PACIFIC GAS AND ELECTRIC COMPANY

CALIFORNIA GAS TRANSMISSION
GAS SYSTEM MAINTENANCE & TECHNICAL SUPPORT
SYSTEM INTEGRITY SECTION
Risk Management

Procedure for Stress Corrosion Cracking Direct Assessment

Procedure No. RMP-13

Integrity Management Program

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1.0 PURPOSE

This document provides guidance on how to identify and classify the potential threat of SCC to pipeline integrity. The procedure is based on 49 CFR Part 192 "Pipeline Safety: Pipeline Integrity Management in High Consequence Areas (Gas Transmission Pipelines)", specifically part 192.917 and ASME B31.8S A3 "Stress Corrosion Cracking Threat" and the NACE Recommended Practice RP0204-2004 on "Stress Corrosion Cracking (SCC) Direct Assessment Methodology". It is PG&E's policy to be in compliance with this practice as well as governing regulations and laws.

2.0 INTRODUCTION

"Stress Corrosion Cracking Direct Assessment (SCCDA) is a process to assess a covered pipe/piping segment for the presence of SCC primarily by systematically gathering and analyzing excavation data for pipe having similar operational characteristics and residing in a similar physical environment."[1]

This plan provides a methodology for implementing an SCCDA program. It includes procedures and protocols written to:

- Ensure consistent and technically sound applications of SCCDA on buried pipeline segments,
- Comply with Title 49 Code of Federal Regulations Part 192 (CFR192) Subpart O. Paragraph 192.929.
- Address the Office of Pipeline Safety's Inspection Protocol for Gas Pipeline Integrity Management,
- Provide individual procedures for data collection, pre assessments, indirect inspections, excavations, and post assessments such that a pipeline company's SCCDA program can be audited per the OPS Inspection Protocol for SCCDA, and
- Improve pipeline safety and prevent the future impact of SCC on pipeline integrity.

This plan provides guidelines and examples to use in implementing SCCDA. It is applicable to buried onshore natural gas transmission and distribution line pipe constructed from steel. It is applicable to both forms of external SCC (near-neutral ph SCC and high ph SCC) Users of this plan are assumed to be familiar with applicable pipeline safety regulations and the NACE Standard Recommended Practice RP0204-2004 on SCC Direct Assessment.

2.1 Scope

This plan provides guidance in identifying and classifying the potential threat of SCC to pipeline integrity along with measures for monitoring and mitigation of pipe segments where SCC is found. The plan is based on 49 CFR Part 192 "Pipeline Safety: Pipeline Integrity Management in High Consequence Areas (Gas Transmission Pipelines)", specifically part 192.917, ASME B31.8S A3 "Stress Corrosion Cracking Threat", and NACE Standard Recommended Practice RP02040-2004 "Stress Corrosion Cracking (SCC) Direct Assessment Methodology."

SCCDA is a continuous improvement process. Through successive applications, SCCDA is intended to identify and address locations where SCC has occurred, is occurring, or may occur.

SCCDA requires that an operator collect and integrate extensive data on its pipeline system. Indirect Inspections (aboveground surveys) may be used but are not required. Direct examinations are used to look for SCC. If SCC is found, mitigation, repair, and remediation are required.

[1] Title 49 Code of Federal Regulations Part 192 (CFR192) Subpart O.

2.2 SCCDA Overview

Direct assessment as per CFR 192.925 and the NACE Standard Recommended Practice RP02040-2004 "SCC Direct Assessment Methodology", is a four-step process for improving pipeline safety. These steps are:

- Pre-Assessment – A compilation of historic and current data to determine whether SCCDA is feasible and to prioritize the segments within a pipeline system with respect to potential susceptibility to SCC. The Pre-Assessment step also identifies specific sites within those segments for direct examinations. The types of data to be collected are typically available from in-house construction records, operating and maintenance histories, alignment sheets, corrosion survey records, other aboveground inspection records, government sources, and inspection reports from prior integrity evaluations or maintenance actions.
- Indirect Inspections – A compilation of additional data that are collected, as deemed necessary by the pipeline operator, to aid prioritization of segments and site selection for direct examination. The need to conduct indirect inspections and the nature of these inspections depends on the nature and extent of the data obtained in the pre-assessment step and the data requirements for site selection. Typical data collected in this step might include close-interval survey (CIS) data, direct-current voltage gradient (DCVG) data, and information on geotechnical conditions (soil type, topography, and drainage) along the right of way.
- Direct Examination – Includes procedures (1) to field verify the sites selected in the first two steps, and (2) to conduct the field digs. Aboveground measurements and inspections are performed to field verify the factors used to select the dig sites. For example, the presence and severity of coating faults might be confirmed. If predictive models based on geotechnical conditions are used, the topography, drainage, and soil type require verification so that they can be related to SCC susceptibility. The digs are then performed; the severity, extent, and type of SCC, if any is detected, at the individual dig sites are assessed; and data that can be used in post assessment and predictive-model development are collected.
- Post Assessment – Includes the analysis of data collected from the previous three steps to determine whether SCC mitigation is required, and if so, to prioritize those actions; to define the interval to the next full integrity reassessment; and to evaluate the overall effectiveness of the SCCDA approach.

Feedback within and between the four steps is important and required. Findings that are consistent with expectations strengthen the process. Inconsistent findings must be evaluated to determine why and how the process application should be changed, or whether SCCDA is not feasible. The inability to correlate historical data, indirect inspection data and predictive modeling to known indications of SCC may indicate that SCCDA is not feasible.

When SCCDA is applied for the first time on a pipeline segment, more stringent requirements apply. When the plan is applied to a pipeline segment that does not have a well-documented history of operations, maintenance, and cathodic protection conditions, additional requirements may also apply.

2.3 Roles and Responsibilities

2.3.1 Manager of System Integrity: The Manager of System Integrity has the overall responsibility to assure that this procedure is implemented effectively. This procedure assigns approval of documents, plans and exceptions to this position. The Manager of System Integrity may delegate some or all of these approving responsibilities.

2.3.2 SCCDA Project Manager: The SCCDA Project Manager (PM) is responsible to assure that all aspects of the assigned SCCDA projects are conducted in full compliance with this procedure. In addition, the PM is responsible for the effective planning, documenting and communicating the various aspects and stages of the assigned SCCDA projects.

2.3.3 SCCDA Project Engineer: The Project Engineer is responsible for the technical evaluations and analyses conducted through out the assessment process. These include, but are not limited to, sufficient data analysis, SCCDA Region Designation, Indirect Inspection results, and remaining strength evaluations.

2.3.4 Inspection Personnel: The Inspection Personnel (IP) are responsible for the assigned tasks corresponding to the SCC Detail Examinations. They are responsible for conducting the inspections and tests in accordance with this procedure and other testing procedures that have been referenced in the assessment process.

2.3.5 Subject Matter Expert: Subject matter experts are individuals that have expertise in a specific area of operation or engineering. The Subject Matter Expert could also be a 3rd Party Contractor that may fill any or all of the roles listed above, and would assume the responsibilities of that position.

2.3.6 Direct Assessment Program Manager: Reports to the Manager of System Integrity and is responsible for the supervision of the DA team and the management of all DA programs (ECDA, ICDA, SCCDA, CDA and Risk Management based DA projects)

2.4 Qualifications

The SCCDA assessment is to be implemented under the direction of competent persons who, by reason of knowledge of the physical sciences and the principles of engineering and mathematics, acquired by education and related practical experience, are qualified to engage in the practice of corrosion control and risk assessment on ferrous piping systems.

The process for achievement of competency, awareness and training of personnel in the subject area they perform within the SCC process shall be documented.

The specific qualifications are described below.

Manager of System Integrity: The Manager of System Integrity shall be a degreed engineer and have gas transmission corrosion related experience to provide guidance and oversight to the personnel conducting the SCCDA process.

SCCDA Project Manager: The PM shall be a degreed engineer (or have equivalent pipeline experience and DA program Manager approval) and have sufficient gas transmission corrosion related experience to provide guidance and oversight to the personnel conducting the SCC process.

SCCDA Project Engineer: The PE shall be a degreed engineer with corrosion control experience in the pipeline industry, or a NACE certified Corrosion Specialist The engineer shall have been formally trained on this procedure.

Inspection Personnel: The personnel performing the Detail Examinations shall meet the Operator Qualification Requirements and be certified with training documentation for the specific inspections they are conducting.

Subject Matter Experts: The subject matter experts (SME) shall be degreed engineers (or have equivalent pipeline experience and DA Program Manager approval) with appropriate level of expertise and experience to fulfill the functions described in this document. SME qualifications shall be properly documented.

DA Program Manager: Shall be a degreed engineer or have equivalent pipeline experience and certification. The Program Manager shall have 3 - 5 years gas related supervisory experience in maintenance, construction, or engineering/estimating. The Program manager shall also have 3 - 5 years gas related project management experience in transmission or distribution gas, construction or maintenance projects. The Program Manager shall have taken the CGT Corrosion Control training course, and be formally trained on this procedure, RMP-12.

2.5 Definitions

Anomaly: Any deviation from nominal conditions in the external wall of a pipe, its coating, or the electromagnetic conditions around the pipe.

B31G[9]: A method (from the ASME standard) of calculating the pressure-carrying capacity of a corroded pipe.

Cathodic Disbondment: The destruction of adhesion between a coating and the coated surface caused by products of a cathodic reaction.

Cathodic Protection (CP): A technique to reduce the corrosion of a metal surface by making that surface the cathode of an electrochemical cell.

Close-Interval Survey (CIS): A method of measuring the potential between the pipe and earth at regular intervals along the pipeline.

Cluster: A grouping of stress corrosion cracks (colony). Typically stress corrosion cracks occur in groups consisting of hundreds or thousands of cracks within a relatively confined area. *See Colony.*

Coal Tar Coating: Coal tar-based anti-corrosion coating

Colony: A grouping of stress corrosion cracks (cluster). Typically stress corrosion cracks occur in groups consisting of hundreds or thousands of cracks within a relatively confined area. See *Clustor.*

Crack Coalescence: Joining of cracks that are in close proximity to form one larger crack.

Critical Flaw Size: The dimensions (length and depth) of a flaw that would fail at a given level of pressure or stress.

Defect: An anomaly in the pipe wall that reduces the pressure-carrying capacity of the pipe.

Dent: A depression caused by mechanical means that produces a visible disturbance in the curvature of the wall of the pipe or component without reducing the wall thickness.

Direct-Current Voltage Gradient (DCVG): A method of measuring the change in electrical voltage gradient in the soil along and around a pipeline to locate coating holidays and characterize corrosion activity.

Direct Examination: Inspections and measurements made on the pipe surface at excavations as part of direct assessment.

Disbonded Coating: Any loss of adhesion between the protective coating and a pipe surface as a result of adhesive failure, chemical attack, mechanical damage, hydrogen concentrations, etc. Disbonded coating may or may not be associated with a coating holiday. See also *Cathodic Disbondment.*

External Corrosion Direct Assessment (ECDA): A four-step process that combines pre-assessment, indirect inspections, direct examinations, and post-assessment to evaluate the impact of external corrosion on the integrity of a pipeline.

