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MEDIUM VOLTAGE PRODUCTS

## **UniSec**

Air-insulated medium voltage  
secondary distribution switchgear  
Informed choice for safety



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# Operator safety legislation for medium-voltage switchgear

All energy sources are potentially dangerous but the required safety level can be ensured by taking the appropriate precautions and using devices that the laws and standards impose or that technical development provides.

The ABB product manual provides precious guidelines and rules about how to use the product safely. It is essential to comply with these rules, but they cannot substitute careful assessment of the specific risks in the site or the safety plan required by the regulations and local laws.



## IEC 62271-200 and 50110-1

The product Standard for Medium Voltage switchgear is IEC 62271-200, “High voltage switchgear and controlgear. Part 200: Metal-enclosed factory-built assemblies for voltage values from 1 to 52 kV”. This standard is used in conjunction with IEC 62271-1, “High voltage switchgear and controlgear. Part 1: Common specifications”. The previously mentioned assemblies can include fixed and removable components housed in compartments that can also be filled with fluid (liquid or solid) to provide insulation. The standard defines quite a lot of switchgear and controlgear with metal enclosures, which differ as to the

effects on continuity of service in the grid during maintenance work and the need for and convenience of the maintenance work itself.



IEC 50110-1, which concerns “Works on electrical installations”, is another important standard which defines the roles and responsibilities that must be assigned to personnel who work on electrical installations.

## Internal arc

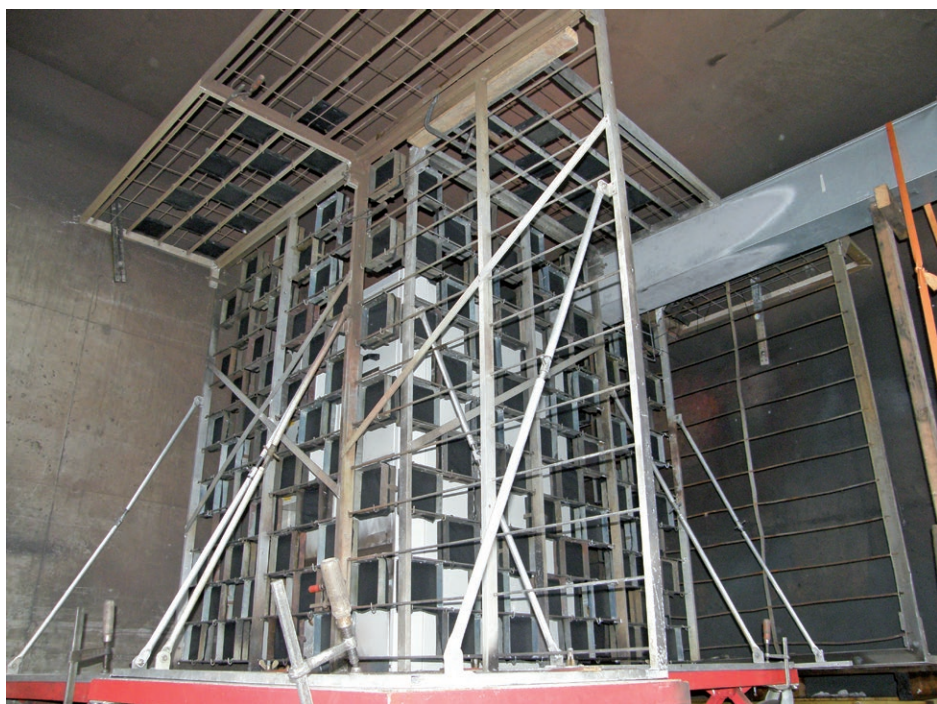
From the point of view of safety and the protection of individuals in general, the most important issue is undoubtedly the internal arc. As mentioned in chapter 11 of IEC 62271-200, it is extremely important to underscore that the correct performance of Medium Voltage switchgear in the event of an internal arc does not merely depend on how the actual switchgear has been designed, but also on the installation conditions and operating procedures. None of the situations described depends on the manufacturer and must be carefully analysed by the manager of the installation, of which the switchgear is only a part. Even though the IEC standards still accept switchgear that is not internal arc resistant, in situations where the risk is considered negligible, ABB proposes UniSec medium-voltage switchgear solely in the internal arc resistant version since the safety of individuals is the prime concern. UniSec switchgear has been designed to minimize the risk of an internal arc occurring and particular attention

