



Arc Guard System™

A guard that saves lives and business

AHMED H HASSAN AND RICHARD PETERSSON WIGH – Every day throughout the world, hundreds of people are seriously injured or die as a result of electrical arc accidents. These accidents aren't just restricted to countries with low safety regulations. Even countries with strict safety regulations suffer deaths and serious injuries. According to public data, one person dies each day in North America due to arc flash accidents and several more are injured. ABB's new Arc Guard TVOC-2 protection device reduces the risk of arc accidents, saving lives and equipment all over the world.

1 The capacity of ABB's ArcGuard System to provide protection



1a Arc accident without protection



1b Arc accident with ABB's ArcGuard System™

Safety

Safety has always been an important issue in the generation and distribution of energy. Increased legal and regulatory requirements have served to emphasize the importance of safety in recent years and have led ABB to introduce TVOC-2 and encourage the adoption of safe working practices. TVOC-2 alone will not prevent accidents from happening but it will significantly reduce the damage such accidents cause.

Although the previous Arc Guard system was simple and reliable, the TVOC-2 was introduced with additional and improved features and functions so that it would maintain its strengths in reliability and simplicity, while providing greater flexibility.

ABB's new Arc Guard TVOC-2 protection device reduces the consequences of arc accidents saving lives and equipment.

Reducing the consequences of arc faults is all about timing and each millisecond is paramount. TVOC-2 reacts in just a millisecond and over-rides standard protection time delays when tripping breakers → 2.

With a design that satisfies safety integrity level 2 (SIL 2), the Arc Guard TVOC-2 is approved for applications today and for the future.

Risks

Everyday hundreds of people face serious injuries or death due to arc accidents.

In any plant, the risk of arc accidents can be reduced through the mechanical and electrical design of the system together with good routines for working with electric equipment. The importance of safety has led ABB to develop 'arc-proof' switchgears. Here the mechanical design, as well as the choice of electrical components, reduces both the risk of an arc accident and its consequences.

Unfortunately, despite these measures, protection against arc accidents are frequently insufficient for two main reasons:

(1) Most accidents happen with the switchgear door open, which reduces the effectiveness of mechanical protection.

(2) Breaker protection is based on over-current only and often includes time delays.

Benefits

1 Increased arc safety in switchgear, which saves lives and reduces damages, since the total tripping time will be faster and more reliable when an accident occurs. It also saves money and time since downtime in production is minimized.

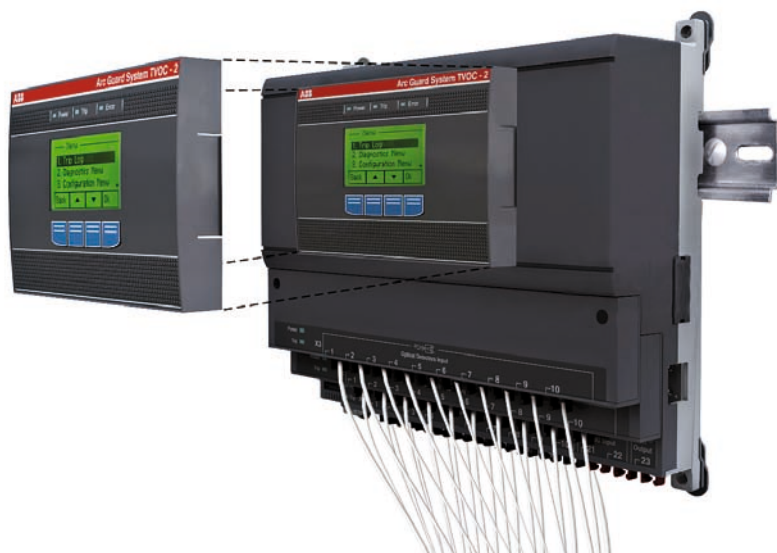
2 Point sensor design makes it simple and fast to locate the error and restart production after an accident.