Fatigue: The phenomenon leading to cracking or fracture of a material under repeated or fluctuating stresses having a maximum value less than the tensile strength of the material.

Fault: Any anomaly in the coating, including disbonded areas and holidays.

Fracture Toughness: A measure of a material's resistance to static or dynamic crack extension. It is a material property used in the calculation of critical flaw sizes for crack-like defects.

High-pH SCC: A form of SCC on underground pipelines that is intergranular and typically branched and is associated with an alkaline electrolyte (pH about 9.3). Also referred to as classical SCC.

Holiday: A discontinuity in a protective coating that exposes the pipe steel surface to the environment.

Hydrostatic Testing: Pressure testing of sections of a pipeline by filling it with water and pressurizing it until the nominal hoop stresses in the pipe reach a specified value.

Indication: Any deviation from the norm as measured by an indirect inspection tool.

Indirect Inspection: Equipment and practices used to take measurements at ground surface above or near a pipeline to locate or characterize corrosion activity, coating holidays, or other anomalies.

In-Line Inspection (ILI): the inspection of a pipeline from the interior of the pipe using an ILI tool. These tools are known as *pigs* or *smart pigs*.

Intergranular Cracking: Cracking in which the crack path is between the grains in a metal (typically associated with high-pH SCC).

Investigative Dig: An inspection of a pipeline at a discrete location exposed for examination.

Leak: Product loss through a small hole or crack in the pipeline.

Magnetic Particle Inspection (MPI): A nondestructive inspection technique for locating surface cracks in a steel using fine magnetic particles and a magnetic field.

Maximum Allowable Operating Pressure (MAOP): the maximum internal pressure permitted during the operation of a pipeline.

Mechanical Damage: Anomalies in pipe—including dents, gouges, scratches, and metal loss—caused by the application of an external force.

Metallography: The study of the structure and constitution of a metal as revealed by a microscope.

Near-Neutral-pH SCC: A form of SCC on underground pipelines that is transgranular and is associated with a near-neutral-pH electrolyte. Typically this form of cracking has limited branching and is associated with some corrosion of the crack walls and sometimes of the pipe surface. Also referred to as low-pH or nonclassical SCC.

pH: The negative logarithm of the hydrogen ion activity written as:

$$pH = -\log_{10} (a_{H}^{+})$$

where a_H^+ = hydrogen ion activity = the molar concentration of hydrogen ions multiplied by the mean ion-activity coefficient.

Pipe-to-Electrolyte Potential: *See Structure-to-Electrolyte Potential.*

Pipe-to-Soil Potential: *See Structure-to-Electrolyte Potential.*

Pressure: A measure of force per unit area.

Remediation: As used in this standard, remediation refers to corrective actions taken to mitigate SCC.

Residual Stress: The locked-in stress present in an object that results from the manufacturing process, heat treatment, or mechanical working of the material.

Rupture: A failure of a pipeline that results from unstable crack propagation and causes an uncontrolled release of the contained product.

RSTRENG[10]: A computer program designed to calculate the pressure-carrying capacity of corroded pipe.

SCCDA: The stress corrosion cracking direct assessment process.

Segment: A portion of a pipeline that is (to be) assessed using SCCDA.

Significant SCC: An SCC cluster is assessed to be "significant" by the Canadian Energy Pipeline Association (CEPA)[2] if the deepest crack, in a series of interacting cracks, is greater than 10% of the wall thickness **and** the total interacting length of the cracks is equal to or greater than 75% of the critical length of a 50% through-wall flaw that would fail at a stress level of 110% of SMYS. CEPA also defines the interaction criteria.

The presence of extensive and "significant" SCC typically triggers an SCC mitigation program (see discussion under Post-Assessment Step).

Specified Minimum Yield Strength (SMYS): The minimum yield strength of a material prescribed by the specification or standard to which the material is manufactured.

Stress: The force per unit area when a force acts on a body.

Stress Corrosion Cracking: Cracking of a material produced by the combined action of corrosion and tensile stress (residual or applied).

Structure-to-Electrolyte Potential: The potential difference between the surface of a buried or submerged metallic structure and the electrolyte that is measured with reference to an electrode in contact with the electrolyte.

Terrain Conditions: Collective term used to describe soil type, drainage, and topography. Often used as input in the generation of SCC predictive models.

Transgranular Cracking: Cracking in which the crack path is through the grains of a metal (typically associated with near-neutral-pH SCC).

Voltage: An electromotive force or a difference in electrode potentials, commonly expressed in volts or millivolts.

Yield Strength: The stress at which a material exhibits a specified deviation from the proportionality of stress to strain. The deviation is expressed in terms of strain by either the offset method (usually at a strain of 0.2%) or the total-extension-under-load-method (usually at a strain of 0.5%).

3.0 PRE-ASSESSMENT

3.1 Purpose

The Pre-Assessment is used to collect and analyze historic and current data to prioritize potentially susceptible segments of pipelines and help select specific sites for more detailed evaluation within those segments. The susceptible segments for high-pH SCC are assumed to be those identified based on the criteria in Part A of ASME B31.8S, as listed below. Similar criteria, except for the one regarding operating temperature, may be used for near-neutral-pH SCC.

[2] Canadian Energy Pipeline Association (CEPA), 1650, 801 6th Avenue SW, Calgary, Alberta, Canada T2P 3W2.

3.2 Procedure

During the pre-assessment, data must be compiled and analyzed in order to make informed decisions on the pipeline's suitability for SCCDA. The same or similar data are often included in overall pipeline risk (threat) assessments. The pre-assessment may be conducted in conjunction with other risk-assessment efforts.

Collecting accurate and complete data at this stage is very important. To maximize efficiency, consider collecting the following:

1. Accurate spatial coordinates of pipeline and related data. SCCDA relies on data alignment, which requires accurate spatial positions.
2. Historical CP and coating performance data that indicate the effectiveness of cathodic-protection systems. SCCDA is designed to preclude future SCC. Hence, data that show the cathodic protection system is working properly support the process. Such data may include annual pipe-to-soil surveys, close-interval surveys and bimonthly rectifier and bond current data.
3. Measurements and data from which estimates of corrosion rates and SCC growth rates can be made. SCCDA requires PG&E to estimate (potential) future corrosion rates. Precise corrosion depth measurements and SCC depth and colony number provide a baseline for calculations and future assessments.
4. Measurements and data related to remaining wall thickness at identifiable locations along the pipeline. SCCDA bases its remaining life calculations on the most severe identified corrosion anomaly.
5. Capturing the experience of field personnel with regard to the pipeline history. Field personnel can provide important information needed to resolve areas of uncertainty, such as calculation of corrosion rates and the start and finish locations of SCCDA regions.

The amounts and types of data to be collected will vary with pipeline condition, history, age, etc. This document provides guidelines for determining data collection needs.

Consequences of good data collection include: SCCDA is more likely to be found effectively, indication severity estimation is improved, and the number of confirmatory digs necessary may be reduced.

3.2.1 Data Gathering and Integration

Pre-assessment data fall into five categories:

1. Pipe Related
2. Construction Related
3. Soil/Environment
4. Corrosion Protection
5. Pipeline Operations

In accordance with the requirements of ASME B31.8S, a Company's SCC threat identification should begin with data gathering and integration:

<u>Collect Data for Initial Susceptibility Assessment</u>

PG&E should collect available and relevant data on the system being analyzed. Information to be collected should include but is not limited to the following:

- Diameter, grade and wall thickness
- Pipe manufacturer and type of longitudinal seam weld

- Year/season of construction
- MAOP (% SMYS)
- Type of external coating (pipe section and girth weld coating)
- Operating temperatures and pressures associated with each pipeline system and/or segment of pipeline
- Proximity to compressor station discharge (miles) and
- Hydrostatic retest information

Using the above information, PG&E should identify those portions of its system that are potentially susceptible to SCC. Potentially susceptible regions should be taken as those that:

- The operating stress exceeds 60% of the specified minimum yield strength.
- The operating temperature has historically exceeded 100°F.
- The segment is less than 20 miles downstream from a compressor station.
- The age of the pipeline is greater than 10 years.
- The coating type is other than fusion-bonded epoxy.
- A segment on which one or more service incidents or one or more hydrostatic test breaks or leaks has occurred and has been caused by SCC unless the condition that led to SCC has been corrected.

Data from Prior Excavation Programs

PG&E should collect and review available and relevant information from prior excavation programs on segments identified as potentially susceptible to SCC. Data to be collected should be collected to assess the following:

- Any observed correlations between the occurrence and/or severity of the detected SCC with coating type, terrain condition (i.e. soil, drainage and topography), distance downstream from compressor station, operating stress levels, and operating temperatures.
- The condition of the coating observed at each excavation site.
- The pH of any electrolyte observed under the coating at each excavation site.
- The types of corrosion products observed at each excavation site.
- CP conditions at each site.
- Proximity to dents, welds, etc.

Pressure Data

PG&E should collect and characterize data on pressure cycles associated with each compressor station located within those pipeline segments deemed to be susceptible to SCC. Based on the characterization, PG&E should prepare a prioritized list of pipelines segments based upon the severity of their maximum and average operating stress levels. This is related to the threshold stress required for initiation of SCC. Laboratory studies of initiation of high-pH SCC have shown that stress corrosion cracks initiate above an applied stress level referred to as the threshold stress which is reported as a percent of the yield stress.)

Locations with High Residual Stress

PG&E should identify locations of potentially high stress intensity caused by corrosion, dents, gouges, bends, high welding residual stresses, geotechnical forces. The location of corrosion, dents and gouges should be identified from in-line inspection (i.e. caliper and/or magnetic flux leakage MFL) data, where available, or as a result of activities such as ECDA. The locations of bends can be identified from alignments sheets. The locations of geotechnical forces can be obtained from geotechnical studies undertaken by or on behalf of PG&E. PG&E should prepare a list of locations of potentially high residual stress.

Ability to Conduct SCCDA

PG&E should determine the suitability of conducting SCCDA aboveground surveys on susceptible pipeline segments to determine areas of potential coating disbondment.

Additional Data Collection

PG&E should consider collecting additional data regarding the likelihood and consequences of SCC. Table 3-1 provides guidelines from the NACE Standard Recommended Practice on SCCDA Methodology (RPO 204-2004. The importance ranking in the fourth column is as follows:

- Required (R). Usually important for prioritizing sites.
- Desired (D). May be important for prioritizing sites in some cases.
- Consider (C). Not relevant to prioritizing, but may be useful for record keeping.

