

Potential Measurements, How to Effectively Monitor the ‘Health’ of your Cathodic Protection System

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ABSTRACT

Structure-to-electrolyte potential measurements are the most fundamental process in the field of corrosion control. The purpose of a potential measurement is to obtain a general idea of the ‘health’ of the cathodic protection system. Potential measurements are often referred to as the ‘language’ of corrosion.

Some companies call it taking a read or measuring a key point, but in the end we are all performing the same type of testing. Many of us perform this activity year after year without acknowledging all of the very import factors involved to complete the work effectively. A well-maintained cathodic protection system requires reliable testing in order to verify its status.

This paper discusses the technical aspect of potential measurements along with testing methods and equipment maintenance recommendations. Simple routine maintenance of the multi-meter, test lead wires and reference electrode can ensure productive testing with trustworthy results. The methods and maintenance discussed will cover everything from reference electrode placement during measurement to the proper tools used for rebuilding a reference electrode.

Key Words: potential measurement, reference electrode, structure-to-electrolyte potentials

INTRODUCTION

Potential measurements are often referred to as the 'language' of corrosion. They are the most fundamental process in the field of corrosion control. The purpose of potential measurements is to obtain a general idea of the 'health' of the cathodic protection system.

TECHNICAL DISCUSSION

The unit for potential measurements is the Volt. Voltage is a measure of electromotive force or the amount of energy (work) to move an electric charge, per unit of electric charge. A pipe-to-soil potential is a measure of the voltage (difference in energy) between the pipe (structure) and the electrolyte (environment).

Potential measurements are generally used to evaluate the effectiveness of cathodic protection. They can be used to classify areas of the structure as anodic or cathodic to one another.

A potential measurement in the field of corrosion control can generally be described as a voltage measurement between a reference electrode (Cu/CuSO_4 $\frac{1}{2}$ cell) and a structure (pipe or tank). This is considered a full cell potential measurement. One $\frac{1}{2}$ cell potential is between the copper rod of the reference electrode and the earth (constant). The other $\frac{1}{2}$ cell potential is between the structure (pipe) and the earth (variable).

A $\frac{1}{2}$ cell is used for stable reproducible measurements. The definition of an adequate reference electrode is: *the $\frac{1}{2}$ cell potential must be stable within reasonable limits under practical field engineering conditions.*

EQUIPMENT

The equipment used for potential measurements include a voltmeter, reference electrode and test lead wires.

The voltmeter should have a high input impedance, 10 mega ohms as a minimum. The purpose of this is to ensure that the meter has a greater resistance than the test lead wires, pipe-to-earth and electrode-to-earth. That way these outside resistances will not affect the measurement. Older (analog) meters were made with low resistance circuits of 1000 to 2000 ohms. Measurements with low resistance voltmeters require corrections (correction factor) for the resistance of the external circuit.

The figure below is an example of a high input resistance multimeter. Be sure to note that there are three (3) voltage settings, Volts AC, Volts DC and millivolts DC. Some meters allow the millivolts setting to be toggled between AC and DC. It is important to select the correct setting. Please note that the author's first day in corrosion yielded pipe-to-earth potential data that was collected with the meter accidentally set to Volts AC in lieu of DC. Needless to say, this error was corrected and not soon forgotten.

