Qual-Tech Engineers, Inc.



201 Johnson Road – Building #1 · Suite 203 Houston, PA 15342-1300

Phone 724-873-9275 – Fax 724-873-8910 www.QualTechEng.com

AN EXAMPLE OF A STANDARD ARC FLASH PPE LABELING STRATEGY

1.0 BACKGROUND INFORMATION:

- 1. The basis for the labeling of equipment for potential electric arc flash hazards is:
 - a. NEC 2014 Article 110.16:

110.16: Arc-Flash Hazard Warning. Electrical equipment, such as switchboards, switchgear, panelboards, industrial control panels, meter socket enclosures, and motor control centers, that are in other than dwelling units, and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field or factory marked to warn qualified persons of potential electric arc flash hazards. The marking shall meet the requirements in 110.21(B) and 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-2012, *Standard for Electrical Safety in the Workplace,* provides guidance, such as determining severity of potential exposure, planning safe work practices, arc flash labeling, and selecting personal protective equipment. [Note: NFPA 70E-2012 is now in effect.]

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.

b. NFPA 70E-2015 Article 130.5(D):

(D) Equipment Labeling. Electrical equipment such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are in other than dwelling units and that are likely to require examination, adjustment, servicing, or maintenance while energized, shall be field-marked with a label containing all the following information:

- (1) Nominal system voltage
- (2) Arc flash boundary
- (3) At least one of the following:
 - a. Available incident energy and the corresponding working distance, or the arc flash PPE category ...
 - b. Minimum arc rating of clothing
 - c. Site-specific level of PPE

Exception: Labels applied prior to September 30, 2011, are acceptable if they contain the available incident energy or required level of PPE.

The method of calculating and the data to support the information for the label shall be documented. Where the review of the arc flash hazard risk assessment identifies a change that renders the label inaccurate, the label shall be updated.

The owner of the electrical equipment shall be responsible for the documentation, installation, and maintenance of the field-marked label.

- 2. Commonly, the labels are applied with both arc flash and shock hazard information.
- 3. The objective is to define labels which are generally applicable to XYZ Company systems, but that do not give the specific arc flash calculations for each particular location.
- 4. The labels are in accordance with NFPA 70E guidelines. In some cases the labeling is more conservative than what is recommended in NFPA 70E.
- 5. It is planned that virtually all equipment at 480V and above would be labeled, except for terminal boxes associated with motors, based on NEC 2011 Article 110.16.
- 6. For Equipment at < 240V and fed from one transformer of < 125 kVA, there is virtually no arc flash hazard and that equipment would not be labeled, unless the plant prefers to label it.
- 7. Although there are no standards on working distances, in this document the labels are based on the following typical working distances:

208V to 750V	18" Working Distance
1 kV to 8 kV	24" Working Distance
8 kV to 15 kV	36" Working Distance

2.0 **DEFINITIONS**

Approach Boundaries for Shock & Flash Protection

The shock protection boundaries are applicable to the situation in which approaching personnel are exposed to live parts. The boundary definitions, as given in NFPA-70E 2015 Article 100, are given below. More detailed information with regard to the application of these boundaries is given in NFPA 70E-2015 Articles 130.4 and 130.5.

- *Limited Approach Boundary* An approach limit at a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists. (It is the closest distance an unqualified person can approach, unless accompanied by a qualified person.)
- **Restricted Approach Boundary** An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased likelihood of electric shock, due to electrical arc over combined with inadvertent movement, for personnel working in close proximity to the energized electrical conductor or circuit part. (It is the closest distance to exposed energized electrical conductor or circuit part a qualified person can approach without proper PPE and tools.)
- Arc Flash Boundary When an arc flash hazard exists, an approach limit at a distance from a prospective arc source within which a person could receive a second degree burn if an electrical arc flash were to occur.

A summary of the boundaries for unqualified and qualified persons is given as follows. The arc flash boundary assumes that both unqualified and qualified persons are dressed in at least a PPE level of 0.

When there are exposed live parts, Unqualified Persons:

- Must stay beyond the limited approach boundary (unless special circumstances exist, as are defined in NFPA 70E 2015 Article 130.4) and the arc flash boundary.
- Must not cross the restricted approach boundary under any circumstances.

