

Arc Flash

Safety 21

Arc Flash

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Introduction

Most people don't think about electricity very much, which is surprising considering how often we use it in our daily lives.

Working around or with electricity does not afford you the opportunity to think like the average person.

Workers are killed by the hundreds each year... injuries are in the thousands.

The National Fire Protection Association (NFPA) created a document called the NFPA 70E standard. This standard helps keep electricians and other workers safe.

OSHA uses this standard to make sure facilities are operating safely under guidelines.

Electrical Hazards

When working around or on electrical equipment, you should first remove all electrical current from the equipment .

Precautions need to be taken when De-Energizing is not an option (when equipment must remain “hot”).

There are two hazards that workers need to protect themselves from...

- Electric Shock
- Arc Flash

Electrical Hazards...**Electric Shock**

On average, one person is electrocuted on the job every day. Electrocutions are the 5th leading cause of injury-related deaths for workers in the United States alone.

When a persons body makes contact with energized equipment, their body then becomes part of an electrical circuit.

All it takes is a small amount of current to be fatal if it crosses a humans chest.

For example: the same amount of current it takes to light a 120 volt bulb can be fatal.

Electric shock can cause life-threatening burns to...

- Organs
- Vascular & Nervous System
- Entry and Exit burns

Electrical Hazards...Arc Flash

Arc Flash happens more than most workers realize. Arc Flash incidents send about 2000 to 3000 people to burn centers each year.

Arc Flash is a type of electrical explosion or discharge that results from a low-impedance connection through air to ground or another voltage phase in an electrical system.

Causes of Arc Flash can be...

- Dust
- Corrosion
- Bad wiring
- Sparks due to breaks or gaps in insulation
- Slipped tool

Electrical Hazards...Arc Flash

What kinds of injuries can Arc Flash cause?

Skin burns from temps that are 4 times hotter than the surface of the sun

Arc Flash produces temps

as much as 35,000

degrees Fahrenheit.

Compare that to the sun

burning at 9000 degrees

Fahrenheit.

- Loss of eyesight
- Loss of memory or brain function
- Hearing Loss
- Shrapnel wounds
- Shock waves that can send a person across the room
- A worker several feet away, can be exposed to heat hot enough to ignite clothing and cause skin burns
- Death

Safety Planning





When it comes to electrical safety, OSHA refers to NFPA 70E, which requires employers to conduct an electrical hazard assessment consisting of a shock hazard analysis and an arc flash hazard analysis before work is performed on live equipment operating at 50 volts and higher.

OSHA regulations state...

- Every employer shall furnish a place of employment free from recognized hazards that are causing or likely to cause death or serious physical harm
- The employer must assess the workplace to determine if hazards are present and select PPE to protect employees

Safety Planning...Electrical Safety Program

Your employer must provide you with your facility's Electrical Safety Program. The NFPA 70E standard assists with this by providing a hazard table. An example of a hazard table is shown on right. Your employee must determine the appropriate PPE that is required for the hazards you will be exposed to.

Hazard/Risk Category 4 cal/cm ² 1	Arc-rated long-sleeve shirt Arc-rated pants or overall Arc-rated face shield with hard hat Safety glasses Hearing protection Leather & voltage rated gloves (as needed) Leather work shoes	
Hazard/Risk Category 8 cal/cm ² 2	Arc-rated long-sleeve shirt Arc-rated pants or overall Arc-rated face shield & balaclava or Arc flash suit with hard hat Safety glasses, Hearing protection Leather & voltage rated gloves (as needed) Leather work shoes	
Hazard/Risk Category 25 cal/cm ² 3	Arc-rated long-sleeve jacket Arc-rated pants Arc-rated flash hood with hard hat Safety glasses, Hearing protection Leather & voltage rated gloves (as needed) Leather work shoes	
Hazard/Risk Category 40 cal/cm ² 4	Arc-rated long-sleeve jacket Arc-rated pants Arc-rated flash hood with hard hat Safety glasses, Hearing protection Leather & voltage rated gloves (as needed) Leather work shoes	

Safety Planning...Electrical Safety Program

Your employer must also update their best work practices and PPE whenever there is a change to the NFPA 70E standard.

The revised section in the 2012 edition reads, "Employees shall wear arc-rated clothing wherever there is a possible exposure to an electric arc flash...."

