ULTIMATE SERVICE ASSOCIATES

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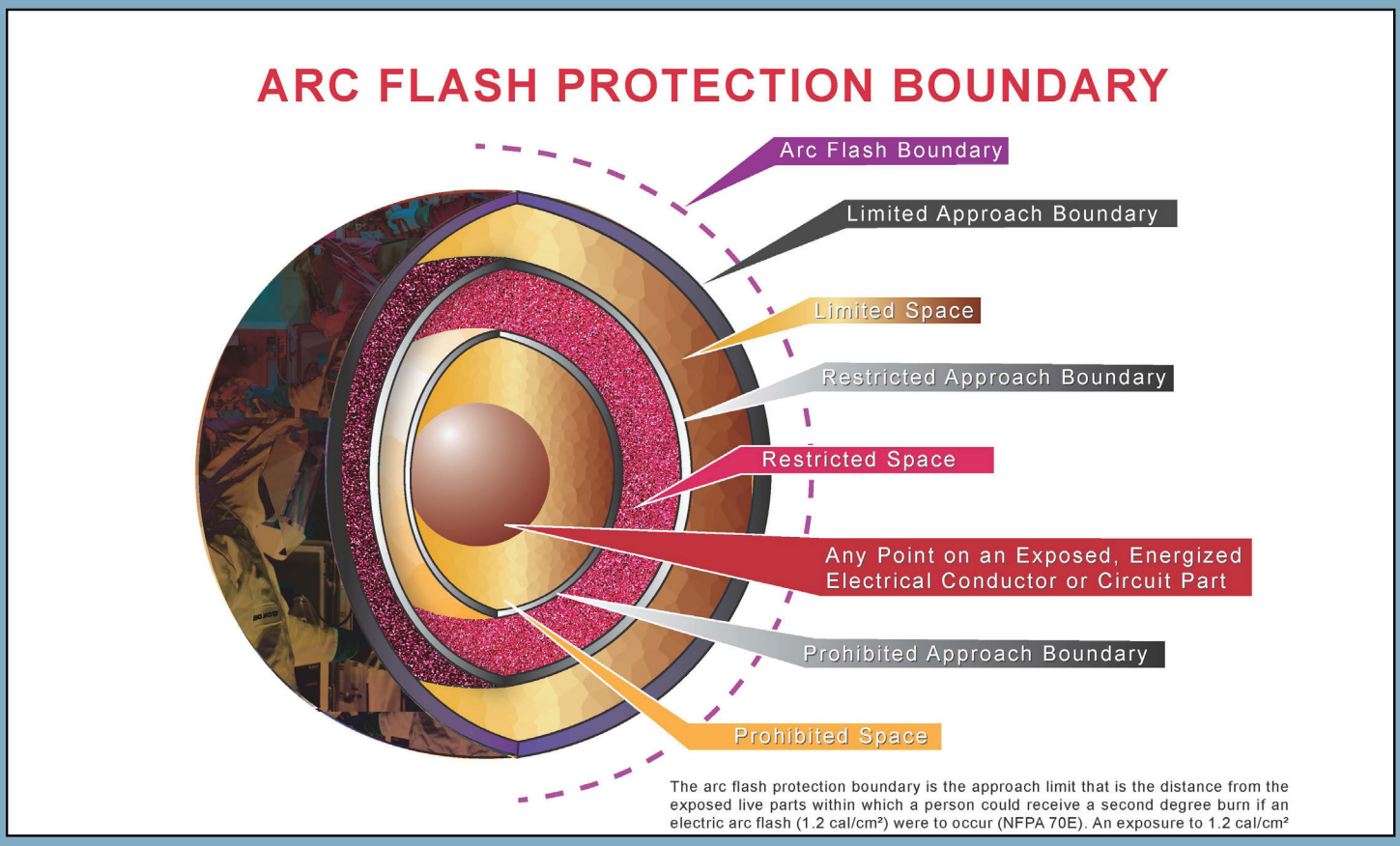
Arc Flash Protection Boundary During ATS Service

1.0 Introduction

When working on any generator system, the technician must be aware of the potential for coming into contact with any uninsulated component carrying an electrical charge. The National Fire Protection Association (NFPA) sets standards for personnel protection and guidance on performing an arc flash study.

This Information Sheet discusses the requirements and standards for Electrical Safety In the Workplace, as covered by NFPA 70E. These requirements are enforced by the Occupational Safety and Health Administration (OSHA). (Continued over)



Risk/Hazard Category	Incident energy (cal/cm2)	Examples of PPE (Personal Protective Equipment) Required*
0	2 or lower	Non-melting clothing
1	2 - 4	Flame-Resistant (FR) shirt and pants
2	4 - 8	FR shirt and pants, cotton underwear
3	8 - 25	FR shirt and pants, FR coveralls, cotton underwear
4	25 - 40 and higher**	FR shirt and pants, full-coverage flash suit, cotton underwaer

* Other combinations are possible; see NFPA 70E for details. Safety boots, face shields, and leather over voltage-rated gloves should be worn.

** Incident energy levels above 40 cal/cm2 require special care to de-energize equipment when possible, as they represent the most extreme hazards. Some companies offer PPE rated above 40 cal/cm2, but in general this level of risk is considered impractical to protect against.

