

IMPACT OF MAINTENANCE ACTIVITIES ON FUTURE INTEGRITY OF TRANSMISSION PIPELINES

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ABSTRACT

Transmission pipeline operators regularly inspect their assets using in-line inspection (ILI) tools to monitor for potential internal and external threats to the system. When these tools identify features that meet excavation criteria, the operators will complete mitigation activities to reduce or remove the threat. Typically, these mitigation activities include excavation of the pipeline, removal of the coating, and non-destructive examination at the targeted feature. Upon completion of the maintenance activities, the pipeline is then re-coated and the backfill restored.

During the maintenance work, the pipeline's coating at the ends of the excavation is exposed to atmospheric conditions (e.g., sun light, humidity, etc.). Moreover, the pipeline is then exposed to disturbed soil with varying moisture content after being backfilled. Depending on the coating type, these conditions may increase the corrosivity of the localized environment at the existing coating (that was left as-is) and at the pipe ends.

Approximately 16,000 digs in Canada and the United States of America were analyzed to determine the impact of maintenance activities on the future integrity of transmission pipelines. A re-visit rate at previously excavated locations of less than 1% was observed based on this analysis. Typically, the re-visit occurs 4 years after the initial visit. As expected, most of the revisits were associated with pipelines that were originally coated with polyethylene tape. Within this paper, strategies to reduce the revisit rate will also be discussed.

Key words: Protective coatings, corrosion effects, corrosion management, underground corrosion

INTRODUCTION

Transmission pipeline companies utilize successive ILI tool runs to identify, size, and determine the corrosion growth rate (CGR) of pipeline features that may be detrimental to the operation of the pipeline [1, 2]. The importance of back-to-back ILI tool runs in monitoring and maintaining the safe operation of a pipeline is further supported by the methodologies' incorporation by US regulators for high consequence areas. The calculated CGR from the ILI tool runs is used to determine maintenance digs required to mitigate the identified features prior to the next scheduled re-inspection interval.

