

GE
Electrical Distribution

How to reduce exposure to arc flash hazards

Multiple solutions for new and existing facilities



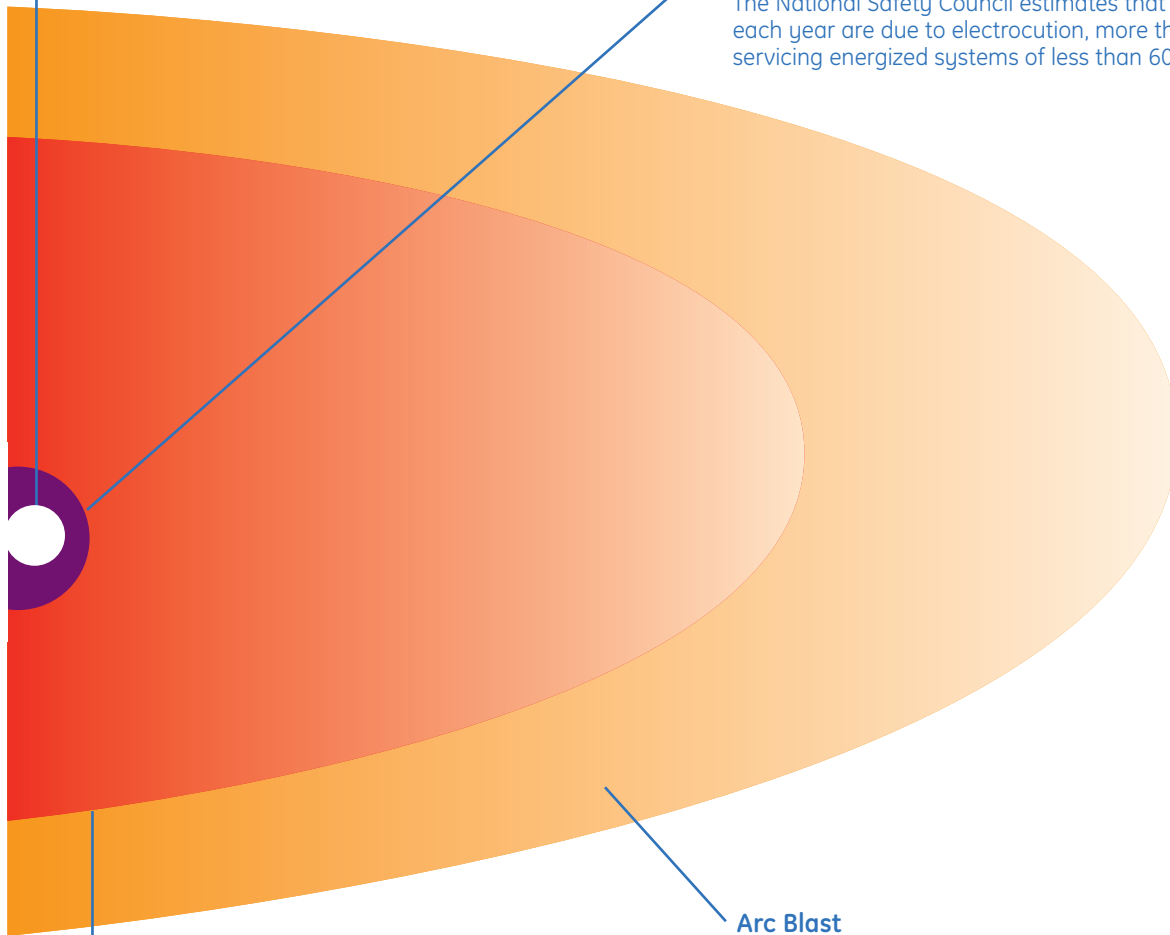
imagination at work

Multiple Issues



Today's power system engineer must not only assure that the facility receives all the power it needs efficiently and reliably, it is also important to make sure it is done as safely as possible, without loss of reliability, and under tight budgetary constraints.

Energized circuit/conductor



Electric Shock

Approximately 30,000 nonfatal shock accidents occur each year. The National Safety Council estimates that about 1,000 fatalities each year are due to electrocution, more than half of them while servicing energized systems of less than 600 volts

Arc Flash

When an electric current passes through air between ungrounded conductors, or between ungrounded conductors and grounded conductors, the temperatures can reach 35,000°F. Exposure to these extreme temperatures both burns the skin directly and causes ignition of clothing, which adds to the burn injury. The majority of hospital admissions due to electrical accidents are from arc-flash burns, not from shocks. Each year more than 2,000 people are admitted to burn centers with severe arc-flash burns. Arc-flashes can and do kill at distances of 10ft (3m).

