Flame Resistant Clothing & Protective Equipment

Contractor Guideline

FirstEnergy®

Forward

In April 2014 OSHA issued a final rule that significantly revised the safety regulations specific to the operation and maintenance of electric power generation, transmission and distribution installations. The regulations are simply known as OSHA Subpart R or Part 269. Similarly, OSHA updated the regulations for the construction of electrical installations which is referred to as OSHA Subpart V.

The revised rule include new requirements for protecting workers from electric arcs and using arc rated clothing and protective equipment. The regulation became law on July 10, 2014, however OSHA adopted delayed compliance deadlines for certain new requirements, including FR PPE which become effective August 31, 2015.

Under the revised rules, OSHA now requires employers (including host employers and contract employers) to:

- Assess the workplace for flame and electric-arc hazards;
- Perform studies to estimate the incident heat energy levels their employees would be exposed. OSHA also identified the acceptable study methods (e.g. IEEE and ArcPro) that are deemed to be in compliance with the regulation; and
- Provide arc-rated FR protective clothing and equipment at no cost to their employees that meets or exceeds the estimated incident heat energy that they may be exposed to while performing work.

As per the regulations, the employer – regardless if it is the host company (FirstEnergy Utilities) or a non-company entity (contractor) – is required to perform an incident heat energy calculation relative to the electrical installation that is to be worked for their specific employee(s). As a means to facilitate the transferring of information, the host company has the responsibility to provide information about the design and operation of the installation; enabling the contractor to perform an incident heat energy calculation and, as a result, provide the appropriate FR protective clothing system to their respective employees.

However, accounting for the fact that some non-company entities do not have the internal resources to perform their own arc flash studies, this Guideline – for reference purposes only – has been prepared to provide non-company entities (contractors) an overview of FirstEnergy Utilities Flame-Resistant (FR) PPE requirements. However, prior to referencing the enclosed information, the contractor is required – ideally during the coordination of work activities that is defined within the Host / Contractor Information Transfer process – to review both the 'Engineering Assumptions' and 'Disclaimer' sections within this respective Guideline.

Transmission FR PPE

As a general rule, 8 cal/cm^2 FR clothing system without FR head or face protection (i.e. arc-rated face shield) is sufficient for working transmission except as noted in the Transmission Exception Tables

Transmission Exception Tables

Parameters:

- Single- Phase
- Open Air
- Working Distance: Varies by voltage class according to MAD and assumed arc gaps
- Working Distance: Calculated based on Minimum Approach Distance (MAD)
- Self-Extraction Time: 5 second
- Reclosing Setting: One-shot (required)

Territory	Voltage	Bus 1	Bus 2	Line / Bus Name	PPE Required	Comments
Central JCP&L	34.5	Oceanview	Whitesvl	E131	11	
Central JCP&L	34.5	Oceanview	Whitesvl	F132	13	
North JCP&L	34.5	Traynor AB	Millburn	T72	14	
CEI	138	Avon	--	All Lines	17	

Exposure	Minimum Head & Face Protection			
	No Face Protection Required	Arc-Rated Face Shield	Arc-Rated Face Shield with Balaclava	Arc-Rated Hood
Single-Phase (Open Air)	< 9 cal/cm^2	9 to 12 cal/cm^2	13 to 20 cal/cm^2	21 to 40 cal/cm^2

Substation FR PPE

As a general rule, 8 cal/cm^2 FR clothing system without FR head or face protection (i.e. arc-rated face shield) is sufficient for working within a substation transmission except as noted in the Substation Exception Tables.

Substation tasks requiring 20 cal/cm^2 FR protection (clothing, face shield and balaclava):

- Racking Breakers (excludes remote racking)
- Switching Exposed Energized Parts (Indoor Substations)

Substation Exceptions

- Certain substations will require 40 cal/cm^2 FR clothing with an arc rated hood for the above tasks
- Refer to the Substation Exception tables

When work is being performed on Station Power, the following FR clothing systems are required:

Primary (tertiary wiring):

- Hot Sticking: Don an 8 cal/cm^2 (Base 8) FR clothing system with no face protection when utilizing a live line tool.
- Gloving: Conduct a site-by-site engineering analysis to define the incident heat energy hazard / FR clothing system.

Secondary:

- Gloving: Refer to the appropriate secondary FR PPE Table to define the required FR clothing system.

