Mitigation Methods For Arc Flash Hazards - Enhancing Personnel Safety

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Arc Flash Characteristics

**Arc Blast & Arc Flash** occur together. The term Arc Flash often refers to both phenomena. From here on, the term Arc Flash will be used for both terms.

Enhancing Personnel Safety

5-10 Number of arc flash explosions that occur in electrical equipment every day in the United States

- According to statistics compiled by Cap-Schell, Inc., a Chicago-based research and consulting firm that specializes in preventing workplace injuries and deaths

2000 Each year the number of patients that are emitted to burn centers due to arc flash events

- Report by research on IEEE Website
Electrical Safety

- Electrical Safety Then and Now

- Workplace Electrical Injury and Fatality Statistics

What System Parameters Can Be Changed to Reduce AFIE?

- From IEEE 1584 Empirical Model:
  - System Voltage
  - Bolted fault current
  - Gap between conductors
  - Arcing time

- System voltage: Generally not practical to change
- Gap between conductors: Would require different equipment construction, not practical to change
- That leaves bolted fault current and arcing time

AFIE – Arc Flash Incident Energy
Effect of Changing Bolted Fault Current on AFIE

- Lower bolted fault current leads to lower arcing current
- Arcing current determines arcing time!
- Overcurrent protective devices, which define the arcing time, may take longer to trip with lower arcing current due to inverse time-current characteristics

Lower arcing current: 1s arcing time
Higher arcing current: 0.06s arcing time

Arc Hazard Control Hierarchy

1. Least Effective
   - Personal Protective Equipment (PPE)
2. Substitution
   - Zone Selective Interlocking (1)
   - Differential Relaying (2)
   - Energy-Reducing Maintenance Switch (3)
   - Arc Flash Detection System (4)
   - Arc Flash Extinguishing System (4)
   - Virtual Main (5)
   - Modified Breaker (5)
   - Breaker Instantaneous Trip Setting (5)

3. Engineering Controls
   - Electrical System Design
   - Safety by Design (Equipment Design)
   - AF Mitigating Features
   - Passive Arc Resistant Equipment

4. Administrative Controls
   - Policy
   - Regulation
   - NFPA70E
   - LOTO
   - Labels
   - Voltage Indicators

5. Ideal State
   - De-energize and Ground Equipment


-NEC 2014, Article 240.87
Changes on the Horizon

IEEE C37.20.7-2007

IEEE guide for testing metal-enclosed switchgear rated up to 38 kV for internal arcing faults

- A procedure for testing and evaluating the performance of metal-enclosed switchgear for internal arcing faults is covered. A method of identifying the capabilities of this equipment is given. Service conditions, installation, and application of equipment are also discussed.
IEEE C37.30.7 Product Annex (Proposed 2016 Revision)

Annex Listing

- Annex D: Metal-enclosed low-voltage power circuit breaker switchgear (IEEE Std C37.20.1)
- Annex E: Metal-clad switchgear (IEEE Std C37.20.2)
- Annex F: Metal-enclosed interrupter switchgear (IEEE Std C37.20.3)
- Annex H: Motor control centers (UL 845)
- Annex I: Medium-voltage ac controllers (UL 347)
- Annex J: Switchboards (UL 891)
- Annex K: Metal-enclosed bus (IEEE Std C37.23)

110.16(B) Arc Flash Hazard Marking

- NEC proposed 2017 First Draft (FD)
- Applies to service equipment
- Revision moves arc flash hazard communication into an installation enforcement position
- Determination of the level and boundary should be performed by a qualified person with supporting documentation provided to the Authority Having Jurisdiction (AHJ)
NEC 2017 (FD) ï Article 240.87

(B) Method to Reduce Clearing Time. One of the following or approved equivalent means shall be provided:

1. Zone-selective interlocking
2. Differential relaying
3. Energy-reducing maintenance switching with local status indicator
4. Energy-reducing active arc flash mitigation system
5. An instantaneous trip setting that is less than the available arcing current
6. An instantaneous override that is less than the available arcing current
7. An approved equivalent means

NEC 2017 (FD) ë NewArticle 240.67

240.67 Arc Energy Reduction. Where the ampere rating of the fusible switch is 1200 A or higher, 240.67(A) and (B) shall apply. This requirement shall become effective January 1, 2020.

(A) Documentation. Documentation shall be available to those authorized to design, install, operate, or inspect the installation as to the location of the fusible switch(es).

(B) Method to Reduce Clearing Time. One of the following or approved equivalent means shall be provided:

(1) Differential relaying
(2) Energy-reducing maintenance switching with local status indicator
(3) Energy-reducing active arc flash mitigation system
(4) A fuse that would open in 0.07 seconds or less, at or below the available arcing current
(5) An approved equivalent means
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- Don’t forget about the significance of the Arc Blast
- Use the graphic to better understand the Control Hierarchy
- NEC 2014 ‒ Article 240.87 Compliance
- Important changes coming

Questions?

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- 11:30 am - 4:00 pm NECA Show Hours