This change forces the fabric to have been arc tested and the garment to be labeled with an arc rating shown as either the Arc Thermal Performance Value (ATPV) or Energy of Breakpoint Threshold (EBT).

Safety Planning... Qualified & Unqualified

*NFPA 70E Article 110
explains more clearly
who is considered
Qualified and
Unqualified workers.*

According to the NFPA 70E standard, a Qualified Worker is someone "...who has skills and knowledge in regards to construction and operation of the electrical equipment and installations and has received safety training on the hazards involved."

There are two types of unqualified workers:

"An unqualified electrician who does not know the equipment or has not received safety training on the potential hazards involved."

"A non-electrician, such as a general maintenance worker or painter, who is not expected to work on live electrical equipment."

Safety Planning...Job Briefing

Job Briefings prevent accidents at work and allow discussions that help control and recognize hazards before they happen.

Job Briefing: an assessment of safety and health conditions related to a specific job or task.

A qualified person will conduct the job briefings.

Job briefings are done before the actual work is performed.

The requirements for job briefings are at least once, unless there is a change during the course of work that will affect the safety of a(n) employee(s).

Employees shall remain alert to any event that may alter the work at hand and alert management as necessary so that modifications can be done to the job briefing.

Safety Planning...Labels



The 70E standard requirements are quite clear: "Equipment shall be field marked with a label containing the available incident energy or required level of PPE" (NFPA 70E 2009 130.2(C)). Additionally, 130.7(E) (1) Safety Signs and Tags says:

"Safety signs, safety symbols, or accident prevention tags shall be used where necessary to warn employees about electrical hazards that might endanger them. Such signs and tags shall meet the requirements of ANSI Z535, Series of Standards for Safety Signs and Tags, given in Table 130.7(F)."

De-Energizing Equipment

During the servicing and maintenance of machines and equipment, the unexpected startup or release of stored energy can result in serious injury or death to workers.

NFPA 70 E standard, Article 120, Section 120.1
Teaches you in six steps how to achieve an electrically safe work environment.

1. Identify power source
2. Disconnect power
3. Isolate equipment from energy sources
4. Apply lockout/tagout device
5. Verify no voltage exists
6. Discharge stored energy

De-Energizing Equipment

In order to identify all sources of power, look to diagrams, current electrical plans, drawings, signs, tags etc.

Step 1

Identify all sources of power



De-Energizing Equipment

Interrupt the load current and open the disconnecting device(s) for each source.

Step 2

Disconnect all sources of power



De-Energizing Equipment

When possible, visually verify blades of the disconnecting devices are fully open or that drawout-type circuit breakers are withdrawn to the fully disconnected position.

Step 3

Verify power is off



De-Energizing Equipment

Apply lockout/tagout according to according to KUKA AT's electrical policy

Step 4

Apply lockout/tagout



De-Energizing Equipment

Test each phase conductor or circuit part to verify that are de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the voltage detector is operating satisfactorily.

Step 5

Verify no voltage exists in equipment



De-Energizing Equipment

Where possible induced voltages or stored electrical energy exists, ground the phase conductors or circuit parts before touching them.

When anticipating the conductors or circuit parts being de-energized could contact other exposed energized conductors or circuit parts, apply ground connecting devices rated for the available fault duty.

Step 6

Discharge stored electrical energy



De-Energizing Equipment

Once all six steps are completed, electrical energy cannot appear accidentally. Once the equipment is in an electrically safe work condition, PPE is no longer required for Arc Flash or Shock.



Working Hot

There are only two instances where working around "live" electrical equipment is allowed by OSHA.

Allowances for NOT de-energizing electrical equipment...

1. When it would increase current hazards
2. Create additional hazards, such as
 - interruption of life support equipment,
 - deactivation of emergency alarm systems,
 - shutdown of hazardous location ventilation equipment
 - removal of illumination for an area.

Only qualified persons may work on equipment that has not been de-energized.

Working Hot

The NFPA 70E standard requires an increase in safety precautions when equipment must remain energized.

Energized Electrical Work Permit needs to be filled out prior to beginning work. A work permit includes...