Substation Exception Tables: CEI

Parameters:

- Three Phase
- Enclosed
- Working Distance: 42” (minimum)
- Self-Extraction Time: 2 second
- Reclosing Setting: One-shot (required)

Company	Substation	Bank	PPE Required	Comments
CEI	WARNER		40	
CEI	BUCKEYE		40	
CEI	CENTER		40	
CEI	SORRENTO		40	
CEI	FIRWOOD		40	
CEI	LANDER		40	
CEI	MARTHA		40	
CEI	INGALL		40	
CEI	FREMONT		40	
CEI	HALL		40	
CEI	PEARL		40	
CEI	PAYNE		40	
CEI	WILSON		40	
CEI	IONA		40	
CEI	ITHACA		40	
CEI	MAPLECREST		40	
CEI	WADE PARK		40	
CEI	DUNHAM		40	
CEI	GIBSON		40	
CEI	BABBITT		40	
CEI	LAKELAND		40	

Exposure	Minimum Head & Face Protection			
	No Face Protection Required	Arc-Rated Face Shield	Arc-Rated Face Shield with Balaclava	Arc-Rated Hood
Single-Phase (Open Air)	< 9 cal/cm^2	9 to 12 cal/cm^2	13 to 20 cal/cm^2	21 to 40 cal/cm^2

Substation Exception Tables: JCP&L

Parameters:

- Three Phase
- Enclosed
- Working Distance: 42” (minimum)
- Self-Extraction Time: 2 second
- Reclosing Setting: One-shot (required)

Company	Substation	Bank	PPE Required	Comments
NNJ	BRIANTPARK	Bank 1 & 2	40	
NNJ	CANOEBROOK	Bank 1 & 2	40	
NNJ	DICKERSON	Bank 1	40	Including Circuit Breakers 14673, 14672, 14671
NNJ	LINCOLNPARK	Bank 1 & 2	40	
NNJ	MILLBURN	Bank 1 & 2	40	
NNJ	PEQUANNOCK	Bank 1	40	
NNJ	POMPTONLAKES	Bank 1 & 2	40	
NNJ	SUMMIT	Bank 1 & 2	40	
NNJ	VALLEYVIEW	Bank 1 & 2	40	
CNJ	LAKEWOOD	Bank 1 & 2	40	
CNJ	TOMS RIVER	Bank 1 & 2	40	

Exposure	Minimum Head & Face Protection			
	No Face Protection Required	Arc-Rated Face Shield	Arc-Rated Face Shield with Balaclava	Arc-Rated Hood
Single-Phase (Open Air)	< 9 cal/cm^2	9 to 12 cal/cm^2	13 to 20 cal/cm^2	21 to 40 cal/cm^2

Substation Exception Tables: Met-Ed

Parameters:

- Three Phase
- Enclosed
- Working Distance: 42” (minimum)
- Self-Extraction Time: 2 second
- Reclosing Setting: One-shot (required)

Company	Substation	Bank	PPE Required	Comments
Meted	FOXHILL	Bank 1	40	
MetEd	FOXHILL	Bank 2	40	
MetEd	GLENDON	Bank 1	40	
MetEd	GLENDON	Bank 2	40	

Exposure	Minimum Head & Face Protection			
	No Face Protection Required	Arc-Rated Face Shield	Arc-Rated Face Shield with Balaclava	Arc-Rated Hood
Single-Phase (Open Air)	< 9 cal/cm^2	9 to 12 cal/cm^2	13 to 20 cal/cm^2	21 to 40 cal/cm^2

Substation Exception Tables: MonPower

Parameters:

- Three Phase
- Enclosed
- Working Distance: 42” (minimum)
- Self-Extraction Time: 2 second
- Reclosing Setting: One-shot (required)

Company	Substation	Bank	PPE Required	Comments
Mon Power	AVERY STREET		40	
Mon Power	EIGHTH STREET		40	
Mon Power	MORGANTOWN		40	
Mon Power	GARDEN LANE		40	

Exposure	Minimum Head & Face Protection			
	No Face Protection Required	Arc-Rated Face Shield	Arc-Rated Face Shield with Balaclava	Arc-Rated Hood
Single-Phase (Open Air)	< 9 cal/cm^2	9 to 12 cal/cm^2	13 to 20 cal/cm^2	21 to 40 cal/cm^2

Substation Exception Tables: Potomac Edison

Parameters:

- Three Phase
- Enclosed
- Working Distance: 42” (minimum)
- Self-Extraction Time: 2 second
- Reclosing Setting: One-shot (required)

