

Transmission Efficiency Initiative: Host Demonstration Project

Application of ACSR Trapezoidal Wire Conductor for a 500-kV Transmission Line



Aluminum-conductor, steel-reinforced trapezoidal wire

Project Scope

As part of EPRI's Transmission Efficiency Initiative, the Bonneville Power Administration (BPA) is evaluating a possible demonstration of the advantages of using trapezoidal wire (TW) conductors on new transmission lines over conventional aluminum-conductor, steel-reinforced (ACSR) round wire conductors.

A new 80-mile-long, 500-kV transmission line is currently under construction in the BPA's system (McNary-John Day line). BPA's engineers have selected three-bundle, ACSR/TW Deschutes conductor for this line. The chosen conductor has, among other advantages, less resistance and more current capacity than the ACSR round wire conductor counterpart, which allows improved efficiency and utilization of the right of way.

The objective of this project is to assess, through a consistent measurement and verification (M&V) process, the actual savings and benefits achieved by selecting the TW conductor. In addition, the lessons learned during the design process, installation, and operation of the TW will be documented.

- Evaluate selected TW conductor for a new 500-kV line.
- Monitor energy losses and utilization and document the results.
- Determine savings by comparing with round-wire ACSR conductor of the same diameter.
- Benefits include reduced losses, increased capacity, right-of-way optimization, and reduced carbon footprint.

Technology Description

A TW cable is a concentric, lay-stranded conductor consisting of a stranded steel central core with one or more layers of trapezoid-shaped aluminum wires. Although this conductor is limited to operation at moderate temperatures, the use of compact trapezoidal strands results in an important resistance reduction for the same diameter round wire conductor and moderately increased ampacity.

Structure design and tower weights are largely dependent on the conductor diameter. Hence, the use of TW conductor of the same diameter permits reduced losses and increased capacity without significant changes in towers structure and footing. The ACSR/TW Deschutes conductor used for the McNary/John Day line has an outside diameter of 1.300 inches. The round wire equivalent ACSR conductor is the Bunting, with an outside diameter of 1.302 inches. The trapezoidal aluminum strands in the Deschutes conductor result in about 27% more aluminum in the conductor cross section than the round rods used in the Bunting conductor, which provides substantial reduction in losses for the same transferred power. In addition, the added aluminum results in a higher summer rating per conductor, 1520 A for Deschutes

and 1360 A for Bunting. For a triple bundle, the Deschutes delivers an additional 480 A of capacity for the same physical bundle size. At 500 kV, this adds an extra 416 MW of capacity.

The added aluminum in the Deschutes conductor also contributes to a higher rated strength than Bunting conductor. The Deschutes conductor's rated strength is 36,000 lb, whereas the rated strength of Bunting is 32,000 lb. The higher conductor rated strength allows higher initial tensions and longer spans with reduced conductor sags. For new lines, this implies saving in tower steel.

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 80-mile, 500-kV transmission line.
- Increase transmission line capacity and consequently better utilization of the right of way.
- Reduce overall carbon footprint by reducing the energy lost in the transmission wires.

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 load flow studies for the studied system for both conductor options: ACSR and ACSR/TW.
- 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. Data collection. BPA will provide EPRI with all the information required for the study, including the following:
 - Detailed data of the 500-kV line to be studied
 - Power flow model and selected scenarios
 - Current and/or MVA power flow over the line for a one-year period, preferably in hourly resolution.
 - Line availability over the study period.
 - Generation dispatch over the study period, in hourly resolution
 - Import and export power flows for the study period, preferably in hourly resolution
2. Evaluation of losses based on the monitored power flows and evaluation of savings by calculating losses with Bunting conductor.
3. Evaluation of CO₂ savings
4. Evaluation of line utilization
5. Documentation of results using EPRI demonstration protocol
6. Final project report, December 2011.

Electric Power Research Institute

3420 Hillview Avenue, Palo Alto, California 94304-1338 • PO Box 10412, Palo Alto, California 94303-0813 USA
800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com