Chapman Engineering

CORPORATE OFFICE:
213 Commerce Ave
Boerne, Texas 78006

April 25, 2025

Mr. Bill Lewis
TR Consultants Via E-Mail: bill@trconsultants.com

Re: **City of Castroville's Gas Distribution System 2025 Annual Cathodic Protection Survey Report**

Dear Mr. Lewis:

Chapman Engineering was tasked with performing the 2025 Annual Cathodic Protection (CP) survey and assessment for the City of Castroville's gas distribution CP system. The city's underground metallic gas pipeline distribution system has two existing Impressed-Current CP (ICCP) systems and multiple supplemental Galvanic Anode CP (GACP) systems installed as a means of corrosion protection. Below is an aerial image of The City of Castroville with the two rectifiers labeled:

City of Castroville

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(830) 816-3311 - (800) 375-7747 – Fax (830) 816-1753
info@chapman.engineering – www.chapman.engineering

The survey work was performed by NACE-Certified Tester (CP-1) Kaleb Estrada and Gerald Schroeder on April 11th of 2025. All work was overseen by NACE-Certified Specialist (CP-4) Cal Chapman, P.E., and NACE-Certified Technician (CP-2) Sam Willimas, E.I.T.

The purpose of the annual CP survey is to ensure that protective current flow, from the various CP systems installed, to buried metallic structures is adequate according to the applicable industry standards and federal, state, and local regulations. The following section details the industry standards set forth by the National Association of Corrosion Engineering (NACE).

CRITERIA FOR ADEQUATE CP

According to NACE Standard Practice SP0169-2013, three criteria are used to determine if adequate CP is being applied to a pipeline for control of external corrosion.

The criteria are:

1. A (cathodic) potential difference of at least -850 millivolts (-0.850 volt or V) is measured with the cathodic protection applied, and with any "IR drop" in the measurement circuit factored out. This potential difference is with respect to a saturated copper/copper sulfate reference electrode contacting the electrolyte.

2. A polarized potential of at least -850 millivolts (-0.850 V) is measured relative to a saturated copper/copper sulfate reference electrode, with the CP current interrupted. Measurement of this "immediate off" or IR-Free (IRF) voltage is done at least 0.1 second after the protective current is interrupted.

3. A minimum of 100 millivolts (-0.100 V) of cathodic polarization is found between the structure surface and a stable reference electrode contacting the electrolyte. The formation or decay of polarization can be measured to satisfy this criterion. This polarization "shift" is obtained by comparing the "immediate off" voltage to the unprotected (or "native") voltage of the structure.

If any one of these criteria is met, then a pipeline is typically judged to be under adequate CP. Please note that many CP practitioners do not feel that the "system on" criterion is valid in most cases, because estimating the contribution of "IR drop" to a "system on" voltage is so cumbersome. Chapman Engineering generally prefers to apply the second and third criteria to determine if adequate CP is being applied.

DATA COLLECTION PROCESS

All pipe-to-soil potentials or voltages were taken with a calibrated high-impedance multi-meter with respect to a copper-copper sulfate reference electrode. Chapman personnel attempted to install synchronized current interrupters to obtain data to prove the system was in compliance with criterion two as well as one but was unsuccessful.

At the Visitor Center, the rectifier exhibited smaller than normal tap setting connections and was unsuitable for current interruption due to poor contact and visible sparking, posing a safety hazard. The rectifier located at the baseball field was mounted at a height that required additional support for safe access. Operating electrical components at that elevation without proper assistance was considered unsafe. Consequently, current interruption testing could not be safely performed at either location.

Photographs of each rectifier followed by the rectifier operating record are shown below:

Gas Distribution System Rectifier Field Imagery

Location	Serial Number	Tap Settings		DC Outputs		Resistance (Ω)
		Coarse	Fine	Volts (V)	Amps (A)	
Visitors Center	992585	2	1	14.11	3.5	4.03
Baseball Field	8861077	3	4	24.94	10.2	2.45

Gas Distribution System Rectifier Operating Record

The City of Castroville's gas distribution system had a total of 55 test points that should be protected by means of ICCP and supplementary GACP systems. 23 test points in this section did not meet any of the criteria. They are as follows:

Structure ID	Criterion Not Met	Structure-to-Soil Potential (mV)
4CER	1, 2, & 3	-576
6CER	1, 2, & 3	-670
7CER	1, 2, & 3	-694
8CER	1, 2, & 3	-662
11CER	1, 2, & 3	-591
15CER	1, 2, & 3	-289
21CER	1, 2, & 3	-710
22CER	1, 2, & 3	-734
23CER	1, 2, & 3	-697
25CER	1, 2, & 3	-642
30CER	1, 2, & 3	-649
31CER	1, 2, & 3	-799
35CER	1, 2, & 3	-711
36CER	1, 2, & 3	-803
37CER	1, 2, & 3	-676
38CER	1, 2, & 3	-762
39CER	1, 2, & 3	-736
40CER	1, 2, & 3	-846
8CTPN	1, 2, & 3	-264
9CTPN	1, 2, & 3	-461
25CTPN	1, 2, & 3	-343
26CTPN	1, 2, & 3	-611
28CTPN	1, 2, & 3	-547

Gas Distribution System Exception Table

All data collected during the annual survey is detailed in a data table appended to this report.