Company	Substation	Bank	PPE Required	Comments
Potomac	Damascus		40	

Exposure	Minimum Head & Face Protection			
	No Face Protection Required	Arc-Rated Face Shield	Arc-Rated Face Shield with Balaclava	Arc-Rated Hood
Single-Phase (Open Air)	< 9 cal/cm^2	9 to 12 cal/cm^2	13 to 20 cal/cm^2	21 to 40 cal/cm^2

Primary Distribution (Main Line) FR PPE

As a general rule, 8 cal/cm^2 FR clothing without head or face protection (i.e. arc-rated face shield) is sufficient for working Primary Distribution (Main Line), except as noted in the Primary Distribution Exception Tables.

Primary Distribution Exception Tables
Main Line: JCP&L

Parameters:

- Single Phase
- Open Air
- Working Distance: 15”
- Self- Extraction Time: 5 second
- Reclosing Setting: One-shot (required)

Company	Substation	Circuit	Voltage	PPE Required	Comments
New Jersey	Seaside Heights	63073	4.16	35	Muni
New Jersey	Lavallette	63079	4.16	12	Muni
New Jersey	Dickerson Sub	14674	4.8	14	
New Jersey	Dickerson Sub	14672	4.8	14	

Exposure	Minimum Head & Face Protection			
	No Face Protection Required	Arc-Rated Face Shield	Arc-Rated Face Shield with Balaclava	Arc-Rated Hood
Single-Phase (Open Air)	< 9 cal/cm^2	9 to 12 cal/cm^2	13 to 20 cal/cm^2	21 to 40 cal/cm^2

Primary Distribution Exception Tables
Main Line: Met-Ed

Parameters:

- Single Phase
- Open Air
- Working Distance: 15”
- Self- Extraction Time: 5 second
- Reclosing Setting: One-shot (required)

Company	Substation	Circuit	Voltage	PPE Required	Comments
Met-Ed	Birdsboro	758	13.2	10	
Met-Ed	Carsonia	766	13.2	9	
Met-Ed	Grantley	404	4.8	11	
Met-Ed	Lincoln Park	750, 751	13.2	10	
Met-Ed	Mt. Rose	660	13.2	15	
Met-Ed	Mt. Rose	562, 563, 564	13.2	16	
Met-Ed	Muhlenberg	505-1	13.2	15	
Met-Ed	Muhlenberg	54-1, 513-1	13.2	11	
Met-Ed	North Hanover	520	13.2	13	
Met-Ed	North Hanover	510, 511	13.2	11	
Met-Ed	Northwood	804, 846	34.5	12	
Met-Ed	Northwood	831	34.5	15	
Met-Ed	Olmsted	672, 673	13.2	9	
Met-Ed	Pleasureville	529, 592, 705, 707, 711	13.2	11	
Met-Ed	Seventh Street	2-1, 3-1, 5-1, 6-1, 16-1, 57-1, 58-1, 70-1	13.2	20	
Met-Ed	Seventh Street	7-1, 17-1, 65-1, 67-1, 69-1, 72-1	13.2	10	
Met-Ed	Seventh Street	60-1	13.2	25	
Met-Ed	Seventh Street	71-1	13.2	12	
Met-Ed	Smith Street	220-4	13.2	25	
Met-Ed	Smith Street	546-4	13.2	15	
Met-Ed	Smith Street	547-4, 554-4	13.2	16	
Met-Ed	Smith Street	540, 541, 542, 548	13.2	11	
Met-Ed	Third and Green	600	13.2	11	

Met-Ed	Third and Green	773	13.2	9	
Met-Ed	Third Street	8-1	13.2	30	
Met-Ed	Violet Hill	524-4, 526-4	13.2	12	
Met-Ed	Violet Hill	500-4, 525-4, 599-4	13.2	14	
Met-Ed	West Reading	63-1, 64-1	13.2	25	
Met-Ed	West Reading	2-1, 3-1,60-1, 502-1, 504-1	13.2	10	
Met-Ed	Whiteford	687-4	13.2	9	

Exposure	Minimum Head & Face Protection			
	No Face Protection Required	Arc-Rated Face Shield	Arc-Rated Face Shield with Balaclava	Arc-Rated Hood
Single-Phase (Open Air)	< 9 cal/cm^2	9 to 12 cal/cm^2	13 to 20 cal/cm^2	21 to 40 cal/cm^2

