PACIFIC GAS AND ELECTRIC COMPANY

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

PG&E
REV 4

Procedure for External Corrosion Direct Assessment

Procedure No. RMP-09

Integrity Management Program

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Approved By: [redacted]ate: 7-20-05

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1		Updated to meet NACE RP-0502-2002			
2	8-12-03	Updated			
3	1-20-04	Updated			
4	7-20-05	Updated			

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1.0 PURPOSE

The purpose of this procedure is to describe the process of performing External Corrosion Direct Assessment (ECDA) survey on identified buried gas transmission pipeline segments. This procedure is in accordance with the NACE RP 0502-2002 *Pipeline External Corrosion Direct Assessment Methodology* and DOT 49 CFR Part 192 Pipeline Safety: Pipeline Integrity Management in High Consequence Areas (Gas Transmission Pipelines); Final Rule (8-04-04). It provides instructions, guidance, and requirements to assure and document that ECDA assessments are in compliance with the recommended practice and the final rule (8-04-04). It is PG&E's policy to be in compliance with this practice as well as governing regulations and laws.

2.0 INTRODUCTION

External corrosion direct assessment is a structured process that is intended to improve safety by assessing and reducing the impact of external corrosion on pipeline integrity. By identifying and addressing corrosion activity, ECDA seeks to proactively prevent external corrosion anomaly from growing to a size that affects the structural integrity of the pipeline segments inspected.

2.1 Scope

This procedure may be used to evaluate the integrity of pipeline segments that are threatened by external corrosion or third party damage. During the assessment process other types of damage may be identified. In those cases other suitable assessment methodologies shall be used to evaluate the integrity of the pipe segments.

2.2 ECDA Steps

The ECDA methodology is a four-step process that requires the integration of data from multiple indirect field inspections and from direct pipe surface examinations with the pipe's physical characteristics and operating history. The four steps of the process are:

Pre-Assessment: The Pre-Assessment step collects historic and current data to determine whether the ECDA is feasible, what indirect inspection tools are appropriate, and defines ECDA regions. The types of data to be collected are typically available in GIS, transmission and distribution plat sheets, job estimates, district and division records.

Indirect Inspection: The Indirect Inspection step covers above ground inspections to identify and define the severity of coating faults, other anomalies, and areas where corrosion activity may have or may be occurring. Two or more indirect inspection tools are used over the entire ECDA section to provide improved detection reliability under the wide variety of conditions that may be encountered along a pipeline right-of-way.

Direct Examination: The Direct Examination step includes analyses of indirect inspection data to select sites for excavations and pipe surface evaluations. The data from the direct examinations are combined with prior data to identify and assess the impact of external corrosion on the pipeline.

Post-Assessment: The Post-Assessment step covers analyses of data collected from the previous three steps to assess the effectiveness of the ECDA process and determine reassessment intervals.

ECDA may detect other pipeline integrity threats, such as mechanical damage, stress-corrosion cracking, etc. When such threats are detected, the ECDA procedure requires documentation of the threat and addressed through the Integrity Management Plan (RMP-06).

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 **ECDA Project Manager:** The ECDA Project Manager (PM) is responsible to assure that all aspects of the assigned ECDA 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 ECDA projects. This procedure has response time requirements. The PM has point responsibility to assure that those time requirements are met throughout the project.

2.3.3 **ECDA 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, ECDA Region Designation, Indirect Inspection results, and remaining strength evaluations and post assessments.

2.3.4 **Indirect Inspection Personnel:** The Indirect Inspection Personnel is responsible for conducting the indirect inspections as well as assigned direct 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 **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 and Risk Management based DA projects).

2.4 Qualifications

The provisions of this procedure shall be applied 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 buried ferrous piping systems. The specific qualifications are described below.

2.4.1 **Manager of System Integrity:** Shall be a degreed engineer and have sufficient gas transmission corrosion related experience to provide guidance and oversight to the personnel conducting the ECDA process.

2.4.2 **ECDA Project Manager:** The PM shall be a degreed engineer or have equivalent pipeline experience. The PM shall have taken CGT Corrosion Control training course and be formally trained on this procedure, RMP-09.

2.4.3 **ECDA Project Engineer:** The project engineer shall be a degreed engineer with experience in corrosion control in the pipeline industry. The engineer shall have taken the CGT Corrosion Control training and be formally trained on this procedure, RMP-11. In addition, the engineer shall have documented training on the use of RSTRENG.

2.4.4 **Indirect Inspection Personnel:** The personnel performing the indirect inspections shall meet the CGT Operator Qualification Requirements as well as being certified with supporting training documentation for the specific inspections they are conducting for the ECDA. If these personnel conduct the Direct Examination they shall be qualified in accordance with PG&E Operator Qualification Program for the performance of the task "Corrosion Control 03-05."

2.4.5 **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-09.

2.5 Definitions

The following are definitions of some key terms used in this procedure:

Shall: Is a requirement that must be complied with or its exception approved and documented in accordance with Section 7.0 of this procedure.

Should: Is a recommendation that is desirable to follow if possible. Not following the recommendation shall be documented on the EXCEPTION REPORT, form M, and approved by the Direct Assessment Program Manager.

Required: "Required" data listed in Table 3.3.1 must be obtained or its omission be approved and documented in accordance with Section 7.0 of this procedure.

Considered: "Considered" is a recommendation that a data element is taken into account for the selection of indirect inspection tools, ECDA regions, or analysis of test results.

Defect: Per ANSI/NACE Standard RP0502-2002 definition, an anomaly in the pipe wall that reduces the pressure-carrying capacity of the pipe.

Desired: "Desired" data listed in Table 3.3.1 should be obtained if it is documented or easily measured. Its omission is not required in order to be approved or documented.

ECDA Region: For the purpose of this document, the definition of the term ECDA Region shall be the same as the ANSI/NACE Standard RP0502-2002 definition, which is "a section or sections of a pipeline that have similar physical characteristics and operating history and in which the same indirect inspections tools are used." An ECDA region can have multiple N-Segs (examples, casings, water crossings and bare pipe, etc.)

ECDA Section: For the purpose of this document, the definition of the term ECDA Section shall refer to a part of the N-Segment having its integrity assessed using the ECDA process.

GIS Pipe Segment or GIS Segment: Is a length of pipe which has specific pipe characteristics associated with it in PG&E's GIS database.

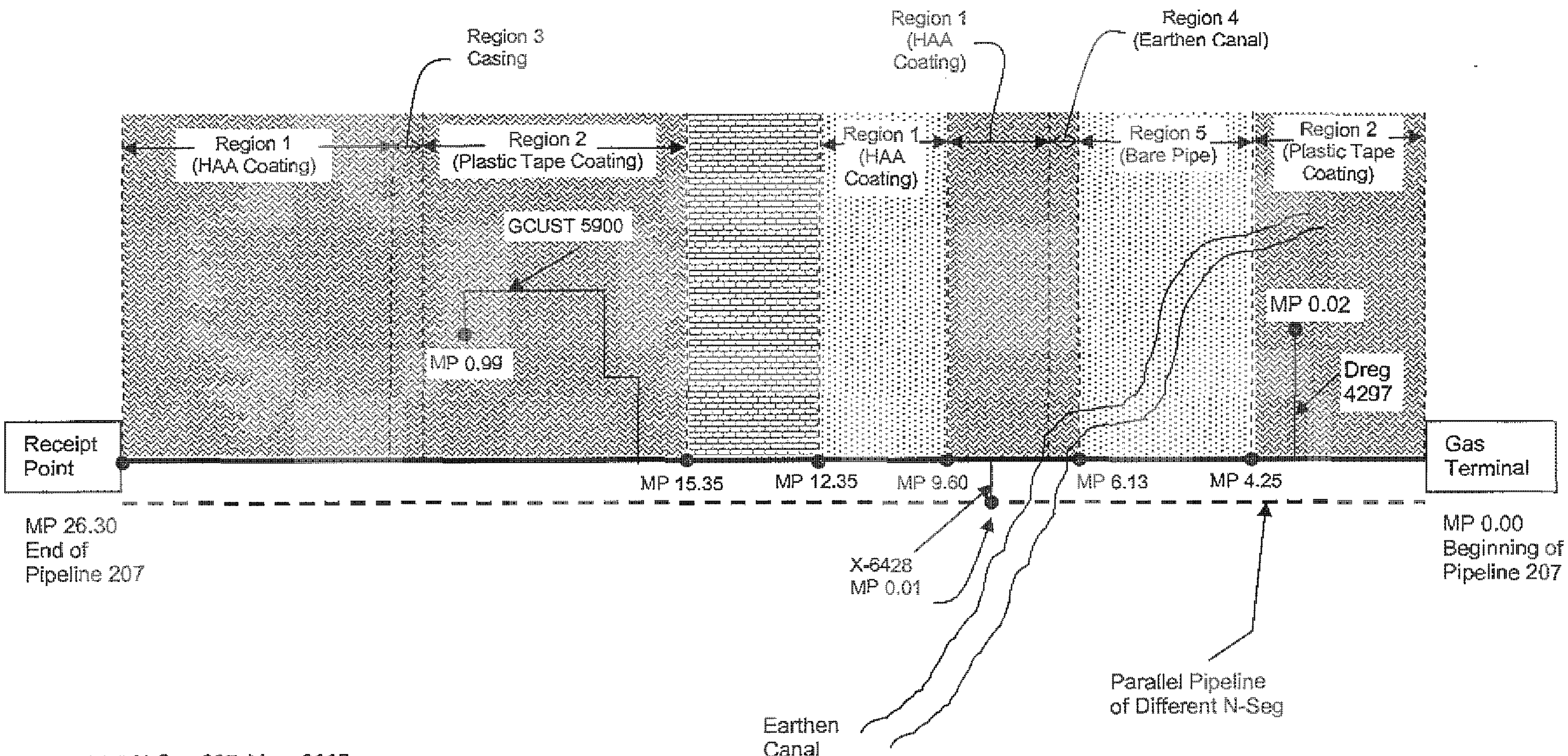
Covered Pipeline: Are pipe segments in a High Consequence Area that meet the characteristics specified by the Office of Pipeline Safety requiring them to be included in the company Integrity Management Plan.

N-Segment: For the purpose of this document, the definition of the term N-Segment (N-Seg) shall be the same as the ANSI/NACE Standard RP0502-2002 definition of the word Segment which is "A portion of a pipeline that is (to be) assessed using ECDA. A segment consists of one or more ECDA Regions." See Figure 2.5.

First Time: The first time the ECDA methodology is used to assess the integrity of all or part of an N-Seg.

Discovery Of A Condition – Per 49 CFR 192.933 (b) "discovery of a condition occurs when an Operator has adequate information about the condition to determine that it presents a potential threat to the integrity of the pipeline." For this procedure the completion of the Direct Examination phase per N-Seg or ECDA Region will constitute the completion of "discovery of a condition."

Figure 2.5 – Illustration of the Term N-Seg



N-Seg 207, Year 2005
- L-207 MP 0.00 – 4.25, MP 6.13 – 9.60, MP 15.35 – 26.30 (GIS Pipe Segments 142.10 – 156.35, 159.20 – 163.10, 171.14 – 183.0)
- GCUST 5900 MP 0.00 – 0.99 (GIS Pipe Segments 501.00, 405.00 – 419.00)
- X-6428 MP 0.00 – 0.01 (GIS Pipe Segments 423.1 – 425.6)
- DREG 4297 MP 0.00 – 0.02 (GIS Pipe Segment 401)

N-Seg 207, Year 2007
- L-207 MP 4.25 – 6.13 (GIS Pipe Segments 156.36 – 159.10)
- MP 9.60 – 12.35 (GIS Pipe Segments 163.11 – 164.92)

Not in EDCA Program – No HCA
- MP 12.35 – 15.35 (GIS Pipe Segments 164.93 – 171.13)

3.0 PRE-ASSESSMENT

3.1 Objectives

The objectives of the pre-assessment process are to:

- Collect the needed pipeline data to determine the feasibility of conducting an ECDA
- Determine the feasibility of conducting an ECDA of the assessment area
- Select Indirect Inspection Tools (IIT)
- Establish ECDA regions
- Document pre-assessment results

Figure 3.1 shows the process for conducting the pre-assessment step of an ECDA. Each step in the figure will be described in the following paragraphs.

3.2 Pipeline Segments Requiring ECDA

3.2.1 Identification of ECDA Projects: Pipeline segments needing or requiring an ECDA can be identified from multiple sources. Usually the requests for ECDA analysis will come from the Integrity Management, or Risk Management Programs. However, the company may utilize ECDA for other business or operating initiatives. This procedure does not address the identification or ranking processes of pipeline segments requiring ECDA.

3.2.2 Information Provided With ECDA Request: The request for an ECDA shall provide the following information:

- Integrity Management (SEGMENT) Name (If applicable)
- SEGMENT Number
- Starting and end points of SEGMENTs
- Route number
- Starting and ending mile points of requested ECDA
- Approval of the Manager of System Integrity

3.3 Data Collection (Pre-field Visit)

3.3.1 Data Collection Objectives: A key aspect of the Pre-assessment step is the collection of pipeline data. Table 3.3.1 PRE-ASSESSMENT DATA provides a checklist of the data elements needed to conduct the ECDA. The data is collected to achieve the following objectives of the process:

- Determine the feasibility of conducting an ECDA
- Selection of an Indirect Inspection Tool (IIT)
- Establishment of ECDA regions
- Use and interpretation of results
- For first time surveys collect all corrosion records for the pipeline section to be surveyed.
- Review the data for additional threats such as Internal Corrosion, Stress Corrosion Cracking or Third Party Damage.

The PM should consider these objectives to assure that appropriate and sufficient data is collected to achieve their intent.

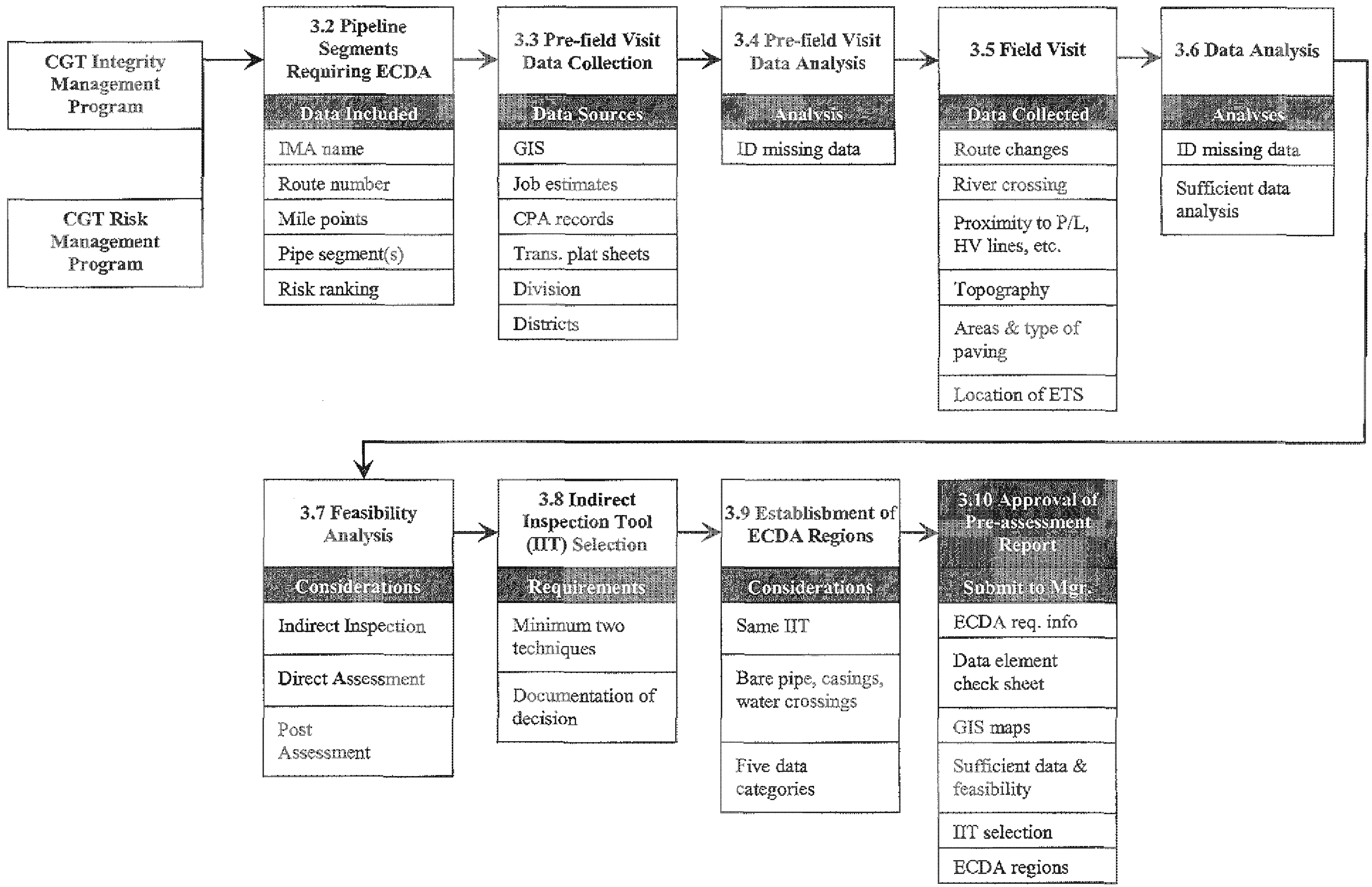


Figure 3.1 Pre-assessment Work Flow

3.3.2 **Data Collection Phases:** Data collection and analysis is a continuous activity throughout the ECDA process. In the Pre-assessment step this procedure divides the data collection into two steps; "Pre-Field Data Collection" and "Field Data Collection."

