Case Study: Underground Transmission Circuit

SensorTran Delivers Complete 110KV PowerCable Monitoring Solution

Overview

A South American Utility was installing a new underground 110KV transmission circuit. The Utility was familiar with the load management and circuit protection benefits of using a DTS system to permanently monitoring their cables, but they had no experience with designing or installing this sort of solution. SensorTran was engaged very early in the project and delivered a complete system which included: one DTS Model 5100, multiple integrated optical sensing fibers, 6 hours of backup power, and a full height 19 inch control room rack. Immediately upon commissioning, the DTS system was able to identify potential trouble spots for the new circuit. It is estimated that the monitoring capability has increased the useable circuit capacity and mitigated several potential multimillion dollar problems.

Problem

The load which an underground transmission cable can carry is dependent upon the temperature of the cable's dielectric. The hotter the dielectric is, the lower its dielectric strength. Simply stated, this means that the total load that a cable can safely carry is a function of the cable's temperature.

When the load is increased on a buried power cable, several factors affect the rate at which it heats up so it becomes very difficult to both identify the hottest point along the cable and to know how hot that point truly is. The temperature that a given point within a cable reaches is influenced by (among other things): the electrical load on the cable, the type of backfill which is used to bury the cable, the compaction of the backfill, the depth at which the cable is buried, the moisture in the soil, the ambient temperature, and the rate at which the ambient temperature has been changing. Not only is it difficult to measure these factors, but they are certain to vary substantially over the length of the installed circuit.

When combined, all of the unknowns and thermal ambiguities result in engineers having a difficult time determining the cable's maximum capacity at any given time. To be on the safe side, engineers typically model the cable's estimated temperature quite conservatively to generate load limits. This results in a circuit's useable capacity being substantially less than what the power cable could actually handle.

Project Summary

Customer:	South American Utility
Application:	Monitoring of New Underground Circuit
Equipment:	Model 5100 DTS + Fiber + Ancillaries
Quantity:	1 System
Deploy Date:	September 2008

Solution & Results

The Utility recognized that a SensorTran DTS would be able to provide an accurate, dynamic view of the temperature along each of the three cables that made up their new circuit. This data was then used to identify hotspots (for potential mitigation), monitor joint integrity, locate the point of highest temperature, and measure the temperature of the constraining point. This information was used to improve the circuit's performance and increased it's useable capacity by about 20%.

Early on in the project it was decided that the sensing fiber should be installed within each of the power cables during manufacturing. Since the Utility had no experience in this area, SensorTran provided the sensing fiber and worked directly with the power cable manufacturer to incorporate the monitoring fiber inside the cable.

During installation, SensorTran provided on-site expertise for joining the cables with the integrated fiber optic probes. SensorTran engineers also completed all necessary fiber splicing and routing.

The DTS Model 5000 was installed in a control room and then calibrated and configured. Appropriate alarm levels were set. SensorTran's AssetViewer™ software allowed for easy visualization of the circuit's real-time thermal profile, and a TCP-IP Modbus communications package was used to tie a critical alarms into the Utility's existing SCADA system.

The DTS is now core element of the Utility's new circuit management program.

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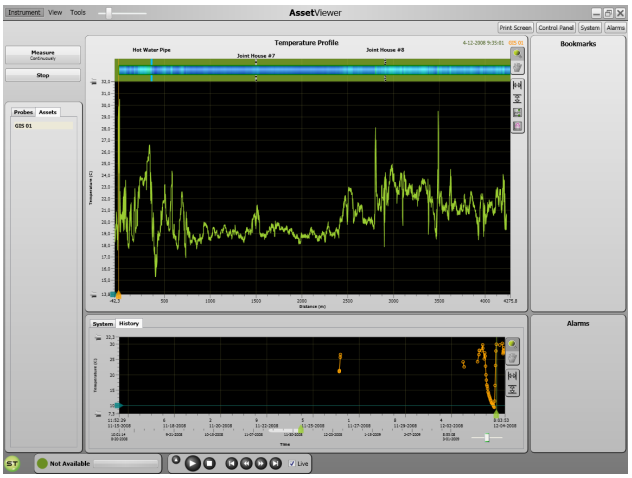
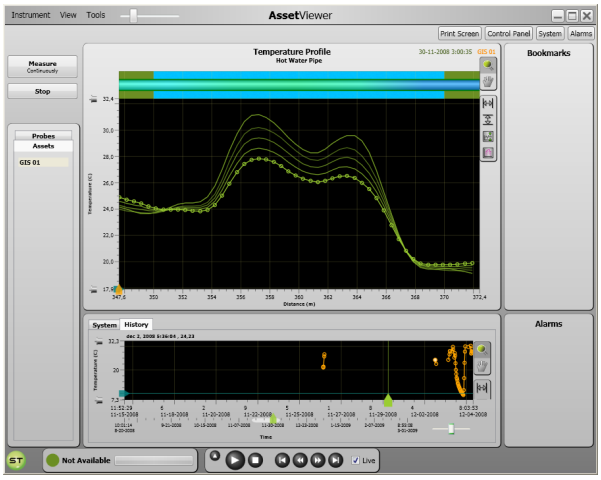


This screenshot from the DTS Model 5100 shows the temperature profile along the entire length of the circuit shortly after initial commissioning of the system.



This screenshot from the DTS Model 5100 shows the local increase in cable temperature due to its intersection with a hot water pipe.

Cable joints and fiber optic splices for each of the phases in the circuit (plus one spare) prior to backfill.

Splice boxes at each of the three phases where the circuit monitoring is terminated.

SENSORTRAN

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