Arc fault protection solutions

IEC low- and medium-voltage arc flash mitigation solutions
for greater protection and productivity

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โซลูชั่นการป้องกันอันตรายจาก Arc Fault ภายในตู้สวิตช์เกียร์ด้วยการตรวจจับแสง

วันที่ 22 มิถุนายน 2564, เวลา 14.00 - 15.00 น.

เนื้อหาในคอร์ส

- ความสำคัญของ Arc fault protection
- ประเภทของ Arc fault protection
- ABB Arc fault protection solution
- ตัวอย่างการใช้งานในระบบไฟฟ้า

เวลาทั้งหมด: 1 ชั่วโมง | คอร์สบรรยายเป็นภาษาไทย

นนทิวัฒน์

Product Marketing Specialist

วรวิทย์

Product Marketing Specialist

The occurrence of an arc flash is the most serious fault within a power system. Its destructive impacts can lead to severe personnel injuries, costly equipment damage and long outages. ABB offers a wide range of solutions to prevent and mitigate the effects of arc flash events, thus enhancing safety, minimizing damage and reducing downtime.

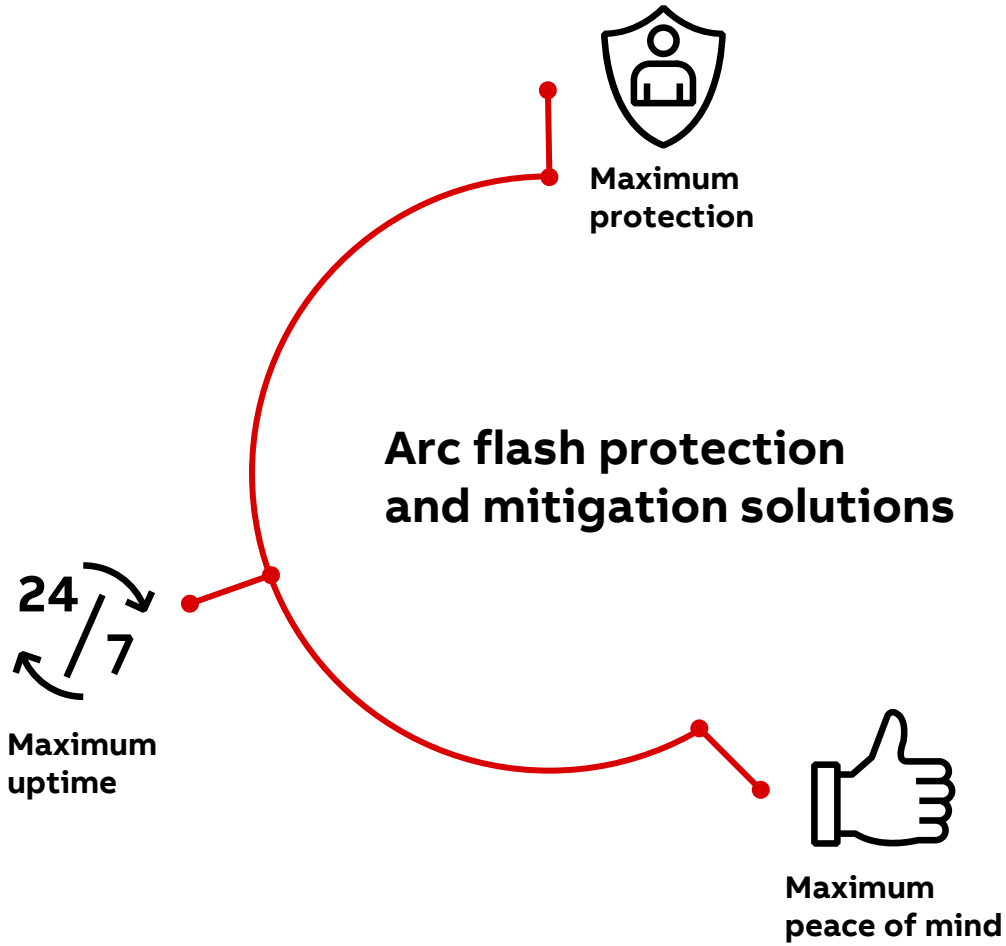
Table of contents

Putting the protection of your people first is a smart choice.

Because safety is not a cost, it is an investment.

It goes without saying that safety should be a priority for every business. Arc flash mitigation solutions are essential because they save lives. But that's not all.

Taking the right precautions today can save you time and money in the future: protecting people and assets, reducing the cost of injuries and damage, limiting downtime and maintenance requirements..



Putting the protection of your people first is a smart choice.

Because safety is not a cost, it is an investment.

Maximum protection.

Protect personnel with solutions ranging from passive protection to ultra-fast arc mitigation solutions. ABB’s portfolio provides enhanced future-proof solutions exceeding the requirements of the current regulations.

Maximum uptime.

ABB's arc flash mitigation solutions keep your business running, improving uptime by limiting the energy of arc faults, therefore limiting the damage they cause to switchgear and assets and the repair time required.

Maximum peace of mind.

You can count on ABB to have a solution that’s right for you –our range covers active, passive and preventive solutions from low- to medium-voltage applications. Our high-quality solutions won’t let you down.

What is an arc flash?

Causes of arc flash

Arc flash is one of the most dangerous and potentially deadly incidents that can occur in electrical installations, causing severe harm to the people and equipment involved. An arc flash is an electrical fault or short-circuit which passes through a physical air gap, or bridge, between two electrodes.

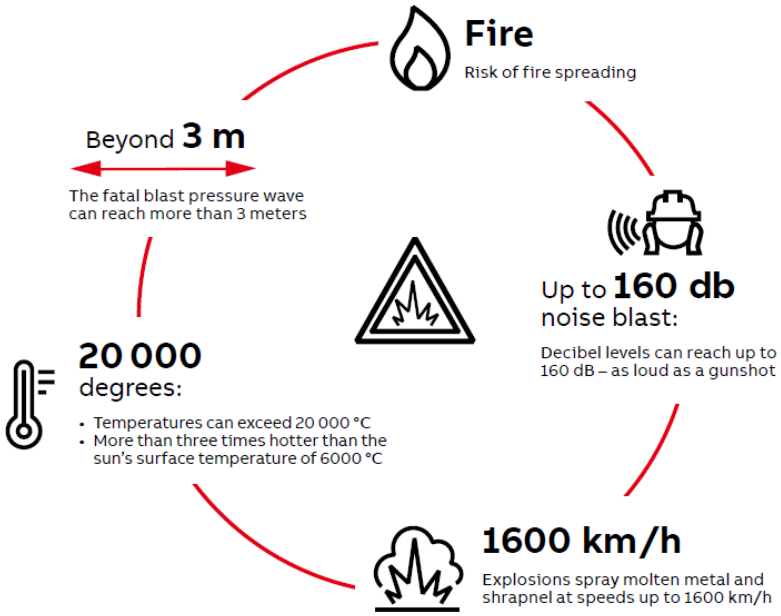
Arc flash incidents can be caused by:

- Dust, impurities, corrosion, condensation, animal intrusion
- Dropping or left behind tools
- Failure of insulating materials
- Improper installation
- Loose bus or cable connections
- Lack of, or inappropriate maintenance
- Inappropriate operating conditions

What is an arc flash?

Arc flash dangers

- Result of a rapid release of energy due to an arcing fault between phases, neutral or a ground
- An arc arises when at least part of the current passes through a dielectric, usually air
- Consequences:
  - Uncontrolled release of energy with arc power up to 40 MW
  - Rapid pressure rise inside of the switchgear
  - Explosive release of plasma, fragments and toxic gases
  - Light with illuminance more than 2000 times higher than a typical office light
  - High acoustic stress level



What is an arc flash?

Reasons for internal arc faults?

Human related

- Working on energized equipment (Intended or unintended)
- Disregard of safety rules
- Forgotten tools and equipment
- Installation faults (cable terminations, busbar joints)

Technically related

- Equipment faults
- Ageing and wear
- Overvoltage
- Overheating

Environmentally related

- Moisture and dirt
- Corrosion
- Vibrations
- Small animals inside the switchgear

What is an arc flash?

