Overview

A municipally-owned electric Utility located in the Southern United States had a low voltage circuit that was thought to be operating very close to maximum capacity. The Utility was concerned that the cables might overheat from overload conditions and was looking for a way to improve the utilization of the available circuit capacity, maintain a safe operating temperature, and limit the risk of cable damage which could lead to blackouts and/or reduced cable life. The Utility was using thermal modeling but was aware of DTS technology and its ability to provide actual real-time temperature data along the entire length of the circuit. Of significant concern was the fact that a fiber optic probe had never been retrofitted to monitor an existing circuit. The Utility worked with SensorTran engineers and field service personnel to design a deployment method to install the fiber optic probe with minimal risk to the circuit. A solution was engineered, the probe was deployed, and the Utility was able to increase the amperage and now has the permanent capability to dynamically optimize maximum cable loadings without risk to the circuits.

Problem

During the warm summer months, the Utility experiences both reduced useable circuit capacity (due to higher ambient temperatures) and high peak loads (due to many customers simultaneously running their air conditioning at or near maximum levels). When combined, these factors put certain substations at great risk.

To safely increase the useable capacity of critical circuits, the Utility desired to install DTS for dynamic thermal profiling of their cables. The intent was to identify the point of greatest risk in each circuit (between the switchgear and the riser), and then use the temperature at this point to better manage the load on the cable.

The problem was that the 12.5KV cable did not contain an optical fiber that could be used by the DTS for temperature measurements. This meant that an external fiber would have to be deployed along all of the cables. When originally deployed, each of the circuits was comprised of a three phase bundle which had been pulled into a bank of five inch ducts.

A technique for retrofitting an optical fiber to a circuit that was already installed in a duct bank, without the risk of damaging aging power cables, was clearly required.

Solution & Results

To address the Utility’s concerns about retrofitting the fiber optic cable to the circuits, SensorTran built a model of a five inch duct bank which was used for deployment testing. This system was used to develop a proprietary process whereby the fiber could be reliably pulled through an already populated duct without damaging previously installed cables. The new technique was successfully demonstrated on 500 meter horizontal duct sections, 10 meter vertical runs, and multiple 90° turns.

At the substation, SensorTran worked in conjunction with crews from the Utility to carry out the actual fiber optic cable retrofit. Utility personnel used SensorTran equipment to pull the fiber, and SensorTran engineers did all the required splicing. In total, fiber was retrofit to monitor more than 50 separate cable runs.

A rack cabinet including a DTS Model 5100 M10 was installed in the main building at the substation. The DTS was equipped with SensorTran’s AssetViewer™ software and configured to display the dynamic thermal profile of each of the feeder circuits from the switchgear to the risers. Each of the cables’ thermal profile was then partitioned into zones (runs, joints, intersections, etc.) so that summary data and specific alarm levels could be configured for each zone. The zone summary and alarm information was then tied into the Utility’s SCADA system via DNP3 protocol over an RS-232 connection.

The DTS now provides instant visualization of the greatest thermal constraints to increasing circuit loads. Circuit ampacity has been increased by an average of 20%. The Utility next plans to implement SensorTran’s full dynamic ampacity software solution to generate actual real-time ratings for each circuit.
This diagram shows the layout of the project. 12.5KV cables were retrofitted with optical fiber and monitored between the switchgear and the riser.

The screenshot above shows SensorTran’s Assetviewer™ software customized for the pilot project implementation.