

DESCRIPTIVE BULLETIN

Service and aftermarket solutions

Electrification Service



ABB's Electrification Service team includes experts across a wide range of product and service offerings. They have the knowledge and experience to help solve your problems and assist in meeting all your service needs, both on- and off-site. With multiple service centers across North America and regionally dispersed field service engineers, Electrification Service is always nearby and ready to support your needs.

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Introduction

Overview

ABB's Electrification Service team includes experts across a wide range of product and service offerings. They have the knowledge and experience to help solve your problems and assist in meeting all your service needs, both on- and off-site. With multiple service centers across North America and regionally dispersed field service engineers, Electrification Service is always nearby and ready to support your needs.

With over 100 years of experience in the design, development, manufacturing and service support of medium and low voltage switchgear, we have established a wealth of technical solutions to meet your specific electrical network reliability needs. We recognize that electrical equipment has different service needs depending on factors such as age, maintenance, application and duty cycle.

ABB has one of the largest installed bases of any switchgear manufacturer in North America. We support our products through a comprehensive range of services, ensuring optimum performance throughout the entire product life cycle.

Electrification Service personnel are highly qualified and certified to perform the field services required to keep your electrical equipment operating properly and safely. ABB's worldwide leadership and manufacturing excellence in medium and low voltage products allows ABB to provide a variety of aftermarket solutions and services for both conventional and nuclear-safety related applications.

Our service portfolio starts with installation and commissioning and continues through the product life cycle to include decommissioning.

Products we support

Electrification Service offers service on a comprehensive range of products for electrical distribution networks.

We supply parts and service for:

- Air insulated switchgear
- Outdoor switchgear
- Gas-insulated switchgear
- Motor control centers
- Secondary switchgear, ring main units
- Compact substations
- Circuit breakers and contactors
- Load break switches and disconnectors
- Distribution protection and control
- Relay systems

In addition, we maintain archives containing complete technical information on a wide range of our heritage brand products. Over the years, ABB brands have included:

- ITE
- Gould
- GE
- Brown Boveri
- ABB
- SACE
- Calor EMAG
- ASEA

ABB is strongly committed to providing aftermarket service and support for all of these brands, including options to extend their life through retrofit and upgrade services to include the latest technology standards.

Service categories

Service solutions

Whatever your needs, we support our switchgear installations with a full service portfolio that covers every network application, from large to small. Each and every job, on- or off-site, is accurately assessed, using highly developed skills and technical tools to help ensure the best outcome.

Our solutions take all factors into consideration, including technical, financial, environmental and safety aspects. The result is a reliable and long-lasting solution.

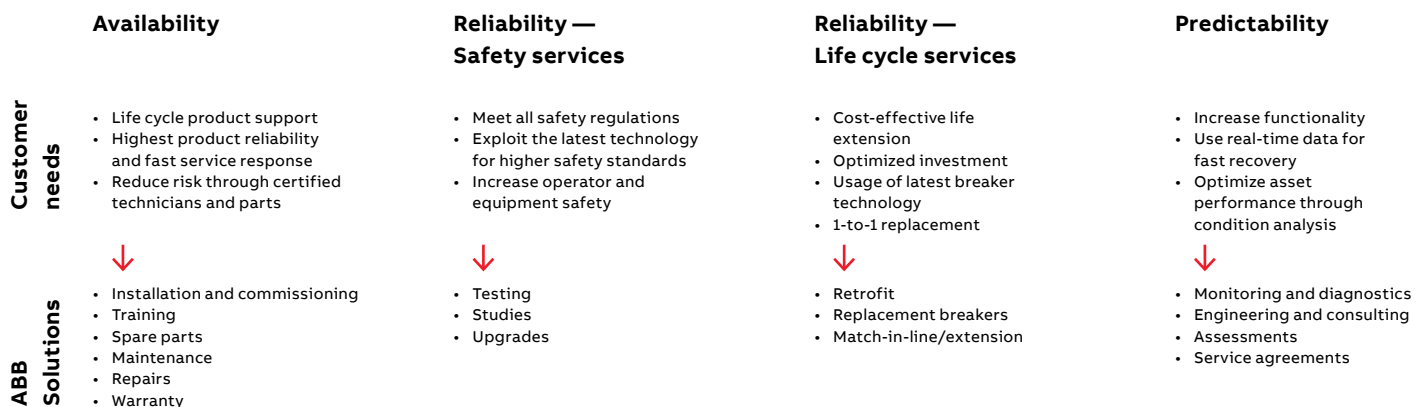
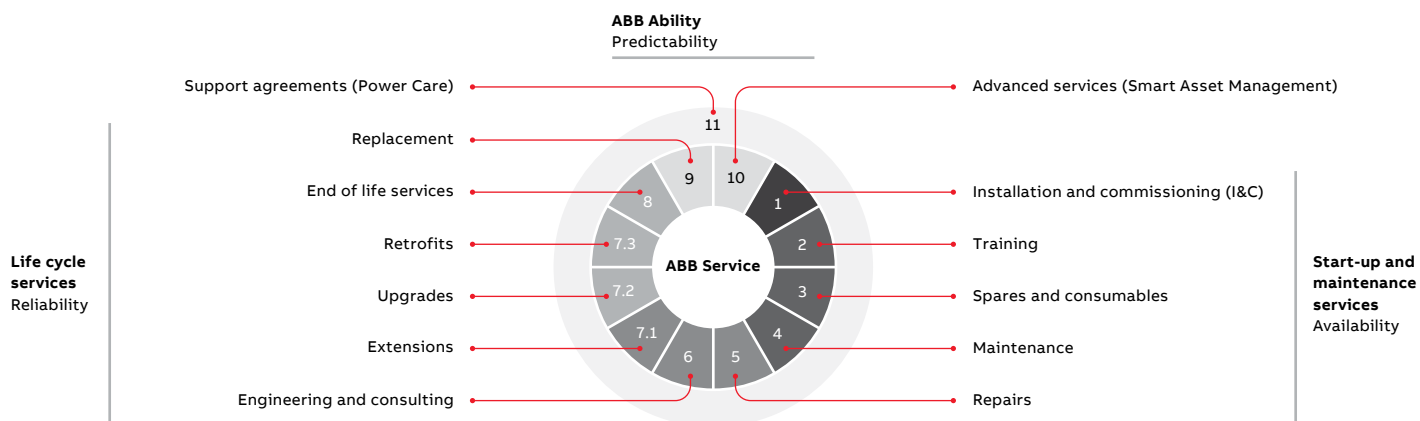
ABB has several long-established switchgear and component factories and a robust R & D infrastructure. Combined with our network of local service centers in North America, this enables us to provide the highest standard of product support from installation to end of life.

Regardless of the age of your switchgear, ABB can provide a solution.

Always one step ahead

Staying ahead means making the right decisions, at the right time, based on the right information. ABB aims to work as an active partner in your business.

We support our installed base through proactive service offerings that help ensure high reliability, safety and optimal performance of switchgear and components.



Start-up and maintenance services

Installation and commissioning

Count on certified on-site installation supervision and start-up testing and commissioning services by ABB experts for high reliability and optimum life cycle performance from the first operation.

Correct installation and commissioning help ensure a high degree of operational reliability. To achieve a problem-free start-up, ABB installation and commissioning procedures must be followed. The use of ABB service personnel helps ensure that switchgear is installed and put into operation in a safe and correct way.

Installation services including:

- Foundation alignment check
- Supervision of cubical erection
- Supervision of transport section connections
- Supervision of incoming/outgoing cable connections
- Switchgear earthing check
- Insulation level testing
- Internal wiring check
- Internal serial communications analysis check
- Auxiliary voltage supply check

Testing and commissioning of switchgear

- Setting of device parameters for circuit breakers, motor starters and feeders
- Operation of circuit breakers, motor starters and feeders

Testing and commissioning of protection and control

- Verify relay settings and integrity of the system
- Trip checks to make sure relays pass acceptance testing
- In-service tests can also be performed
- System wiring is verified against as-built drawings
- Documentation on findings, including test reports, is provided

Benefits

If Electrification Service is managing your switchgear installation and commissioning, your benefits are:

- Reliable switchgear from the first day of operation
- Lower risk for shut down
- Faster start-up
- Optimum life cycle performance
- Extended warranty
- Training for your operators, maintenance teams and engineers

In addition to installation and commissioning of switchgear, Electrification Service also offers this service for:

- Circuit breaker retrofit
- Protection and control retrofit
- Safety upgrades
- Monitoring devices

Start-up and maintenance services

Training

ABB's hands-on training programs educate customers on the proper maintenance and service of ABB electrical power equipment. These training programs are offered at both ABB and customer facilities.

A large selection of specialized training programs is available, and training programs can be tailored to meet the specific needs of customers. The training programs are developed for operators, engineers and technicians to become proficient in the application, installation, operation, maintenance, testing and commissioning of ABB switchgear, circuit breakers, relays and related components and upgrades.

Power service training

Power service training focuses on switchgear and circuit breakers and is available for both nuclear and non-nuclear applications.

Circuit breaker and switchgear training covers all product aspects. Training can also include proper disassembly methods for circuit breakers, identification of components that need to be replaced and re-assembly of the circuit breakers after component replacement.

Standard training classes are available or customer-specific training can be developed according to customer requirements.

Relay training

ABB has comprehensive relay training programs for all relay types including electromechanical, solid-state and microprocessor relays.

Class participants receive instruction on everything about relays from calibration to troubleshooting techniques. ABB also offers relay training programs that teach detailed protective relaying, such as symmetrical components and fault analysis, distribution and transmission protection and protection for many electric power component applications.

Training programs cover:

- Product orientation
- Application
- Installation
- Calibration
- Operation
- Inspection
- Maintenance
- Testing
- Commissioning
- Troubleshooting
- Safety



Start-up and maintenance services

Spares and consumables

Products supported

Original ABB spare parts are distinguished by quality, security and high reliability. Original ABB spare parts have high lifetime expectancies and provide excellent equipment performance, making them the best economical choice.

Accurately defined manufacturer specifications, as well as comprehensive examinations and type testing, help ensure that every ABB spare part complies with our high quality standards and the latest technical status.

ABB supplies spare parts, spare part kits, assemblies and components for the following ABB and heritage brand products:

- Switchgear
- Indoor and outdoor circuit breakers
- Load break switches
- Disconnect switches
- Contactors
- Protection and control relays
- Substation automation
- Reclosers
- Fuses

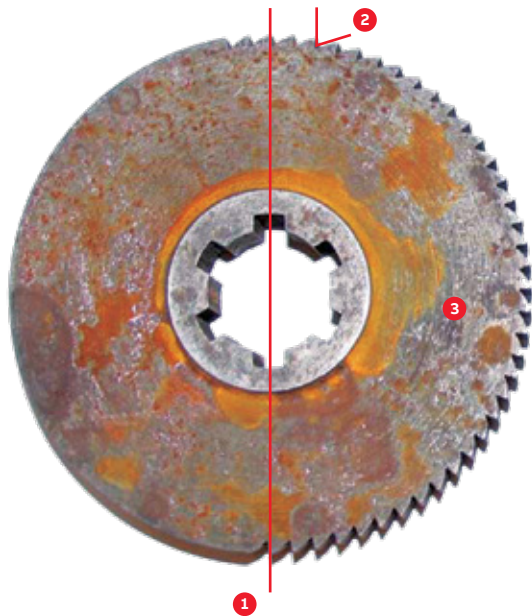
Why use authentic spare parts?

