Real Time Thermal Rating – Smart Grid Solutions for Energy Transmission and Distribution Systems

Distributed Temperature Sensing (DTS) Answers for Modern Power Management

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Rising demand for electricity is creating the need for utilizing important transmission backbones at their maximum capacity. Enormous benefits can be generated by improving utilization of existing and future installations, and this is where EN.SURE can supply valuable assistance. Based on the real time temperature measurements along the entire cable circuit and the actual electrical current reading EN.SURE offers the exact dynamic cable rating of the installation, mainly based on the IEC 60287 and IEC 60853 standards.

The embedded RTTR calculation engine computes the current-carrying capacity (or ampacity) under given conditions of the underground cable installation for the steady state and transient. Cable Operators will greatly appreciate the transient simulation that will allow them to estimate the current that can be safely transferred from another circuit to the monitored installation, due to unusual operating conditions in situations such as emergencies, maintenance, outages, faults, etc. The EN.SURE RTTR engine can be used for emergency ratings from 10 minutes and up to 2000 hours. This covers the entire emergency rating spectrum since typically emergencies last a few hours or days.

Power cable monitoring combined with Real Time Temperature Rating (RTTR) provides valuable data to Operators:
- Real time conductor temperature along the power cable
- Transient Operation – Emergency ratings, transient calculations for Time/Current/Temperature

Furthermore, the EN.SURE RTTR system can provide continuous and automatic adjustment of calculation parameters (self-learning) such as ambient temperature, thermal resistivity, etc..
The EN.SURE emergency rating provides the following information useful for the cable operator under newly given operating conditions:

- Based on a higher load applied for so many hours: What will the cable temperature be at the end of the emergency case?
- Given the operating temperature and the applied (over) load, the EN.SURE RTTR solution predicts the temperature of the cable in the future.
- Based on a higher load for a given period of time: When will the installation reach its design emergency temperature?

Intelligent and Precise Load Management Even During Emergency Events

- Given the operating temperature and the applied (over) load, the RTTR gives the time that it will take for the cable to reach a specified emergency temperature.
- Based on initial conditions and a maximum operating temperature: What is the maximum current that can be carried by the system?
- Given the operating temperature and a time frame for an over load, the EN.SURE RTTR computes the maximum current that the circuit can carry to reach certain emergency temperature.

90 °C / 105 °C conductor temperature
Modelling Capabilities

Virtually every cable construction available in the market can be modelled: one-core, three-core, sheathed cables, concentric neutrals, armoured cables, screens, shields, beddings, servings, jackets and combinations of different types of sheath. Most of the installation types can be modelled: duct banks, multilayer soil, backfills, directly buried, buried ducts, buried pipes, cables in air (including groups of cables and riser poles) and cables in tunnels.

The installation may include adjacent heat sources/sinks such as steam or water pipes. Unique to LIOS EN.SURE is its ability to model several materials with different thermal resistivities, for example: stratified soil layers, multiple duct banks and multiple backfills.

Transient Calculations

The cable operating temperature very much depends on the load shape applied to the cable. In other words, the temperature of a cable depends on the intensity of the current and its time variations. Therefore, cables have different ratings, i.e. steady state, cyclic, emergency and short circuit. Since cables installations have thermal inertia, it takes time to heat up the cable and its surroundings.
Real Time Thermal Rating (RTTR) removes all uncertainty left by the DTS and is an important component of the EN.SURE system. The DTS measures the real time temperature at the sheath or jacket of a cable. The sheath temperature gives a good idea of the temperature of conductor, but unless an accurate model for the conductor is provided there will be some uncertainty left.

The uncertainty is small during steady state operation, but it could be (very) large during an emergency situation. The following figure illustrates the temperature of the jacket and conductor during an emergency situation. One can appreciate that while the temperature difference ($\Delta T$) between the jacket and the conductor can be small in steady state (1), however, moments after the onset of an emergency situation the temperature difference could be very large. The reason is that cable insulation has a large inertia and therefore the heating of the conductor can only be detected at the jacket several minutes (to hours) later. Additionally, the temperature difference changes with the loading level. The temperature difference is larger for larger loading levels.
LIOS Technology GmbH is a dynamic and international operating company based in Cologne, Germany with offices in USA and China.

LIOS is the global leader in the development and supply of state of the art frequency domain based Distributed Temperature Monitoring systems. The LIOS DTS product line comprises a range of real-time fibre optic based linear temperature measuring devices. LIOS offers power management solutions for ampacity predictions of the power cable and overhead transmission line installation transparently integrated with its field proven DTS systems. Besides its strong market position in the power industry LIOS is actively deploying its sensor technology in various market segments like permanent downhole monitoring in oil & gas exploration and fire detection in tunnels and special hazard buildings. With more than 3500 installations worldwide, LIOS sets the benchmark in reliability and track record.

Scan the QR code with your cell phone to learn more.