Consequences of arc flash

Human impact

Arc flash incidents are rare, but they have the highest mortality rate of any accidents in electrical installations. The inhalation of toxic gases, damage to hearing, injuries due to the ejection of materials and burns are all possible consequences.

Equipment damage

Arc flash incidents can also be destructive for switchgear and other assets, even buildings, as shown in images 01, 02 and 03 on the next slide. The explosion and resultant fires often cause great damage to equipment and facilities.

01

02

01 Switchgear damaged by an arc flash incident, without an arc flash mitigation system

02 MV/LV substation damaged by an arc flash incident due to the absence of an arc flash mitigation system

What is an arc flash?

Impacts after an internal arc fault

Switchgear

Circuit breaker

Cable compartment

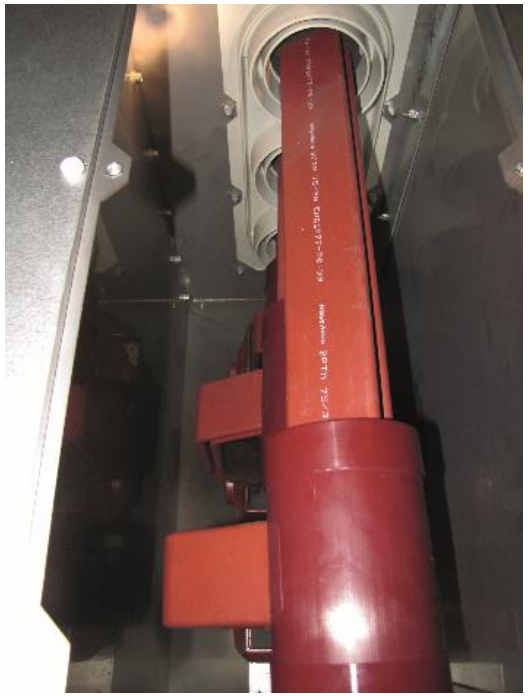
What is an arc flash?

Reducing the effects of arc flash

Use of arc energy mitigation solutions can significantly reduce arc energy and the associated impacts. This improves safety and may drastically reduce the time required to repair the switchgear.

You can see the difference that a fast active arc mitigation system makes in images 01 and 02 on the next slide – the switchgear without arc protection is severely damaged compared to the switchgear with fast arcing fault detection and protection.

To watch the video of ABB arc flash test, follow the link



01

02

01 Busbar compartment of medium-voltage switchgear after arc flash, with an ultra-fast arc flash mitigation system

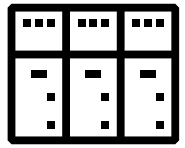
02 Busbar compartment of medium-voltage switchgear after arc flash, without an arc flash mitigation system

Arc flash mitigation solutions reduce damage to equipment, limiting downtime as less time is required for repairs and keeping costs to a minimum. In addition, the safety of personnel is enhanced.

There are three design philosophies which protect operator and equipment in the event of an arc flash incident, one or more may be adopted within the same switchgear.

Passive, active and preventive

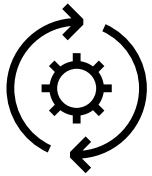
Arc flash protection and mitigation solutions



Passive arc flash protection solutions

Switchgear designed and tested to mechanically withstand the electric arc. Protection is afforded by the containment of the arc within the switchgear and the means to direct the arc gases and debris to a safe area.

Passive solutions also include advanced switchgear design features to reduce the probability of an arc flash occurring.



Active arc flash mitigation solutions

Switchgear equipped with devices and solutions to limit the arc incident energy (the amount of thermal energy generated during an electric arc event) and consequently limit the damage to the equipment.

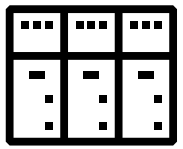
Preventive arc flash protection solutions

Switchgear equipped for remote operation, so that standard operations such as switching, diagnostic and operational monitoring, racking in/out, etc. can be conducted outside of the dangerous arc flash exposure area.

Preventive solutions also include the predictive maintenance of assets.

Passive solutions

Protect by containing or preventing an event



The principle of passive arc flash protection is based on the mechanical design of low- and medium-voltage switchgear. Robust design reduces the risk that a person, standing in front of switchgear with closed and latched doors, will be injured in the event of an arcing current event inside the equipment.

ABB switchgear exceed the standards, as they are always designed and tested to withstand an internal arc caused by a short-circuit current for up to one second.

This test is covered by IEC TR 61641 Ed. 3 for low-voltage switchgear (up to 0.5 seconds) and IEC 62271-200 for medium-voltage switchgear (up to 1 second).

Passive solutions

Protect by containing or preventing an event

Design

Arc resistant switchgear usually have one of the following characteristics:

- Reinforced mechanical structure able to withstand the stresses (overpressure) caused by internal arcing
- A preferential path inside the assembly for the discharge of hot gases and debris created by arcing
- An arc ignition protected zone (AIPZ) to avoid the occurrence of an arc
- Segregation between compartments to inhibit the propagation of the arc
- With respect to medium-voltage, internally separate gas tank for gas-insulated equipment and plug-in cable connections

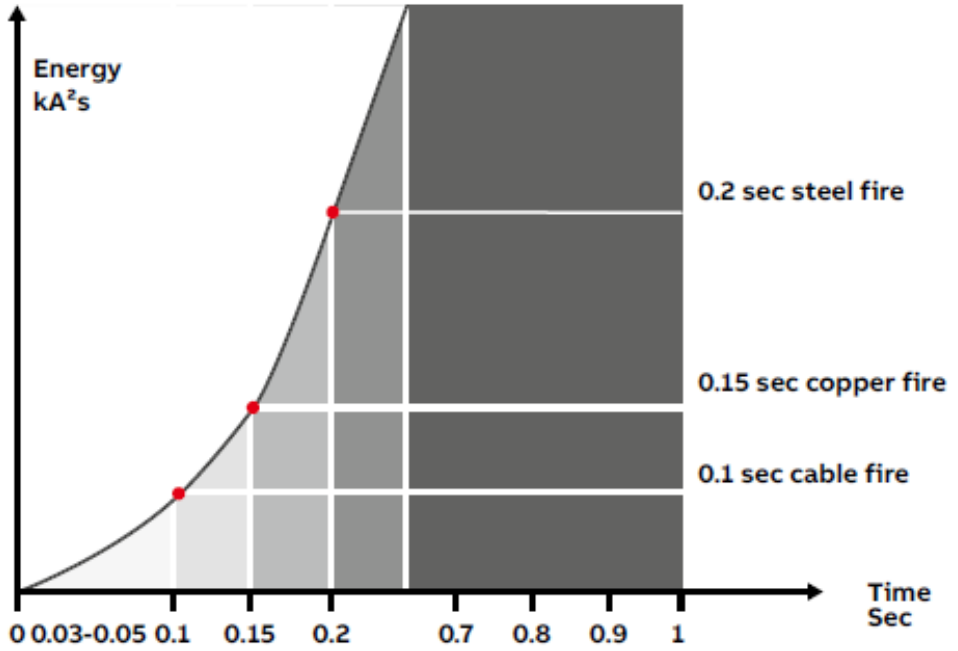
Neogear

Active solutions

Arc flash damage curve

The main parameter of the electric arc, which characterizes its destructive ability, is incident energy. This is directly proportional to the arc duration and arc current.

The arcing fault is usually interrupted by a circuit breaker and relay/trip unit or fuses. Without any active arc flash mitigation solutions in place, the arc clearing time may vary from 0.2 to 0.4 seconds.

