Ultra-Fast Earthing Switch
Type UFES
Ultra-Fast Earthing Switch type UFES
The active internal arc protection by ABB

- The Ultra-Fast Earthing Switch type UFES
- Active internal arc protection in addition to available passive protection applicable for nearly all short-circuit proof, air-insulated switchgear
- Highest possible protection for switchgear in regard to the hazardous impacts caused by an internal arc
Ultra-Fast Earthing Switch type UFES
\textbf{S³ – Speed, Safety, Savings}

- **Speed** – A question of (Operation-) time
  Nearly immediate extinction of an internal arc by fastest intervention of the Ultra-Fast Earthing Switch.

- **Safety** – Greatly enhanced protection for personnel, switchgear and the environment
  A drastically reduced internal arc duration ensures minimized pressure and temperature rise. This leads, as a consequence, to minimal impacts at the fault location.

- **Savings** – The “insurance” for your switchgear
  Greatly increased system and process availability in combination with drastically reduced repair costs.
Arc faults generally cause serious damage

Fault characteristics

- An arc arises when at least part of the current passes through a dielectric, usually air
- Maximum peak power up to 40 MW
- Arc plasma temperature up to five times the surface temperature of the sun (20 000°C)
- Light intensity more than 2000 times that of normal office light
Internal arc faults
Reasons of formation

Typical human and operational errors:

1. Work in a wrong cubicle
2. Operation of a wrong isolator
3. Forgetting to ground the working area
4. Forgetting to test the presence of voltage in the working area

Technical reasons to arc faults:

1. Faults in equipment and false operation of equipment
2. Ageing of insulation and mechanical wear
3. Overvoltage
4. Overheating
5. Moisture, dirt

Other technical reasons to arc faults:

1. Corrosion
2. Foreign objects (e.g. tools) or small animals in the switchgear
3. Installation errors
4. Bad cable terminations and loose busbar joints
Internal arc faults
Impacts

- Rapid temperature rise (up to 20,000°C)
  - Rapid pressure rise
  - Release of material fragments and hot gases
  - Burning and vaporization of metal and insulation material

Heavy damages possible inside of the switchgear, for the integrated devices and for the building

Heavy injuries of the personnel possible for switchgear systems without internal arc classification

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Internal arc faults
Impacts

- Circuit-breaker compartment after internal arc impact
- Cable connection compartment after internal arc impact
- Contact terminal after internal arc impact
Ultra-Fast Earthing Switch type UFES
The basis for effective protection

- Electronic tripping unit
  - Fast and reliable interface to external arc detection systems
  - Tripping of the UFES primary switching elements

- 3 Primary switching elements
  - Ultra-fast initiation of a 3-phase short-circuit earthing after detection of a fault by the electronic
  - Elimination of the arc by resulting breakdown of the internal arc voltage
Ultra-Fast Earthing Switch type UFES
Combinable arc protection by ABB

**UFES + REA**

- Versatile monitoring options with REA system:
  - Optical detection via line or lens sensors
  - Overcurrent detection
  - Selective protection
  - Circuit-breaker failure protection

- Ultra-fast arc extinction by UFES
- Certified interfaces
- Extremely short tripping times < 4 ms (after detection)
Ultra-Fast Earthing Switch type UFES
Example of an application UFES + REA
Ultra-Fast Earthing Switch type UFES
Sequence of tripping operation

1. Arc formation
2. Arc detection
3. PSE tripping
4. Arc extinction
5. Fault current clearing

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Ultra-Fast Earthing Switch type UFES
Ultra-fast reaction time

- Effective limitation of damage requires fastest intervention
- Extinction time of the Ultra-Fast Earthing Switch: < 4 ms after fault detection
Ultra-Fast Earthing Switch type UFES Standard: UFES electronic type QRU100 – Features

- Electronic tripping unit
- Full compatible to the ABB arc protection system of type REA
- 2 Optolink inputs for connection of the REA101 relay
- 2 high-speed inputs (HSI) for connection of external arc detection systems
- Self monitoring including the Optolink connection to the REA system
- Logical combination of the external detection units by use of DIP-switches
- Testing mode for functional check
- Ideal for extension of existing ABB arc protection systems
Ultra-Fast Earthing Switch type UFES
Alternative: UFES electronic type QRU1 - Features

- Electronic detection and tripping unit
- 9 optical inputs for light detection
- 3 current inputs for monitoring of the instantaneous current value
- Up to 5 x 30 additional optical inputs with ABB arc guard type TVOC-2
- Completely in fast analogue technology
- Fast fault localization by use of single lens sensors
- Self monitoring
- Testing mode for functional check
- Simple DIP-switch configuration
Ultra-Fast Earthing Switch type UFES
Primary switching element

Primary switching element type U1

- Vacuum interrupter and operating system integrated in one compact unit
- Fast and reliable micro gas generator operating mechanism
- Fast switching time of ~ 1.5 ms
- Easy handling
- Low-maintenance
- Flexible installation

