Prevention improves availability

Production plants are monitored constantly to prevent machinery standstills and loss of production. One way to increase availibility is to use unearthed networks. The status of such IT systems can be monitored by the insulation monitoring relays of the CM-IWx range from ABB Stotz-Kontakt. The pulsing measuring signal makes it possible to quickly detect and signal symmetrical and unsymmetrical insulation faults in direct, alternating and mixed voltage systems.

Constant vigilance

Be it furniture production, car-making or chemicals: everywhere individual process phases relate closely to and depend on each other. And the same is true for the cooperation with other companies: today's just-in-time philosophy is a cornerstone of the relationship between suppliers and customers, with stock buffers being brought to a minimum. This is why unplanned downtimes of production machinery are a serious and costly issue.

In this respect, maintenance expectations and requirements are constantly rising. The times when routine checks in regular intervals, or only repair work after an incident, sufficed are well and truly over. It has become crucial to detect trouble potential in production before it materializes. This is the only way to prevent standstill.

Constant monitoring of plants and components in service will provide indications for necessary maintenance work in good time. Monitoring systems are valuable tools to avoid damage, unplanned standstill and loss of production to occur. Status monitoring during normal operation does not only refer to wear and tear of the individual plant segments, but also e.g. to checking levels of hydraulic fluids or electrical supply. Higher degrees of productivity, availibility and automation will therefore go hand in hand with a high degree of reliability and safety.

Making the right choice

But not only plant and installations must be monitored if the availibility of equipment is to be optimized. Reliability can also be improved through operation in continuously unearthed networks (IT systems). To do so, isolating transformers are used to galvanically isolate the mains supply from the earth potential so that the power supply is still retained in the case of a single-pole, direct earth fault. The preceding protection element, such as a fuse, miniature circuit-breaker or manual motor starter, trips only with a second fault to disconnect the entire plant, or the parts affected, from the network.

To ensure safe operation of the unearthed system despite this "single fault tolerance", earth faults, which may arise due to insulation faults, have to be prevented. For this reason the insulation resistance to earth has to be continuously monitored. Since no active conductor is directly connected to earth, only a small fault current flows which is mainly caused by the system leakage capacitance. According to DIN EN 61557-8 (DIN VDE 0413-8) appropriate insulation monitoring devices must provide acoustic and visual signals when a minimum value is undercut.

Such devices, which must detect both symmetrical and unsymmetrical insulation degradation, can be employed for:

• IT AC systems with rated voltages up to 1,000 V;
• IT AC systems with galvanically connected DC circuits and rated voltages up to 1,000 V and
• IT DC systems with rated voltages up to 1,000 V.

Task-specific order

The insulation monitoring relays of the CM-IWx range from ABB Stotz-Kontakt GmbH, Heidelberg, are precisely suited to this application in two, three and four-wire systems. The range comprises three devices with two of them based on a new measuring principle for which there is a patent pending:

• CM-IWS.2 for use in pure IT AC systems up to 400 V AC;
• CM-IWS.1 for IT AC systems up to 250 V AC and IT DC systems up to 300 V DC and
• CM-IWN.1 for IT AC networks up to 400 V AC and IT DC systems up to 600 V DC.

This range of products supplements the CM-IVN coupling unit with which the measuring range of the CM-IWN.1 monitoring relay can be expanded to 690 V AC or 1,000 V DC.

All the CM-IWx insulation monitoring relays are characterized by their ease of use and a clearly laid out status indicator. Three LEDs at the front, in red for fault signalling, green for control supply voltage and yellow for the output relay switching position, give information about the operational state. Different LED combinations and signal shapes define the presented information (table).

By pressing the test/reset button, a test function can be triggered when no fault is present. This system test routine also includes a network diagnosis and settings check. In addition, the measuring circuit connections are cyclically checked for wire breakage.

The units and tens places for the threshold value for the application-dependent insulation resistance can be set accurately and securely using two separate ten-position rotary switches. With the CM-IWN.1 device, there is also the possibility of defining two thresholds. In this way, a staged monitoring concept can be configured with prewarning and final switch-off.

The devices operate according to the closed-circuit principle, i.e. the relay de-

energizes when an insulation fault occurs. This is more practicable with regard to safety, because for example then failure of the device supply voltage is also signalled. Additionally, with the CM-IWN.1 insulation monitoring relay, the open-circuit principle can be selected on one of the four DIP switches.

Simple superimposition

Using the CM-IWS.2 insulation monitoring relay, the insulation resistance can be monitored according to IEC 61557-8 in pure IT AC systems. This can take place in both single-phase control circuits and in three-phase main circuits.

To achieve this, a DC measurement signal is superimposed on the sine-wave alternating voltage. The insulation resistance of the system to be monitored is calculated from this signal and the resulting current as measured between the conductors of the unearthed network and the operational earth of the plant. When the set threshold value is undercut, the output relay de-energizes and a fault signal is transmitted.

Sophisticated networks

For tracking down insulation faults in IT AC systems, IT AC systems with galvanically connected DC circuits and IT DC systems, the CM-IWS.1 and CM-IWN.1 insulation monitoring relays are available with their expanded functional features. Both devices operate based on the prognostic measuring principle for which ABB Stotz-Kontakt has filed a patent; it uses a pulsed measuring signal that is fed into the network to be monitored.

The measuring signal changes its shape depending on the insulation resistance and system leakage capacitance. From this modification the change in the insulation resistance is predicted. When the predicted insulation resistance corresponds to the insulation resistance calculated in the next measurement cycle and is smaller than the set threshold value, the output relay de-energizes. This measuring principle is also suitable for detecting symmetrical insulation faults, e.g. due to material ageing, and also for unsymmetrical insulation changes, for example due to a wire breakage. Furthermore, unearthed AC, DC or AC/DC systems are monitored by the CM-IWS.1 and CM-IWN.1 devices for impermissibly high system leakage capacitance. Also in

this case, the output relay de-energizes.

The prognostic principle is a very fast method which leads to a result in pure AC systems after a maximum of 10 s for 1 µF and a half threshold value and after 15 s in mixed networks.

Smart solutions

The capacity of production systems is often fully exploited, which means that their components are more likely to cause disruptions. Improved availibility of plant and automation therefore demand a high degree of reliability and safety. In addition to monitoring systems that have an eye on the components during the actual operation process, it is also really important to choose carefully the right type of power supply. Unearthed IT systems that are constantly monitored for any insulation faults that may occur provide just the extra bit of operational and plant safety.

In achieving this, the CM-IWx devices, made by ABB Stotz-Kontakt, prove to be invaluable with their prognostic measuring principle for which a patent is pending. This applies both to the accuracy and to the speed in detecting symmetrical and unsymmetrical insulation faults. In this way facilities can be intelligently monitored in systems of up to 690 V AC in the frequency range from 15 to 400 Hz and up to 1000 V DC.