Summary of relevant information contained in NFPA 70E Electrical Safety in the Workplace

Scope:

Key Definitions:

Arc Rating: The maximum incident energy resistance demonstrated by a material (or a layered system of materials) prior to breakopen or at the onset of a second-degree skin burn. Arc rating is normally expressed in cal/cm2.

> **Arc Thermal Performance Value (ATPV):** The incident energy on a material that results in sufficient heat transfer through the material for a 50% probability of the onset of a second-degree burn on human tissue.
>
> **Breakopen Threshold Energy (E_{BT}) or Breakopen Threshold Energy Above Stoll (E_{BTAS}):** The energy needed to cause the material to breakopen.

Calorie: Energy measurement used to characterize the amount of arc flash energy which is required to cause a second degree (blister burn) on human skin. Without protection, according to the Stoll Curve, it takes about 1.2 cal/cm² to cause a second degree burn.

Exposed (as applied to live parts): Capable of being inadvertently touched or approached nearer than a safe distance by a person. It is applied to parts that are not suitably guarded, isolated, or insulated.

Flame-Resistant (FR): The property of a material whereby combustion is prevented, terminated, or inhibited following the application of a flaming or non-flaming source of ignition, with or without subsequent removal of the ignition source.
FPN: Flame resistance can be an inherent property of a material, or it can be imparted by a specific treatment applied to the material.

Flash Suit: A complete FR clothing and equipment system that covers the entire body, except for the hands and feet. This includes pants, jacket, and bee-keeper-type hood fitted with a face shield. Some companies for outdoor workers use their uniform clothing and arc thermal resistant raingear to provide the body protection and add the hood for protecting to higher levels.

Flash Protection Boundary: An approach limit at a distance from exposed live parts within which a person could receive a second degree burn if an electrical arc flash were to occur. This boundary for 480V is 4 feet for typical systems. Only a hazard analysis can let you know what this distance is. Working near exposed energized parts requires all clothing worn by the worker to meet the standard requirements.

Electrically Safe Work Condition: A state in which the conductor or circuit part to be worked on or near has been disconnected from energized parts, locked/tagged in

accordance with established standards, tested to ensure the absence of voltage, and grounded if determined necessary.

Protective Clothing Requirements:

Clothing: Must meet ASTM F1506 and provide adequate protection to meet the level of the hazard.
HRC 0 is natural fiber, non-melting clothing for very low level electrical hazards,
HRC 1 has a minimum Arc Rating of 4 cal/cm²
HRC 2 has a minimum Arc Rating of 8 cal/cm²
HRC 3 has a minimum Arc Rating of 25 cal/cm²
HRC 4 has a minimum Arc Rating of 40 cal/cm²

Rainwear: Must meet ASTM F1891. Rainwear is required to be arc thermal resistant as often as it is needed to be used. Melting rainwear does not meet the standard since these materials are excluded from all clothing in the standard. Using nylon or polyester rainwear is expressly excluded and puts one in non-compliance even if worn over arc rated clothing.

Flame Resistance: Rainwear material shall be flame resistant and shall not melt and drip when tested in accordance with ASTM D6413-99 and shall exhibit no more than a 2 second after flame time and less than a 6" char length.

Arc Thermal Performance: Rainwear material shall be tested in accordance with ASTM F1959, a design test, after 3 washings and 1 drying. Testing parameters are set at 8 kA arc current, 12" arc gap, 12" distance from the arc and stainless steel electrodes with a diameter of 0.75 inch. The following information is determined:

- Arc Thermal Performance Value (ATPV) – determine and report value; no minimum value established for conformance. A higher ATPV means it takes more arc energy to cause a second degree burn. ATPV is expressed in calories per centimeter squared (cal/cm^2).
- Breakopen Threshold Energy (E_{BT}) – if ATPV cannot be determined due to fabric breakopen occurring at a lower energy than burn injury, determine E_{BT} and report value; minimum value established at 5 cal/cm^2. A higher E_{BT} means it takes more arc energy to break open the material. E_{BT} is expressed in calories per centimeter squared (cal/cm^2).
- Arc Rating is based on either ATPV or on E_{BT} which ever is lower. When based on ATPV it is expressed as

Labeling Requirements:

- Manufacturer Label: States size, catalog number, manufacturer's name and notation of conformance to F1891, and the label is permanently affixed in each rainwear item.
- F1891 Label: States the Arc Rating (ATPV) or Arc Rating (E_{BT})