When there are exposed live parts, Qualified Persons:

- Must stay beyond the restricted approach boundary and the arc flash boundary unless equipped with the proper PPE and tools.

3.0 CLOTHING STRATEGY

The labeling is based on plant personnel having the appropriate clothing available. The key issues are noted as follows:

- 1. **OPERATORS** In some locations it may be common practice for an equipment operator to perform a task where there is a potential incident energy of ≤ 1.2 cal/cm². (This is referred to as PPE Level 0.). To perform this task with the appropriate PPE level of 0, there are several options:
 - a. **Option 1** The operator is normally dressed in safety glasses, heavy-duty leather shoes, short-sleeve cotton shirt, and pants (such as denim cotton blue jeans). To reach a PPE level of 0, he/she would put on an appropriate cotton jacket, hearing protection (ear canal inserts), and leather gloves. (All underwear is to be cotton with no synthetic materials.) Hard hat and face shield would be used as determined by the Risk Assessment.
 - b. Option 2 The operator is normally dressed in a PPE level of 0 which includes safety glasses, heavy-duty leather shoes, long-sleeve cotton shirt, pants (such as denim cotton blue jeans), and hearing protection (ear canal inserts). To reach a PPE Level of 0, he/she would put on leather gloves. (All underwear is to be cotton with no synthetic materials.) Hard hat and face shield would be used as determined by the Risk Assessment.
- ELECTRICIANS Electricians need to be prepared to perform tasks with PPE Levels of 0 (≤ 1.2 cal/cm²), 2 (≤ 8 cal/cm²), and 4 (≤ 40 cal/cm²). Clothing strategies could include the following:
 - a. **Option 1** The electrician is normally dressed in safety glasses, short-sleeve cotton shirt, pants (such as denim cotton blue jeans), and leather shoes. (All underwear is to be cotton with no synthetic materials.)
 - i. To perform tasks which are a PPE Level 0, he/she would put on
 - an appropriate cotton jacket,
 - hearing protection (ear canal inserts), and
 - heavy-duty leather gloves as needed.

Hard hat and face shield would be used as determined by the Risk Assessment. He/She would use insulated gloves and tools as required.

- ii. To perform tasks which are a PPE Level 2, he/she would put on
 - properly fitted arc-rated coveralls (> 8 cal/cm²),
 - hearing protection (ear canal inserts),
 - arc-rated balaclava,
 - hard hat with arc-rated face shield, and
 - insulating gloves with leather protectors.

He/she would use insulated tools as required.

- iii. To perform tasks which are a PPE Level 4, he/she would put on
 - hearing protection (ear canal inserts),
 - hard hat,
 - flash suit jacket, pants, and hood (\geq 40 cal/cm²), and
 - arc-rated gloves.

He/She would use insulated tools as required.

- b. **Option 2** The electrician is normally dressed in safety glasses, long-sleeve cotton shirt, pants (such as denim cotton blue jeans), and leather shoes. (All underwear is to be cotton with no synthetic materials.)
 - i. To perform tasks which are a PPE Level 0, he/she would put on
 - hearing protection (ear canal inserts), and
 - heavy-duty leather gloves as needed.

Hard hat and face shield would be used as determined by the Risk Assessment. He/she would use insulating gloves and tools as required.

- ii. To perform tasks which are a PPE Level 2, he/she would put on
 - properly fitted arc-rated coveralls (\geq 8 cal/cm²),
 - hearing protection (ear canal inserts),
 - arc-rated balaclava,
 - hard hat with arc-rated face shield, and
 - insulating gloves with leather protectors.

He/She would use insulated tools as required.

- iii. To perform tasks which are a PPE Level 4, he/she would put on
 - hearing protection (ear canal inserts),
 - hard hat,
 - flash suit jacket, pants, and hood (\geq 40 cal/cm²), and
 - arc-rated gloves.

He/She would use insulated tools as required.

