62-7501 REV. 4-65

PACIFIC GAS AND ELECTRIC COMPANY
STANDARD PRACTICE

STANDARD PRACTICE NO. 412-1

EXECUTIVE OFFICE OR DIVISION GAS OPERATIONS

PAGE NO. 1 EFFECTIVE 2-1-69

ISSUING DEPARTMENT GAS DISTRIBUTION

REPLACING PAGE NO. ____ EFFECTIVE ____

SUBJECT:

EXTERNAL CORROSION CONTROL OF BURIED GAS FACILITIES

PURPOSE

1. This Standard Practice establishes responsibilities and procedures for planning, installation, and maintenance of cathodic protection facilities on buried gas mains and services.

RESCISSIONS

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

REFERENCES

3. The current edition of CPUC General Order No. 112.

4. Gas Distribution Department Corrosion Manual.

RESPONSIBILITY

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

APPLICATION

6. The responsibilities and procedures set forth apply equally to the divisions and Pipe Line Operations Department. Whenever the term "division" is used, it is intended to include all 13 divisions and Pipe Line Operations.

7. Procedural details and supplementary information appear in addenda to this Standard Practice.

APPROVED BY: E. H. FISHER
Vice President - Gas Operations

DISTRIBUTION:

Div. Managers	Administrative Analysts or Equiv.
Div. Gas Supts.	Director, Procedures Analysis
Div. Gas Engineers	Pipe Line Operations Department
Distr. Gas Supts.	Corrosion Manual Holders
Distr. Gas Engineers	Department Engineering Research
	Claims and Safety Department

Additional copies of this Standard Practice may be obtained from Gas Operations, 245 Market Street, San Francisco (PG&E Ext. 9-1604).

* Paragraph Revised
** Paragraph Added

(SEE OVER)

PROCEDURAL DETAILS

RESPONSIBILITY

8. The division must determine that a corrosive condition exists on gas facilities and if required initiate the necessary action to protect such facilities from corrosion damage.

9. Divisions must be fully informed of the corrosion control activities of other companies in their area and in consultation with the Gas Distribution Department and the Department of Engineering Research, act to minimize adverse effects on company gas facilities.

PLANNING CORROSION CONTROL FACILITIES

10. The most effective results obtainable from the application of cathodic protection depend upon early recognition of the corrosive condition. Defining a corrosion problem in its early stages requires careful evaluation of facts available from records and field observations. The application of cathodic protection can be justified by certain conditions, such as but not limited to the following guide lines:

a. New Transmission and Collection Lines

Because of the important function and operating pressures of these lines, they should be cathodically protected within three years after installation.

b. Existing Transmission and Collection Lines

Protection of existing facilities should be accomplished as soon as practical provided the piping system can be metallically isolated and the quality of coating will support the application of protection. If the line is bare or excessive coating deterioration has occurred, a periodic review of the line should be made to determine if it is practical to continue required maintenance or whether reconditioning or replacement is necessary.

c. New Distribution Systems

Cathodic protection should be applied to new distribution lines as soon as practical where:

(1) The soil resistivity is below 1,000 ohm-centimeters. However, it may not be feasible to protect minor replacements or short extensions.

(2) The soil resistivity is above 1,000 ohm-centimeters and adjacent piping systems are protected.

d. Existing Distribution Systems

Existing distribution systems, which develop external corrosion leaks at a frequency greater than three or more leaks per mile per year (including any service line leaks within this mile) should be cathodically protected when an investigation based on economic and safety considerations justifies such protection. The investigation should also be considered for systems which develop a lesser leak frequency.

CONTINUITY OF PLANNING

11. To facilitate corrosion protection, it is essential that each division be aware of areas and mains that have been metallically isolated. Persons preparing estimates shall include the necessary insulating fittings that are required to maintain piping system isolation.

12. Whenever an appreciable addition is planned to a protected area or main, the need for additional cathodic protection facilities shall be determined and provided where required.

ESTIMATES

13. All estimates proposing cathodic protection, protection equipment or installation of such equipment, shall be forwarded to the Gas Distribution Department for review.

14. Costs incurred providing cathodic protection shall be charged to the appropriate accounts:

a. Cathodic protection survey costs are chargeable to capital accounts for facilities less than three years old and to maintenance accounts for facilities over three years old.

b. Costs for the installation of cathodic protection equipment and subsequent tests to place the equipment in operation shall be charged to the proper capital accounts.

15. When estimates are prepared for cathodic protection in conjunction with new construction (as provided in 10a and c), the following additional procedures shall normally apply:

a. Allow one 3 ampere, 10 volt rectifier and two graphite anodes with associated coke breeze backfill for approximately each 25,000 square feet of pipe surface to be protected.

b. Special cases, such as long large diameter pipe and compressor station yard piping, shall be reviewed with the Gas Distribution Department.