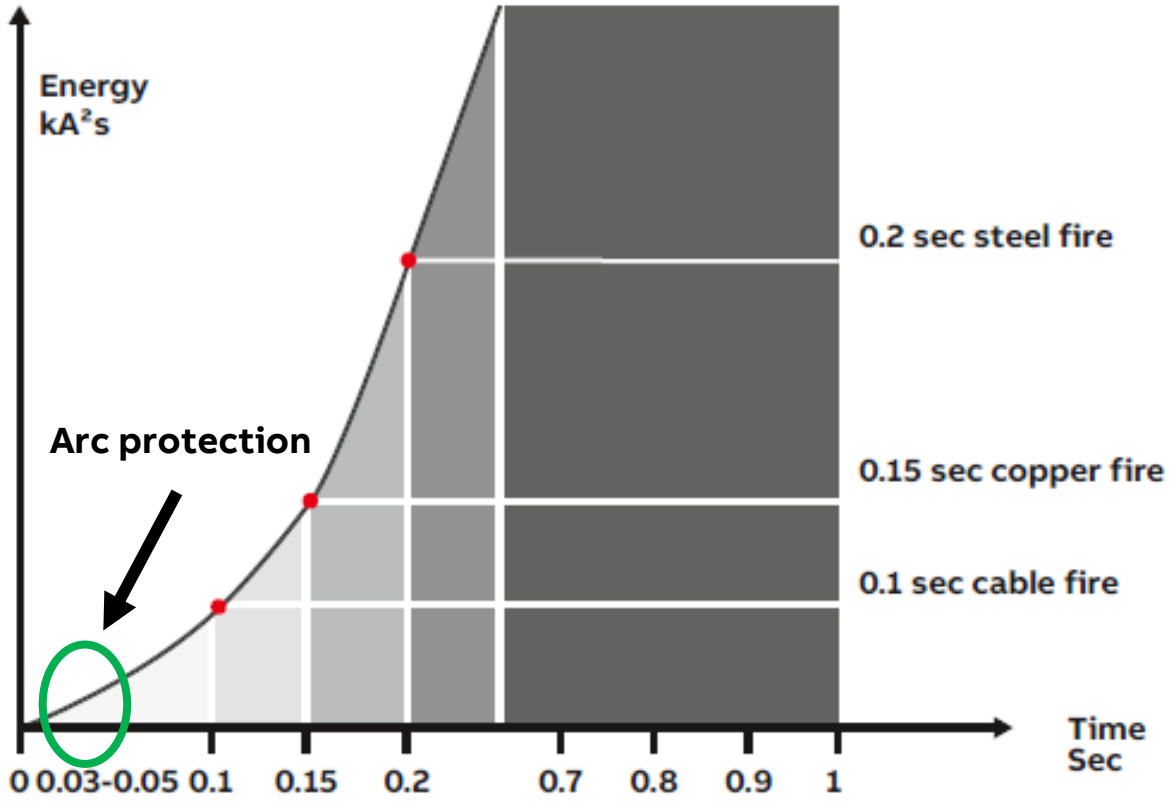


Active solutions

Time is critical!

- **40 ms** - No personal injuries or switchgear damage worth mentioning
- **100 ms** - No serious damage, cleaning and minor repair needed
- **500 ms** - Serious personal injuries and damage to switchgear
- With the fast reaction from the arc-protection relay, the effect of the arc can be minimized!

- Arc flash protection interrupts an arc at an early stage, with operation times as low as 1-2ms.



Active solutions

Time is critical!

Arcing time 500ms

500ms

Arcing time 35ms

35ms

Active solutions

Methods and technologies for arc flash mitigation

Reducing the arc clearing time

In order to reduce the negative effects of an arc event, the arc clearing time must be reduced. This is the role of active arc flash mitigation solutions.

The following methods and technologies are available:

- **Optical-based internal arc-detection devices:**

  Relays that detect the arc flash light and current (optional). When the arc flash is detected, it sends the tripping signal to the circuit breaker.

- **Arc quenching system:**

  Equipment that provides a lower impedance current path after it has detected an internal arc fault in order to cause the arcing current to transfer to the new current path.

- Combination of **arc quenching system** with **current-limiting fuses.**

—
Arc Guard System ™
TVOC-2

—
Protection relay built in
arc protection
Relion sereis

—
Arc protection relay
REA

—
Smart substation
control and protection
SSC600

Active solutions

Methods and technologies for arc flash mitigation

- **Energy-reducing maintenance switch:**

  Limits the duration of the fault current by temporarily lowering the trip threshold of the circuit breaker.

- **Zone-selective interlocking:**

  Application of zone selectivity instead of time-current selectivity to reduce the tripping time delays of overcurrent protection devices.

- **Bus differential protection:**

  Division of the power system into protective zones in order to monitor the current for all connections into and out of the defined zone.

- **Alternative settings group (dual settings):**

  Tripping time delays of the overcurrent protection devices are set to lower values than the main time settings.

- Combination of **optical-based internal arc detection device** and circuit breaker's **energy-reducing arc mitigating algorithm:**

  After receiving a positive signal from the optical sensors, the arc detection device activates the energy-reducing arc mitigating algorithm embedded in the circuit breaker.

Preventive solutions

Avoid internal arc events

Electrical maintenance, trouble-shooting personnel and operators are always exposed to these risks when working in the switchgear room.

Maintaining a safe distance between personnel and equipment during operations provides the most effective means of avoiding injury.

Preventive solutions limit risk by reducing maintenance activity to only the most necessary and targeted actions.

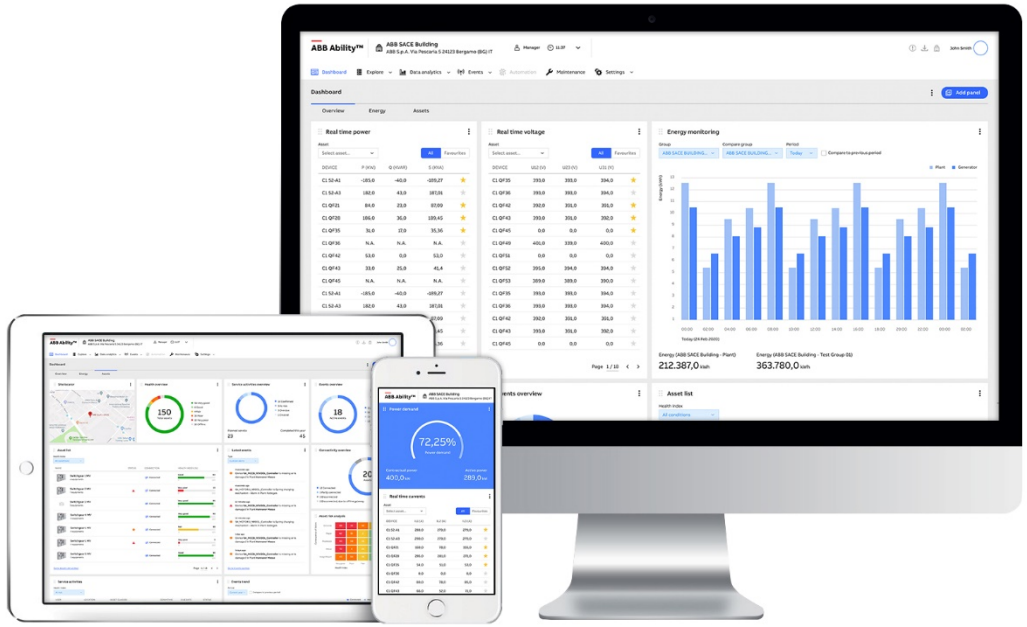


ABB Abillity™ Energy and Asset Manager

Preventive solutions

A safer remote operating environment

Remote operation and circuit breaker racking provide a safer operating environment for personnel by increasing the distance between the operator and potential arc flash incident energy from the switchgear.

Enhanced switchgear operability preventing human errors can be achieved by:

- Remote racking devices
- Embedded plant supervision with metering capabilities and communication protocols to provide status information

Remote Racking Devices – Emax 2

Preventive solutions

Condition monitoring and diagnostics

Asset condition monitoring and diagnostics provide information on the mechanical and electrical health conditions for switchgear and assets, so personnel do not have to approach the switchgear to obtain this information.

The information can be used to schedule more targeted and safer condition-based maintenance, which also reduces costs and can improve overall reliability.