- c. Option 3 The electrician is normally dressed in safety glasses, arc-rated shirt and pants (> 8 cal/cm²), and leather shoes. (All underwear is to be cotton with no synthetic materials.)
 - i. To perform tasks which are a PPE level of 0, he/she would put on
 - hearing protection (ear canal inserts), and
 - heavy-duty leather gloves as needed.

Hard hat and face shield would be used as determined by the Risk Assessment. He/She would use insulated gloves and tools as required.

- ii. To perform tasks which are a PPE level of 2, he/she would put on
 - hearing protection (ear canal inserts),
 - arc-rated balaclava,
 - hard hat with arc-rated face shield, and
 - insulating gloves with leather protectors.

He/She would use insulated tools as required.

- iii. To perform tasks which are a PPE level of 4, he/she would put on
 - hearing protection (ear canal inserts),
 - hard hat,
 - flash suit jacket, pants, and hood (> 40 cal/cm²), and
 - arc-rated gloves.

He/She would use insulated tools as required.

d. Clarifying Notes:

- i. Where reference is made above to use leather gloves for arc flash protection, it is acceptable to use insulating rubber gloves with leather protection.
- ii. The leather protectors are not to be used alone as leather work gloves.

4.0 CAUTIONS

Two key items are noted here:

- 1. **Equipment Maintenance** The PPE labels are based on the proper operation of the upline protective equipment. The protective equipment must be maintained and working properly for the PPE recommendation on the label to be appropriate for that location.
 - a. Consequently, the proper maintenance of all equipment is a basic requirement for a good safety program.
 - b. There is a note at the bottom of each label that emphasizes this point.
- Switching As described in NFPA 70E-2015 Table 130.7(C)(15)(A)(a), the normal operation of a circuit breaker, switch, contactor, or starter does not require arc flash PPE if all of the following are true:
 - a. The equipment is properly installed.
 - b. The equipment is properly maintained.
 - c. All equipment doors are closed and secured.
 - d. All equipment covers are in place and secured.
 - e. There is no evidence of impending failure.

If any one or more of these items is not true, arc flash PPE is required. This guidance is part of the *Arc Flash PPE Categories Method* as given in NFPA 70E-2015. It may be helpful in providing some insight when the *Incident Energy Analysis Method* is used. (See NFPA 70E-2015 130.2(A)(4).) Depending upon the risk assessment for a given equipment, it may be desirable to include a comment on switching on the label. (It is not included on these examples.)

It is XYZ's policy that the PPE Level determined for a given location is to be used for the switching of that device unless a Risk Assessment has determined that it is not required.

5.0 LABELS

A summary of the labels is given in Table 1. An illustration of the labels is given in the following sections.

Table 1
Summary of Proposed Standard XYZ Company PPE Labels
Based on NFPA 70E-2015

						Equipment	
						Arc	
	Nominal	Working		Label		Resistant	
Label	System	Distance	PPE	Size	Metal	Metal	Open
Name	Volts	(Inches)	Category	(Inches)	Enclosed	Enclosed	Air
Main Switchgear	& Next Down-St	ream Device	<u>s</u>				
XYZ-480-2	480	18	2	4 x 6	Х		
XYZ-480-4	480	18	4	4 x 6	Х		
XYZ-480>4	480	18	> 4	4 x 6	Х		
XY7-2400-2	2,400	24	2	4 x 6	х		
XYZ-2400-4	2,400	24	4	4 x 6	X		
XX7-13800-2	13 800	36	2	4 x 6	x		
XVZ-13800-4	13,800	36	1	4 × 6	X		
X12-13000-4	13,000	50	4	4 X 0	~		
XYZ-13800AR-2	13,800	36	2	4 x 6		Х	
XYZ-13800AR-4	13,800	36	4	4 x 6		Х	
XYZ-13800A-2	13,800	36	2	4 x 6			Х
XYZ-13800A-4	13,800	36	4	4 x 6			Х
DDE				4 × 6			
				4 X O			
BOUNDARIES				0 X 4			
Remote Switchin	g						
XYZ-0-R	Any Voltage		0	4 x 3			
XYZ-2-R	Any Voltage		2	4 x 3			
XYZ-4-R	Any Voltage		4	4 x 3			
Down-Stream De	vices at Low Vol	tage					
XYZ-480-0-II	480	18	0	4 x 3	Х		
XYZ-480-2-II	480	18	2	4 x 3	Х		
XYZ-480-4-II	480	18	4	4 x 3	Х		
XYZ-480>4-II	480	18	> 4	4 x 3	X		
XX7-240-II	240			4 x 3	< 240\/ - Tr	ansformer - 1	25 kV/A - Shock Protection Only
XY7-208-II	208			4 X 3	$\leq 240 V$ Tr	ansformer $\sim 1^{\circ}$	25 kV/A - Shock Protection Only
XY7-120-11	120			4 X 3	$\leq 240V = 11$	ansionner < 1	25 kV/A - Shock Protection Only
A12-120-11	120			47.5	<u>> 240 v - 11</u>		