3.3.2.1 **Pre-Assessment Interview Process:** It is recommended the PE facilitate a meeting of key employees to discuss the project and develop a qualitative understanding of the maintenance history of the pipelines to be assessed. An example of the questions to be asked and the people who should attend this meeting can be found in Appendix F.

3.3.3 **Data Requirements:** The "Need" for the data elements is identified in Table 3.3.1 as either "REQUIRED" or "DESIRED." Data elements that are identified as REQUIRED shall be obtained before completion of the Pre-assessment step or approved to be delayed or omitted from data collection in accordance with the "Exception Process" described in Section 7.0 of this procedure. "DESIRED" data elements should be obtained if the data is available in existing records or can be obtained from easily conducted measurements or examinations. The PM may consider desired data sufficiently important to classify it as REQUIRED for a specific ECDA analysis.

3.3.4 **Data Sources:** Table 3.3.1 provides guidance to the possible sources for each data element. If the data element is not available in the listed sources the PM should use good judgment on seeking the data elsewhere

3.3.5 **Data Documentation:** The successful collection of information shall be indicated on the "DATA ELEMENT CHECK SHEET" (Form A) or similar document.

3.3.6 **Project Documentation File:** Each ECDA project shall establish a suitable filing system to house the documentation of the project. The system shall be organized to allow the effective storage of pipeline data, inspection and analysis results, disposition of findings, and re-inspection intervals.

TABLE 3.3.1: PRE-ASSESSMENT DATA LIST

ID #	Data Element	Indirect Inspection Tool Selection	ECDA Region Selection	Use & Interpretation Of Results	Need[1]	Usage: Inspection Tool[2]	Usage: Region Selection[2]	Usage: Interpretation Analysis[2]	Data Source: GIS	Data Source: Job Est.	Data Source: Field	Data Source: Districts or Division	Data Source: Other	Comments
1.0 Pipe Related														
1.1	Material and Grade	ECDA is not appropriate for nonferrous materials	Special consideration should be given to locations where dissimilar metals are joined		R	C	C	R	X	X				Consider for inspection tools and region selection only when non-ferrous, stainless, or cast iron materials are used. Otherwise use only in direct assessment and post assessment phases.
1.2	Diameter	May reduce detection capability of indirect inspection tools		Influences CP current flow and interpretation	R	C	N/R	R	X	X				Investigate the effect of diameter on detect ability
1.3	Wall thickness			Impacts critical anomaly size	R	N/R	N/R	R	X	X				
1.4	Year manufactured			Older pipe materials typically have lower toughness levels, which reduces critical anomaly size and remaining life predictions	C	N/R	N/R	R						Assume the same as year installed
1.5	Seam Type		Locations with pre-1970 low frequency ERW or flash welded pipe with increased selective seam corrosion susceptibility may require a separate region.	Older pipe typically has lower weld seam toughness that reduces critical anomaly size. Pre-1970 ERW or flash welded pipe may be subject to higher corrosion rates than the base metal	R	N/R	CR	C	X	X				
1.6	Bare pipe	Limits ECDA application. Fewer available tools	GIS Segments with bare pipe in coated pipelines should be in separate regions.	Specific ECDA methods provided in Appendix A	R	R	R	R	X	X				

[1] R = Required, D = Desired (See paragraph 2.3 for definitions)
[2] R = Required, C = Considered
N/R = Not required

ID #	Data Element	Indirect Inspection Tool Selectioo	ECDA Region Selectioo	Use & Interpretatioo Of Results	Need[1]	Usage: Inspection Tool[2]	Usage: Region Selection[2]	Usage: Interpretation Analysis[2]	Data Source: GIS	Data Source: Job Est.	Data Source: Field	Data Source: Districts or Division	Data Source: Other	Comments
2.0 Construction Related														
2.1	Year installed			Impacts time over which coating degradation may occur, anomaly population estimates, and corrosion rate estimates	R	N/R	N/R R	R	X	X				
2.2	Recent route changes/ modifications that may not be in GIS		Changes may require separate regions		D	N/R	C	N/R			X	X	As-builts	
2.3	Construction practices		Construction practice differences may require separate regions	May indicate locations at which construction problems may have occurred; e.g., backfill practices influences the probability of coating damage during construction, rocky backfill, etc.	D	C	C	C		X			Engr. Stds. drawings	
2.4	Location of major pipe appurtenances such as valves, and taps		Significant drains or changes in CP current should be considered separately; special consideration should be given to locations at which dissimilar metals	May impact local current flow and interpretation of results; dissimilar metals may create local corrosion cells points of contact; coating degradation rates may be different from adjacent regions	D	N/R	C	C	X	X	X			
2.5	Locations of casings	May preclude the use of some indirect inspection tools	Casings shall be evaluated with PG&E casing protocol	May require operator to extrapolate nearby results to inaccessible regions. Additional tools and other assessment activities may be required	R	R	R	C	X	X			Trans. Plat sheets, CPA Records	
2.6	Location of bends, including miter bends and wrinkle bends		Presence of miter and wrinkle bends may influence region selection	Coating degradation rates may be different from adjacent regions; corrosion on miter and wrinkle bends can be localized, which affects local current flow and interpretation of results	D	C	C	C		X			Trans. Plat Sheet	

TABLE 3.3.1: PRE-ASSESSMENT DATA LIST						Usage			Data Source					
ID #	Data Element	Indirect Inspection Tool Selection	ECDA Region Selection	Use & Interpretation Of Results	Need[1]	Inspection Tool[2]	Region Selection[2]	Interpretation Analysis[2]	GIS	Job Est.	Field	Districts or Division	Other	Comments
2.7	Depth of cover	Restricts the use of some indirect inspection techniques	May require different ECDA regions	May impact current flow and interpretation of results	D	C	C	C			X	X		
2.8	Underwater sections and river crossings	Significantly restricts the use of many indirect inspection techniques	Requires separate ECDA region	Changes current flow and interpretation of results	R	R	R	C	X	X	X			
2.9	Locations of river weight and anchors	Reduces the available indirect inspection tools	May require separate ECDA region	Influences current flow and interpretation of results; corrosion near weights and anchors can be localized which affects local current flow and interpretation results	D	C	C	C		X	X		As-builts	
2.10	Proximity to other pipelines structures, HV electric transmission lines and rail crossing	May preclude the use of some indirect inspection methods	Regions where the CP currents are significantly affected by external sources should be treated as separate ECDA regions.	Influences local current flow and interpretation of results	D	C	C	C	X		X			
3.0 Soils/Environmental														
3.1	Soil characteristics & types.	Some soil characteristics reduce the accuracy of the various indirect inspection techniques	Influences where corrosion is most likely; significant differences generally require separate ECDA regions	Can be useful in interpreting results. Influences corrosion rate and remaining life assessment	C	C	C	C	X		X			
3.2	Drainage		Influences where corrosion is most likely; significant differences may require separate ECDA regions	Can be useful in interpreting results. Influences corrosion rate and remaining life assessment	D	N/R	C	N/R			X			
3.3	Topography	Conditions such as rocky areas can make indirect inspections difficult or impossible.	Can determine region selection by identifying locations of higher water content soils		D	C	C	N/R			X			

TABLE 3.3.1: PRE-ASSESSMENT DATA LIST

ID #	Data Element	Indirect Inspection Tool Selection	ECDA Region Selection	Use & Interpretation Of Results	Need[1]	Usage: Inspection Tool[2]	Usage: Region Selection[2]	Usage: Interpretation Analysis[2]	Data Source: GIS	Data Source: Job Est.	Data Source: Field	Data Source: Districts or Division	Data Source: Other	Comments
3.4	Land use (current/pass)	Paved roads, etc., influence indirect inspection tool selection	Can influence ECDA application and selection	Can be considered in evaluating the potential severity of damage.	R	C	C	C	X		X			Asphalt vs. concrete
3.5	Frozen ground	May impact the applicability and effectiveness of some ECDA methods	Pipeline with some frozen areas should be considered in separate regions.	Influences current flow and interpretation of results	R	C	N/R	N/R			X			
4.0 Corrosion Control														
4.1	CP system type (anodes, rectifiers and locations)	May effect ECDA tool selection		Localized use of sacrificial anodes within impressed current systems may influence indirect inspection. Influences current flow interpretation	R	C	C	C			X		CPA Records	
4.2	Stray Current sources/locations			Influences current flow and interpretation results	D	N/R	C	C	X		X	X	CPA Records. Past survey reports	
4.3	Test point locations (pipe access points)		May provide input when defining ECDA regions		R	N/R	C	N/R	X		X		CPA Records	
4.4	CP evaluation criteria			Used in post assessment analysis	R	N/R	C	C					CPA Records, Paradigm	
4.5	CP maintenance history		Coating condition indicator	Can be useful in interpreting the results	R	N/R	C	C					CPA Records, Paradigm	
4.6	Years without CP applied		May make ECDA more difficult to apply.	Negatively effects ability to estimate corrosion rates and make remaining life predictions	D	N/R	C	C		X				
4.7	Coating type-pipe	ECDA may not be appropriate for coatings that cause shielding (coatings with high dielectric constants)		Coating type may influence time at which corrosion begins and estimates of corrosion rate based on measured wall loss.	R	R	R	R	X	X				
4.8	Coating condition	ECDA may be difficult to apply with severely degraded coatings			D	C	C	N/R	X			X	Direct Assessment	

TABLE 3.3.1: PRE-ASSESSMENT DATA LIST						Usage			Data Source					
ID #	Data Element	Indirect Inspection Tool Selection	ECDA Region Selection	Use & Interpretation Of Results	Need[1]	Inspection Tool[2]	Region Selection[2]	Interpretation Analysis[2]	GIS	Job Est.	Field	Districts or Division	Other	Comments
4.9	Current demand			Increasing current demand can indicate areas where coating degradation is leading to more exposed pipe surface area	D	N/R	N/R	C					CPA Records	
4.10	CP survey data/history			Can be useful in interpreting the results	D	N/R	C	C					CPA Records Paradigm	
5.0 Operational Data														
5.1	Pipe operating temperature		Significant differences generally require separate ECDA areas	Can locally influence coating degradation rates	D	N/R	C	C				Field measu remen ts		Consider when near the discharge of compressor stat. Develop criteria based on distance from compressor station.
5.2	Operating stress level			Impacts critical flaw size and remaining life predictions	R	N/R	N/R	R	X					
5.3	Monitoring programs (Coupon, patrol leak surveys etc.)		May provide input when defining ECDA regions	May impact repair, remediation and replacement schedules.	D	N/R	C	N/R				Corro sion Group		
5.4	Pipe inspection reports-excavation		May provide input when defining ECDA regions		R	N/R	C	N/R	X					
5.5	Repair history/records, steel/composite repair sleeves, repair locations	May effect ECDA tool selection	Prior repair methods, such as anode additions can create a local difference that may influence region selection.	Provide useful data for post assessment analysis	R	C	C	C	X			X	Form A's	
5.6	Evidence of external MIC			MIC may accelerate external corrosion	D	N/R	N/R	C					Corrosion records	
5.7	Type and frequency of third party damage			High third party damage areas may have increased indirect inspection coating fault defects.	R		C	C	X					
5.8	Data from previous over the ground surveys			Essential for pre-assessment and region selection	R	N/R	R	C	X					

TABLE 3.3.1: PRE-ASSESSMENT DATA LIST						Usage			Data Source					
ID #	Data Element	Indirect Inspection Tool Selectinn	ECDA Region Selection	Use & Interpretation Of Results	Need[1]	Inspection Tool[2]	Region Selection[2]	Interpretation Analysis[2]	GIS	Job Est.	Field	Districts or Division	Other	Comments
5.9	Other prior integrity related activities – CIS, ILI runs, etc.	May impact ECDA tool selection-isolated vs. larger corroded areas		Useful post assessment data	R	C	N/R	C	X				Corrosion Group	
6.0 Internal Corrosion (IC) Threat Assessment														
6.1	History of IC leaks	ICDA Procedure	ICDA Region	Useful post assessment data	D	C	D	C	X		X	X		Pipe inspection form
6.2	Topography	USGS data			D	D	D	D	X		X			
6.3	Depth Survey	PCM or Pipe Locator		Need for critical angle determination and low point	D	D	N/R	D	X		X			
6.4	Received gas from gathering or storage lines			To establish threat for potential IC	D	N/R	D	D	X		X			
6.5	Drip Location			To establish history of electrolytes	D	N/R	C	C	X		X			Check drip logs, PLM
6.6	Corrosometer Probe reads			To establish potential internal corrosion threat	D	D	C	D	X		X			
6.7	Inhibitor Injection Sites			To establish potential internal corrosion threat	D	D	C	D	X		X	X		
6.8	Chemical/Microbial analysis of liquid samples			To establish potential internal corrosion threat	D	D	C	D	X		X	X		
6.9	Acid Gas Partial Pressures				C	C	C	C						District or Corrosion Group
6.10	Line Pressure and Flow Rate				D	D	C	D	X		X	X		
6.11	Dew Point & Temp				D	D	C	D	X		X	X		
6.12	Previously "pigged"				D	D	C	D	X		X	X		

TABLE 3.3.1: PRE-ASSESSMENT DATA LIST

ID #	Data Element	Indirect Inspection Tool Selection	ECDA Region Selection	Use & Interpretation Of Results	Need[1]	Usage: Inspection Tool[2]	Usage: Region Selection[2]	Usage: Interpretation Analysis[2]	Data Source: GIS	Data Source: Job Est.	Data Source: Field	Data Source: Districts or Division	Data Source: Other	Comments
7.0 Stress Corrosion Cracking (high ph SCC) Threat Assessment														
7.1	Age of pipe			If Pre-1970	D	C	C	C	X					
7.2	Operating Stress Level			> 50%	D	C	C	C	X					
7.3	Operating Temp			> 100 degrees F	D	C	C	C	X					
7.4	Distance from Compressor station			<= to 20 miles	D	C	C	C	X					
7.5	Coating type			other than FBE	D	C	C	C	X					
7.6	Hydrotest Information			For reasons other than SCC investigations	D									
8.0 Third Party Damage Threat Assessment														
8.1	Review Easement documents for foreign crossings				C	C	C	C						Land Department
8.2	Evidence of new excavation or construction				C	C	C	C						
8.3	Historical concentration of USA tags				C	C	C	C	X					
8.4	Known areas of shallow cover			Review old corrosion surveys for depth information	C	C	C	C	X					Interview Questions, see Appendix F for details
8.5	Pipe inspection reports/repairs				C	C	C	C	X					Interview Questions, see Appendix F for details
8.6	Patrol Records				C	C	C	C	X					Interview Questions, see Appendix F for details
9.0 Hard Spot Threat														
9.1	Threat of hard spots				C	C	C	C						RM Department provided information

3.4 Data Analysis (Pre-field visit)

3.4.1 **Identification of Missing Data:** Once the Pre-field Visit data is collected the PE should analyze the data to identify missing elements, and develop a list of data that will need to be obtained in the field. The DATA ELEMENT CHECK SHEET, Form A, can be used for this purpose.

