TECHNICAL REVIEW ENERGIZE EASTSIDE AC INTERFERENCE ANALYSIS

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Revision Chart

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Sign-off Sheet

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Overview

At the request of Environmental Services Associates (ESA) a review was conducted by Stantec relating to the Energize Eastside project, which would involve upgrading of an existing 115 kV transmission line to 230 kV. The new transmission line would consist of two 230 kV circuits, although initially one of these circuits will be operated at 115 kV.

The proposed upgraded 230 kV transmission line would be collocated with two existing high pressure petroleum pipelines owned by Olympic Pipe Line Company and operated by British Petroleum (BP). These pipelines are presently collocated with the existing Eastside 115 kV circuit.

Det Norske Veritas (U.S.A.), Inc. (DNV GL) was retained by Puget Sound Energy (PSE) to perform an AC interference study related to AC interference from the proposed 230 kV upgraded powerline on the two existing, collocated Olympic pipelines. The study considered two route options and several different powerline configurations, with the objective of determining the option that would minimize the AC interference on the pipelines.

1.0 Scope of Work

Stantec's scope involved a high-level desktop review of the study report only. Confirmation of model input parameters and modeling files was not included in the scope of this review.

2.0 Applicable Standards

The review was based on the following industry standards relevant to AC interference studies between pipelines and powerlines:

1. NACE Standard Practice (SP) 0177, "Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems", 2014.
2. Institute of Electrical and Electronics Engineers (IEEE) Standard 80, "IEEE Guide for Safety in AC Substation Grounding", 2000.

3.0 Opinion

The primary objective of the AC interference study performed by DNV GL was to perform a sensitivity analysis to determine the optimal route and powerline configuration to minimize the AC interference risks on the two collocated pipelines.

An optimal route, phasing, and conductor orientation was selected to minimize the steady-state induced AC voltages on the paralleling pipelines. Shield wires were recommended to minimize the conductive coupling and arcing risks due to a phase-to-ground fault on the powerline structures.

Based on Stantec's experience and industry standards, it is our opinion that the technical approach used to achieve this objective in the subject AC interference study is consistent with industry practice.

The report concluded that the modeling indicated that selection of the recommended optimal route and configuration would result in no AC mitigation requirements on the pipelines. The report further recommends that final mitigation design should be based on field data collected after system energization.

In Stantec's opinion, although the study and modeling performed is sufficient as a sensitivity analysis, it cannot be used to determine the mitigation requirements for the pipelines related to the final design of the powerlines. Furthermore, mitigation based on field testing after energization is also not an acceptable approach, as measurements can only be taken at test stations, which are not necessarily located at locations with highest induced AC voltages and at greatest AC corrosion risk. Additionally, it is not possible to assess safety and integrity risks under powerline fault conditions in the field.

As such, we recommend the following be performed in the detailed design stage of the project prior to energization of the new powerline:

- Perform an AC interference study incorporating the final powerline route, configuration, and operating parameters.
- Obtain and incorporate all of the pipeline parameters required for detailed modeling and study (i.e., locations and details of above-grade pipeline appurtenances/stations, bonds, anodes, mitigation, etc.). This should include a review of the annual test post Cathodic Protection (CP) survey data.
- Fully assess the safety and coating stress risks for phase-to-ground faults at powerline structures along the entire area of collocation. This assessment should include both inductive and resistive coupling.
- Fully assess the safety and AC corrosion risks under steady-state operating conditions on the powerline.
- Reassess the safe separation distance to minimize arcing risk based on NACE SP0177 and considering the findings in CEA 239T817.
- Ensure that the separation distance between the pipelines and the powerline structures exceeds the safe distance required to avoid electrical arcing.
- Design AC mitigation (as required) to ensure that all safety and integrity risks have been fully mitigated along the collocated pipelines.
- Design monitoring systems to monitor the AC corrosion risks along the pipelines.
- Install and commission the AC mitigation and monitoring systems prior to energization of the 230 kV powerline.
- After energization, perform a site survey to ensure that all AC interference risks have been fully mitigated under steady-state operation of the powerline.

Based on the sensitivity analysis performed by DNV GL, it is Stantec's opinion that any remaining AC interference risks to the pipeline identified in the detailed design stage of the project can readily be mitigated via use of standard mitigation strategies.

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