Table 3-1. Pipeline Characteristics and Their Impact on SCC Susceptibility

Factor	Relevance to SCC	Use and Interpretation of Results	Ranking
PIPE-RELATED			
Grade	No known correlation with SCC susceptibility.	Background data needed to calculate stress as percent of SMYS.	C
Diameter	No known correlation with SCC susceptibility.	Background data needed to calculate stress from internal pressure.	C
Wall thickness	No known correlation with SCC susceptibility.	Impacts critical defect size and remaining life predictions. Needed to calculate stress from internal pressure.	C
Year manufactured	No known correlation with SCC susceptibility.	Older pipe materials typically have lower toughness levels, reducing critical defect size and remaining life predictions.	C

Factor	Relevance to SCC	Use and Interpretation of Results	Ranking
Pipe manufacturer	Near-neutral-pH SCC has been found preferentially in the heat-affected zone of ERW pipe that was manufactured by Youngstown Sheet and Tube in the 1950s. Reported to be statistically significant predictor for near-neutral-pH SCC in system model for one pipeline system.	Important factor to consider for near-neutral-pH SCC.	R
Seam type	Near-neutral-pH SCC has been found preferentially under tented tape coatings along DSA welds and in heat-affected zones along some electric-resistance welds. No known correlation with high-pH SCC.	May be important factor to consider for near-neutral-pH SCC.	D
Surface preparation	Shot peening or grit blasting can be beneficial by introducing compressive residual stresses at the surface, inhibiting crack initiation, and by removing mill scale, making it difficult to hold the potential in the critical range for high-pH SCC.[3]	Important factor to consider for both high-pH and near-neutral-pH SCC.	R
Shop coating type	To date, SCC has not been reported for pipe with undamaged fusion-bonded epoxy (FBE) coating or with extruded polyethylene coating.	Important factor to consider for both high-pH and near-neutral-pH SCC.	R
Bare pipe	SCC has been observed on bare pipe in high-resistivity soils.	May be important factor.	D
Hard spots	There have been instances in which near-neutral-pH SCC has occurred preferentially in hard spots, which can be located by ILI that measures residual magnetism.[4]	May be important factor.	D
CONSTRUCTION-RELATED			
Year installed	Impacts time over which coating degradation may occur and cracks may have been growing.	. Age of pipeline used in criteria for selection of susceptible segments in Part A3 of ASME B31.8S.´	R
Route changes/ modifications		May be important for accurately locating each site.	C
Route maps/aerial photos		May be important for accurately locating each site.	C

3 Beavers, J. A., Thompson, N. G., and Coulson, K. E. W., "Effects Of Surface Preparation And Coatings On SCC Susceptibility Of Line Pipe: Phase 1 – Laboratory Studies," CORROSION/93, NACE Paper No. 597. New Orleans, LA, March 1993.

4 Hard spot failures have been known to occur in 1952 pipe manufactured by A.O. Smith.

[redacted]

Factor	Relevance to SCC	Use and Interpretation of Results	Ranking
Construction practices	Backfill practices influence probability of coating damage during construction. Also, time between burying of pipe and installation of CP might be important.	Early levels of CP might be important.	D
Surface preparation for field coating	Mill scale promotes potential in critical range for high-pH SCC.	May be discriminating factor.	R
Field coating type	High-pH SCC found under coal tar, asphalt, and tape. Near-neutral-pH SCC most prevalent under tape but also found under asphalt. Weather conditions during construction also may be important in affecting coating condition.	Important factor to consider for near-neutral-pH SCC.	R
Location of weights and anchors	Near-neutral-pH SCC has been found under buoyancy-control weights.		D
Locations of valves, clamps, supports, taps, mechanical couplings, expansion joints, cast iron components, tie-ins, and isolating joints		May be important for accurately locating and characterizing each site.	C
Locations of casings	CP shielding and coating damage more likely within casings.	May be important for accurately locating and characterizing each site.	D
Locations of bends, including miter bends and wrinkle bends	Might indicate unusual residual stresses.	Residual stress may be an important factor.	D
Location of dents	Might indicate unusual residual stresses.	Residual stress may be an important factor.	D
	SOILS/ENVIRONMENTAL		
Soil characteristics/ types (Refer to Section 4.)	No known correlation between soil type and high-pH SCC, except for some evidence that high sodium or potassium levels might promote development of concentrated carbonate/bicarbonate solutions under disbonded coatings. Some success has been experienced in correlating near-neutral-pH SCC with specific soil types.	Might be important, especially for near-neutral-pH SCC.	D
Drainage	Has been correlated with both high-pH and near-neutral-pH SCC.	Might be important parameter.	D

Factor	Relevance to SCC	Use and Interpretation of Results	Ranking
Topography	Has been correlated with both high-pH and near-neutral-pH SCC, possibly related to effect on drainage. Also, circumferential near-neutral-pH SCC has been observed on slopes where soil movement has occurred (apparently external loading induced circumferential low pH SCC is more common that we thought.	Might be important parameter.	D
Land use (current/past)	No obvious correlations have been found, but use of fertilizer might affect soil chemistry as related to trapped water under disbonded coatings.	Might be important parameter	D
Groundwater	Groundwater conductivity affects the throwing power of CP systems.	Might be important parameter.	D
Location of river crossings	Affects soil moisture/drainage.	Might be important parameter.	D
CORROSION CONTROL			
CP system type (anodes, rectifiers, and locations)	Adequate CP can prevent SCC if it reaches under disbonded coatings.	Important parameter.	D
CP evaluation criteria		Background information.	C
CP maintenance history		Background information.	C
Years without CP applied	For high-pH SCC, absence of CP might allow harmful oxides to form on pipe surface. For near-neutral-pH SCC occurring at or near the open-circuit potential. absence of CP could allow SCC to proceed.	Important parameter.	D
CIS and test station information	Although high-pH SCC occurs in a narrow range of potentials (typically between -575 and -825 mV vs $Cu/CuSO_4$), it has been observed on pipe that appeared to be adequately cathodically protected, because the actual potential at the pipe surface can be less negative than the above-ground measurements because of shielding by disbonded coatings. Nevertheless. locations of cracks might correlate with CP history. especially if problems had been encountered in the past . In the case of low-pH SCC, it is difficult to define a range of susceptible potentials due to the shielding process. Nevertheless, laboratory results have shown that low-pH SCC has been observed at the native potential.	Important factor to consider for both high-pH and near-neutral-pH SCC.	D

Factor	Relevance to SCC	Use and Interpretation of Results	Ranking
Coating-fault survey information	Because SCC requires coating faults, indications of coating condition might help locate probable areas.	Important background information.	D
Coating type and condition	Because SCC requires coating faults, indications of coating condition might help locate probable areas.	Important background information.	R
	OPERATIONAL DATA		
Pipe operating temperature	Elevated temperatures have strong accelerating effect on high-pH SCC. For near-neutral-pH SCC, temperature probably has little effect on crack growth rate, but elevated temperatures can contribute to coating deterioration.	Important, especially for high-pH SCC.	R
Operating stress levels and fluctuations	Stress must be above a certain threshold for SCC to occur. Fluctuating stresses can significantly reduce the threshold stress.	Impacts SCC initiation, critical flaw size, and remaining life predictions.	R
Leak/rupture history (SCC)	There is a high probability of finding more SCC in the vicinity of previously discovered SCC.	Important.	R
Direct inspection and repair history	There is a high probability of finding more SCC in the vicinity of previously discovered SCC.	Important.	R
Hydrostatic retest history	There is a high probability of finding more SCC in the vicinity of previously discovered SCC.	Important.	R
ILI data from crack-detecting pig	There is a high probability of finding more SCC in the vicinity of previously discovered SCC.	Important.	R
ILI data from metal-loss pig	If a metal-loss pig indicates corrosion on a tape-coated pipe where there is no apparent indication of a holiday, the coating is probably disbonded and shielding the pipe from CP, a condition in which SCC—especially near-neutral-pH SCC—has been observed.	May be important.	D
ILI data from caliper tools	Dents located with caliper tools may require investigative digs to detect the possibility of SCC due to stress concentrations	May be important	D

3.2.2 Prioritization

PG&E should prioritize the likelihood and consequences of an SCC incident using a ranking system, and the higher priority segments locations should be scheduled for early assessment (i.e., near the beginning of the baseline assessment program). Other segments can be assessed throughout the implementation period of the baseline assessment plan. For detailed explanation of PG&E's ranking system for SCC see PG&E's RMP06, "Integrity Management Program".

4.0 INDIRECT INSPECTION

4.1 Purpose

Indirect Inspections, which are not always used in SCCDA, can be performed to supplement the data from the pre-assessment step. Data from indirect inspections can serve as input in prioritizing potentially susceptible segments and select the specific sites for direct examination.

4.2 Procedure

Aboveground measurements can include activities such as close interval surveys, coating-fault surveys, geological surveys and characterization.

- Recommended practices are being developed by NACE for close interval surveys. Alternatively, the procedures in Appendix A of NACE Standard RP0502 may be used.
- Recommended practices for coating-fault surveys are also being developed by NACE. Again, the procedures as described in Appendix A of NACE Standard RP0502 may be used.

Other types of data that could be obtained in this step include:

- Locations of dents and bends, found with in-line inspection geometry tools, on pipelines in which the SCC has been associated with such features.
- Areas of coating disbondment and corrosion, located by in-line inspection magnetic-flux-leakage (MFL) tools, on pipelines in which the SCC has been associated with such features.

5.0 DIRECT EXAMINATION

5.1 Purpose

The Direct Examination Step is used (1) to examine the pipe at locations chosen after the pre-assessment and, if applicable, the indirect inspection and (2), if SCC is detected, to assess the presence, extent, type, and severity of SCC at the individual dig sites.

5.2 Procedure

Pipeline segments that are potentially susceptible to SCC are to be subject to a bell hole examination. Pipeline segments that are found to have numerous SCC clusters will require further assessment and testing (beyond the scope of this document), such as inclusion in a hydrostatic test program.

Before the direct examination takes place, dig sites must be selected from the prioritized location list prepared in the pre-assessment step, modified as appropriate by results from indirect inspections. In the absence of a detailed "soils model" for predicting SCC susceptibility, the primary considerations should be the parameters listed earlier in Table 3.1.

5.2.1 Excavations

Pipe must be exposed and the coating removed for magnetic particle inspection (MPI) in accordance with each Company's Bell Hole and defect assessment procedures. Magnetic particle inspection is used to identify possible SCC. Additional details are provided in NACE RPO 204-2004 Appendix B for surface preparation techniques, and Appendix C for MPI. Shallow grinding of local areas can be used to differentiate SCC from benign pipeline anomalies. If SCC is found, in-situ metallography should be used to determine the cracking mechanism (high pH SCC [intergranular] or near neutral pH SCC [transgranular]). Detailed examinations should be conducted in accordance with the NACE SCCDA Recommended Practice. Any cracking and/or external corrosion found should be documented together with relevant dimensions.

Data Collection

Table 5-1 provides guidelines for data collection (taken from the NACE SCCDA Recommended Practice). The importance ranking in the fourth column is as follows:

Required (R): Important element for SCCDA.
Desired (D): May be useful in SCCDA model development.

