

Transmission Efficiency Initiative: Host Demonstration Project

Application of Advanced Conductor ACSS/TW for 345 kV Transmission Line



Aluminum-conductor, steel-supported trapezoidal wire

Project Scope

As part of EPRI's Transmission Efficiency Initiative, Ameren UE is evaluating a possible demonstration of the application of aluminum-conductor, steel-supported trapezoidal wire (ACSS/TW) conductor as a replacement for the existing aluminum-conductor, steel-reinforced (ACSR) 795 kcmil conductor along the 63-mile-long, 345-kV Lutesville-St. Francois A line.

In addition to documenting the lessons learned during the installation and operation of the advanced conductor the project will quantify the impact of the advanced conductor on lifecycle carbon footprint, increased utilization of transmission system and impact on system losses.

Based on preliminary analysis it is expected that the demonstration of this technology will reduce demand by 8 MW, reduce losses by 20,000 MWh per year, and reduce overall carbon footprint by about 21,600 tons per year, if the new conductor is operated under the same parameters as a conventional ACSR conductor. The transmission capacity of the line can be increased by 60%, as the ACSS conductor is operated at 392°F (200°C).

- Evaluate application of advanced carbon-core trapezoidal wire on Lutesville-St. Francois A 345-kV line.
- Monitor before and after energy losses and utilization and document the results.
- Benefits include reduced losses, increased system utilization, and reduced carbon footprint

Through a consistent measurement and verification (M&V) process, this expected benefit will be quantified and validated during the course of the project.

Technology Description

An ACSS conductor consists of fully annealed strands of aluminum, stranded around a stranded, high-strength steel core. ACSS/TW is a variation of the standard ACSS conductor with trapezoidal wires. The ACSS/TW equal-diameter design allows more ampacity in an equal-diameter conductor when compared with a standard ACSS conductor. It is designed to operate continuously at elevated temperatures up to 482°F (250°C) without loss of strength; it sags less under emergency electrical loadings than aluminum-conductor, steel-reinforced trapezoidal wire (ACSR/TW); and it has a high capacity for damping Aeolian vibration. The use of compact trapezoidal strands results in a resistance reduction of about 20% for the same diameter as the original conductor. Thus, if ACSS/TW conductor is used to replace an existing ACSR conductor of the same diameter, it can provide considerable reduction in line losses if the new conductor is operated under the same conditions as the existing ACSR that it is replacing. If, on the other hand, the current on the ACSS/TW conductor is increased, taking

advantage of their higher temperature capability, electrical losses will be greatly increased. Reconducting with ACSS/TW conductors is desirable in particular situations in which extra capacity is required eventually for short periods of times due to N-1 overloads conditions. In this case, the 957.2 kcmil, ACSS/TW Kettle conductor is of the same diameter as the existing conductor and 20% heavier. It is expected, then, that no significant structure reinforcement will be needed to install it. However, it might be necessary to raise some structures to obtain acceptable ground clearance so that the ACSS could operate at 392°F (200°C) at approximately the same wire tension as the existing ACSR. The 345-kV Lutesville-St. Francois A transmission line is a medium-length line with a loading factor of about 0.56, and as such, is a good candidate for reconducting for loss reduction. Ameren UE will deploy the ACSS/TW conductor on the line and evaluate technical and economic performance and impact on system losses.

Expected Benefits

One or more of the following benefits might be realized through the application of this technology:

- Reduce transmission system losses by reducing the resistance of the Lutesville-St. Francois A transmission line.
- Reduce overall transmission system losses by reducing congestion and by allowing more power to flow on a higher voltage overlay by relaxing the constraint on this line.
- Increase utilization of renewable energy by increasing the line capacity.
- Reduce overall carbon footprint by using the same infrastructure and right of way but higher line capacity.

Approach for Measurement and Verification

A key objective of EPRI's Transmission Efficiency Initiative is to verify and validate the "actual" benefits realized by the application of the technology using a consistent M&V methodology that will be developed as part of EPRI's transmission efficiency research portfolio.

The detailed methodology of M&V will be developed during the course of the project using the following general approach:

- Demand, energy, and CO₂ savings will be determined based on transmission load flow cases for the studied system before and after the installation of the advanced conductors.
- Line load and losses will be measured and compared over a one-year period and compared to the calculations. This will lead to an industry-accepted methodology for projecting savings from advanced conductor projects.
- A life cycle carbon footprint methodology will be developed for the advanced conductor application.

Project Schedule

The schedule of the project tasks is as follows:

1. Study system load flows for a period of three months, including transmission demand, energy, and transmission-related CO₂ losses.
2. Conduct feasibility analysis to determine whether it is possible to replace the existing conductor by a TW conductor. This might include field inspections and testing.
3. Conduct detailed engineering design.
4. Replace ACSR conductor with ACSR/TW Cumberland conductor by September 2010.
5. Monitor power flows and transmission-related losses for 12 months, completing in September 2011, and document the results using the EPRI demonstration protocol.
6. Calculate the change in utilization.
7. Final project report, December 2011.

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