Using replacement parts purchased through third-party sources can be a recipe for catastrophic failure. Parts acquired through other sources have an unknown history that could put your plant's electrical system at risk with substandard components.

Buying third-party manufactured parts could mean buying into more problems and added risk. Reverse engineering critical parts is common practice for some third-party vendors, engineering worn tolerances into a seemingly new product with substandard designs.

ABB's warehouse maintains an extensive stock of new switchgear and circuit breaker components to meet emergency needs for both nuclear-safety related and conventional applications, with same-day shipment available on many parts.

Only ABB spare parts comply with 10 CFR 50 Appendix B, 10 CFR Part 21 and NQA1 requirements, when applicable, for nuclear-safety related equipment.



Non-original part



ABB original part

Example of a non-original spare part applied to a circuit breaker operating mechanism.

The following mistakes have been detected on the non-original part:

- 1 First tooth catches the linked mechanism earlier than needed.
- 2 Tooth inclination angle is wider than maximum allowed tolerance.
- 3 The surface is not properly treated to prevent corrosion.

Start-up and maintenance services

Maintenance

When looking at today's maintenance strategies, preventive maintenance is the most common method used. A preventive maintenance approach offers higher reliability and increased safety to customers installed power products. ABB proposes risk- and condition-based maintenance strategies to help ensure maximum plant reliability.

Certified technicians

Maintenance is essential to keep equipment in the electrical network safe and reliable. It helps to eliminate workplace hazards. Lack of maintenance or inadequate maintenance can lead to dangerous situations and accidents, and can jeopardize asset and operator health. Maintenance is a high risk activity. It must be performed correctly and safely.

ABB field service engineers and technicians are highly qualified and certified. This expertise, combined with long industry experience working on power equipment, makes them the best in class.

Choosing ABB as a partner for your maintenance needs provides the following advantages:

- High level of professionalism guaranteed by a continuous factory training process and refresher courses
- Instructions and maintenance schedules specific to each product
- Access to all technical information on the product and relative updates
- Rapid diagnosis thanks to specific testing instruments and identification of faults and/or improperly functioning equipment, thereby helping reduce plant downtime
- Activities are conducted in safe conditions in compliance with appropriate occupational health and safety management systems, such as the OHSAS 18001 standard
- Release of an accurate maintenance intervention report

Preventive maintenance

Maintenance is carried out at predetermined intervals or according to prescribed criteria aimed at helping reduce the failure risk or performance degradation of the equipment.

This method is based on scheduled activities performed on the out-of-service equipment including:

- Visual checks
- Apparatus cleaning
- Mechanical components lubrication
- Testing
- Worn parts replacement
- Functional tests execution



Maintenance cycles are planned according to the need to take the device out of service. The incidence of operating faults is reduced.

Risk-based maintenance

Maintenance is performed based on the results of an asset assessment, which includes analysis, measurement and testing activities.

The gathered information is viewed in the context of the environmental, operation and process condition of the equipment in the system and its importance. The aim is to perform the asset condition and risk assessment and then define the appropriate maintenance program.

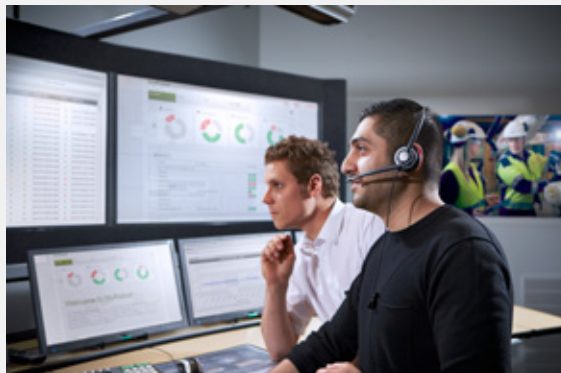


All equipment displaying abnormal values is refurbished or replaced. This makes it possible to extend the useful life and help ensure higher levels of plant reliability, safety and efficiency.

Condition-based maintenance

Maintenance is based on equipment performance monitoring and control of the corrective actions taken as a result.

The actual equipment condition is assessed by the on-line detection of significant working device parameters and their automatic comparison with average values and performance. Maintenance is performed when specific indicators signal that equipment is deteriorating and failure probability is increasing.



This strategy, in the long term, drastically aids in reducing costs associated with maintenance, helping minimize the occurrence of serious faults and optimizing available economic resources management.

Start-up and maintenance services

Maintenance — Testing

Medium voltage switchgear is the core component of distribution networks, industry plants and power generation, and any internal failure may have a significant impact, mainly because restoration is complicated and lengthy.

Relay calibration

Relays are very sensitive equipment that require proper calibration, coordination and testing. Improper calibration can lead to either nuisance trips or an unprotected system if relays are set too low or too high.

After a relay is commissioned, it is important to carry out regular relay calibration testing. One of the advantages of such testing is pinpointing a defective relay before it fails to act during a fault. It will also show where the power system needs to be adjusted, because many feeders and loads may have been added over the years since the relay was installed. Not every type of relay requires the same frequency of maintenance testing; however, it is advisable to schedule periodic maintenance tests on an annual basis.

High potential (Hi-pot)

The Hi-pot test, sometimes called a dielectric withstand test, is used to verify the strength of the insulation between a product's current-carrying components and its chassis or

enclosure. This is performed by applying high voltage from the mains-input lines to the chassis of the product and measuring the resulting leakage current flowing through its insulation. The theory: If a voltage much higher than the product would normally see is applied across the insulation without a breakdown, the product will be able to operate safely under nominal operating conditions.

The Hi-pot test is crucial because it is the best way to uncover workmanship and assembly defects in an electrical product that can lead to insulation breakdown.

Mistakes during assembly or faulty/damaged components exist to an extent in any installation environment, and the Hi-pot test can uncover units that are unfit and dangerous to operate.

In order to detect breakdown in electrical products, this test is typically performed after installation and recommended during routine repair and maintenance.

Partial discharge (PD)

Failure of medium voltage switchgear insulation is the number one cause of system failures, with IEEE statistics indicating that electrical insulation deterioration causes up to 90% of electrical failures. PD testing gives advance warning of pending insulation failure.

PD can occur in the form of cavity discharges and surface discharges. If allowed to continue, PD will erode the insulation, resulting in tracking or a tree-shaped pattern of deterioration, eventually resulting in the complete breakdown and failure of the switchgear. To prevent these types of events in switchgear systems, PD monitoring on a regular basis is essential.

Data obtained through PD testing and monitoring can provide critical information regarding the quality of insulation and its impact on system health. By detecting and trending PD, it is possible to observe its development over time, in order to assist with decisions regarding the repair or replacement of affected assets.



Start-up and maintenance services

Maintenance — Refurbishment

Refurbishments are for circuit breakers with readily available parts. Electrification Service' factory-trained technicians provide refurbishment services for both nuclear and non-nuclear low and medium voltage circuit breakers.

ABB refurbishes used circuit breakers to like-new operating condition, providing a full one-year warranty that covers parts and labor.

One price refurbishment program

ABB offers an exclusive refurbishment program for ABB lineage circuit breakers. ABB will provide a complete circuit breaker refurbishment price, up front, that includes all standard parts normally replaced during circuit breaker refurbishment.

One price benefits

- No surprises — complete circuit breaker refurbishment price up front
- Includes all standard parts normally replaced during circuit breaker refurbishment, plus specific additional components if they do not meet ABB acceptance standards
- Conditional on the circuit breaker being received in working condition, with no apparent damage found during the "as-received" inspection
- Includes a one-year warranty and accompanying documentation

Other manufacturers' circuit breakers

ABB has the expertise to refurbish other manufacturers' used circuit breakers to like-new operating condition. The refurbishment process is the same as that for ABB circuit breakers.

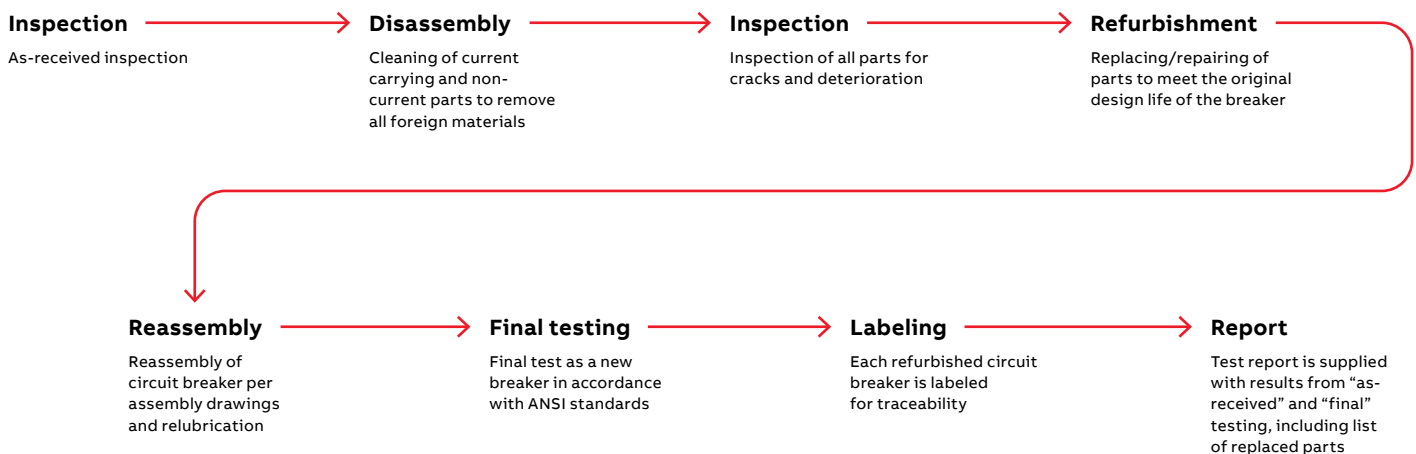
Base prices quoted cover typical refurbishment components and labor from qualified technicians. Other parts and repairs are performed based on additional quotations and customer approval.

ABB customer service solutions

In addition to providing high quality circuit breaker refurbishments, ABB works with customers to create refurbishment programs to meet specific needs and time frames.

Examples of customer service solutions include:

- Loaner/spare circuit breakers for refurbishment rotation to help minimize downtime
- On-site refurbishments



Start-up and maintenance services

Repairs

Rely on Electrification Service' repair competencies and fast response to emergency situations and unexpected or planned outages. Choose factory-approved repairs using parts manufactured to controlled specifications and in accordance with current design revision level.

Our nationwide network of service centers offers medium and low voltage product repairs either on site or in our well-equipped local workshops.

Planned on-site repair

Electrification Service technicians visit your site during a planned outage time. The technician will be trained and certified on the respective products and will arrive well-prepared, allowing the technician to repair the equipment in the minimum time possible.

Workshop repair

Besides on-site repair, workshop repair is offered in our state-of-the-art service workshops. By using our workshops, we can reach a higher range of repair that cannot always be achieved on site. Fundamental failures can be more easily detected and addressed.

In addition to the repair work, the equipment will be fully tested in our testing facility and sent back to the customer with the accompanying documentation.

Emergency repairs

Factory-trained technicians are available 24 hours a day, 365 days a year to support emergency repairs.

Technicians also have the support of the ABB factories to provide necessary parts, drawings and engineering guidance.

Based on deep product know-how and the availability of spare parts, unexpected outage times can be dramatically reduced.



