WP4133-04

Overview	This work procedure (WP) identifies remedial actions to address casings found in electrical contact with gas carrying pipes
Governing Document	Utility Standard S4133, Gas T&D Corrosion Control Requirements' *[not yet issued – expected publication 2009]*
Safety	Perform all physical and atmospheric corrosion inspection work safely and in accordance with applicable safety rules the *Code of Safe Practices*, and Utility Standard Practice (USP) 22, Safety and Health Program

Procedures for Remediating Casing Contacts

1 General Information

Pipeline casings have been required at highway and railroad crossings in the past 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 Since that time, 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

2 Contact Types

There are two types of contacts – metallic contacts and electrolytic contacts described as follows

A Metallic Contacts (Also Known as "Hard" Contacts)

- Metallic 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 that contain metal parts that have been damaged and contact both the pipe and casing, and zinc ribbon that has contacted the casing (installed prior to 1978 in-casings)

- As described above casings can develop a metal-to-metal (hard) contact with a 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 reflects a similar shift Due to the fact that the casing is bare and 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

B Electrolytic Contact (i e , Water or Soil in the Casing Annulus)

- Electrolytic contact can be of 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 electrolyte to the pipe

3 Testing Procedures

A Corrosion mechanics must perform testing in accordance with WP4133 03 Test Procedures for Pipe Casing

B Conduct tests or reviews when the difference between the casing and the carrier pipe pipe-to-soil (P/S) potentials are less than 100 millivolts (mV) and/or when casing P/S potentials are greater than 800 mV

C If a significant contact is confirmed, follow the remediation procedures in the following sections

4 Remediation Procedures

A Perform remediation work in accordance with this WP

B Prepare an action plan for investigation and remediation for cased pipeline crossings suspected to have an electrical contact between the case and pipeline

C Maintain and keep current the action plan in accordance with the requirements of Numbered Document O 16 Corrosion Control of Gas Facilities

The following actions are recommended remediation strategies

A Strategy for Metallic Contacts

1) If feasible, perform a local field investigation to determine the contact location(s)
2) Excavate and expose the ends of the casing examine all possible sources for contacts including the end seals alignments, casing dents, electrolysis test station (ETS), etc
3) Take corrective actions to eliminate contacts such as replacing end seals, replacing ETS, replacing anodes etc
4) In conjunction with corrective actions drain water and clean debris in the annulus
5) Retake the P/S readings to determine whether the casing short is cleared

6) If the contact is cleared, check the end seals to make sure they are properly installed Use sand bags to support the pipe if necessary, and backfill the pit with well-compacted soil Then proceed to Section 4 D, Monitoring Program, on Page 4

7) If the contact cannot be cleared proceed to Section 4 C, Strategy for Establishing Non Corrosive Environment, below

B Strategy for Electrolytic Contacts

1) Perform a local field investigation to determine the electrolytic contact location(s)

2) Excavate and expose the end of the casing To the extent possible, drain water and remove debris in the annulus

3) Retake the P/S readings If the readings meet the criteria (the difference between the casing and the carrier pipe P/S potentials are **greater** than 100 mV and/or when casing P/S potentials are **less** than 800 mV, check the casing ends again to make sure the 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 4 D, Monitoring Program, on Page 4

4) If the contact persists, increase the level of cathodic protection to achieve protected levels If protected levels cannot be achieved, proceed to Section 4 C, Strategy for Establishing Non-Corrosive Environment, below

C Strategy for Establishing Non-Corrosive Environment

1) Take additional actions to remove all debris in the annulus

2) After a dry, non-corrosive environment is established, retake the P/S readings to determine the protection level

3) If the liquids and debris can only be partially removed or if they reappear and the pipeline is operated at a maximum allowable operating pressure (MAOP) equal to or under 40% specified minimum yield strength (SMYS) inject a non-corrosive, non-conductive material, such as dielectric gel, to fill the casing annulus