PROCEDURE

16. When cathodic protection is to be installed, the following procedures will normally apply:

a. Evaluate the project limits, install the required insulating fittings, and locate and clear all metallic contacts to other piping systems.

b. Determine, by test, cathodic protection current requirements. Prepare a written report describing the tests made, the conditions found and recommendations for applying effective cathodic protection, as outlined in Appendix A attached.

c. Install cathodic protection equipment.

d. Tests shall be conducted to determine that cathodic protection has been attained and interference problems have not been created. If interference is detected, consult with the Gas Distribution Department for corrective action.

CONSTRUCTION REQUIREMENTS

17. All new buried steel gas piping and associated fittings shall be wrapped or coated in accordance with applicable standards.

    a. All known holidays or observed coating damage shall be repaired as soon as practicable.

    b. Only approved materials applied in an approved manner shall be used.

18. Dissimilar metals shall not be joined to each other unless an insulating connecting fitting is used at the junction of the metals, except that the fitting may be omitted if adequate cathodic protection is being applied or is planned for all exposed metal surfaces.

19. The most appropriate of the insulating fittings shown in the "Gas Standards and Specification" shall be installed at each customer meter set.

    a. Fittings shall be installed so that metallic continuity is effectively interrupted between the customer's piping and the gas service.

    b. Existing uninsulated meter sets shall be insulated whenever the piping of the set is altered or during the periodic meter change, whichever is earlier.

20. Electrical grounds, whether for telephone or power, shall not be permitted on the street side of the installed gas service insulation.

21. No gas pipe shall be installed in a manner which may cause a metallic contact with a foreign structure, i.e., water pipe, electrical conduit, culverts, and bridges.

    a. A minimum distance of 12" between underground gas piping and foreign structures is recommended and where possible shall not be less than 6" for pipelines and 2" for mains and services.

    b. When such clearance cannot be achieved, the pipe shall be protected with casing or insulating material.

c. Where contact with a foreign structure cannot be avoided as in bridge crossings, the points of contact shall be effectively insulated with a dielectric material, such as bakelite or micarta with adequate compressive strength.

22. All gas pipe shall be metallically isolated from casings. Special care shall be taken to maintain a holiday-free coating on the pipe inside the casing.

23. Wire test leads shall be installed at the following locations in accordance with Gas Standard N20.

a. Transmission and Collection Lines

(1) On either side of buried insulated fittings and on pipelines near casings, unless access for metallic contact to the pipeline is reasonably close.

(2) On pipelines at crossings with other steel pipelines. A test lead should also be attached to the foreign pipeline if consent can be obtained from the owner.

(3) At additional convenient locations, so that the pipeline is metallically accessible at least once between main line valves and at least twice between rectifiers.

b. Distribution Mains

(1) On either side of buried insulated fittings unless access for metallic contact is reasonably close.

(2) At locations listed in 21a for principal feeder mains that are essentially isolated from the distribution network and not readily accessible for testing purposes.

MAINTENANCE OF CATHODIC PROTECTION

24. Pipe-to-soil potential and rectifier output current shall be measured and/or recorded periodically. Pipe-to-soil potentials should be measured at or near a point of expected minimum protection.

a. Distribution System (60 Psi or Less)

(1) Pipe-to-Soil potentials on cathodically protected systems should be measured and recorded once each one-to-three month period. When protection is first applied, the adequacy should be verified monthly. Then as experience indicates, the time period between measurements can be extended, but should not exceed three months. Where underground construction is in progress or where gas meter insulation is frequently bypassed, tests should be conducted monthly.

(2) The data shall be recorded in conformance with Form No. 62-4933 attached.

(3) The minimum number of test locations required should be:

(a) two more than the number of rectifiers installed, or (b) one for each 500 services, but not less than three on galvanic anode protected systems.

b. Transmission Systems

(1) If the protected system piping is located in Class 3 or 4 locations, the frequency of pipe-to-soil potentials should conform to 22a for wrapped pipe.

(2) If the protected system is located in Class 1 or 2 locations, the time between measurements can be extended but shall not exceed six months for wrapped pipe.

(3) The protective level of bare lines can be monitored by inspecting rectifier output at least every six months and supplementing such inspection with pipe-to-soil potentials at least every two years.

(4) Pipeline current span measurements should also be conducted where feasible, preferably on each side of the rectifier.

(5) The pipe-to-soil potential data should be plotted graphically, pipe-to-soil potential versus distance.

(6) If inadequate protection is indicated, prompt steps shall be taken to restore it.

c. Compressor Station Yard Piping

(1) When cathodic protection is first applied to station piping, pipe-to-soil potentials should be measured at numerous locations. Thereafter, the level of protection can be reviewed at random locations for comparison.

(2) The time between these measurements should not exceed one year.

d. Rectifiers

(1) Rectifiers rated at six amperes or less should be inspected and the current output recorded at least once a year.

(2) Rectifiers rated in excess of six amperes should be inspected and the output recorded at least every six months.