5.1 Main Switchgear & Next Down-Line Devices

Label XYZ-480-2

This label is intended to be used on 480 volt metal-enclosed equipment where the working distance is \geq 18 inches with a PPE level = 2.

Possible uses of this label are expected to be: Motor Control Centers (MCCs) Power Distribution Panels (PDPs) Fused switches in main switchgear Circuit breakers in main switchgear Bolted covers and doors on dry type transformers

If an entire MCC or PDP is considered a PPE = 2 location, a single label could be applied to the MCC or PDP, preferable at the incoming main to the MCC or PDP. If it is a large MCC or PDP, it may be preferable to use more than one label at appropriate locations.

AWA	RNING
2 ARC FLASH AL APPROPRIAT Based on NFPA 70E-2015	ND SHOCK HAZARD TE PPE REQUIRED & XYZ Company Safety Directives
ARC FLASH PPE LEVEL 2: Working Distance ≥ 18" Minimum Arc Rating of PPE = 8 cal/cm Arc Flash Boundary = 6 ft	D ²
SHOCK PROTECTION – 480 Insulating Glove Class Limited Approach Boundary Restricted Approach Boundary	0 3 ft 6 in 1 ft
CAUTION: Ensure that all of the appr The PPE Level designation installation and maintena	opriate safety procedures are followed. n on this equipment is based on the proper nce of the up-line protective device

XYZ-480-2

This label is intended to be used on 480 volt metal-enclosed equipment where the working distance is \geq 18 inches with a PPE level = 4.

Possible uses of this label are expected to be: Motor Control Centers (MCCs) Power Distribution Panels (PDPs) Fused switches in main switchgear Circuit breakers in main switchgear Bolted covers and doors on dry type transformers

If an entire MCC or PDP is considered a PPE = 4 location, a single label could be applied to the MCC or PDP, preferable at the incoming main to the MCC or PDP. If it is a large MCC or PDP, it may be preferable to use more than one label at appropriate locations.

A WA	RNING
4 ARC FLASH AN	AD SHOCK HAZARD
APPROPRIAT	E PPE REQUIRED
Based on NFPA 70E-2015 8	& XYZ Company Safety Directives
ARC FLASH PPE LEVEL 4: Working Distance ≥ 18" Minimum Arc Rating of PPE = 40 cal/cn Arc Flash Boundary = 17 ft Note: PPE = 2 at a working distance of	n² 5 ft.
SHOCK PROTECTION – 480	VAC
Insulating Glove Class	0
Limited Approach Boundary	3 ft 6 in
Restricted Approach Boundary	1 ft
CAUTION: Ensure that all of the appro	priate safety procedures are followed.
The PPE Level designation	on this equipment is based on the proper
installation and maintenan	ce of the up-line protective device.

XYZ-480-4

Label XYZ-480>4

This label is intended to be used on 480 volt metal-enclosed equipment where the working distance is \geq 18 inches with a PPE level > 4.

Possible uses of this label are expected to be: Motor Control Centers (MCCs) Power Distribution Panels (PDPs) Fused switches in main switchgear Circuit breakers in main switchgear Bolted covers and doors on dry type transformers

If an entire MCC or PDP is considered a PPE > 4 location, a single label could be applied to the MCC or PDP, preferable at the incoming main to the MCC or PDP. If it is a large MCC or PDP, it may be preferable to use more than one label at appropriate locations.



