Aeolian vibration monitoring

Innovation allowance findings report

December 2025

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Aeolian vibration monitoring: Innovation allowance findings report

1. Introduction

1.1 Purpose of this report

This is Powerco Limited's ("**Powerco**", "**we**") close out report for the Innovation Project Allowance, for the aeolian vibration monitoring and detection project. This report is submitted to the Commerce Commission (**the Commission**) to meet the requirements of the DPP3 Determination Schedule 5.3 clause 5[1]. Clause 5(a) requires that following completion of the innovation project, the EDB must 'submit a report to the Commission that outlines the key findings of that project'. Section 3 of this report outlines the key findings of the project. The report is also published on the Powerco website as required by clause 5(b).[2]

1.2 Powerco's innovation allowance application, approval and completion

Under the DPP3 Determination, Electricity Distribution Businesses (EDBs) may make an application to the Commission for approval of drawdown of the allowance under Schedule 5.3 of the Determination. An 'innovation project' is one which is focused on the creation, development, or application of a new or improved technology, process, or approach in respect of the provision of electricity lines services[3].

The Powerco application for the innovation allowance was submitted in two stages aligned to the two stages of the project:

- Application for stage 1: Procure and install devices in FY24
- Application for stage 2: Six month trial, lab testing and analysis in FY25/26.

The Commission's approval was given for stage 1 and stage 2. The 'completion' of stage 1 and 2 (for the purpose of Schedule 5.3 clause 5) was following receipt of the report and analysis of results. The report showed there would be value in follow up conductor lab testing at 5 locations, which has been delayed due to potential SAIDI implications from taking conductor samples. While we wait for the best opportunity to take conductor samples without unnecessary outages, we have completed this report of results to date.

1.3 Sharing project learnings

This report contributes to Powerco sharing information about this project and our learnings for the benefit of other electricity distributors and the wider electricity sector. Activities we have, or will, undertake to share information include:

- Publishing the two applications
- Publishing this completion report
- Project update in the industry insights section of our website[4]
- Presenting at the EEA conference 2024 on conductor health model, including this project
- Presenting at an Electricity Networks Aotearoa Forum with an EDB audience, 12 November 2025
- Briefings with individual EDBs with an interest in the technology.

[1] The 2020 DPP Determination was updated to include Powerco's transition in November 2022: 5B20225D-NZCC-25-PowercoE28099s-transition-to-the-2020-2025-DPP-Final-determination-30-November-2022.pdf (comcom.govt.nz) The Commission also updated Schedule 5.3 in November 2023 to update clause 5.3(2)(c) relating to the specialist report: Electricity-Distribution-Services-Default-Price-Quality-Path-Innovation-Project-Allowance-Approval-Criteria-Amendment-Determination-2023.pdf.

[2] Electricity disclosures

[3] Input Methodologies Determination, Interpretation section 1.1.4: electricity-distribution-services-input-methodologies-determination-2012-consolidated-as-of-23-april-2024.pdf (comcom.govt.nz)

[4] Aeolian vibration monitoring project overview on Powerco website

2. Project outline

2.1 Project overview

Table 1 presents an overview of the project stages, cost and how the innovation allowance drawdown has contributed.