Primary Distribution Exception Tables
Main Line: Penelec

Parameters:

- Single Phase
- Open Air
- Working Distance: 15”
- Self- Extraction Time: 5 second
- Reclosing Setting: One-shot (required)

Company	Substation	Circuit	Voltage	PPE Required	Comments
Penelec	Quemahoning	Customer Feed	12.47	25	Dedicated feed for 1 customer

Exposure	Minimum Head & Face Protection			
	No Face Protection Required	Arc-Rated Face Shield	Arc-Rated Face Shield with Balaclava	Arc-Rated Hood
Single-Phase (Open Air)	< 9 cal/cm^2	9 to 12 cal/cm^2	13 to 20 cal/cm^2	21 to 40 cal/cm^2

Primary Distribution Exception Tables
Main Line: Toledo Edison

Parameters:

- Single Phase
- Open Air
- Working Distance: 15”
- Self- Extraction Time: 5 second
- Reclosing Setting: One-shot (required)

Company	Substation	Circuit	Voltage	PPE Required	Comments
Toledo	Davis Besse	1516	12.47	10	

Exposure	Minimum Head & Face Protection			
	No Face Protection Required	Arc-Rated Face Shield	Arc-Rated Face Shield with Balaclava	Arc-Rated Hood
Single-Phase (Open Air)	< 9 cal/cm^2	9 to 12 cal/cm^2	13 to 20 cal/cm^2	21 to 40 cal/cm^2

Primary Distribution (Fused Lateral) FR PPE

As a general rule, 8 cal/cm^2 (Base 8) FR clothing with no head or face protection is sufficient for working Primary Fused Laterals, except as noted.

Single-Phase - Open Air - ARCPRO
15" Working Distance, 5-Seconds

Device	Current @ 5-sec (AMPS)	1-15 kV (cal/cm^2) Gap = 2"	15.1 - 25 kV (cal/cm^2) Gap = 3"	34.5 kV (cal/cm^2) Gap = 4"
6T	27	8		8
8T	36			
10T	49			
12T	63.5			
15T	82.3			
20T	104			
25T	135			
40T	217			
50T	276			
65T	356			
80T	438			
100T	564			
140T	888.3			
200T	1449			9
25 L	63	8		
35 L	88			
50 L	126			
70 L	176			
100 L	252			
140 L	353			
280 L	705			

Exposure	Minimum Head & Face Protection			
	No Face Protection Required	**Arc-Rated Face Shield**	**Arc-Rated Face Shield with Balaclava**	**Arc-Rated Hood**
Three-Phase or Enclosed	**< 5 cal/cm^2**	**5 to 8 cal/cm^2**	**9 to 20 cal/cm^2**	**21 to 40 cal/cm^2**

Note: Working Distances for above values equals 15 inches.

Note: Because all underground primary switching is performed with a hot stick – thereby providing sufficient working distances – switching can be performed in a 'Base 8' clothing system with no face protection required.

Note: The referenced incident heat energy values are calculated assuming that the reclosing settings have been placed on 'one-shot' when the recloser serves as the immediate upstream protective device.

Secondary Distribution System FR PPE

As a general rule, 8 cal/cm^2 FR clothing is the minimum. Primary URD – both live front and dead front – may generally be switched using live line tools wearing 8 cal/cm^2 FR PPE. If working within an indoor facility, such as a vault, non-dead front switching requires 20 cal/cm^2 clothing and arc-rated face shield / balaclava. Due to the number of transformer sizes, transformer types, and primary voltages, multiple FR PPE tables are required as noted in the following tables.

Distribution PPE Tables
Primary / Secondary Lateral Feeds

ARC-FLASH EXPOSURE in cal/cm^2 120/240 Volt Single-Phase Over-Head Transformer Source										
1Φ Rating (KVA)	ARCPRO- Enc. Switchgear, 18", 2-sec, 1.25" gap (1.5x)					ARCPRO – Open/Open Air, 15", 5-sec, 2"gap				
	4.2Y/2.4 2.4Δ	7.2Y/4.2 8.3Y/4.8 4.2Δ, 4.3Δ, 4.8Δ	12.47Y/7.2 13.2Y/7.6 7.2Δ, 12.0Δ 12.5Δ	22.9Y/13.2 13.2Δ	34.5Y/19.9	4.2Y/2.4 2.4Δ	7.2Y/4.2 8.3Y/4.8 4.2Δ, 4.3Δ, 4.8Δ,	12.47Y/7.2 13.2Y/7.6 7.2Δ, 12.0Δ 12.5Δ	22.9Y/13.2 13.2Δ	34.5Y/19.9
3	8					8				
5										
7.5										
10										
15										
25										
37.5										
50										
75										
100										
167	8					8				
250										
333										
500	20					20				

