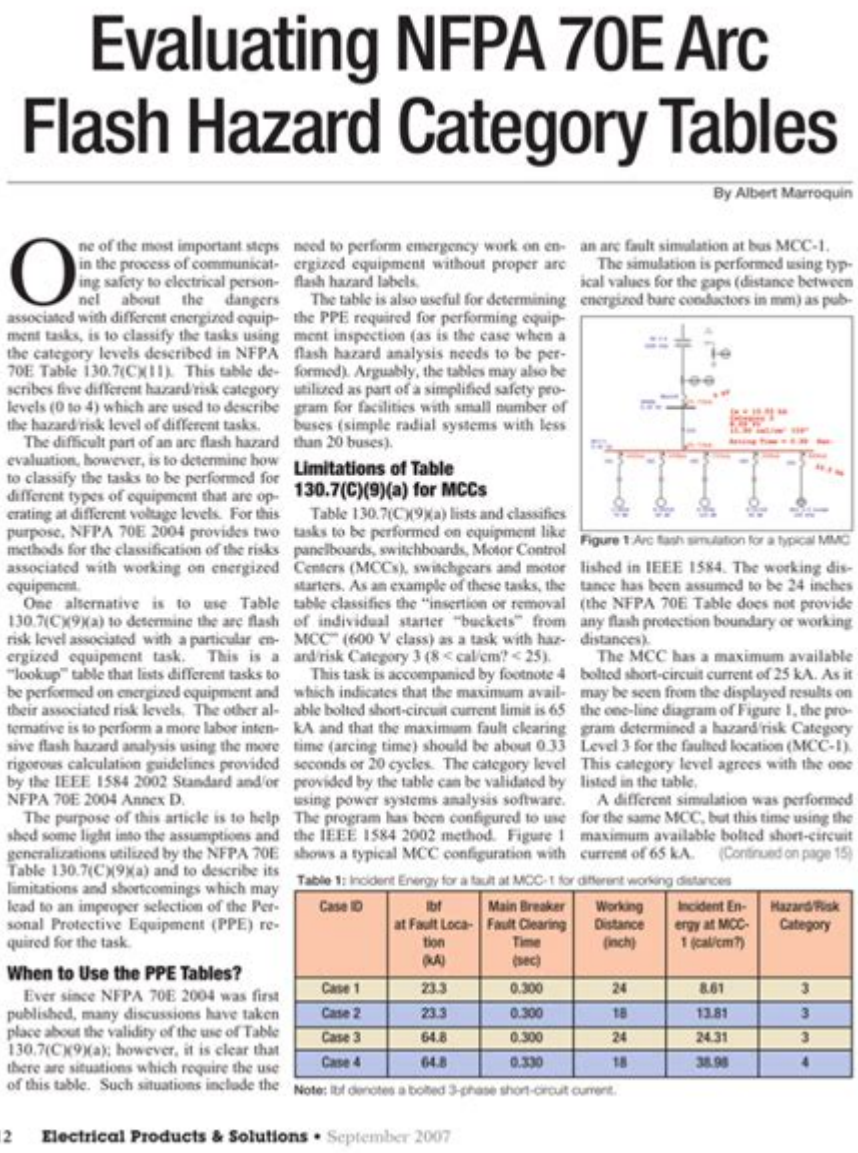
Nfpa 70e Arc Flash Risk Assessment



Evaluating NFPA 70E Arc Flash Hazard Category Tables

By Albert Marroquin

One of the most important steps in the process of communicating safety to electrical personnel about the dangers associated with different energized equipment tasks, is to classify the tasks using the category levels described in NFPA 70E Table 130.7(C)(11). This table describes five different hazard/risk category levels (0 to 4) which are used to describe the hazard/risk level of different tasks.

The difficult part of an arc flash hazard evaluation, however, is to determine how to classify the tasks to be performed for different types of equipment that are operating at different voltage levels. For this purpose, NFPA 70E 2004 provides two methods for the classification of the risks associated with working on energized equipment.

One alternative is to use Table 130.7(C)(9)(a) to determine the arc flash risk level associated with a particular energized equipment task. This is a "lookup" table that lists different tasks to be performed on energized equipment and their associated risk levels. The other alternative is to perform a more labor intensive flash hazard analysis using the more rigorous calculation guidelines provided by the IEEE 1584 2002 Standard and/or NFPA 70E 2004 Annex D.

The purpose of this article is to help shed some light into the assumptions and generalizations utilized by the NFPA 70E Table 130.7(C)(9)(a) and to describe its limitations and shortcomings which may lead to an improper selection of the Personal Protective Equipment (PPE) required for the task.

When to Use the PPE Tables?