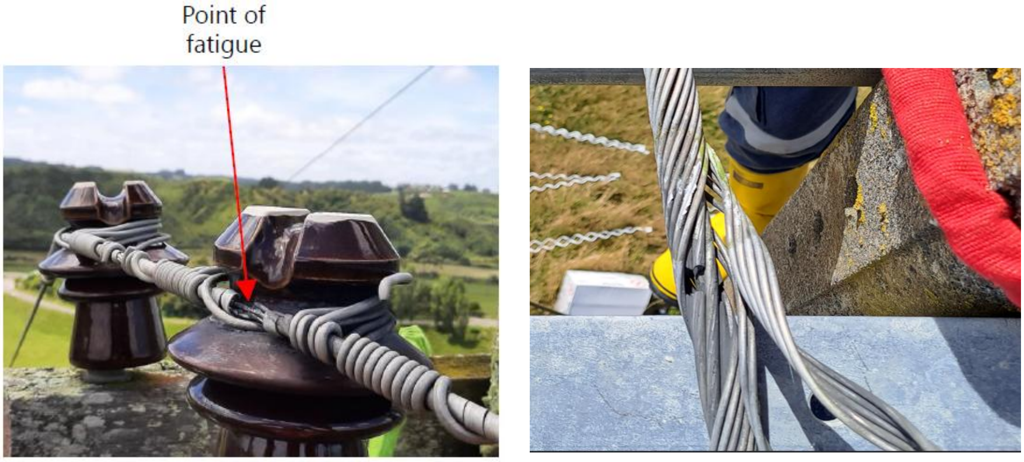
Table 1 Project overview

Project activity		Cost
Stage 1: Procurement and installation	The stage procured and installed 10 Sentrisense vibration monitoring devices, and procured and installed 10 Sentrisense weather station devices.	Cost: $155,691 Allowance drawdown: $77,846
Stage 2: Trial and analysis	This stage procured some additional devices, completed a 6 month field trial, reviewed results, verified some results through lab testing of conductors, and assessed options for next steps.	Cost: $64,328 Allowance drawdown: $32,164

2.2 Project drivers and purpose

Aeolian vibration is the motion caused by wind on conductors with a smooth mid-range wind flow. This creates alternating eddies on the leeward side and an alternating pressure imbalance causing the conductor to move up and down. It occurs with smooth low-mid range winds rather than higher velocity winds. The natural frequencies of a conductor under tension will vibrate in a series of standing waves. This aeolian vibration is relatively common and results in damage to conductors at intermediate structure attachment points- at tied or clamped points. At these positions the conductor cannot flex as it needs to due to the rigid attachment. The restrained movement at these points will fatigue and cause fretting of the conductor strands (see Figure 1) and ultimately cause the conductor to fail and drop.

Figure 1 Damage to conductor at attachment point



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Monitoring conductor aeolian vibration enables estimation of fatigue damage and remaining service life. Conductors fatigue performance varies between AAAC, AAC, ACSR, with AAAC much lower than that for the ACSR.

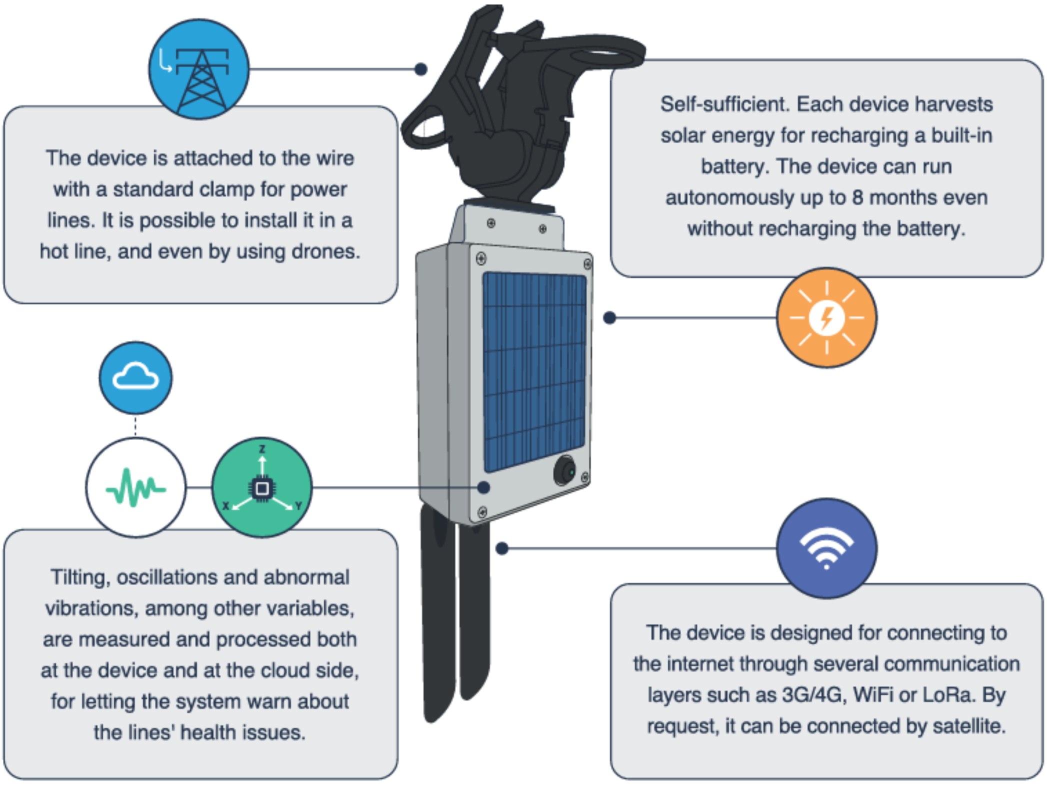
This project tests susceptibility conductor damage due to aeolian vibration, eg is aeolian vibration an issue for shorter spans, or lower tension or where specific ties or armorods are used, or in particular climatic conditions.

