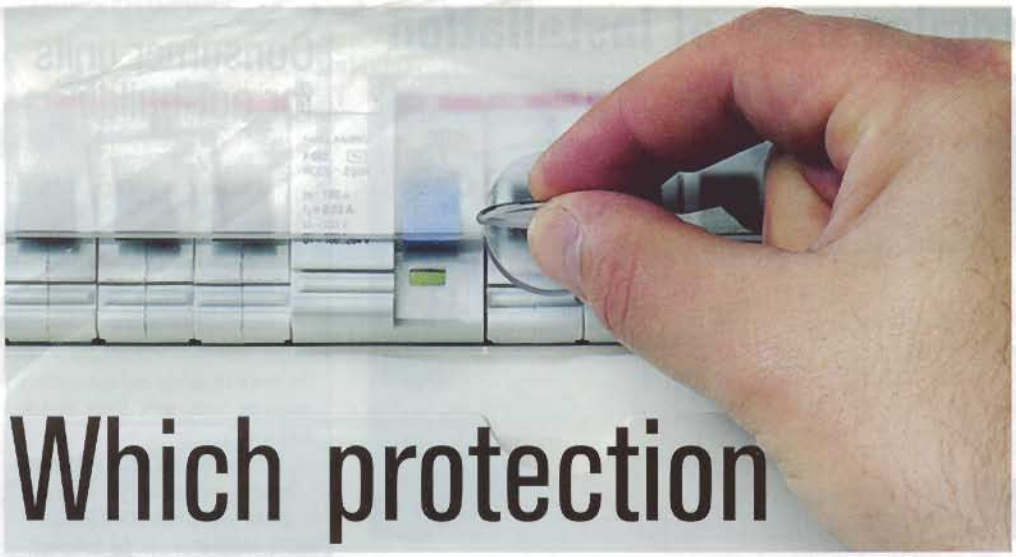

Which protection device is right for you?

Janet Roadway, of ABB, highlights the importance of understanding the behaviour of different devices in order to pick the optimum circuit protection solution

When it comes to fuses versus fuseless technology, it is not a case of either approach being intrinsically superior to the other. Each technology has its pros and cons and these determine which applications it is most suited to. However, there are many middle-ground applications where either approach will be acceptable. It is therefore important to look at the characteristics of the competing technologies.

Fuses

Fuses and their associated switchfuses are cheaper than circuit breakers up to a capacity of around 400A. Fuses are also interchangeable with switches from different manufacturers, which keeps the cost of stocking spares low.

The simplicity of fuses is both an advantage and a disadvantage. It makes discrimination and selectivity simple to achieve – if a user wants to protect against a particular current at a particular point in the distribution system, they simply buy and fit the right element.

However, the fact that they cannot be precisely adjusted to match current requirements means that users may have to specify oversized cables to match the current rating of the fuse. This can make fuses an expensive option.

Fuses also provide only single-shot protection. Once the element has blown it must be replaced, requiring manual intervention. This may also have knock-on effects on maintenance costs. Further, if anyone is tempted to replace a frequently blowing fuse with a higher-rated version or even a piece of copper wire, it can compromise protection.

Finally, fuses lack any intelligence, so they offer only simple on/off protection and give engineers no help tracking down the cause of an ongoing fault.

Thermomagnetic protection

Thermomagnetic circuit breakers adopt a dual approach to protection. A bimetallic strip offers thermal protection against an overcurrent. For short circuits a coil offers magnetic protection by generating a magnetic field instantaneously as the current appears. This field activates a trip bar which trips the switch.

These circuit breakers are easier to automate than fuses and offer multi-shot protection which can reduce necessary manpower. Replacing the protection element is more expensive in the case of circuit breakers, however, because it is the actual switch contacts that break the circuit, rather than a separate fuse. However, the increased complexity of circuit breakers means that 'the copper wire trick' cannot easily be used to compromise protection.

Circuit breakers can also be adjustable, enabling users to more precisely optimise the size of the associated cables. On the downside, their added flexibility makes it more complex to set up reliable discrimination with circuit breakers than with fuses. Like fuses, thermomagnetic circuit breakers lack any intelligence and can only offer information about whether they are on, off, or tripped.

The most fundamental disadvantage of circuit breakers compared to fuses is that they cannot match the level of energy limitation of a fuse. Energy limitation, which gives reduced peak currents during short circuit clearance, also limits the damage seen downstream of the protection device.

Electronic relays and circuit breakers

Electronic relays and circuit breakers use either an external or integral, programmable electronic relay to control the response of the switch. This makes them more complex than fuses, which may be a problem during set up but does allow them to offer more tailored protection. They can, for example, be programmed to trip only after a predefined time at a given overcurrent, or they might provide different levels of protection depending on the direction of the current flow. Like their thermomagnetic cousins, however, they can never match fuses when it comes to delivering an energy limitation to effectively limit the peak current.

For devices between 400 and 630A capacity, the price of fuses and circuit breakers is similar. Above that, circuit breakers are likely to be the cheaper option. However, replacing a worn or damaged protection element will again be more expensive.

A big advantage of this type of device is its intelligence, which can give engineers access to diagnostic information. The current, voltage, power, harmonic content, date and time and settings at the time of a trip can be analysed, which may help diagnose the cause of ongoing electrical problems.

In some applications, there are certain overriding factors that make the protection choice straightforward. In a remote installation, for example, it may be critical to be able to restore power remotely without human intervention after a fault. This means that one-shot solutions such as fuses will not be acceptable. It also requires that the circuit breaker can transmit enough information to allow remote monitoring of whether or not the fault current has been cleared. At the other end of the spectrum, certain equipment calls for the current limiting effect that only fuses can provide. Inverter drives, for example, need the peak current to be limited in order to successfully protect their thyristor circuits.

There are many more applications in which either approach can be used successfully. In these cases, it really is a matter of personal preference. The key is to understand the behaviour and the limitations of the chosen protection and to design a system that takes these considerations properly into account.