Exposure	Minimum Head & Face Protection			
	No Face Protection Required	Arc-Rated Face Shield	Arc-Rated Face Shield with Balaclava	Arc-Rated Hood
Single-Phase (Open Air)	< 9 cal/cm^2	9 to 12 cal/cm^2	13 to 20 cal/cm^2	21 to 40 cal/cm^2
Three-Phase or Enclosed	< 5 cal/cm^2	5 to 8 cal/cm^2	9 to 20 cal/cm^2	21 to 40 cal/cm^2

Distribution PPE Tables
Primary / Secondary Lateral Feeds (Continued)

ARC-FLASH EXPOSURE in cal/cm² 120 / 208Y & 240Δ Volt Over-Head Transformer Source											
1Φ Rating (KVA)	3Φ Rating (KVA)	IEEE - Enclosed Switchgear, 18", 2-sec, 1.25" gap					IEEE – Open/Open Air, 15", 5-sec, 2" gap				
		4.2Y/2.4 2.4Δ	7.2Y/4.2 8.3Y/4.8 4.2Δ, 4.3Δ, 4.8Δ ,7.2Δ[1], 7.6Δ[1]	12.47Y/7.2 13.2Y/7.6 7.2Δ[2], 12.0Δ 12.5Δ, 13.2Δ[1]	22.9Y/13.2 13.2Δ[2]	34.5Y/19.9	4.2Y/2.4 2.4Δ	7.2Y/4.2 8.3Y/4.8 4.2Δ, 4.3Δ, 4.8Δ ,7.2Δ[1], 7.6Δ[1]	12.47Y/7.2 13.2Y/7.6 7.2Δ[2], 12.0Δ 12.5Δ, 13.2Δ[1]	22.9Y/13.2 13.2Δ[2]	34.5Y/19.9
3	9	8					8				
5	15										
7.5	22.5										
10	30										
15	45										
25	75										
37.5	112.5	8					8				
50	150										
75	225										
100	300										
167	500	20					20				
250	750										
333	1000										
500	1500										

(1) Indicates Three-Phase Delta Primary voltage only;
(2) Indicates Single-Phase (Two-conductor) Delta Primary / Single & Three Phase Grounded Wye (kV) only.

Exposure	Minimum Head & Face Protection			
	No Face Protection Required	Arc-Rated Face Shield	Arc-Rated Face Shield with Balaclava	Arc-Rated Hood
Three-Phase or Enclosed	< 5 cal/cm²	5 to 8 cal/cm²	9 to 20 cal/cm²	21 to 40 cal/cm²

Distribution PPE Tables
Primary / Secondary Lateral Feeds (Continued)

ARC-FLASH EXPOSURE in cal/cm² 277/480Y & 480Δ Volt Over-Head Transformer Source												
		IEEE - Enclosed Switchgear, 18", 2-sec, 1.25" gap					IEEE – Open/Open Air, 15", 5-sec, 2" gap				
1Φ Rating (KVA)	3Φ Rating (KVA)	4.2Y/2.4 2.4Δ	7.2Y/4.2 8.3Y/4.8 4.2Δ, 4.3Δ, 4.8Δ ,7.2Δ[1], 7.6Δ[1]	12.47Y/7.2 13.2Y/7.6 7.2Δ[2], 12.0Δ 12.5Δ, 13.2Δ[1]	22.9Y/13.2 13.2Δ[2]	34.5Y/19.9	4.2Y/2.4 2.4Δ	7.2Y/4.2 8.3Y/4.8 4.2Δ, 4.3Δ, 4.8Δ ,7.2Δ[1], 7.6Δ[1]	12.47Y/7.2 13.2Y/7.6 7.2Δ[2], 12.0Δ 12.5Δ, 13.2Δ[1]	22.9Y/13.2 13.2Δ[2]	34.5Y/19.9
3	9	8*	8*	8*	8*	8*	8	8	8	8	8
5	15										
7.5	22.5										
10	30										
15	45										
25	75										
37.5	112.5		8*				8	8			
50	150	8*		8*					8		
75	225				8*		20	20			20
100	300		20						20	8	
167	500	20		20	20	20					
250	750									20	
333	1000			40	40	40	40	40	40	40	40
500	1500	40	40								

*Meter Service work requires a minimum of 20 cal/cm2 for all non-CT-metered equipment;
(1) Indicates Three-Phase Delta Primary voltage only;
(2) Indicates Single-Phase (Two-conductor) Delta Primary / Single & Three Phase Grounded Wye (kV) only.

