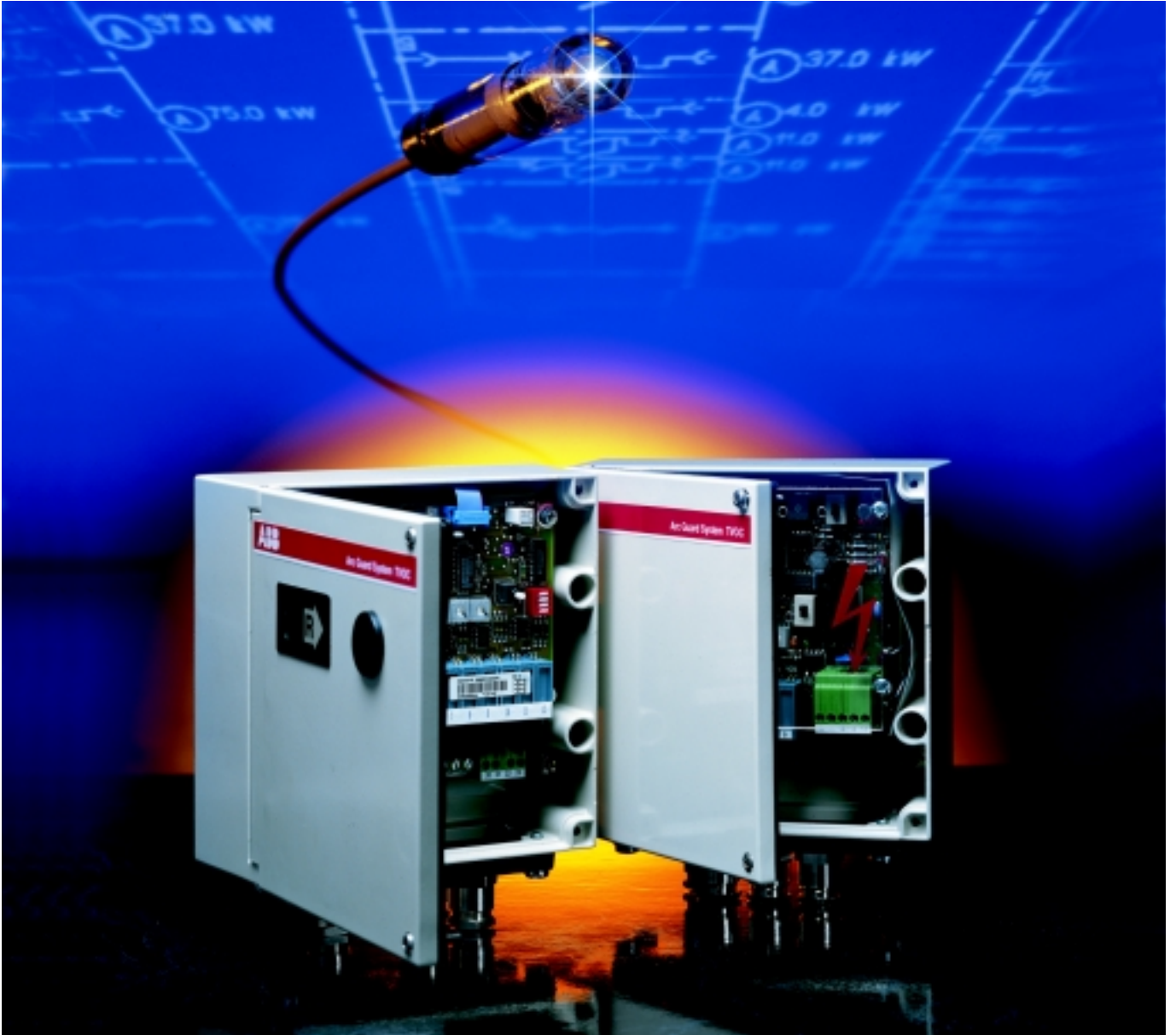


# Arc Guard System TVOC



# Accidents can occur whenever electrical energy is generated or distributed



Short circuits in electrical installations can be a hazard. This is a recognised fact, and measures are normally taken to limit the consequences of a fault. However, most of the measures taken only partly eliminate the risk of a short circuit as they do not adequately cover arcing accidents.