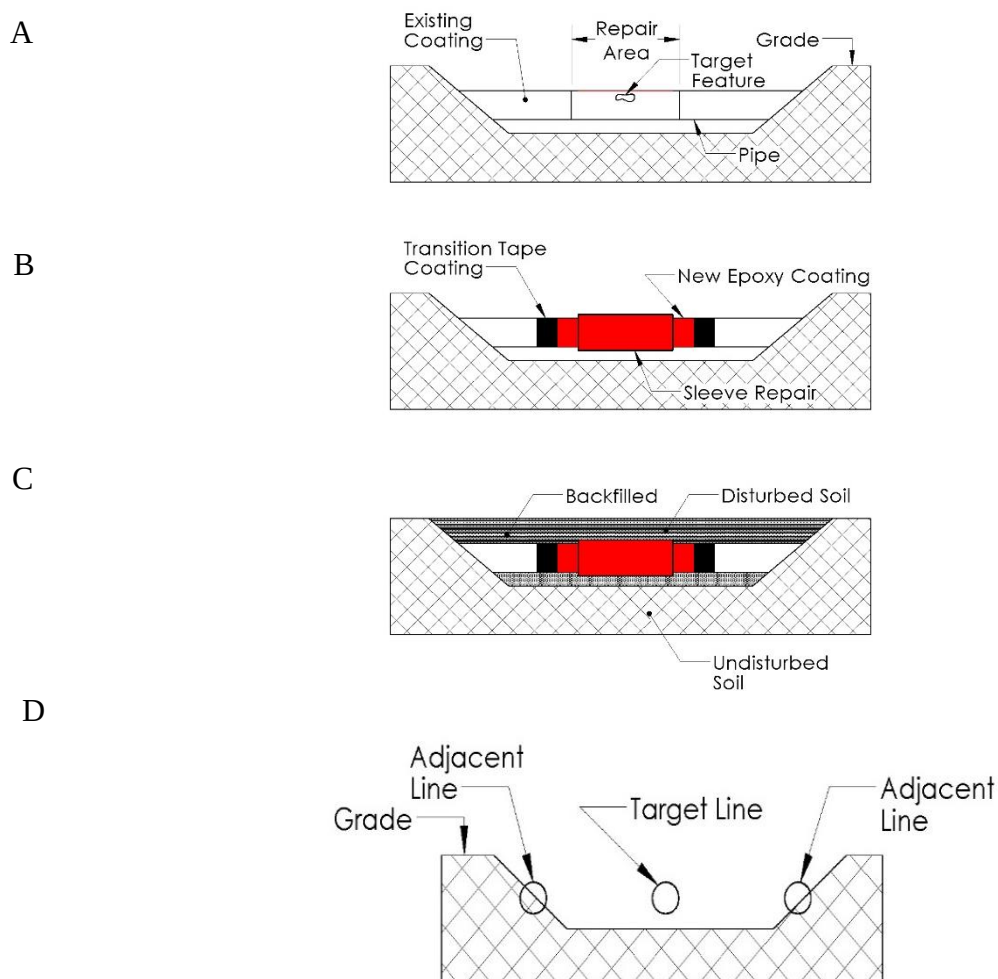


FIGURE 1: DIAGRAM SHOWING A REPRESENTATIVE MAINTENANCE DIG DUE TO AN EXTERNAL CORROSION (“TARGET”) FEATURE.

Figure 1 shows the steps associated with a maintenance dig that would be performed to mitigate an external corrosion feature identified by an ILI tool that meets the excavation and repair criteria. In Figure 1a, the location is excavated to expose the “target” feature. Typically, the amount of exposed pipe is limited to minimize the unsupported span length and the overall exposure of existing coating. For larger excavations with multiple target features, supports would be required to minimize the spans and the loading on the pipe.

After removal of the coating in the repair area, the feature would be scanned using non-destructive examination technologies and, if required, repaired by installing a containment sleeve over the feature (Figure 1b). The repair area would then be recoated with a conventional two-part epoxy and if the existing

coating was polyethylene (PE) tape, coal tar enamel (CTE), or extruded PE, the interface between the existing coating and newly applied epoxy would be overcoated with a transition tape to reduce the risk for delamination of the existing coating [3]. The location would then be back filled with native soil.

High dielectric strength coatings have been utilized to protect pipelines since the early 1920s [4]. The primary function of the coating is to isolate the carbon steel surface of the pipeline from the soil environment and prevent corrosion. Soil corrosivity is a function of the porosity (aeration), electrical resistivity, dissolved salts, moisture, pH, and microbial activity in the soil [5]. The maintenance dig activity disturbs the localized soil conditions surrounding the pipeline (Figure 1c). Corrosion on a pipeline can be more active in post construction excavated regions due to non-homogenous and differential aerated soil conditions that may establish macro-galvanic cells [6]. The increase in the corrosivity of the localized environment at the existing coating (that is left as-is) and at the pipe ends may increase the CGR depending on the condition of the existing coating (i.e., breakdown in its barrier properties). Additionally, the increase in soil corrosivity may also impact cathodic protection performance and metal loss on adjacent pipelines that share the right of way (ROW), Figure 1d.

In most situations, the cathodic protection applied to the pipe can mitigate these concerns for non-shielding coatings assuming the current supplied to the pipe is sufficient. If the cathodic protection current is inadequate or shielded, the corrosion rate of susceptible steel will spike and gradually reduce over time as the backfilled, disturbed soil reaches equilibrium with the undisturbed adjacent soil.

If there is a significant and sustained increase in the localized corrosion rates due to the change in the soil conditions, future ILI tool runs should identify external features requiring mitigation at these previously excavated maintenance dig locations (revisited locations). The expectation is that the impact of disturbed soil would be greatest on existing pipelines with PE tape coatings due to the propensity of this coating type to shield cathodic protection.

EXPERIMENTAL PROCEDURE

Since 2011, 15,920 digs on 13 transmission pipelines totaling over 12,500 km in Canada and the United States of America (USA) were completed as shown in Figure 2. These digs were analyzed to determine the impact of maintenance activities on the future integrity features.