The project tested new solar-powered technology called a Line Guard from Sentrisense, provided by Identimark. The device is attached to the power line and measures vibrations. A weather station is attached to the nearest power pole to the device to capture localised weather data. The device monitors aeolian vibration, as well as capability to detect broken cables, fallen towers, very high winds, sag and oscillation frequency. An overview of the Sentrisense device is illustrated in Figure 2.

The project developed a layer in ArcMap GIS to highlight potential conductor fatigue and problem locations for geospatial analysis. The monitors then provided site specific data and built knowledge of vibration effect in different conditions. Data is monitored live on a dashboard.

The objective of capturing this data on conductor vibration-induced damage is to enable reliable identification and proactive mitigation of potential fatigue before premature replacement or failure occurs. This approach supports efficient prioritization of vibration damper deployment and reduces public safety risks associated with fallen conductors. The information derived from the study will inform where vibration dampening will extend the life of conductors, and identify the appropriate conductor selection for specific sites.

Figure **2**: Overview of Sentrisense device



2.3 Project delivery

The project development, trials and testing progressed as anticipated in our June 2024 and May 2025 applications (link in Section 1.2 above).

The 6 month trial found at least 5 of the 10 sites selected did experience aeolian vibration exceeding the conductor bending amplitude limit, while the others did not. Sites confirmed to experience aeolian vibration exceeding the limit will be subject to conductor samples fatigue testing (in lab). This is a secondary test of the data from the trial and informs the use of the data for conductor life cycle predictions. In addition, we will install vibration dampers at the 5 confirmed sites to test if that mitigates the predicted impact.

The site selection criteria, as described in our June 2024 application (link in footnote 1 above), remain valid. Once we collect more trial data, including from additional sites, further modelling will be completed to inform site selection assumptions.

The trials and analysis through FY25 confirm the anticipated benefit for aeolian vibration prediction. Based on this, we are now looking at options for additional devices and further trials for conductor aging.

Further trials are considered necessary to test a range of network scenarios, given the breadth of the Powerco network and varying climatic conditions. We are planning to install 10 additional devices at new sites and also move some of the existing devices where the initial trial has demonstrated aeolian vibration is not impacting the conductors. This may progress in FY26, dependant on timing of internal approval and the need for trials to be focused across a colder weather period. A decision on a fuller integration of devices into the fleet asset management system will be made following further trials and analysis in FY26.

3. Project findings

3.1 Site selection

Ten sites across the Powerco footprint were selected and modelled in design software by using AS/NZS7000 Table Y1 parameters to see if aeolian vibration was probable at each of the selected location. Site selection criteria included:

- Shorter spans, less than 100 meters
- Conductor types: AAAC, AAC & ACSR
- Clamp Category- Type A or Type B, post of pin insulators with or without armour rods
- Location: Sites with no vibration dampers
- Terrain Type: flat exposed terrain and/or near large water bodies.

Site selection criteria were found to be appropriate and we will use the same criteria for site selection for the next installations.

3.2 Weather devices

Weather stations were needed for trial purposes to capture local weather conditions on the selected span sites. This enabled evaluation of the adequacy of regional weather information for the complete rollout of the trial outcomes. Visibility of the weather data in the dashboard is important (see section 3.3). The importance of the weather data proved that it would not be adequate to rely of regional weather data.

3.3 Setting up the dashboard

Figure 3 shows the geospatial spread of installed vibration sensors and weather stations across Powerco footprint. It shows which devices are active, or not active (red) and need review.

Initially we had one dashboard for vibration recordings and a separate dashboard for weather readings. We found it was more valuable to have these together and we altered the dashboard to visualise weather conditions alongside the event of aeolian vibration simultaneously.

