Monitoring for More Safety

The insulation monitoring relays of the CM-IWx series from ABB Stotz-Kontakt operate with a pulsing measuring signal. This means that symmetrical and unsymmetrical insulation faults in direct, alternating and mixed voltage systems can be detected and signalled extremely quickly.

With potential

In the future, renewable energy sources will play a bigger role in power generation in order to improve climate protection and reduce the dependence on imports. This is because, according to information from the Federal Association for the Energy and Water Industries (BDEW), Berlin, their share of the gross national power consumption of 597 billion kWh should increase from 16% in 2009 to 30% by 2020.

Already 7% of this falls to the generation of wind power. It is estimated that 21,160 wind power systems with about 25,780 MW of installed power are in operation. Leading up to Husum WindEnergy 2010, Gerd Krieger, Deputy Director of VDMA Power Systems, emphasised future opportunities: "A key role will be assigned to the manufacturers of wind energy systems in the restructuring of power generation in Europe. According to an expert forecast from manufacturers of the various power generation technologies, wind energy will account for almost 25% of the total power generation in the EU 27 by 2030." In Germany this implies a three-fold increase – in the EU even a five-fold increase – in wind power capacity. Above all, in this respect Gerd Krieger ascribes a growing role to plant modernisation which was previously hardly relevant at all.

In 2009 photovoltaic systems contributed 1.0% to the gross power generation. For 2010 its share is estimated at 4% to 6%. In total, there are currently photovoltaic systems with a peak output of about 10 GW in the network – as reported by the Federal Association for the Solar Industry (BSW-Solar). So Germany can claim to be the leading PV market. In Germany the demand shot up markedly in 2009 with the Federal Network Agency registering 3.8 GW of newly installed photovoltaic power. And it is expected that this trend will continue despite the changed grant framework conditions. Technical progress and falling costs will also promote propagation, as the success of the Intersolar exhibition in June 2010 demonstrated. There is also evidence of development in the last ten years, in which it has been possible to reduce the costs by 50%. In contrast, wind power systems – at least in the on-shore sector – are almost fully developed, so no further substantial cost reductions are expected.

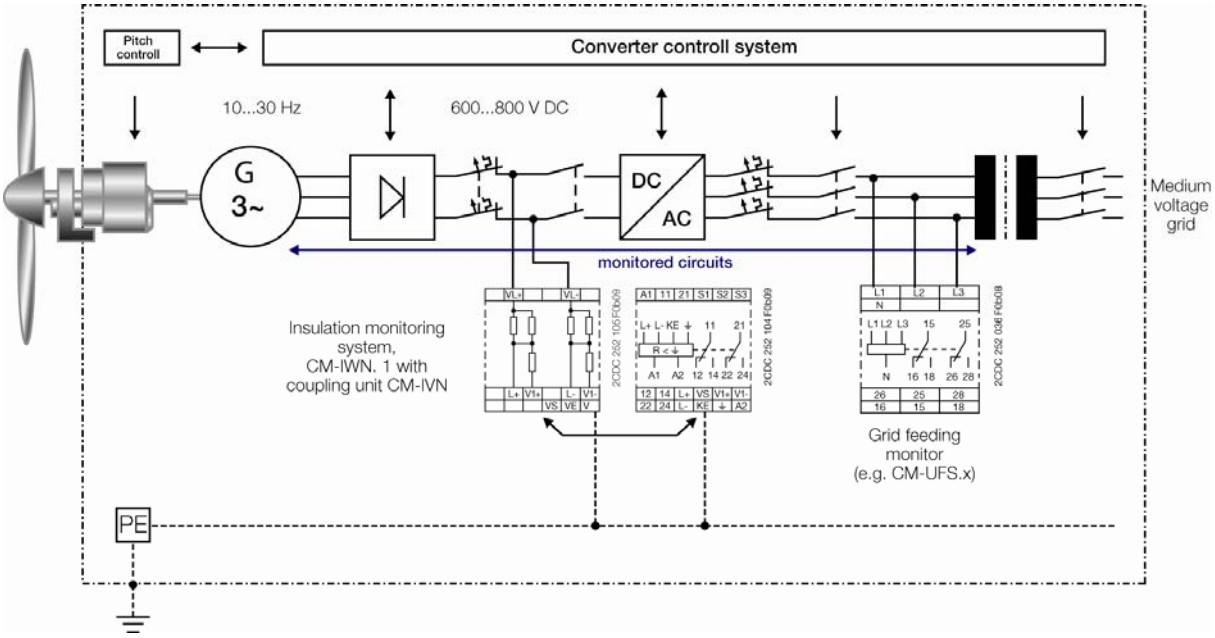
Against this backdrop the subject of security of supply and with it the availability of these types of power generation system come sharply into focus. Reliability can be improved through operation in continuously unearthed networks (IT systems), because with a single-pole, direct earth fault the power supply is still retained. The preceding protection element, such as a fuse, miniature circuit breaker or manual motor starter, trips only with a second fault to disconnect the system 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 electrically connected DC circuits and rated voltages up to 1,000 V and
• IT DC systems with rated voltages up to 1,000 V.



Completely application-specific

The insulation monitoring relays in the CM-IWx Series 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 networks up to 250 V AC and IT DC systems at 300 V DC,
• 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-IWM monitoring relay can be expanded to 690 V AC or 1,000 V DC which are usual, for example, with photovoltaic systems.

All the CM-IWx insulation monitoring relays are characterised 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 measurement 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 advance warning 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.

For alternating voltage alone

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.

Ready for mixed systems

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. Here, a pulsing measuring signal is injected into the network to be monitored.

The measurement 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. Here too, 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.

Consistently and intelligently monitored

With the CM-IWx Series of insulation monitoring relays from ABB Stotz-Kontakt, very specific checks can be made on photovoltaic systems and the availability of such highly technical applications increased. Here, diverse switching devices interact depending on the solar radiation to connect the solar modules in parallel, to increase the power when sufficient voltage is present, or in series, to increase the voltage on overcast days and to achieve the required direct voltage of below 800 V to 1,000 V on the input of the inverter. The monitoring relates not only to the DC link circuit, which is not earthed for various reasons, but rather to all the individual system segments from the generator and the inverter to the medium voltage transformer.

In wind power facilities generators supply low frequency alternating voltage, which is then rectified and finally converted into the required alternating voltage at 50 Hz or 60 Hz and, for example, fed into the 400 V or 10 kV system. Here too, continuous monitoring with the CM-IWx devices makes a significant contribution to the security of supply.

In achieving this, the properties of the prognostic measuring principle, which has been filed for patent, prove to be invaluable. This applies both to the accuracy and to the speed in detecting symmetrical and unsymmetrical insulation faults. In this way facilities in systems of up to 690 V AC in the frequency range from 15 to 400 Hz and at 1000 V DC can be intelligently monitored.