Arc Flash: NFPA 70E Workplace Safety
Drive for Technology Expo

Accelerate your Innovation with CMA/Flodyne/Hydradyne

April 15 -16, 2014 — Hanover Park, IL
Arc Flash: NFPA 70E
Workplace Safety

• Arc Flash Definition
• NFPA 70E
• Arc Flash Prevention
• Rittal Solutions
• Summary
What is Arc Flash?

- An arc flash is an explosion resulting from an electrical short circuit
- Air acts as a conductor to carry current which causes an arc fault
- This arc fault may be caused by a dropped tool, the buildup of conductive dust, or corrosion
- Arc flash explosions are very powerful and are capable of causing severe burns, injury, or death
What is Arc Flash?

- Arc flash is a serious hazard
  - 2,000 workers per year are admitted to burn centers for treatment of severe arc flash burns
- In the United States, the federal agency OSHA (Occupational Safety & Health Administration) regulates work place safety for arc flash
- OSHA’s rules are based on the requirements of the National Fire Prevention Association (NFPA)
  - NFPA 70E Standard

Source: Electrical Safety Foundation International (ESFI)
Arc Flash Statistics

Did you know?

- 5 to 10 arc flash accidents occur every day in the U.S.
- More than 2,000 people are treated annually in burn centers with arc flash injuries
- 1-2 deaths occur per day from an arc flash incident
- $1.5M average cost of medical treatment
- 8-12 months away from work and possibility of permanent disability
- $10-15M average litigation cost for general industry incident
- Two-thirds of all electrical injuries result from inappropriate action of a worker
- Arc Flash can reach temperatures upwards of 30,000°F (hotter than the surface of the Sun)
- Arc Blasts can produce a pressure wave greater than 2,000 lbs/sqft
- 480 volts often times has a greater Arc Flash potential than medium voltage gear (4,160V and above)

Source: Falcon Engineering Consultants
NFPA 70E

- Standard for Electrical Safety in the Workplace
  - The purpose of this standard is to provide a practical safe working area for employees relative to the hazards arising from the use of electricity
  - Tailored to fulfill OSHA’s responsibilities that is consistent with the NEC
  - Considered to be a manual of how to comply with OHSA regulations

- NFPA 70E covers Safety Related Work Practices, Safety Related Maintenance Requirements and Requirements for Special Equipment
  - Arc Flash Hazard Analysis (potential exposure to arc flash energy)
    - Determination of safe work practices, arc flash boundary, and appropriate levels of PPE (personal protective equipment)
### NFPA 70E

- **Arc Flash Boundary**
  - 3 feet at fewer than 750 volts
  - 19 feet at voltages of 15kV to 36kV

- **Arc Flash Boundary** – distance from an exposed energized electrical conductor or circuit – ref. 130.4 (c)(a,b)
  - Limited – shock hazard exists
  - Restricted – increased risk of shock from electrical over arc
  - Prohibited – considered same as making contact
NFPA 70E

- Labeling of Hazards
  - Energized panels or boards must be marked with danger or warning signs that indicate the potential hazard
NFPA 70E

- Personal Protective Equipment (PPE)
  - Protective clothing and equipment rated according to the amount of energy that would cause second-degree burns to exposed skin (5 J/cm²)
  - PPE is required if an employee must go within an arc flash boundary
    - Eye protection - face shield or safety glasses
    - Non-conductive head protection (when danger of head injury)
    - Body protection – arc rated clothing (must not melt below 600F)
    - Hearing protection
    - Hand and arm – in accordance to 130.7(c)(a-c)
    - Shock protection - rubber insulated gloves with leather protectors
    - Foot – insulated leather boots required when the arc flash energy level is high
NFPA 70E

- Personal Protective Equipment Levels
  - Additional equipment required other than listed below

PPE required for Hazard / Risk

**CATEGORY 0**
Protective Clothing, Non-melting or Untreated Natural Fiber (i.e. untreated cotton, wool, rayon, or silk, or blends of these materials) With a fabric weight of at least 4.5 oz/yd²
- Shirt (long sleeve)
- Pants (long)

**CATEGORY 1**
Arc-rated clothing, minimum arc rating of 4 cal/cm² (See Note 3.)
- Arc-rated long-sleeve shirt and pants or arc-rated coverall
- Arc-rated face shield (See Note 2.) or arc flash suit hood
- Arc-rated jacket, parka, rainwear, or hard hat liner (AN)

**CATEGORY 2**
Arc-rated clothing, minimum arc rating of 8 cal/cm² (See Note 3.)
- Arc-rated long-sleeve shirt and pants or arc-rated coverall
- Arc-rated flash suit hood or arc-rated face shield (See Note 2.) and arc-rated balaclava
- Arc-rated jacket, parka, rainwear, or hard hat liner (AN)