Consider (C): Useful background information or information used in other analyses

Table 5-1. Pipeline Characteristics and Their Impact on SCC Susceptibility

Data Element	When Collected	Use and Interpretation of results	Ranking
Pipe-to-soil potential	Prior to coating removal.	Useful for comparison with ground surface pipe-to-soil potential measurements.	C
Soil resistivity	Prior to coating removal.	Related to soil corrosiveness and soluble cation concentration of soil. Useful for comparison with results of soil and groundwater analyses.	D
Soil samples	Prior to coating removal.	Useful in confirming terrain conditions. Soil analysis results can be trended in predictive model.	D
Groundwater samples	Prior to coating removal.	Chemistry results can be trended in predictive model.	D
Coating type	Prior to coating removal.	Required element. Used for field site verification and in predictive model development.	R
Coating condition	Prior to coating removal.	Can be related to extent of SCC found.	D
Measurement of coating disbondment	Prior to coating removal.	Locations of disbondment can be related to presence of cracking and other measured data.	D
Electrolyte	Prior to coating removal.	Useful in establishing type of cracking. Can be related to groundwater chemistry.	D
Photograph of dig site	Prior to coating removal.	Useful in confirming terrain conditions, coating type, and coating condition.	C
Data for other integrity analyses	Before and after coating removal.	Data for other analyses (e.g., dent measurements) may be related to occurrence of SCC.	D,C
Deposit description and photograph	After coating removal.	Useful in establishing type of cracking.	D
Deposit analysis	After coating removal.	Useful in establishing type of cracking.	D
Identification and measurement of corrosion defects	After coating removal.	Used for integrity assessment of corrosion defects. Also used in establishing type of SCC, if present.	R,C
Photograph of corrosion defects	After coating removal.	Used in integrity assessments.	C
Identify weld seam type	After coating removal.	Required element. Used in field site verification.	R
MPI inspection	After coating removal.	Required element for SCCDA. Establishes whether SCC is present.	R
Location and size of each cluster	After coating removal.	Required element for SCCDA. Used to establish correlation of location with other parameters measured.	R
Crack length and depth measurements	After coating removal.	Required element for SCCDA. Used to establish significance of cracking and determine whether there is an immediate integrity concern.	R
In situ metallography	After coating removal.	Used to establish type of SCC.	D
Photograph clusters	After coating removal.	Required element for SCCDA. Used to confirm crack measurements.	R
Wall thickness measurements	After coating removal.	Required element. Used in integrity assessments and field site verification.	R,C
Measure pipe diameter	After coating removal.	Required element. Used in integrity assessments and field site verification.	R,C

Crack-like defects other than SCC might be found. Crack-like defects that could be found include, but are not limited to, Electric Resistance Welded (ERW) or flash-butt welded seam anomalies. These defects include hook cracks, lack of fusion, contact burns, hard-weld-zone cracks, weld centerline segregation cracking, and selective seam weld corrosion, etc. Alternative methods for assessing such defects must be followed. See ASME B31.8S, ASME B31.4, ASME B31.8, API 1160, and similar documents for additional details.

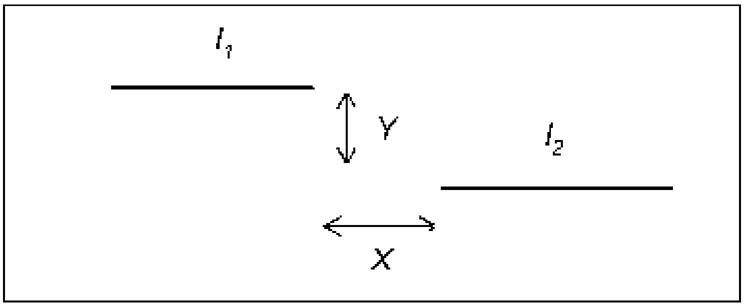
Documentation and evaluation of detected SCC

Following the completion of the MPI, each detected crack cluster shall be documented and evaluated according to the activities indicated below.

Each detected cluster shall be given a unique identifier and the location of the center of the colony shall be identified relative to a reference point such as a weld and a clock position.

Obtain the typical information on an individual crack cluster as follow:

- Axial length, circumferential length, maximum length, and width of the colony. The axial length is the total length of the colony in the axial direction. The circumferential length is the total length of the colony in the circumferential direction. The length of the colony is the maximum length of the colony, which might be different from the axial or circumferential length, depending on the colony orientation. The width of the colony is the dimension of the colony perpendicular to the length direction.
- Presence of interlinking. Cracks are defined to have interlinked if they physically have joined (coalesced) to form one longer crack.
- Presence of interacting cracks. Crack interaction is dependent on the circumferential and axial separation between individual (or interlinked) cracks and is calculated as follows. Two neighboring cracks, as illustrated bellow, are defined as interacting if their circumferential spacing Y is as indicated in Equation (1) and if their axial spacing X is as indicated in Equation (2):



$$Y < 0.14\frac{(l_1 - l_2)}{2} \qquad (1)$$

$$X < 0.25\frac{(l_1 - l_2)}{2} \qquad (2)$$

Where l_1 and l_2 are the individual crack lengths.

Determine the maximum crack length, including interlinking and interacting cracks. The maximum crack length is the total length of the longest interacting and interlinking cracks, as defined above.

Determine the presence of "significant" cracking. An SCC cluster is assessed to be "significant" if the deepest crack, in a series of interacting cracks, is greater than 10% of the wall thickness **and** the total interacting length of the cracks is equal to or greater than 75% of the critical length of a 50% through-wall flaw that would fail at a stress level of 110% of SMYS. See Section 5.3.5.7.5 of the NACE RP0204-2004. A significant crack potentially could fail in a hydrostatic test and therefore is considered to be an eventual integrity threat to the pipeline, but a crack that is labeled "significant" is not necessarily an immediate threat to the integrity of the pipeline.

Determine the maximum crack depth for evaluating whether the cracking is "significant" and in estimating the failure pressure. Use grinding or buffing, in conjunction with MPI. Since typically the longer cracks are also deeper, grinding should be performed on them first. If grinding is to be performed on a pressurized line, the initial wall thickness shall be determined by UT, and a safe wall thickness must be maintained at all times during grinding.

Document the average circumferential separation of adjacent cracks.

In situ metallography can be performed to determine the crack path of the SCC (intergranular versus transgranular) and establish the type of SCC (high-pH SCC [intergranular] versus near-neutral-pH SCC [transgranular]). It will also determine if the indication is a crack, scab, lamination, etc. Removal of metal samples for destructive analysis may provide improved data on crack morphology, origin, and propagation. This includes, but is not limited to core plug sampling, GE-type "scoop sampling" (both of which can be done "hot"), as well as removal of a 360-degree pipe segment.

Measure and document the wall thickness at cluster location.

Photograph the crack cluster under both black light and white light illumination.

Analysis of Type of Cracking

Indications of cracking detected by this SCCDA procedure can be the result of several causes, including near-neutral-pH SCC, high-pH SCC, mechanical damage, or even noninjurious mill imperfections. The tell-tale signs of the 2-types of SCC are enumerated below:

- The presence of cracking in clusters typically distinguishes SCC from other forms of cracking.
- Near-neutral-pH SCC frequently is associated with light surface corrosion of the pipe. High-pH SCC usually is not associated with obvious external corrosion.
- Near-neutral-pH SCC is transgranular and typically is less branched than High-pH SCC usually with evidence of corrosion of the pipe outside surface and crack walls. Near-neutral-pH SCC tends to be wider than high-pH SCC.
- High-pH SCC is intergranular and typically is branched with little evidence of corrosion of the pipe outside surface and crack walls.

5.2.2 SCC Severity Ranking

Following the completion of the MPI, each detected crack cluster must be documented and evaluated to determine its potential impact on integrity. Typical information needed for assessing individual crack clusters is described in Section 5.3.5.7 of the NACE document on SCCDA. Some of the most important parameters are:

- Axial length of the colony,
- Length of the colony,
- Width of the colony,
- Maximum crack length including interlinking and interacting cracks,
- Maximum crack depth and
- Average circumferential separation of adjacent cracks.

The criteria to be used in order to determine SCC severity ranking is based on the CEPA Section 4.3.1 Box 5 definition for "significant" SCC: an SCC cluster is assessed to be "significant" if the deepest crack, in a series of interacting cracks, is greater than 10% of the wall thickness and the total interacting length of the cracks is equal to or greater than 75% of the critical length of a 50% through-wall flaw that would fail at a stress level of 110% SMYS.

If the deepest crack in a series of interacting cracks is less than 10% of the wall thickness, then the SCC is classified as "insignificant".

If no SCC indications are found, the section should be re-coated using the appropriate coating in accordance with PG&E's coating specifications.

When significant SCC indications are detected, the failure pressure should be calculated using "fracture" and "flow" stress approach like PAFFC, CorLAS TM or an equivalent fitness-for-service analysis program.

If the calculated failure pressure is greater than 110% of SMYS, then the SCC may be considered minor. If the calculated failure pressure is 100%-110% of SMYS, then the SCC should be classified as moderate. If the calculated failure pressure is 90%-100% of SMYS, then the SCC must be classified as moderate-severe. If the calculated failure pressure is less than 90% of SMYS, the SCC must be classified as severe.

Engineering Critical Assessment calculation may be needed to determine risk, crack growth rates and satisfactory pipeline safety performance.

5.2.3 Additional Excavations

The SCC DA process helps find representative SCC clusters on a pipeline segment, but might not find all such conditions on the segment. As a result, if SCC clusters that exceed allowable limits are found, it should be assumed that other similar defects might be present elsewhere in the segment.

The number of additional investigations needed to characterize a given segment should depend upon the extent and severity of any SCC detected and the confidence needed in the assessment. In addition, the frequency of subsequent investigations should depend on an assessment as to length of time required for colonies to grow to the dimensions necessary to be deemed "significant".

If minor or moderate SCC is found on excavation, a second excavation should be undertaken within one year at the most likely site for SCC, as described above. The segment should be classified according to the most severe SCC found.

If severe-moderate or severe SCC is found, the segment should be further assessed and the SCC remediated or mitigated. Hydrostatic testing and/or remedial action should take place in accordance with ASME B31.8S and the NACE SCCDA Recommended Practice.

6.0 POST ASSESSMENT

6.1 Purpose

The Post Assessment is used to determine whether general SCC mitigation is required, prioritize remedial action for defects that are not removed immediately, define reassessment intervals, and evaluate the effectiveness of the SCCDA approach.

6.2 Procedure

6.2.1 In general, if the presence of SCC is confirmed, one of the following 3 mitigation methods shall be used:

6.2.1.1 Evaluate repair or removal methods for SCC. Industry research such as PR-218-9307 addresses repair methods for SCC.

6.2.1.2 Hydrostatically test the subject valve section.

6.2.1.3 An Engineering Critical Assessment may be conducted to evaluate the risk and identify any further mitigation methods. Pr

An Engineering Critical Assessment can be used to determine the integrity of the pipeline when SCC is discovered. An engineering assessment should be based on fracture mechanics principles that allow the determination of the maximum tolerable defect size that a pipeline can tolerate without failure.

