

# Transmission Efficiency Initiative: Host Demonstration Project

## Application of Shield Wire Segmentation for 345 kV Transmission Line



Ground wire configuration

### Project Scope

As part of EPRI's Transmission Efficiency Initiative, Ameren UE is evaluating a possible demonstration of the application of shield wire segmentation technology on the 345-kV Aldwin-West Mt. Vernon A line.

In addition to documenting the lessons learned during the implementation and operation of this technology, the project will quantify the impact of the shield wire loss reduction on lifecycle carbon footprint and system losses.

Based on preliminary analysis, it is expected that the demonstration of this technology will reduce demand by 0.5 MW, reduce losses by 950 MWh per year, and reduce overall carbon footprint by about 800 tons per year. 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

Power loss occurs in shield wires of ac transmission lines through mutual coupling from the phase conductors of the

- Evaluate options to reduce losses in ground wires of extrahigh voltage transmission lines
- Monitor before and after energy losses and document the results.
- Benefits include reduced energy losses and reduced carbon footprint.

transmission line. Shield wires are generally steel cables with relatively high resistance compared to the conventional phase conductors such as aluminum-conductor, steel-reinforced (ACSR) conductors. In addition, any induced currents in the shield wires can circulate through the towers to ground, with losses accumulating in the tower footing resistance and ground. The losses can be reduced by breaking the conductive path in the shield wires or by reducing the mutual coupling with the phase conductors. Breaking the conductive path in the shield wires is known as *shield wire segmentation*. The shield wires are also insulated from the tower to avoid loop paths. When the shield wire is segmented, there is no circulating path for fundamental frequency current induced from the mutual coupling with phase conductors; therefore, there is little loss in the shield wire. Because the mutual coupling of the line currents in the phase conductors is the significant factor, losses in an unsegmented shield wire increase with line loading. This technology has been applied extensively in certain countries, but it is not widespread in the United States.

## Expected Benefits

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

- Reduction of power lost in the shield wire of the 345-kV Aldwin-West Mt. Vernon A line
- Reduction in the step and touch voltages by reducing the ground wire current, which will reduce the induced tower voltage
- Potential application for ice melting, which reduces line and structural loading. In certain countries, large blocks of ice form around the ground wire during extreme weather conditions. In some cases, utilities apply a continuous current of 500–1000 A to the ground wire to melt the ice. Of course, this is possible only if the ground wire is insulated and sectionalized.

## 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 CO<sub>2</sub> savings will be determined based on analytical studies. The method of study for determining shield wire losses is to represent the line segment in detail, using an electromagnetic transients model. The transmission line must be represented accurately with a frequency-dependent line model. A careful electromagnetic transient study will determine the magnitude of the loss reduction expected.
- A method to measure shield current will be developed. The reduction in shield wire current will then be determined for different line loading conditions. This will lead to an industry-accepted methodology for projecting savings from shield wire segmentation.

## Project Schedule

The schedule of the project tasks is as follows:

1. Analytical study to evaluate shield wire losses at the existing conditions and the saving that can be achieved by segmenting the shield wires
2. Economic analysis to evaluate the cost and cost-benefit ratio of the project, to determine whether it is cost effective
3. Detailed engineering design
4. Measurement of shield wire current in the existing conditions (measurement to be recorded for M&V analysis)
5. Segmentation of the 345-kV Aldwin-West Mt. Vernon A shield wires.
6. Measurement of shield wire current with the shield wire segmented and comparison with former measurements to determine savings.
7. 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](mailto:askepri@epri.com) • [www.epri.com](http://www.epri.com)