ARC FLASH PPE LEVEL > 4:

The potential arc flash incident energy is greater than 40 cal/cm² for a working distance of 18".

Operation or insertion/removal (racking) of switching device is not to be done unless the equipment is deenergized and confirmed to be deenergized.

No work is to be done on energized electrical conductors.

SHOCK PROTECTION – 480 VAC

Energized parts are not to be exposed.

XYZ-480>4

Label XYZ-2400-2

This label is intended to be used on 2400 volt metal-enclosed equipment where the working distance is \geq 24 inches with a PPE level = 2.

Possible uses of this label at medium voltage are expected to be:

Starters Motor Control Centers (MCCs) Fused switches in main switchgear Circuit breakers in main switchgear Bolted covers and doors on transformers

If an entire MCC is considered a PPE = 2 location, a single label could be applied to the MCC, preferable at the incoming MCC main. If it is a large MCC, it may be preferable to use more than one label at appropriate locations.

A WA	RNING
2 ARC FLASH AN	D SHOCK HAZARD
APPROPRIATE	E PPE REQUIRED
Based on NFPA 70E-2015 &	XYZ Company Safety Directives
ARC FLASH PPE LEVEL 2: Working Distance ≥ 24" Minimum Arc Rating of PPE = 8 cal/cm ² Arc Flash Boundary = 14 ft	
SHOCK PROTECTION – 2400	VAC
Insulating Glove Class	1
Limited Approach Boundary	5 ft
Restricted Approach Boundary	2 ft 2 in
CAUTION: Ensure that all of the approp	priate safety procedures are followed.
The PPE Level designation of	On this equipment is based on the proper
installation and maintenance	e of the up-line protective device.

XYZ-2400-2

Label XYZ-2400-4

This label is intended to be used on 2400 volt metal-enclosed equipment where the working distance is \geq 24 inches with a PPE level = 4.

Possible uses of this label at medium voltage are expected to be:

Starters Motor Control Centers (MCCs) Fused switches in main switchgear Circuit breakers in main switchgear Bolted covers and doors on transformers

If an entire MCC is considered a PPE = 4 location, a single label could be applied to the MCC, preferable at the incoming MCC main. If it is a large MCC, it may be preferable to use more than one label at appropriate locations.

AWA	RNING
4 ARC FLASH AN APPROPRIAT Based on NFPA 70E-2015	ND SHOCK HAZARD TE PPE REQUIRED & XYZ Company Safety Directives
ARC FLASH PPE LEVEL 4: Working Distance ≥ 24" Minimum Arc Rating of PPE = 40 cal/cr Arc Flash Boundary = 74 ft Note: PPE = 2 at a working distance of	m² f 11 ft.
SHOCK PROTECTION – 240 Insulating Glove Class	0 VAC
Limited Approach Boundary Restricted Approach Boundary	5 ft 2 ft 2 in
CAUTION: Ensure that all of the approx	opriate safety procedures are followed.

installation and maintenance of the up-line protective device.

XYZ-2400-4

Label XYZ-13800-2

This label is intended to be used on 13,800 volt metal-enclosed equipment where the working distance is \geq 36 inches with a PPE level = 2.

Possible uses of this label at medium voltage are expected to be:

Starters Motor Control Centers (MCCs) Fused switches in main switchgear Circuit breakers in main switchgear Bolted covers and doors on transformers



N: Ensure that all of the appropriate safety procedures are followed. The PPE Level designation on this equipment is based on the proper installation and maintenance of the up-line protective device.

XYZ-13800-2

Label XYZ-13800-4

This label is intended to be used on 13,800 volt metal-enclosed equipment where the working distance is \geq 36 inches with a PPE level = 4.

Possible uses of this label at medium voltage are expected to be:

Starters

Motor Control Centers (MCCs) Fused switches in main switchgear Circuit breakers in main switchgear Bolted covers and doors on transformers



installation and maintenance of the up-line protective device.

XYZ-13800-4

This label is intended to be used on 13,800 volt arc-resistant, metal-enclosed equipment where the working distance is \geq 36 inches with a PPE level = 2.