Mechanical and electrical health status can be achieved by:

- Condition monitoring systems
- Energy and asset management monitoring systems with predictive maintenance algorithm

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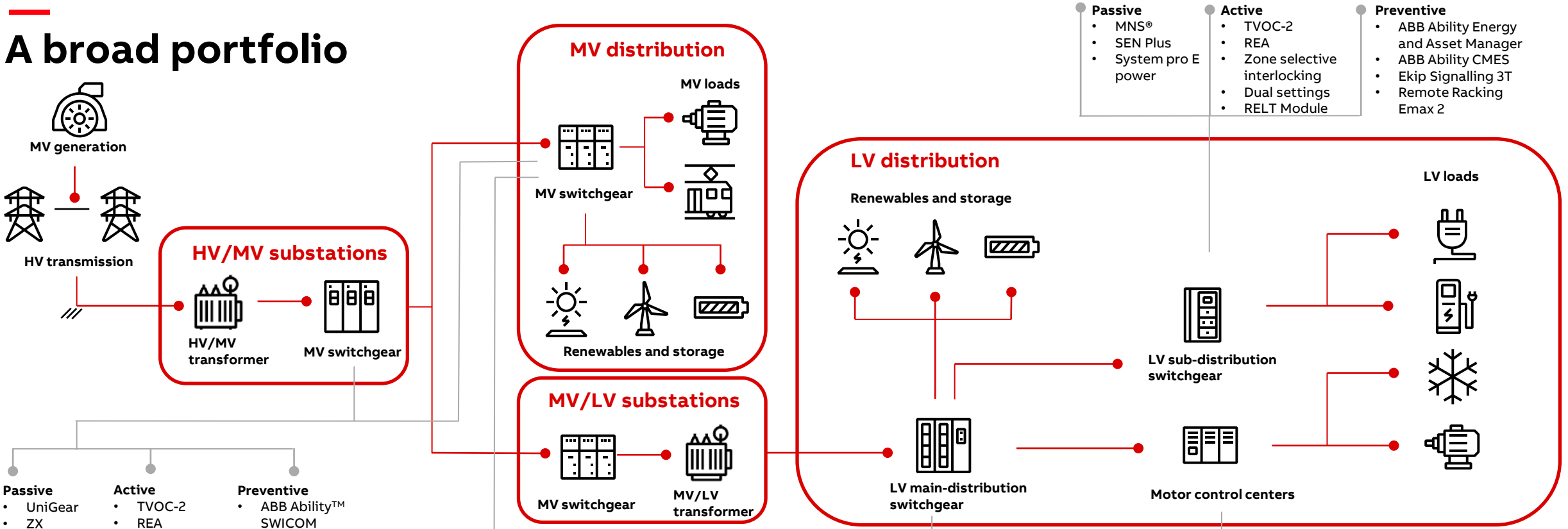
ABB Abillity™ Condition Monitoring for switchgear - SWICOM

A broad portfolio



HV: High-voltage (above 66 kV)
MV: Medium-voltage (between 1 kV AC, or 1.5 kV DC, to 66 kV)
LV: Low-voltage (below 1 kV AC, or 1.5 kV DC)

Passive arc flash protection solutions

Ensuring personnel safety

NeoGear

Switchgear manufacturer	ABB
Product type	Main and sub-distribution board, motor control center
Low-voltage application	Up to 415 (690) V AC 3200 (6300) A 80 (100) kA
Medium-voltage application	-
Arc classification standard	IEC TR 61641 Ed. 3.0 Max. Class I (AIPZ) Min. Class C, 0.5 s
Insulated busbars	Yes (insulated laminated bus plates)
Segregation between compartments	Up to Form 4b
Product web page	https://new.abb.com/low-voltage/products/switchgear/mcc-and-iec-low-voltage-switchgear/neogear

Passive arc flash protection solutions

Ensuring personnel safety

MNS

Switchgear manufacturer	ABB
Product type	Main and sub-distribution board, motor control center
Low-voltage application	Up to 690 V AC 6300 A 120 kA
Medium-voltage application	-
Arc classification standard	IEC TR 61641 Ed. 3.0 Up to Class C, 0.3 s Additional tests with modules removed and open doors
Insulated busbars	Available as an option
Segregation between compartments	Up to Form 4b
Product web page	https://new.abb.com/low-voltage/products/switchgear/mcc-and-iec-low-voltage-switchgear/mns

Passive arc flash protection solutions

Ensuring personnel safety

UniGear

Switchgear manufacturer	ABB
Product type	Air-insulated MV switchgear for primary distribution
Low-voltage application	-
Medium-voltage application	Up to 46 kV AC 4000 A 63 kA
Arc classification standard	IEC 62271-200 Up to AFLR, 1 s
Insulated busbars	Yes
Segregation between compartments	Up to LSC2B
Segregated tank and plug-in cable connection	No
Product web page	https://new.abb.com/medium-voltage/switchgear/air-insulated/iec-and-other-standards/iec-air-insulated-primary-switchgear-unigear-zs1

Passive arc flash protection solutions

Ensuring personnel safety

UniSec

Switchgear manufacturer	ABB / OEMs
Product type	Air-insulated MV switchgear for secondary distribution
Low-voltage application	-
Medium-voltage application	Up to 24 kV AC 1250 A 25 kA
Arc classification standard	IEC 62271-200 Up to AFLR, 1 s
Insulated busbars	Yes
Segregation between compartments	Up to LSC2B
Segregated tank and plug-in cable connection	No
Product web page	https://new.abb.com/medium-voltage/switchgear/air-insulated/iec-and-other-standards/iec-indoor-secondary-distribution-ais-unisec

Passive arc flash protection solutions

Ensuring personnel safety

ZX

Switchgear manufacturer	ABB / OEMs
Product type	Gas-insulated MV switchgear for primary distribution
Low-voltage application	-
Medium-voltage application	Up to 42 kV AC 3150 A 40 kA
Arc classification standard	IEC 62271-200 Up to AFLR, 1 s
Insulated busbars	Yes
Segregation between compartments	Up to LSC2A
Segregated tank and plug-in cable connection	Yes
Product web page	https://new.abb.com/medium-voltage/switchgear/gas-insulated-switchgear

Passive arc flash protection solutions

Ensuring personnel safety

SafeRing / SafePlus

Switchgear manufacturer	ABB / OEMs
Product type	Gas-insulated MV switchgear for secondary distribution
Low-voltage application	-
Medium-voltage application	Up to 40.5 kV AC 630 A 25 kA
Arc classification standard	IEC 62271-200 Up to AFLR, 1 s
Insulated busbars	Yes
Segregation between compartments	Up to LSC2A
Segregated tank and plug-in cable connection	Yes
Product web page	https://new.abb.com/medium-voltage/switchgear/gas-insulated-switchgear

Active arc flash mitigation solutions

Improve safety, reduce damage

Arc Guard System TVOC-2

Technology type	Optical-based internal arc detection and mitigation, which trips LV or MV circuit breaker
Dedicated product or optional function	Dedicated product for arc flash mitigation
Application	Low-voltage, medium-voltage
Operating time	1-2 ms
Total arc clearing time	With LV ABB circuit breaker: 45 … 50 ms With MV ABB circuit breaker: 50 … 100 ms
Certifications	DNV, ABS, BV, TÜV (SIL 2)
Enables personnel safety during maintenance	Yes
Enables arc mitigation 24x7	Yes
Product web page	https://new.abb.com/low-voltage/products/arc-guard

Benefits and features

- Increased personnel safety. Significant reduction of overpressure, toxic gases.
- Outstanding reaction time < 1 ms (< 2 ms with CSU-2)
- All-in-one unit with up to 30 single point sensors in three separate zones for selectivity
- Suitable for MV and LV applications with light only detection or both light
  and current detection
- Open loop Rogowski coils simplify installation and retro fit
- Simple commissioning of TVOC-2 and CSU-2 through HMI, Modbus RTU or
  Ekip Connect
- Factory calibrated sensors – no need for on-site adjustment
- Modbus RTU and ABB Ability Energy and Asset Manager connectivity

Active arc flash mitigation solutions

Improve safety, reduce damage

REA Arc protection system

Technology type	Optical-based internal arc detection and mitigation, which trips LV or MV circuit breaker
Dedicated product or optional function	Dedicated product for arc flash mitigation
Application	Low-voltage, medium-voltage
Operating time	1-2.5 ms
Total arc clearing time	With LV ABB circuit breaker: 45 … 50 ms With MV ABB circuit breaker: 50 … 100 ms
Certifications	DNV-GL, BV
Enables personnel safety during maintenance	Yes
Enables arc mitigation 24x7	Yes
Product web page	https://new.abb.com/medium-voltage/distribution-automation/arc-fault-protection/arc-fault-protection-system-rea

Benefits and features

- Increased personnel safety
- Significant reduction of overpressure, toxic gases
- Can be used as redundant solution with protection relays
- Compact, flexible and easy to integrate additional modules available to extend selective tripping capabilities, to create multiple loops or add more lens detectors.
- Light detection can be with:
  - fiber loop sensor (cost-effective)
  - multiple point lens sensors (increased selectivity)
- Adjustable light and current detection thresholds.

