

Guidelines for the Collection of Reliable and Practicable ECDA Indirect Inspection Data

Miqdaad Fatakdawala
Hatch Ltd.
2800 Speakman Drive
Mississauga, ON, L5K 2R7
Canada

ABSTRACT

In recent years, pipeline leaks in the energy and infrastructure sectors have mandated asset owners to implement more regulated inspection regimes. NACE SP0502¹ – Pipeline External Corrosion Direct Assessment (ECDA) Methodology was created as a guide to apply the ECDA process and mitigate external corrosion on typical pipeline systems. The collection of reliable and practicable field data is crucial in the success of an ECDA process. Techniques and guidelines to obtain quality data in the field across the indirect inspection processes are presented. Some of the datasets discussed include Close Interval Potential Survey (CIPS) data, Direct Current Voltage Gradient (DCVG) data, soil resistivity data, AC induced corrosion data and pipeline interference data. Continued diligence of the surveying field personnel, as well as adherence to guidelines, will eventually save pipeline owners unnecessary excavation costs while also ensuring locations at the highest risk of external corrosion are rehabilitated and repaired as part of the direct examination.

Key words: Corrosion Monitoring, Corrosion Potential, Cathodic Protection, Indirect Inspection, Direct Assessment, ECDA, Coating Defect, Condition Assessment

INTRODUCTION

The External Corrosion Direct Assessment (ECDA) is formally listed as an acceptable integrity assessment method within Subpart O, Part 192 of the code of federal regulations regarding gas transmission pipeline integrity management². It is a 4 step continuous improvement process to identify and address locations where external corrosion activity has occurred, is occurring or may occur¹. In the pre-assessment phase, a comprehensive right-of-way inspection is performed, and pipeline operability data is collected to verify the feasibility of conducting a full ECDA for the pipeline under evaluation. In the indirect inspection phase, the status of cathodic protection and pipeline coating is tested using methods such as Close Interval Potential Surveys (CIPS) and Direct Current Voltage Gradient (DCVG) surveys. In the direct examination phase, specific locations identified in the previous phase are excavated to examine any defects or corrosion and complete any necessary repairs. In the post-assessment phase, a root cause analysis is performed and any future mitigation recommendations are compiled.

The quality of indirect inspection (step 2) data has significant implications for pipeline operational reliability and is a critical factor in the execution of a successful ECDA program. Dig recommendations based on poor quality data may result in unnecessary capital expenditure, while severe coating defects that are missed may introduce a significant risk to public health. Therefore, it is essential to optimize the quality of indirect inspection field data to produce reliable dig recommendations. The present paper is targeted towards inexperienced field personnel who are familiar with the ECDA process and will be required to conduct indirect inspection surveys.

Some corporations utilize junior staff to carry out the indirect inspection portion of the ECDA process; however, it is imperative to have an experienced technician or engineer as part of the indirect inspection team. This paper highlights some of the techniques and guidelines that field personnel can adhere to in order to improve the quality of inspection data they are collecting during this continuous improvement process. Any techniques described should be conducted in parallel with the general ECDA methodology stated in NACE SP0502¹.

PRELIMINARY INITIATIVES

During the pre-assessment phase and prior to beginning the indirect inspection on site, the inspection crew should consider some of the preliminary initiatives discussed in this section. Following these guidelines will result in a streamlined survey that produces higher quality inspection data.

Asset owners typically collect data such as strip maps, construction drawings, aerial photography, pipeline alignment sheets and other maintenance data as part of their risk assessment programs. This data should be collected and organized within the ECDA pre-assessment report for field personnel to reference during the survey. Additionally, information such as influencing rectifiers, proximity of the pipeline to other structures and existing soil resistivity data must also be obtained and documented.

Project managers should consider creating a specific inspection data sheet for field personnel that only highlights what they would find beneficial while conducting the survey. This may include a detailed system configuration outlining the pipeline to be inspected, starting and ending points, any known isolation joints, tie-ins, test stations, influencing rectifiers and locations where the soil resistivity must be tested. This inspection data sheet will provide the field personnel an opportunity to plan the survey more effectively prior to mobilization.