To fulfill our commitment to be the leading network service provider in the Power Generation Industry, the USA, Inc. team maintains up-to-date technology and information standards on Power Industry changes, regulations and trends. As a service, our **Information Sheets** are circulated on a regular basis, to existing and potential Power Customers to maintain awareness of changes and developments in engineering standards, electrical codes, and technology impacting the Power Generation Industry.

2.0 Safe Work Conditions:

The primary focus of NFPA 70E is the establishment of an electrically safe work condition. This means that equipment is fully de-energized and cannot be re-energized while work is being performed. Each of the following steps should be followed to create an electrically safe work condition.

- Determine all possible sources of electrical energy to the equipment.
- Interrupt load current and open disconnecting devices for all sources.
- Where possible, visually confirm that all disconnecting devices are open.
- Follow all appropriate lockout and tag-out procedures.
- Verify that equipment is de-energized using a voltmeter. Until equipment is tested, assume it is still energized.
- Use grounding devices where the possibility exists of stored energy induction, or when auto-reclosing devices may be present.

3.0 Guidelines for NFPA 70E Compliance with OSHA:

It is not always possible to de-energize equipment before beginning work. To minimize the risk of live electrical work, NFPA 70E lays out six (6) steps that employers should take to be in compliance with OSHA regulations.

- Create a facility safety program with defined responsibilities.
- Calculate arc flash hazards for relevant equipment.
- Provide appropriate personal protective equipment (PPE) for live work.
- Train workers on arc flash hazards and safe work practices.
- Provide appropriate tools for working with energized equipment.
- Place warning labels on equipment that poses arc flash risks.

4.0 Arc Flash Safety Program:

NFPA 70E requires companies to create a written program outlining all aspects of the company's electrical safety policy, including work permits, lockout/tag-out procedures, maintenance procedures, assessments of electrical hazards, and personnel responsible for electrical safety. This document should include accurate, up-to-date information on a company's electrical systems, including one-line diagrams and equipment specifications.

Some equipment may warrant two warnings -- one for arc flash and another indicating hazards associated with de-energizing the equipment. The goal of the program should be to establish a culture of safety awareness that includes ALL employees.

5.0 Warning Labels:

The NFPA 70E 2012 edition has a new Section 130.5 (c) that addresses warning labels on electrical equipment items from NEC that are likely to require examination and adjustment. These include switchboards, panel boards, industrial control panels, meter socket enclosures and motor control carriers that are other than dwelling units. Service or maintenance while energized, shall be field marked with a label containing:

- Available incident energy and corresponding working distance.
- Minimum arc rating of clothing.
- Required level of PPE.
- Highest hazard/risk category (HRC) for the equipment

Types of equipment to be labeled and placements of labels are covered by NEC 110.16. Also, NEC 90 intro and NEC 90.1(A) include notations to apply professional discretion beyond the "letter of the code," or to start with the intent, such as safeguarding persons and property, and apply this arc flash NEC article to each application. This means other equipment may also be appropriate for arc flash labeling.

6.0 Personal Protective Equipment (PPE):

This includes cotton and flame-resistant (FR) clothing, voltage-rated gloves, and hard hats with full-face shields, full-coverage flash suits, and insulated blankets. Appropriate PPE MUST be worn whenever live electrical work must be performed. NFPA 70E describes six (6) risk/hazard categories for which varying degrees of PPE are appropriate. All clothing worn round live circuits should be 100% untreated fiber. Synthetic materials such as nylon or acetate will melt onto the skin in the event of an arc flash or electrical shock, increasing the risk of serious burns. The purpose of PPE is two-fold -- arc flash protection and protection from electrocution where systems may be or become energized.

7.0 Tools for Use on Live Equipment:

All tools used to work on energized electrical equipment must be non-conductive. Voltmeters should be insulated and voltage rated for the equipment. In some instances, long-handled tools may also be appropriate, as even a small increase in working distance can cause a significant drop in incident energy.

8.0 Calculating Arc Flash (NFPA 70E) Hazards:

An arc flash hazard analysis is an in-depth study of a company's electrical systems in order to identify equipment that could cause an arc flash and the degree of hazard involved. This requires the work of a competent electrical engineer who is familiar with the electrical system and methods of analysis. For many companies, this hazard analysis is the most expensive and time consuming requirement of NFPA 70E, but it is perhaps the most critical.

9.0 NFPA 70E Arc Flash Training:

NFPA 70E draws a distinction between 'qualified persons' and 'non-qualified' persons. Qualified persons are those who have the skills and knowledge related to the construction and operation of electrical equipment and systems and have received safety training on the hazards involved. It is a good idea to also train non-qualified persons on the general hazards of arc flash, which allows them to identify and avoid hazardous situations.

We recommend that a reputable training firm with specific expertise in arc flash be contracted to assist in providing the needed training.

10.0 Summary Comments:

An electrical study should not strictly be used to generate labels. Before labels are printed, the study should be analyzed for opportunities to make the electrical system easier and safer to maintain. Some opportunities may only require adjustments in breaker settings. Others may require changing out breaker types or adding new breaker features such as arc flash reduction. Such opportunities may help remove drastic maintenance measures, including removing all power to a facility merely to inspect equipment. However, no adjustments for arc flash improvement should be considered without also considering potential impact to the selective coordination of the power system. Ideally, the selective coordination and the arc flash hazards are improved by considering them both together.

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