Ever since NFPA 70E 2004 was first published, many discussions have taken place about the validity of the use of Table 130.7(C)(9)(a); however, it is clear that there are situations which require the use of this table. Such situations include the need to perform emergency work on energized equipment without proper arc flash hazard labels.

The table is also useful for determining the PPE required for performing equipment inspection (as is the case when a flash hazard analysis needs to be performed). Arguably, the tables may also be utilized as part of a simplified safety program for facilities with small number of buses (simple radial systems with less than 20 buses).

Limitations of Table 130.7(C)(9)(a) for MCCs

Table 130.7(C)(9)(a) lists and classifies tasks to be performed on equipment like panelboards, switchboards, Motor Control Centers (MCCs), switchgears and motor starters. As an example of these tasks, the table classifies the "insertion or removal of individual starter "buckets" from MCC" (600 V class) as a task with hazard/risk Category 3 (8 < cal/cm? < 25).

This task is accompanied by footnote 4 which indicates that the maximum available bolted short-circuit current limit is 65 kA and that the maximum fault clearing time (arcing time) should be about 0.33 seconds or 20 cycles. The category level provided by the table can be validated by using power systems analysis software. The program has been configured to use the IEEE 1584 2002 method. Figure 1 shows a typical MCC configuration with an arc fault simulation at bus MCC-1.

The simulation is performed using typical values for the gaps (distance between energized bare conductors in mm) as published in IEEE 1584. The working distance has been assumed to be 24 inches (the NFPA 70E Table does not provide any flash protection boundary or working distances).

Figure 1 Arc flash simulation for a typical MMC

The MCC has a maximum available bolted short-circuit current of 25 kA. As it may be seen from the displayed results on the one-line diagram of Figure 1, the program determined a hazard/risk Category Level 3 for the faulted location (MCC-1). This category level agrees with the one listed in the table.

A different simulation was performed for the same MCC, but this time using the maximum available bolted short-circuit current of 65 kA. (Continued on page 15)

Table 1: Incident Energy for a fault at MCC-1 for different working distances

Case ID	Ibf at Fault Location (kA)	Main Breaker Fault Clearing Time (sec)	Working Distance (inch)	Incident Energy at MCC-1 (cal/cm?)	Hazard/Risk Category
Case 1	23.3	0.300	24	8.61	3
Case 2	23.3	0.300	18	13.81	3
Case 3	64.8	0.300	24	24.31	3
Case 4	64.8	0.330	18	38.98	4

Note: Ibf denotes a bolted 3-phase short-circuit current.

NFPA 70E Arc Flash Risk Assessment is a critical process designed to protect workers from the dangers associated with arc flash incidents in electrical environments. As electrical systems operate under high voltages, the risk of an arc flash—a sudden release of energy caused by an electrical fault—poses significant dangers, including severe burns, injuries, and even fatalities. The National Fire Protection Association (NFPA) has established guidelines in NFPA 70E to help organizations assess and mitigate these risks, ensuring safe working conditions for those who operate and maintain electrical equipment.

Understanding Arc Flash

What is an Arc Flash?

An arc flash is a type of electrical explosion that occurs when electrical

current passes through the air between ungrounded conductors or between a conductor and the ground. This phenomenon can produce extremely high temperatures, often exceeding 35,000 degrees Fahrenheit, which can cause severe injuries and ignite nearby materials.

Causes of Arc Flash

Arc flashes can occur due to various factors, including:

- Equipment failure: Faulty equipment or components can lead to an arc flash.
- Human error: Mistakes made by workers during maintenance or operation can trigger an arc flash.
- Environmental conditions: Dust, moisture, or corrosion can contribute to arc flash incidents.
- Improper installation: Errors during the setup of electrical equipment can create hazardous conditions.

Importance of NFPA 70E

Regulatory Framework

NFPA 70E serves as a standard for electrical safety in the workplace. It provides guidelines for electrical workers and employers to follow to minimize the risk of electrical hazards, including arc flashes. By adhering to NFPA 70E, organizations can create safer work environments while fulfilling legal and regulatory requirements.

Benefits of Implementing NFPA 70E

Implementing NFPA 70E guidelines offers multiple benefits, including:

1. Increased safety: Protects workers from serious injuries and fatalities.
2. Reduced costs: Minimizes the financial burden associated with accidents and injuries.
3. Compliance: Helps organizations meet legal obligations and avoid penalties.
4. Enhanced training: Encourages the development of comprehensive training programs for workers.

Arc Flash Risk Assessment Process

Steps in Conducting an Arc Flash Risk Assessment

A thorough arc flash risk assessment involves several key steps:

1. Data Collection: Gather information on electrical systems, including single-line diagrams, equipment specifications, and operational data.
2. Labeling: Ensure that all equipment is properly labeled to reflect potential arc flash hazards.
3. Short Circuit Analysis: Conduct a short circuit study to understand the maximum fault current for each piece of equipment.

