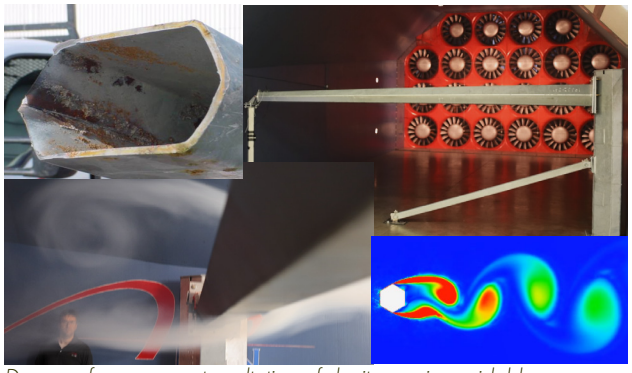
Mitigating Vibration on Steel Pole Davit Arms – Phase II



Damage from resonant exaltation of davit arms is avoidable

- Understand when vortex-induced vibration may become a risk in davit arms
- Effectively mitigate against resonant vibration
- Specify vibration resistant fabrication practices
- Use a validated predictive tool to assess vortex induced vibration
- Understand fatigue limits relevant to utility supports

Background, Objectives, and New Learnings

EPRI recently completed a software tool (DAV Tool v1.0) to assess the risk from vortex induced vibration on davit arms, and to re-optimize them if necessary, considering both structural design and resonant vibration.

Exploratory wind tunnel research on a 6-sided section has revealed that the theoretical CFD models to develop this software are largely valid with respect to vortex shedding frequency, but that validation of other shapes would be useful to ensure accuracy of the software. In addition, further validation of natural frequencies is necessary to incorporate the flexibility of the main pole body to which the davit arm is connected.

A new research question emerged on the subject of vortex cessation, and whether useful cessation exists to enable engineers to effectively design vortex resistant davit arms.

Additionally, questions around the safe design stress limits of circumferentially welded connections have arisen. Although safe design stress limits are available from AWS standards, their applicability to thin-walled high strength steel featuring cold formed bends is of interest.

In this new phase of research, EPRI aims to validate all theoretical models developed for DAV Tool v1.0 by performing a combination of wind tunnel testing and in-field verification.

In addition, a series of cyclic tests to failure will aim to verify the safe design stress limits for cyclic loading typically found on high strength steel tubes when vortex shedding is present.

Benefits

Multiple public benefits may be realized from the successful validation of vortex shedding avoidance, which includes improved construction safety and improved resilience.

Funder benefits include more efficient use of capital expenditure, and the ability to fully validate, and where necessary, improve submitted designs from pole vendors.

Project Approach and Summary

- Conduct wind tunnel experimentation on typical davit arm cross-sections to determine empirical results for:
  - Natural frequency of davit arms
  - Vortex shedding frequency
  - Initiation and cessation wind velocities associated with vortex shedding
- Update DAV Tool Software to reflect empirical results
- Repeat experimentation on re-designed, vibration resistant davit arms to validate efficacy of producing vibration resistant arms
- Validate behavior of wind tunnel testing of davit arms through in-field monitoring
- Adjust DAV Tool software based on in-field results

Deliverables

- Validated Strouhal Relationships for all cross-sections, including 4-, 6-, 8-, 12-sided, and round sectional shapes
- Updated, validated DAV Tool Software
- Results from in-field monitoring, and incorporation into software
- Fatigue limit curves specific to power utility industry

Price of Project

$55,000 – one-time cost

The project qualifies for self-directed funding and tailored collaboration. To perform the outlined scope of the project, collaboration of at least six (6) EPRI members is required.

Project Status and Schedule

The execution of Phase II is 24 months; however, this may be extended depending on the scope in-field experimentation.

Who Should Join

Transmission utilities that currently use, or may be planning to use, steel poles.

Contact Information

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com).

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