

Cathodic Protection Area of Influence Study

Jared Pannell, Naga Vijayasankaran, Elena van Roggen Corpro,
7000 Hollister Road, Houston, TX 77040

ABSTRACT

As Cathodic Protection (CP) becomes more and more of a common practice to reduce the risk of external corrosion, areas are becoming congested with CP systems. This is seen predominantly in shared right-of-ways and in plant facilities. In a plant facility, every underground asset can be tied together through piping and electrical grounding. If test point locations do not meet criteria it can be challenging to determine which CP system should be adjusted to provide proper cathodic protection, without negatively impacting other adjacent continuous sub-surface assets. Area of influence testing is a way to identify the amount of IR (voltage drop) from a single CP system that most affects the sub-surface asset. This test can only be performed if the soil is considered homogeneous in resistivity, so R (resistance due to soil resistivity) becomes a constant. This is where an area of influence study can benefit the owner/operator of the assets.

Testing is done by turning all rectifiers Off and allowing the area to depolarize. Then a single rectifier is cycled On and Off, so that the area cannot polarize, and the IR drop can be recorded accurately at every test point in the area. The step is repeated for every rectifier one by one for the areal extent of the study

Readings taken at every test point location indicate the magnitude of influence of the individual CP system that is interrupted at that geographic location. Using Geographic Information System (GIS) technology, discrete test point readings are converted to a continuous interpolated surface using spatial interpolation algorithms such as Inverse Distance Weighted interpolation and Kriging which can be overlaid on imagery. This visual representation allows engineers to investigate the geographical extent and variance of the CP system influence on underground assets. Cumulative effects of multiple rectifiers in any given region can also be visualized in a similar fashion.

In plant facilities where there are hundreds of CP units, area of influence maps can highlight areas of concern and aids the decision-making process to balance potentials as required to meet criteria.

Key words: corrosion, cathodic protection, interference, GIS, area of influence, map

INTRODUCTION

As Cathodic Protection (CP) becomes more and more of a common practice to reduce the risk of external corrosion, areas are becoming congested with CP systems. This is seen predominantly in shared right-of-ways and in plant facilities. In a plant facility, every underground asset can be tied together through piping and electrical grounding. If test point locations do not meet criteria it can be challenging to determine which CP system should be adjusted to provide proper cathodic protection, without negatively impacting other adjacent continuous sub-surface assets. Area of influence testing is a way to identify the amount of IR (voltage drop) from a single CP system that most affects the sub-surface asset. Using Geographic Information System (GIS) technology, discrete test point readings are converted to a continuous interpolated surface using spatial interpolation algorithms such as Inverse Distance Weighted interpolation and Kriging which can be overlaid on imagery. The imagery displays visually the range and magnitude each CP system has on the surveyed sub-surface assets.

FIELD TESTING METHODOLOGY

To determine if a structure is considered cathodically protected, structure-to-soil potentials are recorded using a reference electrode. Two main criteria determine if a structure is protected: 1) Does it meet 100mV of polarization? 2) Does it meet the -850mV potential compared to a copper copper-sulfate reference electrode with IR drop included. IR drop is created by the current (I) of the cathodic protection source and the resistance (R) of the circuit. The controlling resistance is the soil between the reference electrode and the pipeline. Therefore, if we have uniform soil conditions, we have a constant resistance and we are able to determine the magnitude of CP being applied to each sub-surface asset.

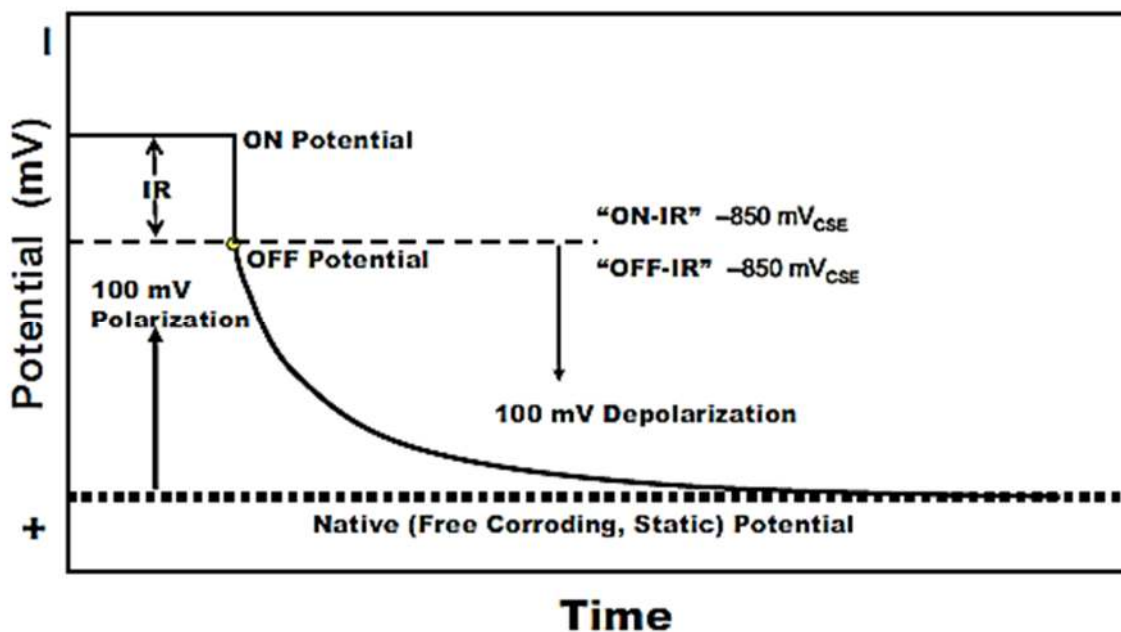


Figure 1. Polarization Curve₃

To identify and quantify the amount of CP being applied to each structure, all CP systems must be turned off long enough to depolarize the structures. Once the structures are depolarized then structure-to-soil readings are recorded for every test point, energizing one CP system at a time.