Start-up and maintenance services

Repairs — Warranty

Extended warranty through installation and commissioning

ABB offers an extended warranty to customers who purchase new ABB switchgear or retrofit solutions where installation and commissioning is performed by Electrification Service. The warranty extension is provided to the customer free of charge.

This warranty can be provided free of charge because experience has shown that risk of product failure in the first year trends towards 0% when ABB technicians handle installation and commissioning services.

This is a result of our continuous internal product training and recertification programs. Experience has shown that this low failure rate is generally unachievable by non-OEM service providers and independent service contractors.

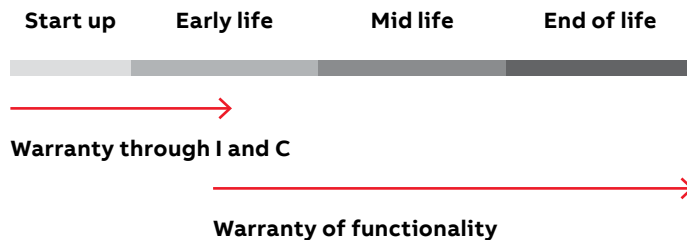
Warranty of functionality

ABB offers a warranty of functionality for equipment that is being assessed/maintained in accordance with the associated service agreement contract (see page 38) up to the next service interval according to ABB's parameters (max. 3 years).

If anything happens to the equipment within that period of time, costs are covered by the warranty, and ABB will repair or replace the affected covered product or component free of charge.

The warranty of functionality can be offered for a wide range of products associated with your electrical distribution network for any MV equipment installed, regardless of manufacturer and life cycle. Some exclusions apply, due to the condition of existing assets and availability of spare parts or replacement options for obsolete equipment.

The warranty of functionality is a unique approach in the market of service agreements and will enable you to plan your operational budget well in advance, with much more certainty.



Life cycle services

Engineering and consulting

Additional services are provided by Electrification Service with a supportive function. In most cases, these services are part of a larger project, but are critical for overall success.

System integration

System integration solutions find the most efficient and economical approach to the integration and application of ABB and other manufacturers' equipment into a site installation. This includes identifying system protection requirements and the proper devices to provide system protection.

To help ensure the highest reliability, Electrification Service also provides system reliability improvement studies involving the general analysis of an electrical power system to determine the cause of power system failures or reduced reliability. Electrification Service will recommend configuration changes and additional equipment necessary to correct system failures and improve overall system reliability.

Engineering and consulting

Use Electrification Service' know-how to identify opportunities for improving system performance and optimizing your processes technically and economically — all while maintaining regulatory compliance.

Along with recommendations on product applications, Electrification Service can develop and provide customized solutions that solve even the most complex of customer challenges.



Life cycle services

Engineering and consulting —

Power systems studies

How do you know if your circuit breaker will work successfully to interrupt an electrical fault or short circuit? And what type of personal protective equipment (PPE) should your personnel be using?

Studies can provide the answers to those questions.

Short circuit study

Short circuit studies are usually performed when changes are made to an existing system, including the installation of new power equipment or the reconfiguration of existing equipment.

ABB has the expertise to provide these studies to help ensure the proper coordination and protection settings related to the electrical equipment and system.

Short circuit analysis and coordination studies will test the configuration of your protective devices, including relays, switches and circuit breakers. Proper function and coordination is necessary to help prevent damage to equipment in the event of a fault.

The short circuit analysis and coordination study looks at loads at various points in the system and how they change after a simulated fault. Ideally, only the protective device closest to the fault will catch and clear it, minimizing the areas affected. This requires calibration of each device, as well as proper coordination between them.

Arc flash study

Arc flash studies reveal the incident energy of a potential arc flash event. These studies are performed to determine the necessary level of PPE to be worn by workers in close proximity to these potential arcs. These studies also help determine the proper application of any arc flash mitigation equipment to be installed.

Section 110.16 of the 2017 National Electrical Code (NEC) requires that electrical equipment be marked to warn qualified personnel of potential arc flash hazards. To accurately evaluate the dangers associated with arc flash, we must quantify the hazard. The measure that has been developed to assess arc flash events is incident energy, which is the energy measured on a surface at a specified working distance from the arc flash location. In the 2017 revision, this section split into an (A) and (B) with 110.16(B) requiring the arc flash hazard marking to also provide additional information on service equipment at 1200 A and higher to assist those performing an arc flash risk assessment. Mainly, we needed to include the nominal system voltage, available fault current at the service, the clearing time of the service overcurrent protective device and the date the label was applied. NEC 2023 revisions aim to improve safety from arc flash hazards with the addition of feeder-supplied equipment to the purview of 110.16(B). The 2023 NEC requires that all service and feeder level equipment at 1000 A and higher must be labeled in accordance with applicable industry practice for such a label, or as already discussed, section 130.5(H) of NFPA 70E.

The result of the arc flash study will categorize the hazard at specific equipment based on the incident energy, as well as identify the arc flash protection boundary. Inside the arc flash protection boundary, a worker must be wearing the proper PPE. The main objective of the PPE is to limit burns to the body resulting from an arc flash event to a survivable level.



Life cycle services

Match-in-line/extension

Expanding an existing switchgear line-up by adding one or more feeder frames is commonly referred to as match-in-line. This technique is increasingly used to satisfy increased power demands.

ABB reproduces heritage brand switchgear that is no longer in active production as both full line-ups or add-on frames for existing installations.

As the OEM, ABB can still manufacture switchgear types such as HK, HKII and K-line to match existing installed switchgear line-ups. The newly manufactured cells are equipped with state-of-the-art components. ABB has the reference drawings and manufacturing capabilities to easily produce exact match expansion frames for ABB lineage designs.

Electrification Service controls both design and manufacturing of all interfaces and extensions, including bus work and protection and control panels. Field service technicians work with customers to install, connect, test and commission the switchgear line-up or match-in-line/extension.

Benefits of match-in-line include:

- Maintain existing equipment, operating procedures and safety standards
- Ensure consistent technical standards
- Optimization of spares and maintenance
- Breaker interchangeability



Life cycle services

Upgrades — safety improvements

In rare cases, a failure inside a medium voltage switchgear cabinet, due to a defect, exceptional service condition or incorrect operation, can cause an internal arc — a short circuit current flowing through the air. This can create a significant hazard due to the instantaneous increase in temperatures at the fault location to around 20,000 °C, well above the melting point of steel, copper and insulation materials. Internal components are vaporized, and the sudden release of heat and plasma (ionized gas) creates an explosive blast.

Maximum protection of all personnel during an arc fault is the number one priority. Approximately 75% of internal arcs occur with an operator working at, or standing in front of, the switchgear. On IAC (internal arc classified) switchgear, personnel protection is fully accomplished by an integrated pressure relief system. On non-IAC switchgear, this passive protection is not provided in full, and heat and plasma can escape.

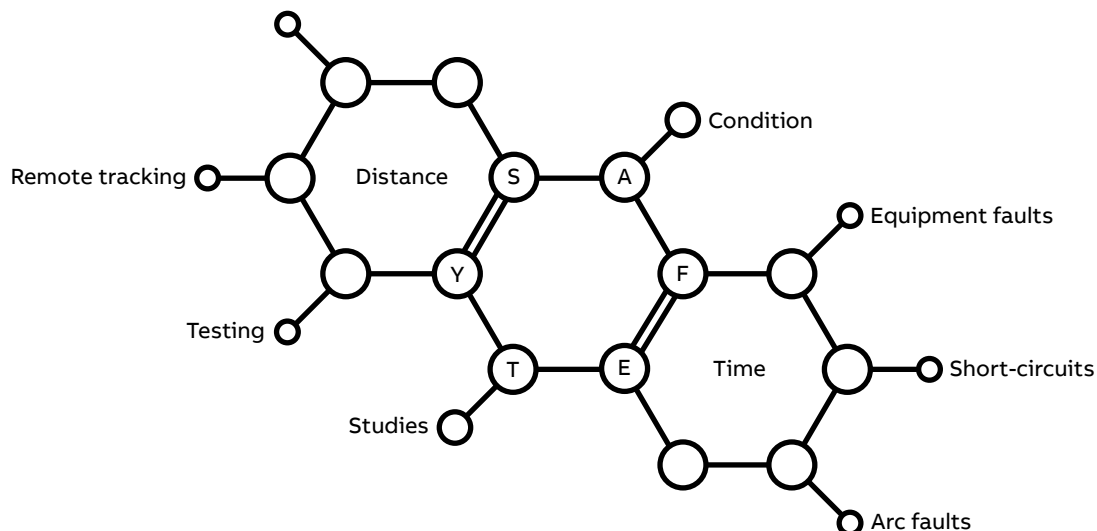
This significantly reduces personnel safety on site, especially in cases where proper passive protection has not been integrated in the past. In those cases, all of the heat and

plasma normally escape at the weakest point of the switchgear, which in many cases happens to be the door.

Passive protection can help increase personnel safety, but it is advisable to take active measures to help prevent such an event from happening in the first place. This not only helps eliminate risk to personnel, but also offers protection against damage and even destruction of system components. The consequential production outage of the plant often results in higher costs than the calculated project costs of the damaged switchgear.

Employee safety and reliable personnel risk prevention are the number one priority for ABB. For this reason, Electrification Service provides a range of offerings to help customers address all safety elements:

- Arc flash relays
- Grounding devices
- Current-limiting devices
- Remote racking
- Testing
- Studies



Life cycle services

Upgrades — Arc fault protection — Fast protection relays

The REA system is a fast and flexible arc fault protection relay for air-insulated low voltage and medium voltage switchgear. A fast and selective arc fault protection system is a natural constituent of a modern switchgear panel, as well as a critical safety and security investment for older switchgear to help protect human lives and prevent or reduce asset damage.

The REA arc fault protection system uses two types of sensors for detecting light: 1) a non-shielded, bare-fiber sensor that detects light along its entire length; and 2) light collecting lens sensors, typically with one sensor installed per switchgear compartment.

The function of the REA arc fault protection system is based on detecting the intense light of an electric arc alone or on a detection of light and simultaneous phase or neutral over-current. Upon detection of an arc fault, the REA arc fault protection system delivers trip commands in less than 2.5 ms to all circuit breakers that feed the fault zone.

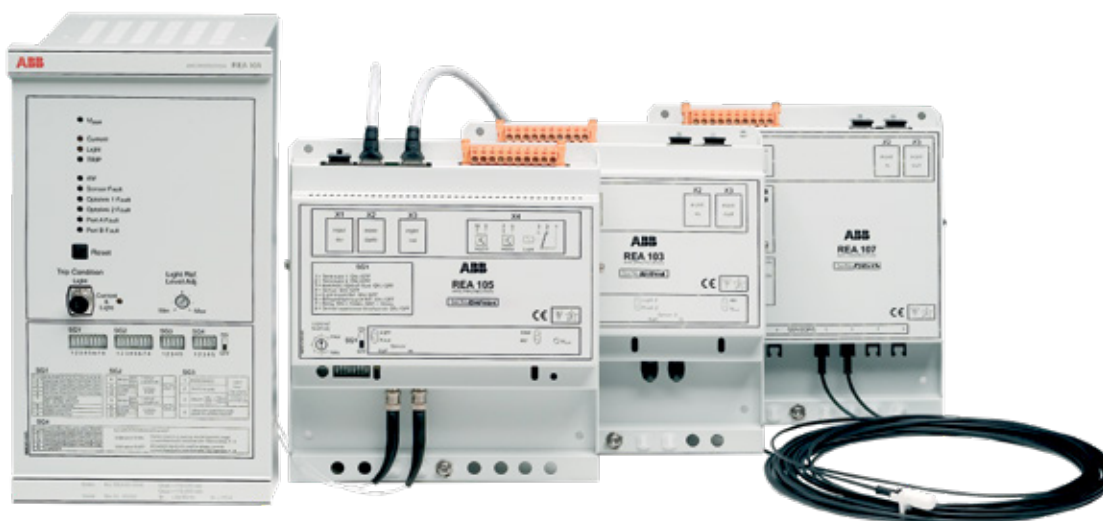
Furthermore, the operation indicators of the REA arc fault protection system help localize faults by selectively guiding the maintenance staff to the fault zone identified by the arc fault protection system.