<u> </u>	WA	RNING
2	ARC FLASH AN APPROPRIAT sed on NFPA 70E-2015 &	E PPE REQUIRED XYZ Company Safety Directives
ARC FLA Arc-Resista Working Dis Minimum A Arc Flash B	SH PPE LEVEL 2: nt Equipment stance \geq 36" rc Rating of PPE = 8 cal/cm ² oundary = 21 ft	2
SHOCK P Insulating G Limited App Restricted A	ROTECTION – 13,8 Nove Class Nove Boundary Neproach Boundary	2 5 ft 2 ft 2 in
CAUTION:	Ensure that all of the appro The PPE Level designation installation and maintenand	priate safety procedures are followed. on this equipment is based on the proper ce of the up-line protective device. XYZ-13800AR-2

This label is intended to be used on 13,800 volt arc-resistant, metal-enclosed equipment where the working distance is \geq 36 inches with a PPE level = 4.

A WA	RNING
ARC FLASH AN	ND SHOCK HAZARD
APPROPRIAT	TE PPE REQUIRED
Based on NFPA 70E-2015	& XYZ Company Safety Directives
ARC FLASH PPE LEVEL 4:	
Arc-Resistant Equipment Working Distance ≥ 36" Minimum Arc Rating of PPE = 40 cal/cr Arc Flash Boundary = 110 ft	n ²
Note: PPE = 2 at a working distance of	16 ft.
SHOCK PROTECTION - 13,8	BOO VAC
Limited Approach Boundary	2 5 ft
Restricted Approach Boundary	2 ft 2 in
CAUTION: Ensure that all of the appro The PPE Level designation	opriate safety procedures are followed. on this equipment is based on the proper

installation and maintenance of the up-line protective device. XYZ-13800AR-4

This label is intended to be used on 13,800 volt open-air equipment where the working distance is \geq 36 inches with a PPE level = 2.

A WA	RNING
2 ARC FLASH AN APPROPRIAT Based on NFPA 70E-2015	ND SHOCK HAZARD TE PPE REQUIRED & XYZ Company Safety Directives
ARC FLASH PPE LEVEL 2: Open-Air Equipment Working Distance ≥ 36" Minimum Arc Rating of PPE = 8 cal/cm Arc Flash Boundary = 8 ft	2
SHOCK PROTECTION – 13,8 Insulating Glove Class Limited Approach Boundary Restricted Approach Boundary	300 VAC 2 5 ft 2 ft 2 in
CAUTION: Ensure that all of the appro The PPE Level designation installation and maintenan	opriate safety procedures are followed. I on this equipment is based on the proper ce of the up-line protective device. XYZ-13800A-2

This label is intended to be used on 13,800 volt open-air equipment where the working distance is \geq 36 inches with a PPE level = 4.

A WA	RNING
4 ARC FLASH AN	ND SHOCK HAZARD
APPROPRIAT	TE PPE REQUIRED
Based on NFPA 70E-2015	& XYZ Company Safety Directives
ARC FLASH PPE LEVEL 4: Open Air Equipment Working Distance ≥ 36" Minimum Arc Rating of PPE = 40 cal/cm Arc Flash Boundary = 18 ft Note: PPE = 2 at a working distance of	n² 7 ft.
SHOCK PROTECTION – 13,8	300 VAC
Insulating Glove Class	2
Limited Approach Boundary	5 ft
Restricted Approach Boundary	2 ft 2 in
CAUTION: Ensure that all of the appro	opriate safety procedures are followed.
The PPE Level designation	on this equipment is based on the proper
installation and maintenant	ce of the up-line protective device. XYZ-13800A-4

An Example of a Standard Arc Flash PPE Labeling Strategy

Label PPE

This label is for PPE as defined in NFPA 70E-2015. It is possible to accomplish the PPE levels with variations in clothing from those given below. - This label is intended to be posted in key locations, such as substations, for general information.