## Short circuits involving an arc may occur for many different reasons:

### Human errors

Installers working under stress may forget or drop tools or equipment on live parts. Simply using a meter set for amps instead of volts is enough to cause a serious arcing accident.

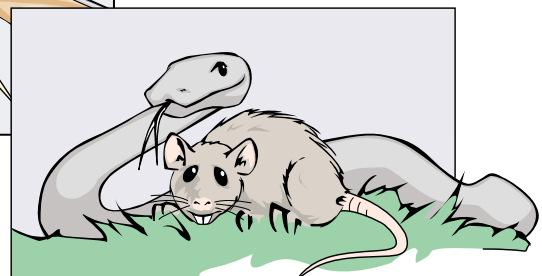
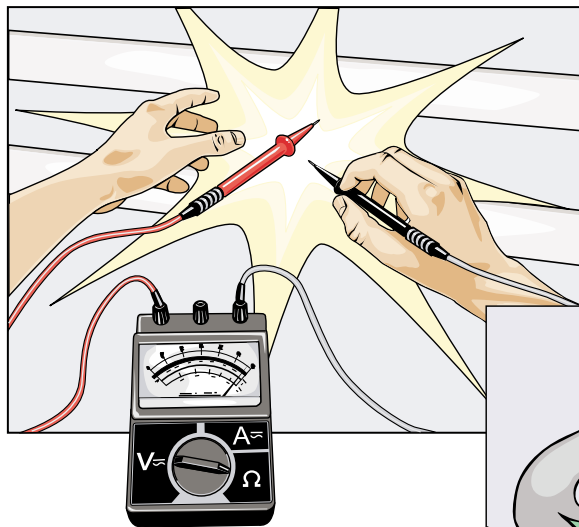
### Bad connections

A poor connection may cause generation of heat, which in the end leads to an arcing accident.

The reason for this may, for instance, be wrong tightening torque being used on the terminals, a hostile environment, excessive vibrations, atmosphere, etc .

### Animals

Animals or vermin entering into electrical installations are very likely to cause short circuits with arcs and such accidents can be difficult to rule out.



# Arcing accidents .. a matter of milliseconds



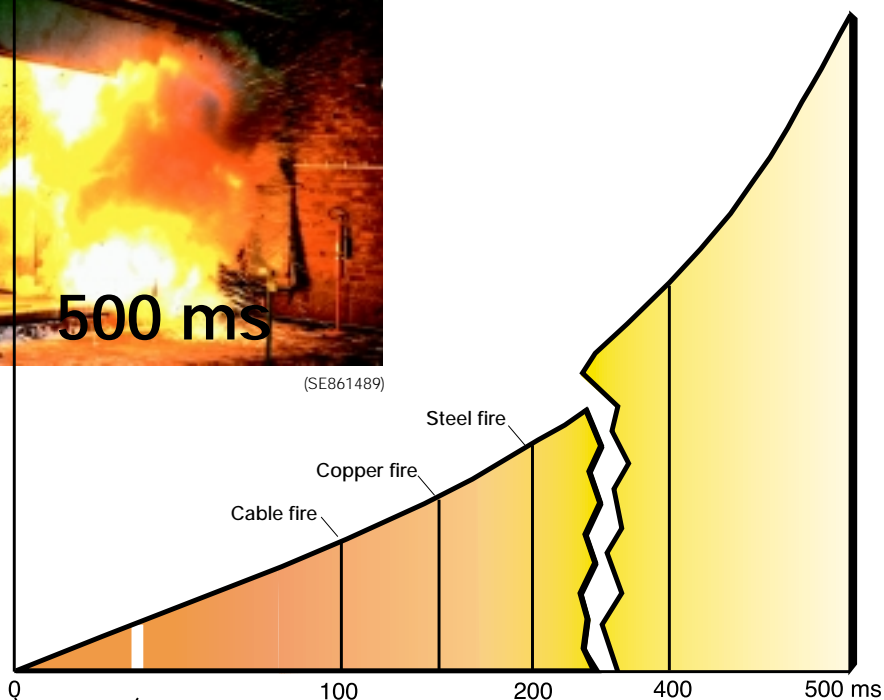
(SE861485)

An arc is developed within milliseconds and leads to the discharge of enormous amounts of energy. The energy discharged in the arc is directly proportional to the square of the short-circuit current and the time the arc takes to develop, i.e. energy  $\sim I^2t$ .