3.5 Field Visit

3.5.1 **General Description:** Examining the physical locations where the ECDA is to be conducted is a key activity in the gathering of data. It is important to collect as much data as possible to achieve the objectives of the Pre-assessment and effectively plan for the Indirect Inspection step of the ECDA process. Hence preparation is key to conducting an effective field visit. Some of the data elements that may require field collection or verification in the field are:

TABLE 3.5.1: TYPICAL FIELD COLLECTED DATA

ID	Description	ID	Description
2.2	Route changes in the pipeline that are not yet reflected in GIS	3.3	Topography where it is extremely rocky or steep or where access is difficult. Also low lying areas where soils are wetter for longer periods of time.
2.7	Dramatic changes in the depth of cover	3.4	The type of paving, accessibility due to private lands, crossing or in busy roads or highways
2.8	Details on under water crossings	3.5	The possibility of frozen ground
2.10	Proximity to other pipelines, HV transmission lines and rail crossings	4.1	CP systems (impressed, galvanic etc.), location of rectifiers, ETS stations, insulation points
3.1	Soil characteristics	4.2	Sources of stray current and their proximity to the pipeline
3.2	Drainage along the pipe line and areas where the pipeline crosses seasonal creeks	4.3	Test point locations and access to the pipe
		6.5	Drip Locations

3.6 Data Analysis

Once the Field Visit data is collected the PM or PE shall analyze the data to identify missing REQUIRED and DESIRED data elements, and conduct a SUFFICIENT DATA ANALYSIS. If it is determined that additional threats exist on the line segment in question (i.e., internal corrosion, stress corrosion cracking, or third party damage) then additional assessment methods shall be required and the following parties shall be notified:

Pipeline Engineer

Direct Assessment Program Manager

System Integrity Manager

Pipeline Engineering Manager

- **Missing Data:** The PM or PE shall document missing data. The DATA ELEMENT CHECK SHEET, Form A, can be used to document the missing data. The GIS pipe segments that are missing data shall be identified on Form B, SUFFICIENT DATA LIST.

3.6.1 **Sufficient Data Analysis:** The data shall be analyzed to determine if there is sufficient data to conduct an ECDA. The analysis should include the following:

- **Missing Required Data:** If there is missing required data and it is felt that this data is not essential to the ECDA then the reason it is not necessary shall be explained in the SUFFICIENT DATA LIST (FORM B).
- **Missing Desired Data:** The PM or PE should review the missing DESIRED data to identify if any of those data elements are essential to conduct the ECDA. If some of the missing desired data is essential then it should be explained in the SUFFICIENT DATA LIST (FORM B).
- **Sufficient Data List:** The PM or PE shall prepare a Sufficient Data List (Form B) concluding there is sufficient data to conduct an ECDA. This list shall have the analyses described in the two paragraphs above and be signed by the PE and PM and dated.

3.7 Feasibility Analysis

3.7.1 **Analysis:** The PE shall integrate and analyze the data collected on the pipeline segments and determine if conditions for indirect inspections can be used and whether the application of the ECDA is appropriate. The framework for this analysis is that the PE shall examine the existing data in each of the nine categories in Table 3.3.1 and assess the following:

- **Indirect Inspection:** Can existing indirect inspection tools be applied to the pipe segments identified in the ECDA project and be expected to provide meaningful results on potential locations where the coating is damaged? **(Reference NACE RP0502-2002 3.3.1.1 to 3.3.1.6)**
- **Direct Assessment:** Is it physically and economically feasible to gain access to the pipeline to conduct direct assessment and be expected to gain meaningful data?
- **Post Assessment:** Can it be reasonably expected to be able to determine reassessment intervals of the GIS pipe segments given the existing data?

If the conditions along a portion of the pipeline are such that the above methods of assessing integrity cannot be applied, then this ECDA procedure is no longer applicable and shall be brought to the attention of the Integrity Management Program Manager.

3.7.2 **Feasibility Analysis Report:** The PE shall prepare the FEASIBILITY ANALYSIS REPORT (Form C) which can be used to present the following information:

- Adverse conditions that may make the ECDA infeasible
- Any special considerations or techniques that need to be incorporated in conducting the ECDA to overcome the adverse conditions
- A conclusion on the feasibility of conducting an ECDA for all the GIS pipe segments in the project
- Signed and dated by the PM and PE

3.8 Indirect Inspection Tool (IIT) Selection

3.8.1 **Number of IIT's:** The Project Engineer (PE) shall select at least two complimentary tools from Table 3.8.1 for each pipeline segment in the study area. The PE may utilize other tools than listed in Table 3.8.1 but shall go through the exception process described in Section 7.0 of this procedure. In addition to the two primary IIT's the PE may select additional inspections to compliment the two IIT's and to gain further corrosion and coating information on the pipeline segments.

3.8.2 **Selection Considerations:** The PE shall select IIT's based on their ability to reliably detect corrosion activity and/or coating holidays under the specific pipeline conditions for each segment. The PE should consider the guidance provided in Table 3.8.1, Table 3.8.2, and Table 3.3.1. The PE should endeavor to select tools that are complimentary to one another with the guidance provided in Table 3.8.2.

3.8.3 **Selection Documentation:** The selection of IIT's shall be documented for each pipeline segment. The documentation shall include the name of each technique used, the number of the technique and any special considerations for conducting the inspections. Form D, INDIRECT INSPECTION TOOLS SELECTION, may used to document the IIT selections.

TABLE 3.8.1 ECDA TOOL SELECTION MATRIX

Conditions	CIS	DCVG/ACVG	Pearson	Electro-magnetic (PCM)	UT Guided Wave
Coating holidays	Yes	Yes	Yes	No	No
Anodic zones on bare pipe	Yes	No	No	No	Yes
Near river or water crossings	Yes	No	No	No	Yes
Under frozen ground	No	No	No	Yes	Yes
Stray currents	Yes	Yes	Yes	Yes	No
Shield corrosion activity	No	No	No	No	Yes
Adjacent metallic structures	Yes	Yes	No	Yes	No
Near parallel pipe lines	Yes	Yes	No	Yes	Yes
Under HVAC electric transmission lines	Yes	Yes	Yes	No	Yes
Shorted casing	Yes	Yes	Yes	Yes	Yes
Under paved roads	Possible	Possible	No	Yes	Yes
Uncased crossings	Yes	Yes	Yes	Yes	Yes
Cased crossings	No	No	No	Yes	Yes
Wetlands	Yes	Yes	Yes	Yes	Yes
Rock terrain, ledges or backfill	No	No	No	Yes	Yes
Exposed Pipe (Visual) *	No	No	No	No	No

* Complete Exposed Pipe Inspection Form N

TABLE 3.8.2 INDIRECT INSPECTION TOOL GUIDE

Indirect Inspection Tool	Measurement Attributes	Typical Uses	Less Suitable for:	Complimentary Tools
CIS	Measures pipe to soil potentials along the pipeline at intervals typically 3 to 10 foot intervals.	Generally used to assess the performance of CP systems and generally estimating the location of coating holidays. Also can detect interferences, shorted casings, electrical or geological shielding, contact with other metallic structures as well as defective electrical isolation joints.	Pipelines that are below paved areas will require holes to be drilled to the soil. Is not effective detecting coating systems that have disbonded and are shielding.	DCVG, ACVG, Guided wave UT
Electro-magnetic	Measures the electromagnetic field attenuation emanating from the pipe induced with an AC signal. Qualitatively ranks coating quality and highlights areas with the largest holidays	Can be used for pipelines under pavement and CP systems that are difficult to isolate.	Not useful determining pipe to soil potential or effectiveness of CP. Is ineffective under HV transmission lines. Is not effective detecting coating systems that have disbonded and are shielding.	CIS, Guided wave
DCVG/ACVG	Measures voltage gradients resulting from current pickup and discharge points at holidays. Capable of locating holidays on the pipeline and for determining if they are actively corroding.	Generally used to locate large and small coatings holidays on soiled covered pipelines.	Pipelines that are below paved areas will require holes to be drilled to the soil. Is not effective detecting coating systems that have disbonded and are shielding.	CIS, Guided wave
Pearson	Measures AC voltage gradients between two movable electrical ground contacts along the pipeline	Used to identify holidays on earthen pipelines.	Difficult to use for pipelines under pavement. Is not effective detecting coating systems that have disbonded and are shielding.	CIS, guided wave, electromagnetic
Guided Wave Ultrasonic	Uses guided ultrasonic waves to detect and axially locate interior and exterior wall loss. Can potentially estimate the degree and circumferential location of the wastage. Can examine 300 to 600 feet of pipe from one bell hole.	Can be used for pipelines under pavement or in casings, pipelines with shielded coatings, or expand the length of pipe examined at a bell holes.	Requires direct access to the pipeline and removal of the coating.	Electro-magnetic, CIS

3.9 Establishment of ECDA Regions

3.9.1 Description: ECDA Regions are pipeline segments that have similar physical characteristics, corrosion histories; expected future corrosion conditions, and uses the same indirect inspection tools. An ECDA region can have non-contiguous pipeline segments within it.

3.9.2 Criteria: The PE shall analyze all the data collected in the Pre-assessment step and assign each pipeline segment to an ECDA region.

3.9.2.1 Indirect Inspection Methods: Each region shall use two of the same inspection tools. Reference NACE RP 0502-2002 3.5.1.1.1.

3.9.2.2 Required Data Elements: Table 3.3.1 lists the data elements that are REQUIRED for the analysis of the ECDA regions. These elements shall be evaluated in establishing ECDA regions.

3.9.2.3 Considered Data Elements: Data elements that are listed as CONSIDERED in Table **3.3.1** should be taken into account when establishing the ECDA region.

3.9.3 Documentation: The ECDA Region description shall be defined and kept in the Project File. Form E, ECDA REGION REPORT, may be used for this documentation. Each ECDA region shall have at least the same two IIT's and one other characteristic that is unique to distinguish it from the other ECDA Regions. The PE shall list all essential characteristics for each region. The ECDA Region Report shall be signed by the PE and reviewed and signed by the project manager.

3.10 Approval of Pre-assessment Report

3.10.1 Requirements: A Pre-assessment report shall be submitted to the Manager of System Integrity or his designate for review and approval.

3.10.2 Contents: The report shall contain forms A through E completed and signed by the Project Manager and the Project Engineer. The report may be in the form of a binder, and may also include other supporting data, such as GIS maps, leak data, etc.

3.10.3 Approval: Forms A through E should be reviewed with the Manager of System Integrity. Recommendations shall be incorporated into the report and the manager shall sign the Form E indicating approval of the Pre-assessment Report.

4.0 INDIRECT INSPECTION

4.1 Objectives

The objectives of the Indirect Inspection process are to:

4.1.1 Locate and define the severity of coating faults, other anomalies, and areas where corrosion may have been or may be occurring

4.1.2 Conduct at least two indirect inspections over the entire length of each ECDA Region

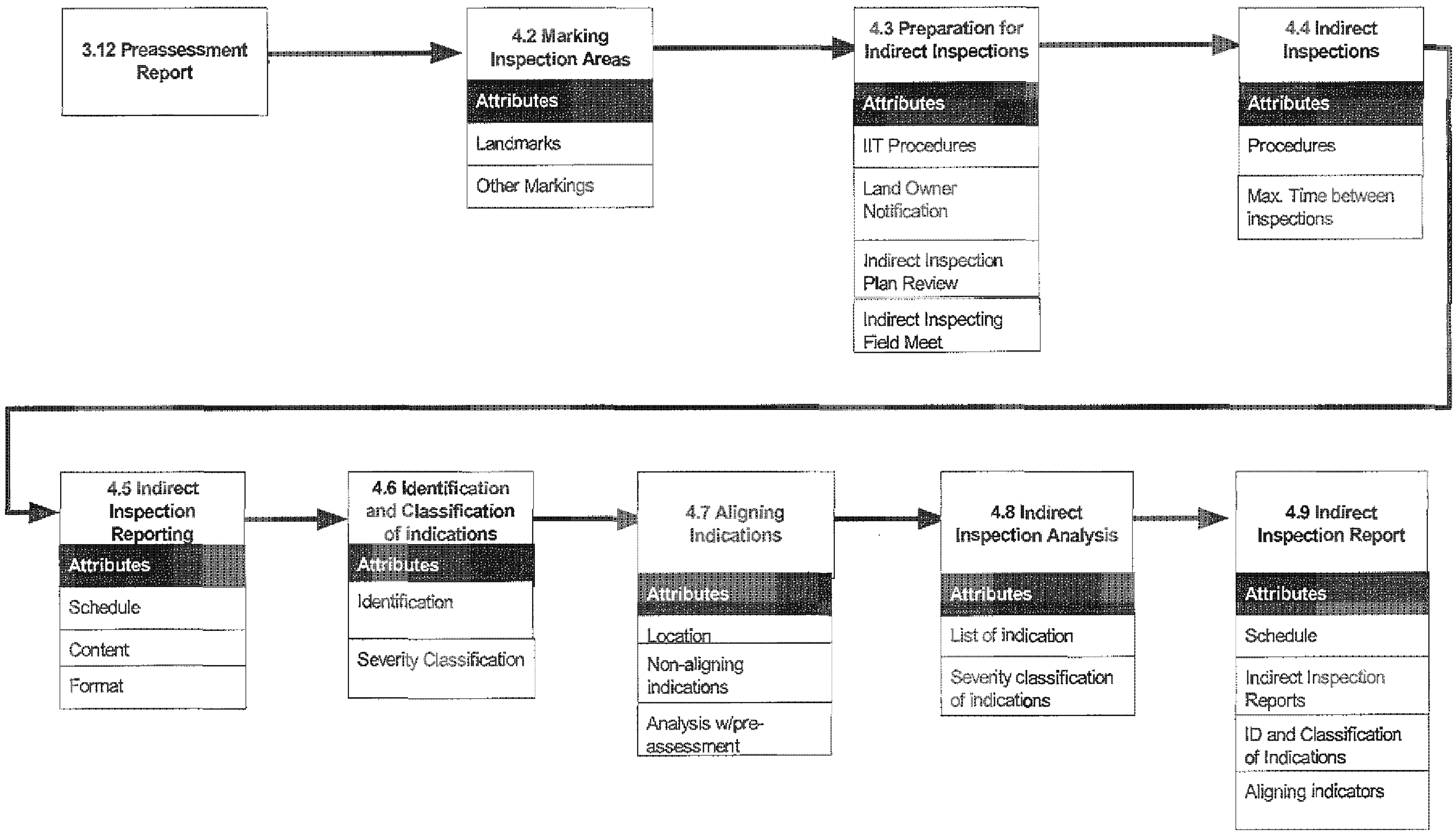
4.1.3 Align and compare the results from the inspections

4.1.4 Identification and classification of indications

4.1.5 Analyze and report results for the Direct Examination step

NOTE: Figure 4.1 shows the process for conducting the Indirect Inspection step of an ECDA. Each step in the figure will be described in following paragraphs.

Figure 4.1 Indirect Inspection Work Flow



4.2 Marking of Inspection Areas

4.2.1 **Objective:** Prior to conducting indirect inspections each inspection area identified as a specific region in the ECDA REGION REPORT, Form E, shall be clearly marked in the field to eliminate any ambiguity as to the boundaries of the regions.

4.2.2 **Type of Markings:** Both ends of each inspection area shall be identified with one or more of the following methods:

4.2.2.1 By a clearly identifiable land mark that has a unique name, such as streets, and buildings

4.2.2.2 Painted markings on the roadway or other pavement with arrows pointing towards the center of the inspection area and with the number of the region.

4.2.2.3 Highly visible stakes, nail markers or other suitable marking device with the Region number on them and an arrow pointing to the center of the region.

4.2.3 **Documentation:** The beginning and end locations of each Region shall be indicated on Form D, INDIRECT INSPECTION TOOL SELECTION.

4.3 Preparation for Indirect Inspections

4.3.1 **IIT Procedures:** Each IIT shall have a written procedure specifically prepared for that technique. The procedures may be from a vendor who is conducting the inspection or from PG&E where the vendor or employees are performing the inspection to the specified procedure.