PROTECTIVE CLOTHING AND PERSONAL PROTECTIVE EQUIPMENT PPE

Based on NFPA 70E-2015 & XYZ Company Safety Directives

ARC FLASH PPE LEVEL 0 (For Tasks < 1.2 cal/cm²)

Nonmelting fiber underlayers (e.g. cotton) Hearing protection (ear canal inserts) Nonmelting fiber long sleeve shirt & pants (e.g. cotton) Leather gloves Safety glasses or safety goggles Insulating gloves and tools as needed Hard hat and arc-rated face shield if exposed to system voltage

ARC FLASH PPE LEVEL 2 (For Tasks < 8 cal/cm²)

Nonmelting fiber underlayers (e.g. cotton) Arc-rated long sleeve shirt & pants or coverall (> 8 cal/cm²) Safety glasses or safety goggles Hard hat, arc-rated face shield, and arc-rated balaclava

Hearing protection (ear canal inserts) Insulating gloves with leather protectors Heavy-duty leather shoes Insulated tool

ARC FLASH PPE LEVEL 4 (For Tasks < 40 cal/cm²)

Nonmelting fiber underlayers (e.g. cotton) Arc-rated long sleeve shirt & pants or coverall Arc-rated arc flash suit and hood (system > 40 calcm²) Safety glasses or safety goggles Hard hat

Hearing protection (ear canal inserts) Arc-rated gloves Heavy-duty leather shoes Insulated tools

XYZ-P

Label BOUNDARIES

This label is to provide a definition of the various boundaries. - This label is intended to be posted in key locations, such as substations, for general information.

APPROACH BOUNDARIES FOR SHOCK & FLASH PROTECTION As Defined in NFPA 70E-2015

DEFINITIONS OF APPROACH BOUNDARIES:

LIMITED APPROACH BOUNDARY – An approach limit at a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists. (It is the closest distance an unqualified person can approach, unless accompanied by a qualified person.)

RESTRICTED APPROACH BOUNDARY – An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased likelihood of electric shock, due to electrical arc-over combined with inadvertent movement, for personnel working in close proximity to the energized electrical conductor or circuit part. (It is the closest distance to exposed energized electrical conductor or circuit part a qualified person can approach without proper PPE and tools.)

ARC FLASH BOUNDARY - When an arc flash hazard exists, an approach limit at a distance from a prospective arc source within which a person could receive a second degree burn if an electrical arc flash were to occur.

BOUNDARY REQUIREMENTS WHEN THERE IS AN EXPOSED ENERGIZED ELECTRICAL CONDUCTOR OR CIRCUIT PART:

UNQUALIFIED PERSONS must stay beyond the *limited approach boundary* and/or the *arc flash boundary*, as dictated by the tasks being performed.

QUALIFIED PERSONS must stay beyond the *restricted approach boundary* and/or the *arc flash boundary*, unless equipped with the proper PPE and tools, as dictated by the tasks being performed.

XYZ-B

5.2 Remote Switching

These labels are for remote switching locations at any voltage.



ARC FLASH AND SHOCK HAZARD APPROPRIATE PPE REQUIRED

Based on NFPA 70E & XYZ Company Safety Directives

ARC FLASH PPE LEVEL 0:

Minimum PPE Rating = 1.2 cal/cm² Remote Operation of Switching Device

CAUTION:

During Remote Breaker Switching, EVACUATE THE SUBSTATION.

The person switching should have an observer standing by the adjacent door.

CAUTION:

Ensure that all of the appropriate safety procedures are followed. The PPE Level designation on this equipment is based on the proper installation and maintenance of the up-line protective device.

XYZ-0-R



ARC FLASH AND SHOCK HAZARD APPROPRIATE PPE REQUIRED

Based on NFPA 70E & XYZ Company Safety Directives

ARC FLASH PPE LEVEL 2:

Minimum PPE Rating = 8 cal/cm²

Remote Operation of Switching Device

CAUTION:

During Remote Breaker Switching, EVACUATE THE SUBSTATION.

The person switching should have an observer standing by the adjacent door.

CAUTION:

Ensure that all of the appropriate safety procedures are followed. The PPE Level designation on this equipment is based on the proper installation and maintenance of the up-line protective device.

XYZ-2-R



XYZ-4-R

5.3 Down-Stream Devices at Low Voltage

<u>Labels 480V</u> - These labels are intended for metal-enclosed equipment rated 480V that is down-stream of motor control center and power distribution panel branch circuits where the working distance is \geq 18 inches.