The assessment can be carried out using analytical models, such as PAFFC, CorLAS™ pC-Crack™ or an equivalent. These models can provide an assessment of the effects of the found SCC and the corresponding growth rates. The final results will be used to schedule reinspection and mitigative actions.

6.2.2 Response and Remediation

The procedures for response and remediation following the discovery of SCC must be in accordance with ASME B31.8S, taking into account the NACE document 'SCC Direct Assessment' and the CEPA document 'SCC Recommended Practice'.

If cracks are classified as insignificant. they do not require any further remedial action (other than pipe recoating etc) prior to reinstatement.

If cracks are classified as minor, they can be removed by grinding (the pipeline maximum operating pressure will be reduced to 80% of the highest recent operating pressure while grinding and assessment takes place). The remaining strength of the ground pipe should be assessed using RSTRENG or an equivalent method and repaired in accordance with ASME B31.8S. The pipeline should then be recoated, reinstated and returned to full service.

If cracks are classified as moderate, they should be removed by grinding and the remaining strength assessed as above (using the measured rather than nominal wall thickness and the pipeline maximum operating pressure will be reduced to 80% of the highest recent operating pressure while grinding and assessment takes place). The pipeline must be repaired in accordance with ASME B31.8S, recoated, reinstated and returned to full service.

If cracks are classified as severe-moderate or severe, the pipeline maximum operating pressure must be reduced to 80% of the highest recent (past 60 days) operating pressure. The cracked section should be cut out, or alternatively cracks must be removed by grinding, assessed as above and repaired in accordance with

ASME B31.8S. The segment can be returned to service at a reduced operating pressure until a hydrostatic test can be completed.

6.2.3 Reassessment

If cracks are classified as insignificant or if no cracks are found, the segment can be returned to the segment prioritization pool and considered for selection in future excavation program activities. PG&E's criteria should be based on a cycle of regular intervals for repeat inspections unless circumstances or results dictate other priorities.

If cracks are classified as minor or moderate, the maximum reassessment interval for each SCC segment shall be taken as no more than one-half the calculated remaining life. Moderate cracks should also be considered to be transferred from the excavation program to a hydrotest program, for hydrostatic testing within 3-5 years or in accordance with the results of the critical engineering assessment results, or other mitigation.

If cracks are classified as severe-moderate or severe, the segment must be transferred from the excavation program to a hydrotest program, for hydrostatic testing within 1 year, or other mitigation. Until hydrostatic testing, the segment must be operated at the reduced pressure (80% of the highest recent operating pressure).

7.0 RECORD KEEPING

This section is to document clearly and concisely the data and information collected and decisions made during the SCCDA process.

7.1 Pre-Assessment Documentation (see Form A, Appendix B).

Pre-assessment documentation should include, but not necessarily be limited to:

- Documentation on the analysis used to select susceptible segments for SCCDA.
- Data elements collected for the segments to be evaluated, in accordance with Table 3.1.
- Methods and procedure used to integrate data, prioritize segments, and select dig sites.

7.2 Indirect Inspections (see Form B1 and B2, Appendix B).

Indirect Inspection documentation should include, but not necessarily be limited to:

- Documentation on the analysis used to identify data needs and select specific indirect inspection techniques.
- Data elements collected for the segments to be evaluated.
- Methods and procedure used to integrate data, prioritize segments, and select dig sites.

7.3 Direct Examination Documentation (see Form H, Appendix B).

Direct examination documentation should include, but not necessarily be limited to:

- Data collected for field site verification, prior to coating removal, and after coating removal.
- Results of analysis of cracking, if found.
- Results of assessment of severity of cracking, if found.

7.4 Post Assessment (see Form D1 and D2, Appendix B).

Post assessment documentation should include, but not necessarily be limited to:

- Whether mitigation was required, the type of mitigation selected, and the justification for the selection.
- Criteria used to select reassessment intervals and the intervals selected.
- Scheduled activities, if any.
- Criteria used to assess SCCDA effectiveness and results from assessments.

APPENDIX A

Soil Collection & Laboratory Testing Protocol

PG&E Soil Collection & Laboratory Testing Protocol

1.0 PURPOSE

The purpose of this protocol is to outline industry-accepted practices to be followed in the collection and testing of soil samples from each excavation that is made in conjunction with PG&E's investigative excavation programs.

2.0 SCOPE

The scope of this protocol includes collection, handling, packaging, shipping and laboratory testing of soil samples obtained from selected excavation sites.

3.0 MATERIALS FOR COLLECTION, PACKAGING, & SHIPPING OF SOIL SAMPLES

- Trowel or shovel for sampling soil
- Screw-cap plastic jars or gallon-size plastic freezer bags (e.g. Ziplock™ bags)
- Tape
- Sharpie™ waterproof marker
- Anaerobic Dilution Solution (ADS) bottles (available from Bioindustrial Technologies)
- Coolers to transport soil
- Ice or dry ice

4.0 REQUIREMENTS

- A minimum of two (2) soil samples are to be collected at each excavation site. One of the samples is to be representative of the native soil at pipe depth (i.e. to be obtained from the ditch wall perpendicular to the pipe), while the other is to be collected immediately adjacent to the pipe and preferably near any anomaly(s) (i.e. metal loss, SCC, dents, etc) under investigation.

  - All samples at pipe depth should be collected as soon as possible after being exposed to the atmosphere to avoid chemical changes and loss of viable anaerobic bacteria.

  - Preservation of a portion of the soil in ADS solution should be done as quickly as possible to avoid loss of viable anaerobic bacteria.

5.0 COLLECTION & HANDLING

5.1 Native Soil Sample

- Using a clean sampling device, obtain a "grab" sample of the native soil at approximately pipe depth.

  - If the native soil visibly appears to have significant differences within an excavation, a native soil sample should be obtained from each different soil.

- The minimum quantity of soil obtained should at least be able to 30% fill a gallon-sized plastic bag, or the equivalent volume in plastic jars. The soil sample(s) should be sealed in a sample container as quickly as possible to preserve the natural moisture.

- In preparation for bacteria media bottle inoculations, place about ½-teaspoon of each soil sample in an ADS bottle and cap as soon after sampling as possible to help prevent the loss of any viable anaerobic bacteria. Shake the bottle, vent the gas, label the bottle, and seal with tape.

- Clean the sampling device after each soil sample has been taken to avoid cross-contamination.

5.2 Near-Pipe Soil Sample

- Using a clean sampling device, obtain a "grab" sample of the soil from immediately adjacent to the pipe and preferably near any anomaly(s) (i.e. metal loss, SCC, dents, etc) under investigation.

  - If there are several anomalies at an excavation, a "composite" sample can be obtained that consists of small "grab" samples from each anomaly location.

  - Composite samples should only be collected if the individual samples do not appear to be significantly different. If there are significant differences in the appearance of the soil, then separate grab sample should be taken.

- The minimum quantity of soil obtained should at least be able to 30% fill a gallon-sized plastic bag, or the equivalent volume in plastic jars. The soil sample(s) should be sealed in a sample container as quickly as possible to preserve the natural moisture.

- In preparation for bacteria media bottle inoculations, place about ½-teaspoon of each soil sample in an ADS bottle and cap as soon after sampling as possible to help prevent the loss of any viable anaerobic bacteria. Shake the bottle, vent the gas, label the bottle, and seal with tape.

- Clean the sampling device after each soil sample has been taken to avoid cross-contamination.

6.0 PACKAGING & SHIPPING

- If bags are used, double-bag each sample and seal securely. If jars are used, be sure the cap is securely attached and wrap tape around the lid.

- Using a Sharpie™ waterproof marker, legibly label each sample container with the pertinent information that needs to be recorded in the lab report. A separate listing of the soil identification and pertinent information should be securely attached to the exterior of the cooler.

- Place the sealed sample containers in a cooler. Add ice to the cooler to lower the temperature of the samples to retard chemical changes during transport.

- On each cooler of samples, place an address label for the laboratory that the samples are being shipped to.

  - Per the United States Department of Agriculture's (USDA) Animal and Plant Health Inspection Services (APHIS) Plant Protection and Quarantine Program (PPQ), soils may only be shipped to laboratories authorized to receive foreign and/or domestic soil samples.

  - Observe the soil movement regulations given in Figure **1**.

  - The address label on each container of samples being shipped must include the laboratory's Soil Import Permit Number

- The cooled samples should be shipped overnight to the laboratory as soon as possible after sampling. Per Section 8.1.3 of the ASTM G 51 Standard for pH measurement, "*it is recommended that the soil be packed in dry ice to retard any changes in pH due to chemical or biological reactions*."

  - The ADS bottles containing soil may have to be shipped in a separate box/container so as to prevent freezing of the solution and breakage of the bottles.

7.0 LABORATORY TESTING

7.1 pH, Resistivity, and Moisture Content

- The pH of the soil shall be determined as soon as possible per the ASTM G 51 Standard using a calibrated pH meter.

  - Calibrate the pH meter over the anticipated pH range.

- Resistivity of the soil shall be determined per the ASTM G57 Standard using a Nilsson Soil Resistance meter and 4-pin soil box.

- Resistivity shall be determined on the as-received soil and after saturation with deionized water.

- The percent moisture shall be determined at 60°C per the ASTM 2216 Standard.

7.2 Soil Extraction for Analyses of Ions

- Select a representative portion of the oven-dried soil and pass it through a 2-millimeter (#10) sieve.

- Extract the soluble ions with deionized water. The ratio of soil to water to be used will depend on the amount of ions that will dissolve. A suggested ratio is 100 grams of soil in 300 mL of deionized water.

  - Mix the soil and water for a minimum of one (1) minute to extract the soluble ions.

  - Filter the slurry to obtain a clear extract. The extract is to be used in the analyses of ions.

7.3 Cation Analyses

- The following cations shall be determined from the water extract by the inductively coupled plasma (ICP) technique: sodium, potassium, calcium, magnesium, manganese, and iron.

- EPA Method 365.4, or equivalent methodology, shall be used to determine total phosphorous.

7.4 Anion Analyses

- EPA Method 310.1, or equivalent methodology, shall be used to determine the alkalinity (hydroxide/carbonate/bicarbonate/carbonic acid) of the extract.

The total alkalinity of a water is the sum of the bases that are titratable with strong acid:

$TA = [HCO_3] + 2[CO_3] + [B(OH)_4] + [OH] + [HPO_4] + 2[PO_4] + [SiO(OH)_3] + [HS] + 2[S] + [NH_3] - [H] - [HSO_4] - [HF] - [H_3PO_4]$[1]

In most natural freshwaters, such as soil extracts, total alkalinity is roughly equal to the carbonate alkalinity because the concentrations of the other species are so low [2] e.g.:

$TA = [HCO_3] + 2[CO_3]$

The relative concentration of $H_2CO_3/HCO_3/CO_3/OH$ is then determined based on the pH of the extract.