Primary switching element – section view

1. Epoxy insulator
2. Fixed contact
3. Ceramic insulator
4. Moving contact pin
5. Rupture joint
6. Piston
7. Cylinder
8. Moving contact system
9. Micro gas generator
Ultra-Fast Earthing Switch type UFES
Switching principle

Service position

Position after tripping

Vacuum interrupter

Moving direction

Drive

Current flow after tripping

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Ultra-Fast Earthing Switch type UFES
Speed – Differentiation

Conventional protection device
- Fault detection by standard relay
- Clearing of the arc fault current by the upstream circuit-breaker

Fast-acting protection relay with supplementary equipment
- Fast fault detection by special protection relay
- Clearing of the arc fault current by the upstream circuit-breaker

Ultra Fast Earthing Switch type UFES
- Fast fault detection by UFES electronic or REA system
- Ultra-fast extinction of an internal arc by switching of the UFES primary switching element type U1
- Final clearing of the fault current by the upstream circuit-breaker
Ultra-Fast Earthing Switch type UFES

**Speed – Differentiation**

* Constant arc voltage & fault current for the complete fault time
  \[ W_{arc} \cdot I_k \cdot t = Warc \] (linear function)

**Conventional protection device**
- Dramatic consequences possible
- Fire/Explosion hazard, heavy injuries of personnel (depending on switchgear design)

**Fast protection relay**
- Limited consequences for equipment and personnel (depending on switchgear design)

**Ultra-Fast Earthing Switch type UFES**
- Drastic reduction of thermal damage
- Drastically reduced pressure rise
- No consequences to be expected!

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Ultra-Fast Earthing Switch type UFES

Speed & Safety – Pressure curves

Exemplary pressure curve, with and without UFES, in a compartment of an air insulated medium voltage switchgear, for an internal arc fault current of 130 kA (peak) / 50 kA (rms)

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Ultra-Fast Earthing Switch type UFES
Safety & Savings – The internal arc test with UFES

- Busbar compartment after internal arc impact with active UFES protection
- Point of fault initiation in the busbar compartment
Ultra-Fast Earthing Switch type UFES S³ – Comparison

- Busbar compartment after internal arc impact with active UFES protection

- Busbar compartment after internal arc impact without active UFES protection (50 kA / 100 ms)
Ultra-Fast Earthing Switch type UFES
The formula for effective internal arc protection

UFES = $S^3$

- Speedy arc suppression
- Safety for investment and personnel
- Savings in regard of repair and downtime costs
Ultra-Fast Earthing Switch type UFES
Applicable for highest requirements

Maximum rated voltage:
$U_r = 40.5\, \text{kV} \rightarrow I_k = 40\, \text{kA} \, (3s)$

Maximum rated short-time withstand current for medium voltage:
$I_k = 50\, \text{kA} \, (3s), 63\, \text{kA} \, (1s) \rightarrow U_r = 17.5\, \text{kV}$

Maximum rated short-time withstand current for low voltage:
$I_k = 100\, \text{kA} \, (0.5s) \rightarrow U_r = 1.4\, \text{kV}$
Ultra-Fast Earthing Switch type UFES
Available as … loose components

Standard: UFES-Kit-100* as OEM produkt, consisting of:

- Electronic detection and tripping unit type QRU100
- 1 set (3 off) Tripping cables (10 m) with special plug for PSE and electronic
- 3 Primary switching elements (PSE)

* For extension of existing or new arc protection systems. Full compatibility to the ABB arc protection system type REA.
Ultra-Fast Earthing Switch type UFES
Available as ... loose components

Alternative: UFES-Kit-1 as OEM produkt, consisting of:

- Electronic detection and tripping unit type QRU1
- 1 set (3 off) Tripping cables (10 m) with special plug for PSE and electronic
- 3 Primary switching elements (PSE)
Ultra-Fast Earthing Switch type UFES
Available as … ABB Service retrofit solution

- Service-Box
  (Illustration: Side-mounted)

- Draw-out technology
Ultra-Fast Earthing Switch type UFES
Available for ... ABB switchgear (AIS)
Ultra-Fast Earthing Switch type UFES
Available for … ABB dry type transformer

ABB Resibloc with UFES protection
Ultra-Fast Earthing Switch type UFES S³ - Unbeatable advantages

Indirect benefit

- Greatly increased system and process availability by avoidance of heavy damages inside the switchgear, of the equipment and the direct environment
- Drastic reduction of downtimes and repair costs

Example for a production site (e.g. chemical-, paper- or oil industry)

- Risks: Exchange of damaged switchgear panel(s) or equipment necessary
- Consequence: Loss of production for possibly some days or weeks
- Costs: Up to multiple 100.000 EUR / day possible
Ultra-Fast Earthing Switch type UFES S³ - Unbeatable advantages

Direct benefit

- Greatly increased operator safety for switchgears
- Minimization of pressure rise and gases in the faulty compartment and surrounding switchgear building
Ultra-Fast Earthing Switch type UFES
UFES = S³

Are you attracted by the UFES?

Please contact…
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