Arc-Flash Mitigation Technologies

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The purpose of the session is to provide an overall understanding of the strategic impact of arc-flash. Special focus is on the tactical means to minimize operational exposure of the users to the electrical equipment.

Risk Reduction through Design & Technology

Method	Detection	Mechanism	Benefit	Drawbacks
Discourage Energized Work-Permitting	None	De-energized equipment with lockout tagout	- Provides no arc-flash hazard	- May cause interruptions to normal work processes
Fuses as protective devices	Direct current energy	Relies on current-limiting interruption	- Fastest interruption if Ia > current-limiting threshold - Long history of industry usage	- Large fuses have CL thresholds > arcing current & may be slow to react - Concern over fuse replacement & lack of other capabilities offered by circuit breakers
Current-limiting circuit breakers	Direct current energy	Relies on current-limiting interruption	- Fast current interruption similar to fuses if Ia > current-limiting threshold - Expands standard AIC ratings of breakers to values as high as 200KAIC	- Limited in availability relative to fuses and subject to similar limitations - May require replacement after limited number of operations - Not easily available in a broad range of sizes
Circuit breakers with instantaneous trips	Current; may be combined with light detection	Relies on fast fault interruption	- Provides fast current interruption - Possibly expands coordination capabilities	- Not as fast as current-limiting fuses or circuit breakers - Use of the instantaneous at arcing current levels may negatively affect selectivity - Requires adjustable-trip circuit breakers
Bus differential protection	Current differential	Relay based system	- Fast elimination of all contributing fault sources - Long history of industry usage	- Breaker operation speed - Usually requires dedicated set of CT's for every breaker
Zone selective interlocking	Current with restraint signal	Trip unit or relay based	- Speeds up interruption of ST and/or GF and/or Inst protective functions - Maintains coordination settings in normal mode	- Breaker operation speed - Requires specific capable trip/relay system and wiring
Remote operation	None	Operator outside arc flash boundary	- No impact on system selectivity - Some remote racking devices can be used on existing equipment	- Does not improve downstream or equipment protection - May be costly and difficult to retrofit into existing installations
Arc-resistant switchgear	None	Enclose switchgear volume	- Protects in proximity of the switchgear from arc flash and blast energy - Mechanical/Structural solution	- Enclosure integrity must be maintained (doors closed) - Blast energy must be exhausted - Complex installation - Does not improve equipment protection nor can it be added to existing equipment
Crowbar system	Light detection and current	Fast protection from arc blast and flash	- Protects in proximity to switchgear from arc flash and blast energy - May reduce immediate equipment damage	- One-time use, may damage distribution equipment and other equipment connected in the system - Localized protection only - Increased stresses on transformers
Temporary reduced settings	Current measurement	More sensitive and faster temporarily	- Reduces incident energy under specific conditions	- Requires specific capable trip systems and does not provide protection if the event does not occur during planned activity
Single processor protection	Current and voltage combined with intelligent algorithms	Multiple inputs to centralized redundant processor	- Equipment system protection not islands of intelligence - Upgrades and options are software based	- Requires specific capable trip systems - Difficult to retrofit into existing installations
Fast energy capture Activation switch	Current only	Fast protection from arc blast and flash	- Provides lowest incident energy even with doors open - Reduces equipment damage - Immediate retrofit application	- System is only based on current - Maintenance mode activation
Fast energy capture Always on	Light detection and current	Fast protection from arc blast and flash	- Provides lowest incident energy even with doors open - Reduces equipment damage - Continuous monitoring	- New equipment lineup design - Placement of light sensors in existing gear