4.3.1.1 **Procedure Content:** Each of the procedures shall consider the following:

4.3.1.1.1 **Numbering:** The procedure shall have a unique alphanumeric number assigned to it with a revision number.

4.3.1.1.2 **General Description:** The scope of the procedure and the general theory how the procedure works including what it measures and what it is capable of detecting.

4.3.1.1.3 **Limitations:** Where the procedure should not be used, what it cannot detect, and its level of sensitivity.

4.3.1.1.4 **Procedure Qualification:** How the procedure was qualified and where the records exist that document the qualification.

4.3.1.1.5 **Safety Considerations:** General and specific safety considerations, including the following of PG&E's clearance procedure and safety regulations, and safety equipment that is required. Listing of general hazards, and what to do in case of an injury.

4.3.1.1.6 **Instrumentation:** List of equipment by name and model number that is allowed for the inspection. This list should also include special measurement equipment that will be used in case of special field situations such as stray currents.

4.3.1.1.7 **Personnel Qualifications:** The qualification requirements of the personnel conducting the exam including how the personnel were trained on the specific procedure.

4.3.1.1.8 **Step-by-step Instructions:** Specific easy to follow instructions on conducting the survey. These instructions shall include:

- **Calibration:** The calibration of the equipment prior to and during the survey
- **Equipment Connection:** The connection of instrumentation, the set-up interrupters
- **Pipe Location:** The method of locating the pipe
- **Measurements:** The method of taking measurements and the frequency or interval the measurements should be taken
- **Special Diagnostics:** The techniques and when they are used to address special field situations
- **Distance Measurement:** The method of tracking the distance traveled along the survey; the frequency of geo-references
- **Recording Data:** The recording of data, and special diagnostic techniques

4.3.1.1.9 **Prepared and Approval:** The procedure shall document the person who prepared it and the date it was prepared. It shall have been reviewed and approved by a responsible person in the organization that issued it. Both of the above requirements are indicated by signatures and dates.

4.3.1.2 **Procedure Review:** The PE shall review each procedure for adequacy. They shall record their comments for each IIT procedure on the IIT PROCEDURE REVIEW FORM, Form F.

4.3.1.3 **Procedure Filing:** Each approved procedure with any amendments shall be kept in the ECDA program management file

4.3.2 **Landowner Notification:** A landowner notification plan should be developed for each ECDA Project. The PM is responsible for this plan.

4.3.3 **Indirect Inspection Field Meet:** The vendor should have a field meet with operations and maintenance personnel responsible for maintaining the CP system, the PG&E inspector, PM and responsible engineering staff members. The meeting shall be scheduled by e-mail and phone call. This notification shall be made at least 2 weeks prior to starting the survey. At this meeting they should cover the following while referring to the IIT Selection, ECDA Region Forms, and GIS Maps as well as other documents:

4.3.3.1 **ECDA Regions:** View first hand the boundaries of each ECDA Region.

4.3.3.2 **Cathodic Protection Equipment:** The location and operation of all cathodic protection equipment.

4.3.3.3 **Inspection Tools:** Review all the inspection tools that will be used in the ECDA project. The method to achieve contact with the soil if the area is paved. Use additional tests for special circumstances.

4.3.3.4 **Access to ECDA Regions:** How the vendor should access the work areas, contacts, schedule, etc.

4.3.3.5 **Schedule:** What exact dates and times the vendor will conduct the survey.

4.3.3.6 **Landowner Contact:** Protocol if landowners question field personnel.

4.3.3.7 **Safety Hazards:** Discuss safety hazards such as traffic, overhead lines, rectifier potentials, flora and fauna.

4.3.3.8 **Notification Procedure:** The vendor shall notify the PM or his designate when abnormal conditions or situations develop. Discuss what these conditions are; such as extreme data, unusual landowner contact, pipeline safety concerns, inspection tool does not appear appropriate, personnel injury, and changes in inspection dates and times.

4.3.3.9 **Changes:** Any changes to the Indirect Inspection Plan shall be documented on the appropriate form. The changes shall be approved as previously required.

4.4 Indirect Inspections

4.4.1 **Breadth of Inspections:** Each of the primary indirect inspections shall be conducted over the entire inspection region. When CIS is performed over asphaltic cement concrete (AC) or steel reinforced Portland Cement Concrete (Concrete) the surface shall be drilled and efforts taken to ensure that the test probe is adequately contacting the electrolyte. The ONE CALL service (USA) shall be called when drilling and all utilities that are marked as crossing or running in parallel to the pipeline being surveyed in the ONE CALL area shall be GPS'd and recorded in the data stream.

4.4.1.1 **3rd and 4th Inspections:** Indirect inspections other than the first and second specified may be conducted in specific areas as determined by the PE and documented on the Form D, INDIRECT INSPECTION TOOL SELECTION.

4.4.1.2 **Station Numbering:** Each ECDA section shall start with a station of 0+00.

4.4.2 **Data Collected:** The following data shall be collected for indirect inspections in conjunction with the IIT readings. A data dictionary is provided in Appendix B defining the units of the data elements.

TABLE 4.4.2 DATA ELEMENTS COLLECTED FOR IIT

• Line number	• Type CP equipment*
• Flag number	• Description of Land use
• Pipe Line Angle Point*	• Valves*
• Depth of pipe every 50 feet and at each change in the configuration of the pipeline*	• Roadway description including street names, driveway addresses, etc.*
• Type Pipeline markers*	• Topographical features*
• Foreign Line Crossings	• Spans/Exposed Pipe*

*GPS readings and PCM current attenuation value should be taken for these data elements

4.4.3 **Procedures:** The indirect inspections shall be performed strictly in accordance with the approved procedures. Any deviation from the procedure shall be approved and documented in the Exception Process of this procedure described in Section 7.0.

4.4.4 **Time Between Primary Inspections:** The PM should have the two indirect inspections conducted as close in time as reasonably possible. When ECDA is applied for the first time, the inspections shall not occur more than 90 days apart. If this occurs it shall be approved and documented through the Exception Process in Section 7 of this procedure or earlier indirect inspection redone.

4.5 Indirect Inspection Reporting

4.5.1 **Reporting Time Requirement:** The survey data shall be submitted to the PM or the designate no later than 90 days after the completion of the last indirect inspection survey.

4.5.2 **Content:** The report shall have the following content.

4.5.2.1 **Location and Dates:** Description of the location where the inspections were performed as well as the dates they were conducted.

4.5.2.2 **IIT Types:** Description of the indirect inspections that were performed as well as other tests such as soil resistivity, and depth survey. The testing procedures that were followed as well as the personnel conducting the test shall be listed.

4.5.2.3 **Current Sources:** A table listing the current sources that were interrupted with output and ratings of the rectifiers with corresponding mile points and field stations. Also include rectifier data sheets.

4.5.2.4 **Survey Plots:** All IIT results should be plotted with station distances at 100-foot intervals and at all changes in the configuration of the pipeline. Street names, type of foreign line crossings (i.e., water crossing, pressurized sewer crossing, etc.) and landmarks shall be noted on the chart as well as other test data such as depth surveys, soil resistivity, ETS, rectifiers, anodes, MLVs, P/L markers, angle points, region and other control points. The period when the tests were conducted shall also be included on the plots.

4.5.2.5 **GPS Coordinates:** GPS coordinates shall be provided at street names, type of foreign line crossings (i.e., water crossing, pressurized sewer crossing, etc.) and landmarks, as well as ETS's, monitor points, rectifiers, anodes, MLVs, P/L markers, angle points, region and other control points, etc., and at least every 100 feet.

4.5.2.6 **Electronic Format:** The report shall be provided in both hardcopy and electronic format.

4.6 Identification and Classification of Indications

4.6.1 **Objective:** This section describes the process of identifying and classifying indications. The classification is the process of estimating the likelihood of corrosion occurring at each indication.

4.6.2 **Identification Criteria:** For each indirect inspection the data shall be analyzed to identify indications. Table 4.6.1 under "Minor Indications" provides the minimum criteria of an indication for each indirect inspection technique.

4.6.3 **Classification Criteria:** The severity of each indication shall be initially classified in accordance with Table 4.6.1.

TABLE 4.6.1 INDIRECT INSPECTION TOOL INDICATION AND SEVERITY GUIDE

Indirect Inspection Tool	Classification Severe Indications	Classification Moderate Indications	Classification Minor Indications	No Reportable Indications (NRI)
CIS (impresses current)	All of the following must exist: • Less than 600 mV off • 200 mV depression over baseline • Convergence of on/off potential --10 mV or less constitutes convergence • Or: • Other condition that the PE wants to document • Or: <500 off (any case)	All of the following must exist: • Less than 600 mV off • 200 mV depression over baseline • Other condition that the PE wants to document	Any of the following can exist: • Between 600 to 850 mV off • Other conditions that the PE wants to document	• >850 mV off or 100 mV polarization
Close Interval Survey (CIS) with Non-Interruptible Galvanic Anodes Attached to the Pipeline	On pipe to soil measurements less negative than -0.850 V. "AND" A minimum and maximum calculation with a difference of 0.200 V within a 200-ft. sample area.	On pipe to soil measurements less negative than -0.850 V. "AND" a minimum and maximum calculation with a difference of 0.150 V within a 200-ft. sample area.	A minimum and maximum calculation with a difference of 0.100 V within a 200-ft. sample area.	On pipe to soil measurement more negative than -0.850 V.
PCM	Greater than 50% change in 100 feet	>30 and =<50% change in 100 feet	1-30% in 100 feet	No significant change
PCM with A-frame (ACVG)	>70dBμV (2 ft intervals)	Between 50-70 dBμV	Between 30-50 dBμV	<30dBμV
DCVG/ACVG*	6 or more indications in 100 ft.	3 – 5 indications in 100 ft.	2 or less indications in 100 ft.	Zero Indications
C-Scan (EM AC Atten.)	Between 60-100%	Between 25-60%	Between 10-25%	<10%
Cell-to-Cell (with soil resistivity)	<10 mV & > 5000 ohm-cm	>10 mV & between 3000 - 5000 ohm-cm	<10 mV & <3000 ohm-cm	

*In order to distinguish between "No Indication" and "No Test" NI shall be used for no indication and NT shall be used for no test.

4.6.4 **Analysis Time Requirements:** The analysis of indications should be completed no later than 30 days after receipt of the data. The analysis should include all paragraphs up through paragraph 4.7 of this procedure.

4.6.5 **Documentation:** The severity of the indications shall be documented on the INDICATION CLASSIFICATION AND DIRECT EXAMINATION FORM, Form G. The following shall be documented on Form G or other appropriate document:

- **Inspection Tool:** The inspection technique used to identify the indication
- **Location:** The location of the indication along the pipeline
- **Severity Classification:** Whether the indication is minor, moderate, and severe.

4.7 Aligning Indications

4.7.1 **Comparison:** The Project Engineer shall compare the results from the indirect inspections to determine if they are consistent. The location and severity of the indications from each indirect inspection shall be compared to the indications from other indirect inspections.

4.7.2 **Misalignment:** If two or more indirect inspections tools indicate significantly different sets of indications at locations that do not align with each indirect inspection and if the differences cannot be explained by the inherent capabilities of the tools or specific and localized pipeline features or conditions, additional indirect inspections or preliminary direct examinations shall be conducted. The Project Engineer shall do one or more of the following until the discrepancy is explained:

4.7.2.1 **Direct Examinations:** Preliminary direct examinations may be used to resolve discrepancy in the alignment of indications.

4.7.2.2 **Additional Indirect Inspections:** Additional indirect inspections may be used to resolve discrepancies in the alignment of indications.

4.7.2.3 **ECDA Feasibility Evaluation:** The Project Engineer may reevaluate the feasibility of the ECDA and choose to use another integrity assessment technology

4.7.2.4 **Classified Indications Severe:** Any indications where there is a discrepancy in alignment that has not been resolved shall be classified as severe.

4.7.3 **Documentation:** The vendor shall complete the INDICATION CLASSIFICATION AND DIRECT EXAMINATION FORM, Form G. The PE shall document any discrepancy and its resolution. The PM, the PE, the DA Program Manager, and the Manager of System Integrity shall sign Form G, INDICATION CLASSIFICATION AND DIRECT EXAMINATION FORM.

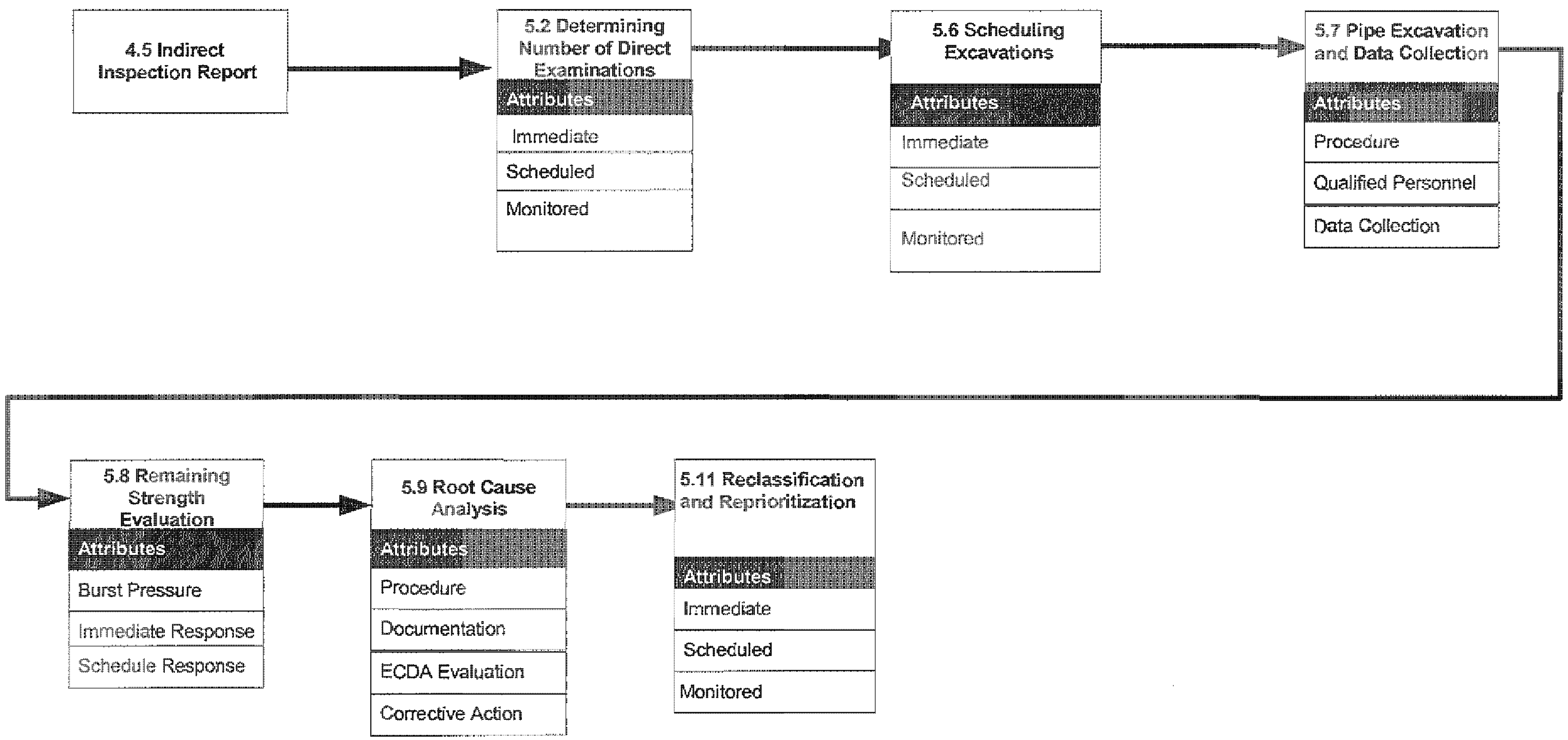
4.7.3.1 **Preliminary Direct Examination:** Direct examination of a sample of the non-aligning indications may be used to resolve the discrepancy.

4.7.3.2 **Additional Indirect Inspections:** Additional indirect inspections may be used to resolve the discrepancy.

4.7.3.3 **Re-classification:** The non-aligning indications are reclassified as severe.

4.7.3.4 **Reassessment of ECDA Feasibility:** Review of the data, from the above actions and determine if the ECDA is still feasible for this region(s).

