



Structure, Tower &  
Antenna Council  
Conseil des structures,  
pylônes et antennes

# STAC Bulletin

**Tripole Vibration Issues –  
Inspection and Mitigation Recommendations**  
Ref. # SB-0001 February 16, 2018

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**Date:** February 16, 2018

**Bulletin Reference #:** SB-0001

## **Tripole Vibration Issues – Inspection and Mitigation Recommendations**

### **ISSUE:**

A shrouded tripole in Ontario on December 5th had a serious issue where the tripole had significant cracks at one of the tube legs at the base of the structure. Upon investigation, it was determined that these cracks had been caused by Galloping vibrations, which occur when the top of the structure exhibits a somewhat oblong or ovular motion in a direction that is at 90 degrees to that of the wind.

It was also determined that current CSA S37 requirements relating to fatigue design do not adequately account for Galloping vibrations on shrouded tripoles, or for Vortex Shedding on shrouded monopoles.

For more information about this issue, please see [STAC Alert SA-0003 \(December 14, 2017\)](#).



Cracked weld caused by galloping vibrations on a shrouded pole.

### **PURPOSE:**

The purpose of this bulletin is to provide site owners and contractors with recommended best practices for identifying and inspecting shrouded tripole towers that may be potentially affected by Galloping vibrations and for mitigating the potential damages caused by repetitive Galloping vibrations, up to and including structural fatigue causing failure.

This bulletin also provides recommendations relating to inspection frequency of shrouded monopoles, as well as mitigation strategies for new towers. These recommendations are expected to serve as stop-gap measures until the release of the CSA S37-18 standard, which may provide further guidance on the design requirements.

Please note that a follow-up bulletin will also be provided shortly to address similar issues relating to flag poles and shrouded monopoles.

**WARNING: NOT HEEDING THIS BULLETIN MAY RESULT IN SHROUDED TRIPOLES SUFFERING FROM EARLY FATIGUE, AND COULD POSE A PUBLIC HAZARD IF LEFT UNATTENDED.**



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### RECOMMENDED STEPS FOR TOWER OWNERS:

It is recommended that all site owners with shrouded tripoles perform the following actions immediately to assess their tower inventory for potentially hazardous situations caused by Galloping vibrations. Detailed description of each step follows in the sections below.

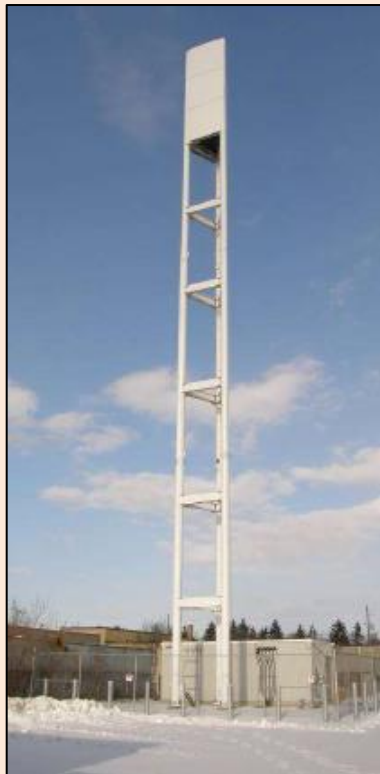
1. Identify affected towers
2. Inspect potentially affected towers
3. Perform a dynamic analysis
4. Mitigation (as necessary)

### DETAILED RECOMMENDATIONS FOR TOWER OWNERS:

#### 1. Identification

STAC recommends that site owners immediately assess their entire inventory of shrouded tripole towers to determine which, if any, have a shrouded portion that is equal or greater in height than 3X the width of the tripole's face. For example, a tower would be considered within this grouping if the tower face is 2.5 meters wide and there is a shroud that is 7.5 meters or longer in height.

This is the minimum ratio known to produce this issue at this time. Site owners who have tripole towers with these characteristics in their inventory should proceed to Recommendation 2 (Inspection) for each tripole matching this description.



The above images show two tripoles with shrouds of differing lengths. The shroud in the image on the right is clearly more than 3X as long as the tower's width, and would cause the tower to be susceptible to galloping vibrations.



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### 2. Inspection

STAC recommends that site owners who identify potentially affected tripoles in their inventory move forward with condition assessment inspections of each potentially affected tower. All such inspections should only be completed by, or with the assistance of, one or more qualified engineer(s), and should put emphasis on the following elements:

1. Inspect tower for signs of fatigue, including:

- Weld cracks
- Concrete foundation cracks
- Anchor bolt cracks
- Sheared bolts or excessive number of loose bolts
- If any cracks are discovered, discontinue all other work on or near the tower and take immediate action to repair the cracks under the direct supervision of a qualified engineer. Once all cracks are repaired, proceed to Recommendation 3 (Dynamic Analysis) and Recommendation 4 (Mitigation)
- If no cracks are discovered, complete inspection and proceed to Recommendation 3 (Dynamic Analysis) and Recommendation 4 (Mitigation)
- Note: even if there are no visible signs of cracking on or around the tower, it is possible that cracks and other effects of Galloping vibrations can manifest in the near future.

2. Measure “actual dampening” and “natural frequency”

- Site measurement of the structural damping is important as it provides valuable information for the dynamic analysis. This is achieved by instrumenting and recording accelerations of the structure.

### 3. Dynamic analysis

After completing inspections on all shrouded tripoles matching the profile outlined above, STAC recommends that site owners perform a dynamic analysis on each such tower to determine each tower's dynamic susceptibility to Galloping vibrations. These analyses must be completed by an engineer who is knowledgeable in the field of structural dynamics.

### 4. Mitigation

Depending on the outcome of the results of Recommendation 3 (Dynamic Analysis), the responsible engineer may recommend mitigation solutions, including removing the shroud or installing a vibration dampening device (such as a tuned liquid dampener or a tuned mass dampener). While other solutions may be developed going forward, these are the only solutions that have been proven to be effective at this time as wind tunnel testing is required to demonstrate the efficiency of other hypothesized mitigation methods.

Notably, while fatigue cracks can develop over a long period of time, cracks caused by Galloping vibrations can also develop over a very short period of time compared to other common fatigue issues, including in as little as six months. As such, STAC strongly recommends that site owners place a high priority on mitigating any shrouded tripoles that are identified as being susceptible to galloping vibrations.



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### ADDITIONAL APPLICATION – NEW TOWERS:

With regards to new shrouded tripole towers currently under consideration or development, STAC recommends that all such towers be subjected to a dynamic analysis to determine their susceptibility to galloping vibrations, so as to ensure the towers' safety.

Two design considerations that site owners may want to consider incorporating under these circumstances include:

- The addition of a damper for new tripoles that are still in the design stage, and for which a dynamic analysis suggests the tower will be susceptible to galloping vibrations as currently designed;
- The addition of a connection at the top of new tripoles already under construction to facilitate the addition of a dampener at a later date should a dynamic analysis suggest the tower could be susceptible to Galloping vibrations in the future.

### ADDITIONAL APPLICATION – INSPECTION CYCLE:

Finally, STAC also recommends that future inspections of shrouded tripoles should occur every four years going forward, even if the above recommendations have been followed and mitigation strategies employed. This recommendations represents an increased inspection frequency compared to the current six-year inspection cycle for these towers that is recommended by CSA S37-13 Annex D.

### CONTACT:

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