TIP 23g: EPRI P35 Supplemental: Compression Fittings – High Temperature Effects on Conventional Conductor Systems

Context

Over the past 20 years, utilities have been operating older lines at 100°C that were originally designed for a maximum temperature of 49ºC. Recently there has been a move to raise operating temperatures even further to well above 100°C in order to achieve higher power transfer capacity. Utilities are greatly concerned as to how fittings on the existing lines will behave at the higher temperatures.

Between 2005 and 2009, EPRI conducted tests to evaluate the performance of compression fittings at elevated temperatures. Test results confirmed that certain fittings experienced temperature runaway above 100°C with subsequent reduction in their mechanical strength.

This project, previously called "Mitigation Measures for Compression Fittings for High-Temperature Operations" investigated different methods that can be applied to "high risk" compression fittings operating at high temperatures. While the investigated mitigation measures showed promise, the complete mitigated system must be well understood before these measures can be applied successfully. Further research to address these knowledge gaps will support practical application of these mitigation measures with confidence.

Description

This project builds on previously completed EPRI work evaluating shunt devices. BPA spearheaded this work and has since put it in to action by upgrading some lines to a maximum of 175 deg C.

In this phase, the project will correlate surface temperature with the core temperature which controls conductor sag and clearances. IEEE 738 determines conductor surface temperature based on electrical loading and ambient weather conditions.

EPRI has already established a temperature window in which we know steel core wire galvanizing begins to break down. This work will narrow the window in order to increase confidence in operating aluminum-conductor steel-reinforced (ACSR) cable at high temperatures.

The project will study if, when operating at high temperatures, the aluminum of an ACSR conductor goes into compression, adding tension to the steel core.

Because a clean conductor is essential to establish an electrical connection between a shunt and conductor, this work will develop a device to chemically clean an un-cut conductor in a manner similar to EPRI's conductor cleaner used for splices and DE fittings.

The current equations used for predicting how quickly the aluminum will anneal were developed more than 50 years ago. Over that time the manufacturing process for aluminum strands has changed, and recent preliminary tests suggest that the equations may no longer hold true. This work will help develop updated equations that hold true to today's conductors.

Why It Matters

Knowing precisely how high we can rate conventional conductors to operate in a safe, reliable manner is of great value to BPA. By applying proper mitigation measures and understanding the complete mitigated system, utilities will be able to achieve an increase in transmission capacity without risking overhead line failures.

Results from this project will allow the setting of knowledgeable limits for many different conductor types providing expanded options for upgrading lines.

Goals and Objectives

Deliverables will include:

- Galvanized Core Coating Study
- Annealing Equations Review
- Radial Thermal Gradient Study
- Resistance Evaluation at Elevated Temperatures
- Develop Dead End shunt with sufficient mechanical strength
- Elevated Temperature Creep
- Knee-Point Field Study (Predicted Sag-Tension vs. Aluminum Compression)

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Project Start Date: October 1, 2012

Project End Date: September 30, 2016

Funding

BPA FY2014 Membership: $25,000

Reports & References (Optional)

Links (Optional)

Participating Organizations

EPRI

For More Information Contact:

BPA Project Manager:
Tyler Ashburn, txashburn@bpa.gov