has been paid to operator safety in internal arc situations. The switchgear units feature extremely high mechanical strength since they are able to withstand the pressure and thermal effects caused by high internal arc currents. UniSec switchgear has been subjected to the internal arc withstand test as specified by IEC 62271-200, Annex AA.

UniSec switchgear offers various solutions for different requirements as to accessibility and for exhausting the hot gas after an internal arc. As mentioned above, choosing the correct solution from among those available is the task of the person responsible for the installation. To ensure that a correct and informed choice can be made, ABB describes all the solutions in detail in the UniSec Catalog (doc. 1VFM2000003) and in the UniSec Technical Guide (doc. 1VCP000587).

A brief outline is given in the following pages.

Internal arc withstand test structure for ABB UniSec switchgear





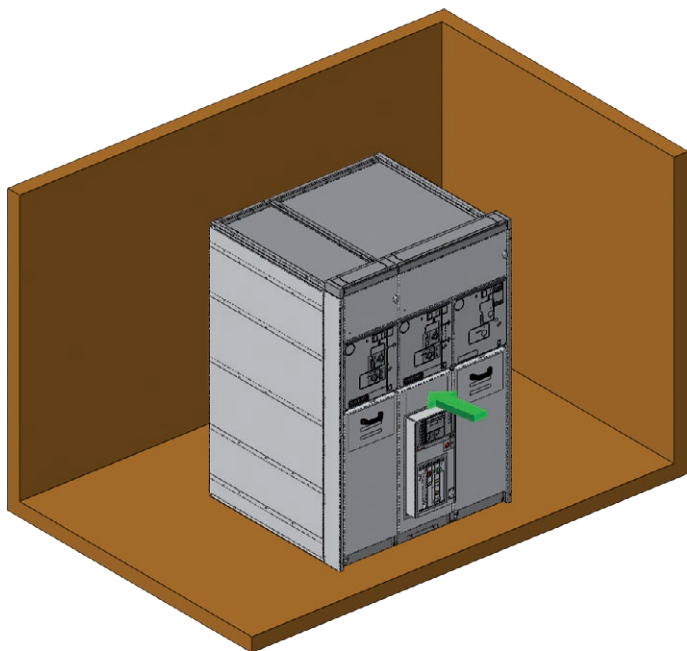
# IAC solutions for UniSec Medium-Voltage switchgear

## IAC AF 16 kA 1s

### Basic proposal <sup>(1)</sup>

This version only protects the operator against the effects of an internal arc if he is in front of the switchgear. The installation manager must implement procedures that prevent access to the other sides of the switchgear when in service. Protection at the Front (F) is guaranteed for 1 second up to 16 kA.

The switchgear can be positioned against a wall or in the middle of the room. The gases produced by the arc are exhausted into the switchgear cabin.



