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Induced Currents in Gas Pipelines due to Nearby Power Lines

A thesis submitted in fulfillment of the requirements for the award of the degree

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by

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CERTIFICATION

I, Dejan Markovic, declare that this thesis, submitted in partial fulfilment of the requirements for the award of Masters by Research, in the School of Electrical, Computer and Telecommunications Engineering, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualification at any other academic institution.

Dejan Markovic

28 October 2005

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Abstract

Significant voltage levels can be induced in gas pipelines due to power lines in areas where they share the same corridor, especially during a fault. These voltages can affect the operating personnel, pipeline-associated equipment, cathodic protection systems and the pipeline itself. Quite often, mitigation is required to reduce these induced voltages to levels that are safe for personnel and integrity of the pipeline. This thesis investigates and evaluates the performance and capabilities of two software packages that have been developed to calculate and manage induced voltages on pipelines, PRC and CDEGS. As it was the superior package, CDEGS and the interference analysis based on it is presented in detail.

The complete interference analysis, including steady state and fault conditions, was performed on the Young-Lithgow pipeline and power line shared corridor. It is shown that pipeline coating stress voltages in excess of levels recommended by the CDEGS procedure may exist for faults on particular power lines. Possible remedial measures are suggested.

Subsequently, the existing mitigation system on the Brisbane pipeline, employing insulating joints with permanent earths, is assessed using CDEGS. It is shown that this mitigation is sufficient in regard to controlling pipeline coating stress voltages. Touch voltages on three test points are in excess of levels allowed by IEEE recommendations, but still within levels allowed by Australian Standards.

The same pipeline layout is used to analyse the hypothetical case of a mitigation system implemented with zinc gradient control wire. While the pipeline coating stress voltages are within recommended limits, only one test point touch voltage is in excess of IEEE recommendations and again all are within Australian Standards limits.

Apart from performance, the two mitigation methods are compared in terms of cost of installation and other features. It is concluded that despite the lower costs of installation of a system with insulating joints, some other features and costs associated with maintenance of the two compared systems favoured the gradient control wire method and made it the preferred method for mitigation of induced currents in pipelines for many configurations.

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