Exposure	Minimum Head & Face Protection			
	No Face Protection Required	Arc-Rated Face Shield	Arc-Rated Face Shield with Balaclava	Arc-Rated Hood
Three-Phase or Enclosed	< 5 cal/cm²	5 to 8 cal/cm²	9 to 20 cal/cm²	21 to 40 cal/cm²

Distribution PPE Tables
Primary / Secondary Lateral Feeds (Continued)

ARC-FLASH EXPOSURE in cal/cm² 1-Φ PAD-MOUNTED TRANSFORMERS					
ARCPRO – 120/240 Volt, Enclosed, 18", 2-second, 1.25" gap (1.5x)					
KVA	4.2Y/ 2.4kV	8.3Y/4.8kV 7.2Y/4.2kV 4.3 kVΔ 4.8kVΔ	12.5Y/7.2kV 13.2Y/7.6kV 7.2kVΔ	22.9Y/13.2kV 24.9Y/14.4kV 12.0 kVΔ	34.5Y/ 19.9kV
15	8				
25					
37.5					
50					
75					
100					
167	8				

Exposure	Minimum Head & Face Protection			
	No Face Protection Required	Arc-Rated Face Shield	Arc-Rated Face Shield with Balaclava	Arc-Rated Hood
Three-Phase or Enclosed	< 5 cal/cm²	5 to 8 cal/cm²	9 to 20 cal/cm²	21 to 40 cal/cm²

Distribution PPE Tables
Primary / Secondary Lateral Feeds (Continued)

ARC-FLASH EXPOSURE in cal/cm^2 3Φ PAD-MOUNTED TRANSFORMERS					
IEEE Method – 120/208Y & 240Δ Volt, Enclosed, 18", 2-Second					
KVA	4.2Y/ 2.4kV	8.3Y/4.8kV 7.2Y/4.2kV 4.3 kVΔ 4.8kVΔ	12.5Y/7.2kV 13.2Y/7.6kV 7.2kVΔ	22.9Y/13.2kV 24.9Y/14.4kV 12.0 kVΔ	34.5Y/ 19.9kV
45	8				
75					
112.5					
150					
225	8				
300					
500	20				
750					
1000					
1500					
2000					
2500					

Exposure	Minimum Head & Face Protection			
	No Face Protection Required	Arc-Rated Face Shield	Arc-Rated Face Shield with Balaclava	Arc-Rated Hood
Three-Phase or Enclosed	< 5 cal/cm^2	5 to 8 cal/cm^2	9 to 20 cal/cm^2	21 to 40 cal/cm^2

Distribution PPE Tables
Primary / Secondary Lateral Feeds (Continued)

<table>
<tr><th colspan="6">ARC-FLASH EXPOSURE in cal/cm^2
3Φ PAD-MOUNTED TRANSFORMERS</th></tr>
<tr><th colspan="6">IEEE Method – 277/480Y & 480Δ Volt, Enclosed, 18”, 2-Second</th></tr>
<tr><th>KVA</th><th>4.2Y/
2.4kV</th><th>8.3Y/4.8kV
7.2Y/4.2kV
4.3 kVΔ
4.8kVΔ</th><th>12.5Y/7.2kV
13.2Y/7.6kV
7.2kVΔ</th><th>22.9Y/13.2kV
24.9Y/14.4kV
12.0 kVΔ</th><th>34.5Y/
19.9kV</th></tr>
<tr><td>45</td><td rowspan="2">8*</td><td rowspan="2">8*</td><td rowspan="2">8*</td><td rowspan="3">8*</td><td rowspan="2">8*</td></tr>
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<tr><td>150</td></tr>
<tr><td>225</td><td rowspan="4">20</td><td rowspan="5">20</td><td rowspan="2">8*</td></tr>
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<tr><td>500</td><td>20</td><td>20</td><td rowspan="3">20</td></tr>
<tr><td>750</td><td rowspan="5">40</td><td rowspan="4">40</td><td rowspan="4">40</td></tr>
<tr><td>1000</td></tr>
<tr><td>1500</td></tr>
<tr><td>2000</td><td rowspan="2">40</td></tr>
<tr><td>2500</td></tr>
</table>

