Electrical Safety Program
Arc-Flash
How It Impacts Projects

October 7, 2013
Our Obligation – Provide a safe work environment
What is Arc Flash?
How will this affect OPM Projects?
Creating and Maintaining Arc Flash Studies?
Arc Flash Study Flow Diagram
Expectations of OPM – AF Study
Our Obligation – Safe Work Environment

✉ Overall Requirements
- OSHA and NFPA 70E requires Duke to inform employees & contractors of work hazards, mitigate those hazards where possible and provide information regarding appropriate PPE.
- Comply with Duke’s Electrical Safety Program & other Work Procedures
- FMD’s Electrical Safety Program (ESP) is based entirely upon:
  • OSHA Electrical Safe Work Practices
  • NFPA 70E: Standard for Electrical Safety in The Workplace®

✉ FMD ESP applies to:
1. All FMD employees and contractors working at Duke involved in any electrical work over 50V.
Providing an Electrically Safe Work Environment

- Three types of electrical hazards
  - Electrical Shock
  - Arc Blast [http://www.youtube.com/watch?v=4bBvmPRqfmo](http://www.youtube.com/watch?v=4bBvmPRqfmo)
  - Arc Flash (burns) [http://www.youtube.com/watch?v=xCwVnWp6YhU](http://www.youtube.com/watch?v=xCwVnWp6YhU)

- An Arc Flash Study will be conducted for every building on campus *(In-progress)*

- Each study will produce labels identifying the Hazard Category, Available Fault Current, Voltage, **PPE Required**, and Approach Distances at each electrical panel.
Arc Flash: An electrical breakdown of a gas which produces an ongoing plasma discharge, resulting from a current flowing through normally nonconductive media such as air.

- Plasma temperature can reach 35,000° F.
- Fatal burns can occur at distances over 10 feet.
- Over half of arc flashes occur at 277 volts.
- Energy released is measured in calories.
### Shock/Arc Flash Labeling

**WARNING**

**Arc Flash and Shock Hazard**

<table>
<thead>
<tr>
<th>Appropriate PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 inches</td>
</tr>
<tr>
<td>0.63 cal/cm^2</td>
</tr>
<tr>
<td>Category 0</td>
</tr>
<tr>
<td>10.81 kA</td>
</tr>
<tr>
<td>480 VAC</td>
</tr>
<tr>
<td>00</td>
</tr>
<tr>
<td>42 inches</td>
</tr>
<tr>
<td>12 inches</td>
</tr>
<tr>
<td>1 inches</td>
</tr>
</tbody>
</table>

**Panel:** SWBD-MDP(PG4)  

Jacobs Engineering Group  
111 Corning Road, Suite 200  
Cary, NC 27518

**Job#: FEWE0801**  
**Prepared on:** 07/06/12  
**By:** EHL

*Warning: Changes in settings or configuration will invalidate the calculated values and PPE requirements*
Hazard Risk Category (HRC) – Utilize Table 3 For PPE

<table>
<thead>
<tr>
<th>Hazard Risk Category (&quot;PPE Category&quot;)</th>
<th>Incident Energy (Calories/cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>≤ 1.2</td>
</tr>
<tr>
<td>1</td>
<td>1.2 – 4</td>
</tr>
<tr>
<td>2</td>
<td>4.1 – 8</td>
</tr>
<tr>
<td>3</td>
<td>8.1 – 25</td>
</tr>
<tr>
<td>4</td>
<td>25.1 – 40</td>
</tr>
</tbody>
</table>
# Shock/Arc Flash Labeling

## Danger

**No safe PPE exists**

**Energized work prohibited**

| 189 inches | Flash Hazard Boundary |
| 57 cal/cm² | Flash Hazard at 18 inches |
| Dangerous! | No FR Category Found |
| 26.73 kA | Available Fault Current (Isc) |
| 208 VAC | Shock Hazard when cover is removed |
| 00 | Glove Class |
| 42 inches | Limited Approach |
| Avoid Contact | Restricted Approach |
| Avoid Contact | Prohibited Approach |

Panel: PNL-DOP-P (0021)
Duke Electrical Safety Policy – What to Expect

- OSHA and NFPA 70E both **require de-energization to work on circuits** above 50V unless it creates a higher hazard or is infeasible.