Figure 4 shows the dashboard.

Figure 3 Geospatial spread of installed devices

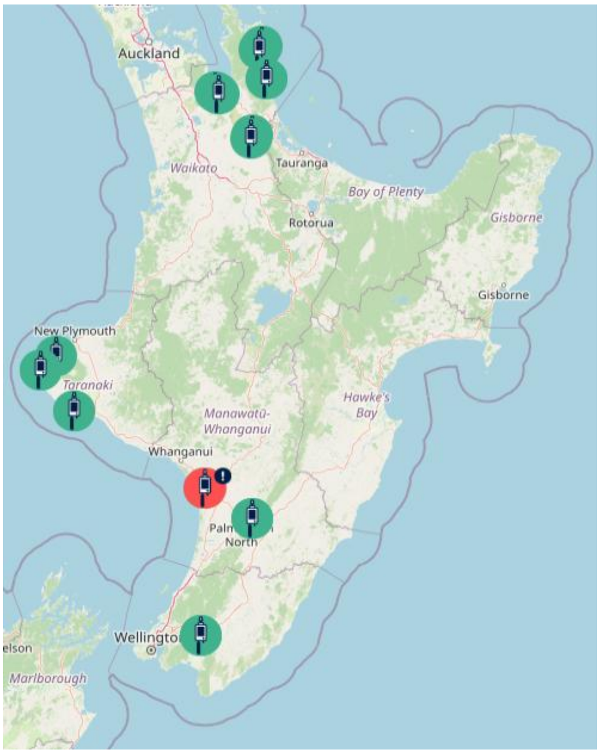
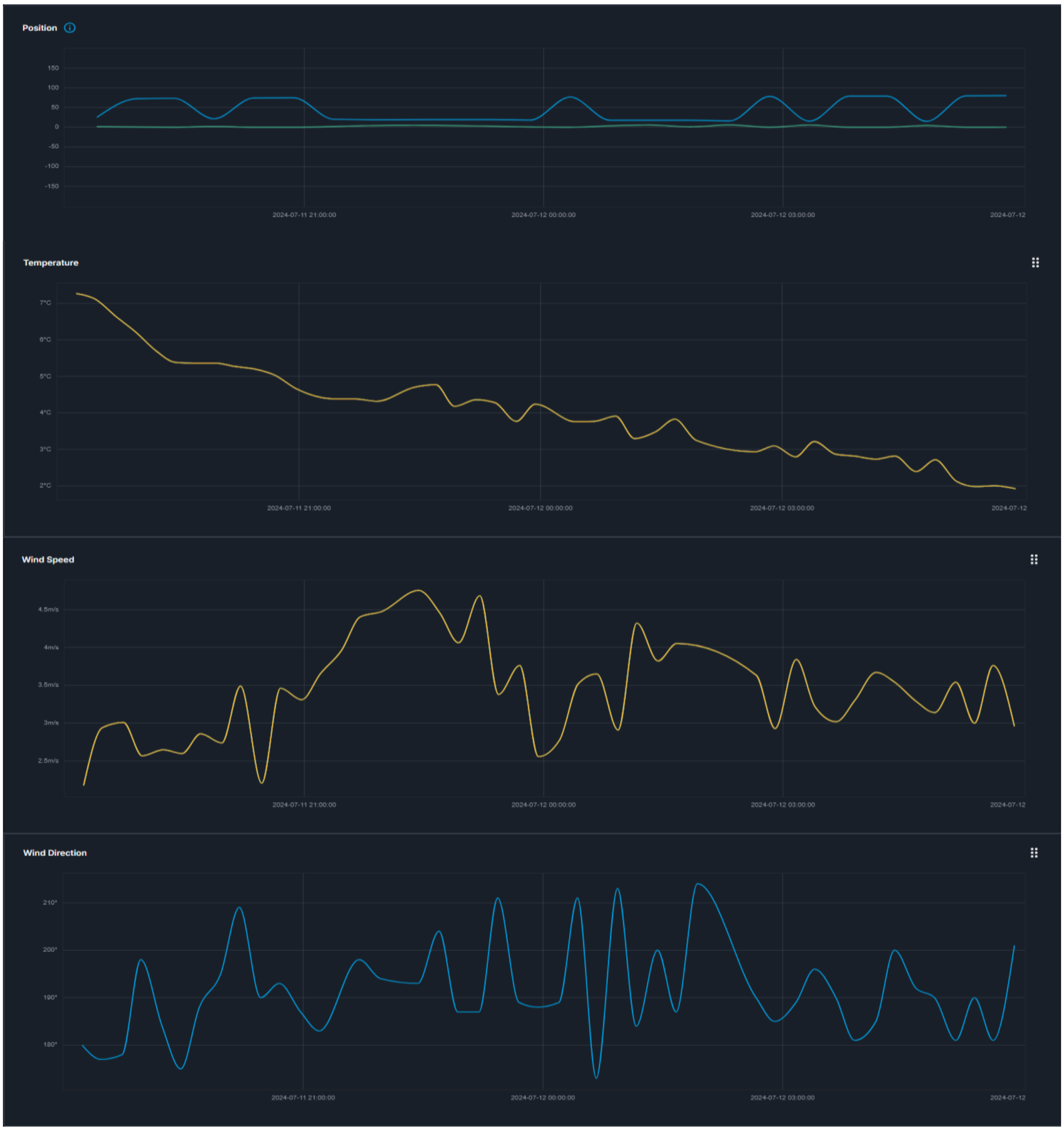


