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From Division or Department **GAS DISTRIBUTION**

To Division or Department
FILE NO. 203

RE: LETTER OF
SUBJECT Revised Standard Practice 412-1
"Corrosion Control of Gas Facilities"


April 18, 1984

DIVISION MANAGERS:

Attached is the revised Standard Practice 412-1 "Corrosion Control of Gas Facilities" effective April 1, 1984.

All sections of this Standard Practice have been revised and are in consort with the current issue of G.O. 112. Divisions and Districts should review their corrosion related procedures and modify corrosion control practices as required. Audits in 1984 by the Gas Distribution Department will include, where possible, discussion of the various aspects of Standard Practice 412-1.


N. L. BRYAN


cc Managers, Gas Operations
Division Gas Superintendents

PACIFIC GAS AND ELECTRIC COMPANY

STANDARD PRACTICEGeneral Office -
Gas Operations

STANDARD PRACTICE NO. 412-1

EXECUTIVE OFFICE OR DIVISION _____

PAGE NO. 1 EFFECTIVE 4/1/84

ISSUING DEPARTMENT Gas Distribution

REPLACING PAGE NO. 1 EFFECTIVE 2/1/69

SUBJECT:

CORROSION CONTROL OF GAS FACILITIES

PURPOSE

1. This Standard Practice establishes responsibilities and procedures for planning, installing and maintaining corrosion control equipment on pipeline facilities.

POLICY

2. All new steel pipe is to be externally coated and cathodically protected. Analysis will be conducted on existing facilities for the presence of external or internal corrosion. When evidence of external corrosion is found, the need for cathodic protection will be analyzed and provided where appropriate. When evidence of internal corrosion is found, an analysis will be made and the appropriate mitigating measures taken.

RECISSIONS

3. All previous instructions, written or oral, that do not conform to this Standard Practice.

REFERENCES

4. The current edition of CPUC General Order No. 112.
5. Gas Distribution Department Corrosion Manual and applicable Gas Standards.

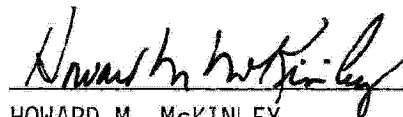
RESPONSIBILITY

6. It is the responsibility of the Division Gas Superintendents and the Manager of Pipe Line Operations to enforce the requirements of this Standard Practice.

APPLICATION

7. The procedures set forth apply to the Divisions and Pipe Line Operations Department. Whenever the term "Division" is used, it is intended to include all thirteen Divisions and Pipe Line Operations.
8. This Standard Practice supplements and clarifies G.O. 112 Subpart I which is the primary guideline for corrosion control and cathodic protection. Additional information is contained in the "Gas Standards and Specifications Book" and in the Gas Department "Corrosion Manual". Procedural details appear in the Supplement of this Standard Practice.

Approved By


HOWARD M. MCKINLEY,
Vice President, Gas Operations* Paragraph Revised
** Paragraph Added

(SEE OVER)

PACIFIC GAS AND ELECTRIC COMPANY

STANDARD PRACTICE

EXECUTIVE OFFICE OR DIVISION Gas Operations
General Office

ISSUING DEPARTMENT Gas Distribution

STANDARD PRACTICE NO. 412-1

PAGE NO. 2 EFFECTIVE 4/1/84

REPLACING 2 EFFECTIVE 2/1/69

SUBJECT:

CORROSION CONTROL OF GAS FACILITIES (cont'd)

Distribution

- Division Managers
- District Managers
- Division Gas Superintendents
- District Gas Superintendents
- Manager, Gas Mech. Services
- Manager, Pipe Line Operations
- Managers, Gas Operations

Additional copies of this Standard Practice may be obtained from Gas Operations, 77 Beale Street, San Francisco, Extension 222-1604.

* Paragraph Revised
** Paragraph Added

(SEE OVER)

PROCEDURAL DETAILS
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9. All new or replacement metallic pipeline facilities must be installed with a coating and must be cathodically protected within one year after installation. This includes all transmission, distribution and service lines.
 - 9.1. See Appendix "A" for cathodic protection guidelines for steel mains and services.
 - 9.2. Transmission main cathodic protection requirements shall be determined by test and galvanic anodes or rectifier stations installed as required.
 - 9.3. Steel components in plastic piping systems shall be protected according to Gas Standards A 90.2, A 90.3 and A 91.2.
 - 9.4. Unless approved by the Gas Distribution Department all existing coated transmission and distribution facilities are to be cathodically protected by January 1, 1990.