The actual REA arc fault protection system consists of one or more arc fault protection main modules and a necessary number of extension modules. The main module can operate as a stand-alone device or cooperate with other main modules, as well as with the extension modules. The extension modules allow the number of sensor fibers and/or lens sensors to be increased to extend the area of protection.

The use of extension modules, including fast trip outputs, enables the creation of protection schemes with increased selectivity.

The ABB REA arc fault protection system is widely used in aftermarket applications because of the increased personnel and property protection and the easy switchgear installation.

Electrification Service technicians are trained to properly install, test and commission the REA system.



Life cycle services

Upgrades — Arc fault protection — Ultra-fast earthing switch (UFES)

The occurrence of an arc fault — the most serious fault within a switchgear system — is typically associated with extremely high thermal and mechanical stresses in the area concerned. A new, active arc fault protection system, based on the know-how gained from decades of experience with the ABB vacuum interrupter and I_s -limiter technology, now effectively helps avoid these negative effects if a fault should occur.

The new active arc fault protection device for switchgear

The ultra-fast earthing switch (UFES) is a combination of devices consisting of an electronic tripping unit and the corresponding primary switching elements that initiate a three-phase short circuit to ground in the event of a fault. The extremely short switching time of the primary switching element, less than 1.5 ms, in conjunction with the rapid and reliable detection of the fault, helps ensure that an arc fault is extinguished almost immediately after it arises (extinguishing time <4 ms after detection).

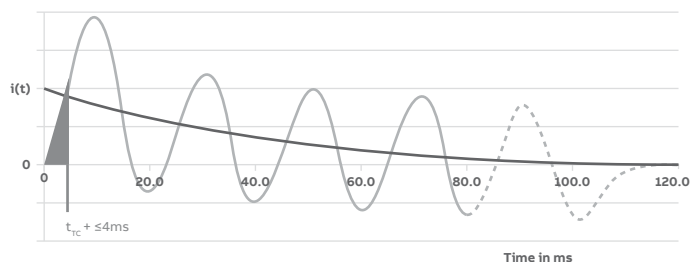
This extension enables passively protected switchgear to achieve the highest possible level of protection for personnel and equipment.

Unbeatable advantages

- Highly increased system and process availability
- Highly increased operator safety for switchgear — particularly during or after maintenance work
- Drastically reduced repair costs due to helping minimize the effects of faults on the system
- Minimization of pressure rise and gases in the faulty compartment and surrounding switchgear building

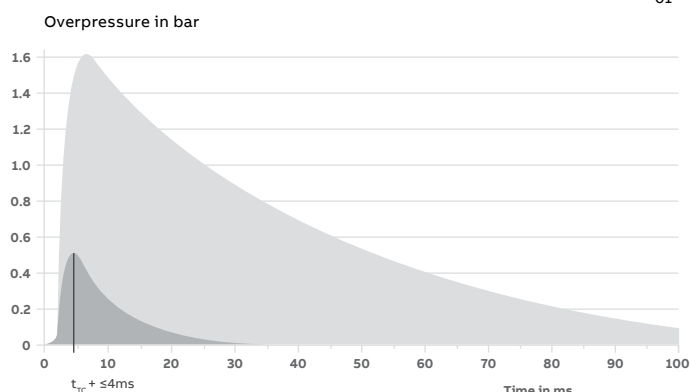
Help avoid severe effects of an arc fault, such as:

- Extreme pressure
- Temperature rise up to 20,000 °C
- Burning/vaporization of metal and insulating material
- Release of substances and hot gases



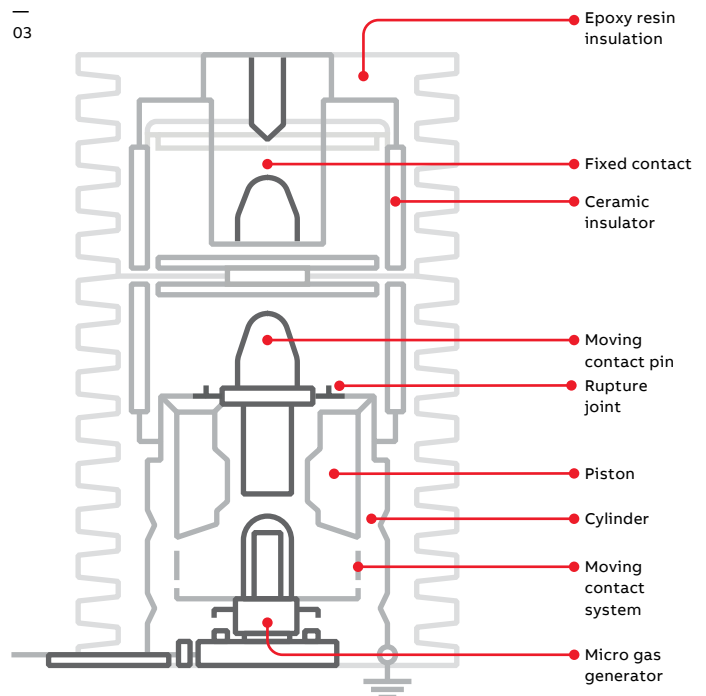
— Short circuit current I_x — Arcing time with UFES — Final cleaning of fault current by upstream circuit-breaker - 80 ms + Zeit x
— DC component t_{TC} Reaching time for tripping criteria

01



— Pressure curve with UFES (4ms) — Pressure curve without UFES t_{TC} Reaching time for tripping criteria

02



01 The ultra-fast earthing switch eliminates the arc fault well before the first peak of the fault current. | 02 Example pressure curves, with and without UFES, in a compartment of an air-insulated medium voltage switchgear system with an internal arc fault current of 130 kA (peak)/50 kA (rms). | 03 Primary switching element for one phase.

Life cycle services

Upgrades arc fault protection — Remote racking

Maintaining a safe distance between personnel and equipment during critical operations provides the most effective means of avoiding injury by keeping people out of harm's way.

Remote racking provides a safer operating environment for personnel through the proven method of adding distance between the operator and arc flash incident energy at the switchgear site, bringing operation of power circuit breakers to a new level of safety.

The process of racking a circuit breaker into and out of the connected position is one of the most frequent exercises that expose an operator to risk. Increased focus on operator safety has caused owners to question the adequacy of prior switchgear designs that require the cell door to be open to connect or disconnect the primary circuit and secondary control circuit. A malfunction during this operation has the potential for catastrophic consequences to equipment and personnel.

Supervised, closed-door circuit breaker racking is a fundamentally recognized safety practice. Furthermore, older circuit breakers are more complex and vulnerable to mechanical failures that create safety problems.

ABB can provide a portable external driver to be mounted on the switchgear door for remote racking. The system can be used with ABB, ITE heritage brands and other manufacturers' low and medium voltage switchgear and roll-in replacement solutions.

ABB can deliver fully automated remote racking systems, remote circuit breaker operation devices and the necessary accessories.

During the installation and commissioning of the remote racking devices, Electrification Service field service technicians will provide on-site training on functionality so the customer's service personnel feel comfortable using the devices.



— SmartRack for Advance®/Safegear®

Remote racking provides a safer operating environment through the proven method of adding distance between the operator and the arc flash incident energy at the switchgear site.

Life cycle services

Retrofit

Retrofit stands for the replacement of phased-out devices by components that are mechanically and electrically adapted for the existing engineering. Retrofitting is an optimal measure for subsequently upgrading older equipment in power transmission and distribution systems by integrating state-of-the-art components to achieve a clearly defined goal: maintaining a high level of availability and helping ensure the necessary safety standards at a minimal cost.

Full-scale solutions from a single source

We offer our customers specialized expertise as a system provider for implementing optimized retrofit solutions for electrical substations. Thanks to our global and local experience, ABB is known for fast and competent implementation of retrofit projects.

Our services are also available for systems and devices that were originally provided by other manufacturers, as well as for products whose manufacturers no longer exist. Additionally, we can integrate a variety of supplementary services to create tailored full-scale solutions.

Have you thought about the following?

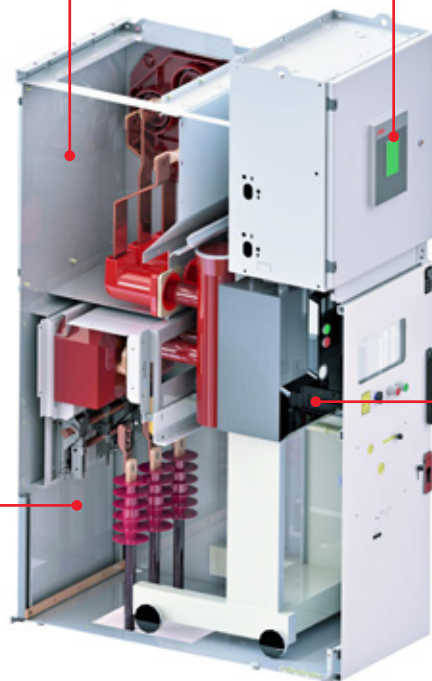
- Is fast supply of spare parts certain for your plant/system?
- How high is the risk of production stoppages due to unexpected maintenance activities?
- Are you in a position to ensure maximum safety for your operating staff?
- How can you enhance the productivity of your plant/system?

Busbar compartment

- Retrofitting the arc fault protection system UFES (ultra-fast earthing switch)
- Retrofitting the busbar compartment — replacing parts of the insulating material
- Replacing asbestos sheets that pose health hazards by installing non-hazardous partition components

Cable connection compartment

- Retrofitting current transformers
- Replacing asbestos sheets that pose health hazards by installing non-hazardous partition components
- Retrofitting earthing switches



Low voltage compartment

- Retrofitting the protection relay
- Preventive maintenance (preventive testing and maintenance of the protection relay)
- Retrofitting the control facilities

Circuit breaker compartment

- Retrofitting the switchgear truck/circuit breaker

Life cycle services

Circuit breaker retrofit options

Circuit breaker retrofits are used to replace phased-out devices with current production versions, and they are mechanically and electrically engineered to adapt to the existing solution on site. Electrification Service experts conduct site audits on existing installations to assess the condition of equipment, recommend the proper solution and support the right investment decision. Circuit breaker retrofits are a cost-effective switchgear modernization solution. The result is a noticeable improvement in safety, reliability, maintenance and performance.

ABB is a full-system provider, offering:

- Site data collection
- Design
- Manufacturing
- Testing
- Installation and commissioning

With our expertise, both ABB and non-ABB equipment can be addressed.