- Examples of higher hazard are:
  - Interruption of life support systems
  - Deactivation of life safety alarm systems
  - Shutdown of ventilation equipment serving a Classified Hazardous Location

- Infeasible example: Testing & troubleshooting typically require circuits to be energized. It is infeasible to perform these tasks with the circuit de-energized.

- Feasible example: Changing a receptacle that is on the same circuit as the room lighting. It is feasible to provide temporary lighting so this circuit can be de-energized.

- De-energized condition is always the goal!

*Also, it’s the right thing to do!*
Maintaining Accurate Labels

- Duke is required to maintain and update AF labels as changes are made to the electrical system.
  - FMD-Engineering will be responsible for updating all existing AF Models and Labels as changes are made to a building’s electrical system.
  - Engineering, MS Shops, and OPM must work together to maintain accurate AF models and labels by documenting changes to a building’s electrical system as they occur.
3 Types of Projects

- **New Construction:**
  - Will include design of entirely new electrical system
    - i.e. new building
  - Designer shall complete full Arc Flash Study (SKM model) per Duke University Design Guidelines website – [16570 – Arc-Flash Studies](#)
  - Labels must be applied prior to building acceptance
  - SKM model must be turned over to FMD

- **Major Renovation:**
  - Will include design to extensively modify or replace existing electrical system
    - i.e. adding/removing/replacing several pieces of electrical equipment
  - Designer shall complete full Arc Flash Study (SKM model) per Duke University Design Guidelines website – [16570 – Arc-Flash Studies](#)
  - Labels must be applied prior to building acceptance
  - SKM model must be turned over to FMD

- **Selective Renovation:**
  - Small jobs requiring little modification to electrical system model
    - i.e. replacing device protection serving only 1 or 2 panels
  - If an AF Study exists, FMD-Engineering shall update existing model and provide new labels.
  - If a study does not exist, a partial study shall be completed and partial labels shall be provided (partial studies may be done in-house or by one of our AF consultants depending on scope and workload).
When is an AF Model Update Required?

✍ Update Required if:
  - Work that alters existing Available Fault Current or Clearing Time.
  - Add / Remove / Replace equipment with Overcurrent Protection Devices
    - Switchboards
    - Metal-Clad Switchgear
    - Panelboards
    - Motor Control Centers (MCC)
    - Circuit Breakers
    - Fused Disconnects
    - Fuses
  - Adjustment to Breaker Settings

✍ Update NOT Required if:
  - Install new Feeders / Cables without new Panel
Expectations of OPM – AF Study

- Coordinate with FMD-Engineering during the early stages of electrical system projects that may affect Arc Flash models. Send written notice to Bill Jordan.

- Ensure New Construction & Major Renovation projects includes AF Study in scope & cost estimate.
  - Allow time & cost for data collection, study, and review
  - Ensure all labels are applied prior to building acceptance
  - Refer to Duke University Design Guidelines website
    - 16570 – Arc-Flash Studies

- Ensure preliminary AF study is completed and submitted for approval prior to construction

- Ensure final study is submitted and labels are applied at project completion

- Compliance with FMD Electrical Safety Program is a requirement.
  - OPM shall notify Contractor of FMD’s ESP
  - OPM shall verify Contractor has a their own ESP that complies with OSHA and NFPA
  - OPM shall verify Contractor has trained, qualified personnel to complete work.
Condition associated with the possible release of energy caused by an electric arc. A condition may exist when energized electrical conductors or parts are exposed or when an individual is interacting with the equipment or device in a manner that could cause an electric arc. Equipment operating automatically that has been properly installed and maintained is not likely to pose an arc-flash hazard.
Possible Triggers of Arc Flash

- Panelboards 240V & Below
  - Voltage testing
  - Remove/install breakers
  - Remove bolted covers
- Panelboards 240V to 600V
  - Same as above
  - CB or switch operation with cover open
- Switchboards/Switchgear 240V to 600V
  - Same as above
  - Work on 120V control circuits
  - Opening hinged covers
  - Racking breakers w/doors open or closed
  - Application of grounds