

KCP Arc Flash Policy

How we have reduced Arc Blast Exposure

11/29/2007

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Outline

- **Overview of Old Policy**
- **Why Change Was Needed**
- **Information From Research**
- **Preparation Work Done**
- **New Policy**
- **Work Aids, Labels**
- **Third Party Evaluation**
- **Why This Worked For Us**

Simplified Two Category Flame Resistant Clothing System

This policy utilizes NFPA 70E Table 130.7(C)(9)(a) Hazard/Risk Category Classification



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Table Used in Simplified Approach

NFPA 70E Table 130.7(C)(9)(a) Hazard Risk Category Classifications
(Partial)

Other 600 V Class (277 V through 600 V, nominal) Equipment — Note 3	Hazard/ Risk Category	V-rated Gloves	V-rated Tools
Lighting or small power transformers (600 V, maximum)	—	—	—
Removal of bolted covers (to expose bare, energized parts)	2*	N	N
Opening hinged covers (to expose bare, energized parts)	1	N	N
Work on energized parts, including voltage testing	2*	Y	Y
Application of safety grounds, after voltage test	2*	Y	N
Revenue meters (kW-hour, at primary voltage and current)	—	—	—
Insertion or removal	2*	Y	N
Cable trough or tray cover removal or installation	1	N	N
Miscellaneous equipment cover removal or installation	1	N	N
Work on energized parts, including voltage testing	2*	Y	Y
Application of safety grounds, after voltage test	2*	Y	N

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Why Change Was Needed



- **Poor Visibility**
- **Impaired Color Recognition**
- **Reduced Agility**
- **Reduced Dexterity**
- **Reduced Hearing**
- **Increased Heat Stress**
- **Increased Risk For Accident**

HRC 2* PPE reduces or eliminates heat and flame injuries from Arc Flash, Does Not protect worker from blast wave and shrapnel.

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Information From Research

- **IEEE Findings on 240VAC**
- **Fuses Can Reduce Hazard Level**
- **Bulk Approach for Large Facilities**
- **Labeling Requirements**

IEEE Findings on 240VAC

Electrical and Electronic Engineers (IEEE). In accordance with IEEE 1584-2002 IEEE **Guide for Performing Arc-Flash Hazard Calculations**, Section XYZ -- “Equipment below 240V need not be considered [arc-flash hazards] unless it involves at least one 125 kVA transformer or larger low-impedance transformer in its immediate power supply.” Therefore, electrical equipment at the KCP operating at below 240V and fed from less than 125 kVA transformer can be considered HRC 0.

Proper Fuses Reduce Hazard Level

Upgrading to A6D Class RK1 fuses can reduce arc flash energies because these fuses have lower let-through energies in their current limiting range and lower current limiting thresholds. The superior current limiting ability of RK1 fuses is illustrated in Figure 1. The RK1 fuses are compared to the RK-5 fuses, the next closest in current limiting ability.

Note that under similar circuit conditions an RK-5 fuse of the same ampere rating can allow the let-through current to reach peak instantaneous values (I_p) twice that of the RK1 fuse as shown in Figure 1.

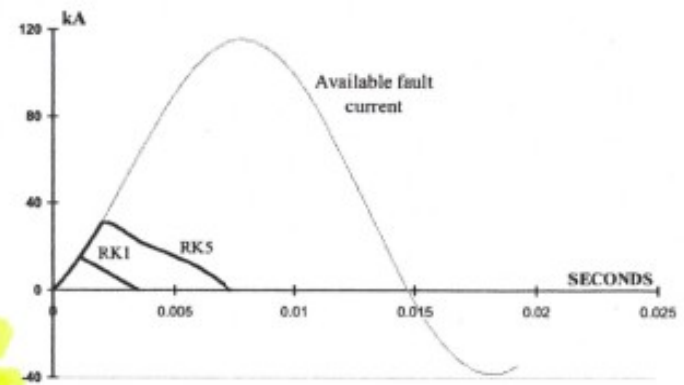


Figure 1: I_p Comparison

Bulk Approach for Large Facilities



An article Limiting Arc-Flash Exposure, published in the IEEE *Industry Applications* magazine, May/June 2006, documents a bulk approach method where circuits protected by class RK1 fuses and the three-phase bolted fault (short circuit) current is greater than 20 kA at the busway results in an incident energy less than 1.2 cal/cm^2 and an arc-flash HRC of **0** using a maximum circuit length.


