



## TIP 23f: EPRI P35 Supplemental: Aeolian Vibration of Bundle Conductors

### Context

Aeolian vibration is a natural force vibration caused by wind flowing over a conductor. When a “smooth” stream of air passes across a cylindrical shape, such as a conductor or overhead shield wire (OHSW), vortices (eddies) are formed on the leeward side (back side). These vortices alternate from the top and bottom surfaces, creating alternating pressures that tend to produce movement at right angles to the direction of the air flow. The resulting vibration can, eventually, cause the wire to fatigue. Lines damaged by vibration may have to be de-rated or even taken out of service until repairs can be made. This could impact an entire network.

Design of Extra High Voltage (EHV) transmission lines often involves handling a bundle conductor with multiple spacer dampers along its span. Currently, the methods of assessing the performance of such a system with respect to Aeolian vibration are not advanced.

### Description

This project aims to develop a more rational, yet practical tool for assessing the control/damping performance of spacer dampers when installed along a span. Due to the success of developing the EPRI Vibration 3.0 software tool for design and analysis of Aeolian vibration for single conductors, this research will expand the concept for single bundle conductors to include bundle conductor vibration.

The approach is to reduce a bundle conductor and a spacer damper to an equivalent of a single conductor and an equivalent of mechanical impedance, respectively. This simplifies the problem to a tensioned beam with a number of mechanical impedances along a span.

The end product will be a computer module integrated into the existing EPRI Vibration software.

The project deliverables will allow BPA design engineers to refine the placement of spacer dampers using a mathematical approach instead of relying only on an empirical approach. Using this new approach

BPA design engineers can then compare the mathematically calculated results of spacer damper placement to the empirical calculations BPA currently employs to determine the amount of risk BPA has assumed through the use of empirical spacer damper placement.

### Benefits

There is a need for a practical tool for consistent and reliable design and analysis of Aeolian vibration performance from spacer dampers. The calculated mathematical placement of spacer dampers will aid in enhancing line reliability thus saving maintenance costs.

### Accomplishments

The main goal of this project was to develop a computationally efficient mathematical model to analyze vibration problems for bundle conductors.

### Deliverables

- Verified theory that bundled conductors can be modeled as single beams (single cables) for the purpose of Aeolian vibration analysis and mitigation.
- EPRI developed a mathematical model of analysis but nothing has been shared with the funding members about the model or how to use it

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**Project Start Date:** January 2014

**Project End Date:** December 2018

### Funding

Included in membership

### Reports & References

EPRI staff and a vibration expert traveled to the laboratory to verify the setup prior to data collection.

### For More Information Contact:

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### Participating Organizations

Electric Power Research Institute

### Conclusions:

The original goals of this supplemental project was to produce:

- EPRI computer model to assist in the design of bundle conductors with respect to Aeolian vibration
- A theory manual to provide detailed theoretical background of the new module
- A user's manual detailing how to use the new module with typical worked examples

Due to lab and funding deficiencies, the scope had to be dialed back to verify if bundled conductors can be modeled as a single beam and what the mathematical equations might look like. This reduced goal was accomplished.

