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The INGAA Foundation, Inc.

Criteria for Pipelines Co-Existing with Electric Power Lines

Prepared For:
The INGAA Foundation

Prepared By:
DNV GL

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Objective:

The primary objective of this report is to present the technical background, and provide best practice guidelines and summary criteria for pipelines collocated with high voltage AC power lines. The report addresses interference effects with respect to corrosion and safety hazards, and fault threats.

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EXECUTIVE SUMMARY

The primary objective of this report is to present the technical background, and provide best practice guidelines and summary criteria for pipelines collocated with high voltage AC power lines. The report addresses interference effects with respect to corrosion and safety hazards, and fault threats. The guidelines presented address mitigation and monitoring, encroachment and construction, risk severity classification, and recommendations for further industry development.

This report addresses the technical background to high voltage interference with respect to collocated and crossing pipelines, and presents basic procedures for dealing with interference scenarios. The provisions of this document are recommended to be used under the direction of competent persons, who are qualified in the practice of corrosion control on metallic structures, with specific suitable experience related to AC and/or DC interference and mitigation. This document is intended for use in conjunction with the reference materials cited herein.

Collocated pipelines, sharing, paralleling, or crossing high voltage power line rights-of-way (ROW), may be subject to electrical interference from electrostatic coupling, electromagnetic inductive, and conductive effects. If the interference effects are high enough, they may pose a safety hazard to personnel or the public, or may compromise the integrity of the pipeline. Because of increased opposition to pipeline and power line siting, many future projects propose collocating high voltage alternating current (HVAC) and high voltage direct current (HVDC) power lines and pipelines in shared corridors, worsening the threat.

Predicting HVAC interference on pipelines is a complex problem, with multiple interacting variables affecting the influence and consequences. In some cases, detailed modeling and field monitoring is used to estimate a collocated pipeline's susceptibility to HVAC interference, identify locations of possible AC current discharge, and design appropriate mitigation systems to reduce the effects of AC interference. This detailed computer modeling generally requires extensive data collection, field work, and subject-matter expertise. Basic industry guidelines are needed to help determine when more detailed analysis is warranted, or when detailed analysis can be ruled out based on the known collocation and loading parameters. A consistent technical guidance document will benefit the pipeline industry by increasing public safety and allowing for an efficient approach in assessment and mitigation of threats related to high voltage interference.

The INGAA Foundation contracted Det Norske Veritas (U.S.A), Inc. (DNV GL) to develop this guidance document. The project included a detailed industry literature review to identify applicable technical reports, international standards, existing guidance and operator procedures. In addition to the literature review, numerical modeling was performed to determine the effects of key parameters on the interference levels. The document addresses interference effects with respect to corrosion and safety hazards, mitigation, monitoring, encroachment and construction, prioritization and modeling. It also includes recommendations for further development.

The following severity ranking tables were developed for key variables and their impact on the severity of AC interference. Further background for the development of these rankings is provided throughout the report. Guidelines for determining the need for detailed analysis and applying these severity rankings are provided in Section 6.2.

Separation Distance

Table 3-Severity Ranking of Separation Distance

Separation Distance - *D* (Feet)	Severity Ranking of HVAC Interference
$D < 100$	High
$100 < D < 500$	Medium
$500 < D < 1{,}000$	Low
$1{,}000 < D \leq 2{,}500$	Very Low

HVAC Power Line Current

Table 4-Relative Ranking of HVAC Phase Current

HVAC Current - *I* (amps)	Relative Severity of HVAC Interference
$I \geq 1{,}000$	Very High
$500 < I > 1{,}000$	High
$250 < I < 500$	Med-High
$100 < I < 250$	Medium
$I < 100$	Low

Soil Resistivity

Table 5-Relative Ranking of Soil Resistivity

Soil Resistivity - ρ (ohm-cm)	Relative Severity of HVAC Corrosion
$\rho < 2{,}500$	Very High
$2{,}500 < \rho < 10{,}000$	High
$10{,}000 < \rho < 30{,}000$	Medium
$\rho > 30{,}000$	Low

Collocation Length

Table 6-Relative Ranking of Collocation Length

Collocation Length: *L* (feet)	Relative Severity
$L > 5{,}000$	High
$1{,}000 < L < 5{,}000$	Medium
$L < 1{,}000$	Low

Collocation / Crossing Angle

Table 7-Relative Ranking of Crossing Angle

Collocation/Crossing Angle - θ (°)	Relative Severity
$\theta < 30$	High
$30 < \theta < 60$	Med
$\theta > 60$	Low

The research and analytical studies accentuated the need for accurate power line current load data when assessing the susceptibility of a steel transmission line to high voltage interference. For this reason, collaboration between the respective pipeline and power line operators is advised to accurately determine where detailed assessment is required, and develop efficient mitigation where necessary.

The general safety recommendations and guidelines for interference analysis presented in Section 6 provide guidance on the relative susceptibility of AC interference associated with the selected variables. They primarily address the likelihood or susceptibility of AC interference, and do not address the consequence aspect of an overall risk assessment, as these details are specific to each individual assessment.