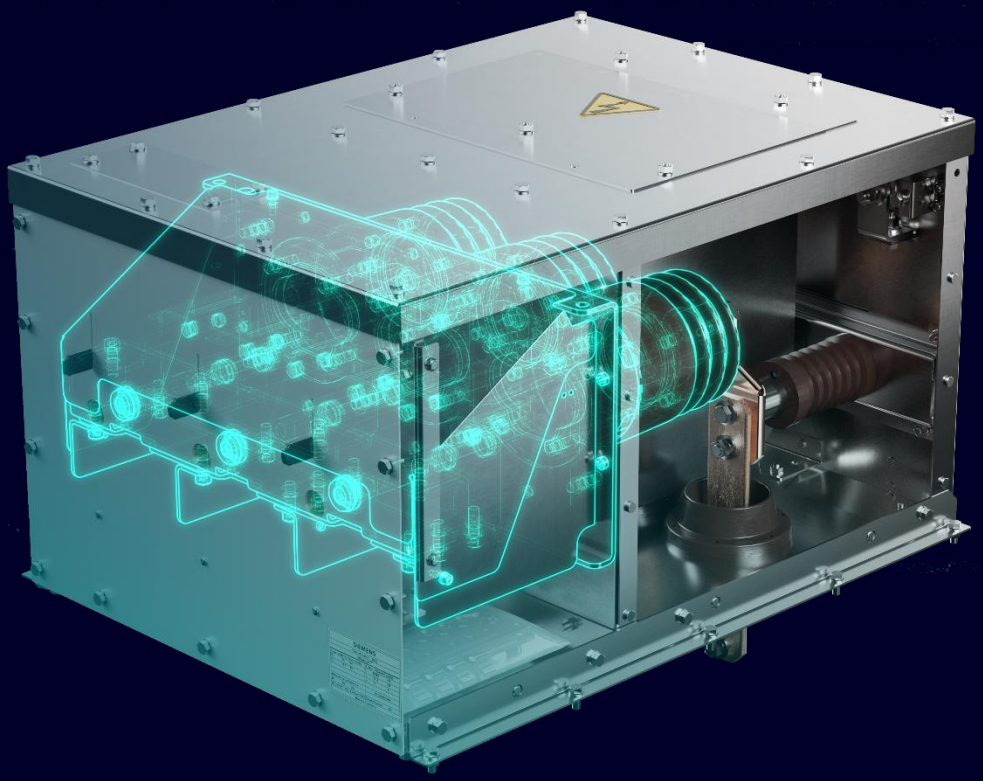

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SMART INFRASTRUCTURE ELECTRIFICATION & AUTOMATION

SIQuench – Arc quenching device for medium-voltage applications

Protection beyond the standards

SIEMENS

Protection beyond the standards

The occurrence of an internal arc fault in a well-designed, type-tested, correctly installed, and operated switchgear is improbable – but not impossible – mostly linked to human-related errors or environmental causes.
The safety risk is only one aspect of arc faults. The damage to equipment causing power supply and process disturbance may lead to substantial costs, in the order of millions of euros per incident. In the case of occupational incidents, the total costs may be even higher due to medical and legal expenses.
Said catastrophic effects could be mitigated by acting on the arc itself by limiting its duration.

A new approach

There are some parameters, already fixed without room for adjustment in regard to limiting the arc flash incident energy. Amongst the parameters, it is fault-clearing time we can act on, by utilizing fast-tripping CBs and early detection of arc via light or pressure sensors.

What if, we would have the chance to act directly on the arc itself?

What if…

- …arc could be quenched in ≤5ms?
- …top-class safety could remain effective even when the doors/compartment covers are open?
- …it would be possible to restore service rapidly immediately after an arcing fault, leading to minimized service outages?
- …the surroundings could be fully protected from contamination and toxicity effects of an arc flash?
- …this protection system was reusable and could withstand 5 consecutive arc faults with the full rated short-time withstand current and without the need for replacement.
- …this protection system was maintenance-free for 20 years?

