Corrosion Technology Services

Case Study: CS-04-02-2013

AC Mitigation Study on 20” Oil Pipeline

Start: 2013
Completion: 2013
Scope of Project: Computer modeling study for the interference effects developed on a pipeline running parallel to overhead powerlines

Introduction

This case study provides a brief description on the process involved in carrying out a computer modeling study for the interference effects developed on a pipeline that is parallel to an existing 220kV power line, and the mitigation measures that were developed to counteract these effects in the event of a single phase to ground fault scenario.

Overhead powerlines can create safety hazards for to personnel working on pipelines

Scenario

A 40km long 20’’ oil pipeline runs parallel to a 220kV power line from in multiple locations, with differing separation distances. The separation distance between the power lines and pipeline varies between 30m and 150m.

Two modeling scenarios are to be developed as a part of the study:

1. The AC interference effects that may be developed on the pipeline during the normal operating state of the power line. This would include the measurement of AC induced voltages that may arise on the pipeline during this state.
2. The AC interference effects that may be developed on the pipeline during a single phase to ground fault scenario at a location closest to the pipeline. This would generally means the power line transmission tower that is closest to the pipeline would generate a fault scenario, and the effects due to such a process were to be simulated. Modeling would include the calculation of AC voltages that may develop on the pipeline during this state, and also the estimation of the touch and step voltages that would be developed during a fault load.

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Process

Based on power line & pipeline data provided, a model was developed in Right-Of-Way™ software. The results were verified for normal operating load condition and for a single phase to ground fault.

The model was created by splitting the entire pipeline route into various “regions” based on differing characteristics such as soil resistivity, pipeline-to- power line separation distance, pipeline and / or power line route change etc.

Each “region” was individually modeled in SES Right-Of-Way™ and then combined together to build the complete model. A test run was then performed on the model to identify if any anomalies were present. Once this had been verified, the model ran its course, and provided a graphical representation of the results. Refer Figure 1 for the AC induced voltages that were predicted across the pipeline during a normal load scenario and Figure 2 for the touch voltages that were calculated across the pipeline during a fault scenario.

It was determined that no significant AC voltages were developed along the pipeline during normal operating load conditions, but significant touch voltages would be developed during a fault condition. These were identified as being much higher than the safety threshold limits as calculated by IEEE Std. 80.

As a result, mitigation measures were implemented across the affected sections of the pipeline to counteract the effects that may arise due to a fault scenario. The mitigation measures included the installation of a Polarization Cell Replacement (PCR) connected to a zinc ribbon anode that acts as an earthing electrode to bring down voltages that would be developed.

Refer Figure 3 for a typical AC mitigation facility. The software model was modified after the inclusion of these facilities along the pipeline route and then re-run to verify the results.

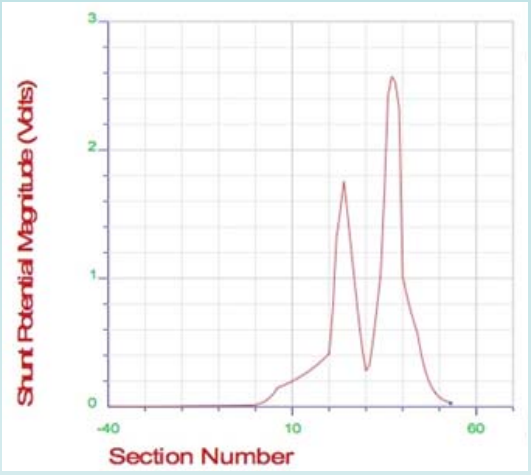

Fig 1. AC Induced Voltage during Normal Load

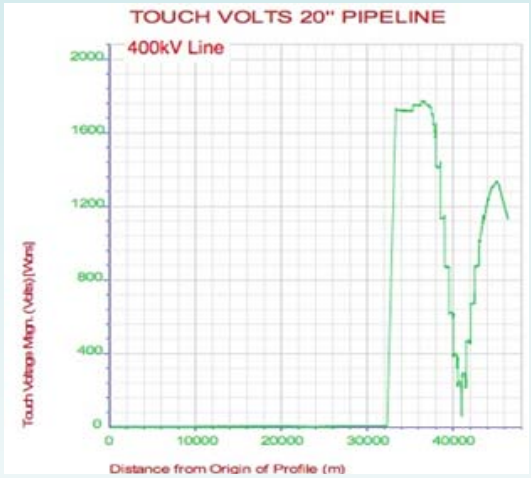

Figure 2: Touch Voltages across pipeline during Single Phase to Ground Fault Scenario

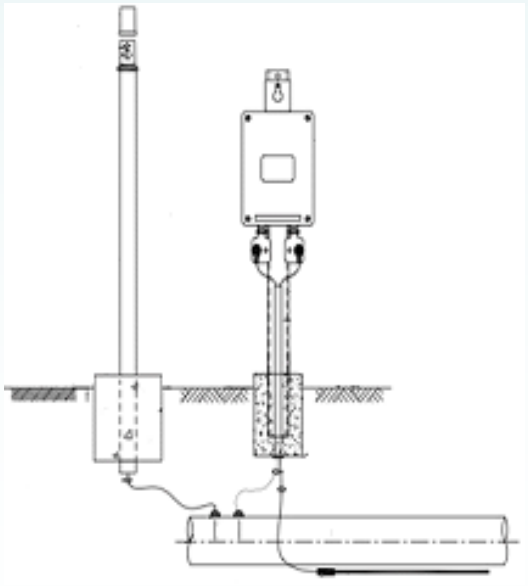

Figure 3: Typical AC Mitigation Facility

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