The damage resulting from an arcing accident depends on the arcing current and the time. Of the two parameters only the time can be influenced, i.e. reduced to a minimum.



(SE861489)



Total breaking time = Arc Guard System TVOC (2 ms) + the clearing time of the breaker

- <100 ms arcing duration  
Personnel and equipment may sustain little or no injury or damage.
- 100 ms arcing duration  
Personnel and equipment can be at risk.
- >500 ms arcing duration  
Catastrophic damage to equipment and injury to personnel are likely to occur.

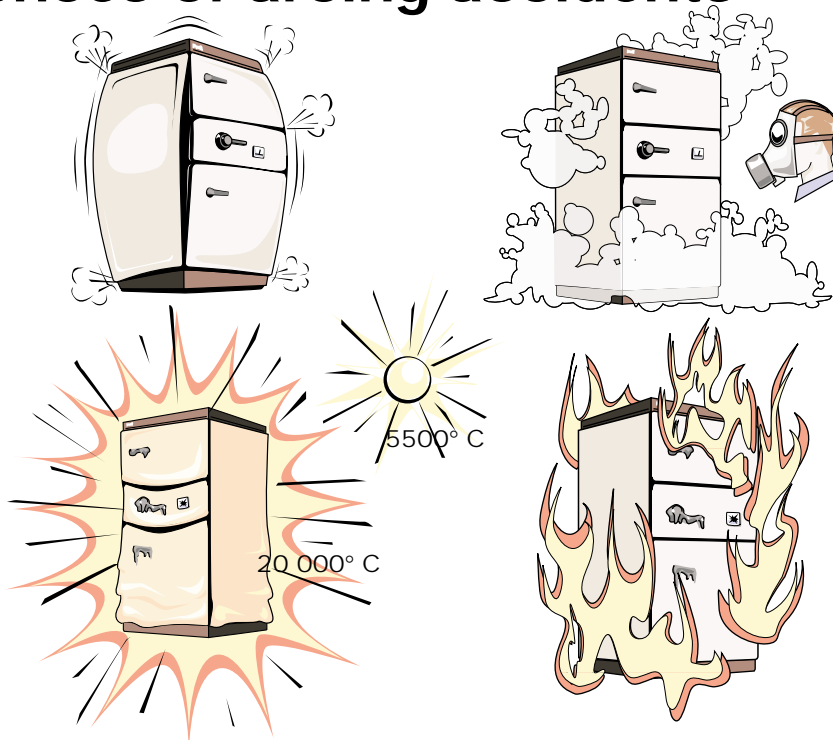
## Serious consequences of arcing accidents

The arc leads to a rapid build-up of pressure and heat. The arc temperature has been determined to be about 20 000 °C, i.e. twice the temperature of the surface of the sun! The extreme heat of the arc leads to the burning of metals, which results in generation of toxic gases. Due to the vast amounts of energy released in an arcing accident, the resulting damage is often extensive. This leads to considerable economic losses.

- Loss of production. Long downtimes are to be expected, due to the extensive damage often following an arcing accident.

If non-arc-proofed switchgear is used, it may additionally lead to:

- Injuries due to pressure, heat or the generation of toxic gases.
- Damage to equipment and buildings



# Why normal protection is often not enough

Normal short-circuit protection equipment has problems in detecting the arc fault before considerable damage has occurred. This is due to the fact that in an arc the resistance may be quite high, and consequently the current may not be very high, i.e. not high enough for the magnetic release of the breaker so that it trips.

The inability of breakers to eliminate the risk of arcing accidents is accentuated in the following two cases:

- 1 In order to achieve the required selectivity, the incoming breaker has been delayed by 150–200 ms. During the delay time an arc may cause major damage, depending on how arc-proof the switchgear is.
- 2 The incoming breaker is set at a high trip level in order to avoid unintentional tripping due to high inrush currents when energising the transformer. The fault current upon the occurrence of an arc may be lower than the set level and the breaker then does not trip.