- for a circuit protected by a 400A RK1 fuse, the maximum circuit length is 750 feet;
- for a circuit protected by a 200A RK1 fuse, the maximum circuit length is 890 feet;
- for a circuit protected by a 100A RK1 fuse, the maximum circuit length is 1,200 feet.



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Labeling Requirements

 WARNING 
<p>Arc Flash and Shock Hazard</p> <p>FR Clothing and PPE Required</p> <p>When Exposed to Internal Voltages</p> <p>Failure to Comply Can Result in</p> <p>Death or Serious Injury</p>

 WARNING	
<p>Arc Flash and Shock Hazard</p> <p>Appropriate PPE Required</p>	
<p>FLASH PROTECTION</p> <p>Flash Hazard at 18 inches</p> <p>Min. Arc Rating: 0.99 cal/cm²</p> <p>Flash Protection Boundary: 16 inch</p> <p>Glove Class: 00</p> <p>Clothing - Hazard Risk: Category 0</p> <p>Untreated Cotton, Long Sleeve Shirt, Long Pants and Safety Glasses</p>	<p>SHOCK PROTECTION</p> <p>Shock Hazard when cover is removed 480 VAC</p> <p>Limited Approach 42 inches</p> <p>Restricted Approach 12 inch</p> <p>Prohibited Approach 1 inch</p>
CE# 16010	

110.16 Flash Protection.
Switchboards, panelboards, industrial control panels, and motor control centers in other than dwelling occupancies, that are likely to require examination, adjustment, servicing, or maintenance while energized, shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

FPN No. 1: NFPA 70E-2000, *Electrical Safety Requirements for Employee Workplaces*, provides assistance in determining severity of potential exposure, planning safe work practices, and selecting personal protective equipment.

FPN No. 2: ANSI Z535.4-1998, *Product Safety Signs and Labels*, provides guidelines for the design of safety signs and labels for application to products.

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Preparation Work Done

- **All Substation breaker trip coordination was reviewed and adjusted to reduce available exposure**
- **Single Line of Plant Updated and Calculated**
- **Replace RK-5 Fuses With RK-1 In Stores and Assure Only RK-1 Fuses Could be Purchased**
- **Create Policy**
- **Create Training Programs**
 - **Qualification Training** **All Electrical Workers**
 - **Mandated Training** **All Craft, Maint. Planners, Fire Dept.**
- **Design Labels**
- **Design and Create Work Aids**
- **Design and Create Information Worksheet (E-form)**



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Labels

 WARNING	
Arc Flash and Shock Hazard Appropriate PPE Required	
FLASH PROTECTION Flash Hazard at 18 inches Min. Arc Rating: 0.99 cal/cm² Flash Protection Boundary: 16 inch Glove Class: 00 Clothing - Hazard Risk: Category 0 Untreated Cotton, Long Sleeve Shirt, Long Pants and Safety Glasses	SHOCK PROTECTION Shock Hazard when cover is removed 480 VAC Limited Approach 42 inches Restricted Approach 12 inch Prohibited Approach 1 inch
CE# 16010	

RK-1 TYPE

FUSE ONLY!!

Date: _____

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Independent 3rd Party Assessment

Washington Group International

Evaluation of Electrical FR Implementation Program

1. **A Balanced Approach to Managing Arc-Flash Exposure Risks at the KCP (600 VAC and Below / excluding substations), (White Paper)**
2. **Arc Flash Decision Flow Chart**
3. **KCP PPE Clothing Wear-Implementation Requirements (Policy)**
4. **Arc Flash Calculation Worksheet**

Why it Works For Us

- **240 VAC and Below Bulk Plan**
 - Verified all transformer sizes
 - Verified proper protection
 - Calculated and labeled all hazards above HRC 0
- **480 VAC Bulk Plan**
 - One line diagrams provide exposure at the bus duct
 - Developed tools and aides to reduce exposure at equipment

Questions

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