Source: Lewellyn Technology

**Least potential of arc flash danger**

**Highest potential of arc flash danger**
Routine Opening and Closing of Circuits

- Require load rated switches, circuit breakers, or other devices specifically designed as a disconnecting means... under load conditions
  - Means to shutoff/disconnect incoming power

- Lockout/Tag out
  - A lockout or tag out program is required when work must be done on machinery
    - Each worker has a lock or tag that is placed on the energy source before beginning work and removed when finished
    - The machine may be powered up only after determined the circuit can safely be energized and every lock or tag is removed
Examples of Isolating Main Line Side Power

- Small enclosure on main enclosure
  - Separate line side power outside main enclosure
  - Difficult to separate low and high voltage
  - Aesthetics not good
  - Un-useable floor space
  - Potential workplace obstruction hazard

- Small enclosure inside main enclosure
  - Line side power inside main enclosure in separate Type 1 enclosure
  - Live power still in enclosure being worked on

- Modular TS8 enclosure attached to enclosure suite
  - Separate line side power outside main enclosure
  - Aesthetics are pleasing
  - Cabinet can be used for other energized parts
  - Design allows for separation of high and low voltage
TS8 Modular Design Benefits

- Can isolate low voltage (<50v) components in separate cabinet to allow diagnostics and testing of energized compartment (minimal PPE)
- All cabinets can be interlocked (do not need to interlock low voltage if using barrier)
- Modular design allows expansion with standard components
- Aesthetics with out obstruction hazard
TS8 Modular Design Benefits

- Overhead Interlocking: Safety - doors cannot be opened when power is on
  - Disconnect and main line power in cabinet outside disconnect cabinet
  - If a low voltage is separated, cabinet no interlocking required
    - Allows access with minimal PPE
- Partition wall between enclosures to seal off access
TS8 Modular Design Benefits

- All enclosures separated by partition walls
- Control enclosures housing low voltage does not need to be interlocked

![Diagram showing isolation enclosure housing line side power, power enclosure for high voltage, and control enclosure for low voltage (<50v).]
Arc Flash Safety and Prevention

Arc Flash Assessment

- An arc flash assessment determines the potential for an arc flash (electrical arc) and the possible intensity of that arc flash
- This is critical information needed by anyone who will be working on or near energized electrical parts, switches, breakers or equipment
- Calculations can be found in IEEE 1584 (Guide for Performing Arc-Flash Hazard Calculations)
  - Standard of the Institute of Electrical and Electronics Engineers that provides a method of calculating the incident energy of Arc Flash events

Reasons to complete an arc flash hazard assessment

- Comply with NESC 410A3 (National Electric Safety Code) and the OSHA General Duty Clause (place of employment free from recognized hazards)
- Provides information required to be on arc flash labels
- Provides for the correct selection of (PPE)
- Allows complete and appropriate training to be provided
- Identifies the appropriate tools needed for working on energized equipment

Source: Steve Hudgik at www.arcflash.me
Arc Flash Safety and Prevention

- Conduct regular arc flash hazard assessments
- Reduce human error by offering regular safety training to personnel
- Ensure that workers wear necessary personal protective equipment and follow safety procedures
- Isolate main line side power to minimize exposure of personnel
TS8 Arc Flash Solution

- **Power Enclosure**
  (Higher Voltage)

- **Isolated Enclosure**
  (houses line side power)

- **Control Enclosure**
  (Lower Voltage)

- **Flange Mount Disconnect Door**
TS8 Arc Flash Solution

- Isolates lower voltage components from higher voltage components
- Configured standard TS8 component assemblies
  - Available now by ordering individual components and having our factory assemble
- Available as a specifiable part number
  - 16 part numbers satisfy most popular market needs
TS8 Arc Flash Solution

2 page brochure
Competitive Solutions

• Hoffman SEQUESTR®
  – Box on a Box
  – First to market
  – Specifiable Solution

• Saginaw
  – Box in a Box (Type 1)
    • Not well accepted
  – Box on a Box
    • Hoffman “me too” solution
Additional Arc Flash Solutions

Innovative and creative solutions to isolate voltage
Summary

• Arc flash accidents occur suddenly, causing serious injury and major down time within a fraction of a second
• It is up to individual facilities to ensure that they are compliant with NFPA 70E
• Risk of arc flash can be reduced by isolating line side power
• Sufficient arc flash safety helps to protect your most important asset: your people
Thank You

Any Questions??

Piero Fagiolo
Product Manager – Industrial Enclosures
Email: fagiolo.p@rittal.us
Phone: 224-244-1920