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## Arc Flash Safety Guide for Field Technicians and Engineers

*(Medium & High Voltage Systems)*

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### 1. Introduction: Why Arc Flash Safety Matters

Arc flash is one of the most dangerous hazards in electrical work. It occurs when an electrical current leaves its intended path and travels through the air between conductors or from a conductor to ground. The results can be catastrophic: temperatures hotter than the surface of the sun, molten metal, pressure waves, shrapnel, and blinding light.

#### Key risks include:

- Severe burns (often fatal within seconds)
- Blast pressure causing blunt trauma or ruptured eardrums
- Flying molten copper/aluminum shrapnel penetrating PPE
- Secondary fires and equipment damage
- Long-term health effects: PTSD, hearing/vision loss, chronic injury

**Takeaway:** No job is worth cutting corners. The best arc flash defense is awareness, preparation, and prevention.

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### 2. Arc Flash Awareness

Before approaching any medium- or high-voltage gear, new techs and engineers must understand:

- **Where Arc Flash Happens:**
  - Switchgear, switchboards, MCCs, panelboards, and transformers
  - Energized busbars, circuit breakers, contactors, and disconnects
  - Improperly racked breakers, corroded terminations, or failed insulation
- **Common Causes:**
  - Dropped tools or loose hardware

- Incorrect racking or removal of breakers
- Failure to verify absence of voltage
- Defeated or bypassed interlocks
- Inadequate maintenance leading to degraded insulation or loose connections
- **Warning Signs:**
  - Equipment humming, buzzing, or smelling like ozone/burning insulation
  - Visible damage (pitting, discoloration, cracks)
  - Heat at terminals or unexpected hot spots (use IR thermography when safe)

**Golden Rule:** Treat all gear as energized until proven otherwise with proper testing.

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### 3. Preparedness: Planning Before the Job

Preparation is 90% of arc flash prevention.

#### 3.1 Documentation & Work Planning

- Review **one-line diagrams** and protective device coordination studies.
- Consult the **Arc Flash Hazard Analysis/Labeling** for each piece of gear.
- Understand the **incident energy levels** and PPE category.
- Prepare **switching orders** and **lockout/tagout (LOTO)** sequences.

#### 3.2 Job Briefings

- Hold a **tailboard / job hazard analysis (JHA)** before beginning work.
- Confirm roles: who is qualified, who observes, who communicates with system operations.
- Identify **energized work boundaries** (limited, restricted, prohibited).
- Establish an **escape path** in case of failure.

#### 3.3 Tools & Test Equipment

- Voltage detectors (rated for system voltage)
- Properly rated insulated tools

- Arc-flash shields, barriers, and hot sticks as applicable
  - Ensure **calibration is current** on all test gear
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## 4. PPE and Arc Flash Boundaries

### 4.1 Arc Flash PPE

PPE is the **last line of defense**. Always wear equipment rated above the calculated incident energy.

- **Clothing:** Arc-rated (AR) shirt, pants, and coveralls (no synthetics)
- **Head/Face:** Arc-rated hood or face shield with balaclava
- **Hands:** Voltage-rated gloves with leather protectors
- **Feet:** EH-rated leather boots (no steel toes unless AR rated)
- **Hearing:** Ear canal inserts (arc blasts rupture eardrums)

### 4.2 Approach Boundaries (per NFPA 70E)

- **Limited Approach:** Distance an unqualified person must stop
- **Restricted Approach:** Only qualified workers with PPE and justification may cross
- **Prohibited Approach (legacy term):** Essentially contact—treat like live conductor

Always establish **arc flash boundary distance**, where incident energy exceeds **1.2 cal/cm<sup>2</sup>**.

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## 5. Safe Work Practices

### 5.1 Verification and Lockout/Tagout

- Test for absence of voltage **using the live-dead-live method**
- Apply LOTO devices to all energy sources (including backfeeds and DC storage)
- Ground conductors when required, especially in medium/high voltage

### 5.2 Energized Work

Work on energized equipment is only justified if:

1. De-energizing introduces greater hazards (e.g., hospitals, grid stability)

2. Equipment design does not permit shutdown
3. Testing/diagnostics require it

If energized work is required, **obtain written Energized Electrical Work Permit (EEWP)** and follow strict procedures.

### **5.3 Housekeeping**

- Keep work areas clean and uncluttered—dropped tools are common arc initiators
  - Use insulated mats and barriers where possible
  - Maintain clear access to egress routes
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## **6. Prevention and Maintenance**

### **6.1 Preventive Maintenance**

Arc flash risk increases with poorly maintained gear:

- Tighten terminations to torque specs
- Perform IR scans and ultrasonic inspections
- Clean dust/debris (especially conductive dust)
- Test protective relays and breakers regularly

### **6.2 Engineering Controls**

- Arc-resistant switchgear construction
  - Remote racking devices and remote switching
  - Current-limiting fuses and fast-acting relays
  - Proper labeling and signage
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## **7. Emergency Response**

Even with preparation, incidents may occur.

- **If Arc Flash Happens:**
  - Do not rush in—shut off power if possible

- Only trained personnel with fire-rated PPE should attempt rescue
  - Call emergency services immediately
  - Provide first aid for burns only if safe
  - **First Aid Basics:**
    - Remove smoldering clothing if safe
    - Do not apply ointments—cover burns with sterile dressings
    - Treat for shock (lay flat, keep warm) until EMS arrives
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## 8. Key Takeaways

- Always assume equipment is energized until proven otherwise
- Preparation, planning, and PPE save lives
- LOTO is non-negotiable
- Maintenance and engineering controls reduce risk
- Never compromise safety for speed or convenience

**Remember:** Arc flash doesn't give second chances. Every decision you make in the field matters—for you, your crew, and your family.