Active arc flash mitigation solutions

Improve safety, reduce damage

Protection relay : Relion 615

Protection relay : Relion 620

Protection relay : Relion 640

Relion 615-620-640

Technology type	Optical-based internal arc detection and mitigation, which trips MV circuit breaker
Dedicated product or optional function	Optional card and sensors for Relion family
Application	Medium-voltage
Operating time	2.5-6 ms
Total arc clearing time	With MV ABB circuit breaker: 60 … 110 ms
Certifications	DNV, LR, BV, KEMA, RMRS, UL, ABS, GL
Enables personnel safety during maintenance	Yes
Enables arc mitigation 24x7	Yes
Product web page	https://new.abb.com/medium-voltage/distribution-automation/numerical-relays

Benefits and features

- Increased personnel safety. Significant reduction of overpressure and toxic gases.
- Compact and easy to integrate additional card into multifunctional relay; is the perfect solution if a relay for protection is required.
- Light detection by use of:
  - loop (cost effective)
  - single point (increased selectivity)
  - supervised FO on REX640 up to 4 loops of 60 m
- Adjustable threshold levels.

Active arc flash mitigation solutions

Improve safety, reduce damage

Ultra-Fast Earthing Switch UFES

Technology type	Arc quenching system with arc detection and switching devices
Dedicated product or optional function	Dedicated product for arc flash mitigation
Application	Low-voltage, medium-voltage
Operating time	1.5 ms
Total arc clearing time	In combination with TVOC-2 or REA: <4 ms In combination with Relion: <10 ms
Certifications	DNV, VdS, UL
Enables personnel safety during maintenance	Yes
Enables arc mitigation 24x7	Yes
Product web page	https://new.abb.com/medium-voltage/apparatus/arc-fault-protection/ultra-fast-earthing-switch-ufes

Benefits and features

- Increased personnel safety.20 times faster than standard arc protection. Significant reduction of overpressure and toxic gases
- Compact switching devices and detection electronics enable easy integration into almost every switchgear.
- Tremendous reduction of downtime and repair costs, up to 98%.
- Monitoring system compatible with REA, TVOC-2 and Relion Relays.
- Ultra-fast switching vacuum interrupter and operating system integrated in one compact unit. Fast and reliable micro-gas generator operating mechanism.
- Available as loose product, within ABB MV and LV switchgear or as retrofit solution by ABB Service.

Active arc flash mitigation solutions

Improve safety, reduce damage

ArcLimiter

Technology type	Combination of arc quenching system with current-limiting fuses
Dedicated product or optional function	Dedicated product for arc flash mitigation
Application	Low-voltage arc mitigation with medium-voltage application
Operating time	1.5-2.5 ms
Total arc clearing time	In combination with REA: 4 ms
Certifications	As per REA and UFES systems
Enables personnel safety during maintenance	Yes
Enables arc mitigation 24x7	Yes
Product web page	https://new.abb.com/medium-voltage/service/extension-upgrades-and-retrofits/arclimiter

Benefits and features

- Unique solution which uses ultra-fast earthing switch (UFES) in combination with fuses, solves the LV arc fault problem at MV level.
- Improves power quality for upstream processes during mitigation. Reduces voltage dip duration seen by upstream devices during fault clearing.
- Incident energy reduced to under 1 cal/cm2, resulting in hazard risk category (HRC) zero.
- Embeds UFES benefits as part of the system solution.
- Suitable for upgrading existing plants, allowing use of existing MV fused switches and thereby avoiding replacement with relay and breakers.
- Also covers the area between transformer secondary and line side of the LV breaker.

Active arc flash mitigation solutions

Improve safety, reduce damage

Emax 2 and Tmax XT - Zone-selective interlocking

Technology type	Zone-selective interlocking
Dedicated product or optional function	Optional function of Emax 2 and Tmax XT circuit breakers
Application	Low-voltage
Operating time	40 ms with S protection (ANSI 50TD, 51)
Total arc clearing time	Depends on circuit breaker frame and fault current
Certifications	
Enables personnel safety during maintenance	Yes
Enables arc mitigation 24x7	Yes
Product web page	https://new.abb.com/low-voltage/solutions/selectivity

Benefits and features

- Increased personnel safety with hardwired or digital zone selectivity between circuit breakers.
- Can be used for zone selectivity interlocking i.e. selective short circuit, ground fault, instantaneous and directional protections.
- Digital zone selectivity can be provided with Ekip Link or Ekip Com IEC61850 to integrate the ABB circuit breakers in a substation automation system.

Active arc flash mitigation solutions

Improve safety, reduce damage

Emax 2 and Tmax XT - Alternative settings group (dual settings)

Technology type	Alternative settings group (dual settings)
Dedicated product or optional function	Optional function of Emax 2 and Tmax XT circuit breakers
Application	Low-voltage
Operating time	5-7 ms to change alternate settings
Total arc clearing time	Depends on circuit breaker frame and fault current
Certifications	
Enables personnel safety during maintenance	Yes
Enables arc mitigation 24x7	No
Product web page	https://library.e.abb.com/public/8ad2cd16efa94ec781470c02aa157334/1SDC200047L0201.pdf

Benefits and features

- Increased personnel safety. Add an extra level of protection with two user selectable sets of settings for circuit breakers.
- All protection settings can be changed between SET A and SET B to reduce trip protection thresholds and time delays.
- Can be easily activated by Ekip Connect.
- Different input can be set for the parameter change, e.g. - selector switch, open door microswitch.

Active arc flash mitigation solutions

Improve safety, reduce damage

Emax 2 and Tmax XT - RELT module

Technology type	Energy-reducing maintenance switch with RELT module
Dedicated product or optional function	Optional function of Emax 2 and Tmax XT circuit breakers
Application	Low-voltage
Operating time	2.5 ms
Total arc clearing time	Emax 2: 28 … 42 ms at 60 Hz
Certifications	
Enables personnel safety during maintenance	Yes
Enables arc mitigation 24x7	No
Product web page	https://new.abb.com/products/1SDA074169R1/relt-ekip-2k-3-e1-2-e6-2-tmax-xt

Benefits and features

- Increased personnel safety. Dramatically reducing the impact of an arc flash event.
- The 2I is a temporary protection that is faster than the normal instantaneous protections.
- Depending on the fault current, this function can provide a total clearing time as low as 1.5 cycles at 60 Hz.
  - Cannot be deactivated remotely
  - Positive feedback provides a clear indication that the safety function is working properly
  - Easy to use wizard is automatically engaged during initial installation
  - Commissioning can be executed through the circuit breaker touch screen·

Active arc flash mitigation solutions

Improve safety, reduce damage

Smart Substation Control SSC600

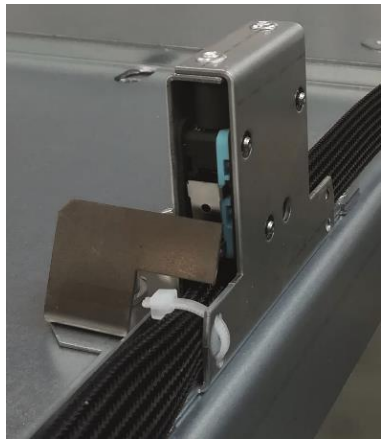
Technology type	Bus differential protection and optical-based internal arc-detection and mitigation, which trips MV circuit breaker
Dedicated product or optional function	Centralized protection based on Relion inputs
Application	Medium-voltage
Operating time	2.5-6 ms
Total arc clearing time	60 ... 80 ms
Certifications	UL, Intertek
Enables personnel safety during maintenance	Yes
Enables arc mitigation 24x7	Yes
Product web page	https://new.abb.com/medium-voltage/distribution-automation/numerical-relays/multiapplication/ssc600

Benefits and features

- Increased personnel safety. Significant reduction of overpressure and toxic gases.
- Compact and easy to integrate: additional card into multifunctional relay; is the perfect solution if a relay for protection is required.
- Low-impedance busbar current differential can also detect busbar faults without light detection.
- Operates based on detection of light and current from arc, which trips the MV circuit breaker or busbar differential.
- Light detection can be with:
  - loop (cost effective)
  - single point (increased selectivity)
  - differential current on 1 or 2 busbar sections
- Adjustable threshold levels and high logical selectivity.

