ABOUT ARC FLASH PROTECTION AND SAFE ELECTRICAL WORK PRACTICES

LENGTH: 13 MINUTES

PROGRAM SYNOPSIS:
Our workplace is full of hazards, hazards that can hurt us or kill us. Controlling these hazards and preventing injuries is the point of our safety and health program. One such hazard is presented by energized electrical parts. Energized electrical parts expose workers to the risk of electric shock or exposure to an arc flash. Protecting workers from these two electrical hazards can prevent injuries and save lives. That is the point of our facility's electrical safety program and that is the point of this program. So, pay close attention as we get to the point about arc flash protection and safe electrical work practices.

Topics include Limited and Restricted Approach Boundaries, the Arc Flash Boundary, Incident Energy Analysis, PPE Categories and creating an electrically safe condition.

PROGRAM OBJECTIVES:
After watching the program, the participant will be able to explain the following:
- What Limited and Restricted Approach Boundaries are;
- What the Arc Flash Boundary is and how it is determined;
- How an incident energy analysis is conducted to determine the Arc Flash Boundary;
- How the appropriate arc-rated clothing and protective equipment for a specific job are determined;
- What the requirements of each of the four PPE Categories are;
- How an electrically safe condition is created.

PROGRAM OUTLINE

APPROACH BOUNDARIES
- There are two main hazards presented by energized electric parts: the risk of electric shock and exposure to the powerful effects of an arc flash.
- To protect workers from electric shock, two approach boundaries have been established. The distance from energized parts to each of these boundaries depends on the nominal voltage of the energized parts.
- The first boundary is known as the Limited Approach Boundary. The Limited Approach Boundary is the shock protection boundary farthest away from the energized parts and is established to keep unqualified personnel a safe distance away.
- Unqualified workers are not permitted to cross the Limited Approach Boundary unless they have been briefed on the hazards and are continuously escorted by a qualified worker.
- The second boundary is known as the Restricted Approach Boundary. The Restricted Approach Boundary is the shock protection boundary closest to the energized parts and may only be crossed by qualified electrical workers using insulated tools and wearing voltage rated shock protection.
- Qualified electrical workers must be able to determine these approach boundary distances for the equipment they intend to service.
- Once the nominal system voltage is determined, the appropriate approach boundaries may be looked up in reference tables published by the controlling regulatory authority on safe electrical work practices. In some cases this information may be displayed on the equipment in the form of an informational label.

THE ARC FLASH BOUNDARY
- The Limited Approach Boundary and Restricted Approach Boundary are established to prevent electric shock. A third boundary, known as the Arc Flash Boundary, must also be established. The Arc Flash Boundary is established to protect workers from exposure to an arc flash.
- When an arc flash occurs, a great deal of heat energy, also known as thermal energy, is released. Thermal energy is measured in calories.
- The amount of thermal energy at a specific distance from an arc source is referred to as the "incident energy level." The Arc Flash Boundary must be established at the distance from a potential arc source where the incident energy level is 1.2 calories per square centimeter. 1.2 calories per square centimeter is the amount of thermal energy required to cause the onset of a second-degree burn on unprotected skin.
- In other words, the point of establishing the Arc Flash Boundary is to limit the potential burn injury of an unprotected worker to the onset of a second-degree burn. A second degree burn is painful, but it's easily treatable and usually causes no permanent damage.
- Workers may not cross the Arc Flash Boundary unless they are wearing the appropriate arc rated clothing and protective equipment.

INCIDENT ENERGY ANALYSIS
- An incident energy analysis is one method that can be used to determine the Arc Flash Boundary distance. This is a detailed calculation based on the specific design of the electrical system and equipment.

- Two critical factors used in an incident energy analysis are the maximum amount of short-circuit current or "fault current" available to the equipment and the speed of the system's overcurrent protection. This information can be used to determine the incident energy level at any specific distance from a potential arc source.
- For many pieces of electrical equipment, an incident energy analysis has been performed and the arc flash boundary distance is displayed on an informational label.
- For common types of electrical systems and equipment, the arc flash boundary has been calculated and may be looked up in reference tables published by the controlling regulatory authority on safe electrical work practices. Using these types of reference tables makes it easier for electrical workers to determine the appropriate Arc Flash Boundary distance.
- Before using these types of tables, you must understand that the calculations are based on very specific fault current and fault clearing times. If your equipment doesn't match the specifications noted in the table, then an incident energy analysis must be performed in order to determine the arc flash boundary distance.

ARC FLASH PROTECTION

- The intense heat of an arc flash can cause normal clothing to burst into flames, resulting in severe and often fatal burns to the arc flash victim.
- For this reason, our organization provides electrical workers with arc-rated clothing and protective equipment designed to withstand both the intense heat and force of an arc blast without bursting into flames or breaking open.
- Arc-rated clothing and protective equipment must be selected to meet or exceed the predicted incident energy level of a potential arc flash at the "working distance" of the task being performed.
- The working distance is the distance of a worker's face and chest area from a potential arc source while performing a specific task.
- One method used to determine the appropriate arc flash protection for a given job is to perform an incident energy analysis to determine the incident energy level at the working distance. Once the incident energy level is determined, appropriate arc flash protection can be selected to meet or exceed the expected amount of thermal energy.
- For common tasks performed on common electrical systems, these calculations have been performed and the appropriate arc flash protection is listed in a reference table published by the controlling regulatory authority on safe electrical work practices.
- Once again, it's crucial that you understand that these reference tables are based on the specific short-circuit current, fault clearing time and working distance noted in the tables. If your intended task or equipment does not match these specifications, you cannot use these tables to determine the appropriate arc flash protection.