SIQuench is an active arc effect mitigating system by Siemens, quenching the internal arc in sub-cycle times.
It dramatically reduces pressure and avoids thermal, contamination, and toxicity effects that damage the equipment with its surroundings. In the event of an internal arc fault, it minimizes the duration of downtime for operations, resulting in drastically reduced economic losses.

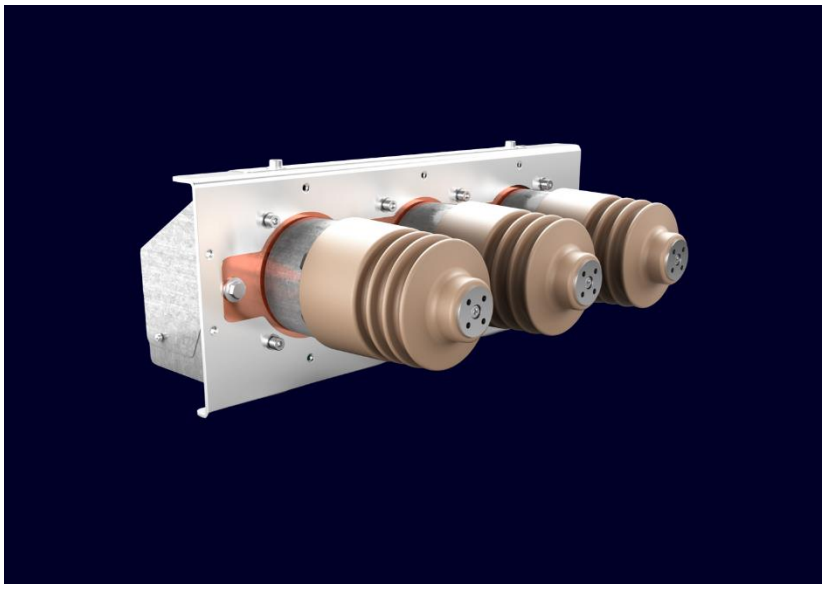


Figure 1
SIQuench® Core with primary switches

The value received = reliability + capability + functionality + availability + maintainability

The system works in conjunction with an arc protection relay to detect the ignition of an internal arc rapidly and reliably via continuous monitoring of light and overcurrent – the standard characteristics of an arc that make it detectable. Upon detection of an internal arc, the arc protection relay simultaneously sends a trip signal to the main circuit breaker and a trigger signal to the controller of the SIQuench.

The enhanced arc effects mitigation functionality provided by SIQuench is achieved by consciously and rapidly closing the main current path of the switchgear to earth via dedicated phase-wise primary switching devices – creating a lower-impedance current path to the fault current – and transforming the open arc into a controlled 3-phase metallic short circuit. Continuous self-supervision maximizes the reliability of the system.

It is capable of extinguishing the arc fault in less than 5 ms* – long before the pressure peak, and before the arc can cause any significant damage.

* From arc ignition to closing of the quenching device

Final clearance of the dead short circuit provided by the SIQuench is done by tripping the main circuit breaker.

The damage to the switchgear is limited to an insignificant level and wholly avoided for the direct surroundings. This leads to an extreme reduction of repair costs along with the absolute elimination of switchgear room and surroundings cleaning costs. The switchgear can be restored back to operation within minimum maintenance time, meaning an incredible boost in system and process availability. The system needs no replacement after an arc fault.

Oil is the insulating medium with a set of strengths perfectly matching the SIQuench application. Operated by a manually charged disc spring mechanism and a latch device actuated by an electromagnetic solenoid, the switching process is reversible.

SIQuench is reusable up to its permissible switching duties:

- Capable of switching 5 times at the full rated short-time withstand current (with peak withstand current)
- Capable of switching 30 times without load for testing/commissioning purposes

SIQuench is maintenance-free for 20 years and capable of serving for 30 years with maintenance at the end of the given maintenance-free period.