Bare steel distribution main and cast iron will not be cathodically protected because of possible interference.

10. Cathodic Protection (C.P.) areas are to be designed in accordance with the following guidelines:
 - 10.1. Judgment is to be used when delineating cathodic protection areas so that they are not excessively large or small. Ideally, an area should contain no more than three rectifiers.
 - 10.1.1. Rectifier and or galvanic anode systems may be designed and installed on the basis of the current requirement estimate.
 - 10.1.2. Any cathodic protection system or isolated pipe section having average current requirements greater than 0.2 MA/sq. ft. must be approved by the Gas Distribution Department.
 - 10.2. Rectifier sites are selected so as to maintain a minimum 50-foot separation (2.5 Amp output) between the anode bed and any foreign underground metallic structures such as water lines, underground electric with bare neutral, metal sheathed telephone or cable TV, chain-link fence posts, metal barbwire fence posts, electric ground rods, and guy wire anchors, etc.

A minimum separation of 10 feet for each Amp of current output is required between anode beds and protected gas mains or services to prevent coating damage. If these conditions cannot be met, a deep well anode is required. A 120-foot deep ground bed shall be limited to 3.5 Amps. If the 120-foot cannot be obtained, the current output is derated at 0.5 Amp for each 10 feet; i.e., 3.0 Amps at 110 feet, 2.0 Amps at 90 feet, etc. Rectifier sites shall be reviewed annually for conflicts with newly installed buried facilities; i.e., water services, mains, electric underground, chain-link fences, etc.

Rectifiers are to be permanently marked with the maximum allowed current output based on the preceding guidelines.

- 10.3. Insulating devices may be used in underground vaults. When protection from possible arcing is required, the metallic separation achieved in insulating devices usually is sufficient to provide the necessary protection. If additional protection is required, contact the Gas Distribution Department.
- 10.4. It may be necessary to provide additional galvanic grounding on pipelines which closely parallel 230 KV or 500 KV circuits. Where pipelines parallel these AC circuits for appreciable distances (over one mile) and are within 1,000 feet of an AC conductor, grounding should be considered. Special precautions may be necessary if well coated pipelines are being constructed and operated under the conditions described above. Grounding procedures required vary greatly from one location to another and where problems are encountered or anticipated contact the Gas Distribution Department.
- 10.5. Wire test leads are to be installed in accordance with Gas Standard 0-10 and 0-10.1 at the following locations:
- 10.5.1. Transmission Pipeline
- On either side of buried insulated fittings and on pipeline near casings.
- On pipelines at crossings with other steel pipelines. Additional test leads should also be attached to major foreign pipelines if consent can be obtained from the owner.
- At additional locations, so that the pipeline is metallically accessible at least once per mile.
- On new pipelines, current span test stations should be installed at least once each side of a rectifier (Gas Standard 0-10).
- 10.5.2. Distribution Pipeline
- On either side of buried insulated fittings and on pipelines near casings.
- When numerous plastic services are installed on a steel main, test leads may be required unless there is sufficient access to the pipeline at existing test leads or existing steel services.
- 10.6. Cathodic protection systems owned by PGandE are to be designed and operated to minimize any adverse effects on adjacent underground metallic structures. Where stray currents from foreign cathodic protection systems (cathodic and anodic) are affecting PGandE gas

10.6 (cont'd)

lines, corrective measures are to be taken to limit or eliminate the stray current condition. Stray currents from other sources, i.e., transit systems, telluric earth currents, etc. may affect PGandE gas lines and should be controlled where possible.

It is the responsibility of Division and District Gas Departments to identify where these conditions exist and establish corrective measures. If difficulties are encountered or if contact with outside companies is required, contact the Gas Distribution Department.

10.7 A C.P. area is to have all contacts cleared before being designated as protected. The location of underground contacts should be verified with current span calculations as well as with pipe locator signals (Tinker, etc.) before excavation. Cathodic protection systems will be considered adequately protected when the lowest pipe-to-soil potential is at least as negative as 850 millivolts with reference to a copper-copper sulfate electrode. Other criteria is normally not applicable to pipeline and must be approved by the Gas Distribution Department before being used. After protection is considered adequate current flow must be accounted for down to 0.2 Amp or less.

10.7.1. The number of final P/S potential readings are to be considerably greater than the number of locations selected for routine readings. Approximately one per block.