ARC FLASH AND SHOCK HAZARD APPROPRIATE PPE REQUIRED

Based on NFPA 70E-2015 & XYZ Company Safety Directives

ARC FLASH PPE LEVEL 0:

Working Distance ≥ 18" Minimum PPE Rating = 1.2 cal/cm² Arc Flash Boundary = 1 ft 6 in



SHOCK PROTECTION - 480 VAC

Insulating Glove Class0Limited Approach Boundary3 ft 6 inRestricted Approach Boundary1 ft

CAUTION:

Ensure that all of the appropriate safety procedures are followed. The PPE Level designation on this equipment is based on the proper installation and maintenance of the up-line protective device.

XYZ-480-0-II





ARC FLASH AND SHOCK HAZARD APPROPRIATE PPE REQUIRED

Based on NFPA 70E-2015 & XYZ Company Safety Directives

ARC FLASH PPE LEVEL 2:

Working Distance ≥ 18" Minimum PPE Rating = 8 cal/cm² Arc Flash Boundary = 6 ft



SHOCK PROTECTION - 480 VAC

Insulating Glove Class 0 Limited Approach Boundary 3 ft 6 in Restricted Approach Boundary 1 ft

CAUTION:

Ensure that all of the appropriate safety procedures are followed. The PPE Level designation on this equipment is based on the proper installation and maintenance of the up-line protective device.

XYZ-480-2-II



ARC FLASH AND SHOCK HAZARD

Based on NFPA 70E-2015 & XYZ Company Safety Directives

ARC FLASH PPE LEVEL >4:

The potential arc flash incident energy is greater than 40 cal/cm² for a working distance of 18".

Operation or insertion/removal (racking) of switching device is not to be done unless the equipment is deenergized and confirmed to be deenergized.

No work is to be done on energized electrical conductors.

SHOCK PROTECTION - 480 VAC

Energized parts are not to be exposed.

XYZ-480>4-II

5.4 Phase II – < 240V & < 125 kVA

Labels XYZ-240-II, XYZ-208-II, XYZ-120-II – These labels are intended for metal-enclosed equipment where the circuit is rated 240 Volts or less and is supplied by one transformer rated less than 125 kVA. (These labels are optional. See Section 1.0, item 6)



SHOCK HAZARD APPROPRIATE PPE REQUIRED

Based on NFPA 70E & XYZ Company Safety Directives

This panel is rated 240 Volts or less and is supplied by one transformer rated less than 125 kVA.

SHOCK PROTECTION - 120 V	AC
Insulating Glove Class	00
Limited Approach Boundary	3 ft 6 in
Restricted Approach Boundary	1 ft

CAUTION: Ensure that all of the appropriate safety procedures are followed where required (such as lockout and tagout procedures).

XYZ-120-II



SHOCK HAZARD APPROPRIATE PPE REQUIRED Based on NFPA 70E & XYZ Company Safety Directives

This panel is rated 240 Volts or less and is supplied by one transformer rated less than 125 kVA.

SHOCK PROTECTION - 208 VAC Insulating Glove Class 00 Limited Approach Boundary 3 ft 6 in Restricted Approach Boundary 1 ft

CAUTION: Ensure that all of the appropriate safety procedures are followed where required (such as lockout and tagout procedures).

XYZ-208-II



APPROPRIATE PPE REQUIRED Based on NFPA 70E & XYZ Company Safety Directives

This panel is rated 240 Volts or less and is supplied by one transformer rated less than 125 kVA.

SHOCK PROTECTION - 240 VAC

Insulating Glove Class 00 Limited Approach Boundary 3 ft 6 in Restricted Approach Boundary 1 ft

CAUTION: Ensure that all of the appropriate safety procedures are followed where required (such as lockout and tagout procedures).

XYZ-240-II

Qual-Tech Engineers, Inc.

201 Johnson Road - Building #1 - Suite 203 Houston, PA 15342-1300 724-873-9275 FAX 724-873-8910 www.QualTechEng.com

QT-625-0615