- Authorized signature
- Description of safe work practices
- Method used to keep unqualified workers from entering work area
- Information about approach Boundaries

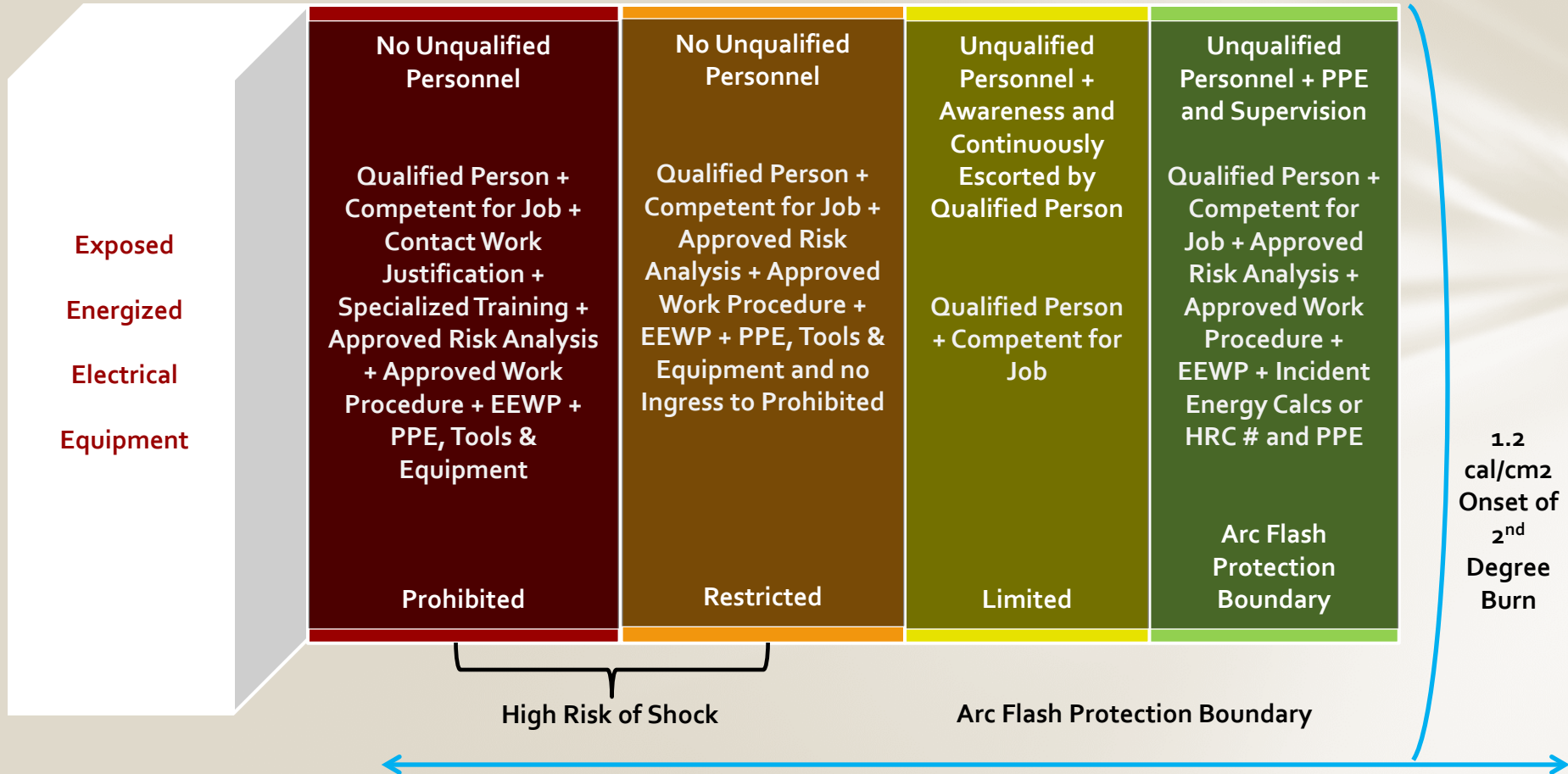
Working Hot

Approach Boundaries are defined distances used around energized equipment in order to keep qualified and unqualified workers safe.

There are four approach boundaries

1. Limited Approach Boundary
2. Restricted Approach Boundary
3. Prohibited Approach Boundary
4. Flash Protection Boundary

Working Hot



Working Hot

Exposed
Energized
Electrical
Equipment

The flash boundary is the farthest established boundary from the energy source. If an arc flash occurred, this boundary is where an employee would be exposed to a curable second degree burn (1.2 calories/cm²). The issue here is the heat generated from a flash that results in burns.