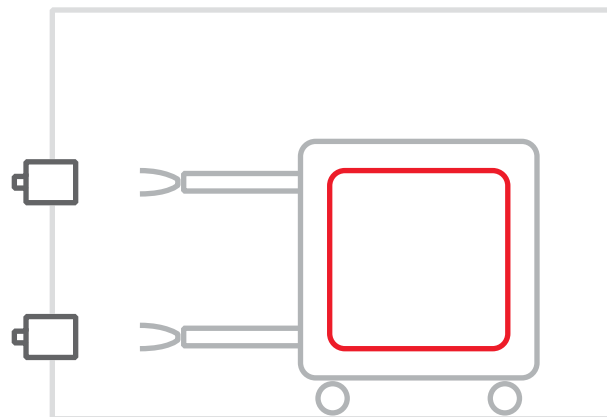
Characteristics of the different technical solutions for retrofit:

Roll-in replacement

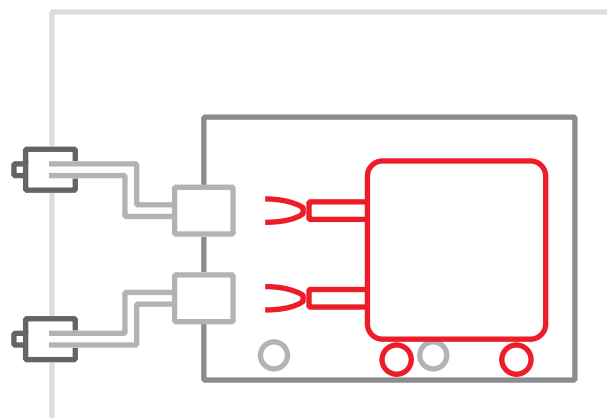
- Only new components used
- The new truck carries a standard circuit breaker
- High performance and additional features
- Reduced downtime
- Fully type tested
- Plug-and-play solution

Hard bus retrofill

- Only new components used
- The new frame hosts a standard circuit breaker
- An additional power circuit makes the connection
- Existing bushings generally remain in place



Roll-in replacement



Hard-bus retrofill

— Original components — New device — Adaptation system — New frame/cassette

Life cycle services

Circuit breaker retrofit — Roll-in replacement

Based on long-time experience and expertise, ABB developed roll-in replacement retrofit solutions specially tailored to most existing limited and obsolete, floor-rolling medium voltage circuit breakers that were produced by ABB and other manufacturers. As a result, ABB can offer the opportunity to eliminate outdated air magnetic technology through the use of the latest vacuum interrupting technology. The result is a significant improvement in reliability, safety, maintenance and performance.

The circuit breaker

ABB roll-in replacement solutions for technical outdated switching technologies are equipped with the state-of-the-art ABB vacuum circuit breaker, valued for outstanding quality and reliability.

- Equipped with embedded poles that help ensure process stability and quality
- Embedded poles provide optimum protection for the vacuum interrupter from moisture, dust and external damage
- Low maintenance magnetic operating mechanism or modular spring stored energy operating mechanism available

Standards and testing of roll-in replacement solutions

- Designed, built and tested according to the latest applicable ANSI standards
- Circuit breakers are type tested and each breaker undergoes full production testing
- Tested in a switchgear cell to ensure integrity and fit
- Nuclear certification available

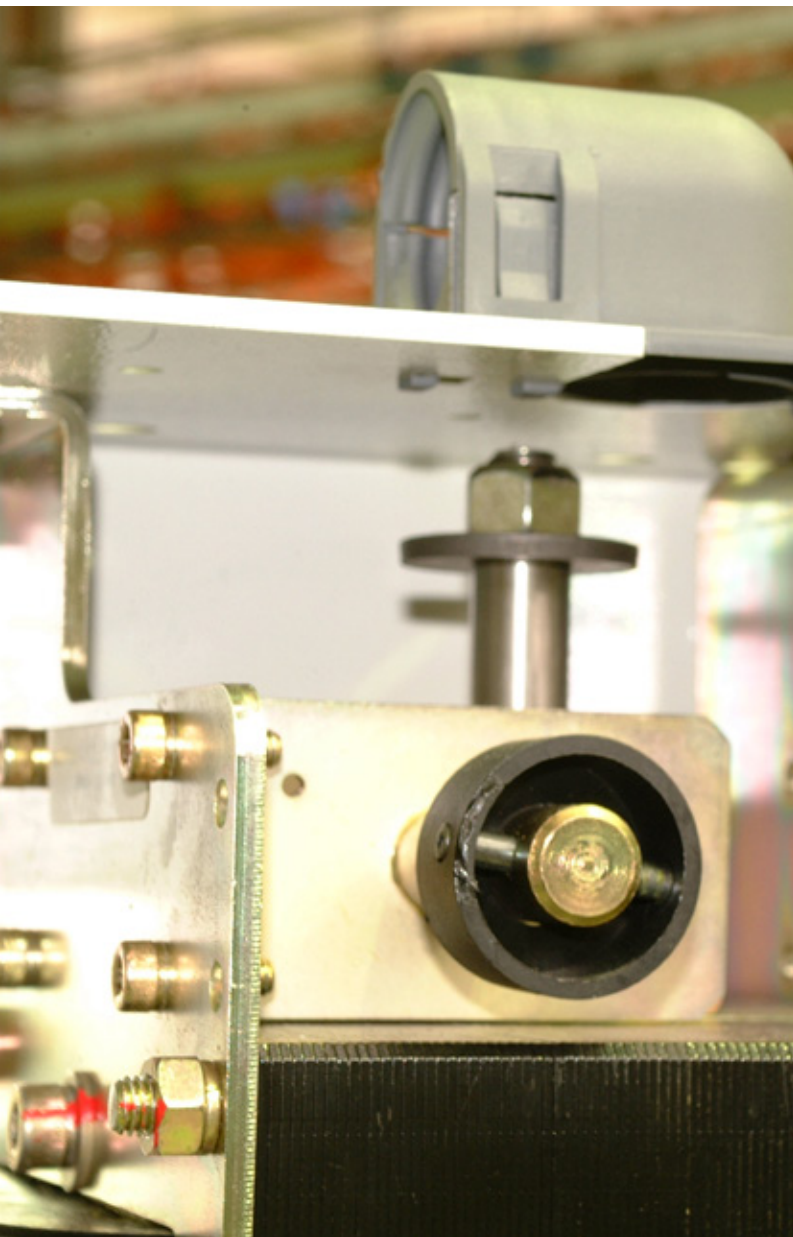
Customization

All ABB roll-in replacement solutions are customized. This helps ensure that the retrofit solution bushing and truck match the existing panel on the customer site and that only a short downtime for the exchange will be required.

- Built with all new parts
- Modification of the existing circuit breaker switchgear compartment is not typically necessary
- Switchgear interlocking safeguards are incorporated

Installation and commissioning

Electrification Service field service engineers and technicians are the best-in-class option for installation and commissioning of a retrofit. Allowing ABB to perform or supervise the installation helps ensure a smooth project and provides an extended warranty to the customer.



Life cycle services

Circuit breaker retrofit — Hard bus retrofit

This is a modernization process including replacement of the circuit breaker and some of the functional components of the switchgear power compartment. It is applicable where the existing switchgear frame is still in functional condition and may have faulty or defective interlocks, shutters, mechanism-operated contacts or truck-operated contacts.

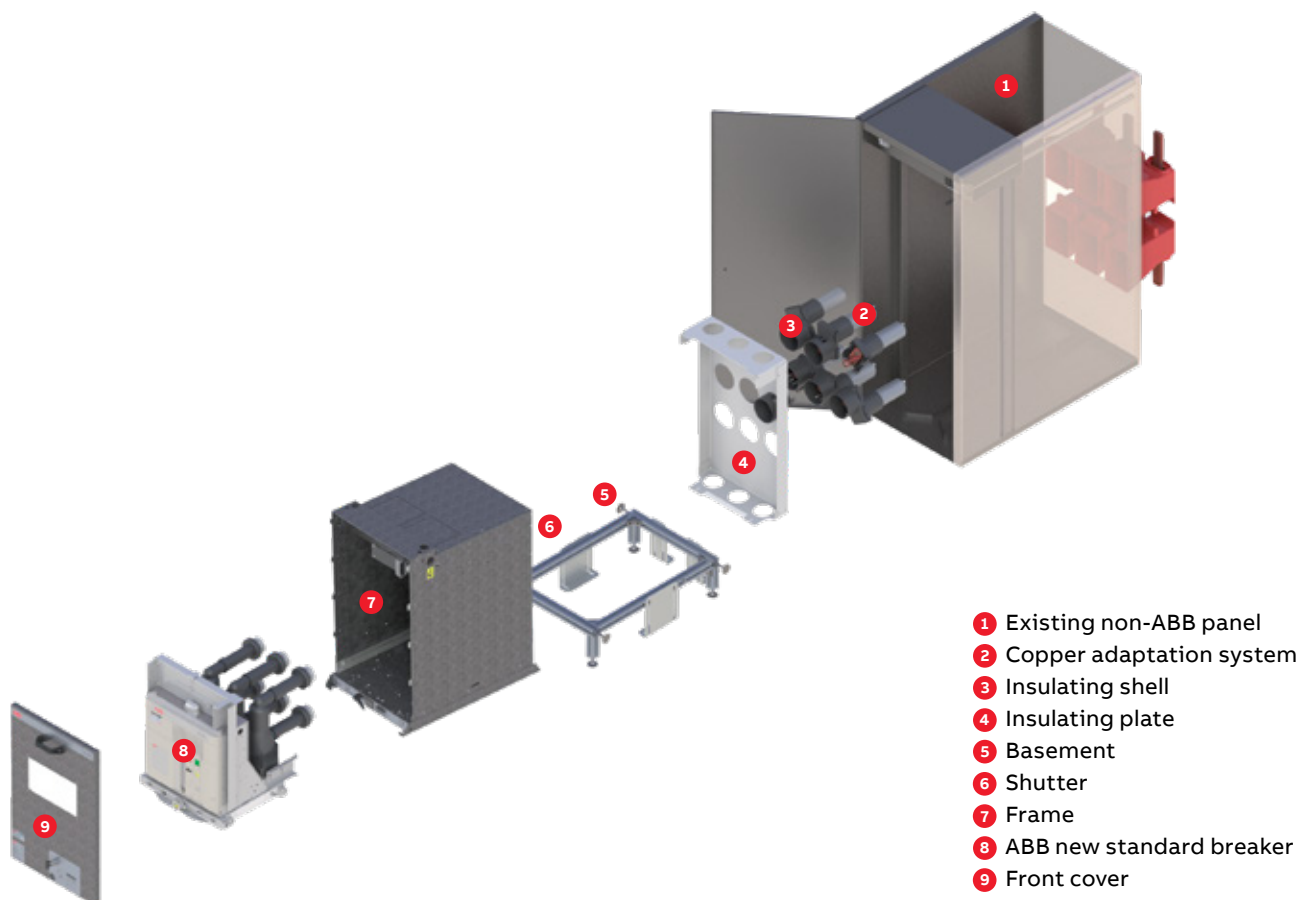
OneFit

OneFit is the latest ABB hard bus retrofit design concept, embedding an integrally safe plug-in technology to easily connect the new circuit breaker to a wide range of existing panels.

OneFit consists of a frame hosting the new circuit breaker. It is connected to the existing switchgear bushings by a copper adaptation system and an insulating shell that also acts as an inner interface with the new circuit breaker.

This solution balances the need for a retrofit solution with reasonably limited site work and linked outage.

OneFit is fully tested to all relevant ANSI standards regarding switchgear modernization. ABB is the only service provider that can provide a fully pre-engineered and pre-tested hard bus retrofit solution.



Life cycle services

Medium voltage load interrupter switch retrofit



Life cycle services

Medium voltage load interrupter switch retrofit

ABB's medium voltage load interrupter switch (LIS) retrofit solution reduces arc flash incident energy levels for existing medium voltage equipment.