Figure 5.1 Direct Examination Work Flow



5.0 DIRECT EXAMINATION

5.1 Overview

5.1.1 **Objective:** The Direct Examination step is to calibrate and validate the severity and initial prioritization of indications.

5.1.2 **Activities:** The Direct Examination Step includes the following activities:

5.1.2.1 Prioritization of indications found during the indirect inspections

5.1.2.2 Scheduling the excavations

5.1.2.3 Excavating the indications and collecting data at areas where corrosion activity is most likely

5.1.2.4 Measurement of coating damage and corrosion defects

5.1.2.5 Evaluation of remaining strength of the GIS pipe segment

5.1.2.6 Root cause analysis

5.1.2.7 Re-prioritization of indications

5.2 Number of Excavations

5.2.1 The number of excavations is governed by the number and priority of the indications, as well as if it is the first time ECDA is applied to the N-seg. Table 5.2.1 provides a summary of the number of excavations required.

5.2.2 **Immediate:** All immediate indications shall be planned to be excavated for direct examination.

5.2.2.1 **Reprioritization:** If immediate indications are reprioritized to a lower Priority as described in 5.8 the excavation criteria shall be followed for that priority. Note that a portion of each immediate indication must be excavated and directly examined prior to reprioritizing the rest of the immediate indication footage to be scheduled.

5.2.3 **Scheduled:** For all ECDA regions that contain scheduled indications but did not contain immediate indications, a minimum of one Scheduled indication shall be excavated. When ECDA is applied for the first time an additional Scheduled indication shall be excavated. (Ref. NACE 0502-2002 5.10.2.2.1)

5.2.3.1 If an ECDA region contains scheduled indications and it contained one or more immediate indications, at least one scheduled indication must be subjected to direct examination in the ECDA region at the location considered most severe by the PE. When ECDA is applied for the first time, a minimum of two additional direct examinations shall be performed. (Ref. NACE 0502-2002 5.10.2.2.2)

20% Wall Loss Criteria: If the results of an excavation at a scheduled indication show corrosion that is deeper than 20% of the original wall thickness and that is deeper or more severe than at an immediate indication, at least one more direct examination is required. When ECDA is applied for the first time at least two additional direct examinations shall be performed. (Ref. NACE 0502-2002 5.10.2.2.3)

5.2.3.2 **Reprioritization:** If Scheduled indications are reprioritized as described in Paragraph 5.11 then they shall follow the excavation criteria for that priority. If one or more Scheduled indications are reprioritized to Immediate then there shall be at least one more excavation per ECDA Region of a Scheduled indication, in rank order. If this occurs, the PE shall review the criteria and the root cause analysis to determine and document future decisions.

5.2.4 **Monitored:** Monitored indications are not required to be excavated, and can be either monitored, or reprioritized, as described in Paragraph 5.11.

5.2.4.1 If an ECDA Region contains monitored indications but the ECDA region did not contain any immediate or scheduled indication, one excavation is required in the ECDA region at the most severe indication. When ECDA is applied for the first time, a minimum of two direct examinations shall be performed.

5.2.4.2 If multiple ECDA Regions contain monitored indications but did not contain any Immediate or Scheduled indications, then at least one Monitored indication shall be excavated in the ECDA region identified as most likely for external corrosion in the Pre-assessment Step. When ECDA is applied for the first time, a minimum of 2 direct examinations shall be performed.

5.2.5 **ECDA Effectiveness Digs:** One additional excavation is required to assess the ECDA evaluation process. The location shall be at the next most severe scheduled indication or if there are no remaining scheduled indications it will be at the most severe monitored location. These excavations are applied per segment surveyed.

5.2.5.1 **Initial ECDA Projects:** Two additional excavations shall be conducted the first time an ECDA survey is performed. One excavation shall be at a Scheduled indication and the other where no indications were detected.

5.2.5.2 **Evaluation:** The excavation site shall be assessed per the requirements in **5.4** through 5.6. The effectiveness of the ECDA shall be repeated or an alternate integrity assessment is used if any of the conditions exist as specified listed below:

- Scheduled is evaluated as an Immediate
- Monitored is evaluated as a Scheduled

5.2.6 **Selected Indications:** Indications of selected pipe to be excavated shall be shown on Form G, INDICATION CLASSIFICATION AND DIRECT EXAMINATION FORM.

Table 5.2.1 Excavation Summary Table

Priority of Indications Found Sect. 3.10			Required Excavations Sect. 4.2			Trigger of Additional Excavations Sec. 4.2.4 to 4.2.5	Additional Excavations Sec. 4.2.4 to 4.2.5					Comments
							Per Region			Per N-Seg		
										Effectiveness Digs		
I	S	M	I	S	M		I	S	M	Initial	Normal	
X			All							2	1	
X	X		All	1		First time ECDA		1-2		2	1	Two excavations are required for First time ECDA
X	X	X	All	1		First time ECDA		1-2		2	1	Two excavations are required for First time ECDA
	X			1		First time ECDA		1-2		2	1	Two excavations are required for First time ECDA
	X	X		1		First time ECDA		1		2	1	Two excavations are required for First time ECDA
		X			1	First time ECDA			1	2	1	
No Indications			1 Excavation based on Pre-assessment			First time ECDA	1 Excavation based on Pre-assessment			2	1	

5.3 EXAMPLES

Problem 1 – Given an N-Seg with 3 regions with the following number of indications determine the minimum number of direct examinations required for the first time ECDA is performed on the N-Seg.

Region 1 has 3 immediates, 9 scheduleds and many monitors and "no indication." Region 2 has nothing with a priority higher than monitored indications - no immediates or scheduleds.

Region 3 has 3 scheduleds and the remaining indications are at least monitors.

Answer – Minimum number of D.E.'s required for the N-Seg = 11.

Solution: Region 1 requires 5 D.E.'s - 3 immediates, 1 scheduled (required), 1 scheduled for 1st time ECDA.

Region 2 requires 2 D.E.'s – 1 monitor is required by the RP in the region identified as most likely for external corrosion in the Pre-assessment Step. An additional monitor is required because it's the first time that ECDA is being applied to the N-Seg.

Region 3 requires 2 D.E.'s – 1 scheduled is required by the RP and a second one is also required because it's the first time that ECDA is being applied to the N-Seg.

The summation of the above breakout for each region above = 9 as the minimum number of D.E.'s required but there are 2 effectiveness digs required per NACE RP0502-2002 –6.4.2 and 6.4.2.1. 1 D.E. required at a scheduled indication and 1 required at any area of no indication. Had this not been the first time that ECDA was applied to the N-Seg then only 1 effectiveness D.E. selected randomly along the N-Seg would have been required.

Problem 2 – Given the same information as in problem 1 above for region 1, it's determined that during the excavation phase there was less than 20% corrosion found on any of the immediates in region 1. However, while excavating the scheduleds required for that region it was discovered that one of them had no corrosion but the second one had 25% wall loss. It passed RSTRENG and it was determined that the re-assessment life is 10 years. Are more excavations required?

Answer – Yes, at least 2 more excavations are required.

Solution: Because there was greater than 20% wall loss found at the scheduled indication, 1 D.E. is required by the RP and a second one is required because it's the first time that ECDA is applied to the N-Seg. Keep in mind that excavations of the scheduled indications in region 1 may need to continue to be D.E'd until there is no corrosion found that is greater than 20% wall loss found at an indication.

Problem 3 – Given the same information as in problem 1 above for region 1, there was less than 30% wall loss found while sampling the immediates. The remaining pipe wall passed RSTRENG and it was determined that the re-assessment life for that point is 10 years. While sampling the scheduled indications it was determined that less than 20% wall loss was found on the pipeline. Are more excavations required?

Answer – No, additional excavations are not required.

Solution: Because the wall loss due to corrosion that was found on the scheduled D.E. was less than that found on the Immediate D.E. no additional scheduleds need to be excavated.

Problem 4 – Given the same information as in problem 1 above for region 3, while excavating the scheduleds required for that region one of them had no corrosion but the second one had 25% wall loss. RSTRENG was performed and it passed. It was also determined that the reassessment life is at least 10 years. Are more excavations required?

Answer – No, additional excavations are not required.

Problem 5 – Determine the number of minimum required excavations for the N-Seg in Problem 1 above, however assume that it is not the first time that ECDA has been performed on the N-Seg.

Answer – A minimum of 7 D.E.'s would be required for the N-Seg.

Solution:

Region 1 – 3 immediates, 1 scheduled.

Region 2 – 1 scheduled

Region 3 – 1 monitored

Effectiveness D.E.'s – 1 required for the N-Seg.

Problem 6 – Given an N-Seg with 3 regions and it's the first time the segment has been ECDA'd, it's determined that there are no scheduled or immediate indications. How many excavations are required for this N-Seg?

Answer – 4 D.E.'s are required for this N-Seg.

Solution: One excavation will be required in the region identified as most likely for external corrosion pre-assessment step. Because it's the first time that ECDA has been applied to this segment, an additional excavation is also required. There is one effectiveness excavation required and because it's the first time ECDA has been performed an additional effectiveness excavation is required (1 monitor, 1 NI).

Note: Effectiveness excavations are per N-Seg and not per region

5.4 Criteria for scheduling excavations of indications for each urgency level (Ref 49CFR192.925 (2)(iv))

5.4.1 Objective: Once the priorities have been established for the indications the project engineer must select the sites for direct examination and determine the order for excavation for each N-Seg.

5.4.2 **Process**: The process includes combining soils analysis with the initial prioritization of indications into a relative risk ranking equation (Ref. RMP-02). The risk ranking in descending order will establish the order of excavations from first to last, irrespective of its priority. Figure 5.5 shows the overall process of prioritizing indications.

5.4.3 Initial Prioritization: The indications shall be initially prioritized per table 5.5.2 and a list of proposed direct examination locations shall be provided by the project engineer.

5.4.4 Soil Sampling and Analysis: Once the initial prioritization and direct examination sites have been established, soil sampling and analysis of the locations should be performed. The intent of the soil sampling and analysis is to determine relative corrosivity of the soil, potential for soil stresses and the potential for the existence of depolarizers such as Microbiologically Influenced Corrosion (MIC), hydrocarbons (i.e., diesel, MTBE, gasoline, etc.) and other threats such as shallow pipes with noted foreign line crossings, etc. The soil "chemistries" to be analyzed for are as follows (See Appendix C for soil sampling protocol – pre-D.E.'s):

Ph

Resistivity (as found and saturated)

Chlorides

Sulfates

Sulfides

Redox

T.O.C

Water content (%)

Sieve Analysis

Uniform Soil Classification

Once the risk calculations are completed then the order of the proposed excavations will be determined. It should be noted that the risk calculations will not reprioritize the initial priority determined by the PE using table 5.5.2. Rather, this process will establish the order of excavation for each urgency level.

Example

The PE has determined that N-Seg #1 has 3 regions with the priority of indications established as follows:

Region 1 – 3 immediates - (1, 2 & 3) & 2 scheduleds (4 & 5)

Region 2 – 2 scheduleds - A & B

Region 3 – 2 monitors - A1 & A2

Effectiveness D.E's - To be excavated in Region 1 – E1 (no indication) E2 (schedule) (Note: Soil sampling is not performed for effectiveness digs prior to D.E.'s. It will be performed in conjunction with the bell hole examinations.)

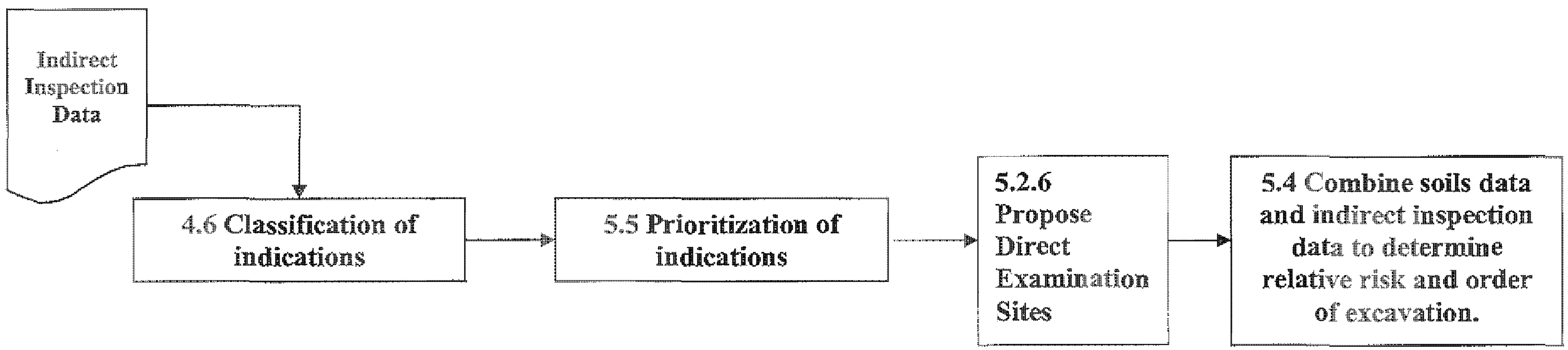
The PE provided the above information to the PM who then scheduled the soil sampling and analysis. Once the soils analysis was completed and reported to the PM, the risk calculations were completed by the PM for the 11 excavations proposed above and the order of excavations were determined to be as follows:

2 – 1 – 3 – A – 4 – 5 – B – A1 – A2 – E1 – E2

5.5 Prioritization of Indications:

5.5.1 Objective: Prioritization is the process of estimating the need for direct examination of each indication based on the likelihood of current corrosion activity plus the extent and severity of prior corrosion. (Ref. NACE RP0502-2002 5.2.1.1) Figure 5.5 shows the prioritization process from the Indirect Inspection step to the Post Assessment step.

Figure 5.5 - Prioritization Process of Indications



5.5.2 **Initial Priorities:** All indications shall be initially prioritized into the following categories:

5.5.2.1 **Immediate:** This priority should include indications that are likely to have on-going corrosion activity and that, when coupled with past corrosion could pose a threat to the pipeline segments. Indications that fall in this priority are:

5.5.2.1.1 **Isolated Indications:** Indications that were prioritized as severe by two IIT inspections as shown in Table 5.5.2.

5.5.2.1.2 **Multiple Severe Indications:** Multiple severe indications that are in close proximity. Example: Four or more indications within a 200mv or more depressed zone.

5.5.2.1.3 **Discrepancies Between IIT:** For initial ECDA applications, indications that seem to have discrepancies between different IIT techniques.

5.5.2.1.4 **Prior Corrosion Zones:** Other severe or moderate indications that are known to have significant corrosion based on historical data.

5.5.2.1.5 **Difficult to Characterize Indications:** Indications for which the likelihood of ongoing corrosion cannot be determined. For example, indications that are a result of interference with CP current.

5.5.2.2 **Scheduled:** This priority should include indications that may have on-going corrosion activity but when coupled with prior corrosion history does not pose an immediate threat to the pipeline under normal operating conditions. See Table 5.5.2.

5.5.2.3 **Monitored:** These indications are minor and have the lowest likelihood of being active. See Table 5.5.2.

TABLE 5.5.2 PRIORITIZATION OF INDICATIONS

xx		CIS			
		Severe	Moderate	Minor	NRI
PCM	Severe	I	S	S	M
PCM	Moderate	I	S	M	NRI
PCM	Minor	I	S	M	NRI
DCVG	Severe	I	S	S	M
DCVG	Moderate	I	S	M	NRI
DCVG	Minor	I	S	M	NRI
DCVG	NRI	I	S	M	NRI

5.5.3 **Indirect Inspection Analysis**

5.5.3.1 The PE shall compare the results of the indirect inspections with the pre-assessment results for each ECDA region to see if they rationalize each other. If the assessment results are not consistent with operating history, the PM must reassess the feasibility of the ECDA.

5.5.4 **Indirect Inspection Report**

5.5.4.1 The PE shall complete Form G, INDICATION CLASSIFICATION AND DIRECT EXAMINATION FORM, documenting the analysis of the incorrect inspection data.

5.6 **Scheduling Excavations:** Scheduling of the excavations is to assure that they are performed within the prescribed timeframe and conducted in the most efficient manner.

5.6.1 **Schedule:** The first excavation per N-Seg should be completed within 180 days of receiving the indirect inspection report.