*Meter Service work requires a minimum of 20 cal/cm2 for all non-CT-metered equipment

Exposure	Minimum Head & Face Protection			
	No Face Protection Required	Arc-Rated Face Shield	Arc-Rated Face Shield with Balaclava	Arc-Rated Hood
Three-Phase or Enclosed	< 5 cal/cm^2	5 to 8 cal/cm^2	9 to 20 cal/cm^2	21 to 40 cal/cm^2

Secondary Distribution Network

Location	216Y / 125 (120 / 208) Volts	480Y / 277 Volts	Discussion
Network Protectors	20 cal/cm^2	40 cal/cm^2	Enhanced PPE is required until the network protector fuse and transformer link are removed, using long insulated tools. Once the links are removed and energized surfaces guarded workers may reduce FR PPE to their base layers. To mitigate risk, the network protector shall be opened prior to removing or installing network protector fuses and links.
Secondary Network Cables	8 cal/cm^2	8 cal/cm^2	Cover-up, care, and worker procedures shall limit the possibility of a fault. Extreme care shall be used while connecting cables in parallel to avoid cross-phasing.
Cable Limiters	8 cal/cm^2	8 cal/cm^2	Cover-up, care, and worker procedures shall limit the possibility of a fault. The cause of a failed cable limiter shall be adequately investigated to avoid re-energizing failed cables.
Secondary Service Cables	8 cal/cm^2	8 cal/cm^2	Cover-up, care, and worker procedures shall limit the possibility of a fault. Extreme care shall be used while connecting service cables in parallel to avoid cross-phasing. If work is associated with a customer outage, work should be coordinated in a manner that allows as much of our work as possible to be performed de-energized.
Secondary service switches and Metering CT Cabinets	20 cal/cm^2	100 cal/cm^2	Arc-flash exposure values are still being assessed, and these recommendations may change as additional industry testing is completed and documented.
Secondary Network Fed Meters–Self Contained	20 cal/cm^2	100 cal/cm^2	Arc-flash exposure values are still being assessed, and these recommendations may change as additional industry testing is completed and documented.
Secondary Network Fed Meters–CT Metered	8 cal/cm^2	8 cal/cm^2	See secondary network fed meters – self-contained above for the FR PPE requirements when working with the CT portions of the metering installation.

NOTES:

- All recommendations are based on the facilities being worked as the only on arc-flash hazard in the vicinity of the work being performed. If there are other electrical facilities in the vicinity the worker, that also pose an arc-flash hazard, the worker may have to increase FR PPE levels to account for that hazard.
- For detail discussion on Network Secondary Systems, see the "Arc Flash Hazard Assessment: Underground Secondary Network Systems (<600 V)" located within the FEU Safety Share Point Site.

Engineering Assumptions

FirstEnergy Utilities (Company) made broad-brush arc-flash assessments of the arc-flash energies that could result on the Company's transmission, substation, primary, and secondary systems. In general, this assessment identified an arc-flash exposure of 8 cal/cm^2 or less for the bulk of the system, with some exceptions. To perform this broad-brush assessment many individual cases were not evaluated where a new Company standard of 8 cal/cm^2 PPE would suffice, for example:

- If a certain size T-link fuse was found to limit the arc-flash exposure to less than 8 cal/cm^2, smaller fuse sizes were not evaluated.
- N-link and K-link fuses operate quicker than similarly sized T-link fuses, so these fuse types were not evaluated.
- Single, slow-trips (D curves) of 280 ampere hydraulic reclosers, at 15 kV were found to limit the arc-flash exposure to less than 2 cal/cm^2, so quicker (lower rated) settings were not evaluated.

Key assumptions for primary line and secondary arc-flash assessments were as follows or as detailed in each chart:

- IEEE 1584 and ARCPRO were used for analysis;
- Insulated cover-up is sufficient to limit the arc-flash exposure to a single-phase exposure
- Single fault/arc flash event (i.e. where devices could reclose, only the first operation was considered)
- System nominal voltage
- The worker distance to the arc
- Maximum time of worker exposure
- Open or Enclosed exposures
- For secondary exposures, the kVA of the source transformers

Key assumptions for transmission and substation arc-flash assessments were as follows:

- ARCPRO was used for analysis
- Phase-to-phase distances are sufficient to limit the arc-flash exposure to a single-phase exposure
- Single fault/ arc flash event (i.e. auto-reclosing is disabled)
- System nominal voltage
- The Minimum Approach Distance for the system voltage
- Maximum time of worker exposure (2 seconds for work on ground, 5 seconds for work aloft)
- Open or Enclosed exposures

Key assumptions for secondary network arc-flash assessments are as detailed in the chart.