3 TVOC-2 has a user friendly start-up menu and all connections are accessible from the front, which gives easy access to the required information. It

After more than 35 years, ABB's well known Arc Guard System™ has become the market leader in switchgear safety. Today the Arc Guard System™ is considered to be a standard part of switchgear equipment in northern Europe. Although the system cannot prevent arcing faults, it can reduce the threat to human life and equipment. Arc faults are usually caused by external factors, mainly human error or negligence. Their occurrence, therefore, can never be totally prevented or predicted. What can be prevented, however, is the extent of the damage and injury caused. An arc fault normally begins as a short circuit between two or more contact points. If it lasts for a few hundred milliseconds, the internal core temperature may reach 20,000 °C, posing a serious threat to personnel and the switchgear assembly within its proximity → 1a.

Since switchgear is found in all industries as well as power utilities, commercial buildings, hospitals, ships, and many other locations, ABB has tried to produce 'arc-proof' switchgear through mechanical design as well as the choice of electrical components. These design innovations, together with ABB's new Arc Guard TVOC-2 system, will help reduce the risk of arc accidents and their consequences in the future → 1b.

2 TVOC-2 showing the possibility to put HMI (Human Machine Interface) mounted on a panel-door



has a trip log with time stamp, tripping breakers and a host of additional features.

Functional safety design

- Faster and more reliable tripping than short circuit protection
- Modularized one unit product that is easier to design, expand and fit into a limited space.
- HMI on the door, easier than flush mount and gives more information → 3
- Reliable arc monitor TVOC-2
- Functional safety design, SIL 2, gives a reliable and future proof product.

Product specifications

- Fiber optic sensors eliminate risks of EMC distortions via the detector cables.
- Pre-fabricated and calibrated sensors in different lengths, removing risks of faulty mounting.
- 10 sensors as standard, modularized design, gives possibility of up to 30 sensors, adaptable to the customer's need.
- DIN rail / wall mounting – flexible and simple assembly.
- Up to 2 HMI, product, external or both, typically mounted on cabinet door, easy to mount and access.
- Easy to extend the system with one unit design (modularized)
- Current condition if required
- Trip selectivity, possible to trip different breakers depending on sensors, reduces the need of several arc monitors and makes a special design simple.

Overcoming challenges

One of the biggest challenges was to achieve SIL2 certifications.

ABB had to change its first product concept. All safety related activities are made by traditional electronics without any software. The micro controllers used are partly for diagnostics purpose, partly for user friendliness.

The requirement specifications are based on a number of interviews with customers and potential customers that prioritized their most critical functions. This provides added value compared with competitors and ABB's old generation product.

All the work with functional safety was guided by the Safety Manager Dr Zaijun Hu from ABB Research in Germany.

Perspectives

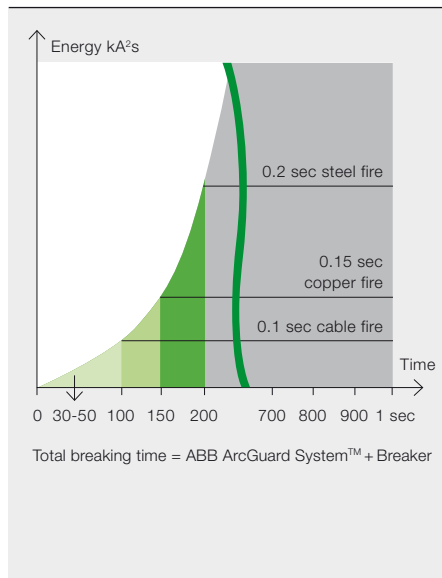
Reliability

- Certified according to functional safety (SIL 2) standard
- Over 35 years of experience in Arc Guard Systems
- Pre-calibrated optical sensors

Flexibility

- HMI can be mounted on the panel-door
- Expands with up to 30 optical sensors
- Configuration according to various needs

3 TVOC-2 reacts in just a few milliseconds



ABB's well known Arc Guard System™ has become the market leader in switchgear safety.