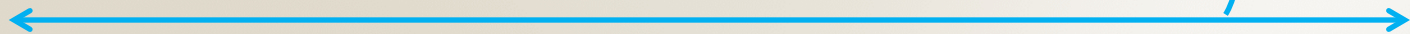
Unqualified
Personnel + PPE
and Supervision

Qualified Person +
Competent for
Job + Approved
Risk Analysis +
Approved Work
Procedure +
EEWP + Incident
Energy Calcs or
HRC # and PPE

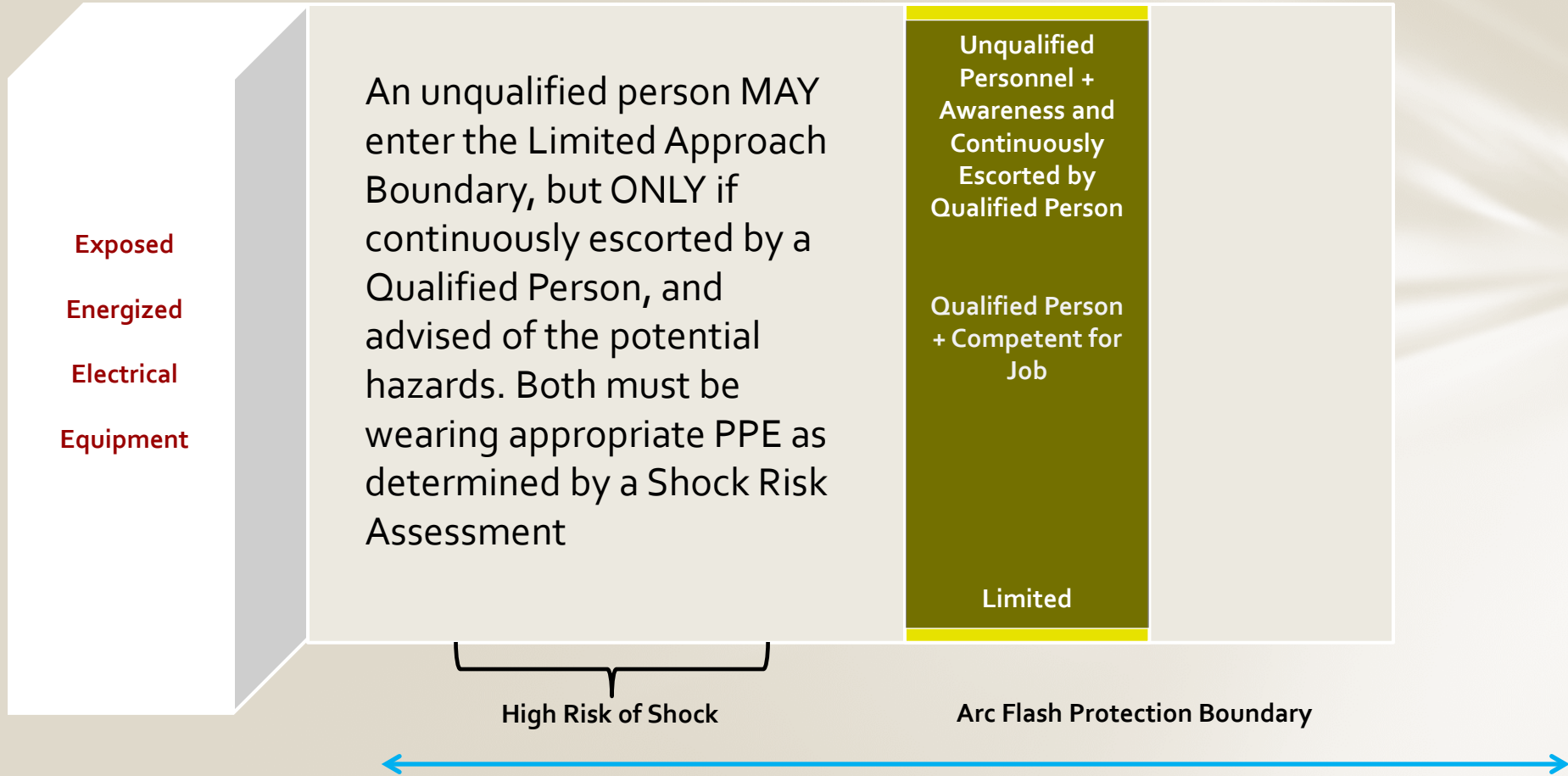
Arc Flash
Protection
Boundary

1.2
cal/cm²
Onset of
2nd
Degree
Burn

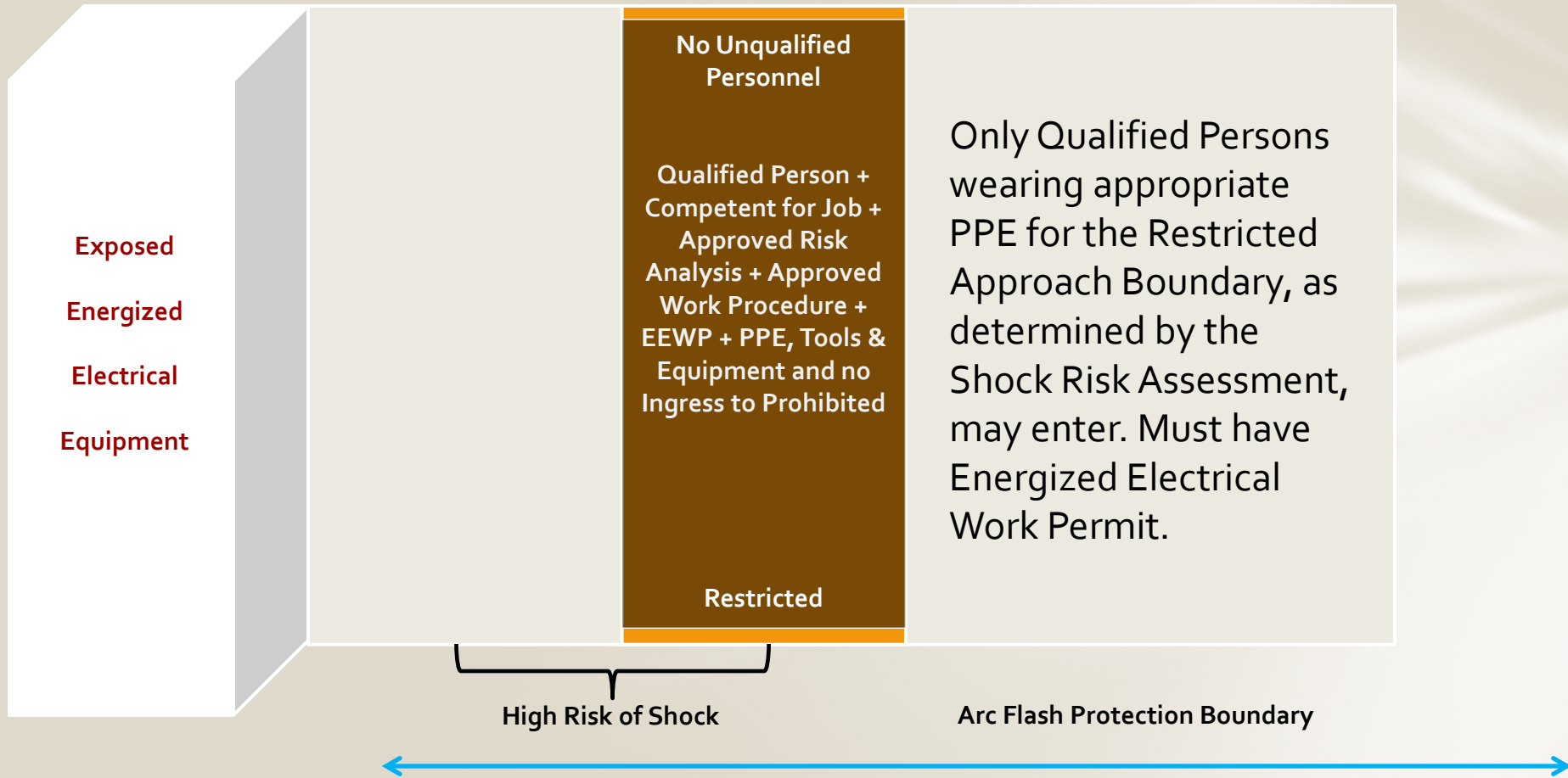
Arc Flash Protection Boundary



Working Hot



Working Hot



Working Hot

