

Real Time Thermal Rating – Sophisticated Answers for Modern Power Management



Temperature monitoring is a key factor for the optimisation of underground power transmission installations. The conductor temperature depends on the load, but other factors such as the thermal soil resistivity, the power line arrangement, adjacent cables and other sources dissipating heat into the surrounding area have an important impact on the performance of the installation.

Up to now, it has been almost impossible to foresee the temperature distribution along the cable route, so that the maximum applicable current load was usually set as a compromise between understanding of operation conditions and risk minimisation.

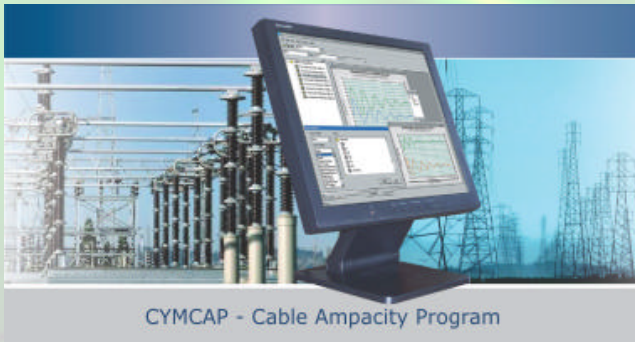
Field Proven Technology Based on IEC Standards

Typically the actual maximum temperature reading of each configured cable section and the actual electrical current reading are computed to build the dynamic cable rating of the installation, based on the IEC 60287 and IEC 60853 standards.

When the geometry of the installation is not included in the IEC standards, the RTTR evaluation uses finite element methodologies to complement the IEC calculations.

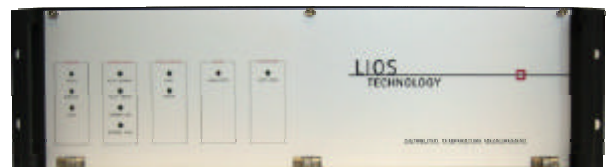
Closely Integrated Temperature Monitoring and Real Time Thermal Rating Software Package

The availability of Distributed Temperature Sensing (DTS) systems that measure in real time temperatures all along the cable is a first step in monitoring the transmission system capacity. Dynamic or "Real Time" Thermal Rating (RTTR) provides the ability to the Operator to predict the behaviour of the transmission system upon major changes made to its initial operating conditions.



LIOS Technology GmbH (Germany) offers the Real Time Thermal Rating (RTTR) feature to predict the behaviour of the installation transparently integrated with its field proven DTS based monitoring software. LIOS has selected CYME International T&D Inc. (Canada) to provide the Thermal Calculation engine that is at the core of CYMCAP (Cable Ampacity Program) – in daily use by hundreds of electrical utilities world wide.

LIOS' DTS and CYMECAP technologies are well integrated to produce an integrated system (DTS/RTTR) capable of computing the future cable ampacity based on real-time temperature measurements.



Utilisation of Reserves in Extreme Situations without Having to Exceed Permissible Conductor Temperature



Power cable monitoring combined with Real Time Temperature Rating (RTTR) provides valuable data to Operators:

- Steady State Operation – Power cable conductor temperature at the core of the conductor
- Transient Operation - Emergency ratings, transient calculations for Time, Current, Temperature

Modelling Capabilities

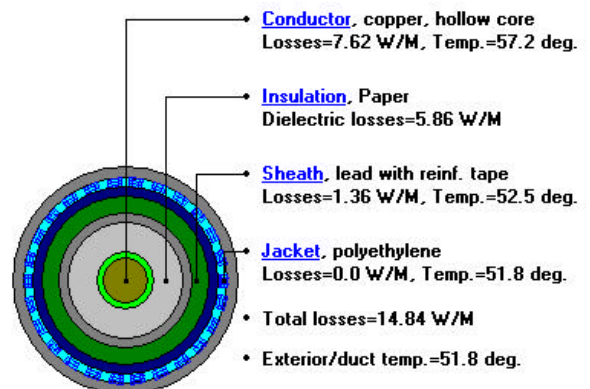
Virtually every cable construction available in the market can be modelled: one-core, three-core, sheathed cables, concentric neutrals, armoured cables, screens, shields, beddings, servings, jackets, combined sheath, etc. Most of the installation types can be modelled: duct banks, backfills, directly 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 CYMCAP is its ability to model several materials with different thermal resistivities, for example: stratified soil layers, multiple duct banks and multiple backfills.

Furthermore, the RTTR system can provide continuous and automatic adjustment of calculation parameters such as (ambient temperature, thermal resistivity, etc.).

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.

The RTTR 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 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.



Respond Quickly and Dynamically to Transmission Requests by Online Metering of the Grid Capacity



Transient	Circuit
Current / Ampere	Current / Ampere
Temperature / °C	Temperature / °C
Time / Hours	Time / Hours
Current / Ampere	20 Minutes Emergency Rating
Current / Ampere	3 Hour Emergency Rating
Current / Ampere	24 Hour Emergency Rating

LIOS Technology GmbH is the global leader in the development and supply of state of the art frequency domain based Raman DTS Systems. DTS units from LIOS have been successfully proven in critical applications like fire detection in road and rail tunnels and special hazard buildings, power cable and transmission line monitoring, in oil & gas exploration for permanent downhole monitoring and for industrial induction furnace surveillance. These systems have been equipped in worldwide projects with more than 1000 permanent installations since 1997.

CYME International T&D is a world-class Power Engineering Solutions provider standing behind thousands of T&D projects in over 100 countries around the world. CYME has developed an extensive line of Power Engineering Software that features some of the most advanced analysis tools for transmission, distribution and industrial power systems. CYME has also developed and commercializes the CYMCAP software for the Calculation of Cable Ampacity based on the IEC standards.

The 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 the cable temperature will be at the end of the emergency case?
- Given the operating temperature and the applied (over) load, the RTTR software 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?
- Given the operating temperature and the applied (over) load, the RTTR gives the time that it will take to 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 pushed in the system?
- Given the operating temperature and a time frame for an over load, the RTTR computes the maximum current that the circuit can carry to reach certain emergency temperature.

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