CEATI

Design guide for conductor vibration and galloping in transmission lines

Overview

Damage to overhead lines comes in many forms, ranging from loosening of hardware, rubbing through the conductors, fatigue at the suspension clamps, broken spacers, spacer-dampers, etc.

Vibration and galloping in transmission line can lead to failed conductors, fallen hardware, damaged insulators, broken tower arm members, or even complete tower failures. Many of these effects are due to the long-term conductor vibration caused by wind.

This report presents the current understanding of conductor vibration based on an extensive literature survey, a questionnaire to utility asset managers, and on international guides.

Overhead Transmission Design Interest Group

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How to use this research

The report is a user-friendly guide on conductor vibration modes to assist transmission utilities' personnel in planning inspections of the lines. The intended audiences for the report are managers of utility overhead conductor assets and their staff, staff from design and operating departments of utilities, and organizations supporting utilities in managing overhead line assets. In addition, the report can help utility professionals to:

- Help control and assess conductor vibration modes
- Gather information on the specific repairs required for systems damaged by wind vibration
- Facilitate collaboration of experienced professionals and devise solutions for combatting vibration issues
- Help plan new designs

Key questions Addressed

- What causes various wind-induced vibrations and galloping impacts on transmission line conductors?
- How to predict the damage caused by conductor vibration?
- What are the best design practices to control vibration and galloping?
- What steps should be taken during transmission line inspections to identify situations where damage could occur?

Research Summary

The report includes a literature review and a utility survey to gather information regarding utility design and inspection practices on how to control and assess vibration modes and conduct repairs where needed. The detailed literature review documents the conditions leading to the various vibration modes and the resulting amplitudes and frequencies of motion. A questionnaire was sent out to 24 professionals who worked in utility services, showcasing their depth of knowledge in this specific area.

The study discusses aeolian vibration and found that it is more complex than single conductor vibration due to the wakes created by the leeward sub conductors and the ensuing increase of wind energy imparted to the downwind sub conductors. These results in wake-induced oscillation, which at medium to high wind speeds, causes damage to spacers and spacer-damper clamps, especially when the clamp slip strength is low. Recommendations for solving this problem are detailed in the report.

Additionally, the effects of conductors that face fatigue (caused by rubbing and wear between strands of the conductor) are discussed heavily as well, and the report includes examples of failed strands. Another key finding concerns the galloping of conductors (due to the environmental impacts of wind and ice). While rare, galloping causes significant damage, which is costly to repair.

Solutions were devised, such as ice melting for low voltage lines, implementing alternative twisted pasted conductors, etc. However, these techniques must be instituted under specific conditions for each utility.

Torsional damper with worn rubber bushings

Broken hinged twin bundle spacer

Broken triple bundle spacer damper

About CEATI Research

CEATI facilitates the planning and implementation of collaborative R&D projects among its electric utility members. This approach enables members to solve shared challenges and maximize their return on investment.

Get the Full CEATI Report

CEATI Overhead Transmission Design group members can access the report here.

If you're interested in joining the Overhead Transmission Design group to access the full report as well as additional research, expert guidance, networking events, and more contact us today at https://ceati.com/membership