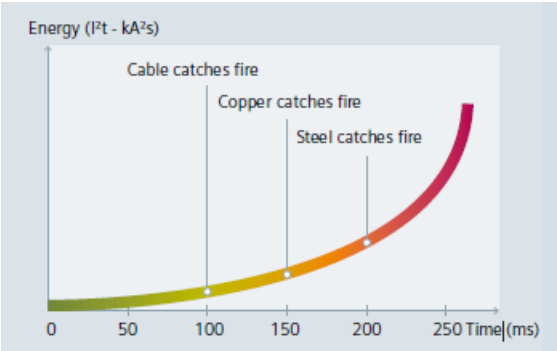


Figure 2
Damage caused by incident arc energy

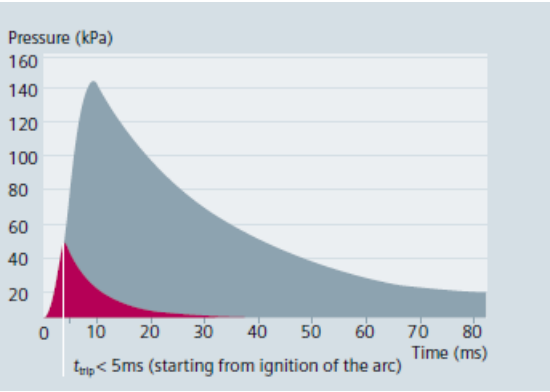


Figure 3
Sample pressure curve in a compartment for an internal arc fault current of 80 kA (peak) / 31.5 kA (rms)

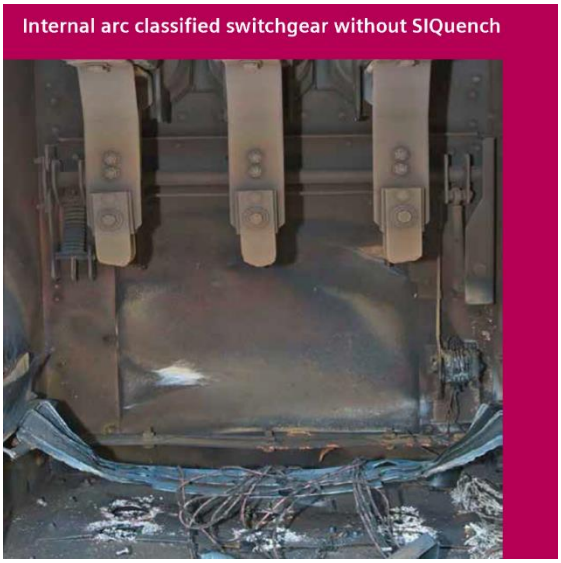


Figure 4/5
Condition of a 12 kV NXAIR SWG cable compartment after an internal arcing test with a fault current of 80 kA (peak) / 31.5 kA (rms), with arc ignition inside the cable compartment

Benefits

Highly increased equipment and process availability is at the core!

- Minimizes the damage within the switchgear due to reduced arc energy and pressure
- Possibility of restoring service rapidly, leading to minimized service outages

Reliability through consistency!

- Continuous self-supervision of the system alarming on any faulty condition
- Capable to switch 30 times without load for testing/ commissioning purposes without the need for replacement
- Contains no explosive medium as energy storage for switching operations