## IAC AFL 12.5 kA 1s

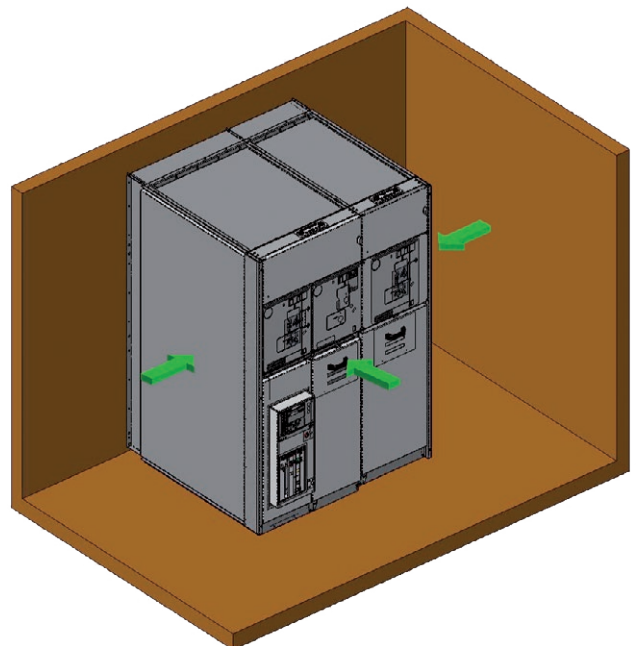
This solution protects the operator against the effects of an internal arc both when he is in front or at the sides of the switchgear, while protection at the rear is not provided. The installation manager must implement procedures that prevent access to the rear of the switchgear when in service. Protection at the Front (F) and Laterally (L) is guaranteed for 1 second up to 12.5 kA.

### Switchgear completely against a wall <sup>(2)</sup>

The switchgear must be positioned right against a wall of the cabin. Closing plates at the top and sides of the switchgear convey the incandescent gas towards the rear and into a specially created compartment.

### Filters installed at the rear of each individual unit <sup>(2)</sup>

The switchgear can be positioned against a wall or in the middle of the room. The gases produced by the arc are exhausted into the switchgear cabin after having been conveyed into the filter at the rear of each panel which cools them and reduces their pressure.

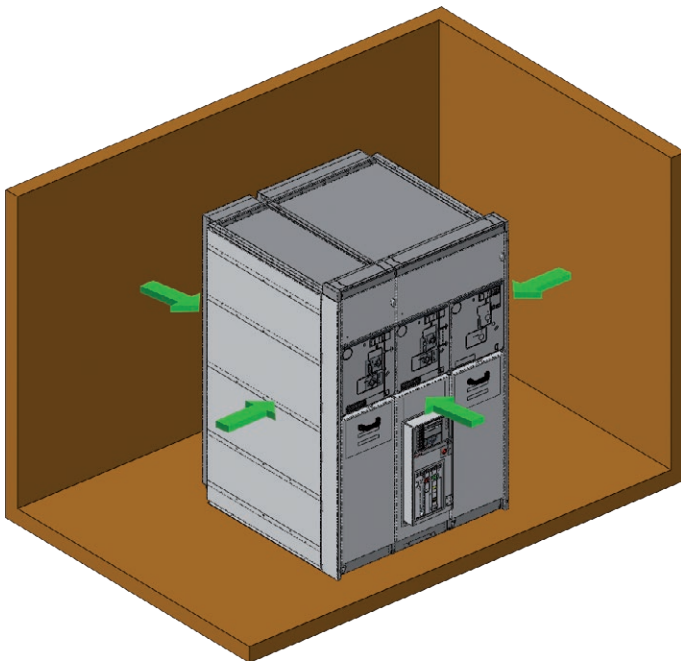


## IAC AFLR 21/25 kA 1s

This solution protects the operator against the effects of an internal arc in whichever position he may be. Protection at the Front (F), Laterally (L) and Rear (R) is guaranteed for 1 second up to 21 kA (25 kA in some configurations).

### Filters installed at the rear of each individual unit <sup>(3)</sup>

The switchgear can be positioned against a wall or in the middle of the room. The gases produced by the arc are exhausted into the switchgear cabin after having been conveyed into the filter at the rear of each panel which cools them and reduces their pressure.