CONCLUSIONS

As previously noted, not all structure-to-electrolyte (pipe-to-soil) voltage measurements met the NACE SP0169-2013 criteria during the 2025 annual CP survey. The majority of test points located failed to satisfy the -850 mV protection threshold, as outlined earlier in the report. The majority of the test locations exhibited structure-to-soil voltage values and visible site conditions indicative of either the lack of an anode, depleted galvanic anodes or undersized anodes insufficient to deliver adequate protective current.

Furthermore, the proximity of test points with significantly different potential readings suggests electrical discontinuity within sections of the gas distribution system. This discontinuity may be attributed to high-resistance mechanical joints or transitions from metallic to polyethylene (PE) pipe segments where leak repairs have been made. In such cases, each isolated section may effectively behave as an electrically independent system and should be treated as a separate CP zone requiring its own anode installation and monitoring. This may also contribute to the inefficiency of the rectifiers, as the current from the ICCP system cannot physically reach these isolated sections of pipes.

At multiple locations, one-pound magnesium anodes were observed to be directly connected to the metallic gas piping. These smaller anodes, while nominally capable of producing protective current, are generally inadequate for long-term CP performance, particularly when soil conditions or system demands exceed design expectations.

RECOMMENDATIONS

Chapman Engineering recommends the replacement of anodes at all locations where insufficient pipe-to-soil potentials were found. The anode will be placed at an appropriate depth of 24” to ensure effective current distribution, which will help prevent further degradation of the underground gas piping system.

Each location of gas piping is identified as electrically discontinuous and will be evaluated and protected as an independent system, with dedicated 5-pound anodes instead of 1-pound anodes. This will help ensure that each electrically isolated segment receives sufficient protective current to meet NACE standards and mitigate long-term corrosion risk.

Chapman Engineering personnel were unable to locate several test points. To improve future monitoring and system management, Chapman also recommends enhanced documentation practices for the gas distribution system. This should include precise geographic coordinates (latitude and longitude), comprehensive location descriptions, detailed mapping of all metallic and non-metallic components, depth of cover, and identification of transition fittings. Improved records will facilitate targeted maintenance, compliance reporting, and more effective troubleshooting.

Finally, Chapman recommends that TR Consulting continue ongoing monitoring of CP effectiveness, including regular evaluation of both the ICCP systems and any supplemental GACP protective current output. This includes periodic verification of current output, structure-to-electrolyte potential or voltage measurements, and system continuity to ensure continued compliance with applicable NACE and RRC standards.

Chapman Engineering recommends 5lb. anodes be installed at 21 locations. To perform the anode replacement work, briefly described above, Chapman Engineering offers the following work scope, budget, and timeline.

SCOPE OF WORK

To complete the anode installations safely and successfully, Chapman Engineering will perform the following work steps:

- Submit a Texas-State One-Call 48 hours prior to start of project;
- Mobilize two-man crew to specified project site;

- Measure structure-to-soil voltage on specified piping, test station, etc. as a baseline for later comparison;
- Hand-dig a 2-foot deep excavation for 5 lb. anode placement;
- Carefully place One (1) 5 lb. anode in the excavation being careful not to damage the anode lead;
- Hydrate the prepackaged 5 lb. anode in the excavation per manufacturer's recommendations;
- Backfill and compact anode excavation;
- Measure structure-to-soil voltage on specified piping, test station, etc. to determine the difference between the baseline and as-built.

Once all anode installations and commissioning testing are completed, Chapman Engineering will prepare a detailed report to include data findings, conclusions, and recommendations.

PROJECT BUDGET & TIMELINE

To complete the above-stated scope of work, Chapman Engineering offers a cost estimate in the form of a day rate of **$2,875.00.** Chapman Engineering anticipates the ability to complete 2-3 anode installs in a 10-hour day.

This cost estimate includes travel, equipment, material, labor, and final reporting associated with this project. This proposal does not include Texas state sales tax.

Chapman Engineering project management will coordinate scheduling with TR Consultants if awarded the project.

ADDITIONAL WORK

We must have your approval of any change-order prior to any additional costs being incurred. If change-order work becomes necessary, all Time and Materials work and travel will be billed according to our Rate Sheet on file with your company.