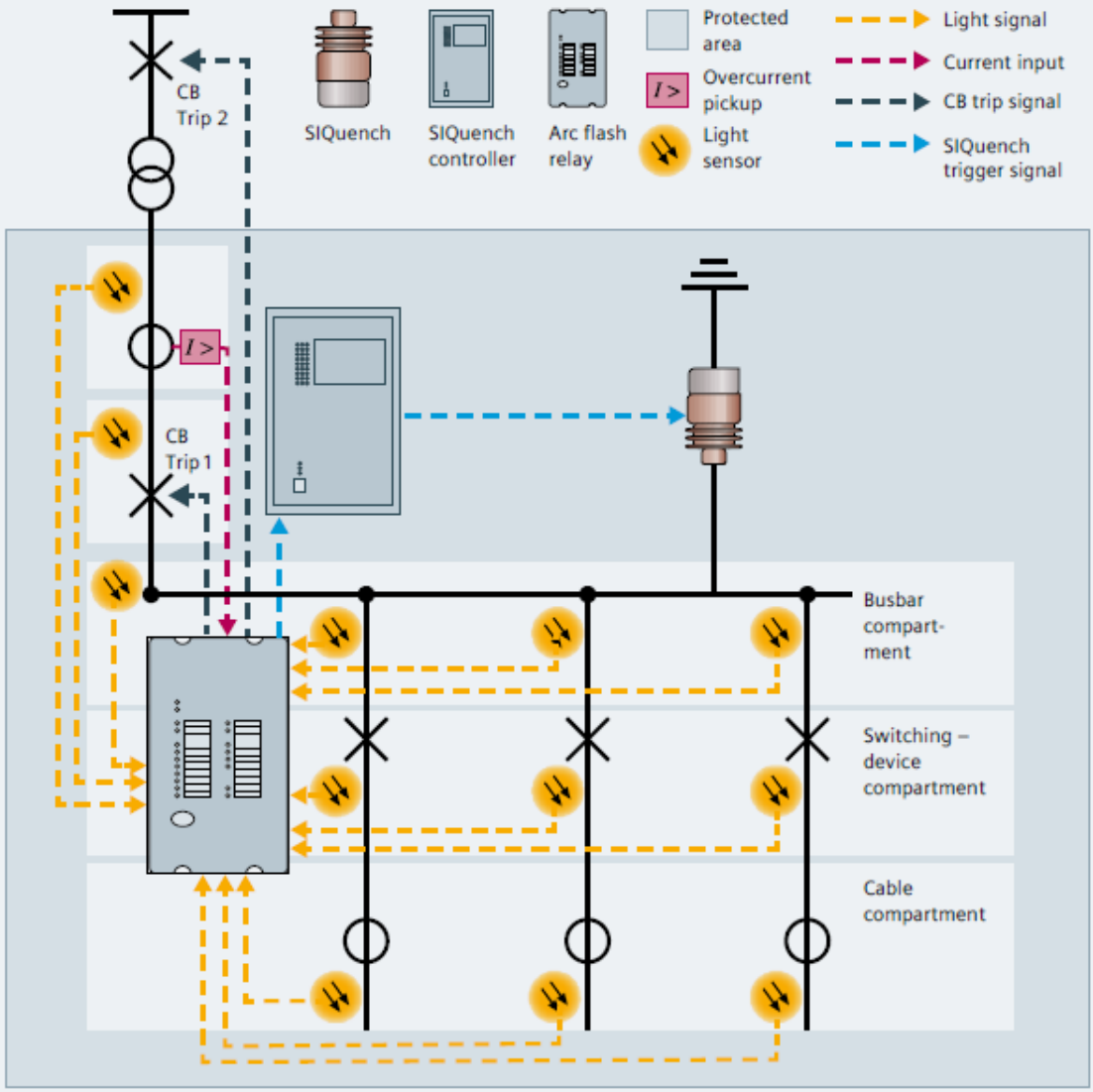
Reduced OPEX through cost-efficient measures!

- Minimized repair costs – The faulty functional unit of the switchgear can be used again
- The surroundings are fully protected from contamination and toxicity effects, also eliminating related cleaning costs
- Reusable – Capable to switch 5 times without the need for replacement
- Maintenance-free for 20 years

Safety excellence requires more than just following the compliance!