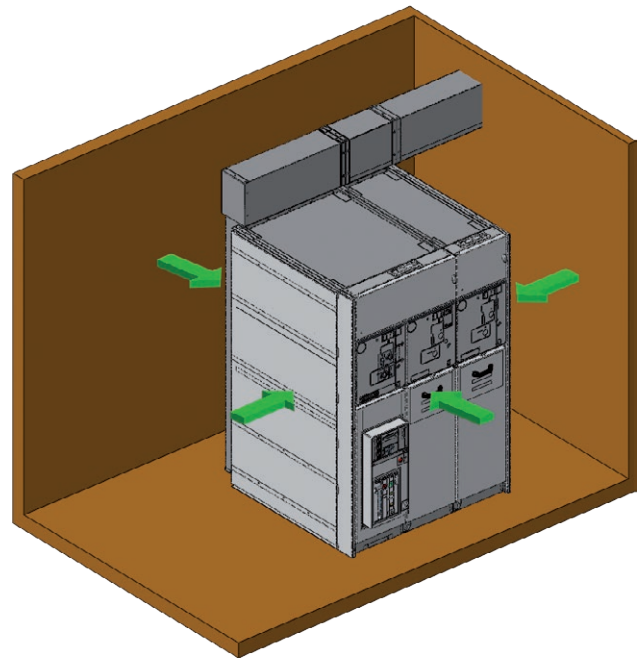


### Gas exhausted downwards <sup>(3)</sup>

The switchgear can be positioned against a wall or in the middle of the room. The gas produced by the arc is exhausted into the shaft through a duct installed at the rear of each panel.

### Gas exhaust duct <sup>(4)</sup>

The switchgear can be positioned against a wall or in the middle of the room. The gases produced by the arc are exhausted outside the switchgear cabin through a dedicated duct between the switchgear itself and the wall.



# Accessibility

Another important issue to bear in mind is how the medium-voltage compartments can be accessed during normal operation, for maintenance work or any other reason.

## Product standard

IEC 62271-200 also gives clear indications about this in Chapters 5 and 11 by defining the accessible compartments and giving details about the interlocks.

The standard defines three methods for controlling the way an accessible compartment is opened:

- The first involves the use of interlocks for ensuring that all live parts inside the switchgear are dead and earthed before the compartment is opened.
- The second is based on the user's procedure and on a locking device to ensure safety. In this case, the compartment is equipped with padlocks, keys, locking magnets or some other equivalent device.
- The third method does not provide for any integrated devices to ensure electrical safety prior to opening, but tools are required to open the compartments; even commonly used objects, like screwdrivers or pliers, are considered tools.

The first two types of compartment are available to operators. If a compartment requires tools for opening (the third type), this is normally a clear indication that the user must adopt other controls to guarantee safety. The procedures to be complied with in the installation and the roles and responsibilities of the various different individuals involved, as described in 50110-1, must be defined prior to any other activity, made available and known.

All interlocks between the different positions of the apparatus and doors required to guarantee safety are mandatory in UniSec switchgear. As an option, it also

provides a wide variety of keys, padlocks and locking magnets for the purpose of creating specific procedures for each installation. As mentioned above, choosing the correct solution from those available is the responsibility of the installation manager, since he is familiar with the entire installation of which the switchgear is only a part.

An example is access to compartments declared accessible only with tools, such as a direct incoming feeder in duct, cable, or busbar. In this case, the standard does not envisage a disconnector and, as required by standard IEC 50110-1, the installation designer and user should provide for an adequate procedure when maintenance or other work is required. This procedure could also involve earthing at the other end of the cable. When the offer is being made, it is always advisable to coordinate with the installation designer to ensure that all needs to access the installation are addressed, not just access to the switchgear.

Keys allowing a procedure to be created for earthing earthing-switches (for busbars, the line, incoming or outgoing feeders) are another example. The ability to earth a disconnector or to access a compartment in safe conditions does not only depend on the state of the panel and/or switchgear but also on the state of the installation. The safe state of any apparatus connected, e.g. the power transformers or the circuit-breaker on the load side of an incoming feeder, must also be ensured. Keys are the best things to use for this.

To ensure the a correct and informed choice is made, ABB describes all the solutions in detail in the UniSec catalog (doc. 1VFM200003) and in the UniSec Technical Guide (doc. 1VCP000587).

A brief outline is given in the following pages.



