

«ASTRO» - Distributed Temperature Sensing System

High-voltage power cable failure is an extraordinary emergency due to its serious technological consequences; it demands urgent and costly repair. Often the cable failure originates from local overheating, which can be caused by an increase of the cable current load, or worsening of cooling along the cable, or it can result from the defects in the insulation of cables and joints.



that corresponds to the reflected optic light spectrum.

«ASTRO» Diagnostic Features

«ASTRO» ability to effectively sense the distributed temperatures allows the effective cable operation, notably:

Timely detection of the overheated zones in cables and joints is possible when using temperature monitoring systems with fiber optic integrated into the cable. Such systems of distributed temperature sensing by laser pulse dissipation in fiber optic, known as Raman, are rather widely used nowadays.

«ASTRO» system (produced by Inversion-Sensor, Ltd) is for efficient on-line distributed temperature sensing in cable.

«ASTRO» Principle of Operation

Some diagnostic laser pulses are injected into the fiber optic which is integrated into the cable beside the cable shield and under the cable sheath. The reflection of light is measured. The basic diagnostic parameters are the time of the reflection arrival relative to the pulse injected into the cable and the reflection spectrum.

If there is any change in the fiber optic parameters caused by the temperature, then the local temperature is calculated for each part of the cable.

The local temperature for each part of the cable is calculated by the difference of the time of the laser pulse injection into the fiber optic and the time of the reflection arrival. Knowing the velocity of the light propagation in the fiber optic, it is possible to quite accurately calculate the place in the cable



- Temperature monitoring of long cables (up to 16 km); thus one device can monitor one long object, or several objects, connected in consecutive order;

- Cable loading optimization, while taking into account the climate conditions and the cable laying specific features;

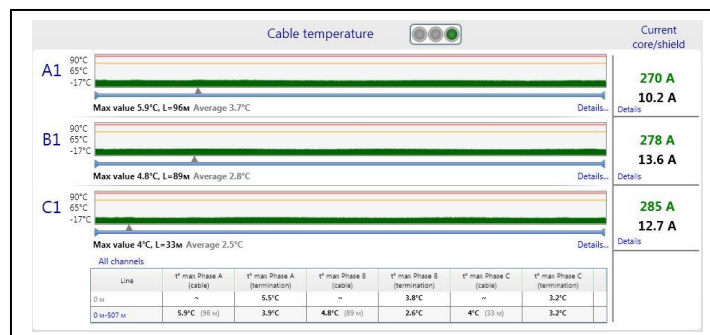
- Calculating the cable conductor temperature and transient overheating during sudden load changes by «ASTRO» software - this is especially important when the possibilities of the load increment are considered.

- Locating of such defects in cables which are accompanied by local overheating; assessing the degree of the defect development.

- Locating cable breaks after fatal failures or after accidental dynamic effects on the cable.

«ASTRO» system can be an important part

of the integrated cable monitoring system, which includes several mutually complementary subsystems. An example of such a cable line monitoring system



is «KMK» (Cable Monitoring Complex) system by «DIMRUS», which includes the following subsystems:

- Cable distributed temperature sensing system, such as «ASTRO»; this is the subsystem for operation modes monitoring and cable parameters monitoring.

- The system of partial discharge measurement and analysis in insulation, such as «CDR» (by «DIMRUS»). This is a diagnostic subsystem with the function of efficient defect detection at the early stages of their development, which is impossible to do by the temperature monitoring system.

- The system of capacitive currents and cross currents monitoring in the cable shields. Knowing the values of these currents, it is possible to forecast the possible increase in the cable load more correctly.

«ASTRO» Design

The distributed temperature sensing system consists of two elements: fiber optic, laid along the cable, which is the temperature sensor, and the measuring device in protective enclosure, which also does the primary information processing.

If the cable is meant for distributed temperature sensing, then the fiber optic is set under the cable sheath during the cable manufacturing.

If the distributed temperature sensing system is planned to be installed on the cable without the fiber optic inside, then the fiber optic should be laid outside the cable, and fixed as close as

possible to the monitored cable. This outer fiber optic installation method is less preferable, because it has less accuracy and much more exposed to the external temperature influence.

The distributed temperature sensing system cabinet includes «ASTRO» device, an industrial computer with the installed software for data processing, insulation condition assessing and evaluation of the possibility of load increasing on the cable; there are also UPS and SCADA communication means.

The climatic configuration of the monitoring system cabinet depends on the customer requirements. The cabinet can be mounted near the cable termination or up to several kilometers away from it – depending of the cable length. Outdoor enclosure is provided with an internal temperature conditioning system.

«ASTRO» Communication and Control Interfaces

«ASTRO» distributed temperature sensing system operates in automated mode in accordance with the inner expert algorithms and the individual settings for each monitored object.

The information of the current temperature mode of the cable and the results of the cable expert diagnostics are constantly displayed by the inbuilt industrial computer. The information about the cable condition is uploaded into SCADA through fiber optic using a standard IEC 61850.

«ASTRO» System Specifications

Parameter	Value
Temperature range, °C	-55 ...+400
Temperature measurement cycle, sec.	5 and more
Measurement accuracy, °C	1 and more
Spatial resolution, m	1 and more
Fiber optic length, km	up to 8, optionally up to 16
The number of measurement channels	1, 4, 8
Emission wavelength, nm	1550
Fiber optic type	MM
Operation temperature, °C	0...+40
Ambient humidity, %	up to 80
Power supply, V	220
Consumed power, W	40
Device dimensions, mm	230*320*70
Device weight, kg	3.0