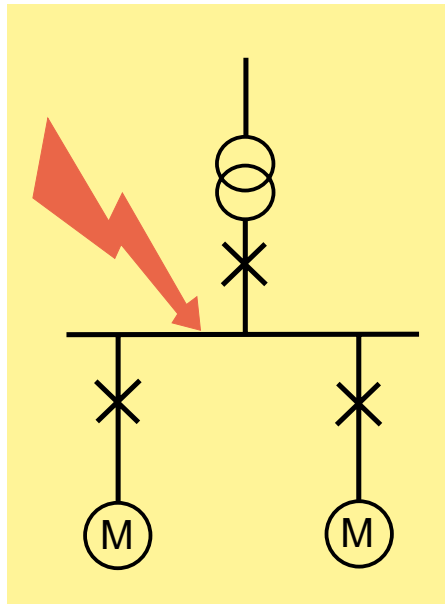


Fig. 1

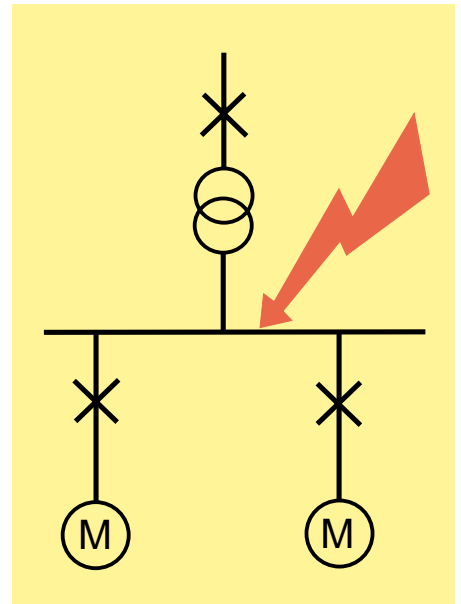


Fig. 2

## How to extinguish the arc before severe damage arises

The modern arc-proof switchgear MNS from ABB is designed and tested to withstand internal arc faults, often of very long duration (300 ms). These tests take place at ABB and experience has shown that surroundings are not affected and personnel not endangered.

The use of Arc Guard System TVOC will minimise the arc fault time.

The advantages are as follows:

- Safety of personnel even when switchgear door is open.
- Reduced damage inside the cubicles.
- Reduced shutdown cost of the plant.
- Reduced expense for insurance companies when reconstructing after accidents.H



Low voltage switchgear during test (CRL97 665-11)



Damage caused to medium voltage switchgear by an arc fault (SE902001)



(CRL97 665-04)

## The solution is ABB's Arc Guard System TVOC

ABB has recognised the hazards of arcing accidents and has developed a system which significantly reduces the damage resulting from an arcing accident. Using the Arc Guard System TVOC in combination with today's modern breakers the total disconnection time can be reduced to less than 50 ms.

### This is how it works....

The purpose of the Arc Guard System TVOC is to quickly disconnect the switchgear directly after an arcing fault. The watchful eye of the Arc Monitor detects any large increase in light intensity. Upon detection of an arc, the Arc Monitor sends a signal directly to the tripping mechanism of the breaker, thus omitting any delays caused by relay protection or set delays due to selectivity.

### ...by using the speed of light

The Arc Guard System TVOC uses the speed of light. The Arc Guard System delivers the trip signal in approximately 1 to 2 milli-seconds. The actual disconnection time depends on the type of circuit-breaker used, but the entire process is normally over in less than 50 milliseconds.

### Fibre optics ensure no interference...

In the environment of switchgear and other electrical installations, elevated electromagnetic fields, especially in the event of a fault, are common. The Arc Guard System TVOC is designed to withstand the severest disturbances. Fibre optics, which are totally insensitive to electro-magnetic fields, are used both for the detectors and the communication between the optical detector and other units of the Arc Guard System.

The Arc Guard System is immediately activated when the power is turned on and will react to existing arc faults. This ensures the protection of installations such as substations, which are not at all times under power.

### ...and easy installation in new and old switchgear

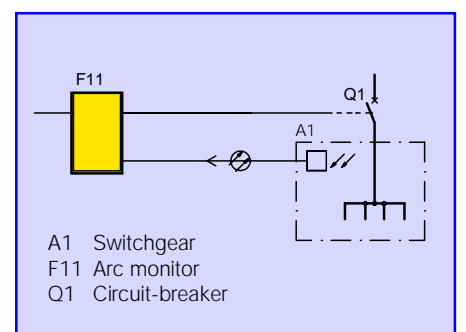
The Arc Guard System is easily installed in all types of switchgear, whether of new, old, high voltage, low voltage, metal clad or open type.

