

Quarterly Report: Conductor Condition Monitoring

Project Summary:

Energy Networks Association (ENA) member utilities have almost 800,000 kilometres of overhead conductor in service, valued at several billion dollars. Many of this critical infrastructure is ageing with some already reaching 70 years. This project investigates the effective ways of condition monitoring of overhead conductor in Australian distribution networks. The objectives are:

- Review of conductor failure modes, degradation mechanisms and ageing parameters and current Australian industry practices to asset manage overhead conductors.
- Define the criteria for quantifying conductor condition and its end-of-life, and determine the probability of conductor failure and estimate its remaining useful life.
- Identify the core areas of research and development for improving condition assessment of conductors in Australian Distribution Network Service Providers (DNSPs) networks.
- Survey state-of-the-art conductor condition monitoring techniques that could be used to monitor distribution conductor condition and assess the practicality and economics of applying these techniques in Australian networks.

This project was started on June 20, 2018. Having been working closely with project industry partners, the UQ team has successfully completed Milestone 1 tasks. The Milestone 1 report was submitted to ENA on December 20, 2018. Since the completion of Milestone 1, the UQ team has conducted a feasibility study on the implementation of conductor health index methodology in Australian DNSP's networks in line with the requirements of the Milestone 2 of the project.

Project Objectives

Milestone 1

- Review of conductor failure modes, degradation mechanisms, and parameters, which are primarily responsible in influencing conductor degradation; and current Australian industry practices to test, operate, inspect, and asset manage (maintain, replace and refurbish) overhead distribution conductors. This review will be based on the ENA 2015/16 conductor survey and any other individual utility surveys. If an additional industry survey is required, it will be undertaken as an additional activity approved by the industry steering committee.
- Define the criteria for quantifying conductor condition and its end-of-life, and subsequently determine the probability of conductor failure and estimate its remaining useful life.
- Identify the core areas of research and development for improving condition assessment of conductors in Australian DNSPs' networks.

Milestone 2

- Investigate globally documented conductor 'health index' methods including the Canadian method (the health index is a weighted sum of conductor condition parameters, field inspection data, and service

records, used to estimate the remaining useful life of conductor). Compare alternative Health index methods, assess suitability for Australian conditions and select the best to be trialled in the project.

- Demonstrate the selected 'health index' method on a representative type of distribution conductor for the participating ENA members, and benchmark the results against past conductor investigation of conductor samples and metallurgical studies (such as those undertaken by Western Power and other ENA members). Trialling the Health index will only be possible provided the ENA member DNSPs provide, as an in-kind contribution, the necessary conductor data and information, including the results of inspections, tests, validation and previous measurements for the selected conductor type.

Milestone 3

- Survey state-of-the-art conductor condition monitoring techniques (e.g. smart sensor and other advanced overseas tested and validated techniques) that could be used to monitor distribution conductor condition without having to de-energise the distribution network. Assess the practicality and economics of applying these techniques and evaluate their suitability for Australia.

Project Progress / Methodology

Since the completion of the Milestone 1 of the project, UQ team has been closely working with the industry partners to achieve an expected outcome for Milestone 2. According to the original project business case, Milestone 2 report should be on the methodology and trial of a health index method for assessing conductor condition. It needs to demonstrate the health index method in quantifying the condition of a representative type of conductor for the partner's distribution networks.

Following is a list of project outcomes since January 2019.

- Conducted a feasibility study on application of existing Health Index (HI) methods for evaluating the health of bare overhead conductors in the Australian power distribution network.
- Identified a weighted sum based HI methodology, which has the flexibility to be modified to suit the Australian distribution network operating conditions.
- Identified the input parameters, which can accurately represent major conductor degradation mechanisms (annealing and Corrosion) in Australian distribution network.
- Identified the numerical values of the input parameters and weighting factors considering the differences in network operating conditions in different Australian states.
- Trialled the developed health index methodology on field test data supplied by Western power.
- Developed a methodology for determining the probability of conductor failure.

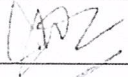
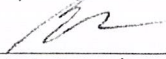
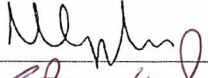
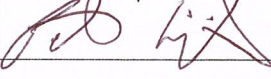
Conclusions

The research outcomes since the completion of milestone 1 are,

- (1) A weighted sum based HI methodology with a set of input parameters (specially defined to suit Australian network operating conditions) can be used on conductors in the Australian distribution network.
- (2) Corrosion and annealing are the input parameters that should be used when computing health index of the Australian distribution conductors.

The identified methodology was successfully trialled on Western Australian field test data. Project team (both UQ and Industry) has decided that the research objectives of the Milestone 2 have been completed. UQ team is currently working on the Milestone 2 report.

Checked by Project Industry Partners

	Signature	Date
Ayan Ghosal (Western Power)		12/08/19
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