DISTRIBUTION & CUSTOMER SERVICE (DCS) **GENERATION, TRANSMISSION & SUPPLY (GTS)**			
		DCS Standard D-S0354 ***GTS Standard S4126***	
ISSUING DEPARTMENT:	**Gas System Maintenance and Technical Support**	EFFECTIVE DATE:	**12-98**
DCS OFFICER:	**VP - DE&P**	REVIEW DATE:	**12-03**
GTS OFFICER:	**VP - G&ET**	PAGE NO.:	**1** OF **6**
TITLE: Cathodic Protection Standards for Cased Pipeline Crossings			

Purpose:

This standard describes steps to be taken to address the problem of casings that may be in electrical contact with gas-carrying pipes.

Standard Sponsor:

The Vice President, Distribution Engineering & Planning (DE&P) and the Vice President, Gas & Electric Transmission (G&ET) are responsible for authorizing, approving and revising this standard.

Contacts:

Gas Distribution: Corrosion Specialist [redacted]

California Gas Transmission: Corrosion Engineer [redacted]

Implementation Responsibilities:

This standard is to be implemented by including it as part of the *Gas Distribution Maintenance Manual*, the *California Gas Transmission (CGT) Standards* book and the Gas System Maintenance and Technical Support Department *History File Requirements Manual*, and distributing this Standard to all managers with responsibilities for gas piping. As casing shorts are discovered in the field, field personnel must implement the procedures contained in this standard, as appropriate to the situation.

Compliance:

Implementation and effectiveness are measured by responsible managers/superintendents. In addition, periodic audits can be conducted by internal company departments. The CPUC also conducts compliance reviews on the requirements in this standard. Cathodic protection area maintenance reports revealing the need for corrective actions will be reviewed and acted upon by area gas operating supervisors and CGT district superintendents.

Procedures:

General

Pipeline casings have been required in the past at highway and railroad crossings. Since 1994 Caltrans has allowed non-cased crossings, if the conditions in Caltrans Memorandum "Exception to Policy - Uncased High-pressure Natural Gas Pipeline Crossings" are met. Technology has improved to allow casingless bores in the most difficult ground conditions. However, situations may still exist that require casings when there is no feasible alternative.

There are two types of Contacts: metallic contacts and electrolytic contacts. Metallic (also known as hard) contacts often occur at the end of casings where differential settlement is most likely. Differential settlement may be caused by high stress on the pipeline related to tie-ins, fill for overpasses, or ground movement. Corrugated nestable casing (no longer used) often partially collapses, thereby causing the contact. Other causes of a hard contact may be improperly adjusted link seals with the bolts/washers contacting the pipe and casing; poor compaction; insulation spacers which contain metal parts that have been damaged and contact both the pipe and casing; and zinc ribbon (installed prior to 1978 in casings) that has contacted the casing.

As described above, casings can develop a metal to metal (hard) contact with the gas pipeline. With hard contacts, the casing and pipe potentials are approximately the same. If the pipe potential is increased outside the casing, the casing usually will reflect a similar shift. Because the casing is bare and is in contact with the pipeline, it acts as one very large holiday requiring excessive amounts of current. Consequently, the pipeline outside and adjacent to the casing may not receive adequate cathodic protection.

An electrolytic contact (i.e., water or soil in the casing annulus) can also be a concern. In most cases, the pipe within the casing can be cathodically protected; however, the level of cathodic protection cannot be determined. Electrolytic contacts between the casing and pipe often develop when end seals fail or corrugated nestable casing allows infiltration at seams and holes in the casing. As the annular space is filled with electrolyte, the protective current passes through the ground, casing pipe wall, and through the electrolyte to the pipe.

Testing

Tests or reviews shall be conducted when the difference between the casing and the carrier pipe pipe-to-soil potentials are less than 100 mV and/or when casing pipe-to-soil potentials are greater than 800 mV. Testing shall be done by corrosion mechanics in according to Gas Engineering Guideline EG4126.1. If a significant contact is confirmed, follow the remediation procedures in the following paragraphs.

Remediation

Once the tests are done and the source and type of contacts are identified a remediation plan shall be established. Remediation plans should be the joint effort of local supervision, engineering, corrosion mechanics, and the corrosion engineer and/or specialist. The corrosion engineer or corrosion specialist shall approve the final plan. These plans should be developed and initiated within six months of the discovery of a shorted casing. The following are recommended remediation strategies:

A. Strategy for Metalic Contacts:

1. If feasible perform local field investigation to determine the contact location(s).
2. Excavate and expose the ends of casing, examine all possible sources for contacts including the end seals, alignments, casing dents, ETS, etc.
3. Take corrective actions to eliminate the contacts such as: replacing end seals, replacing ETS, replacing anodes, etc.
4. In conjunction with corrective actions also drain water and clean debris in the annulus.
5. Retake the pipe to soil readings to determine whether casing short is cleared.
6. If the contact is cleared, check the end again to make sure it is properly installed. Use sand bags to support the pipe if necessary and backfill the pit with well compacted soil then proceed to Section "D" -- Monitoring Program.
7. If the contact can not be cleared, proceed to Section "C" -- Establishing Non-corrosive Environment.