From the arc-flash hazard perspective, disabling auto reclose avoids the double-exposure of a worker to an arc hazard; and this is important when the worker is at those close working distances

associated with gloving (please refer to the Appendix section for more information regarding auto-reclose settings). Note: FR clothing is only rated, and tested, per the ASTM Standards for one momentary exposure and the FR fabric can be damaged, in providing arc-flash protection, and still pass per the Standard. The longer worker-to-arc distances that may occur when using live-line tools (hot-sticking) provide additional worker arc-flash protection. Based on these facts, if rubber cover-up is being.

Disclaimer

In accordance with OSHA standards (29 CFR Parts 1910 and 1926 – Electric Power Generation, Transmission, and Distribution; Electrical Protective Equipment – Final Rule), FirstEnergy Utilities ("FEU") has performed an assessment to estimate the incident heat energy to which FEU employees may be potentially exposed from electric arc hazards. The estimates and other information (including but not limited to OSHA guidance) have been used to establish the FEU Fire Retardant Protective Clothing and Equipment Requirements (the "Clothing and Equipment Requirements."). The Clothing and Equipment Requirements were prepared solely and exclusively for the use and safety of FEU employees.

The Clothing and Equipment Requirements are made available to contractor employers and others for information and illustrative purposes only and are subject to change at any time without notice. They do not supersede any general duties or OSHA regulatory requirements for contractor employers and others to perform their own assessments, including the appropriate FR protective clothing and equipment to be worn by their employees to protect against potential or actual hazards.

The Clothing and Equipment Requirements are based on broad estimates, assumptions, and OSHA guidance, and are not specific to individual tasks being performed, or to every exposure scenario that contractor employees and others may be exposed to.

FEU's Clothing and Equipment Requirements are not intended to supplant or serve in lieu of the contractor employer's own responsibilities to create clothing and equipment standards or requirements. Contractor employers and others shall consult the applicable OSHA standards for the specific requirements applicable when developing their own company-specific FR clothing and protective equipment policies and programs. Contractor employers who wish to use the Clothing and Equipment Requirements as a model for their own employees must ensure that they are applicable for the tasks or risks their employees are to perform or be exposed to.

Appendix: Auto-Reclosing for Distribution Primary

As a result of our continued efforts to assess and evaluate the FR Program changes, the FR team has revised the requirement of when auto reclosing must be disabled. These revisions maintain compliance with OSHA regulations and our current PPE requirements. The clarifications for this change are:

- When working downstream of a line fuse, the incident energy to which the employee is exposed is at or below our Base 8 PPE requirement even when considering a second operation of a recloser.
- When performing tasks on conductors and supports that are in good physical condition which limit the worker interaction with secured energized conductors and the worker's ability to control the conductor, the risk of a fault is mitigated.

When Auto Reclosing Must Be Disabled:

1. Installing and removing conductors over or near energized conductors (greater than 600 volts), regardless of location of work being performed.
2. When working between a substation or a line recloser and a line fuse, where energized conductors or conductor supports are being moved or changed. Examples include:
    - Replacing cross arms, brackets, and pins
    - Changing insulators and tying in energized conductors
    - Working on structures where there are obvious structural deficiencies in the energized conductor supports, including cross arms, brackets, insulators, and poles
    - Cutting energized conductors to install insulators, switches, and cut-outs

When Auto Reclosing Does Not Need To Be Disabled*:

1. Performing live-line tool applications
2. When working downstream of any fuse, except when installing and removing conductors over or near energized conductors.
3. When the conductors and supports are in good physical condition, and energized conductors are secured and not being moved or changed. Examples include:
    - Installing rubber cover-up materials
    - Installing stirrups and connecting / disconnecting equipment risers to stirrups
    - Installing and removing transformers, capacitors, and URD risers

    * NOTE: Auto reclosing may be disabled if deemed necessary to mitigate other hazards of the job.

The FR Program Team will continue to research this practice to determine if there are additional opportunities to refine these requirements.