4) Install vents at both sides of the casing Vent pipe should have a threaded coupling installed +/- 3 feet (ft) above grade in order to allow a portion of the vent pipe and elbows to be removed allowing gel injection Install a vent at the 12 00 o'clock position on the high side of the casing and 6 00 o'clock position on the low side of the casing On casings 7 ft deep and below, consider installing a 3 inch vent pipe from the casing to grade and reduce to 2 inches for above grade vent pipe Drill a 1-1/2 inch diameter hole in the casing for a 2 inch vent pipe and a 2-1/2 inch diameter hole for a 3 inch vent pipe Photograph the drilled casing holes and include in the job as-builts on the form H for verification of "as installed" drilled size Ensure link seals and end boots are installed and sealed properly Backfill to at least 3 ft above casing before testing air flow, standing pressure test, or injecting gel Apply a high volume air flow (5-8 pounds [lb] per square inch gauge [psig]) test by connecting the air hose to the 12 00 o'clock position vent pipe to ensure unobstructed flow through the casing and out the 6 00 o'clock vent pipe Reverse the air flow by connecting to the 6 00 position vent blowing out through the 12 00 position vent pipe When unobstructed air flow

is determined, apply a 5 psig standing pressure test in the casing and vent pipes to confirm that the boot and link seals will hold gel Only the responsible gas corrosion engineer and/or gas corrosion specialist can approve a specific remediation plan to waive or modify this step

5) Retake the P/S readings to determine the status of the cathodic protection Check the casing ends again to make sure the 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 this Section 4 C fail to clear the contact on a pipeline operating under 40% SMYS the pipeline may be left as is and monitored in accordance with Section 4 D, Monitoring Program, below

6) If the liquids and debris can only be partially removed, or if they reappear and the pipeline is operated at a MAOP over 40% SMYS the responsible gas corrosion engineer and/or gas corrosion specialist must prepare a specific remediation action plan Implement the remediation action plan and proceed to the following Section 4 D, Monitoring Program

D Monitoring Program

If a cased pipeline crossing determined to have an electrical contact cannot be cleared as outlined in this procedure, a gas corrosion engineer must evaluate the cased crossing to determine if monitoring the cased crossing for leaks is an appropriate long-term remediation strategy

Monitoring a cased crossing for leaks consists of periodic testing with approved combustible gas leak detection instruments to determine if leakage within the cased crossing exists The gas corrosion engineer must consider the cased crossing s location risk of over pressure condition of the pipe, environmental factors, risks to the public, and possible affects on Pacific Gas and Electric Company s (the Company s) ability to serve customers when determining if a monitoring program is appropriate for a specific contacted cased pipeline crossing

If the gas corrosion engineer determines that a monitoring program is appropriate the corrosion engineer must determine appropriate monitoring intervals

1) Monitoring Class Locations 3 and 4

At a minimum monitor the cased crossing in Class Locations 3 and 4 four times per year at intervals not to exceed 4 ½ months, to the date

2) Monitoring Class Locations 1 and 2

At a minimum monitor the cased pipeline crossing in Class Locations 1 and 2 twice each year at intervals not to exceed 7 ½ months, to the date

Note If monitoring detects a leak in the pipeline within the cased crossing take immediate action to repair the leak

5 Recordkeeping

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

Definition of Terms

Annular The space between the outside wall of the gas-carrying pipe and inside wall of the casing pipe

Annulus The space between the outside wall of the gas-carrying pipe and 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 that does not corrode

Cathodic protection Reducing or preventing corrosion of a metal surface by making it cathodic, for example, by using sacrificial anodes or impressed current rectifier protection systems

CPA Cathodic protection area

ETS (electrolysis test station) A structure to house the test wires bonded to buried metallic piping or structures These wires are run up to the ETS in a location normally at or above ground level to test 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 requiring a rectifier to be turned on and off at preset time intervals and typically used to troubleshoot a CPA

mV (millivolts) The typical unit of electrical measure for pipe-to-soil readings

Sacrificial anodes The electrode of a corrosion cell designed to corrode in order to protect the cathode (typically a gas-carrying pipe) Usually 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 (specified minimum yield strength) The minimum yield strength prescribed by the specification under which the pipe is manufactured and qualified

Recision

This WP cancels and supersedes Utility Standard D-S0354/ S4126, Cathodic Protection Standards for Cased Pipeline Crossings, issued 12/98

Reference Documents

Caltrans memorandum, Exception to Policy – Uncased High-pressure Natural Gas Pipeline Crossings, dated November 9, 1994

Code of Federal Regulations (CFR), Title 49, Transportation, Section 192 467 (c) External corrosion control Electrical Isolation

Code of Safe Practices

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)

Numbered Document O 16, Corrosion Control of Gas Facilities

UO Policy 3 7, Gas and Electric Operation, Maintenance and Construction

Utility Standard Practice (USP) 22, Safety and Health Program

Utility Standard S4111, Patrolling Pipelines and Mains

WP4133-03, Test Procedures for Pipe Casing

Contact for More Information

[redacted]

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Approved by

Brian Daubin
Senior Manager

Revision History

Chg No	Date	Description	By (LAN ID)
00	November 2008	Issued new work procedure	[redacted]