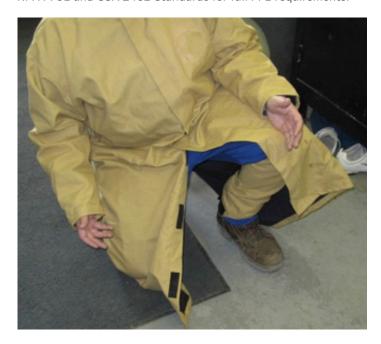# Long Coat Protection Concerns

Based on the original white paper published by Dr. Tom Neal.

OBERON

OVERVIEW

The "Long Coat" design arc flash suit can potentially expose an electrical worker to an arc flash hazard. The Long Coat style, otherwise referred to as a smock or lab coat, is designed to be worn as an over coat with leggings to create a full garment system. The coat is long enough to extend down below your knees but above your ankles. The leggings are designed to cover your lower legs from the knees down to the top of your footwear. Appropriate arc-rated face and head protection, i.e. arc flash suit hood, along with hand and foot protection is required to complete the protective system for full body coverage. Refer to the NFPA 70E and CSA Z462 Standards for full PPE requirements.

POPULARITY

Without realizing the dangers of this design, electrical workers have requested this type of arc flash suit for ease of use. Donning the Long Coat is much faster than any other arc flash suit design. The length of the coat fits a wide variety of sizes so the Long Coat style is perceived as the best type of arc flash suit for sharing amongst workers. However, the protection concerns of this design far outweigh the benefits.

LONG COAT DESIGN ISSUES

The Long Coat design has several potential protection issues:
- A floor level arc flash event can expose the worker's thighs and crotch.
- The Long Coat front closure does not extend to the bottom of the coat so the coat panels will flap open during the arc flash blast.
- The super-heated gases emanating from a floor level arc flash incident will tend to be directed upward and can move up under the opening of the long coat.
- The leggings extend only up to the bottom of the knee and thus do not provide protection for the knee, thigh and crotch areas.
- Workers can forget (or ignore) the need to wear leggings to complete the protective system.
- If non-FR clothing is worn under the long coat; it can ignite at the knee, thigh and crotch areas and burn upward onto the torso due to the creation of a chimney effect under the long coat.
- When workers who are wearing a long coat arc flash design are crouching or kneeling:
    - They tend to move their legs farther apart to widen their stance in order to better maintain their balance.
    - They may also lift up the coat to assist in establishing a wider stance. This leaves the knees, thighs and crotch vulnerable to direct exposure.
- Difficult to use properly because the correct way to use a Long Coat when kneeling involves tucking the coat under the knees as the worker assumes the kneeling position, but this is much easier said than done.

FLOOR LEVEL ARC FLASH EXPOSURE

Figure 1 shows a floor level breaker compartment that was the site of an arc flash incident at a large chemical company. The incident energy for this arc flash exposure was estimated to be approximately 80 cal/cm2. The workers involved were wearing two layers of flame resistant (FR) material. The compartment door extended from floor level to approximately 12" above floor level. During the arc flash incident, the compartment door blew open and exposed the legs of the workers.

Figure 1: Arc Flash in a Floor Level Compartment

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FR CLOTHING DAMAGE PATTERNS

Figure 2 shows the FR clothing the workers were wearing. Even though the source of the arc flash exposure ranged from floor level to approximately 12" above floor level, the thermal damage on the FR coveralls extends to the crotch area and above. This is due to the "arc blast" convective energy emanating from the compartment and being deflected upward as the compartment door is blown open and also due to the tendency of super heated gases emanating from the compartment to rise.

Figure 2: Two Layers of FR Coveralls after the Floor Level Arc Flash Incident

ARC-IN-A-BOX CONFIGURATION

Figure 3 shows the tendency for heat to expand and project both above and below an open enclosure for an "arc-in-a-box" configuration. Adding the confining geometry of the door and the floor as is shown in Figure 1, causes the super heated gases to move upward and to the side of the door that has blown open.

Figure 3: Arc-In-A-Box Flash Incident

NFPA 70E Arc Flash PPE Selection

NFPA 70E guidelines for approved arc flash PPE selection can be found in Table130.5(G) when using the Incident Energy Method and Table 130.7(C)(15)(c) when using the PPE Category Method. It is important to note that Long Coats and Leggings are *not* listed in either of these tables and thus are not endorsed by NFPA 70E as an approved method of arc flash PPE.

TYPES OF ARC FLASH SUITS

There are three basic types of arc flash suits available;
• Coat, Bib-Overall & Hood.
• Coverall & Hood.
• Long Coat, Leggings & Hood.

The most protective design is the Coat, Bib-Overall & Hood design. This is due to the overlapping design that creates layer on layer of protection. This design is also easier to use as compared to coveralls, because when a worker no longer is required to wear their arc flash suit, they can remove the hood and coat portions, leaving only the bib-overalls on. Before they need the arc flash suit again (i.e. re-energization), they can easily don the coat and hood as required.

BENEFITS FROM LAYERING

Overlapping areas of an arc flash suit design increase the protection for workers. The Coat, Bib-Overall and Hood design from Oberon is designed to overlap on the front of a workers torso area. This is important for extra protection of a workers vital organs in the event of an arc flash exposure. The combined protection created by the multiple layers is significantly higher than an individual layer. During an arc flash exposure the arc can move closer to the worker, resulting in increased thermal exposure. The overlapping design provides extra protection to prevent worker injuries when this occurs. When testing at a laboratory, you can see evidence of charring on the inside of an arc flash suit where the arc had moved closer to the material.