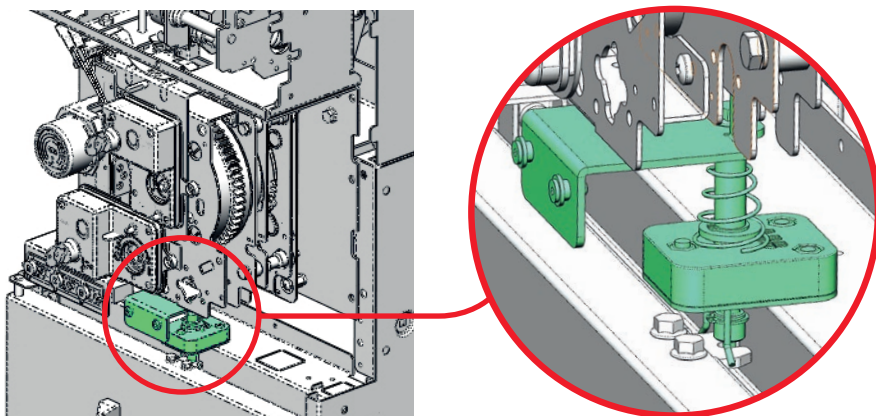
# Solutions for UniSec medium-voltage switchgear access

## Mandatory Interlocks

Allowing the user to access a compartment during normal operation is a responsibility which, in the case of interlocking devices, lies with manufacturers of switchgear and controlgear and with the user, who receives product manuals (1VFM200004 and 1VFM200005) containing instructions about how to use the products correctly. On the other hand, the purpose is to ensure high level safety for operators who must perform tasks during the normal operation of the installation, by preventing them from performing incorrect operations. These devices must also

be sufficiently sturdy to withstand attempted incorrect operations without damage. These interlocks are mandatory and always present in UniSec medium-voltage switchgear. To ensure that a compartment is always accessed in complete safety, the most important interlock is the one between the earthing position of the earthing switch and the door.

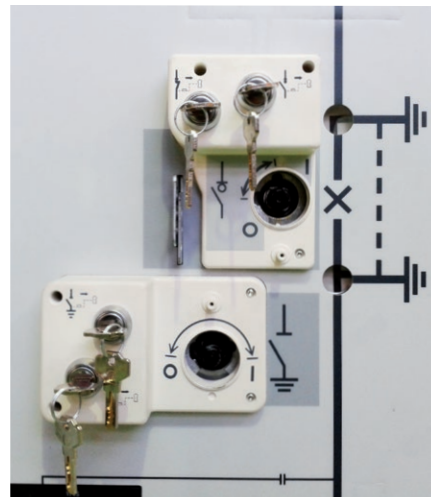
Another important interlock is provided by shutters on the operating seats of the disconnecter to prevent the operating lever from being inserted when this is not allowed.



## Optional Interlocks

All interlocks designed to implement an accessibility procedure are considered optional. This, therefore, is the case of keys, padlocks and locking magnets use of which is not mandatory but linked to the specific requirements of the installation. For instance, to prevent an operation that is correct in principle (e.g. removal of an earthing connection for successive putting into service) but not permitted at that particular time, since there are maintenance technicians at work. In this case, the key provides enhanced safety when the procedure is implemented. The installation manager evidently plays a fundamental role in all this by indicating that keys or other systems are required when the installation is designed. It is always advisable to coordinate with the installation designer when the offer is being made to ensure that all needs to access the installation have been addressed.

In addition, the installation manager must make sure that the users are aware that one or more procedures have been implemented, and that they have been adequately trained according to their levels of responsibility.