PAYMENT TERMS

The client agrees to pay the Chapman Engineering invoice(s) in such a manner as described in the Master Service Agreement in place between our companies. If no discussion is made in the proposal, then Client agrees to pay any Chapman Engineering invoice upon receipt. If payment is not received within 30 days from the invoice date, Client agrees to pay a service charge on the past due amount at the prevailing legal rate, including reasonable attorney's fees, if collected through an attorney. No deduction shall be made from the invoice on account of liquidated damages or other sums withheld from payments to contractors or others. Either party may terminate this Agreement without cause upon 30 days written notice to the other party. In the event Client requests termination prior to completion, Client agrees to pay Chapman Engineering for all costs incurred plus reasonable charges associated with termination of work.

Any requested changes to previously completed work or additional work requested by the Client will be charged on an hourly basis and are not included in any "not to exceed" fees listed above.

AUTHORIZATION

Please find attached an "Acceptance" block, for you to complete should you give us authorization and "notice to proceed." We will set a schedule with you for performance of the project work once that "notice" has been received in our office. Issuance of a PO is acceptance of the terms of this quote.

Please call our office with any questions or comments, and we thank you very much for your business.

Respectfully Submitted,

Samuel Williams, E.I.T.
Project Manager
NACE CP Technician #43971
NACE Coating Inspector #66564

Cal Chapman, P.E.
President
Texas PE #81268
Oklahoma PE #26056
NACE-Certified Cathodic Protection Specialist #23357

Data Summary Tables:

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UNIQUE NUMBER	LOCATION TEST POINT	P/Sf (VOLTS)	F/S (VOLTS)	REMARKS
01 CER	1102 GENTILZ	-1.231	-0.324	
02 CER	1405 GENTILZ	-1.351	-0.325	
03 CER	1113 FLORENCE	-1.116	-0.312	
04 CER	812 ALGIERS	**-0.576**	-0.320	5lb. magnesium anode recommended
05 CER	1308 MADRID	-0.948	-0.327	
06 CER	1205 LAFAYETTE	**-0.670**	-0.323	5lb. magnesium anode recommended
07 CER	810 HIGHWAY 90	**-0.694**	-0.320	5lb. magnesium anode recommended
08 CER	1105 LAFAYETTE	**-0.662**	N/A	P/SF 5lb. magnesium anode recommended, F/S abandoned meter
09 CER	905 FLORENCE	N/A	N/A	the gas riser assembly was not located during the inspection
10 CER	904 GENTILZ	N/A	N/A	anodeless riser, no CP required
11 CER	616 LAFAYETTE	**-0.591**	-0.334	5lb. magnesium anode recommended
12 CER	521 HIGHWAY 90	-1.611	-0.638	
13 CER	200 FM 471	-2.674	-0.384	
14 CER	232 MAY	-1.208	-0.263	
15 CER	214 BRAIDEN	**-0.289**	-0.280	recent installation of mag anode, 5lb. magnesium anode recommended
16 CER	215 ALVIA	-1.220	-0.262	
17 CER	1011 FM 471	N/A	-0.319	anodeless riser, city side (upstream) has riser, F/S runs beneath grade, 5lb. magnesium anode recommended
18 CER	FM 471& RIVERSIDE	N/A	N/A	the gas riser assembly was not located during the inspection
20 CER	208 LAFAYETTE	N/A	N/A	locked gate, no access to gas riser assembly
21 CER	1207 ISABELLA	**-0.710**	-0.514	recent installation of mag anode, 5lb. magnesium anode recommended
22 CER	200 HOUSTON	**-0.734**	-0.444	5lb. magnesium anode recommended
23 CER	1619 SAN JACINTO, APT.#3	**-0.697**	-0.319	5lb. magnesium anode recommended
24 CER	305 BERLIN	N/A	N/A	anodeless riser, no CP required, tracer wire not present
25 CER	501 WASHINGTON	**-0.642**	N/A	5lb. magnesium anode recommended
26 CER	901 WASHINGTON	-1.344	N/A	F/S abandoned meter
27 CER	1213 CHATEAU	-1.262	-0.187	
28 CER	1404 WASHINGTON	N/A	N/A	locked gate, no access to gas riser assembly
29 CER	1306 BERLIN	N/A	N/A	anodeless riser, no CP required
30 CER	1715 MEXICO	**-0.649**	-0.404	5lb. magnesium anode recommended, F/S runs beneath grade (CP recommended)

CATHODIC PROTECTION CRITERION -0.850 VOLTS - All "P/Sf" READINGS IN BOLD ARE FAILINGNote: all potentials are measured in negative volts with respect to a saturated copper-copper sulfate reference electrode.

P/Si = initial pipe-to-soil potential. **P/Sf** = final pipe-to-soil potential. **F/S** = foreign pipe-to-soil potential (structure side).