Simplicity

- User-friendly start-up menu
- DIN-rail or wall-mounted
- Easy to expand as the switchgear grows

TVOC-2 is designed with its main focus on reliability. Every aspect is covered. This includes sensors being precalibrated at the factory as well as major features such as the self-monitoring system of the arc monitor.

To ensure that we have not left a single part to chance, TVOC-2 is designed according to the functional safety (SIL 2) concept. This compliance means that the product is designed so that a fault in a component will not result in a safety function failure. For example, certain capacitors have built-in redundancy to cope with component break-downs. Critical functions of the system are self-monitoring providing alerts should anything go wrong. Many of the added functions are handled by a microprocessor, but importantly, none of the safety functions.

Functional safety for the future

The world wants safer and more reliable equipment and is moving quickly and decisively in that direction. One example is the new EU machinery directive (2006/42/EC) that requires the machine builder to

in the arc so that personal injury and equipment damage are kept to a minimum. Using TVOC-2 means that customers can meet the highest safety requirements. For example, NFPA70E, a US standard for the safe installation of electrical wiring and equipment, states: “a flash hazard analysis shall be done in order to protect personnel from the possibility of being injured by an arc flash. The analysis shall determine the Flash Protection Boundary and the personal protective equipment that people within the Flash Protection Boundary shall use.” With Arc Guard System™, these calculations will show that the energy from an arc flash is decreased to a level that reduces the need for additional protection. Note that the requirements for functional safety ensure the reliability of the figures used in these analyses.

Flexibility

TVOC-2 is built as a flexible unit that fits into a wide range of switchgear and system sizes. ABB's goal is to provide customers with a system they actually need. The standard configuration includes 10 detectors to cover the need for normal-sized switchgear. If a customer's system grows or requires additional sensors, the product can be extended to include up to 30 detectors by simply adding two extension modules on the main unit. Customers can mount TVOC-2 on either a

DIN-rail or directly on a panel wall. Furthermore, the HMI that shows the customer the system information and setup, can be placed either on the product itself or on the door. If

required, it can even be mounted on both. To fit a customer's application, we have added functionality to trip up to 3 breakers. The system can be configured to trip different breakers depending on where in the switchgear the arc occurs.

Simplicity

One of the most important aspects of designing the TVOC-2 has been to make it simple for ABB's customers and end-users. This is important not only to make the system design and installation easy and simple, but also to minimize the risk of errors. ABB have designed TVOC-2 as a single unit (even if customers choose

to extend it with additional sensors) and with the minimum number of parts. At installation, all in/outputs, sensors and settings are accessible from the front to give a good clear overview that minimizes the risk of error. The HMI menu has a user-friendly interface that guides the customer through installation. Here the customer can, for example, check the trip log to see which sensor was triggered at what time. Even better, since it can be placed on the door, the customer can do this without opening the switchgear. As the customer's business grows so too can the TVOC-2 system. The customer has complete flexibility, from expanding the number of sensor modules to simply adding other components to the system – all done in minutes.

Today ABB's Arc Guard System™ is considered to be a standard part of switchgear equipment in northern Europe.

eliminate risks throughout the foreseeable lifetime of the machine, even when misused.

Harmonized standards provide tools for verifying that these requirements are met. Functional safety is a tool not only used to ensure safety, but reliability as well. Using TVOC-2, which is SIL 2-certified according to IEC 61508 and IEC 62061, ensures that the diagnostic coverage meets the safety level demands. This corresponds to performance level d according to EN ISO 13849-1. Arc Guard System™, clears an arc within an extremely short time, reducing the energy

Ahmed H Hassan

Richard Petersson Wigh

ABB Low Voltage Products

Västerås, Sweden

ahmed.h.hassan@se.abb.com

richard.petersson-wigh@se.abb.com