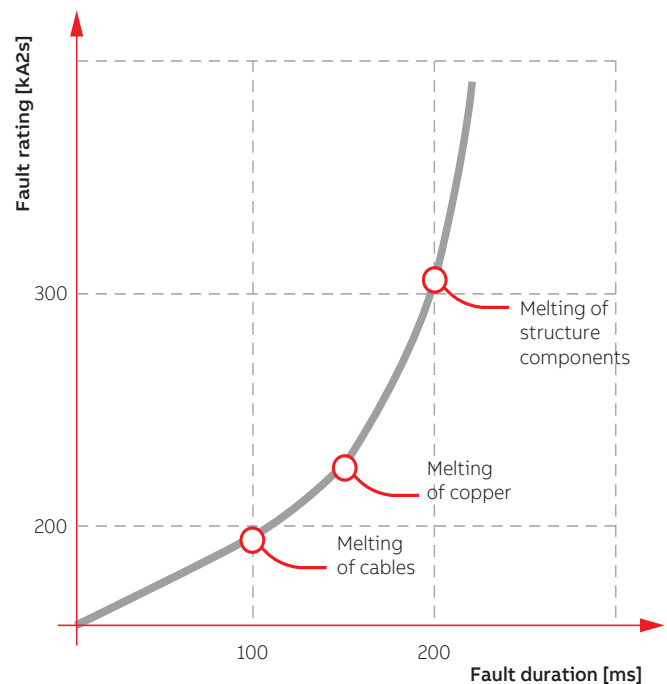
## Additional protection measures

In addition to the switchgear structure being guaranteed by having passed the internal arc resistance test, standard IEC 6227-200 chapter 8 establishes that other “active” measures can be adopted to provide the highest possible level of protection for individuals if an internal arc occurs. These measures are directed towards limiting the external and internal consequences of such an event thanks to ultra-fast fault interruption times obtained by devices sensitive to light, pressure or heat. Alternatively, devices are available that reduce the risk for the operator by enabling the operations to be carried out in the remote mode instead of from in front of the apparatus. ABB can provide advanced technological solutions that also address this aspect of the standard and that have been implemented in UniSec switchgear.

It is only right to remember that besides increasing operator safety, reducing the duration of the internal arc also reduces the damage caused by the event itself to a considerable degree. Time is a critical parameter with regard to reducing the effects of the arc, since the energy issued increases exponentially as time goes by. The longest part of fault extinguishing time is due to the break time of the circuit-breaker, while detector systems act in less than 15 ms. This means that the overall response can take less than 100 ms, so long as the circuit-breaker opens instantly and is sufficiently fast. Trip times of less than 100 ms considerably reduce both the risks for individuals and damage to the equipment, considering that UniSec medium-voltage switchgear is tested for 1 sec. duration.

## ABB systems for arc detection by light available in UniSec switchgear

ABB can supply systems with optical fiber sensors able to detect the light generated by an internal arc. These systems consist of sensors and fiber installed in the various medium-voltage compartments, which are connected to the control units housed in the low voltage compartment. Regarding safety against false trips, the system only detects the lower part of the spectrum, including the ultraviolet part. Secondly, it is also connected to current sensors and can therefore combine both data items.





## TVOC-2 or REA

These are two ABB arc detecting systems based on the principle described above whereby the light produced by the electric arc is detected. The typical trip time is 2/2.5 ms, to which the circuit-breaker break time should be added. The total break time is less than 100 ms.



## Protection with IED

Certain IED (Intelligent Electronic Devices) such as REF615, RET615, REM615 and REF610, can use light sensors and create rapid, selective internal arc protection. The advantage of this solution is that no additional devices are required other than the protection and measuring relay. The typical trip time is 12 ms, to which the circuit-breaker break time should be added. The total break time is less than 100 ms.