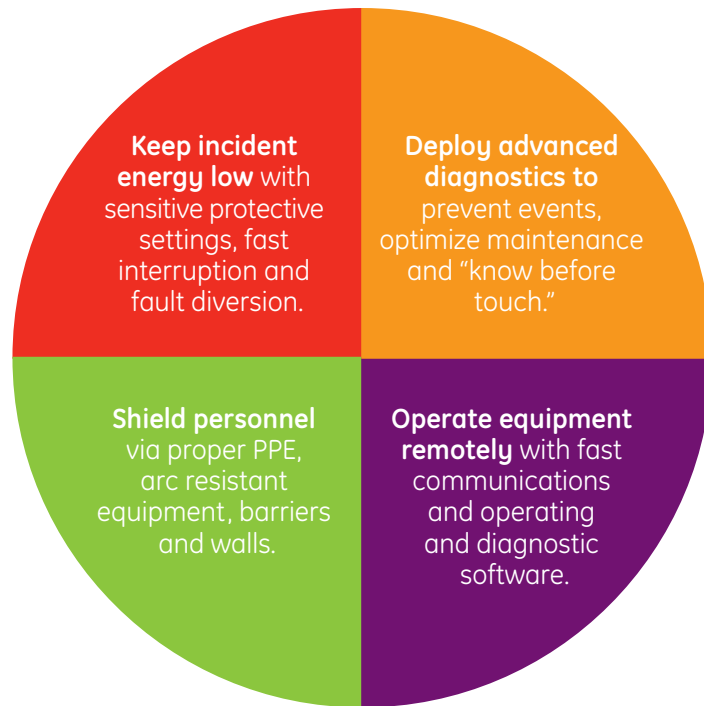
Arc Blast

The tremendous temperatures of the arc cause the explosive expansion of both the surrounding air and the metal in the arc path. For example, copper expands by a factor of 67,000 times when it turns from a solid to a vapor. The danger associated with this expansion is one of high pressures, sound, and shrapnel. The high pressures can easily exceed hundreds or even thousands of pounds per square foot, knocking workers off ladders, rupturing ear drums, and collapsing lungs. The sounds associated with these pressures can exceed 160dB. Finally, material and molten metal is expelled away from the arc at speeds exceeding 700 mph (1600 km/hr), fast enough for shrapnel to completely penetrate the human body.

Being near live electrical equipment is dangerous, whether shock or arc flash hazard. GE solutions exist to help reduce hazard risk levels in a wide range of conditions and needs.

Multiple Solutions

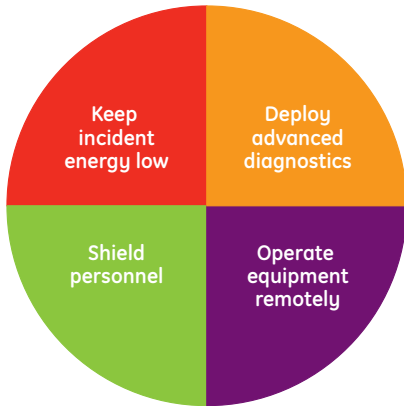
Arc flash hazard exposure is a function of fault clearing time at an arcing current and a worker's distance from the event. Multiple techniques can be employed to limit exposure.



GE delivers multiple products and services that minimize exposure in both new and existing facilities.

	Keep incident energy low	Deploy advanced diagnostics	Operate equipment remotely	Shield personnel
Entellisis® low-voltage switchgear	●	●	●	
AKD-20 low-voltage switchgear	●	●	●	
Evolution Series E9000® motor control centers	●	●		
Arc-resistant medium-voltage switchgear				●
EntelliGuard® TU trip units	●			
Circuit breaker and trip unit test kits		●		
Remote racking devices			●	
Arc flash hazard analysis				●

Multiple Solutions



Entellisys® 4.0 low voltage switchgear

Keep incident energy low

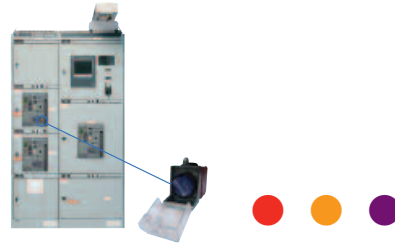
- Based on IEEE testing, arcing faults are approximately 43-60% of bolted fault levels. Bus differential will identify these levels and act fast, while maintaining 100% selectivity, by seamlessly working with dynamic zone selective interlocking
- Reduced temporary settings for individual circuit breakers or any system subset
- Time delays as fast as 1.5 cycles minimize clearing time

Deploy advanced diagnostics

- Integral metering capability at every circuit breaker
- System-wide waveform capture is synchronized to within a few microseconds
- Monitoring of every pickup, control signal and trip event synchronized with waveform capture
- Contact wear prediction and circuit breaker mechanism timing enabled
- Up to 128 programmable I/O plus ability to include internal protective pickups in control logic

Operate equipment remotely

- HMI screen allows complete diagnostic and control access up to 300 feet away
- Remote control stacks allow maintenance of most components with no exposure to high incident energy levels
- Internet software affords secure access via networked computers
- Feeder level HRG fault identification minimizes dangerous location troubleshooting