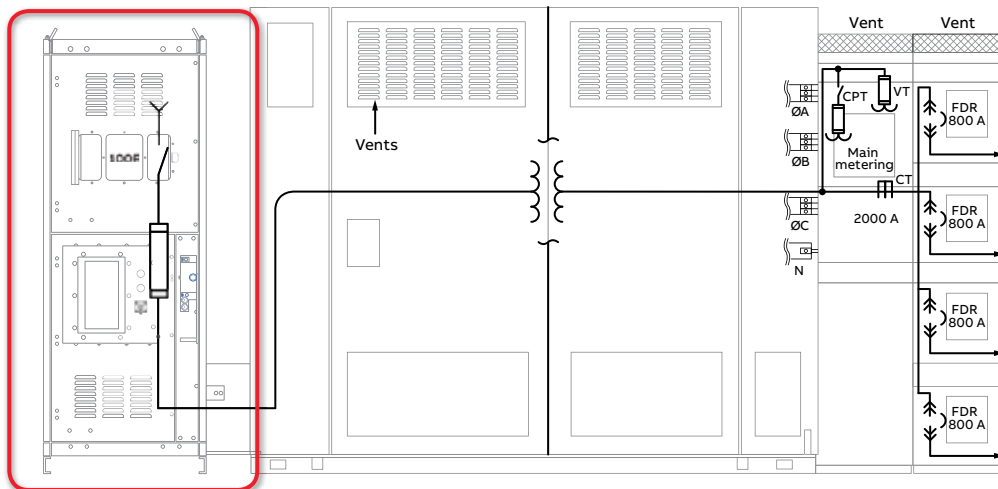
For facilities concerned with arc flash safety standards, the options may seem daunting and the costs out of reach. The fuses used by LIS to protect the transformer in an overcurrent situation are no longer adequate. Existing LIS may provide poor fault current interrupting times, resulting in high arc flash incident energy.

ABB's solution retrofits a fixed mounted ABB vacuum circuit breaker (VCB) into the fused compartment of the LIS. Operating in three cycles, the fast-acting VCB is superior to fuses and provides a new arc flash mitigation solution designed in response to current arc flash safety standards.

With modifications, ABB can also provide retrofits to LIS made by other manufacturers.

The medium voltage LIS retrofit solution delivers safety and flexibility to existing equipment, offering:

- Reduced arc flash levels from the transformer down to the low voltage system
- Transformer protection via the latest relay technology (bus and transformer differential protection)
- Added transformer protection via an optional snubber application
- Relay options that provide upstream and/or downstream communications
- Retrofitting into existing LIS enclosures
- Minimal downtime for installation and commissioning (approximately 8–12 hours)
- Added reliability and quality of a fast-acting, 3-cycle vacuum circuit breaker with embedded pole technology
- Separate low voltage door for access during maintenance — without the need to open the high voltage compartment



A separate low voltage door permits access for breaker operation without the need to open the high voltage compartment

Life cycle services

Medium voltage load interrupter switch retrofit

VM1 circuit breaker for quality protection

The VM1* circuit breaker is a three-phase AC indoor circuit breaker with 15 kV rated voltage. It controls and protects electrical equipment in industrial and mineral applications and in power plants and substations. Durable and reliable, the VM1 is especially suited for conditions that require frequent operation.

The ABB magnetically actuated design offers superior performance with minimal maintenance. Embedded pole technology simplifies pole assembly and provides increased assembly accuracy and quality. Embedded pole technology also improves the environmentally resistant capability of the breaker. The primary circuit is completely embedded in epoxy resin, helping minimize the risk of insulation fault caused by operating environment conditions such as dust, humidity, vermin, polluted ambient and high altitudes.

Differential relay options

The medium voltage LIS retrofit features Relion® relays. If required, customer-specified relays may be used as an alternative.

Circuit breaker rating tables

Rated voltage, kV	Up to 15
Frequency, Hz	50 / 60
Rated current, A	1200
Rated power frequency withstand voltage (1 min), kA	38
Rated lightning impulse withstand voltage (peak values), kV	95
Rated short circuit breaking current, kA	31.5
Rated short time withstand current (3 sec), kA	31.5
Rated peak withstand current, kA	82
Close and latch rating	82
Operating sequence, kA	10,000 operations
Rated auxiliary control voltage, V	30–50 V DC or 100–250 V AC/V DC
Opening time cycles	3
Closing time, ms	45–60

Standards and approvals

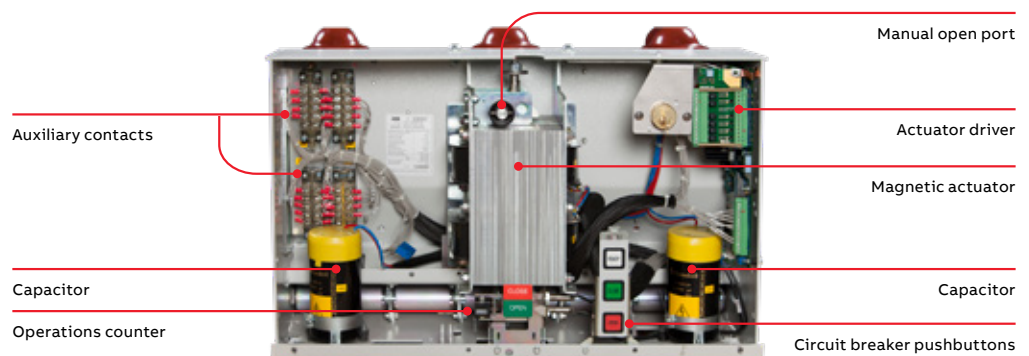
American National Standards Institute (ANSI) applicable sections of:

- ANSI/IEEE C37.20.3, C37.20.4, C37.22 — as existing and installed
- IEC-62271-200 standard
- National Electrical Code (NEC)

* VM1 standard offering is magnetically actuated; an alternative spring-charged circuit breaker solution is available.



Relion® relay



ANSI magnetic mechanism vacuum circuit breaker

Life cycle services

Limitamp® equipment

The Limitamp medium voltage motor control center (MCC) was originally developed in the 1950s using air-break contactor technology. The early platform was IC7160. During the 1980s, the product was upgraded with vacuum-break technology with the 194 platform. Today, Limitamp is fully supported through the entire product life cycle by Electrification Service with new line-ups, cable-in/cable-out sections, splice-on sections, spare contactors and spare parts. Please note that the original air-break contactors are now obsolete, but they can be directly replaced with specially designed vacuum contactors.



New equipment support

New equipment is supplied primarily in support of customers with an existing installed base. Highlights of supported new equipment include:

- Bolted section designs in 22", 32", 36", 38", 40" and 48" widths
- 36" and 40" two-high section widths
- 90" height
- 30" depth (except 3000 A with 42" depth)
- 2.4 kV – 7.2 kV
- 1200 A, 2000 A or 3000 A main bus
- NEMA 1, NEMA 1A gasketed or NEMA 12
- FDR, FVNR, FVR, INC, LBS, MVSS/RVSS, PFC and SYNC controller types
- 800 A FDR and FVNR in 48"-wide section

Standards and testing of new Limitamp equipment

- Designed and built to the latest ANSI standards
- System is type-tested, and each contactor undergoes full production testing
- Seismically rated

Customization

- Each Limitamp system is requisition engineered to meet the customer's site-specific requirements
- Depending on site conditions, many options are available:
 - New equipment line-up
 - Splice-on sections to Limitamp, switchgear or load break switch
 - Standalone cable-in/cable-out section
- A wide variety of control options exist, using Relion® relays or other popular protective relays

Installation and commissioning

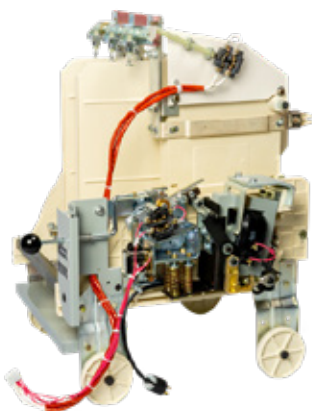
Electrification Service field service engineers and technicians are the best-in-class option for installation and commissioning of Limitamp equipment. Allowing ABB to perform or supervise the installation helps ensure a smooth project and provides an extended warranty to the customer.

For more information, visit the [Limitamp MV — Previous Generation MCC webpage](#).

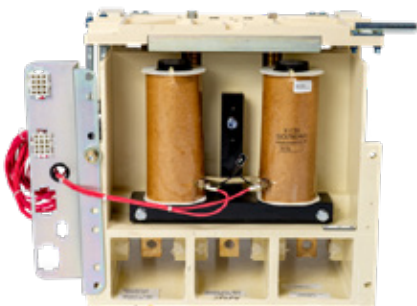
Life cycle services

Limitamp® contactor replacement

Limitamp equipment was originally developed in the 1950s using air-break contactor technology. The early design used IC2812, IC2814 and IC302 air-break contactors. During the 1980s, the product was upgraded with vacuum-break technology using 193B, 193C, 193D and 193E contactors. Today, Limitamp contactors are fully supported through the entire product life cycle; however, air-break contactors are now obsolete and may be directly replaced by specially designed vacuum contactors.



193V / 193W: Direct replacement for IC2812, IC2814 and IC302



193B / 193C / 193D / 193E: Current contactor designs

Upgrades for legacy IC7160 Limitamp

The older IC7160 Limitamp design used air-break contactors from the 1950s through the early 1980s. These contactors were slower acting, more maintenance intensive and not as safe as modern designs. The older air-break contactors can now be directly replaced by 193V or 193W contactors.

Contactor type	Description
193V	400 A, clip-in fuse
193W	400 A, bolt-in fuse

For more information, refer to the CR193V and CR193W draw-out vacuum **Limitamp contactors catalog**.

Please note that for an air-break contactor upgrade to vacuum technology, the nameplate data from the original air-break contactor must be supplied to ABB. The nameplate data for the line-up or section is not sufficient to define the engineering requirements for the new contactor.

Aftermarket parts for current 194 Limitamp

The new 194 Limitamp design has used vacuum contactors since the 1980s. Vacuum contactors are still available today in four configurations:

Contactor type	Description
193B	400 A, bolt-in
193C	800 A, bolt-in
193D	400 A, stab-in
193E	800 A, stab-in

For more information, refer to the CR193 vacuum **Limitamp contactors catalog maintenance instructions**.

For the active contactors, all parts are available in the empower online store. No engineering is required for direct replacements. They may be ordered directly by part number.

Life cycle services

Motor control center (MCC)

buckets and spare parts

Electrification Service provides support for ABB MCCs dating from 1960. Brands supported include ABB, BBC, GE, Gould and ITE. For most products, spare parts and units/buckets are available; however, a wide variety of legacy components were used over the decades to manufacture MCCs. To properly support older MCCs, ABB provided modern buckets that were engineered to be compatible with the legacy section and bus systems.



—

Equipment support by product line

Product Line	Support
ABB ReliaGear™	This is an active product, fully supported with splice-on sections, buckets and spare parts.
ABB MNS	This is an active product, fully supported with splice-on sections, buckets and spare parts.
GE E9000	Fully supported with splice-on sections, buckets and spare parts.
GE 8000	Fully supported with splice-on sections, buckets and spare parts.
GE Spectra	Fully supported with splice-on sections, buckets and spare parts.
GE 7700	Fully supported with splice-on sections, buckets and spare parts.
GE 2700	Fully supported with splice-on sections, buckets and spare parts.
BBC	Legacy product line with limited support. New buckets available.
Gould	Legacy product line with limited support. New buckets available.
ITE	Legacy product line with limited support. New buckets available.