Figure 4 Dashboard displaying weather sensor data and Conductor motion



3.4 Trial results indicate vibration-induced stresses can be predicted

Out of the 10 monitored sites, 5 locations showed vibration-induced stresses as a critical factor affecting conductor life expectancy. Four of the locations had AAAC, and one featured AAC conductor.

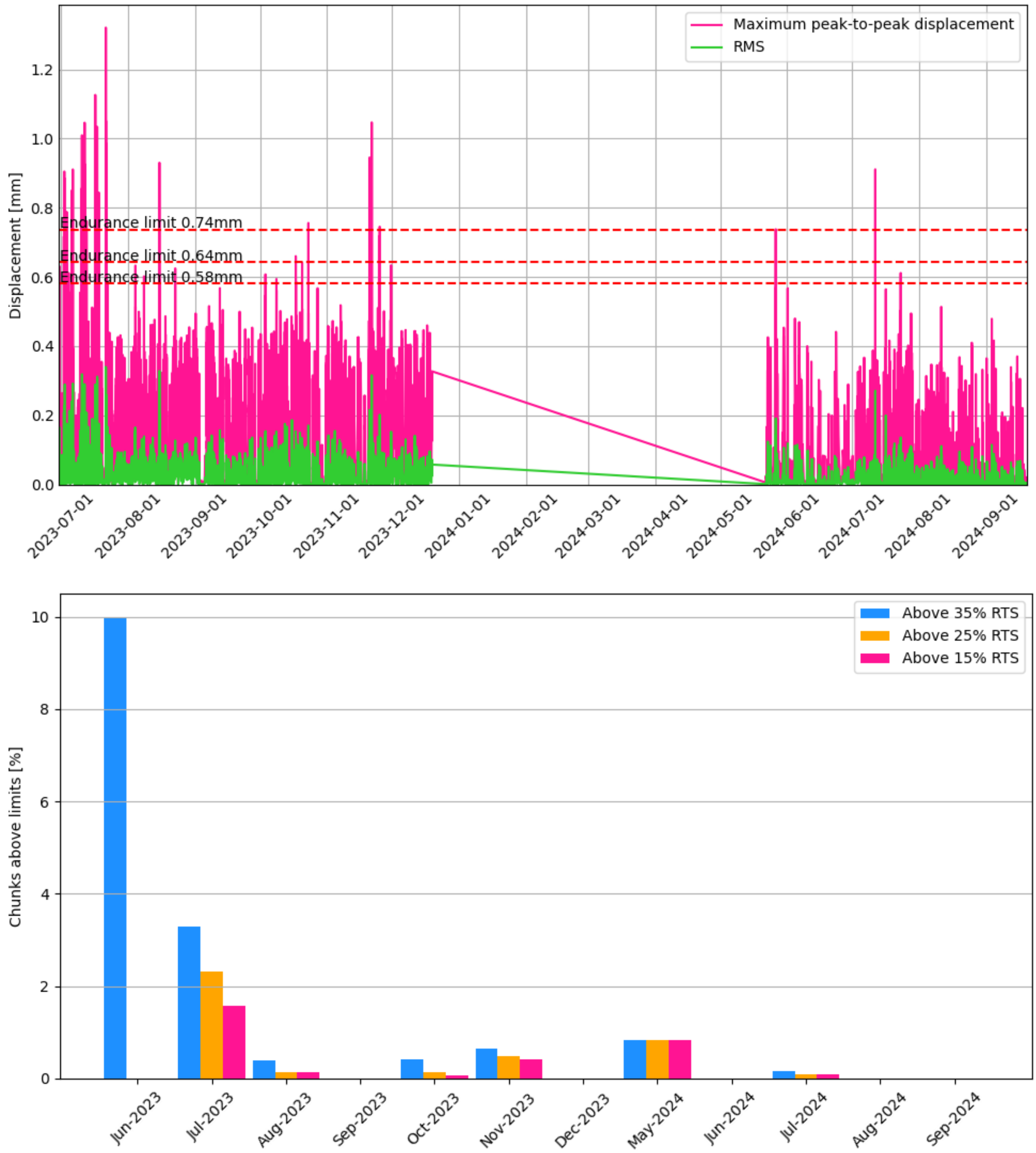
At these sites, measured conductor bending amplitudes exceeded the acceptable threshold limits, indicating elevated dynamic strain. This condition accelerates fatigue accumulation in the conductor material, thereby reducing its operational lifespan. ACSR Ferret and AAC Weke conductor's measured bending amplitudes were found to be within the acceptable limits which correspond to conductor tension. Therefore, vibration is not likely to be a problem.