5.6.2 **Reprioritization Analysis:** Sufficient time should be allowed between excavations so that the data collected from the Direct Examination is analyzed and that a Reprioritization Analysis can be conducted before further excavations.

5.6.3 **Exceptions:** Excavations that do not meet the schedule requirements described in paragraph 5.4 shall be documented in accordance with the exception policy described in Section 7.0 of this procedure.

5.7 **Pipe Excavation and Data Collection**

5.7.1 **Procedure:** The pipe shall be excavated in accordance with PG&E Utility Operations Guideline G14413 *"Procedure for Excavating Pipeline and Services."*

5.7.1.1 **Location and Size of Excavation:** The location and size of the excavation site shall be identified and recorded on Form H, DIRECT EXAMINATION DATA SHEET. The center and each end of each excavation shall be located and recorded with a GPS instrument. The length of the excavation shall be physically measured and recorded on Form H. The GPS coordinates shall be stored in an electronic file and copied on the contractor's project CD.

5.7.1.2 **Expansion of Excavation:** The PM may have the excavation expanded in length if it appears that the severity of corrosion increases beyond the excavation site. The expansion shall be performed cautiously and documented on Form H.

5.7.2 **Qualified Personnel:** Pipe shall be inspected by a person that is qualified by PG&E Operator Qualification Program for the performance of the task "Corrosion Control 03-05." The person shall complete and sign the DIRECT EXAMINATION DATA SHEET (FORM-H).

5.7.3 **Data Collection:** Collecting data on the condition of the coating and the pipe at the excavation site is a key step of the ECDA process. The collection of data shall follow reviewed and approved procedures as described in paragraph 4.3.1. The data that is to be collected is identified in Table 5.7.3

TABLE 5.7.3 DIRECT EXAMINATION DATA COLLECTION REQUIREMENTS

Data Element	DATA Type	Required	Description
1.0 Before Coating Removal			
1.1	Native Soil Type	R	Check the appropriate box to determine the type of soil the pipe is bedded in. The reference location shall be the middle of the bell hole length at the springline location. Also, in the comments section record the type of soil the pipe is bedded in using the USC classification system. Clayey Loam, clayey sandy loam, etc.
1.2	Existing Coating Type	R	Report the existing coating type, its approximate thickness, and the number of layers. For reference use the middle of the excavation length at the springline of the pipe.
1.3	Holiday Testing	R	This test allows for electrical identification of location and size of coating holidays, and is particularly valuable in identifying areas to pay special attention to during coating removal. The holidays should be mapped electrically unless the coating is sufficiently degraded to where it is obvious where the holidays are. These areas could provide significant evidence and help in determining the root cause of any corrosion that is found. In addition these areas could be critical in determining if the corrosion is active or inactive.
1.4	Measurement of pipe to soil potential	R	These measurements shall be performed in accordance with NACE Standard TM0497. The reference electrode shall be placed in the bank of the excavation within 1-2 inches of the coating. These potentials may help identify dynamic stray currents, as well as help in determining the root cause of any corrosion present (active vs. inactive).
1.5	Soil Resistivity	R	Soil resistivity measurements: (1) 4-pin method: The pin alignment shall be taken transverse to the pipe. The nearest probe shall be at least 10 feet from the pipe. Pin spacing shall approximate the pipe centerline depth. This is intended to be a measurement of **native (original)** soil conditions. (2) Soil Box: The soil desired here is that in which the pipe is bedded at the springline location in the middle of the excavation length. Note whether the soil is native or sand.
1.6	Soil Sample	R	The soil immediately adjacent to the pipe surface shall be collected with a clean spatula or trowel and placed in a 16 oz. plastic jar with a plastic lid. The soil desired here is that in which the pipe is bedded at the springline location in the middle of the excavation length. In some cases special samples must be obtained in-situ using a "spoon" that will keep the sample confined. The data will be used for determining the soil corrosivity using a risk based weight-function model, and should be used for prioritizing excavations within the same priority. The sample jar should be packed full to displace as much air as possible. Tightly close the jar, seal with plastic tape and using a permanent marker or label to record the sample location on both jar and lid.
1.7	Groundwater Samples	D	If required by the PE, take groundwater samples if water is present in the excavation. Water should always be collected from the open ditch when possible. **Completely fill** the plastic jar and seal and identify location as described above. For special situations it will be used for determining the bulk groundwater chemical properties.
1.8	Coating Condition	R	Document the general coating condition. Three conditions could exist (1) Coating is in good condition and completely adhered to pipe; (2) Coating partially disbonded and/or degraded; (3) The coating is significantly disbonded or missing, i.e., most of it comes off with the soil.
1.9	Map Of Coating Degradation	R	Note in the map the location of all coating holidays, calcareous deposits, etc. The zero reference shall be the farthest upstream location that is inspected.
1.10	Photodocumentation	R	Document the coating condition with a digital camera. Photos shall have ruler or other device to determine magnification of photographs showing details of the pipe and coating condition. The minimum requirements shall be to document the following: • The type of cover • Macros showing the cross-section of the excavation (depth of pavement, soil strata, etc.); cross section showing the strata under the pipe especially if rocks are present. • Macros of areas where the jeep test shows holidays • As-found condition of the coating after excavation is complete • General condition of coating • Showing the overall presence or absence of calcareous deposits after the coating has been completely removed but prior to sandblasting. • Presence or absence of rocks embedded in the coating (preferably at the 6:00 position) • Pitting before and after sandblasting • Any unusual characteristics of the pipe or excavation • After recoating • Documenting the as-left condition of the site Macro as well as perspective views shall be recorded. The photo log on page 9 of 10 of the H-form shall be filled out with any necessary descriptions of the photographed areas.

Data Element	DATA Type	Required	Description
1.11	Coating Sample	R	Two samples of the coating shall be obtained. One will be sent to a lab for asbestos testing. The other sample will be stored for physical examination and aid in determining root cause. This sample may also be used to determine the electrical and physical properties of the coating as well as for performing microbial tests. This sample shall be obtained from an area where the worst pipe damage was found, if possible. This sample shall be given to the PE.
1.12	Under coating liquid pH analysis	R	If any liquid is detected underneath the coating the pH shall be determined with pH litmus paper. This test infers the relative level of CP reaching the pipe surface.
1.13	Corrosion Product Removal	R	Carefully remove any corrosion deposit for analysis. The presence or absence of corrosive species in the corrosion products can guide the root cause analysis. Analysis may include, but is not limited to, MIC testing, chemical testing, and in some cases XRD testing.
1.14	Soil pH	R	Obtain soil pH reading at the upstream and downstream ends of the bell hole using the Sb electrode. This must be done in the soil the pipe is bedded in. Helps determine the corrosivity of the soil.
2.0 After Coating Removal			
2.1	Pipe Temperature & Pipe Diameter	D	Measure the bare pipe surface temperature. This factors into the tendency for coating to disbond and SCC susceptibility. Measure the circumference of the pipe using a pi tape or other suitable device and compute the actual outside diameter of the pipe.
2.2	Weld Seam Identification	D	The type of weld seam shall be identified and recorded. It will be used to compare with GSAVE, and the presence of brittle seam welds could also be determined. If the seam type cannot be determined, check that box. In some cases it will be necessary to perform a macroetch to locate and characterize the weld type and condition. The macro will only be done when specifically called for by the PE.
2.3	Girth Weld Coordinates	R for ILI	This is required for ILI inspections. ILI keys on the nearest girth weld to determine the location of the bell hole and to compare to ILI girth weld data.
2.4	Other Damage	R	Other damage to the pipe surface that can be visually detected shall be recorded, and immediately reported to PG&E. Examples of such damage would include gouges, cracking, dents and out of roundness
2.5	UT Wall Thickness Measurements	R	Ultrasonic wall thickness shall be taken at every quadrant on the pipe to establish original/nominal wall thickness. In cases where an ICDA preassessment has been performed, a UT grid shall also be obtained at the 6:00 location for a length of 1-foot circumferential by 1-foot axial. Grid size shall be 1"x1". The minimum thickness measured in each grid box shall be recorded. This ICDA grid shall be recorded on page 6 of 10 on the H-form.
2.6	Wet Fluorescent Magnetic Particle Inspection	R	For determining the presence or absence of SCC this test shall be performed. Only the AC yoke method shall be used. Surface preparation shall be light sandblasting. On occasion the PE may require walnut shell blasting. Dry powder methods are not acceptable. Direct electric current methods are not acceptable. All indications shall be photodocumented under both black and white light and the photos included in the report. The PG&E PM shall be notified immediately of any indications found.
2.7	Photographic Documentation of Corroded Area	R	The corroded surface shall be photographed, preferably with a digital camera to document the morphology and extent of the corrosion. The photo log on page 9 of 10 of the H-form shall be filled out with any necessary descriptions of the photographed areas.
2.8	Overview Map Of Corroded Area.	R	An overview map of the corroded area shall be sketched out onto the form. Enough detail shall be included to sufficiently document where and how large the corroded areas are. The zero reference point shall be the farthest upstream location that is inspected.
Page 3 of 10	Excavation Drawing	D	The pipeline inclination angle and the depth profile shall be measured and recorded at each end and in the middle of the bell hole. The inclination angle shall be recorded in the boxes above the grid, and the depth profile shall be measured and documented in the grid.
Pages 4 of 10 and 5 of 10 of the H-Form	Pit Depth Measurement Grid Sheets	R	Corrosion damage shall be measured with sufficient detail to enable accurate RSTRENG analyses of the corrosion area. A grid of wall loss measurements shall be taken over the entire corroded areas. The grid shall be oriented so that columns are circumferentially oriented on the pipe and the rows lie parallel to the longitudinal axis of the pipe. The grid size should be sufficiently fine to document the variation of wall thickness but in no case shall be greater then a one-inch mesh. The grids shall be documented on pages 4 of 10 and 5 of 10 on the H-Form
3.0	**Pipe Recoat Data**		
3.1	Sandblast Media	R	Record the type of media used – sand, grit, or copper slag are all acceptable. Use of shot is prohibited. Also record the final anchor profile measurement using the TesTex Press-O-Film tape method.
3.2	Re-coating Type	R	Record the coating type used to recoat the pipe.

Data Element	DATA Type	Required	Description
3.3	Environmental Conditions	R	Document the relative humidity, temp, dew point, etc., at the time of coating. For epoxy systems, the pipe must be over 50 degrees F, at least 5 degrees F above the dew point and the relative humidity must be less than 80%.
3.4	Repair Coating Hardness	R	For epoxy systems measure and record the final hardness before the pipe has been released for burial.
3.5	Coating Thickness	R	Measure the coating thickness at the locations given. Each clock position listed shall be the average of 3 readings within a 4 cm circle. The repair coating shall be holiday tested and all holidays must be repaired and retested. It is preferable to repair holidays using the same coating system, although alternative repair systems can be acceptable. The PG&E Project Engineer must approve all alternative repair systems.
3.6	Coupon Test Station Installation	R	Document the type of test station left behind. For coupons, the commissioning should begin no sooner than 3 months after installation. The test station should be installed at the extreme end of the bell hole adjacent to or in the "old" coating that is **NOT** being reconditioned.
3.7	Backfill Material	R	Note what material was used for backfill and whether or not pipe protection was used.
3.8	P/S Readings	R	Perform at least 1 P/S on reading over the pipeline after backfilling but **BEFORE** paving or any concrete work is done. In some cases perform a local "on" survey and record the results.
3.9	Site Sketch	R	A sketch of the site arrangement shall be made, showing the inspected area as well as measured distances from physical features such as roads, buildings, distance from upstream girth weld (if available), etc. The purpose would be to be able to determine the location using physical markers in the field (without using GPS) should the area be paved over, and to confirm the locations of those structures in GSAVE.

5.8 Remaining Strength Evaluation

5.8.1 Objective: The objectives of the remaining strength calculations are threefold:

- **Predicted Burst Pressure:** To determine the predicted burst pressure at the corroded area and assure it meets the Area Class Location Design Requirements.
- **Reprioritization:** Provide input into the reprioritization process to evaluate if the remaining indications are in the appropriate Priority.
- **Reassessment:** Provide input in determining the re-inspection interval in the Post Assessment Step of this procedure.

5.8.2 Predicted Burst Pressure Procedure: The following procedure shall be used to calculate the failure pressure for each corroded area with a wall loss greater than 20%. Other analytical techniques, such as linear elastic fracture mechanics, may be used as deemed appropriate with approval by the Manager of System Integrity or his designate.

Documentation: Form I, "REMAINING STRENGTH EVALUATION," or similar documentation shall be completed with the pertinent background data including pipe geometry, pipe material properties, and corrosion mapping data (Form H, page 4 of 10 and page 5 of 10). The RSTRENG analysis results shall also be documented on this form. The interaction rules for corrosion defects should be 1 inch axially or 6t circumferentially. Other technically supported methods may also be used.

Predicted Burst Pressure (*Pf*): The predicted pressure shall be calculated for each corroded area with a wall loss greater than 20% using the RSTRENG or equivalent (i.e., ASME B31G) calculation methodology.

Analyst: An individual qualified to use RSTRENG or an equivalent calculation methodology shall make these calculations. The qualification records shall be maintained in the Integrity Management Program file.

Determination of Safety Factor: The safety factor of the evaluated area shall be determined that it meets the minimum safety factor required by the class location.

Calculation: The safety factor shall be determined by:

$$SF_{corr} = \frac{Pf}{MAOP}$$

SF_{corr} = *Safety factor of corroded area*

$MAOP$ = *Maximum allowable operating pressure*

Pf = *Predicted Burst Pressure*

Comparison to Class Design Requirements: The safety factor shall be compared with the safety factor for the class location of the evaluated area (SF_{DR}). Table 5.8.2 provides the corresponding safety factor for each class location.

TABLE 5.8.2 DESIGN REQUIREMENTS BY AREA CLASS LOCATION

Area Class	% SMYS	SF_{DR}
1	0.72	1.39
2	0.6	1.67
3	0.5	2.00
4	0.4	2.50

5.8.3 **Response:** If SF_{corr} is less then SF_{DR} specified in Table 5.8.2 for the given class location it will require a repair. If the anomaly meets the requirements for an immediate repair as stated below then the pressure in the pipeline shall be reduced and the pipeline shall be repaired.

5.8.4 **Immediate Repair Condition:** To maintain safety, the operating pressure of the pipeline shall be temporarily reduced or shut down if any of the following conditions are met:

A calculation of the remaining strength of the pipe shows an SF_{corr} less then or equal to 1.1 times the Maximum Allowable Operating Pressure at the location of the anomaly

A dent that has any indication of metal loss, cracking or a stress riser

An indication or anomaly that in the judgment of the qualified person evaluating the assessment results requires immediate action (Ref. for above 49 CFR 192.933 (d) – (i-iii))

5.8.5 **Determining Reduction in Pressure:** If it is determined that the pressure shall be reduced, then temporary reduction in pressure shall be reduced using ASME/ANSI B31G or "RSTRENG" or reduce operating pressure to a level not exceeding 80% of the level at the time the condition was discovered (Ref. 49CFR 192.933 (a)).

5.8.6 **Remediation:** The PM shall work with the Pipeline Engineer to have the damage per UO4134 remediated in order to restore the pipe to the MAOP with the appropriate safety factor specified in Table 5.8.2 or reduce MAOP to establish the safety factor.

5.8.7 **Notification:** If any of the above conditions are met the following people shall be contacted:

- Responsible Pipeline Engineer
- Manager of System Integrity
- Manager of Pipeline Engineering
- Director of GSM&TS

The PM shall then communicate and document all required operational/pressure changes to Gas System Operations (GSO) and the date that this determination is made shall be documented on Form I.

5.9 Root Cause Analysis

5.9.1 **Procedure:** The PM shall assure that a root cause analysis is performed for each area of corrosion greater than 20% wall loss found during any of the direct examination.

5.9.2 **Objective:** The analysis is to determine the likely causes for the corrosion and determine the following:

- Is the ECDA process suitable for finding degradation caused by the identified mechanism?
- The likelihood that it will occur elsewhere in the ECDA region.
- Determine if the corrosion is active or inactive.
- Identify mitigative measures to eliminate future continued corrosion of the same type.

5.9.3 **Analysis Content:** The analysis should discuss the following aspects:

5.9.3.1 **Coating Failure:** The extent and reason for the coating failure. Discussion if the failure is localized or widespread.