ABB purchased the GEIS MCC product lines in 2018. ABB purchased the BBC/Gould/ITE product lines during the 1980s.

Bucket manufacturing

ABB manufactures new buckets for active and legacy ABB and GEIS branded MCCs. These units are all built with modern ABB components and are UL 845 listed. Standard units can be purchased from the empower online store using the FASTRAC configurator. Specially engineered units are also available.

Replacement buckets are also available for BBC, Gould and ITE branded MCCs; however, they are custom designed for each customer’s applications.

Spare parts

Full spare parts are available for all ABB and GEIS branded MCCs listed above. Please note that the GE Spectra, 7700 and 2700 MCCs are based on the GE 8000 design, so most parts are compatible with the 8000 MCC.

Life cycle services

Relay retrofit

The reliability threat posed by aging electric power systems and the need to reduce operating costs increases the importance of protective relays in existing substations and power plants.

As the installed base of electromechanical protection and control relays continues to age and becomes more and more costly to support, replacement with up-to-date micro-processor-based relays becomes increasingly important.

Relay retrofit project

With a wide range of microprocessor-based protective relay systems, ABB is uniquely positioned to provide expert relay solutions due to a large installed base and long experience with different applications.

The diversity of different engineering designs and global development capabilities make Electrification Service the most reliable partner for relay retrofit projects.

ABB provides customers with engineering and technical support in every aspect of system protection, from initial testing of existing relays to managing complete turnkey relay retrofit projects.

During a relay retrofit project, existing relay and control panels and doors are modified and retrofitted at the customer's location. ABB replaces the outdated and technically obsolete relays in the existing panels with new microprocessor relays. ABB furnishes the necessary engineering, documentation, relay settings and commissioning per customer requirements.

—
PCMU unit with
Relion 615 relay



—
PCMU features the
same terminal layout
as your existing relay

The whole exchange process can be accomplished within a short period of time, requiring only minimal downtime of the switchgear.

Testing and commissioning services

During the testing and commissioning, ABB verifies that the relay settings are correct and performs system functional tests to verify the integrity of the system. The relays are run through trip checks to make sure they pass acceptance testing.

After the testing, the system wiring is verified against as-built drawings, and the whole project is completed with the delivery of documentation on findings, including test reports, to the customer.

Benefits of ABB relay retrofit solutions

- Advanced technology upgrade to the latest capabilities in protection, control, metering and fault recording
- Expanded communication capabilities — Relion® series IEDs come standard with Modbus, DNP3.0 and IEC61850 GOOSE

Relay benefits:

- Installation time savings
- Wire-like-unit rear terminals exactly match old unit — no change at wire bundles
- Installation can be completed in as little as 40 minutes
- Form and fit the existing cutout
- Engineering time savings — save up to 70% of the time required to update existing drawings after the upgrade



Life cycle services

Replacement legacy ABB circuit breakers

Emax 2 retrofill standard features

- UL listed (tested in original GE gear)
- Increases short circuit rating on AK-25 and AKR-30S while maintaining UL listing
- Remote racking using the modern racking device
- High-quality modern mechanism means a lower maintenance circuit breaker
- Through-the-door racking
- Single finger cluster design generates less heat, provides a solid, reliable connection and reduces number of failure mode points when compared to designs with finger clusters on both the cassette and circuit breaker (direct replacement models)
- Factory pre-wired for WavePro retrofill to simplify site installation
- Easy field wiring of AK-AKR retrofill with ABB-provided AS-IS drawings
- Retrofill solutions are always provided with door adaptation kits. As alternative, pre-punched doors available with or without holes for pilot lights and RELT switch for all stack widths (when applicable) for legacy GE equipment.

—
Cradle-in-cradle
retrofill for AKD5



—
Direct replacement
retrofill for AKD5
2000 A, AKD6,
AKD8 and AKD10



Options

- UL field-installable accessories include:
 - 10 NO/NC auxiliary contacts
 - Coil signaling contacts
 - Close coil and motor operator
 - Bell alarm
 - Shunt trips
 - Undervoltage releases
- Emax 2 Ekip trip unit:
 - Advanced arc flash mitigation technology provides arc flash protection and selectivity at the same time
 - Metering, relaying, Modbus/Profibus/DeviceNet/IEC61850, waveform capture, ground fault alarm and RELT
 - Free Ekip Connect software and EPiC mobile application enable users to manage, monitor, test and customize parameters (for more information load QR code links).

Ekip Connect



Google Play



AppStore



—
Single finger
cluster design



—
Accessible
secondary wiring



—
Microprocessor-based
trip unit technology with
color touch screen HMI



—
ABB Connect free
trip unit software
for programming,
commission and testing

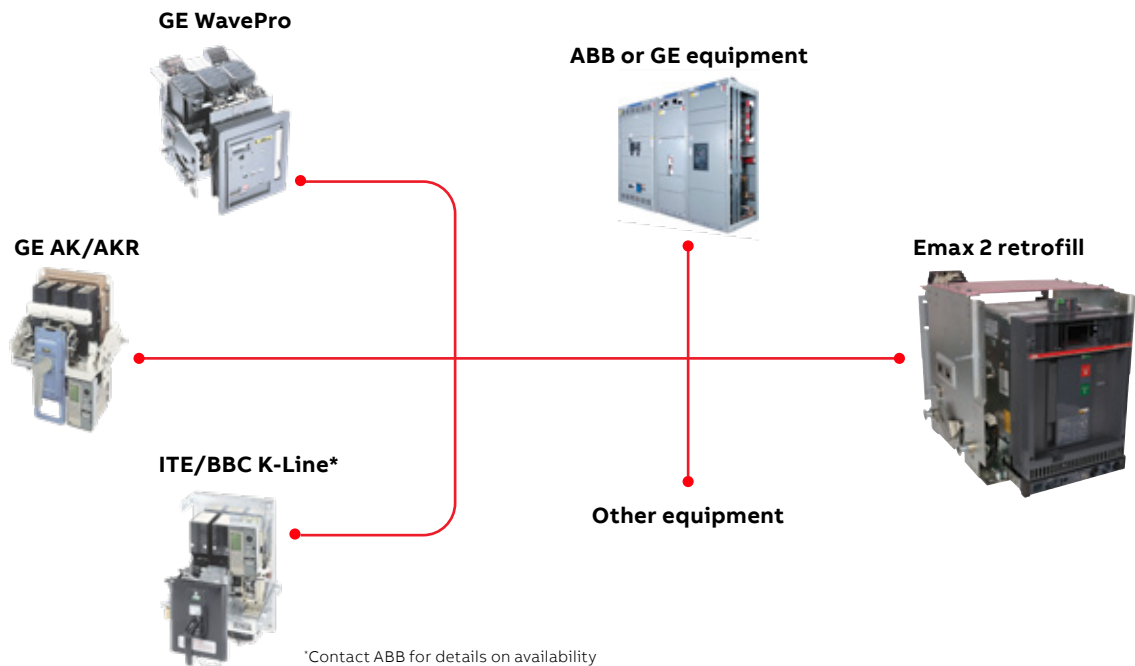


—
EPiC mobile
application for
Android and Apple, for
Bluetooth connection
with trip units

Life cycle services

Replacement legacy ABB circuit breakers

Emax 2 circuit breaker retrofill is available for ABB/BBC/ITE/GE solutions and other manufacturers' OEM equipment.



NOTE: EntelliGuard® R retrofill and EntelliGuard G breaker are still available. This option is intended to bring flexibility to add a column to line-up and provides a streamlined solution to replace an EntelliGuard G breaker and existing future space. The EntelliGuard R retrofill solution offers the option to include the EntelliGuard TU trip unit for both arc flash protection and selectivity at the same time. The EntelliGuard R and Emax2 retrofills offer a means to increase reliability and enhance the protection of your existing electrical system.

NOTE: We can also retrofit some competitors' designs such as Allis-Chalmers and Westinghouse. Please contact ABB for details on availability.

Life cycle services

Replacement legacy ABB circuit breakers

ABB provides continuous design improvements for heritage brand products. Our goal is to help protect customers' investments beyond the factory manufacturing life cycles of products caught in this continuous evolution.

ABB continues sales for heritage brand products until an equivalent or better product is available. It is ABB's intention to continually support heritage brand products — as long as there are significant customer requirements — by making replacement circuit breakers available. ABB has all the updated drawings and can provide the engineering support to help ensure customers get exactly the circuit breaker that is needed based on the original configurations. Exceptions to this may occur if components or technologies required for products are no longer available to ABB.

Circuit breakers ABB supports as new legacy are:

- K-Line
- HK
- VHK
- VHKX
- Emax
- New Emax

For more information on Emax and new Emax, refer to this **service note**.



Non-original part



ABB original part

Life cycle services

Replacement legacy ABB circuit breakers

With few modifications to your existing switchgear, retrofit kits are a sustainable solution to upgrade your electrical system. The direct replacement retrofit kits allow for a very fast and reliable upgrade of the old Emax and new Emax circuit breakers and switch disconnectors to Emax 2.

Air circuit breakers put into service many years ago might not provide the reliability and safety assurances required today. Making certain that people, equipment and processes are properly protected is a growing concern. When maintenance is no longer sufficient, owing to lack of materials or when components are out of production, retrofit kits are the best solution. ABB Electrification Service offers a unique way to upgrade installed hardware and software to the next generation, by changing the worn or outdated parts while maintaining the original plant and equipment configuration. The kits are tested in the ABB SACE Division Lab, accredited by ACCREDIA and acknowledged by important international certification bodies such as ACAE / LOVAG, ANCE, ASTA, ETL SEMKO, UL, CSA and Naval Registers.

Safety and service continuity

- Safety improvement
- Service continuity guaranteed
- Ease of installation
- Reduction of maintenance costs
- Long availability of the product and its spare parts
- Factory-tested solution
- Wide range of mechanical and electrical accessories with Emax 2

From circuit-breaker to power manager

SACE® Emax 2 helps improve the efficiency of electrical plants, creating the new standard of:

- Control — Ekip PowerController to improve energy efficiency and savings
- Connectivity — Integrated communication modules with different protocols, including Modbus RS-485, Modbus TCP, Profibus, DeviceNet, EtherNet/IP, IEC61850 and Bluetooth
- Ease of use — Creation of efficiency and simplicity through power measurement with Emax 2 advanced trip units
- Ease of maintenance — Diagnosis and installation with Ekip Connect software; automatic notifications to remind maintenance activities; ABB Ability™ EDCS is also available with Emax 2 for predictive maintenance

Sustainable solutions

Retrofit kits help extend the lifespan of your electrical system, keeping it alive and efficient as long as possible, minimizing CO₂ emissions and raw materials usage.



Life cycle services

Replacement legacy ABB circuit breakers

How to retrofit an Emax or a new Emax circuit breaker

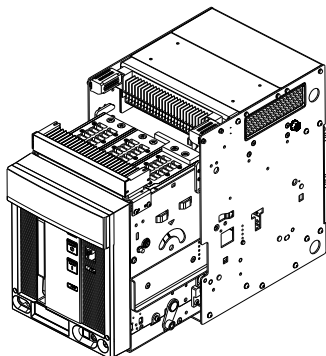
ABB offers a complete range of solution to upgrade Emax and new Emax circuit breakers with Emax 2 retrofit solutions:

- **Hard bus retrofit (RF):** The traditional retrofit kit for which the complete Emax and new Emax circuit breakers need to be dismantled. The kit consists of a new Emax 2 circuit breaker equipped with special terminals to fit the existing busbars. This solution is available for both fixed and withdrawable versions.
- **Direct replacement (DR):** The most advanced retrofit solution type. In this case, only the mobile part of withdrawable circuit breakers need to be removed. A special version of the Emax 2 moving part is supplied by ABB to be racked in/out on the installed fixed part.