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UNIQUE NUMBER	LOCATION TEST POINT	P/Sf (VOLTS)	F/S (VOLTS)	REMARKS
31 CER	1604 NAPLES	**-0.799**	-0.346	5lb. magnesium anode recommended, F/S runs beneath grade (CP recommended)
32 CER	913 HOUSTON	-1.070	-0.466	
33 CER	1308 HOUSTON	-0.882	-0.322	remove debris from around gas riser assembly, potential hazard
34 CER	1511 JACKSON	-0.866	N/A	F/S abandoned meter, currently uncapped and requires proper capping to prevent gas migration or water intrusion
35 CER	1409 HOUSTON	**-0.711**	N/A	5lb. magnesium anode recommended, F/S abandoned meter
36 CER	811 PETERSBURG	**-0.803**	-0.414	5lb. magnesium anode recommended
37 CER	1415 LORENZO	**-0.676**	-0.278	5lb. magnesium anode recommended
38 CER	509 HIGHWAY 90	**-0.762**	-0.351	5lb. magnesium anode recommended
39 CER	1116 ANGELO	**-0.736**	N/A	master meter- magnesium anode recommended, F/S anodeless riser, no CP required,
40 CER	1209 BERLIN	**-0.846**	-0.355	5lb. magnesium anode recommended
01 CTPN	PG&E PURCHASE STATION	N/A	N/A	the gas line was not located during the inspection, the exact location remains unclear, and additional information or utility records will be required to verify its presence and status
02 CTPN	HIGHWAY 471 ROAD CROSSING	N/A	N/A	the gas line was not located during the inspection, the exact location remains unclear, and additional information or utility records will be required to verify its presence and status
03 CTPN	CR 4713 CROSSING	N/A	N/A	the gas line was not located during the inspection, the exact location remains unclear, and additional information or utility records will be required to verify its presence and status
04 CTPN	CR 5711 & CR 483	N/A	N/A	the gas line was not located during the inspection, the exact location remains unclear, and additional information or utility records will be required to verify its presence and status
06 CTPN	FM 471 & MEDINA VALLEY HS	N/A	N/A	the gas line was not located during the inspection, the exact location remains unclear, and additional information or utility records will be required to verify its presence and status
08 CTPN	HIGHWAY 90 (RECTIFIER SOUTH SIDE)	**-0.264**	N/A	5lb. magnesium anode recommended, F/S none
09 CTPN	HIGHWAY 90 (RECTIFIER SOUTH SIDE)	**-0.461**	N/A	5lb. magnesium anode recommended, F/S anodeless riser, no CP required
10 CTPN	225 LOWER LACOSTE	N/A	N/A	the gas line was not located during the inspection, the exact location remains unclear, and additional information or utility records will be required to verify its presence and status
11 CTPN	925 LOWER LACOSTE	N/A	N/A	the CP test station at this location was found to be damaged and is no longer suitable for accurate testing, repair or replacement is recommended to ensure continued monitoring of CP levels.
21 CTPN	HIGHWAY 90 & CONSTANTINOPLE	N/A	N/A	the gas line was not located during the inspection, the exact location remains unclear, and additional information or utility records will be required to verify its presence and status

CATHODIC PROTECTION CRITERION -0.850 VOLTS - All "P/Sf" READINGS IN BOLD ARE FAILING

Note: all potentials are measured in negative volts with respect to a saturated copper-copper sulfate reference electrode.
P/Si = initial pipe-to-soil potential. **P/Sf** = final pipe-to-soil potential. **F/S** = foreign pipe-to-soil potential (structure side).

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UNIQUE NUMBER	LOCATION TEST POINT	P/Sf (VOLTS)	F/S (VOLTS)	REMARKS
25 CTPN	MEXICO & LISBON	**-0.343**	-0.110	5lb. magnesium anode recommended
26 CTPN	LISBON & NAPLES	**-0.611**	N/A	5lb. magnesium anode recommended, F/S none, gas riser assembly pipe damaged
28 CTPN	7 EWPL ON FLORENCE	**-0.547**	N/A	F/S anodeless riser, no CP required
48 CTPN	1102 WASHINGTON	-0.904	-0.243	
60 CTPN	1402 VIENA	-0.915	-0.595	
61 CTPN	FM 471 & CR 583	N/A	N/A	the gas line was not located during the inspection, the exact location remains unclear, and additional information or utility records will be required to verify its presence and status

CATHODIC PROTECTION CRITERION -0.850 VOLTS - All "P/Sf" READINGS IN BOLD ARE FAILING

Note: all potentials are measured in negative volts with respect to a saturated copper-copper sulfate reference electrode.
P/Si = initial pipe-to-soil potential. **P/Sf** = final pipe-to-soil potential. **F/S** = foreign pipe-to-soil potential (structure side).

SURVEYED BY:

NACE-Certified Tester (CP-1) Kaleb Estrada
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