4. Coordination Study: Analyze the protective devices to ensure they will operate correctly in the event of a fault.
5. Arc Flash Analysis: Calculate the incident energy levels for various equipment under different operating conditions.
6. Risk Evaluation: Determine the severity of the risks based on the calculated incident energy levels and the duration of exposure.
7. Documentation: Compile all findings and recommendations in a comprehensive report.

Key Components of the Assessment

A successful arc flash risk assessment should address the following components:

- Incident Energy Analysis: This calculation determines the thermal energy that a worker might be exposed to during an arc flash event.
- Flash Protection Boundary: This boundary indicates the distance at which a worker may be exposed to a specific incident energy level.
- Personal Protective Equipment (PPE): Based on the assessment results, appropriate PPE must be identified and provided to workers.

Personal Protective Equipment (PPE)

Importance of PPE

PPE is crucial in protecting workers from the risks associated with arc flashes. Properly selected and maintained PPE can significantly reduce the severity of injuries sustained during an incident.

Types of PPE for Arc Flash Protection

When selecting PPE, organizations must consider several types of protective gear, including:

- Arc-rated clothing: This includes flame-resistant garments specifically designed to protect against arc flash hazards.
- Face shields: Protect workers' faces from thermal burns and flying debris.
- Hard hats: Essential for head protection against falling objects and electrical shock.
- Safety glasses: Guard against eye injuries from flashes and flying particles.
- Gloves: Insulated gloves designed for electrical work can protect hands from shocks and burns.

Training and Awareness

Importance of Training

Training is an integral part of the NFPA 70E arc flash risk assessment process. Workers must understand the risks associated with electrical work and how to protect themselves effectively.

Training Components

Effective training programs should include:

- Understanding arc flash hazards: Workers should be educated about the nature and risks of arc flash incidents.
- Proper use of PPE: Training should emphasize the importance of wearing appropriate protective gear and how to use it correctly.
- Emergency response: Workers should be trained on how to respond in the event of an arc flash incident, including evacuation procedures and first aid.

Conclusion

Conducting an NFPA 70E arc flash risk assessment is essential for any organization that operates electrical systems. By systematically identifying and mitigating risks, organizations can protect their employees and create a safer working environment. The process not only complies with regulatory requirements but also minimizes the potential for costly accidents and injuries. Through proper training, the use of appropriate PPE, and adherence to NFPA 70E guidelines, organizations can significantly reduce the risks associated with arc flashes, ensuring the well-being of their workforce. Taking proactive measures today will lead to a safer and more productive workplace for everyone involved in electrical operations.

Frequently Asked Questions

What is NFPA 70E and why is it important for arc flash risk assessment?

NFPA 70E is a standard for electrical safety in the workplace, focusing on protecting workers from electrical hazards, including arc flash. It is important for ensuring safe work practices and compliance with regulations.

What are the main components of an arc flash risk assessment according to NFPA 70E?

The main components include identifying electrical hazards, analyzing the potential incident energy, evaluating protective measures, and implementing appropriate safety procedures and training.

How often should an arc flash risk assessment be conducted?

Arc flash risk assessments should be conducted every 3 to 5 years, or whenever there are significant changes to the electrical system or equipment.

What is the purpose of calculating incident energy in arc flash risk assessment?

Calculating incident energy helps determine the level of protective measures needed, such as personal protective equipment (PPE), to protect workers from the thermal effects of an arc flash.

What role does PPE play in arc flash safety according to NFPA 70E?

PPE is crucial for protecting workers from arc flash hazards. NFPA 70E provides guidelines on selecting appropriate PPE based on the calculated incident energy levels.

What is the significance of the arc flash boundary in risk assessments?

The arc flash boundary is the distance from the source of an arc flash where the incident energy equals 1.2 cal/cm², which is the threshold for a second-degree burn. It helps determine safe working distances.

How does NFPA 70E guide employers in training employees about arc flash risks?

NFPA 70E requires employers to provide training on electrical safety, including arc flash risks, safe work practices, and the proper use of PPE to ensure workers understand and can mitigate hazards.

What is the process for determining the arc flash hazard category?

The arc flash hazard category is determined based on the incident energy analysis, which considers factors like equipment type, fault current, and clearing times to assign a category that dictates required PPE.

What changes were made in the latest edition of NFPA 70E regarding arc flash assessments?

The latest edition of NFPA 70E emphasizes risk assessment as an ongoing process, updates requirements for documentation, and provides clearer guidelines for establishing safe work practices.

How can organizations ensure compliance with NFPA 70E regarding arc flash risk assessments?

Organizations can ensure compliance by regularly conducting risk assessments, maintaining accurate documentation, providing employee training, and updating safety practices based on the latest NFPA 70E standards.

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