PPE CATEGORIES

- There are four PPE categories of arc flash protection, ranging from Category One to Category Four with Category Four being the highest level of protection.
- PPE Category One requires a worker to wear arc-rated clothing of at least four calories per square centimeter, a voltage rated hardhat and an arc-rated face shield or arc-rated flash suit hood.
- PPE Category Two requires a worker to wear arc-rated clothing of at least eight calories per square centimeter, a voltage rated hardhat and an arc-rated face shield in combination with an arc-rated balaclava. An arc-rated flash suit hood may be used in place of the face shield and balaclava.
- PPE Category Three requires a worker to wear arc-rated clothing of at least 25 calories per square centimeter and an arc-rated flash suit hood.
- PPE Category Four requires a worker to wear arc-rated clothing of at least 40 calories per square centimeter and an arc-rated flash suit hood.
- Electrical workers are also required to wear safety glasses, earplugs, proper footwear and arc-rated gloves or voltage-rated gloves with leather protectors.
- There are some tasks in which an arc flash hazard is not present and do not require arc rated PPE. When this is the case, electrical workers may wear long sleeves and long pants made from non-melting fibers such as 100 percent cotton or wool.

CREATING AN ELECTRICALLY SAFE CONDITION

- Of course, the best way for electrical workers to protect themselves from shock and arc flash hazards is to create an electrically safe condition. This must always be the first choice for electrical workers.
- An electrically safe condition is defined as a state in which an electrical conductor or circuit has been disconnected from energized parts, locked and tagged in accordance to established standards, tested to ensure the absence of voltage and grounded if determined necessary.
- An electrically safe condition is created by first identifying all possible sources of electrical energy to the equipment.
- Any active loads must be disconnected and then the disconnecting device for each source of electrical supply must be opened.
- If possible, visually verify that all blades of disconnecting devices are fully open or that draw-out type circuit breakers are withdrawn to the fully disconnected position.
- Company-approved lock and tags should then be applied to the open disconnecting devices in accordance with our organization's lockout/tagout procedures.
- Finally, and most importantly, testing must be done to verify there is an absence of voltage and protective grounds installed when necessary.
- The test instrument used to determine an absence of voltage must be verified to be working properly by measuring a known voltage source immediately before voltage testing and again immediately afterwards.
- The equipment must be considered energized until you have verified the existence of an electrically safe working condition. This includes establishing approach boundaries and using properly insulated tools as well wearing voltage rated shock protection and appropriate arc flash protection.
- Once the existence of an electrically safe working condition has been verified, shock and arc flash protection are no longer necessary and can be removed. Other workers who are not qualified electrical workers may then enter the area to perform work as needed.

TO THE POINT ABOUT ARC FLASH PROTECTION
AND SAFE ELECTRICAL WORK PRACTICES
REVIEW QUIZ

Name_____Date_____

The following questions are provided to check how well you understand the information presented during this program.

1. Electricity presents two main hazards: electric shock and exposure to an arc flash.

a. True
b. False

2. Which of the following approach boundaries is not established for shock protection?

a. The Limited Approach Boundary
b. The Arc Flash Boundary
c. The Restricted Approach Boundary

3. It takes approximately 1.2 calories per square centimeter of thermal energy to cause the onset of a _____ burn on unprotected skin.

a. First-degree
b. Second-degree
c. Third-degree

4. Which of the following is not a critical factor when calculating incident energy?

a. The equipment manufacturer
b. The maximum amount of short-circuit current
c. Speed of overcurrent protection

5. To provide an appropriate level of protection, arc rated clothing and protective equipment must be selected to meet or exceed the incident energy level of a potential arc flash at the _____.

a. Outermost boundary
b. Working distance
c. Restricted approach boundary

6. Which PPE category requires arc-rated protection of at least 8 calories per square centimeter in addition to a hard hat, arc rated face shield and arc rated balaclava?

a. PPE category 1
b. PPE category 2
c. PPE category 3
d. PPE category 4

7. What is the most important part of creating an electrically safe working condition?

a. Disconnecting any active loads
b. Determining all possible sources of electrical supply to the equipment
c. Testing to verify there is an absence of voltage

8. When should a voltage test instrument be verified to be working properly?

a. Immediately prior to testing
b. Immediately after testing
c. Both immediately prior to testing and immediately after testing

9. Once the existence of an electrically safe working condition has been verified, shock and arc flash protection are no longer necessary and can be removed.

a. True
b. False

ANSWERS TO THE REVIEW QUESTIONS

1. a
2. b
3. b
4. a
5. b
6. b
7. c
8. c
9. a