10.7.2. A record of the final area data; i.e., pipe square footage, final P/S potentials, final current spans, map plats, etc., must be maintained for the life of the C.P. area.

11. Cathodic protection systems shall be maintained in accordance with the following procedures:

11.1. Monitoring for effectiveness of cathodic protection shall be performed in accordance with the schedule listed below. Test stations selected for monitoring shall be at locations where the level of protection is the lowest for its C.P. area. The number of test stations shall be at least twice the number of rectifiers in a C.P. area.

SCHEDULE OF MONITORING INTERVALS

	Pipe to Soil (P/S) Monitoring	Rectifier Monitoring
Divisions	*On Rectifier Interval	*On P/S Interval
P.L.O.	*On P/S Interval	*On Rectifier Interval

*Intervals as prescribed in the current issue of CPUC G.O. 112 for monitoring rectifiers and for monitoring P/S potentials.

As indicated in the schedule above, monitoring of rectifier performance will be accomplished primarily through pipe to soil potential measurement with the exception of Pipe Line Operations where rectifier examination will be the more frequent monitoring.

- 11.1.1. When cathodic protection areas are found with P/S potentials below 850 millivolts or if any potential has decreased by 200 millivolts from the established protection level, the area must be scheduled for restoration. Rectifiers are to be read any time an area requires restoration. Unless extenuating circumstances exist, areas are to be restored within 30 calendar days of the time they are found below protection. If this criteria cannot be met, the circumstances must be documented. An area when restored should approximate the same P/S potentials and rectifier output as existed before the level of protection dropped.
- 11.2. Facilities protected with galvanic anodes will be monitored by pipe-to-soil potential in the following way:
 - 11.2.1. Pipe segments, excluding individual services, over 100 feet in length will be monitored annually. This includes plastic systems utilizing locating wire to distribute protection to multiple service risers, steel pipe, steel valves, etc.
 - 11.2.2. Individual isolated services of any length, fittings and isolated main segments less than 100 feet in length will be monitored at least once each ten years. Each year at least 10% of all such facilities will be monitored with a different 10% monitored each successive year. Each newly protected installation will be initially monitored within the year following installation, and thereafter at not greater than ten-year intervals.
 - 11.2.3. Evaluation of galvanic anode protection installed at leak repairs and short (less than 100 feet) non-insulated sections of pipe will be performed at three-year intervals by leak detection survey.
- 11.3. Monitoring of cathodic protection on bare transmission line will require electrical surveys or annual flame ionization leak survey.
12. Any time a pipeline is exposed it must be inspected for evidence of external corrosion and remedial action taken as appropriate.
 - 12.1. A written report shall be made of each inspection as outlined in Standard Practice 460.2-2. Form 62-3117, "Leak Survey, Inspection and Repair Report" Form "A", shall be used for all distribution and transmission pipeline facilities and services.

If the pipe inspected is coated, it is not necessary to disturb the coating to determine the external condition of the pipe.
 - 12.2. Corrosion damage is to be repaired in accordance with the applicable Gas Standards in Section A of the Gas Standards and Specifications Book.

- 12.3. When external corrosion leaks are repaired on steel pipe, not cathodically protected, regardless of whether the pipe is wrapped or bare, install one nine pound magnesium or five pound zinc anode in accordance with Gas Standard 013.1 without the shunt and without the valve frame and cover. It is not necessary to install anodes at leak repairs in cathodically protected areas. However, continuing corrosion leakage in protected areas must be investigated and corrective measures must be taken.
 - 12.4. Where corrosion leaks occur on transmission lines, a Corrosion Mechanic should measure a pipe-to-soil potential at the leak site. If low levels of protection are identified as a possible cause for the leak, remedial measures are to be taken.
 - 12.5. Because cathodic protection increases the moisture surrounding a pipe, an increase in leakage may occur following the application of cathodic protection. This leakage is the result of moisture softening corrosion products in corrosion pits that otherwise act as plugs preventing the leakage. For this reason leak surveys are recommended in cathodic protection areas approximately one-year after the protection is completed.
13. Where internal corrosion has been found on gas lines, the effects must be monitored at six-month intervals. Internal corrosion caused by sulfate reducing bacteria is associated with liquids carried in pipelines; and, therefore, does not affect the entire PGandE gas system. Where water is known to exist inside pipelines, bottle-nail tests are to be performed at the above mentioned interval and recorded on Gas Department Form 75-95. Instructions for performing the bottle-nail test are contained on the back of Form 75-95.
 - 13.1. Where corrosion is indicated by the bottle-nail test, it should be confirmed with a second bottle-nail test. Additional confirmation is available in the form of bacteria cultures (contact Gas Distribution Department for additional information). Once it is established that a problem exists, an inhibitor program is to be initiated. The effectiveness of the corrosion inhibitor is usually monitored with corrosometer (electrical resistance) probes and data recorded on "Corrosometer Probe Data Sheets". Probe readings are to be made at the above mentioned interval. If necessary, contact the Gas Distribution Department for assistance in selecting probe locations.
 - 13.2. Corrosometer probe readings are recommended at monthly intervals until history shows the corrosion is under control.
 - 13.3. Whenever pipe is removed from a pipeline, it is to be inspected for evidence of internal corrosion and this inspection is recorded as outlined in Standard Practice 460.2-2 using Form No. 62-3117, Leak Survey, Inspection and Repair Report, Form "A".