Active arc flash mitigation solutions

Improve safety, reduce damage



Ith Limiter

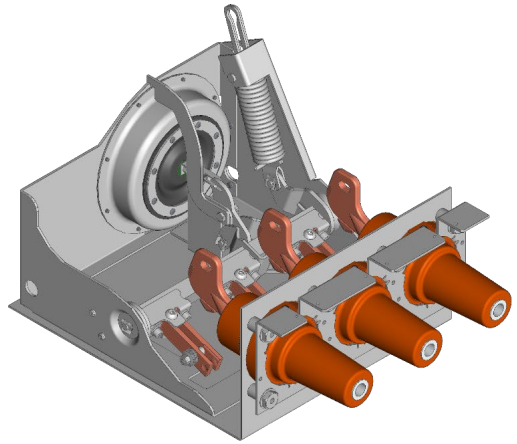
Technology type	Mechanical-based internal arcdetection and mitigation devices, which trips MV circuit breaker
Dedicated product or optional function	Optional devices for ABB UniGear switchgear
Application	Medium-voltage
Operating time	15 ms
Total arc clearing time	70 ... 90 ms
Certifications	
Enables personnel safety during maintenance	Yes
Enables arc mitigation 24x7	Yes
Product web page	https://new.abb.com/medium-voltage/switchgear/air-insulated/iec-and-other-standards/iec-air-insulated-primary-switchgear-unigear-zs1

Benefits and features

- Increased personnel safety with a basic solution.
- Integrated system with UniGear platform.
- Operates based on the indirect detection of overpressure generated by the arc. Mechanical switches mounted on the pressure relief flaps trip the MV circuit breaker.

Active arc flash mitigation solutions

Improve safety, reduce damage



Arc-Suppressor

Technology type	Mechanical-based internal arcdetection and mitigation devices, which short circuit incoming feeder
Dedicated product or optional function	Optional devices for ABB SafeRing / SafePlus switchgear
Application	Medium-voltage
Operating time	Less than 30 ... 50 ms
Total arc clearing time	30 ... 50 ms
Certifications	Tested according to IEC
Enables personnel safety during maintenance	Yes
Enables arc mitigation 24x7	Yes
Product web page	https://new.abb.com/medium-voltage/switchgear/gas-insulated-switchgear

Benefits and features

- Increased personnel safety. No overpressure outside switchgear compartment. The arc is extinguished without any emission of hot gases.
- Internal arc fault in the tank will have no impact on the surroundings. Integrated solution with SafeRing and SafePlus platform: 12kV, 24kV and 36kV.
- Insensitive to corrosion and environmental impact give optimum reliability. No links or release mechanisms outside gascompartment.
- The pressure detector is insensitive to pressure changes due to variation in atmospheric temperature or pressure, as well as external phenomena such as vibrations or shocks.
- Operates based on the direct detection of overpressure generated by the arc inside gas compartment.
- Optional mechanical switch for electrical signaling.

Preventive arc flash protection solutions

Safer operations at a distance

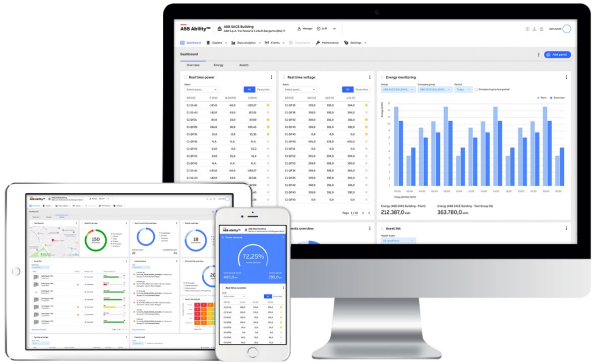


ABB Ability Energy and Asset Manager

Technology type	Energy and asset management cloud-computing platform and predictive maintenance indication
Dedicated product or optional function	Dedicated product
Application	Low-voltage, medium-voltage
Product web page	
Benefits and features	ABB Ability Energy and Asset Manager, the innovative cloud-computing solution designed to monitor, optimize, predict and control the electrical system. ABB Ability Energy and Asset Manager assists anytime and anywhere via smartphone, tablet or personal computer.
Product web page	https://new.abb.com/about/our-businesses/electrification/abb-ability

Benefits and features

The user can:

- Monitor
  Oversee site performance, supervise the electrical system and allocate costs.
- Explore
  Visualize the system structure, verify asset health and get actionable insights following predictions and prescriptions.
- Analyze
  Schedule and analyze automatic data exports, improve the use of assets and make the right business decision.
- Act
  Set up alerts to notify key personnel while remotely implementing an effective efficiency strategy, managing maintenance activities and scheduling next actions.

Preventive arc flash protection solutions

Safer operations at a distance

ABB Ability Condition Monitoring for electrical systems

Technology type	Condition monitoring and energy management on-premise based platform
Dedicated product or optional function	Dedicated product
Application	Low-voltage, medium-voltage
Product web page	https://new.abb.com/low-voltage/launches/abb-ability-condition-monitoring-for-electrical-systems
Benefits and features	On-premise solution for plant-wide condition and energy monitoring. Data storage and analytics to prevent failures, predict asset maintenance and optimize production. Simple web browser access to intuitive user dashboard with health index, single line and panel views, trends. Integrated Knowledge Base provides root cause and suggested action on any event.

Benefits and features

- Integrated data analysis to provide detailed insights on asset health and prediction of upcoming maintenance needs.
- Monitoring temperature of critical connection with detailed analysis of switchgear thermal situation and early warning about developing issues.
- Report function of switchgear condition and statistics as well as energy report, which indicates trends up to each individual load in low-voltage switchgear and MCC.
- Integration capability of ABB and 3rd-party products based on Modbus communication protocol.

Preventive arc flash protection solutions

Safer operations at a distance

ABB Ability Condition Monitoring for switchgear – SWICOM

Technology type	Condition monitoring
Dedicated product or optional function	Dedicated product
Application	Medium-voltage
Product web page	https://new.abb.com/medium-voltage/service/advanced-services/condition-monitoring-for-switchgear-SWICOM
Benefits and features	Monitoring and diagnostic unit providing mechanical and electrical health status of a fleet lineup. Any new or existing panel can become truly ABB digital compliant by having SWICOM onboard, regardless of age, design or brand. One unit covers information from the whole switchgear lineup.

Benefits and features

- Detects the primary circuit hot spots and monitors their trends as one of its crucial health monitoring tasks.
- Detects partial discharges (surface, corona, inner void and floating electrode discharges) before the insulation component is further degraded, to prevent complete breakdown of insulation resulting in a possible arc fault.
- Fully integrated monitoring solution providing detailed analysis of switchgear health situation and early warnings about developing issues.

Preventive arc flash protection solutions

Safer operations at a distance

Ekip Signalling 3T module and PT1000 probes – Emax 2 and Tmax XT

Technology type	Condition monitoring
Dedicated product or optional function	Optional module for Emax 2 and Tmax XT
Application	Low-voltage
Product web page	https://search.abb.com/library/Download.aspx?DocumentID=1SDC210109D0201&LanguageCode=en&DocumentPartId=&Action=Launch
Benefits and features	ABB PT1000 sensor can be installed directly on the busbar, Ekip Connect software allows easy programming for plug-and-play installations. Emax 2, Tmax XT or Ekip UP can replace the external unit for temperature monitoring. Ekip Signalling 3T can monitor three PT1000 sensors and one 4-20 mA input.