5.9.3.2 **Cathodic Protection Ineffectiveness:** Why the CP was ineffective in this area. Include discussion of history of CP in the area. The expected presence and reasons for shielding of CP current or the presence of stray currents.

5.9.3.3 **Corrosion Mechanism:** Identify the main drivers for corrosion in the area including soil chemistry and physical properties, such as chlorides, sulfates, sulfides, total organic carbon (TOC), pH, moisture, corrosive microbes, rock shielding, etc. Is the corrosion active or inactive?

5.9.3.4 **Degradation in other areas:** Discuss the likelihood and location characteristics of where similar corrosion may be occurring.

5.9.3.5 **Mitigative Measures:** Identify potential mitigative measures to arrest corrosion at the particular location and at all other similar locations on the pipe.

5.9.3.6 **ECDA Feasibility:** Discuss the suitability of the ECDA process on identifying similar areas of degradation.

5.9.4 **Documentation:** The root cause of the external corrosion for each Immediate or Scheduled indication excavated shall be documented and placed in the project file and summarized on Form I "REMAINING STRENGTH EVALUATION AND ROOT CAUSE ANALYSIS." A root cause analysis can cover multiple indications provided that they are similar in all the characteristics listed in paragraph 5.9.3.

5.9.5 **ECDA Evaluation:** If the root cause analysis identifies a degradation mechanism that the ECDA process is not well suited to detect then it shall be documented in the analysis and on Form I. A suitable assessment method shall then be used to evaluate that the segments of pipe for that degradation mechanism.

5.9.6 **Corrective Action:** If corrective action was taken to address the root cause during the assessment then it shall be documented on Form I.

5.10 In Process Evaluation

5.10.1 Once the direct examinations root cause analyses and remaining strength evaluations are completed, an evaluation to critically assess the original criteria used to prioritize indications and classify indications shall be performed.

5.10.2 If corrosion activity is less severe than classified, the criteria may be adjusted to redefine the severity of the indications. In addition, the prioritization criteria may also be adjusted.

5.10.3 If corrosion activity is worse than originally classified or prioritized, the operator shall adjust the criteria used for the indications. In addition, consideration should be given to performing additional indirect inspections to gain further indication resolution.

5.10.4 If the classification or prioritization criteria is modified, at least one additional direct examination must be performed in each region in the highest priority areas to validate the new criterion.

5.11 Reclassification and Reprioritization of Indications

5.11.1 **Overview:** Figure 4.8 shows the method of reprioritization of indications. The additional data collected from the direct examination and the resulting analyses shall be used to evaluate the appropriateness of the initial assigned priority of indications. This evaluation may result in indications being raised or lowered in priority as well as be classified as non-reportable indications.

The reprioritization process first involves determining the actual condition of the pipe, in terms of remaining strength and calculated safety factor, and then assigning it a priority (immediate, scheduled, monitored) base on its <u>actual</u> condition, or remaining strength. This data is then used to reprioritize the remainder of the indirect inspection indications that have not been excavated.

5.11.2 **Reprioritization Criteria:** The following describes how actual pipe conditions are prioritized and how this data is used to reprioritize the remaining indirect examination indications. Table 5.11 summarizes the requirements of reprioritization. *SFcorr* is the safety factor determined in 5.5.2.3 SF_{DR} is for the class areas are given in Table 5.8.2.

5.11.2.1 **Immediate:** Indications in this category have a SF_{corr} less than 1.1.

5.11.2.1.1 **Additional Requirement:** If any Immediate indications in an ECDA region are validated from direct examinations to meet the criteria in Table 5.11 then all remaining Immediate indication footage of the specific indication must be directly examined, smart pigged, or hydro tested.

5.11.2.2 **Scheduled:** Indications in this category have an SF_{corr} of greater than SF_{DR} and have evidence of inactive or active corrosion greater than 20% wall loss.

5.11.2.3 **Monitored:** Indications in this category have no sign of active or inactive corrosion greater than 20% wall loss.

5.11.2.4 **No Indications (NI):** Indications in this category have no sign of active or inactive corrosion and meet a code compliance criteria.

TABLE 5.11 REPRIORITIZATION CRITERIA BY AREA CLASS

Area Class	SF_{corr} Requirements for Priority Categories			
	Immediate	Schedule	Monitored	NI
1	<1.39	>1.39 w/corrosion > 20% wt	No corrosion > 20% wt	No corrosion w/850 "on" or 100mV
2	<1.67	>1.67 w/corrosion > 20% wt	No corrosion > 20% wt	No corrosion w/850 "on" or 100mV
3	<2.00	>2.00 w/corrosion > 20% wt	No corrosion > 20% wt	No corrosion w/850 "on" or 100mV
4	<2.5	>2.5 w/corrosion > 20% wt	No corrosion > 20% wt	No corrosion w/850 "on" or 100mV

5.11.3 **Reprioritization Process:** Complete Form J, REPRIORITIZATION, for all indications that are direct examined in the following two steps:

Prioritization Evaluation: Complete the upper portion of the form with the appropriate information. Document what priorities need to be reprioritized.

Reprioritization Indications: From the prioritization evaluation data reprioritize all indications as appropriate. Document the reprioritization on the lower half of Form J.

5.11.4 **Reprioritization Requirements:** The following requirements or allowances shall be applied to the reprioritization of indications.

Reprioritization is required if the above methodologies shows that the corroded area is worse than its assigned Priority.

When an indication's priority is raised the Project Engineer shall re-evaluate other indications that may have similar root causes in the ECDA region.

If remediation is performed on a portion of an Immediate indication, (e.g., 10 feet has been exposed and directly examined), then it may be moved to a lower priority provided:

- No corrosion meeting the Immediate criteria in 5.11 is found
- Adequate CP has been restored

If remediation is performed on a Scheduled indication then it may be moved to Monitored if no corrosion is found and may be further reduced to an NRI provided it can meet the cathodic protection criteria.

6.0 POST ASSESSMENT

6.1 **Purpose:** The purpose of the Post Assessment step is to determine the remaining life and reassessment intervals for an ECDA Region and the overall effectiveness of the ECDA process.

6.2 **Remaining Life Determination:** This procedure calculates the remaining life of a corroded area based on the given length of time at an assumed corrosion rate that a corroded area thins to the predicted burst pressure divided by SF_{DR}.

$$RL = f\left(\frac{Pf}{SF_{DR}}\right)$$

6.2.1 **Corroded Area Dimensions:** The most severe (lowest remaining strength and lowest safety factor) Scheduled Indication found in a given ECDA Region and shall be used in determining remaining life.

6.2.1.1 **Root Cause Exception:** If the root cause analysis determined that the corroded area is unique then the next smaller size corroded area may be used. If this occurs, the PE must document this decision on Form K.

6.2.2 **Corrosion Rate:** Methods based on the data developed may be used for corrosion rate estimates. (Ref. NACE RP 0502-2002 D3.1)

6.2.2.1 When other data are not available, a pitting rate of 0.4 mm/y (16 mpy) is recommended for determining re-inspection intervals. This rate represents the upper 80% confidence level of maximum pitting rates for long-term (up to 17-year duration) underground corrosion tests of bare steel pipe coupons without CP in a variety of soils including native and non-native backfill. (Ref NACE RP0502-2002 D3.2)

6.2.2.2 The corrosion rate in Paragraph 6.2.2.1 may be reduced by a maximum of 24% provided it can be demonstrated that the CP level of all pipelines or segments being evaluated have had at least 40 mV of polarization (considering IR drop) for a significant fraction of the time since installation. (Ref NACE RP0502-2002 D3.3)

6.2.2.3 **Exceptions:** ASME B31.8S (2001) page 63, Table B1, shows average corrosion rates related to soil resistivity which are provided in Table 6.2.1. Other corrosion rates that are scientifically supported may also be used. The corrosion engineer or the Manager of System Integrity shall approve using these rates.

TABLE 6.2.1 CORROSION RATES VS. SOIL RESISTIVITY

Corrosion Rate (mpy)	Soil Resistivity (ohm-cm)
3	>15,000+no active corrosion
6	1,000 – 15,000 and/or active corrosion
12	<1,000 (worst case)

6.2.3 **Predicted Burst Pressure:** The Pf used in this methodology shall be the "Predicted Burst Pressure" calculated in RSTRENG.

6.2.4 **Remaining Life Determination:** The equation below shall be used to calculate the remaining life:

$$RL = \frac{0.85}{YP}\left[Pf - MAOP\right]\frac{t}{CR}$$

where:

RL = Remaining Life (years)

YP = *Yield Pressure*

Pf = Burst Pressure by RSTRENG (psi)

$MAOP$ = Maximum Allowable Operating Pressure (psi)

t = Thickness (in)

CR = Corrosion Rate (inches/year)

6.2.4.1 **Calculation:** All Priority Scheduled indications after the reprioritization process shall have their remaining life determined.

6.2.4.2 **Documentation:** The remaining life shall be documented on Form K.

6.3 Reassessment Intervals

6.3.1 **Remaining Life:** The reassessment interval shall not exceed half of the remaining life calculated in 6.2.4.

6.3.2 **Maximum Reassessment Interval:** When corrosion defects are found during the direct examinations, the maximum reassessment interval for each ECDA region shall be taken as one half the calculated remaining life. (Ref NACE RP0502-2002 6.3.1). (Note: CDA is required in 7 years).

6.3.3 **Other Governing Codes and Regulations:** Other documents such as OPS regulations and ASME B31.8 may have further limitations on the reassessment intervals.

6.3.4 **Documentation:** The reassessment interval for each Integrity Management Area shall be recorded on Form K and signed by the Project Engineer, Project Manager and the DA Program Manager.

SAMPLE REPRIORITIZATION, REMAINING LIFE AND REASSESSMENT INTERVAL CALCULATIONS

Example 1) Determine the actual priority and the remaining life according to NACE RP – 0502-2002. Also determine the reassessment interval per NACE and also according to ASME B-31.8S. Apply to the following data set:

Site 1: The original IIT priority was "Scheduled." This site is in a class 3 location in region 2 (possibly shielding coating), and direct examination showed that the maximum corrosion was 3% of the depth. The RSTRENG failure pressure (P_f) is1830 psig. The pipe data is:

- Class location 3
- MAOP 400 psig
- Wall thickness 0.312
- 24-inch diameter
- Grade X-60

Solution:
The actual priority of the indication should be determined first. Accordingly, determine the SFcorr (P_f/MAOP) and the SF_{dr} (code design requirements):
- SFcorr = 1830/400=4.55
- SFdr = 2.0

From this use Table 5.11 to determine the actual prioritization. This table uses the actual burst pressure (Pf) with the level of polarization to determine the actual priority. The actual numbers used in the table are based on the minimum code design factors plus some additional margin ranging from 7% to 13% of the code design factor. Based on the location being a class 3 location, and that there was no corrosion greater than 20% of the wall thickness, the actual priority is derated to "Monitored." Note that all indications that are directly examined must go through the reprioritization process. Once this has been done, then the entire region may be collectively reprioritized to the highest level represented (most conservative level) of the entire data set.

The next step is to compute the remaining life according the NACE formula below:

$$RL = \frac{0.85}{YP}\left[Pf - MAOP\right]\frac{t}{CR}$$ where:

RL = Remaining Life (years)

YP = Yield Pressure

Pf = Burst Pressure by RSTRENG (psi)

SF_{DR} = Design Requirement Safety Factor (Table 5.5.1)

$MAOP$ = Maximum Allowable Operating Pressure (psi)

t = Thickness (inch)
CR = Corrosion Rate (inches/years) (from Table 6.2.1 or by direct measurement using LPR coupons, etc)

The first input should be to calculate the yield pressure:

Yield Pressure (YP) = $\frac{2St}{D}$
Where S is the material grade, t the thickness, and D is the diameter.

YP= $\frac{2(60{,}000)lbs(0.312)inch}{(inch)(inch)(24 - inch)}$ = 1560 psi

The corrosion rate is determined from the measured soil resistivity (H-form) data using Table 6.2.1 or by direct corrosion rate measurement. For this example the soil resistivity was measured to be 6400 ohm-cm. Therefore the equivalent corrosion rate is 6 mpy. Now that all the variables for the remaining life equation have been determined, simply plug in the appropriate vales.

$$RL = \frac{0.85}{YP}\left[Pf - MAOP\right]\frac{t}{CR} = \frac{0.85}{1560}\left[1820 - 400\right]\frac{0.312}{0.006}$$ = 40.23 years

Application of the NACE RP 0502 –2002 half life requirement makes the reassessment interval 20.11 years. Additionally, the ASME B31.8S Code limits the reassessment interval to 10 years maximum. Therefore the reassessment interval for this site cannot exceed 10 years.

Example 2) Determine the actual priority and the remaining life according To NACE RP – 0502-2002. Also determine the reassessment interval per NACE and then B-31.8S. The data set:

Site 2. The original IIT priority was "Scheduled." This site is in a class 3 location in region 1 (non shielding coating), and direct examination showed that the maximum corrosion was17% of the depth. The RSTRENG failure pressure (P_f) is2692 psig. The pipe data is:

- Class location 3
- MAOP 650 psig
- Specified wall thickness 0.188". Actual wall thickness in area adjacent to corrosion damage 0.228".
- 6-inch diameter (6.625" actual OD)
- Grade B (35 ksi SMYS)
- P/S = - 998 mV

Calculations needed to determine the actual priority:

SF corr = P_f/MAOP = 2692/650 = 4.14
SFdr = 2.0

Reprioritization is accomplished using the criteria in Table 5.11. Accordingly, the actual priority is determined to be "Monitored."

The next step is to compute the remaining life according the NACE formula below:

$$RL = \frac{0.85}{YP}\left[Pf - MAOP\right]\frac{t}{CR}$$ where:

RL = Remaining Life (years)

YP = Yield Pressure

Pf = Burst Pressure by RSTRENG (psi)

SF_{DR} = Design Requirement Safety Factor (Table 5.5.1)

$MAOP$ = Maximum Allowable Operating Pressure (psi)

t = Thickness (inch)
CR = Corrosion Rate (inches/years) (from Table 6.2.1 or by direct measurement using LPR coupons, etc)

The yield pressure calculation is:

Yield Pressure (YP) = $\frac{2St}{D}$

Where S is the material grade, t the thickness, and D is the diameter.

$$YP = \frac{2(35{,}000)lbs(0.228)inch}{(inch)(inch)(6.625 - inch)} = 2409 \text{ psi}$$

The corrosion rate is 3 mpy based on a measured soil resistivity of 35,150 ohm-cm. Therefore the remaining life is

$$RL = \frac{0.85}{YP}\left[Pf - MAOP\right]\frac{t}{CR} = \frac{0.85}{2409}\left[2692 - 650\right]\frac{0.228}{0.003} = 54.76 \text{ years}$$

The half life requirement makes the calculated reassessment interval 27.38 years. The B-31.8S requirements limit it to 10 years. Therefore the reassessment interval may not exceed 10 years.

6.4 **ECDA Performance Report**: The PM shall complete the ECDA Performance Report, Form L. The report shall be filed in the ECDA project file as well as the Integrity Management Program file under "Performance Measures."

6.5 **Project Report:** The PM shall prepare a project report and submit it for approval to the Manager of System Integrity.

6.5.1 **Contents:** The report shall contain a cover letter which summarizes any mitigation requirements and associated suggested timetables and the following information in the suggested order:

- Form L: ECDA Performance Reports
- Form K: Remaining Life Determination
- Form J: Reprioritization Reports
- Form I: Remaining Strength Evaluation and Root Cause Analysis
- Form H: Data Excavation Sheets
- Form G: Indication Classification and Direct Examination
- Form E: ECDA Region Report
- Form D: Indirect Inspection Tool Report
- Form C: Feasibility Analysis Report
- Form B: Sufficient Data Analysis
- Form A: Data Element Check Sheet
- Form M: Exceptions Reports

6.5.2 **Documentation:** After the Manager of System Integrity approves the report it shall be distributed as appropriate and filed in the ECDA project file.

6.5.3 **Communication of recommended mitigation plan:** Efforts shall be made to communicate mitigation tasks that pertain to the pipeline being assessed. For example a meeting should be held to discuss what types of mitigation are recommended to improve pipeline integrity such as pipeline replacement, recoating, installation of additional monitoring points, upgrade of CP system, etc. The following responsible parties should be included in this meeting:

Responsible Pipeline Engineer, T&R Supervisor or District Superintendent, Responsible Senior Gas Distribution Engineer, Local Transmission Superintendent, DA Project Engineer, DA Project Manager, etc.