The results enabled estimation of daily fatigue damage on the conductor on selected sites, which can be used to predict its remaining lifespan.

We have determined that results from 20 sites (10 initial and 10 additional) will be required to replicate findings across the network.

Figure 6 shows results from one site showing conductor potential damage due to aeolian vibration. In this case safe bending amplitude limits for conductor tensions at 15%, 25% and 35% of RTS are shown.

Figure 5 RMS and maximum peak to peak displacements.



3.5 System integration

The results obtained from the trial are promising and support the deployment of additional devices across the network footprint. Additional devices will enhance data collection to develop a geospatial predictive model for aeolian vibration damage within ArcGIS, which will subsequently inform the overhead conductor health model in Copperleaf.

The data collected from 10 sites will be replicated across other sites with similar conditions. Using a polygon approach we will then integrate this into ArcGIS.

System integration will require some effort and is not intuitive in the device software. We will investigate this further in the next stage of the project as a mechanism to automate the replication and data visibility will be important.

3.6 Cost benefit / efficiency

The information collected from the devices will be used to inform where we require vibration dampers at the planning stage. Data will also feed into the Overhead Conductor Health Model, enabling predictive assessment of conductor condition and remaining life. This offers a significant efficiency in proactive and targeted use of vibration dampers, and pre-emptive conductor replacement at the optimal timing to achieve efficiency and reduced risk of incidents.

The damage caused by the aeolian vibration is hidden and by the time it causes failure of the conductor it is too late. Through correlating conductor parameters, risks, and work prioritisation, there is opportunity for cost and quality benefits for consumers.

Figure 6 Enabling targeted use of Spiral Vibration Dampers designed
to reduce the effects of aeolian vibration

The monitoring device and weather station can be easily moved and set up in different locations. There is no network interruption during the instalment. This provides efficiency and options to use the devices in different areas should risk factors change.

Based on the results, and the opportunity to both move the devices around and potential to use the devices to monitor other elements of conductor health, we have found that the Sentrisense monitoring devices and software licencing are cost effective. The original 10 devices were around $5,000 per unit (total around $13,000 per site including installation, weather stations and software). The additional 10 we are installing show a slight increase from the original costs.

4. Conclusion and next steps

Based on the trial results, Powerco plans to scale up device deployment across additional locations during FY26 and FY27. A broader coverage will improve geospatial modeling for assessment of aeolian vibration risk. The results to date are promising and further trials will support testing a range of network scenarios, given the breadth of the Powerco network and varying climatic conditions.

POWERCO