Benefits and features

- Ekip Signalling 3T acquires signals from three PT1000 temperature sensors directly connected to the module. Additional channel 4-20 mA collects information from external sensors or equipment.
- Emax 2, Tmax XT or Ekip UP can house two modules: Ekip Signalling 3T-1 and Ekip Signalling 3T-2.
- Pressure, relative humidity, vibration and further data monitoring is also possible using the additional 4-20 mA input.

Preventive arc flash protection solutions

Safer operations at a distance

Remote Racking Device – Emax 2

Technology type	Remote racking
Dedicated product or optional function	Optional device for Emax 2 circuit breakers
Application	Low-voltage
Product web page	https://new.abb.com/low-voltage/products/circuit-breakers/emax2/rrd-remote-racking-device
Benefits and features	The new Remote Racking Device (RRD) for Emax 2 enables operation of the circuit breakers from a distance. The remote control is connected to the main device with a 10 meter (33 ft) cable.

Benefits and features

- RRD improves employee safety due to the distance between the circuit breaker and the operator.
- Immediate visual verification of the circuit breaker position, thanks to the 3 LEDs on the device and on the remote control.
- It is possible to interrupt the operation at any time using the emergency pushbutton on the remote control.
- Certification: RRDs have been investigated by UL in accordance with the Standard(s) UL 2876.

Preventive arc flash protection solutions

Safer operations at a distance

Remote Racking TruckMaster

Technology type	Remote racking
Dedicated product or optional function	Optional device for MV circuit breakers
Application	Medium-voltage
Benefits and features	TruckMaster allows remote and safe racking in and out of a circuit breaker with the panel door closed.
Product web page	https://new.abb.com/medium-voltage/service/extension-upgrades-and-retrofits/truckmaster

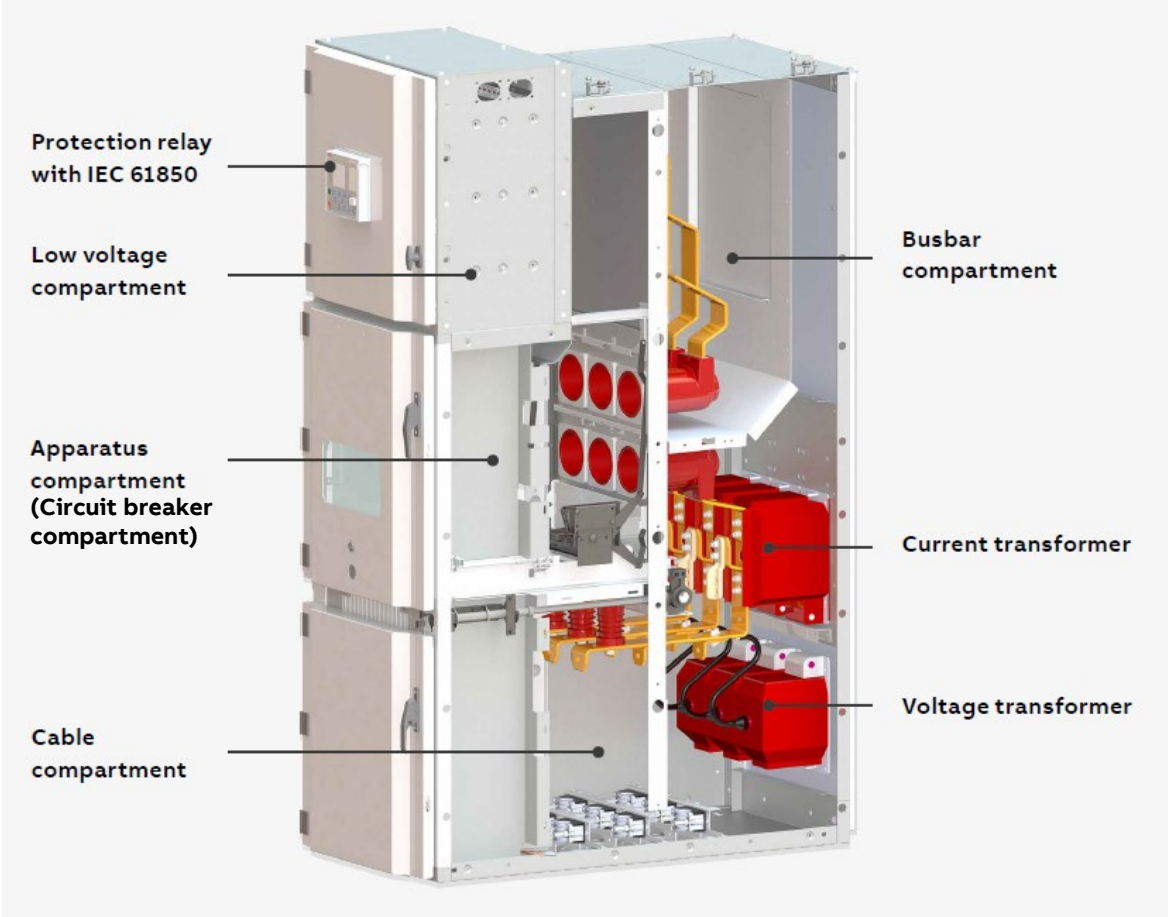
Benefits and features

- Reduces exposure to arc flash energy; preserves mechanism and interlock integrity.
- Easy application due to the detachable driver docking technology.
- Only one driver docking needed for the whole switchgear motorization.
- Connects to the original circuit breaker door without or with minor modifications.

