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July 2017

Potash Corporation
Suwannee River Chemical Plant
Post Office Box 300
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ATTN: Mr. Ken Tut
Project Representative

Suwannee River Chemical Plant
Effectiveness of Cathodic Protection
Survey Underground Natural Gas System

INTRODUCTION

The annual cathodic protection survey was conducted for Potash Corporation's Suwannee River Chemical Plant during the month of July 2017. During this survey, the Suwannee River Chemical Plant natural gas system was inspected for the effectiveness of cathodic protection, as applied. The cathodic protection system for Potash Corporation consists essentially of Galvomag Magnesium anodes placed in various locations throughout the natural gas distribution system.

RESULTS AND ANALYSIS

A total of Six [6] structure readings, Three [3] anode readings and One [1] casing reading were taken during this survey. As can be seen by the structure-to-soil potential measurements and the enclosed data sheet, 100% of the structure readings obtained are indicative of cathodic protection. A structure-to-soil potential of 850 millivolts or more negative is the basis used in this report to confirm cathodic protection.

IR DROP CONSIDERATION

The effectiveness of any cathodic protection system can be determined by taking potential measurements between the structure and a reference electrode. These potential measurements have traditionally been recorded with “average reading” digital voltmeters while the protective current is flowing or applied. These on-potential measurements contain the error produced by the voltage drop in the soil (electrolyte) and the voltage drop in the structure being protected. This error is referred to as *IR* drop. Interpretation of a current applied measurement requires consideration of the significance of voltage drops in the earth and metallic paths.

An instant off-potential measurement is the reading taken instantaneously after the protective current reaches zero. Off-potential measurements eliminate the *IR* drop error, allowing the true *IR* drop free polarized potential of a cathodically protected structure to be determined in the field. *IR* drop error is eliminated since there is no current flowing when the measurement is taken (i.e., $I=0$).

SURVEY TEST INSTRUMENTATION

The Cathodic Protection Analyzer, developed by Universal Rectifiers, Inc, (Hereinafter referred to as CPA), is a handheld instrument used with a reference electrode to measure the uninterrupted characteristics of the signal generated from a CP source. The analyzer can be used to evaluate the coating of a pipeline to ensure that the pipe is fully protected from corrosion. The CPA is designed for use with any pipeline system or structure at risk to corrosion factors. Aging pipes and changing conditions can cause significant problems, such as an increase in applied CP levels and enlarged holidays in coating. In addition, increased environmental concerns also emphasize the need to minimize leaks as much as possible.

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The CPA has computer capabilities of filtering interfering signals. The instrument is also capable of measuring several facets of the protection waveform. The software-driven instrument reads the minimum, average, and maximum voltage levels emanating from the pipe, thereby allowing an overview of the entire CPv signature. Digital signal processing makes the accuracy and precision of the CPA possible. It utilizes software to provide the extra speed and flexibility that is becoming increasingly important in the field.

The CPA is operated in conjunction with a Copper – Copper Sulfate [Cu/CuSO₄] shielded reference electrode known by its model number SPI, which allows the measurement of the cathodic protection voltage without interrupting the potential source.

RECOMMENDATIONS

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The sacrificial galvanic anode arrangement designed to protect the coated and wrapped steel natural gas system indicates adequate current to afford cathodic protection to the steel distribution system. Structure-to-soil readings obtained from Cathodic Test Points and gas risers on the steel distribution system indicate CP readings above State and Federal minimum standards of -0.850 volts direct current. The Railroad casing at CTP #2 was inspected and indicates a sacrificial anode installed on the casing pipe. The taped black casing wire on CTP #3 could not be located and requires remedial action to allow collection of potential readings of this gas casing pipe.

The six-inch steel gas pipe from the metering station to the limestone unloading area indicates adequate cathodic protection at this time. Structure-to-soil readings at the limestone unloading area indicate adequate cathodic protection levels and remedial action is not required to bring these piping areas into compliance with State and Federal minimum guidelines for applied cathodic protection.

At this time, the Natural Gas Distribution System for Potash Corporation's Suwannee River Chemical Plant complex indicates acceptable cathodic protection levels. Locate or replace the casing test lead for CTP #3 to allow determination of casing voltage and isolation status. I trust the above information to be satisfactory and in sufficient detail, however, should you require additional information, please contact me.

Sincerely,



Mitchell L. Whitfield
C.P. Tester

CATHODIC TEST POINTS

CATHODIC TEST POINTS

Potash Corporation – Suwannee River Chemical Plant
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CTP - #1

Red Anode Wire	-1.582 Vdc
Black Gas Pipeline Wire	-1.377 Vdc
Anode / Gas Line Wires Combined	-1.502 Vdc

CTP - #2

Red Anode Wire	-1.391 Vdc
Black [Tape] Casing Pipeline Wire	-0.994 Vdc
Black Gas Pipeline Wire	-1.008 Vdc
Anode / Gas Line Wires Combined	-1.214 Vdc

CTP - #3

Red Anode Wire	-1.327 Vdc
Black [Tape] Casing Pipeline Wire	Missing Wire
Black Gas Pipeline Wire	-0.991 Vdc
Anode / Gas Line Wires Combined	-1.229 Vdc

STRUCTURE-TO-SOIL POTENTIALS
GAS PIPE CASINGS

STRUCTURE-TO-SOIL POTENTIAL - GAS PIPE CASINGS

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<u>Test Location</u>	<u>Energized Potentials Volts</u>
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*Railroad Casing @ CTP #3	-0.000
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Scale House Drive Casing @ CTP #2	-0.796
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*Casing Anode Installed - Cathodic Test Point Missing Casing Wire which requires locating or replacing.

STRUCTURE - TO - SOIL POTENTIAL DATA

STRUCTURE – TO – SOIL POTENTIAL DATA

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Test Location	Energized Potentials Volts
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Metering Station [6" Steel Line Outlet]	-1.215
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Limestone Loading [6" Riser Inlet]	-1.134
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