changes in the documents of the governing authorities

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Thank You

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For the Opportunity to Give this Presentation
It is hope that the time has been worthwhile