B. Strategy for Electrolytic Contacts:

1. Perform local field investigation to determine the electrolytic contact location(s).
2. Excavate and expose the end of casing. To the extent possible, drain water and clean debris in the annulus.
3. Retake the pipe to soil readings; if the readings meet the criteria (the difference between the casing and the carrier pipe pipe-to-soil potentials are greater than 100 mV and/or when casing pipe-to-soil potentials are less than 800 mV), check the casing ends again make sure end seals are properly installed. Use sand bags to support the pipe, if necessary, and backfill the pit with well compacted soil. Proceed to Section "D" -- Monitoring Program.
4. If the contact persists, increase the level of cathodic protection to achieve the protected levels. If this can not be achieved, proceed to Section "C" -- Establishing Non-corrosive Environment.

C. Strategy for Establishing Non-corrosive Environment:

1. Take additional efforts to remove all debris in the annulus.
2. After a dry, non-corrosive environment has been established, retake the pipe to soil readings to determine the level of protection
3. If the liquids and debris can be only partially removed or if they reappear , and the pipeline is operated at a MAOP equal or under 40% SMYS, inject a non-corrosive, non-conductive, material, such as dielectric gel to fill the casing annulus. (Note: vents must be in place at both ends of the casing; and the gel injection shall start from the vent at the lower end of the casing. This step can only be waived or modified by a specific remediation plan approved by the CGT Corrosion Engineer and/or DCS Corrosion Specialist.)

4. Retake the pipe to soil readings to determine the status of the cathodic protection. check the casing ends again make sure end seals are properly installed. Use sand bags to support the pipe, if necessary, and backfill the pit and trench with well compacted soil. If all attempts in Section "C" fails to clear the contact on a pipeline operating under 40% SMYS, the pipeline may be left as is and monitored in accordance with Section "D".
5. If the liquids and debris can be only partially removed or if they reappear, and the pipeline is operated at a MAOP over 40% SMYS, a specific remediation plan shall be prepared by the CGT Corrosion Engineer and/or DCS Corrosion Specialist. Implement the remediation plan and proceed to Section "D" -- Monitoring Program.

D. Monitoring Program:

CGT District Foremen and DCS Supervisors responsible for patrolling pipelines shall monitor all casings for gas indications according to DCS/CGT Standard S0352/S4111 "Patrolling Pipelines and Mains" and shall take soil to pipe and soil to casing potentials annually.

Recordkeeping:

Record actions taken on cathodic protection records and file test results in the appropriate CPA folder.

Definition of Terms:

Annular: (adj.) Describes the space between the outside wall of the gas-carrying pipe and the inside wall of the casing pipe.

Annulus: (n.) Is the space between the outside wall of the gas-carrying pipe and the inside wall of the casing pipe.

Casing: A pipe that does not carry gas in normal operations, but is used to facilitate the installation or repair of a gas-carrying pipe, normally used under a railroad or highway crossing.

Casingless Bores: A construction technique to install a gas-carrying pipe underground by drilling a hole through the earth and pushing and/or pulling the pipe through it without using an open trench or a casing, typically used under a freeway or water crossing.

Cathode: The electrode of a corrosion cell where a net reduction reaction occurs. In the corrosion process, the cathode is usually the area which does not corrode.

Cathodic Protection: Reduction or prevention of corrosion of a metal surface by making it cathodic; for example, by the use of sacrificial anodes or impressed current rectifier protection systems.

ETS: Abbreviation for Electrolysis Test Station, which is a structure to house the test wires that are bonded to buried metallic piping or structures. These wires are run up to the ETS, in a location normally at ground level or above ground to test the adequacy of the cathodic protection system.

Holiday: A break or imperfection in a coating exposing the metal (typically a gas-carrying pipe) directly to the electrolyte (typically soil).

Interrupt Rectifiers: A process where a rectifier is turned on and off at preset time intervals and used typically to troubleshoot a cathodic protection area.

mV: Abbreviation for millivolts, which is the typical unit of electrical measure for pipe-to-soils.

Sacrificial Anodes: The electrode of a corrosion cell which is designed to corrode to protect the cathode (typically a gas-carrying pipe). Typically it is made of zinc, magnesium, or other metals which are buried and expended over time by the application of dc current flows into the soil.

Shielding: A condition in which the cathodic protection current cannot reach the carrier pipe to achieve minimum cathodic protection levels.

SMYS: Abbreviation for Specified Minimum Yield Strength, which is the minimum yield strength prescribed by the specification under which the pipe is manufactured and qualified.

Date Issued/Updated:

Effective: December 30, 1998

Review Date: December 30, 2003

Signed,

Shan Bhattacharya
Vice President, Distribution Engineering and Planning

Signed,

William R. Mazotti
Vice President, Gas and Electric Transmission

Reference Documents:

- 49 CFR 192.467 (c)
- DCS Policy *Gas and Electric Maintenance and Operation*
- Gas Standard &Specification O-16, "Corrosion Control of Gas Facilities"
- Letter from DOT RSPA to California Public Utilities Commission, August 19, 1993 (WIN.DOT Letter #9 Section 192.467)
- Letter from DOT RSPA to Public Service Commission, Kentucky, July 24, 1986 (WIN.DOT Letter #8 Section 192.467)
- Caltrans Memorandum "Exception to Policy - Uncased High-pressure Natural Gas Pipeline Crossings", November 9, 1994
- DCS/CGT Standard S0352/S4111 "Patrolling Pipelines and Mains"
- CGT Engineering Guideline EG4126.1 "Investigation of Suspected Pipe-to-Casing Contact"