- Being a state-of-the-art solution in the range of proactive safety measures available, it takes the switchgear to another level, going beyond the safety set by the standards
- Improves safety also for maintenance maneuvers
- Prevents the emission of toxic gases after an internal arc fault, which have severe respiratory distress effects on human beings

Illustration of the system integration in an exemplary arc protection application
(one incoming feeder with single protection zone)



SIQuench applications

NXAIR switchgear from Siemens

SIQuench is available as a complete solution integrated into type-tested, internal arc classified, medium-voltage switchgear type NXAIR, rated up to 17.5 kV, 50 kA, 4000 A.

Fixed mounted in busbar compartment of NXAIR:

- Possible in 600 mm and 800 mm panel widths
- Can be integrated into any functional unit*

Figure 6
NXAIR switchgear

Siemens legacy or non-Siemens equipment

The use of SIQuench provides the highest level of protection for equipment and operator safety, especially for switchgear systems that are older and not qualified by IAC.

- **with SIQuench® Core:** SIQuench in its simplest form. The type-tested SIQuench Core can be integrated according to the requirements of the user and the conditions of the system for a tailor-made solution.
  Targeting OEMs, panel builders, contractors, etc., can be utilized irrespective of the manufacturer.

  Available in 3 versions:
  - ≤ 17.5 kV, ≤ 31.5 kA
  - ≤ 17.5 kV, ≤ 50 kA
  - ≤ 24 kV, ≤ 50 kA

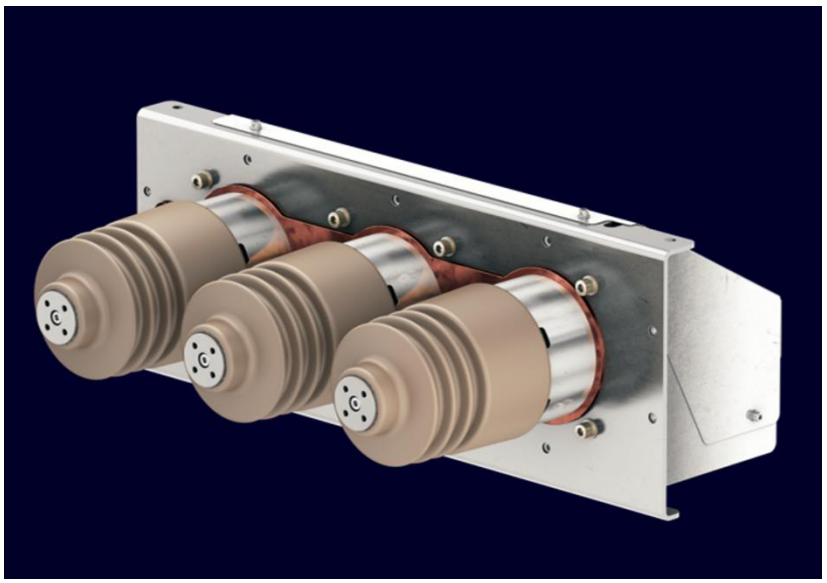


Figure 7
SIQuench Core

* Functional units having busbar components
(e.g., VTs, busbar earthing switch, ventilation box, etc.) are out of this scope

- **with SIQuench® QuickFit:** Targeting modernization of old/existing systems.
  The type tested SIQuench QuickFit module can be utilized irrespective of the manufacturer.
  Maximum flexibility, with low implementation costs.
  The core elements of a proper integration design is resolved at the source.
  Whether it is installed horizontally, vertically, or even up-side-down, the flexibility ensures seamless/easy integration with existing as well as new systems.