AKD-20 low voltage switchgear

- Epoxy bus insulation, complete live bus and compartment isolation, compartmentalized control wiring and automatic shutter system minimize arcing fault generation
- Non-vented front panels keep probability of arc effluent exiting towards operating personnel low
- Infrared port access, hinged equipment panels, control circuitry drawers and remote communications improve maintenance results
- Fast, ultra-selective protection provided by EntelliGuard G circuit breakers and EntelliGuard TU trip units
- Temporary extra-sensitive, faster protection (usually HRC1 or HRC2 protection levels) delivered by RELT (Reduced Energy Let-Through) settings with positive status indication



Evolution Series E9000® motor control centers

- Starters up to 600A protected by current limiting circuit breakers and motor circuit protectors minimize incident energy
- Fully insulated horizontal bus, fully compartmentalized horizontal bus, fully isolated vertical bus bars minimize risk of arcing energy
- Electronic monitoring allows advanced monitoring, diagnostics and communication capability, minimizing the need for hands-on maintenance
- Visible blade disconnect option available
- IP20 and separable terminal blocks minimize risk of shock during work in starter cubicles
- EntelliGuard TU reduces incident energy at main bus, often without loss of selectivity, and RELT (Reduced Energy Let-Through) settings provide fast, extra-sensitive protection when needed



Arc-resistant medium voltage switchgear

Arc-resistant switchgear channels the energy released during an internal arc fault in ways that minimize the potential for injury to personnel and damage to surrounding equipment. It's available in ANSI Type 1 or Type 2 construction, with a footprint no larger than the standard switchgear design. Circuit breakers are interlocked for added protection. An optional plenum allows for indoor construction.



Circuit breaker and trip unit test kits

Testing can put maintenance personnel at risk; not testing can imperil operating personnel and system reliability. GE's fast, easy-to-use test kits can confirm trip and circuit breaker operation with minimal time and trouble, reducing risk to all personnel and to operations.



EntelliGuard® TU trip unit

Industry-leading capabilities optimize selectivity and mitigate arc flash hazards.

- Waveform recognition instantaneous algorithm provides optimized selectivity
- Instantaneous zone selective interlocking allows fast and sensitive protection as well as simultaneous selectivity up to 100kA for mains and ties
- RELT (Reduced Energy Let-Through) settings with positive status indication provide extra sensitive and fast protection
- Up to 44 different long time delay bands in two distinct shapes
- Up to 11 short time delays as fast as 1.5 cycles to commit
- Multiple short time I²t curves set selectively without sacrificing protection
- Four different ground fault curve shapes provide optimal selectivity when implementing ground fault protection in systems with circuit breakers or fuses
- Metering, waveform capture, protective relays, Modbus and Profibus communications
- Plug-and-play upgradeability for a wide range of low voltage power circuit breakers



Remote racking devices

With our remote racking device, maintenance personnel can rack low voltage breakers in and out from as far away as 30 feet for greater arc flash protection. It connects easily to WavePro®, EntelliGuard and medium voltage PowerVac® circuit breakers.



Arc flash hazard analysis

Understand your potential risk by performing an arc flash hazard analysis in your facility. We can calculate the NFPA-based level of Personal Protective Equipment (PPE) required in a given environment and communicate PPE and approach distance to exposed energized equipment through a warning label system.

How GE helps lead the way in reducing arc flash hazards



Arc flash hazard analysis

GE's comprehensive arc-flash hazard study, designed to assist in addressing the recommendations of the National Fire Protection Association's (NFPA) Standard 70E, helps promote employee safety against dangers associated with the release of energy caused by an electrical arc. Key elements of an arc-flash hazard safety program are:

- calculating the NFPA-based level of personal protective equipment (PPE)
- communicating PPE and approach distance to exposed energized equipment through a warning label system

Applying experience

Drawing on over 100 years experience in analyzing power systems, GE supports the detection of arc flash hazards throughout your systems via data collection methods, detailed calculations and thorough software-based analysis to calculate the incident energy and NFPA-based PPE for each potential hazard.

Industry leadership

Through continuous research, product development, technical publications and industry support, GE helps lead the way in arc flash hazard reduction by:

- continuously conducting field surveys to address concerns that relate to arc flash protection
- investing in research and development of products that help reduce the risks of arc flash
- supporting industry-wide efforts, such as our sponsorship and participation in *Plant Engineering's* Arc Flash University and in IEEE events
- offering training on NFPA70E and Electrical Safety

Useful links on arc flash hazard reduction

- www.geelectrical.com/industrial
- <http://standards.ieee.org>
- www.nfpa.org
- www.nfpacatalog.org
- www.youtube.com/gearcflashinnovation
- www.plantengineering.com/webcast/
- www.gepower.com/industrial_service

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