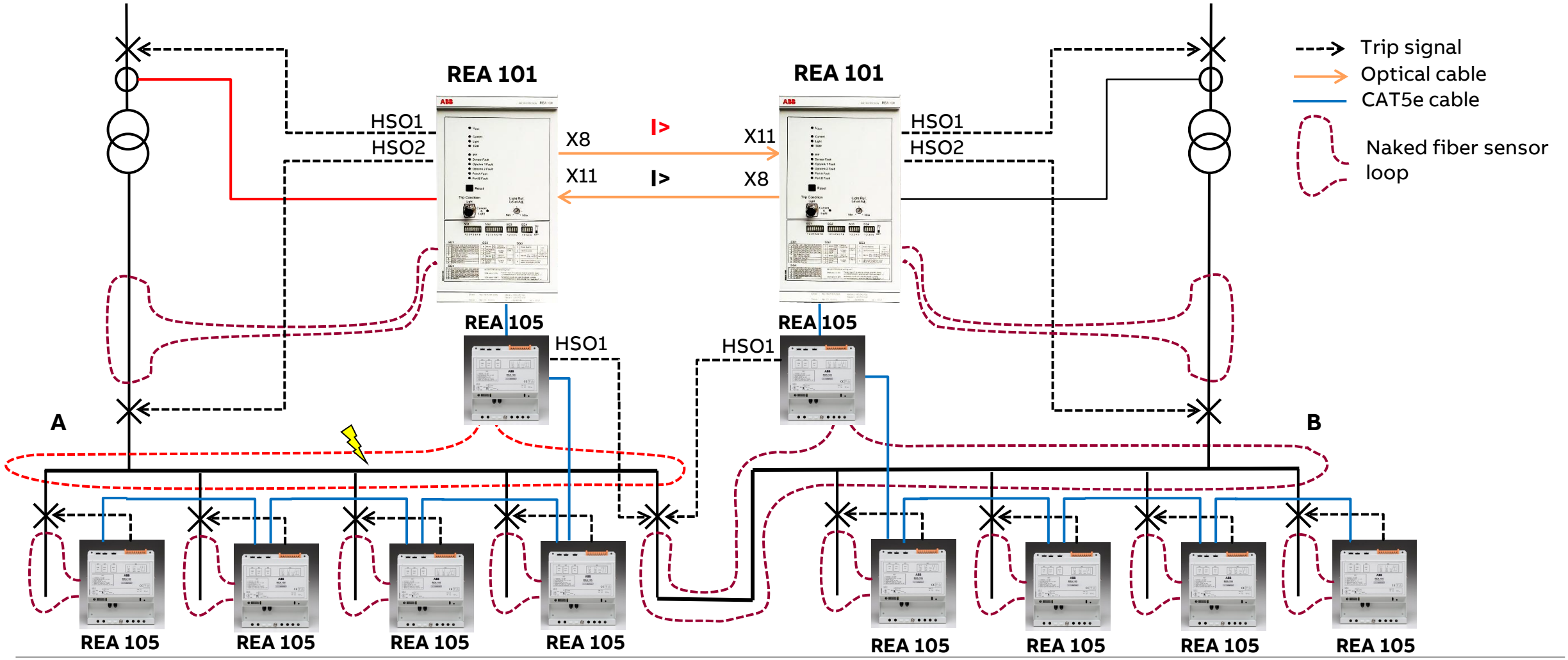
Solution examples

STRUCTURE OF MEDIUM-VOLTAGE AIR-INSULATED SWITCHGEAR PANEL

UNIGEAR ZS1

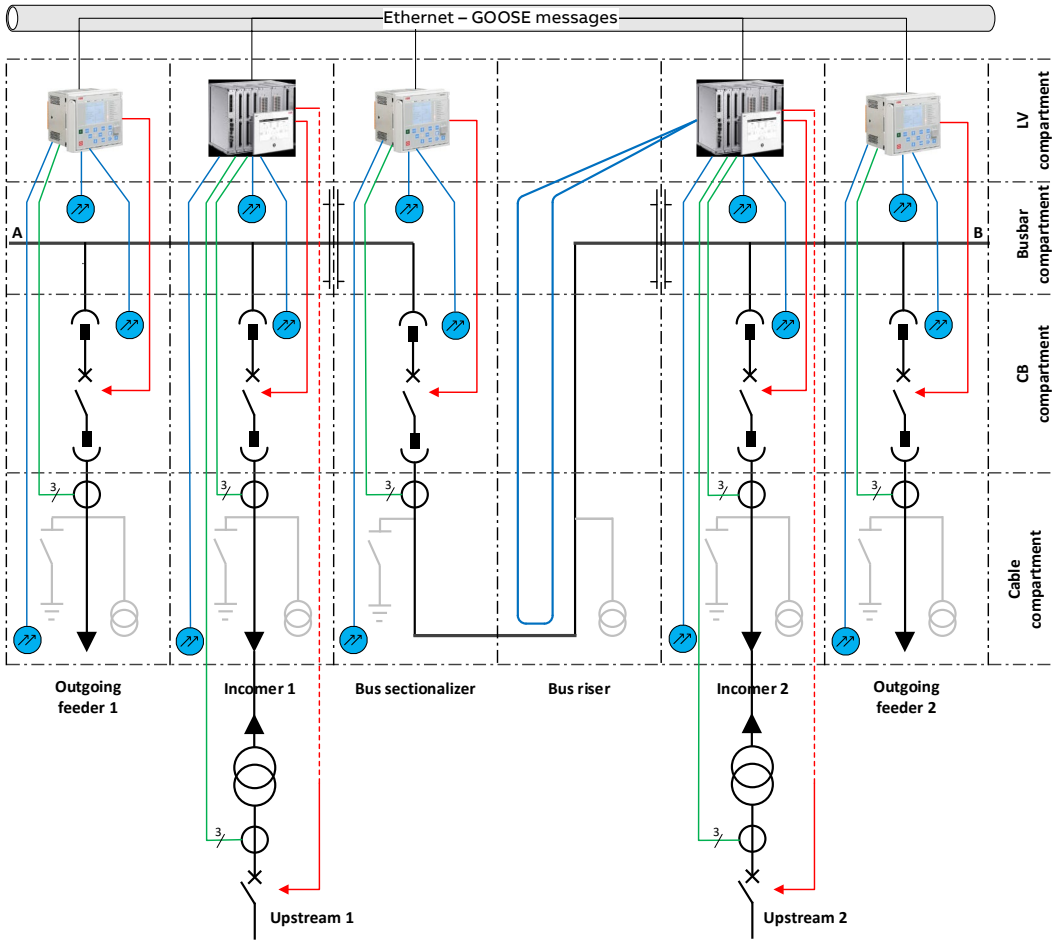


REA Arc Fault Protection System Example 1



Arc protection solution with REX640 and REF615/620

Single busbar AI switchgear with two sections



Selective tripping scheme

Arc light detected by sensor in …	Fault current detected at …							CB to trip (or lockout if already open)						
	Upstream of Incomer 1	Outgoing feeder 1	Incomer 1	Bus sectionalizer	Incomer 2	Outgoing feeder 2	Upstream of Incomer 2	Upstream of Incomer 1	Outgoing feeder 1	Incomer 1	Bus sectionalizer	Incomer 2	Outgoing feeder 2	Upstream of Incomer 2
Bus bar section A			X						X	X	X			
Bus bar section B					X						X	X	X	
Outgoing feeder 1 CB compartment			X							X	X			
Outgoing feeder 1 cable compartment		X							X					
Incomer 1 CB compartment			X					X		X	X			
Incomer 1 cable compartment	X							X		X				
Bus sectionalizer busbar A side			X						X	X	X			
Bus sectionalizer CB compartment			X	X					X	X	X	X	X	
Bus sectionalizer cable compartment			X	X	X						X	X	X	
Bus riser				X	X						X	X	X	
Incomer 2 CB compartment					X						X	X		X
Incomer 2 cable compartment							X					X		X
Outgoing feeder 2 CB compartment					X						X	X		
Outgoing feeder 2 cable compartment						X							X	

Summary

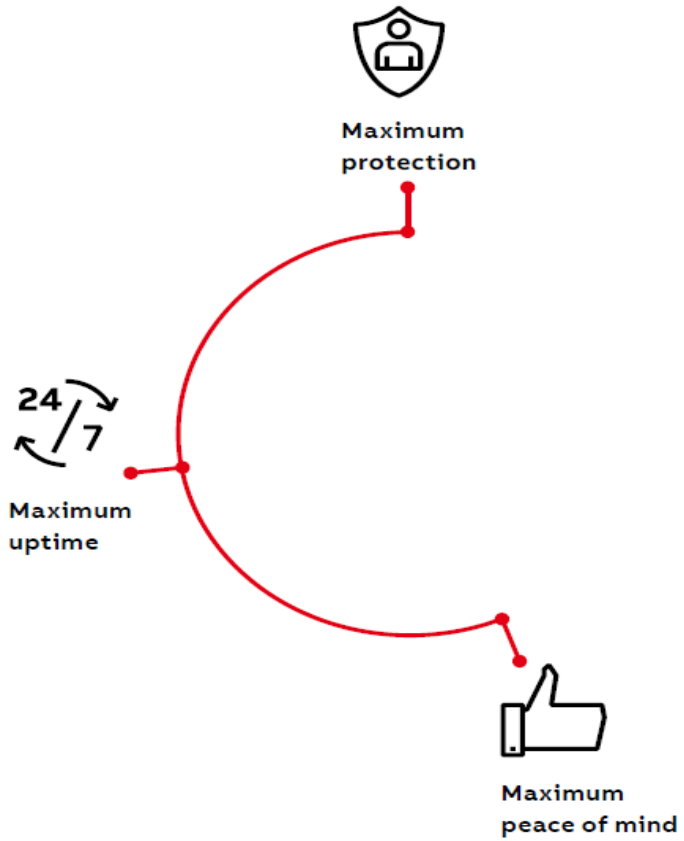
Main drivers for investing in arc protection

- Protect personnel
  - Most accidents are caused by human errors during maintenance and repair work
  - Increased risks due to varying aged equipment and increasing power consumption

→ Maximum protection with arc protection

- Protect assets
  - Limit damages caused by arc faults
  - Extend life-time of older equipment safely
  - Flexible planning of maintenance

→ Maximum uptime with arc protection



Q&A

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