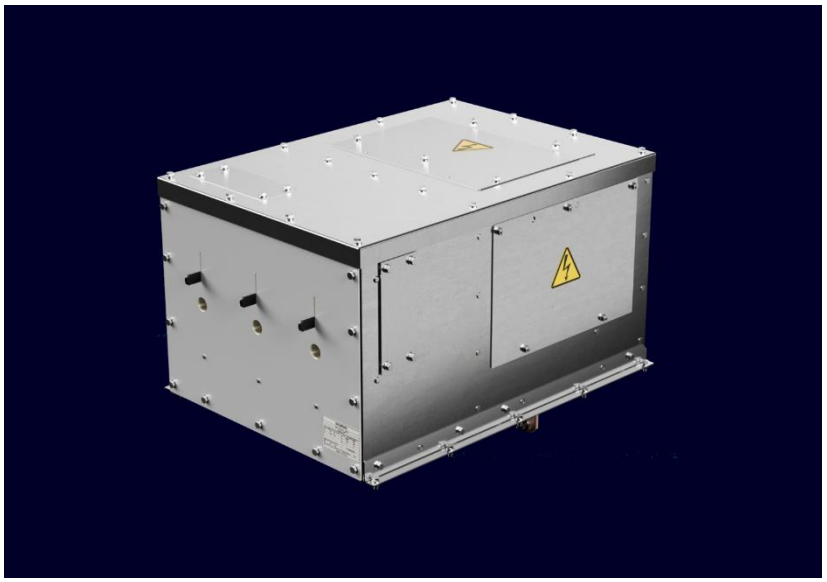


Figure 8 SIQuench QuickFit module

Sample integration options:

- Integration from the end wall of an end panel
- Roof mounting
- Mounting from underneath

Available in 3 versions:

- ≤ 17.5 kV, ≤ 31.5 kA
- ≤ 17,5 kV, ≤ 50 kA
- ≤ 24 kV, ≤ 31.5 kA

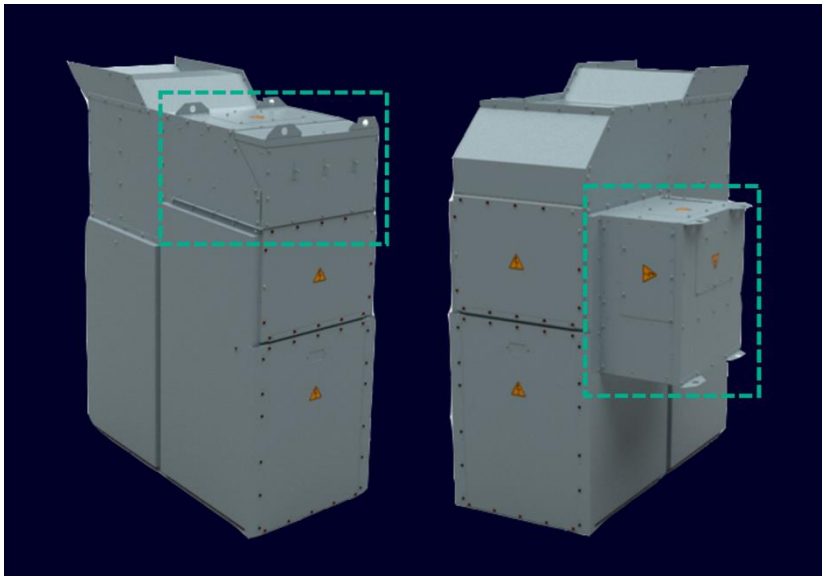


Figure 9 Possible integration options

SIQuench® Core article no	
3AM4132-1DA12-0AB2	17.5 kV, 31.5 kA, 170 mm pole center distance, with controller
3AM4133-3DA12-0AB2	17.5 kV, 50 kA, 210 mm pole center distance, with controller
3AM4143-3DA12-0AB2	24 kV, 50 kA, 210 mm pole center distance, with controller

SIQuench® QuickFit article no	
3AM4732-1DA12-0AB2	17.5 kV, 31.5 kA, 170 mm pole center distance, with controller
3AM4733-3DA12-0AB2	17.5 kV, 50 kA, 210 mm pole center distance, with controller
3AM4743-1DA12-0AB2	24 kV, 31.5 kA, 210 mm pole center distance, with controller

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