All pre-determined rectifiers must be interrupted prior to conducting any survey work. A digital oscilloscope should be used to record waveforms during the 'ON' and 'OFF' cycles to ensure all influencing rectifiers are being interrupted and the survey will produce high quality, reliable data. Results from a frequency analysis that categorizes the pipeline signal into 60Hz, 120Hz and 180Hz signals will help identify signatures of influencing rectifiers left ON or any rectifiers that are being

interrupted asynchronously. If all existing rectifiers are being interrupted correctly, there will be no residual DC current flow during the OFF cycle and a lack of 120Hz and 180Hz components within the oscilloscope measurement. Field personnel should be adequately trained to interpret this data as it must be reviewed after interrupting all current sources, but prior to surveying.

In North America, aging water infrastructure has commonly been cathodically protected with the use of sacrificial anodes directly welded to the pipeline. Since these permanently buried anodes cannot be interrupted, provisions such as the use of an 'ON' potential cathodic protection (CP) criteria may need to be considered for these types of systems. If sacrificial anodes are bonded through accessible test stations, they should be identified and interrupted by field personnel prior to surveying.

CLOSE INTERVAL POTENTIAL SURVEY

Close interval potential surveys are the foundation of an indirect pipeline CP inspection. The principle of a CIPS is to record the pipe-to-soil (P/S) potential profile at close intervals along the pipeline that will be used to assess the effectiveness of cathodic protection across the entire structure. CIPS surveys must be conducted on the pipeline without disconnecting any bonds that are usually in place to provide an accurate condition of the pipeline as it regularly operates.

Reference electrodes such as copper-copper sulfate half cells should be kept clean and serviced regularly to ensure error free readings. Prior to beginning the survey, the field reference electrodes should be compared with a known, calibrated electrode to validate their effectiveness. If a 5 mV difference in potential exists, the field electrode should be emptied out, cleaned and refilled as per manufacturers recommendations prior to use in a survey.

When field personnel measure a P/S potential, the amount of pipe that is being reflected in the measurement is considered the length of pipe encompassed by a 120° arc centered from the position of the reference electrode³. The length of pipe sampled within a single P/S potential reading is depicted in Figure 1.

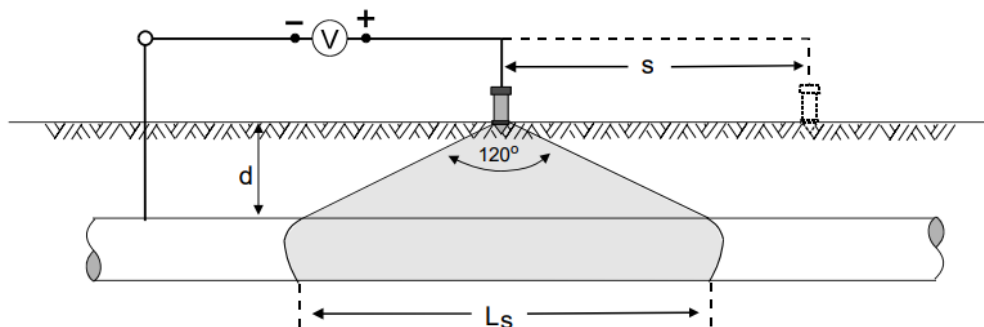


Figure 1: Length of Pipe Sampled within a P/S Measurement³

A simple approximation that should be used to determine the minimum reference electrode spacing interval (L_s), in feet, as a function of pipe depth (d), in feet, is given by the equation:

$$L_s = 3.5d + 1 \quad (\text{Eq.1})$$

This equation may be used by field personnel to ensure all regions of the pipeline are being accounted for. If a minimum spacing interval has been set within a contract, it must be lower than the spacing determined using the above equation if depth of pipeline is known.