## Remote operations

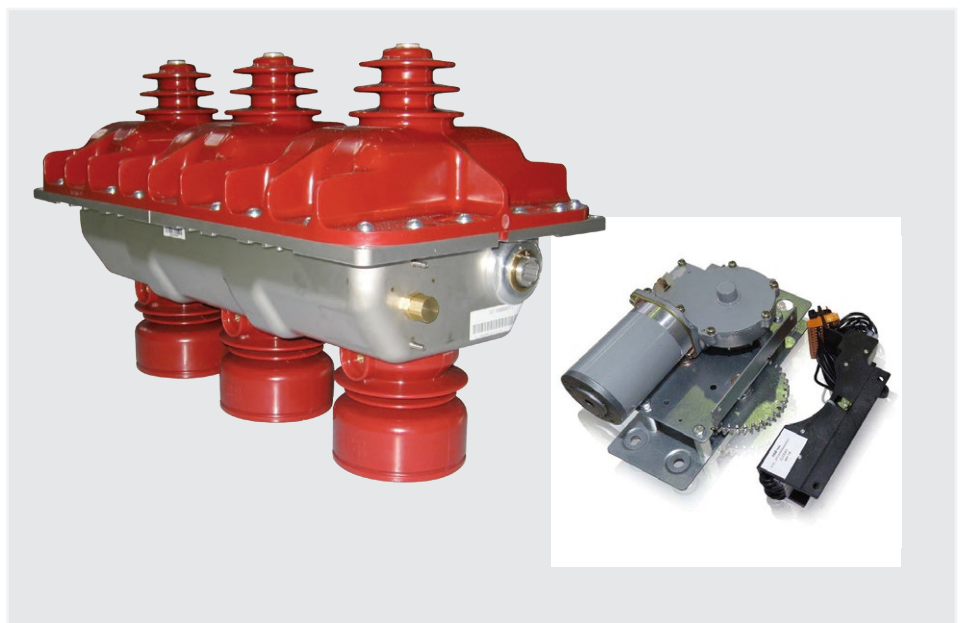
The standard generically indicates remote operation rather than operation in front of the switchgear. This means that there is a certain distance between the operator and a potential internal arc, allowing the various operations to be performed in safer conditions.

To achieve this further safety parameter, the apparatus must be motor-operated, a feature with which all the components available in UniSec switchgear can be equipped.

Withdrawable vacuum circuit-breakers can be equipped with remote motor-operated loading of the springs for opening and closing operations as well as motor-operated trucks so as to perform the racking-in operation in the remote mode. The earthing switch is also available in the motor-operated version.

GSec switch-disconnectors are also available with motor-operators in both the line and earth positions for complete remote control.

Besides enhanced safety for the operator, who no longer has to work in front of the switchgear, operating procedures performed in the remote mode by a supervisor can also be added.



# Maintenance

Switchgear and controlgear safety must be maintained over time. The installation manager is responsible for implementing use and maintenance procedures able to ensure that the safety level remains constant.

Instructions for correctly servicing UniSec switchgear and its main components are given in the dedicated manuals (1VFM200004 e 1VFM200005), but it is of fundamental importance to know the real condition of the installation since it is based on this key information that the priorities able to mitigate risks and avoid effectively hazardous situations can be defined.

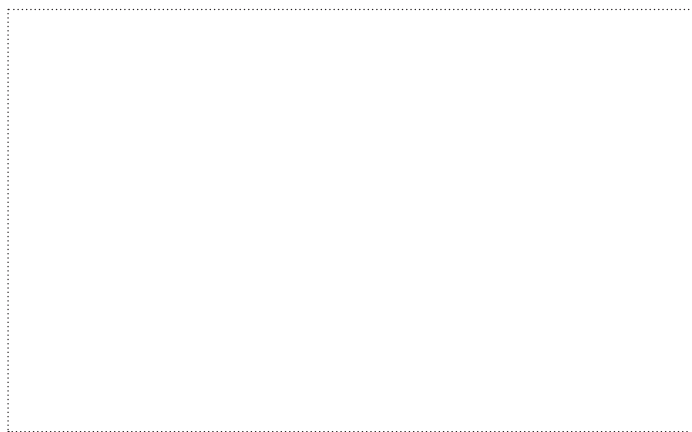
This, obviously, in conjunction with the procedures and in compliance with the laws in force, as fully described above.

Maintenance based on continuous monitoring of the installation is certainly the most advanced. ABB proposes MySiteCare, which is available for UniSec switchgear. MySiteCare is a monitoring and diagnostic device that acquires the typical data of the circuit-breakers and processes them into diagnostic data for the purpose of determining the operating conditions and allowing maintenance to be planned. The data collected by MySiteCare are mechanical (such as time and number of operations) and environmental (such as temperature). Using these data, the device processes predictive diagnostic algorithms that provide information about the conditions of the circuit-breaker.



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