The fibre optic cables and detectors can be installed in the switchgear without any concern about the power or control cabling since they are non-conductive and not sensitive to electrical or magnetical fields. The placing of the detectors is not crucial since the detector's wide angle



Detector

(CRL97 665-12)



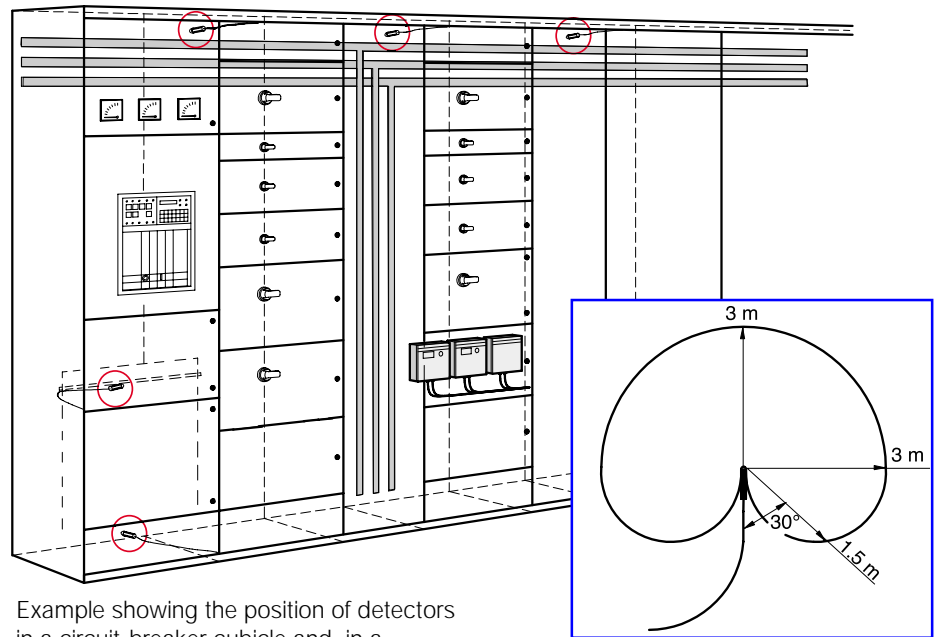
lens can "see" a large area around itself. The detectors are provided in fixed lengths and all are adjusted to ensure the same sensitivity to light.

All this makes the Arc Guard System very easy to install.

# It must be possible to discover arcs wherever they occur in the switchgear

## With Arc Guard System TVOC the whole switchgear assembly can be monitored

One of the key features of the Arc Guard System is the design of the detectors, which have a detection range of almost 360°. As many as nine detectors can be connected to each arc monitor. Several arc monitors can be connected together. In principle, one detector should be placed in each closed unit or cell. The number of detectors required to ensure satisfactory protection depends on how the switchgear is arranged with respect to internal screening, etc.



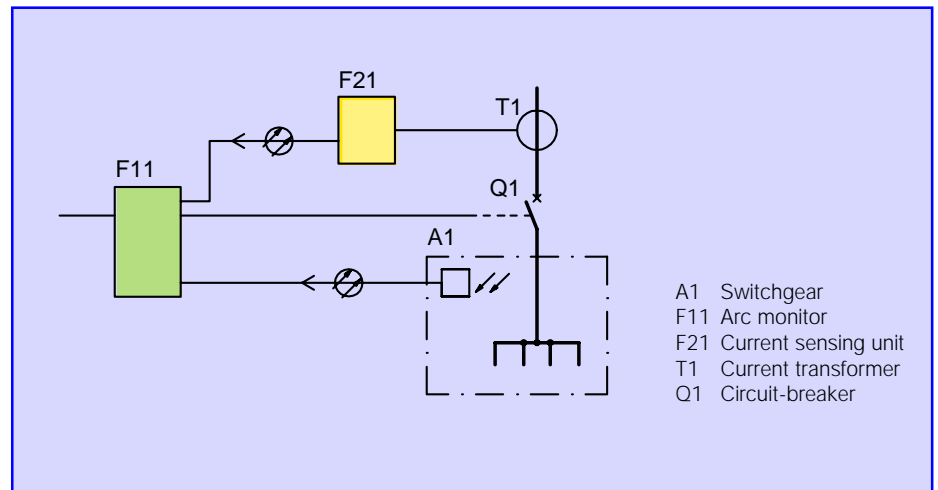
Example showing the position of detectors in a circuit-breaker cubicle and in a horizontal busbar system.

