What is Arc Flash?

An arc flash is a voltage breakdown of the resistance of air resulting in an arc which can occur where there is sufficient voltage in an electrical system and a path to ground or lower voltage. The massive energy released in the fault instantly vaporizes the metal conductors involved, blasting molten metal and expanding plasma outward with extreme force, resulting in the destruction of equipment, fire, and injury to workers. The most common contributing factors to an initiation of an arc flash are:

- High concentrations of air impurities such as dust or water vapor;
- Surface contaminate build up between an energized part(s) and/or ground;
- Inadvertent contact causing a short circuit.

Once an arc has been initiated, the short circuit fault current is capable of producing a large amount of electrical energy. This energy can be converted into several other forms of hazardous energy, such as:

- Intense heat - temperatures up to 35,000^{o}F can radiate from the source.
- Toxic gases - the intense heat can vaporize metal and insulation material that can be inhaled by the worker, causing serious harm to the respiratory system.
- Shock waves - the intense heat can cause the air around the flash to expand rapidly, producing a shock wave capable of throwing a worker several feet away and possibly breaking bones.
- Blinding light — capable of causing temporary to permanent blindness.

An arc fault in open air will naturally radiate out, dispersing its energy in every direction. A fault within a confined space will direct its energy through the opening facing the worker, exposing the worker to a much higher level of fault energy.

"Standards and Codes"

As utility managers prepare to comply with all the mandates for worker safety, it may be difficult to understand which standards and codes apply in regards to arc flash hazards. The following list can help:

- NESC 410.A.3 – Applies to utilities (effective January 1, 2009)
- NFPA 70E - Applies to Industrial workplaces
- OSHA 29 CFR 1910.269 - Applies to electrical workers; developed prior to the 2009 changes adopted by the NESC
- ASTM F1506 - Applies to the protective clothing requirements
- IEEE 1584 - Used by all the above as guidelines in arc flash hazards

The pertinent standard for utilities is NESC 410.A.3. "Effective January 1, 2009, the employer shall ensure that an assessment is performed to determine potential exposure to an electric arc for employees who work on or near energized parts or equipment. If the assessment determines a potential employee exposure greater than 2 cal/cm^2 exists, the employer shall require employees to wear clothing or a clothing system that has an effective arc rating not less than the anticipated level of arc energy."

Arc Flash Assessment

The purpose of an arc flash assessment is to calculate the incident energy at each study location. The magnitude of the total energy (cal/cm^2 - cal = heat and cm^2 = surface area on the employee) emitted by an arc flash is a function of:

- Voltage;
- Fault current;
- Distance from the arc;
- Length of arc;
- Time it takes the protective device to clear the fault.

By assessing the incident energy, a determination can be made of the type of Personal Protective Equipment (PPE) required at each location and the arc flash protection boundary can be established. Additionally, tables 410 -1 and 410-2 located in the NESC 410 can be used to determine the clothing system required for voltages of 1000V and above.

IEEE Standard 1584-2004 recommends the following steps in an arc flash analysis:

- Collect system and installation data.
- Determine the system modes of operation.
- Determine the bolted fault currents.
- Determine the arc fault currents.
- Find the protective device characteristics and the duration of arcs.
- Document the system voltages and classes of equipment.
- Select the working distances.
- Determine the incident energy for all equipment.
- Determine the flash-protection boundary for all equipment.

These additional steps help translate the arc flash calculations into practical safety measures.

- Labeling of equipment
- Selection of proper PPE
- Training of employees