When downtime duration is an issue, DR solutions are preferable. Installation time is reduced to a minimum because the existing fixed parts are not removed. With few adaptations on-site, the new Emax 2 moving part can be inserted. All retrofit solutions have been tested for mechanical and electrical operations, short circuit breaking capacity, short circuit withstand current and dielectric properties according to IEC standards. The DR solution is suitable when the existing part is fully working. Before ordering, it is important to verify integrity of the fixed part according to the directions on the document 1SDH001279R0002. When the fixed part is not fully working, the best retrofit solution is the RF.

Refer to **1SDC001052L0201** for more details on ratings and protection.

Direct replacement for 3-pole version



Retrofit kit solutions for replacing Emax/new Emax with Emax 2

Emax/ new Emax	Performance level	Version		
		Fixed HR terminals	Fixed HR terminals	Withdrawable VR terminals
X1*	B	RF	RF	RF
	N	RF	RF	RF
E1	B	RF	DR - RF	DR
	N	RF	DR - RF	DR
E2	B	RF	DR - RF	DR - RF
	N	RF	DR - RF	DR - RF
	S	RF	DR - RF	DR - RF
E3	N	RF	DR - RF	DR - RF
	S	RF	DR - RF	DR - RF
	H	RF	DR - RF	DR - RF
	V*	RF	DR - RF	DR - RF
E4	S	RF ⁽¹⁾	DR - RF	DR - RF ⁽¹⁾
	H	RF ⁽¹⁾	DR - RF	DR - RF ⁽¹⁾
	V*	RF ⁽¹⁾	DR - RF	DR - RF ⁽¹⁾
E6	H	-	DR - RF	DR - RF ⁽²⁾
	V	-	DR - RF	DR - RF ⁽²⁾

* Devices available only for new Emax series; (1) Available only for 3p versions; (2) Available also for 4p/f versions

The DR kit consists of:

Special Emax 2 moving part assembled and tested in ABB factory and ready to be racked in to Emax/new Emax fixed part. It includes:

- Sliding contacts
- Mechanical signaling
- Anti-insertion lock
- Racking in/out lever
- Kit for the door's adaptation

Direct replacement for 4-pole version

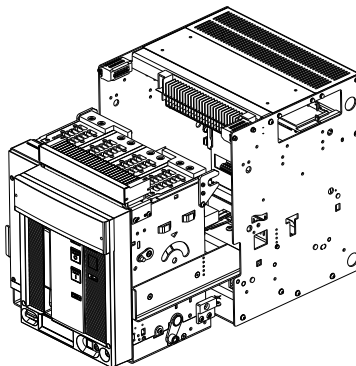


ABB Ability™

Monitoring and diagnostics

Condition-based maintenance is one of the best service approaches for the electrical system, helping to ensure high uptime, immediate response, focused maintenance and reduced life cycle costs. MyRemoteCare is the remote condition monitoring system supporting this concept.

Condition-based maintenance helps ensure maintenance process optimization by providing a root-cause analysis of the asset condition and suggesting proper maintenance actions.

Electrification Services experts take care of the equipment thanks to MyRemoteCare, providing correction of failures either before they occur or before they develop into major defects.

The most important benefits of MyRemoteCare condition monitoring are:

- Reduced unscheduled downtime and operational costs
- Increased asset availability and linked production

MyRemoteCare enables maintenance and operation teams to have continuous supervision of the circuit breaker conditions, alarms (sent as text message to an operator), events and performance trends. Electrification Service engineers analyze this data and define proper maintenance, at the proper time, for each asset.

This allows maintenance to be planned only when required, helping reduce the need for purely schedule-based maintenance activities.

With MyRemoteCare, the following information characteristics are continuously monitored:

- Opening/closing time
- Closing signaling contact quality
- Position error
- Number of operations and fault current operations
- Inactivity timer
- Operating mechanism spring charging time
- Operating mechanism spring failure to attempt
- Circuit breaker compartment air temperature
- Auxiliary voltage quality
- Power contacts wear (Ikt)

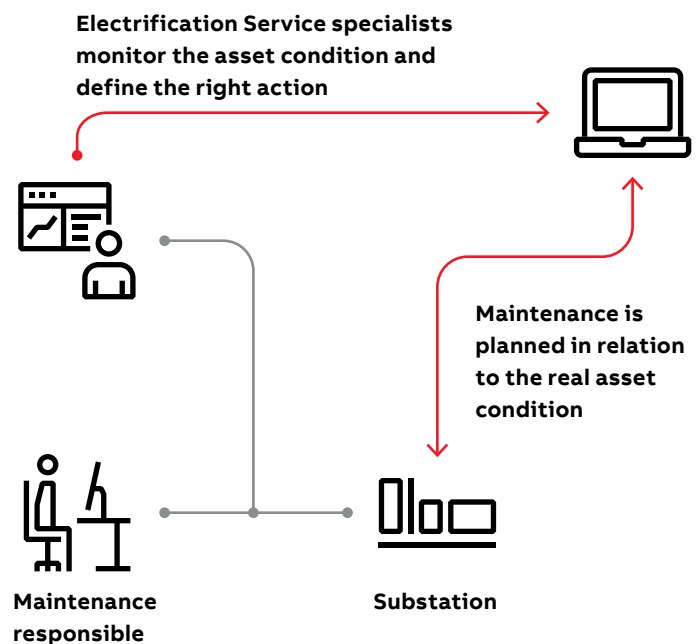


ABB Ability™

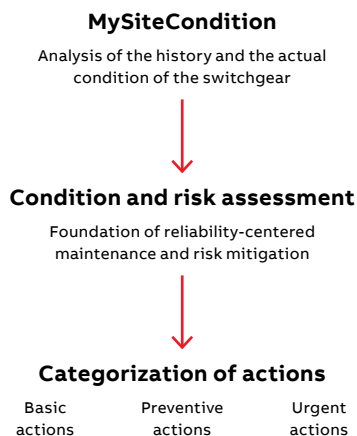
Assessments

Assessments help evaluate the condition and assess the reliability of your electrical network equipment to mitigate asset risks. Knowing and improving the condition of the equipment is a key factor in helping reduce the likelihood of failure, damage and injury, and offers the possibility to move from a time-based to a reliability-centered maintenance approach.

Knowing the condition of the installed equipment, and where to spend the operational budget to grow reliability, is an issue of increasing importance in today's electrical network operations due to the aging installed base.

MySiteCondition is the ABB methodology to support the decision by assessing:

- Importance of the equipment
- Actual site condition
- Critical points in the network
- Available historical data
- Operator and asset safety



— Process of MySiteCondition methodology

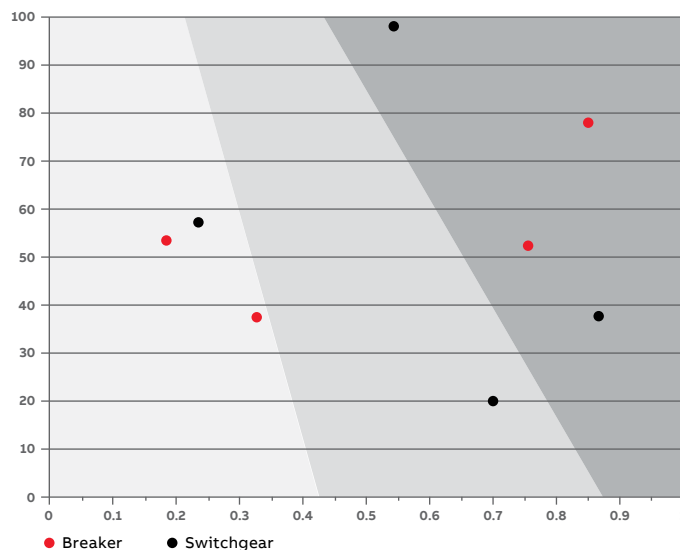
After the assessment is conducted, the collected data is carefully analyzed and factored by an engineered algorithm technique to evaluate the risks and consequences of a failure.

The outcomes of the assessment are detailed reports and illustrations that explain and visualize the actual status of the overall plant condition and each asset, and how performance and safety can be improved by prioritizing maintenance needs.

The documented and transparent decision-making framework provided by MySiteCondition supports operators in the risk-based maintenance approach in times when knowledge is decreasing and switchgear line-ups are reaching a critical age.

The assumption that all assets are fit for the future can be a dangerous gamble.

The identification of increased future risk and the mitigating effect of various intervention strategies is mandatory information for a safer and more reliable operation.



— Importance / condition matrix

ABB Ability™

Service agreements

ABB specializes in products, systems and service solutions that help improve productivity and availability of customers' plants, while also helping reduce operational costs. With increasing competition, customers concentrate more on their core businesses and leave operation, maintenance and refurbishment of their electrical system assets to qualified partners.

PowerCare — Your maintenance contract for LV and MV equipment

PowerCare is the most convenient and efficient way of helping ensure medium and low voltage equipment availability and reliability.

ABB provides a choice of different service packages with customizable agreements to suit your company's needs. PowerCare is a pre-defined framework, based on different service levels and types, and packaged to fit each customer's unique requirements.

Services range from an entry level 24/7 hotline and a single point of contact for asset assessments and preventive maintenance, including warranty of functionality, to high level diagnosis and remote monitoring services.

With this unique service approach, ABB can help ensure a continuous dialog with you regarding asset optimization throughout the entire life cycle. On a regular basis, ABB supports you in developing future-based service strategies with the aim of a long lifetime for your installed power products.

Have you ever asked yourself?

- If you have a direct contact who knows your equipment in case of an emergency?
- If your future service costs are projectable?
- If you have a competent partner who is taking full liability and responsibility for your equipment after the maintenance work is performed and offers a functionality warranty?
- If unplanned outages can be reduced by proactive measures?
- If the manufacturer of your switchgear is available anytime?
- If you have a reliable on-site service partner available?

PowerCare Basic → PowerCare Plus → PowerCare Advanced → PowerCare Excellence

- 24/7 emergency hotline personal contact
- Contractually guaranteed reaction times
 - Callback of specialist within one hour
 - On-site failure recording within 10 hours
 - On-site troubleshooting within 24 hours
- Reduced hourly emergency rates

- PowerCare Basic
- Contractually guaranteed reaction times
- Callback of specialist within one hour
- On-site failure recording within 10 hours
- Online access to ABB's personalized PowerCare portal
- Technical support
 - HelpDesk support
 - Troubleshooting by phone
- Inspection
 - Inspection of the equipment covered in the contract

- PowerCare Basic
- PowerCare Plus
- Warranty of functionality
 - Assessment and maintenance of the equipment covered by the contract
 - Warranty of functionality of covered equipment up to the next service interval according to ABB's parameters (max. three years)
- Testing
 - Relay calibration / testing (optional)
- Discounted service offerings
 - Retrofit

- PowerCare Basic
- PowerCare Plus
- PowerCare Advanced
- 24/7 spare parts delivery
- Remote monitoring
- On-site safety analysis
- Further customer requests
 - Project-driven

Additional information

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