Polar diagram of detector in three dimensions.

# Current sensing unit to prevent unintentional tripping



(CRL97 665-08)



- A1 Switchgear
- F11 Arc monitor
- F21 Current sensing unit
- T1 Current transformer
- Q1 Circuit-breaker

The detectors can also react to other forms of intense light such as camera flashes, direct sunlight or welding. In order to avoid power loss due to unintentional tripping a current sensing unit can be installed. When combining the arc monitor with a current sensing unit the trip or release level can be adjusted just above the normal operation current of the installation. A current-dependent condition is introduced, which prevents tripping due to irrelevant light sources.

# Arc Guard System TVOC

## – an investment in safety

The Arc Guard System from ABB is an insurance against the severe damage and high costs which may result in the event of a serious arcing accident.

### The benefits of the Arc Guard System TVOC

- Power loss is reduced to a minimum, increasing operational safety and reliability.
- The safety of personnel is greatly enhanced.
- The cost of replacing switchgear and components, as well as the repairs to buildings, is significantly reduced.
- Easy installation, suitable for retrofit. The fish-eye design of the detectors ensures detection in all applications.
- Immediate activation by power-up ensures the protection of installation in intermittent use.

### A recommended standard by authorities and insurance companies

The hazards of arcing accidents are well known and in many countries protection against arcing accidents is legislated for. The Low Voltage Directive of the European Community stipulates that measures in order to ensure protection against damage from heat, caused by arcing accidents, for example, are to be adopted. Several insurance companies also re-recommend the use of arc guard systems and may in some cases grant premium reductions.

### ABB arc protection saved a million!

–A success story from Danisco Paper, Denmark

Danisco Paper has experienced many fires in its panels. Sometimes several a year, which has made investment in the Arc Guard System TVOC an obvious choice. Hugo Andersen is the head of the Department of Electricity and Instruments, and his story is as follows.

#### Saved money and time

– Thanks to the Arc Guard System from ABB we have saved a considerable amount of money. A fire before the installation of the Arc Guard System caused a production breakdown of 32 hours. The first fire after this system caused a production stop of only 3 hours.

#### The investment - a clear saving

- It is a simple calculation. With a downtime cost of 40 000 DKK per hour and an investment cost of a fraction of the downtime cost, we have saved a very large amount of money.

#### 3.5 MW

– Nearly 100 per cent of all faults are in the low voltage section. A short circuit results in an enormous discharge of more than 3.5 MW. In a single second all equipment is destroyed by fire.

#### Reacts in milliseconds!

The Arc Guard System TVOC is installed at Danisco Paper to protect everything downstream of the main circuit-breakers (ABB SACE). The Arc Guard System reacts within two milliseconds of the arc fault. Including the reaction time of the breakers, the arc-fault area



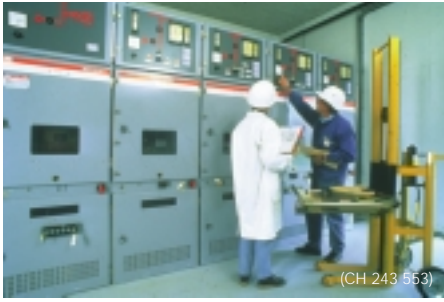
Hugo Andersen, Danisco Paper: No doubt that the Arc Guard System from ABB saves much money. (CRL97 665-13)

is discharged 30–40 milliseconds after the fault, which is fast enough to avoid major damage.

#### 90 000 000 kWh

Danisco Paper uses a lot of energy at this plant. 13 MW per hour, or 90 000 000 kWh per year. 26 transformers are in continuous 100 per cent operation. The machinery has to work. All the year round. The Arc Guard System from ABB helps to ensure this!

- We now install arc guard protection as standard in all switchgear. It might seem excessive in the case of smaller switchboards, but our experience tells us that the investment is well worth it.



(CH 243 553)



(IAD 16)



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(CH 239 167)



(TMS 16)

**ABB is the world leader in Arc Guard Systems  
and has more than 30 years of experience  
in arc accident protection.**

**Why not get in touch with us for more information  
as to how we may help you improve your protection.**



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