

TABLE OF CONTENTS

CATHODIC TEST POINTS-----	5
GAS PIPE CASING-----	7
INTRODUCTION-----	1
<i>I</i> R DROP CONSIDERATION-----	2
RECOMMENDATIONS-----	4
RESULTS AND ANALYSIS-----	1
STRUCTURE-TO-SOIL POTENTIAL DATA-----	9
SURVEY TEST INSTRUMENTATION-----	2

July 2017

Potash Corporation
Swift Creek Mining Plant
Post Office Box 300
White Springs, Florida 32096-0300
ATTN: Mr. Ken Tut
Project Representative

Swift Creek Mining Plant
Effectiveness of Cathodic Protection
Survey Underground Natural Gas System

INTRODUCTION

The annual cathodic protection survey was conducted for Potash Corporation – Swift Creek Mining Plant during the month of July 2017. During this survey, the Swift Creek Mining Plant natural gas system was inspected for the effectiveness of cathodic protection, as applied. The cathodic protection system for the Swift Creek Mining Plant consists essentially of Galvomag Magnesium anodes placed in various locations throughout the natural gas system.

RESULTS AND ANALYSIS

A total of Seven [7] structure readings, Three [3] anode readings and Five [5] casing readings were taken during this survey. As can be seen by the structure-to-soil potential measurements and the enclosed data sheet, 100% of the gas pipeline readings obtained are indicative of cathodic protection. A structure-to-soil potential of 850 millivolts or more negative direct current 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. It 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.

Swift Creek Mining Plant
July 2017

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

Potash Corporation – Swift Creek Mining Plant
Underground Natural Gas System
July 2017

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. One [1] highway casing, two [2] railroad casings and Two [2] CTP casings were inspected during this survey.

At this time, the Natural Gas Distribution System for Potash Corporation's Swift Creek Mining Plant complex indicates cathodic protection levels exceeding State and Federal minimum guidelines for applied cathodic protection I trust the above information to be satisfactory and in sufficient detail, however, should you require additional information, please contact me.

Sincerely,



Mitchell Whitfield
C.P. Tester

CATHODIC TEST POINTS

CATHODIC TEST POINTS

Potash Corporation – Swift Creek Mining Plant
Underground Natural Gas System
July 2017

CTP - #1

Black Anode Wire	-1.542 Vdc
Black Gas Pipeline Wire	-1.201 Vdc
White Casing Pipe Wire	-0.564 Vdc

CTP - #2

Black Anode Wire	-1.129 Vdc
Black Gas Pipeline Wire	-1.008 Vdc
White Casing Pipe Wire	-0.611 Vdc

CTP - #3

Black Anode Wire	-1.421 Vdc
Green Gas Pipeline Wire	-1.233 Vdc

STRUCTURE-TO-SOIL POTENTIALS
GAS PIPE CASINGS

STRUCTURE-TO-SOIL POTENTIAL - GAS PIPE CASINGS

Potash Corporation – Swift Creek Mining Plant

Underground Natural Gas System

July 2017

<u>Test Location</u>	<u>Energized Potentials Volts</u>
Railroad Casing - #1	-0.422
Railroad Casing - #2	-0.534
Highway Casing - #3	-0.449

STRUCTURE - TO - SOIL POTENTIAL DATA

STRUCTURE – TO – SOIL POTENTIAL DATA

Potash Corporation – Swift Creek Mining Plant

Underground Natural Gas System

July 2017

<u>Test Location</u>	<u>Energized Potentials Volts</u>
Gas Metering Station - Inlet	-1.137
Gas Metering Station – Outlet	-1.109
4” Gas Riser @ Plant	-1.211
2” Gas Riser @ Boiler Room	-1.274