- EPA Method 325.2, or equivalent methodology, shall be used to determine the chloride concentration in the extract.

- EPA Method 352.1 or equivalent methodology shall be used to determine the nitrate concentration in the extract.

- EPA Method 375.4, or equivalent methodology shall be used to determine the sulfate concentration in the extract.

7.5 Carbon Analyses

- Total inorganic carbon and total organic carbon shall be determined by industry-accepted methodology.

7.6 Texture

- The percentage of sand, silt, and clay shall be determined industry-accepted methodology.

7.7 Bacteria Media Inoculations

- Media bottles should be inoculated with the soil/ADS solution as soon as is reasonably possible to prevent loss of viable bacteria.

- The serial dilution technique shall be used, per manufacturer's instructions, to inoculate a string of 5 media bottles for each of the following groups of bacteria: aerobic, anaerobic, acid producing, sulfate reducing, and iron relate.

- Label each tray with the sample identification, date of inoculation, and dilution number.

- Incubate the bottles at room temperature and follow manufacturer's instructions for determining viable bacteria counts.

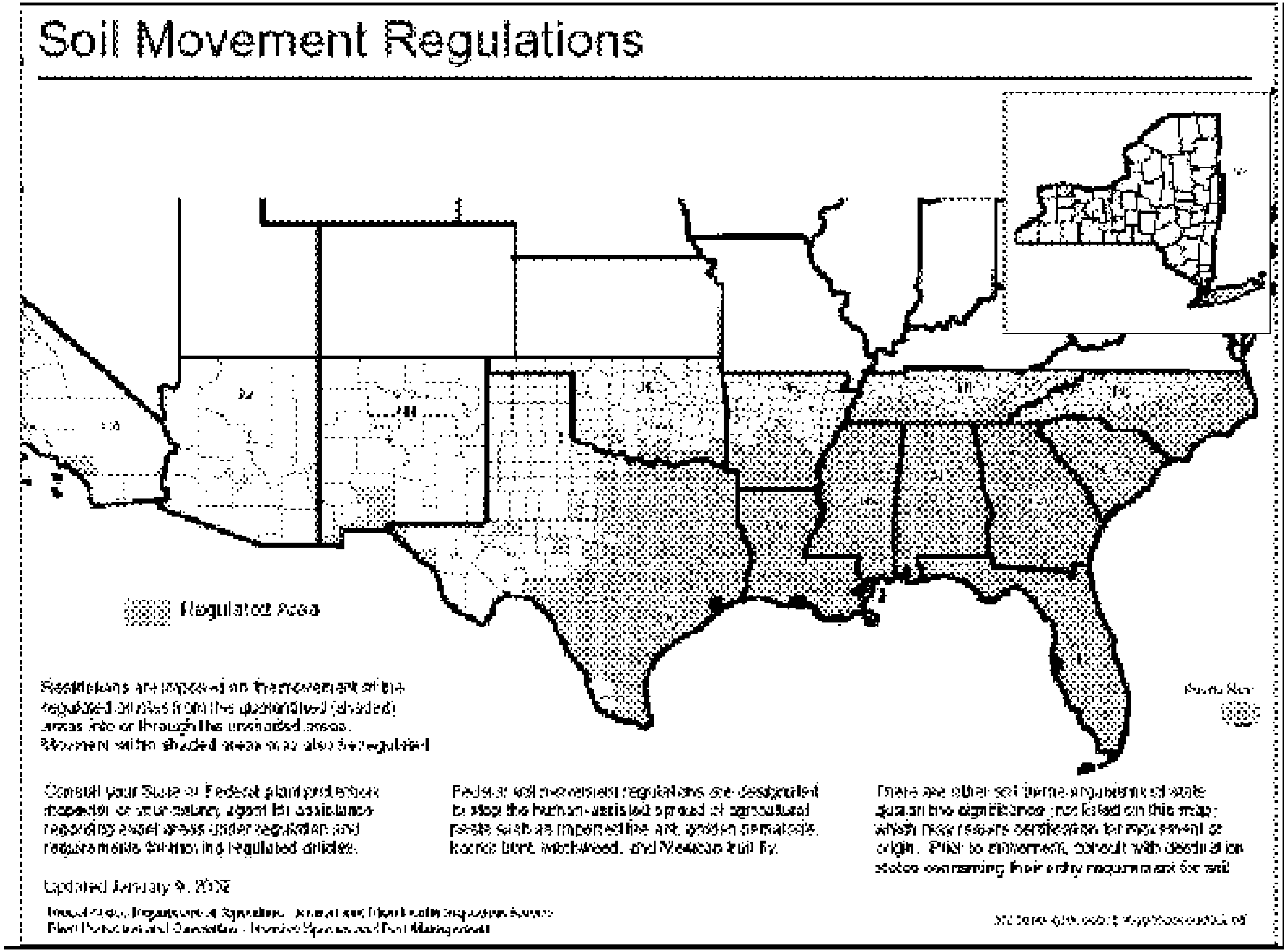


Figure 1. Map Illustrating Regulated Areas for Soil Movement.

APPENDIX B

SCCDA Report Forms

[redacted]

FORM A. SCCDA DATA ELEMENTS FORM

Company Name:____________________ Date:____________________
SCCDA Region/Name:____________________ Condition:____________________
Starting Mile point: ____________________ Line Number: ____________________
Ending Mile Point: ____________________

Factor	Use and Interpretation	Ranking[1]	Data Sources	Comments
	PIPE-RELATED			
Grade	Background data needed to calculate stress as percent of SMYS.	C		
Diameter	Background data needed to calculate stress from internal pressure.	C		
Wall thickness	Impacts critical defect size and remaining life predictions. Needed to calculate stress from internal pressure.	C		
Year manufactured	Older pipe materials typically have lower toughness levels, reducing critical defect size and remaining life predictions.	C		
Pipe manufacturer	Important factor to consider for near-neutral-pH SCC.	R		
Seam type	May be important factor to consider for near-neutral-pH SCC.	D		

[1] R = Required. C = Considered, D = Desired, N/R = Not Required
Data Sources: Division/Archive Files, GIS. Field, Pipeline Databases. Maps. Other

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Factor	Use and Interpretation	Ranking[1]	Data Sources	Comments
Surface preparation	Important factor to consider for both high-pH and near-neutral-pH SCC.	R		
Shop coating type	Important factor to consider for both high-pH and near-neutral-pH SCC.	R		
Bare pipe	May be important factor.	D		
Hard spots	May be important factor.	D		
	CONSTRUCTION-RELATED			
Year installed	Age of pipeline used in criteria for selection of susceptible segments in Part A3 of ASME B31.8S.[1]	R		
Route changes/ modifications	May be important for accurately locating each site.	C		
Route maps/aerial photos	May be important for accurately locating each site.	C		
Construction practices	Early levels of CP might be important.	D		
Surface preparation for field coating	May be discriminating factor.	R		
Field coating type	Important factor to consider for near-neutral-pH SCC.	R		
Location of weights and anchors		D		
Locations of valves, clamps, supports, taps, mechanical couplings, expansion joints, cast iron components, tie-ins, and isolating joints	May be important for accurately locating and characterizing each site.	C		

[redacted]

Factor	Use and Interpretation	Ranking[1]	Data Sources	Comments
Locations of casings	May be important for accurately locating and characterizing each site.	D		
Locations of bends, including miter bends and wrinkle bends	Residual stress may be an important factor.	D		
Location of dents	Residual stress may be an important factor.	D		
SOILS/ENVIRONMENTAL				
Soil characteristics/ types (Refer to Section 4.)	Might be important. especially for near-neutral-pH SCC.	D		
Drainage	Might be important parameter.	D		
Topography	Might be important parameter.	D		
Land use (current/past)	Might be important parameter	D		
Groundwater	Might be important parameter.	D		
Location of river crossings	Might be important parameter.	D		
CORROSION CONTROL				
CP system type (anodes, rectifiers, and locations)	Important parameter.	D		
CP evaluation criteria	Background information.	C		
CP maintenance history	Background information.	C		
Years without CP applied	Important parameter.	D		
CIS and test station information	Important factor to consider for both high-pH and near-neutral-pH SCC.	D		

[redacted]

[redacted]

Factor	Use and Interpretation	Ranking[1]	Data Sources	Comments
Coating-fault survey information	Important background information.	D		
Coating type and condition	Important background information.	R		
	OPERATIONAL DATA			
Pipe operating temperature	Important, especially for high-pH SCC.	R		
Operating stress levels and fluctuations	Impacts SCC initiation, critical flaw size, and remaining life predictions.	R		
Leak/rupture history (SCC)	Important.	R		
Direct inspection and repair history	Important.	R		
Hydrostatic retest history	Important.	R		
ILI data from crack-detecting pig	Important.	R		
ILI data from metal-loss pig	May be important.	D		
ILI data from caliper tools	May be important	D		

[redacted]

FORM B1. IN-DIRECT INSPECTION TOOL SELECTION (SCCDA)

Date:______________________________
Starting Mile point: ______________________________ Name: of SCCDA Project:____________________________
Ending Mile Point: ______________________________ Line Number:______________________________

Pipe Segment Number	SCCDA Start/Stop	GPS Coordinates	Boundary Marking Type[1]	1st IIT	2nd IIT	3rd IIT	SCCDA Region Number	Comments

Reviewed by:______________________________ **Date:**____________

Approved by:______________________________ **Date:**____________

[1] RW = Roadway, street. or other landmark, P = Marking on painted pavement, S = Stake, nail marking, or other suitable means for soil locations.

FORM B2. INDICATION CLASSIFICATION AND DIRECT EXAMINATION FORM

Date: ____________________

Starting Mile point: ____________________ Name: of SCCDA Project: ____________________

Ending Mile Point: ____________________ Line Number: ____________________

SCCDA Start/Stop	CIS Severity[1]	DCVG Severity[1]	PCM Severity[1]	Other Severity[1]	Selected for Direct SCCDA Exam Yes/No	Date Scheduled	Comments

Reviewed by: ____________________ **Date:** __________

Approved by: ____________________ **Date:** __________

[1] Severity Classification: Severe, Moderate, Minor in accordance with NACE Standard RPO0502-2002.