14. All new pipe installed above ground must be coated or jacketed with a PGandE approved product. (Section "E", Gas Standards and Specifications Book.) All above ground pipe must be monitored for atmospheric corrosion at intervals not greater than three years and if atmospheric corrosion is found, appropriate action must be taken. Meter sets may be monitored by a sampling method.

15. Records

Records shall be maintained to show the location details of all protected structures and sufficient test data to demonstrate the adequacy of installed corrosion control measures. A file folder shall be maintained for each cathodic protection system containing location maps delineating the protected piping system. File folders should also contain information on the number, kind, and location of rectifiers and anodes, a complete history of monitoring information (Form 62-4953) current span data, bond data, and any other pertinent information.

These records are to be maintained for the life of the facility.

APPENDIX "A"

CATHODIC PROTECTION GUIDELINES
FOR STEEL MAINS AND SERVICES

Install New Wrapped
Steel Pipe

Install New Wrapped
Steel Services

EXISTING
WRAPPED
PIPE
SYSTEM
NOT PRO-
TECTED

100 FEET IN LENGTH OR LESS

1. Do not insulate.
2. Install one 17-lb. magnesium or one 15-lb. zinc anode on each end of new pipe.
3. Monitor in accordance with leak survey methods.

OVER 100 FEET IN LENGTH

1. Insulate on each end.
- *2. Install the appropriate number of galvanic anodes.
3. Monitor P/S annually.

ANY LENGTH

1. Do not insulate at main, use insulated valve stop riser (GS F-80).
2. Install one 17-lb. magnesium or one 15-lb. zinc anode on each end of service pipe.
3. Monitor in accordance with leak survey methods.

EXISTING
BARE PIPE
SYSTEM
NOT PRO-
TECTED

10 FEET IN LENGTH OR LESS

1. Do not insulate.
2. Install one 9-lb. magnesium or one 5-lb. zinc anode.
3. Monitor in accordance with leak survey methods.

OVER 10 FEET IN LENGTH

1. Insulate at each end.
- *2. Install appropriate number of galvanic anodes.
3. Monitor P/S on 10% of those pipe sections which are 100 feet in length or less, yearly; if pipe length is over 100 feet, monitor yearly.

ANY LENGTH

1. Insulate at both the main and the riser.
2. Install one 5-lb. zinc or one 9-lb. magnesium anode on the service pipe.
3. Monitor P/S on 10% of these installations per year.

EXISTING
CAST IRON
PIPE
SYSTEM

ANY LENGTH

1. Insulate cast iron to steel transition with insulating 39-62 style coupling per GS C15.5.
- *2. Install appropriate number of galvanic anodes.
3. Monitor P/S on 10% of those pipe sections which are 100 feet in length or less, yearly; if pipe length is over 100 feet, monitor yearly.

ANY LENGTH

1. Install malleable iron saddle, Dresser Style 91 or equivalent and malleable iron insulating street tee, Dresser Style 90 or equivalent.
2. Wrap saddle and tee according to Section E Gas Standards and Specifications.
- *3. Install appropriate number of galvanic anodes.
4. Monitor P/S on 10% of these installations per year.

<u>*Footage Pipe Installed</u>	<u>Anode Type</u>	<u>No.</u>	<u>Code No.</u>
0 - 500	15 lb. zn. 17 lb. mg. (Alternate)	1	56-9146
500 - 1000	30 lb. zn. 32 lb. mg. (Alternate)	1	56-9126 56-9087
Steel Services	5 lb. zn. 9 lb. mg. (Alternate)	1	56-9145 56-9144

