Testing and Commissioning
Addison Natural Gas Project
(30 Mile Section)

Prepared for:

Vermont Gas Systems, Inc.

Prepared by:

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1 INTRODUCTION

ARK Engineering designed a cathodic protection (CP) system for the Vermont Gas Addison Natural Gas Project. The CP system consists of two (2) impressed current anode systems designed to protect the 30 mile section of pipeline.

2 DATA

Addison Natural Gas Project - Section 2 - CP Systems:

Shunt voltage was measured with the positive lead of the multimeter connected to the pipe side of the shunt and the negative lead of the multimeter connected to the anode side of the shunt. All shunts in the test stations were sized at 0.01 Ω.. The anodes were read from left to right in the junction box, and their results are listed below. Table 2.1 is the Rotax Road system location and Table 2.2 is the U.S. 7 system location.

Monkton/Rotax Road Anode Bed:

This anode bed consists of ten (10) anodes. The anode bed is 135 feet in length and the anodes are installed approximately 15 feet apart. The anodes are insulated with LORESCO SC-3 Coke Breeze Backfill and covered using clean backfill.

Monkton/Rotax Road Rectifier:

Rectifier Information:

JA Electronics
Model: CSA 1
Serial Number: 2150055
Rated at:
DC: 40 VDC and 20 Amps
AC: 120/240

The unit was set at Course A, Fine 1 with an output of 1.368 VDC and 0.11 amps. The commissioning survey was completed at this level.

Table 2.1 Anode readings from the junction box located at Rotax Road

Anode	Shunt	DC Voltage (Volts)	DC Current (Amps)
Lead 1	.01 ohm	.15 mv	0.015 A
Lead 2	.01 ohm	.12 mv	0.012 A
Lead 3	.01 ohm	.09 mv	0.009 A
Lead 4	.01 ohm	.35 mv	0.035 A
Lead 5	.01 ohm	.19 mv	0.019 A
Lead 6	.01 ohm	.14 mv	0.014 A
Lead 7	.01 ohm	.11 mv	0.011 A
Total	.01 ohm	1.15 mv	0.115 A

NOTE: Leads 1 through 6 are individual anodes. Lead 7 has four (4) anodes on a single header cable.

Middlebury/U.S. 7 Anode Bed:

This anode bed consists of five (5) anodes. The anode bed is 60 feet in length and the anodes are installed approximately 15 feet apart. The anodes are insulated with LORESCO SC-3 Coke Breeze Backfill and covered using clean backfill.

Middlebury/U.S. 7 Rectifier:

Rectifier Information:

JA Electronics
Model: CSA 1
Serial Number: 2150056
Rated at:
DC: 40 VDC and 20 Amps
AC: 120/240

The unit was set at Course A, Fine 1 putting out 1.436 VDC and 0.15 amps. The commissioning survey was completed at this level.

Table 2.2 Anode readings from the junction box located at U.S. 7.

Anode	Shunt	DC Voltage (Volts)	DC Current (Amps)
Lead 1	.01 ohm	.35 mv	0.035 A
Lead 2	.01 ohm	.25 mv	0.025 A
Lead 3	.01 ohm	.28 mv	0.028 A
Lead 4	.01 ohm	.28 mv	0.028 A
Lead 5	.01 ohm	.24 mv	0.024 A
Total	.01 ohm	1.40 mv	0.14 A

Pipeline Potential Measurements: Pipe-to-soil voltage measurements were taken using a Fluke 87V digital voltmeter and a copper-copper sulfate electrode (CSE). Potentials were measured at accessible test stations and SSD's along the pipeline. Measurements were recorded on 3/16-17/2017 and are listed in Table 2-3.

Table 2.3 Pipeline Potential Measurements:

Pipeline Distance	DC Voltage (On)	DC Voltage (Off)	AC Voltage
1050+00	-1.282 VDC	-1.179 VDC	0.468 VAC
1114+00	-1.172 VDC	-1.062 VDC	0.625 VAC
1309+00	-1.215 VDC	-1.157 VDC	0.165 VAC
1424+50	-1.195 VDC	-1.138 VDC	0.372 VAC
1525+25	-1.185 VDC	-1.141 VDC	0.108 VAC
1568+00	-1.155 VDC	-1.116 VDC	0.347 VAC
1712+80	-1.192 VDC	-1.112 VDC	0.222 VAC
1769+00	-1.172 VDC	-1.095 VDC	0.247 VAC
1846+00	-1.098 VDC	-1.015 VDC	0.217 VAC
2010+00	-1.200 VDC	-1.156 VDC	1.42 VAC
2148+50	-1.321 VDC	-1.162 VDC	1.06 VAC
2172+50	-1.066 VDC	-0.946 VDC	0.482 VAC
2279+88	-1.024 VDC	-0.941 VDC	0.247 VAC

3 CONCLUSIONS

There were several pipe-to-soil potential measurements taken during the initial survey that seemed to be more negative than they should be compared to normal "native" potentials expected of steel pipelines. This would be evidence that these areas could be receiving CP current from an outside source (other than the two intended impressed current systems). It was found that there were pieces of zinc ribbon accidentally shorted to the pipeline at a nearby station under construction at the time of the initial survey. These inadvertent shorts were removed as they were discovered. However, due to the amount of time they were shorted and the pipe being very well coated, potentials in the area remained artificially negative. Once the rectifiers were turned on and balanced, the potentials for these test locations reflected normal magnitudes in comparison with the rest of the pipeline potentials.

The cathodic protection system for this pipeline section is functioning as designed and providing adequate CP in accordance with 49 CFR 192 and accepted NACE criteria as recommended in NACE Standard Practice - SP 01-69.

While we were unable to test the entire line due to weather issues, we did gather enough data during our first two runs to confirm that the SSD's as well as the test stations that are currently installed are functioning as designed. The pipeline DC voltage is consistently in the -1.1 VDC range and only falls below -1.0 VDC at the start of the section. The CP voltage in this area is still well above the requirements in 49 CFR 192.

4 RECOMMENDATIONS

ARK Engineering notes the following:

- With the impending tie in of additional piping, this will increase the surface area protected by these rectifiers. Upon completion of the tie-in, ARK Engineering recommends that additional testing take place and adjustments to the rectifiers to accommodate any additional current requirement.

Please contact the author if you have any questions or require additional information.