FORM D1. MITIGATION AND JUSTIFICATION FOR THE SELECTION FORM

Date:______________________________
Starting Mile point: ____________________ Name: of SCCDA Project:_____________
Ending Mile Point: ____________________ Line Number:_______________________
Joint #:_____________ Length of Joint:_____________ Pipe Diameter:__________

Pipe Data
Diameter:______ WT:______ Material:______ MAOP:______

Isolated SCC Location – Detail

Indication No.	Type	Distance from Zero ref	O'Clock Position	Length	Width	Max Depth	Quantity (I.e. Number of Defects, etc)	Severity Ranking

Sketch of SCC Indication and Ultrasonic Inspection Layout (Indicate % size, type, depth, etc)

[redacted]

Critical Engineering Assessment Analysis

Analytical Model Used (PAFFC, CorLAS™ pC-Crack™ or other):________________________

Calculated Growth Rates____

Comments:____

____

____

Remedial Action

Cut out ☐ Reinforcing sleeve ☐

Recoat ☐ Other ☐ Specify__________________

Actual recoat chainage________________________________
Actual chainage of reinforcing sleeve________________________________
Actual cutout chainage________________________________
Coating used________________________________
Replacement pipe________________________________

Is Reprioritization Indications recommended? Yes No
Are Repeat Indirect Inspections Required? Yes No

Comments:____

____

____

Reviewed by:________________________________ **Date:**______________

Approved by:________________________________ **Date:**______________

FORM D2. REPRIORITAZION

Date:____________________ SCCDA Region Number:____________________
Name: of SCCDA Project:____________________
Line Number:____________________

Prioritization Evaluation

Location of Indication MP or MP Range	Original Priority	Cracks Present Yes/NO	Crack Depth	Corrosion Present	Reprio. Yes/No	Priority	Comments

Reviewed by:____________________ **Date:**__________

Approved by:____________________ **Date:**__________

[redacted]

FORM H: DIRECT EXAMINATION DATA SHEET 1 OF 10

DA/ILI		DA		ILI	
ROUTE NUMBER:		N-SEGMENT:		ILI LOG DISTANCE:	
DATE OF EXCAVATION:		IMA NUMBER:		RMP-11 REF. SECTION:	Table 5.6.2
MILE POINT:				REFERENCE GIRTH WELD:	
EXAMINATION PERFORMED BY:		REGION NUMBER:		DISTANCE FROM GIRTH WELD:	
PG&E PROJECT MANAGER:		SUBREGION # (ICDA)			
APPROVED BY:		STATIONING:			
ORDER NUMBER:					

EXCAVATION PRIORITY:
☐ IMMEDIATE ☐ SCHEDULED (FOR ILI - ☐ 1 YEAR ☐ OTHER)
☐ MONITOR ☐ EFFECTIVENESS ☐ ICDA

EXCAVATION REASON:
☐ ECDA ☐ ILI ☐ RECOAT
☐ ICDA ☐ OTHER ____________

IF PRACTICAL, TAKE P/S OR CIS READS BEFORE EXCAVATION: ____________

EXCAVATION DETAILS: CENTERLINE GPS COORDINATES (BASED ON GIS):
NORTHING: ____________ PLANNED EXCAVATION LENGTH (FT.): ____________
EASTING: ____________ ACTUAL EXCAVATION LENGTH (FT.): ____________

CENTERLINE GPS COORDINATES (UNCORRECTED FIELD MEASUREMENT): GPS FILE NAME:
NORTHING: ____________
EASTING: ____________

CENTERLINE GPS COORDINATES (CORRECTED FIELD MEASUREMENT):
NORTHING: ____________
EASTING: ____________

1.0 DATA BEFORE COATING REMOVAL

1.1 **NATIVE SOIL TYPE:** ☐ CLAY ☐ ROCK ☐ SAND ☐ LOAM ☐ WET ☐ OTHER ____________
DEPTH OF COVER (FT.): ____________
COMMENTS: ____________

1.2 COATING TYPE: ☐ HAA ☐ SOMASTIC ☐ PLASTIC TAPE ☐ WAX TAPE ☐ FBE ☐ POWERCRETE
☐ BARE/NONE ☐ PAINT ☐ OTHER: ____________ COMMENTS: ____________
COATING THICKNESS (INCHES): ____________ NUMBER OF LAYERS: ____________

1.3 **HOLIDAY TESTING PERFORMED?:** ☐ YES ☐ NO VOLTAGE USED: ____________ MAP LOCATION OF HOLIDAYS BELOW.
DEVICE USED: ☐ COIL ☐ WET SPONGE COMMENTS: ____________

1.4 **PIPE-TO-SOIL POTENTIALS IN DITCH (-mV):** US: ____________ DS: ____________
COMMENTS: ____________

1.5 **SOIL RESISTIVITY IN DITCH (Ω cm):**
METHOD: ☐ 4-PIN ____________ ☐ SOIL BOX ____________

1.6 **SOIL SAMPLE LOCATION:** COMMENTS: ____________

1.7 **GROUND WATER PRESENT?** ☐ YES ☐ NO **SAMPLE(S) COLLECTED?:** ☐ YES ☐ NO SAMPLE PH: ____________
COMMENTS: ____________

1.8 **COATING CONDITION:** ☐ GOOD – ADHERED TO PIPE ☐ FAIR – COATING PARTIALLY DISBONDED OR DEGRADED
☐ POOR – COATING SIGNIFICANTLY DISBONDED OR MISSING
COMMENTS: ____________

1.9 **MAP OF COATING DEGRADATION*:** **ZERO REFERENCE POINT:** ____________
*NOTE ANY CALCAREOUS DEPOSIT LOCATIONS

FLOW →

12 O'CLOCK										
9 O'CLOCK										
6 O'CLOCK										
3 O'CLOCK										
12 O'CLOCK										
FEET	0	1	2	3	4	5	6	7	8	9	10

[redacted]

FORM H: DIRECT EXAMINATION DATA SHEET 2 OF 10

DA/ILI		DA		ILI	
ROUTE NUMBER:		N-SEGMENT:		ILI LOG DISTANCE:	
DATE OF EXCAVATION:		IMA NUMBER:		RMP-11 REF. SECTION:	Table 5.6.2
MILE POINT:				REFERENCE GIRTH WELD:	
EXAMINATION PERFORMED BY:		REGION NUMBER:		DISTANCE FROM GIRTH WELD:	
PG&E PROJECT MANAGER:		SUBREGION # (ICDA)			
APPROVED BY:		STATIONING:			
ORDER NUMBER:					

1.10 PHOTOS TAKEN?* ☐ YES ☐ NO
*SEE PHOTO LOG FOR ADDITIONAL INFORMATION.

1.11 COATING SAMPLE TAKEN? ☐ YES ☐ NO LOCATION OF SAMPLE: ______________________

1.12 LIQUID UNDERNEATH COATING? ☐ YES ☐ NO IF YES, PH OF LIQUID:

1.13 CORROSION PRODUCT PRESENT? ☐ YES ☐ NO IF YES, WAS SAMPLE TAKEN? ☐ YES ☐ NO
COMMENTS: ____

1.14 SOIL PH (SB ELECTRODE): UPSTREAM: ______________ DOWNSTREAM: ______________

2.0 DATA AFTER COATING REMOVAL

2.1 PIPE TEMPERATURE (^{0}F): __________ MEASURED PIPE DIAMETER (IN.): ______________________

2.2 WELD SEAM TYPE: ☐ DSAW ☐ SSAW ☐ ERW ☐ SMLS
☐ SPIRAL ☐ LAP ☐ FLASH ☐ AO SMITH ☐ IF CAN'T DETERMINE, VISUALLY PERFORM MACROETCH TO LOCATE & IDENTIFY TYPE (SEE TABLE 5.7.3, ELEMENT 2.2)

2.3 GIRTH WELD COORDINATES:
NORTHING: ______________________
EASTING: ______________________
ELEVATION: ______________________ WELD CLOCK POSITION: ______________

2.4 OTHER DAMAGE: ____

2.5 UT WALL THICKNESS MEASUREMENTS: TDC: ________ 3 O'CLOCK: ________ 6 O'CLOCK: ________ 9 O'CLOCK: ________
UT WALL THICKNESS GRID @ 6:00 IS REQUIRED. BE SURE TO ATTACH GRID TO H-FORM ELECTRONICALLY. SEE PAGE 6 OF 10.

2.6 WET FLUORESCENT MAG. PART. IS REQUIRED. COMMENTS: ______________________
WERE THERE ANY LINEAR INDICATIONS? ☐ YES ☐ NO IF YES, ATTACH NDE REPORT ELECTRONICALLY AS PART OF THE H FORM. REPORT TO INCLUDE BLACK LIGHT AND WHITE LIGHT PHOTOS OF INDICATIONS

2.7 TAKE PHOTOS TO DOCUMENT CORROSION AND OTHER ANOMALIES.*
*SEE PHOTO LOG FOR ADDITIONAL INFORMATION.

2.8 OVERVIEW MAP OF CORRODED AREA*:

*SEE PIT DEPTH MEASUREMENT GRID FOR ADDITIONAL INFORMATION

Zero Reference Point: ______________________

FLOW ——————→

*NOTE ANY CALCAREOUS DEPOSITS.

12 O'CLOCK										
9 O'CLOCK										
6 O'CLOCK										
3 O'CLOCK										
12 O'CLOCK										
FEET	0	1	2	3	4	5	6	7	8	9	10

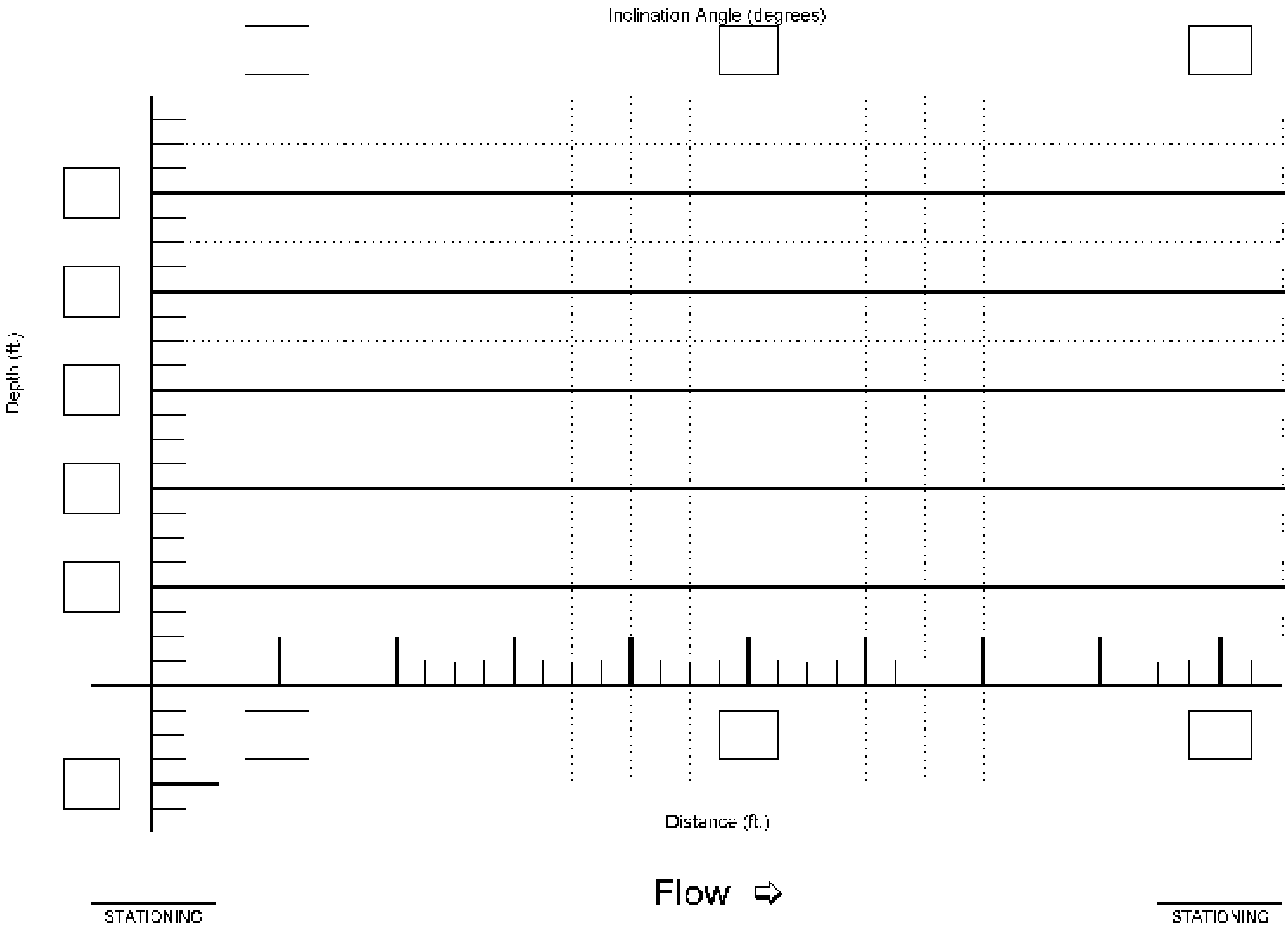
[redacted]

