

Marine Arc Flash Hazard

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! WARNING

**Arc Flash and Shock Hazard
Appropriate PPE Required**

| | |
|----------------|-----------------------------------------------------|
| 19 inch | Flash Hazard Boundary |
| 1.29 | cal/cm² Flash Hazard at 18 inches |



US Army Corps of Engineers
BUILDING STRONG

OUTLINE

- General Arc Flash Hazard Info
- USACE Arc Flash Hazard Policy
- Marine Arc Flash Hazard Considerations



Hazards Associated with Arcing Faults

- **Arc Blast**

Large current arcing through air
Temperature nears 35,000 degF

- **Thermal Radiation**

Impact depends on clothing,
area exposed

- **Pressure Wave**

Force from blast
25kA @ 2 ft = 480 pounds

- **Projectiles/Debris**

Molten metal, debris



Hazards Associated with Arcing Faults

➤ **IEEE 1584** - Estimating Incident Energy and Arc Flash Protection Boundary

➤ **Incident Energy (cal/cm^2)** – Function of:
Fault Current Available
Clearing Time Duration
Distance from Arc



Causes of an Arc Flash

Most common causes of Arc Flash:

- Switching Operations: Unavoidable, but switchboard design can help to mitigate the effect, e.g. the use of arc chutes;
- Equipment Failure & Degradation: This can include the breakdown of insulation via partial discharge, damage to equipment from external influences and creepage and clearance faults;
- Human Error: Dropping tools across live conductors, accidental contact with energized parts;
- Improper Work Procedure: Incorrect live working on exposed conductors or the removal of covers for maintenance of energized equipment;
- Environmental Conditions: Dirt (or even dust) build-up on exposed conductors, or organic compounds (e.g. oil) in the atmosphere surrounding the conductors.

The most common cause of an Arc Flash is human error, therefore:

- The majority of Arc Flash events occur when equipment is being worked on;
- Personnel are often in the vicinity, meaning a high chance of injury.



Arc Flash Risk Mitigation

Prevention – The best way to deal with the risk of the arc flash hazard is to stop the arc flash event from occurring

Protection - Both personnel and ships systems need to be protected from injury and damage



Arc Flash Risk Mitigation

- **Prevention**

- Remote Operations: Racking of breakers, Switching
- Switching Operations: Internal arc qualified switchgear (arc chutes)
- Operating procedures: De-energize equipment, second person a safe distance away, equipment maintenance, thermal surveys
- Tooling: Use insulated tools
- Training: Ensure personnel have awareness of Arc Flash



Arc Flash Risk Mitigation

Protection

- **Minimize Available Fault Current** – Minimize the amount of online generation.
- **Arcing Time** – Light and current-based protection can be set up with dedicated Arc Flash protection relays
- **Distance** – Remote operation
 - Increased distance = Lower level of incident energy
- **Personal Protective Equipment**

| ! WARNING | |
|----------------------------------------------------------------|-----------------------------------------------|
| Arc Flash and Shock Hazard Appropriate PPE Required | |
| 19 inch | Flash Hazard Boundary |
| 1.29 | cal/cm ² Flash Hazard at 18 inches |
| Class 0 | Untreated Cotton |
| 480 VAC | Shock Hazard when cover is removed |
| 42 inch | Limited Approach |
| 12 inch | Restricted Approach |
| 1 inch | Prohibited Approach |
| Bus Name: | MDP, Prot Device: MA 800A |



Arc Flash Standards

- **Shoreside Standards**

- IEEE 1584 - Guide to Performing Arc Flash Calculations
- NFPA 70 - National Electrical Code®
- NFPA 70E - Standard for Electrical Safety in the Workplace
 - This standard does not cover safety-related work practices for installations in ships, watercraft
- OSHA 1910 and OSHA 1926

- **U.S. “Marine” Arc Flash Standards = None**

- USCG is the U.S. Marine Regulatory Agency
- Mitigation Required by Shoreside Standards May Conflict with USCG Regulations



USACE Arc Flash Policy

- **ER 385-1-100 USACE Arc Flash Hazard Program**
 - Not Published yet on USACE Website
 - Specifically Includes Floating Plant in Scope
 - However Silent on Applicability of USCG Rules
 - Invokes NFPA 70E - Standard for Electrical Safety in the Workplace
 - This standard specifically excludes safety-related work practices for installations in ships, watercraft
- **EM 385-1-1 USACE Safety Manual**
 - Arc Flash Requirements included in Section 11
 - Relationship of Section 11 to Section 19 (Floating Plant)?



USACE Arc Flash Policy

- **MDC Comments to ER 385-1-100**

2-4. Hazard Mitigation. Hazard mitigation shall be completed by applying the Hierarchy of Controls to remove, reduce, or achieve an acceptable level of risk. For arc flash hazards on U.S. Coast Guard inspected USACE Floating Plant, hazard mitigation must not violate applicable USCG protective device coordination requirements, thereby maintaining the reliability of the vessel's electrical power and distribution systems.



Marine Arc Flash Summary

- The Arc Flash hazard on Marine Vessels needs to be recognized and assessed, and appropriate control measures should be put in place so that both personnel and essential equipment may be adequately protected.
- Personnel need to be made aware of the Arc Flash hazard through training.
- Prevention is about engineering Arc Flash out of new designs and reducing its likelihood in existing plant, noting many causes are still currently due to human error and equipment failure
- Protection in most cases is very much a last line of defense



DISCUSSIONS/QUESTIONS

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