RECORDS

25. Adequate records of corrosion leak repairs made on steel mains and services shall be maintained. Each repair location is to be posted, such as on a "leak map" so that concentrations of leaks are readily apparent. Leaks shall be logged as either external or internal.

26. In those areas with extensive cathodic protection facilities, it is recommended that suitable maps of isolated piping systems be maintained so that existing insulation is not inadvertently shorted or bypassed.

27. At the time rectifiers are turned on, Form No. 62-4932, attached, shall be completed. The person recording this information shall write his last name and the date recorded in the appropriate place on this form. A copy shall be maintained in division files as long as the station location is utilized. A copy of the completed form shall be forwarded to the Gas Distribution Department.

28. The periodic pipe-to-soil potential and rectifier output data shall be recorded on Form No. 62-4933. The person recording this data shall write his last name and the date (day and month) in the appropriate place on this form. These reports shall be retained for a period of at least five years.

29. A file shall be established and maintained to show the yearly accumulation of miles of pipeline and main receiving cathodic protection and the number of rectifiers and galvanic anodes installed each year.

ATTACHMENTS: Exhibit "A" - "Outline of Report Information."
Form 62-4933 Rev. 1-69 - "P.G.&. E. Cathodic Protection Report."
Form 62-4932 Rev. 1-69 - "P.G.&. E. Cathodic Protection Station Report."

Appendix A
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OUTLINE OF REPORT INFORMATION

Title: Describe area location and state whether cathodic protection survey or cathodic protection post-installation tests were conducted.

Summary: Make a brief statement summarizing the objectives of the tests conducted.

Recommendations: State specifically the equipment recommended to achieve the objective desired. Such as the number and rating of rectifiers, anodes, etc. Generally, post-installation tests do not require recommendations.

Identification of Structure: Refer to any previous reports which pertain to the piping system being tested. List the number of gas services, the linear feet of various diameter pipe, and the total square footage of main and services in the piping system. A drawing showing the schematic arrangement of distribution system and related test data should be attached. Transmission line systems can be shown schematically or test data can be plotted graphically, pipe-to-soil potential versus distance.

Procedure: Describe briefly the tests conducted and list the number of non-insulated or faultily insulated taps or services and the number of underground contacts to other metallic systems.

Discussion: Describe any unique conditions encountered, such as type and quality of coating, cathodic protection interference caused by adjacent foreign protection systems, and the reason for deep anodes if required.

Drawings: A detailed drawing should be attached for each recommended rectifier and associated anode. It should include soil resistivity data for average depths of 2.5, 5.0, 7.5, 10.0 and 15.0 feet, and dimensions for rectifier and anode locations. The schematic system identification drawing should include sufficient test data to corroborate recommendation made or to verify the adequacy of installed protection.

Date of Report: Each report should be signed by the person responsible for the report and dated by him.

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PG AND E
CATHODIC PROTECTION STATION REPORT

COMPANY NO.	C.P. SYSTEM NO.	DIVISION	DISTRICT

RECTIFIER

LOCATION			
MANUFACTURER	TYPE	MODEL	SERIAL NO.
PRIMARY RATING VOLTS		ACTUAL PRIMARY VOLTAGE VOLTS	
SECONDARY RATING AMPS VOLTS	INITIAL SETTING AMPS VOLTS	DATE PLACED IN OPERATION	

ANODE

NUMBER	WEIGHT AND/OR SIZE
TYPE	BACKFILL USED

SOIL RESISTIVITY

PIN SPACING - FT.	OHMS	MULTIPLIER	OHM-CM
2.5		500	
5.0		1000	
7.5		1500	
10.0		2000	
15.0		3000	

STRUCTURE PROTECTED

SHOW LOCATION OF RECTIFIER AND/OR ANODE(S) AND PERTINENT DIMENSIONS

DATE: PREPARED BY (SIGNITURE)

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PG AND E CATHODIC PROTECTION REPORT

LOCATION		C.P. SYSTEM NO.
DIVISION	DISTRICT	YEAR

PIPE TO SOIL POTENTIAL MILLIVOLTS

TEST LOCATION														REMARKS
1.														
2.														
3.														
4.														
5.														
6.														
7.														
8.														
9.														
10.														
DATA RECORDED BY														
DATE (DAY AND MONTH)														

GALVANIC ANODE LOCATION OR RECTIFIER NO. AND LOCATION	OUTPUT – MILLIAMPERES OUTPUT – AMPERES													
DATA RECORDED BY														
DATE (DAY AND MONTH)														

401.6

401.6

OPERATING AND MAINTENANCE STUDIES

All pipelines operating or intended to operate at or above 20% of the specified minimum yield strength of the pipe material, were subjected to periodic surveys and patrolling during 1968. Surveillance inspections and patrols were performed in accordance with the Company's procedures on file with the California Public Utilities Commission.

Special studies and action taken on those specific pipelines which presented unusual operating and/or maintenance conditions such as failures, leakage, corrosion, or substantial changes in cathodic protection requirements, are a part of this report and are included in this section on the following pages.