<u>FORM H</u>: DIRECT EXAMINATION DATA SHEET 3 OF 10

DA/ILI		DA		ILI	
ROUTE NUMBER:		N-SEGMENT:		ILI LOG DISTANCE:	
DATE OF EXCAVATION:		IMA NUMBER:		RMP-11 REF. SECTION:	Table 5.6.2
MILE POINT:				REFERENCE GIRTH WELD:	
EXAMINATION PERFORMED BY:		REGION NUMBER:		DISTANCE FROM GIRTH WELD:	
PG&E PROJECT MANAGER:		SUBREGION # (ICDA)			
APPROVED BY:		STATIONING:			
ORDER NUMBER:					

Excavation Drawing:

At minimum draw pipe elevation profile and indicate stationing of 1) low point and 2) critical inclination angle.
Place an arrow on the drawing indicating direction of gas flow in the region(s). Other labels may also be added (e.g. "to Station").



NOTES (Record stationing and names of nearby landmarks such as creeks and roads. Provide any additional information that may help in spatially positioning pipe)**:**

Form H
Page 4 of 10

EXTERNAL PIT DEPTH MEASUREMENT GRID SHEETS

DA/ILI

ROUTE NUMBER: ______
DATE OF EXCAVATION: ______
MILE POINT: ______
EXCAVATION PERFORMED BY: ______
PG&E PROJECT MANAGER: ______
APPROVED BY: ______
ORDER NUMBER: ______

DA

N-SEGMENT: ______
IMA NUMBER: ______
REGION NUMBER: ______
SUBREGION # (ECDA): ______
STATIONING: ______

ILI

ILI LOG DISTANCE: ______
RMP-11 REF SECTION: Table 5.6.2
REFERENCE GIRTH WELD: ______
DISTANCE FROM GIRTH WELD: ______

GRID SIZE – ______ INCH x ______ INCH (SPECIFY GRID SIZE)

ANOMALY #: ______

GRID #: ______

Clock Position (Specify below)

	1	2	3	4	5	6	7	8	9	10	11	12	13	[illegible]	15	16	17	18	19	20	21	22	23	24
A																								
B																								
C																								
D																								
E																								
F																								
G																								
H																								
I																								
J																								
K																								
L																								
M																								
N																								
O																								
P																								
Q																								
R																								
S																								
T																								
U																								
V																								
W																								
X																								

PIT DEPTH GRID 1 OF 2

[redacted]

Form H
Page 5 of 10

EXTERNAL PIT DEPTH MEASUREMENT GRID SHEETS

[redacted]

DA/ILI ______ DA ______ ILI ______

ROUTE NUMBER: ______ N-SEGMENT: ______ ILI LOG DISTANCE: ______
DATE OF EXCAVATION: ______ IMA NUMBER: ______ RMP-11 REF. SECTION: Table 5.6.2
SET POINT: ______ REGION NUMBER: ______ SUPPR. END GIRTH WELD: ______
EXCAVATION PERFORMED BY: ______ SUBDIVISION #/ICDA#: ______ DISTANCE FROM GIRTH WELD: ______
PG&E PROJECT MANAGER: ______ STATIONING: ______
APPROVED BY: ______
ORDER NUMBER: ______ ANOMALY #: ______ GRID #: ______
GRID SIZE = ______ INCH x ______ INCH (SPECIFY GRID SIZE)
Clock Position (Specify Below)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
A																								
B																								
C																								
D																								
E																								
F																								
G																								
H																								
I																								
J																								
K																								
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N																								
O																								
P																								
Q																								
R																								
S																								
T																								
U																								
V																								
W																								
X																								

PIT DEPTH GRID 2 OF 2

Form H – **Page 6 of 10** **INTERNAL CORROSION PIT DEPTH GRID**

DA/ILI

ROUTE NUMBER:
DATE OF EXCAVATION: ____________
MILE POINT: ____________
EXAMINATION PERFORMED BY: ____________
PG&E PROJECT MANAGER: ____________
APPROVED BY: ____________
ORDER NUMBER: ____________

DA

N-SEGMENT:
IMA NUMBER: ____________
REGION NUMBER: ____________
SUBREGION # (ICDA) ____________
STATIONING: ____________

ILI

ILI LOG DISTANCE:
RMP-11 REF. SECTION: Table 5.8.2
REFERENCE GIRTH WELD: ____________
DISTANCE FROM GIRTH WELD: ____________

Grid Size = __1__ inch x __1__ inch
Clock Position (specify below)

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												
E												
F												
G												
H												
I												
J												
K												
L												

INTERNAL CORROSION GRID
Page 1 of 1

Form H – **Page 7 of 10**

COATING DAMAGE

DA/ILI

ROUTE NUMBER:
DATE OF EXCAVATION: ____________
MILE POINT: ____________
EXAMINATION PERFORMED BY: ____________
PG&E PROJECT MANAGER: ____________
APPROVED BY: ____________
ORDER NUMBER: ____________

DA

N-SEGMENT:
IMA NUMBER: ____________
____
REGION NUMBER: ____________
SUBREGION # (ICDA) ____________
STATIONING: ____________

ILI

ILI LOG DISTANCE:
RMP-11 REF. SECTION: Table 5.6.2
REFERENCE GIRTH WELD: ____________
DISTANCE FROM GIRTH WELD: ____________

NO.	FEET FROM REFERENCE	O'CLOCK	MAX LENGTH (IN.)	MAX CIRC EXTENT (IN.)

[redacted]

Form H – **Page 8 of 10** **CORROSION LOG**

DA/ILI

Route Number:
Date of Excavation: ____________
Mile Point: ____________
Examination Performed By: ____________
PG&E Project Manager: ____________
Approved By: ____________
Order Number: ____________

DA

N-Segment:
IMA Number: ____________
____
Region Number: ____________
Subregion # (ICDA) ____________
Stationing: ____________

ILI

ILI Log Distance:
RMP-11 Ref. Section: Table 5.8.2
Reference Girth Weld: ____________
Distance From Girth Weld: ____________

IC or EC	FEET FROM REFERENCE	O'CLOCK	MAX PIT DEPTH (MILS)	MAX LENGTH (IN.)	MAX CIRC EXTENT (IN.)

Form H – **Page 9 of 10** **PHOTO LOG**

DA/ILI

Route Number:
Date of Excavation: __________
Mile Point: __________
Examination Performed By: __________
PG&E Project Manager: __________
Approved By: __________
Order Number: __________

DA

N-Segment:
IMA Number: __________
____
Region Number: __________
Subregion # (ICDA): __________
Stationing: __________

ILI

ILI Log Distance:
RMP-11 Ref. Section: Table 5.6.2
Reference Girth Weld: __________
Distance From Girth Weld: __________

PHOTO NO.	LOCATION	DESCRIPTION	COMMENTS

Form H - Page 10 of 10

DA/ILI		DA		ILI	
ROUTE NUMBER:		N-SEGMENT:		ILI LOG DISTANCE:	
DATE OF EXCAVATION:		IMA NUMBER:		RMP-11 REF. SECTION:	Table 5.8.2
MILE POINT:				REFERENCE GIRTH WELD:	
EXAMINATION PERFORMED BY:		REGION NUMBER:		DISTANCE FROM GIRTH WELD:	
PG&E PROJECT MANAGER:		SUBREGION # (ICDA)			
APPROVED BY:		STATIONING:			
ORDER NUMBER:					

RECOAT DATA

3.1 SANDBLAST MEDIA: ____________ ANCHOR PROFILE MEASUREMENT: ____________

3.2 PIPE RECOATED WITH:

☐ POWERCRETE J ☐ WAX TAPE ☐ BAR-RUST 235 ☐ DEV GRIP 238 ☐ DEV TAR 247 ☐ PROTAL 7200 ☐ PE TAPE

3.3 FOR EPOXY COATING SYSTEMS, RECORD ENVIRONMENTAL CONDITION:

AIR TEMPERATURE: ____________ DEW POINT: ____________
PIPE TEMPERATURE: ____________ RELATIVE HUMIDITY: ____________
TIME OF DAY: ____________

3.4 REPAIR COATING HARDNESS (IF ARC COATING): ____________

3.5 MEASURED COATING THICKNESS: 3:00 6:00 9:00 1200:
HOLIDAY TESTED?: ☐ YES ☐ NO
DEVICE USED: ☐ COIL ☐ WET SPONGE VOLTAGE USED: ____________ REPAIR ALL HOLIDAYS.

3.6 COUPON TEST STATION INSTALLED?: ☐ YES ☐ NO ETS INSTALLED?: ☐ YES ☐ NO
IF YES, DATE INSTALLED: ____________
SURFACE CONFIGURATION: ☐ FINK ☐ G-5 BOX ☐ CARSONITE ☐ OTHER ____________

3.7 BACKFILL MATERIAL: ☐ NATIVE ☐ IMPORTED SAND ☐ OTHER: ____________

COATING PROTECTIONS: ☐ YES ☐ NO
IF YES, CHECK ONE: ☐ ROCKGUARD ☐ TUF-E-NUF ☐ CONWED OTHER: ____________

3.8 PIPE-TO-SOIL READINGS OVER BELL HOLE AFTER BACKFILL: ____________
*IF NEEDED, A CIS SHOULD BE DONE FOR APPROXIMATELY 100' ON EITHER SIDE OF THE BELL HOLE. ATTACH DATA.

COMMENTS: ____________

3.9 ATTACH SITE SKETCH OF EXCAVATION SITE

MISC. COMMENTS/INFO: ____________

[redacted]