7.0 EXCEPTION PROCESS

7.1 **Expectations:** It is expected that all requirements of this procedure be met in conducting an ECDA. However, when this is not possible, then exceptions can be made by obtaining approval, and documenting the exceptions, as prescribed in this section. Note: If it is the intent to take exception to a "shall" stated in either the DOT Integrity Management Rule or the NACE RP0502-2002 Recommended Practice for ECDA then a waiver must be obtained from OPS.

7.2 **Objective:** The purpose of this section is to provide control and documentation of exceptions taken of this process. This control and documentation is to maintain the integrity of conducting an ECDA process, to continuously improve the process by providing feedback, and to have an auditable trail and be in compliance with the procedure at all times.

7.3 **Exception Requirements:** The following process is required for taking an exception with this procedure. It shall be documented on Form M, EXCEPTION REPORT:

7.3.1 **Section of Procedure:** State the specific paragraph number where the exception is being taken. Briefly state in your own words the requirements of the paragraph.

7.3.2 **Alternative Plan:** State what is proposed instead of what is required in the procedure.

7.3.3 **Reason:** Provide the reason the exception is needed.

7.3.4 **Recommendation:** Indicate if it is recommended to change the procedure or that this exception is project specific.

7.3.5 **Approval:** Obtain approval from the Manager of System Integrity or his designate prior to acting on the exception.

7.3.6 **Documentation:** Document the above steps on Form L, EXCEPTION REPORT. Place all exception reports in the project file.

APPENDIX A

ECDA Forms

FORM A: DATA ELEMENT CHECK SHEET

DATE: ______

STARTING MILE POINT: ______

ENDING MILE POINT: ______

ROUTE NUMBER: ______

PM: ______

		Requirements				Data Location						
ID #	Data Element Description	Need[1]	InspectionTool[2]	Region Selection[2]	Interpretation Analysis[2]	GIS	As-built Job file	Field	Districts or Division	Other	Sign Off	Comments
1.0 Pipe Related												
1.1	Material and Grade	R	C	C	R	X	X					
1.2	Diameter	R	C	N/R	R	X	X					
1.3	Wall thickness	R	N/R	N/R	R	X	X					
1.4	Year manufactured	C	N/R	N/R	R							
1.5	Seam Type	R	N/R	C	C	X	X					
1.6	Bare pipe	R	R	R	R	X	X					
2.0 Construction Related												
2.1	Year installed	R	N/R	N/R	R	X	X					
2.2	Recent route changes/ modifications that may not be in GIS	D	N/R	C	N/R			X	X	As-builts		
2.3	Construction practices	D	C	C	C		X			Engr. Stds. drawings		
2.4	Location of major pipe appurtenances such as valves, and taps	D	N/R	C	C	X	X	X				
2.5	Locations of casings	R	R	R	C	X	X			Trans. Plat sheets, CPA Records		
2.6	Location of bends, including miter bends and wrinkle bends	D	C	C	C		X			Trans. Plat Sheet		
2.7	Depth of cover	D	C	C	C			X	X			

[1, 2] R = Required, D = Desired (See paragraph 2.5 for definitions)

[2] R = Required, C = Considered

FORM A: DATA ELEMENT CHECK SHEET

DATE: ____________________
STARTING MILE POINT: ____________________
ENDING MILE POINT: ____________________

ROUTE NUMBER: ____________________
PM: ____________________

		Requirements				Data Location						
ID #	Data Element Description	Need[1]	InspectionTool[2]	Region Selection[2]	Interpretation Analysis[2]	GIS	As-built Job file	Field	Districts or Division	Other	Sign Off	Comments
2.8	Underwater sections and river crossings	R	R	R	C	X	X	X				
2.9	Locations of river weight and anchors	D	C	C	C		X	X		As builts		
2.10	Proximity to other pipelines structures, HV electric transmission lines and rail crossing	D	C	C	C	X		X				
3.0 Soil Environmental												
3.1	Soil characteristics & types. Refer to Appendix B and D	D	C	C	C	X		X				
3.2	Drainage	D	N/R	C	N/R			X				
3.3	Topography	D	C	C	N/R			X				
3.4	Land use (current/pass)	R	C	C	N/R	X		X				
3.5	Frozen ground	R	C	N/R	N/R			X				
4.0 Corrosion Control												
4.1	CP system type (anodes, rectifiers and locations)	R	C		C			X		CPA Records		
4.2	Stray Current sources/locations	D	N/R	C	C	X		X	X	CPA Records. Past survey reports		
4.3	Test point locations (pipe access points)	R	N/R	C	N/R	X		X		CPA Records		
4.4	CP evaluation criteria	R	N/R	C	C					CPA Records, Paradigm		
4.5	CP maintenance history	R	N/R	C	C					CPA Records, Paradigm		
4.6	Years without CP applied	D	N/R	C	N/R		X					

FORM A: DATA ELEMENT CHECK SHEET

DATE: ____________________

STARTING MILE POINT: ____________________

ENDING MILE POINT: ____________________

ROUTE NUMBER: ____________________

PM: ____________________

		Requirements				Data Location						
ID #	Data Element Description	Need[1]	Inspection Tool[2]	Region Selection[2]	Interpretation Analysis[2]	GIS	As-built Job file	Field	Districts or Division	Other	Sign Off	Comments
4.7	Coating type-pipe	R	R	C	C	X	X					
4.8	Coating type-joints	D	C		C		X		X			
4.9	Coating condition	D	C	C	N/R	X			X	Direct Assessment		
4.10	Current demand	D	N/R	N/R	C					CPA Records		
4.11	CP survey data/history	D	N/R	C	C					CPA Records Paradigm		
5.0 Operational Data												
5.1	Pipe operating temperature	D	N/R	C	C					Field measurements		
5.2	Operating stress level	R	N/R	N/R	R	X						
5.3	Monitoring programs (Coupon, patrol leak surveys etc.)	D	N/R	C	N/R					Corrosion Group		
5.4	Pipe inspection reports-excavation	R	N/R	C	N/R	X						
5.5	Repair history/records, steel/composite repair sleeves, repair locations	R	C	C	N/R	X			X	Form A's		
5.6	Leak rupture history (EC)	R	N/R	C	N/R	X	X					
5.7	Evidence of external MIC	D	N/R	N/R	C					Corrosion records		
5.8	Type and frequency of third pary damage	R	N/R	C	N/R	X						
5.9	Data from previous over the ground surveys	R	N/R	C	N/R	X						
5.10	Hydro test dates/pressures	D	N/R	C	C	X						

FORM A: DATA ELEMENT CHECK SHEET

DATE: ____________
STARTING MILE POINT: ____________
ENDING MILE POINT: ____________

ROUTE NUMBER: ____________
PM: ____________

ID #	Data Element Description	Requirements: Need[1]	Requirements: InspectionTool[2]	Requirements: Region Selection[2]	Requirements: Interpretation Analysis[2]	Data Location: GIS	Data Location: As-built Job file	Data Location: Field	Data Location: Districts or Division	Data Location: Other	Sign Off	Comments
5.11	Other prior integrity related activities – CIS, ILI runs, etc.	R	C	N/R	C	X				Corrosion Group		
6.0 Internal Corrosion (IC) Threat Assessment												
6.1	History of IC leaks	D	C	D	C	X		X	X			Pipe inspection form
6.2	Topography	D	D	D	D	X		X				
6.3	Depth Survey	D	D	N/R	D	X		X				
6.4	Received gas from gathering or storage lines	D	N/R	D	D	X		X				
6.5	Drip Location	D	N/R	C	C	X		X				Check drip logs, PLM
6.6	Corrosometer Probe reads	D	D	C	D	X		X				
6.7	Inhibitor Injection Sites	D	D	C	D	X		X	X			
6.8	Chemical/Microbial analysis of liquid samples	D	D	C	D	X		X	X			
6.9	Acid Gas Partial Pressures	C	C	C	C							District or Corrosion Group
6.10	Line Pressure and Flow Rate	D	D	C	D	X		X	X			
6.11	Dew Point & Temp	D	D	C	D	X		X	X			
6.12	Previously "pigged"	D	D	C	D	X		X	X			
7.0 StressCorrosion Cracking (high ph SCC) Threat Assessment												
7.1	Age of pipe	D	C	C	C	X						
7.2	Operating Stress Level	D	C	C	C	X						

FORM A: DATA ELEMENT CHECK SHEET

DATE: ____________________
STARTING MILE POINT: ____________________
ENDING MILE POINT: ____________________

ROUTE NUMBER: ____________________
PM: ____________________

		Requirements				Data Location						
ID #	**Data Element Description**	**Need[1]**	**InspectionTool[2]**	**Region Selection[2]**	**Interpretation Analysis[2]**	**GIS**	**As-built Job file**	**Field**	**Districts or Division**	**Other**	**Sign Off**	**Comments**
7.3	Operating Temp	D	C	C	C	X						
7.4	Distance from Compressor station	D	C	C	C	X						
7.5	Coating type	D	C	C	C	X						
7.6	Hydrotest Information	D										
8.0 Third Party Damage Threat Assessment												
8.1	Review Easement documents for foreign crossings	C	C	C	C							Land Department
8.2	Evidence of new excavation or construction	C	C	C	C							
8.3	Historical concentration of USA tags	C	C	C	C	X						
8.4	Known areas of shallow cover	C	C	C	C	X						Interview Questions, see Appendix F for details
8.5	Pipe inspection reports/repairs	C	C	C	C	X						Interview Questions, see Appendix F for details
8.6	Patrol Records	C	C	C	C	X						Interview Questions, see Appendix F for details
9.0 Hard Spot Threat												
9.1	Threat of Hard Spots	C	C	C	C							Information provided by Risk Management Department

Form B: Sufficient Data List

DATE: ____________________
STARTING MILE POINT: ____________________
ENDING MILE POINT: ____________________

N-SEGMENT: ____________________
ROUTE NUMBER: ____________________
PM: ____________________

SUFFICIENT DATA ANALYSIS

Missing Required Data Elements

ID#	Data Element Description	GIS pipe segments	Reason for missing data	Explanation why it is not needed (if any)

Sufficient Data: Yes ______ No ______

Project Manager: ____________________ Date: ____________

Project Engineer: ____________________ Date: ____________

Form C: Feasibility Analysis Report

DATE: :____________________
STARTING MILE POINT:____________________
ENDING MILE POINT:____________________

N-SEGMENT" ____________________
ROUTE NUMBER:____________________
PM:____________________

Instructions: Analyze each data category to answer the general questions listed under each ECDA step in the table below. In answering the question include the following:

1) Any adverse conditions that may make the GIS pipe segments infeasible to ECDA. Refer to Table 3.3.1 for guidance.
2) Any special considerations, techniques that need to be incorporated or considered in conducting the ECDA to over come the adverse conditions
3) A conclusion on the feasibility of conducting an ECDA for all the GIS pipe segments in the ECDA project

ECDA FEASIBILITY ANALYSIS

ID #	Data Categories	**Indirect Inspection** Can existing indirect inspection tools be applied to the GIS pipe segments identified in the ECDA project and be expected to provide meaningful results on potential locations where the coating is damaged? If any of the conditions listed in paragraph 3.7.2 is present an explanation shall be provided here why ECDA is feasible for the subject GIS pipe segments.	**Direct Assessment** Is it physically and economically feasible to gain access to the pipeline to conduct direct assessment and be expected to gain meaningful data?	**Post Assessment** Can it be reasonably expected to be able to determine reassessment intervals of the GIS pipe segments given the existing data?
1.0	Pipe Related			
2.0	Construction Related			
3.0	Soils/Environmental			
4.0	Corrosion Control			
5.0	Operational Data			

ECDA Feasible: Yes_____ No_____

Project Manager: ____________________ **Date:** ____________________

Project Engineer: ____________________ **Date:** ____________________

Form D: Indirect Inspection Tool Selection

DATE: ______________________

STARTING MILE POINT: ______________

ENDING MILE POINT: ______________

N-SEGMENT: ______________________

ROUTE NUMBER: ______________________

PM: ______________________

Route #	GIS Seg. #	MP Start	MP Stop	Boundary Marking Type[4]	1st IIT	2nd IIT	3rd IIT	ECDA Region Number (Form. E)	Coating Type	Comments

Project Engineer: ______________________ Date: ______________

Project Manager: ______________________ Date: ______________

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

Form E: ECDA Region Report

DATE:____________________
STARTING MILE POINT:____________________
ENDING MILE POINT:____________________

N-SEGMENT NUMBER:____________________
ROUTE NUMBER:____________________
PM:____________________

Instructions: For each ECDA region record the two IIT's for that region and the unique data element(s) that are used to establish the region. The Indirect inspection methods and at least one other characteristic must be recorded for each region. Bare pipe, casings, and water crossing require separate ECDA regions (Table 3.3.1) .

ECDA REGION DESCRIPTIONS

ECDA Region	Pipe Related Characteristics (include Data Element #)	Construction Related Characteristics (include Data Element #)	Soils and Environmental Characteristics (include Data Element #)	Corrosion Control Characteristics (include Data Element #)	Operational Data Characteristics (include Data Element #)

Project Engineer: ____________________ **Date:** __________

Project Manager: ____________________ **Date:** __________

Manager System Integrity: ____________________ **Date:** __________

Form F: IIT Procedure Review Form

DATE: ____________________ IIT METHOD: ____________________
REVIEWER: ____________________ VENDOR: ____________________
VENDOR CONTACT: ____________________ VENDOR PROCEDURE NUMBER: ____________________

INSTRUCTIONS: Paragraph 4.3.1 in the ECDA Procedure provides instructions on completing and filing of this form

Procedure Content Review

Acceptable	Not Acceptable		Comments
☐	☐	Procedure Number	
☐	☐	General Description	
☐	☐	Limitations	
☐	☐	Procedure Qualification	
☐	☐	Safety	
☐	☐	Instrumentation	
☐	☐	Personnel Qualifications	
☐	☐	Calibration	
☐	☐	Equipment Connections	
☐	☐	Pipe Locator	
☐	☐	Measurements	
☐	☐	Special Diagnostics	
☐	☐	Distance Measurements	
☐	☐	Data Recording	
☐	☐	Approval	

General Comments: ____________________

Approved	Not Approved	
☐	☐	Comment: ____________________

Project Engineer: ____________________

Date: ____________________

Form G: Indication Classification and Direct Examination Form

DATE:______________________

STARTING MILE POINT:______________________

ENDING MILE POINT:______________________

N-SEGMENT NUMBER:______________________

ROUTE NUMBER:______________________

PM:______________________

MP or (MP Range)	CIS Severity[1]	DCVG Severity[1]	PCM Severity[1]	Depth (inches)	Pipe Gradient	Other Severity[1]	Alignment[2]	Initial Prioritization[3]	Selected for Direct Exam & Date Scheduled	Comments

Project Engineer:______________________ **Date:**__________

Project Manager:______________________ **Date:**__________

DA Program Manager:______________________ **Date:**__________

System Integrity Manager:______________________ **Date:**__________

[1] Severity classification Severe, Moderate, Minor in accordance with Table 4.6.1

[2] Alignment classifications; Yes IIT indications, align. No IIT indication, do not align. If no, see Paragraph 4.7.2 for required action and document in comment section of form.

[3] Preliminary Category Priority; Priority I, II or III. See Table 5.5.2 for Prioritization

FORM H: DIRECT EXAMINATION DATA SHEET 1 OF 10

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: ____________

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

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 (°F): ____________ MEASURED PIPE DIAMETER (IN.): ____________

2.2 WELD SEAM TYPE: ☐ DSAW ☐ SSAW ☐ ERW ☐ SMLS
☐ SPIRAL ☐ LAP ☐ FLASH ☐ AO SMITH ☐ CAN'T DETERMINE

2.3 GIRTH WELD COORDINATES:
NORTHING: ____________
EASTING: ____________
ELEVATION: ____________

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 MEASURMENT GRID FOR ADDITIONAL INFORMATION

Zero Reference Point: ____________
FLOW ⟶

*NOTE ANY CALCAREOUS DEPOSITS.

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

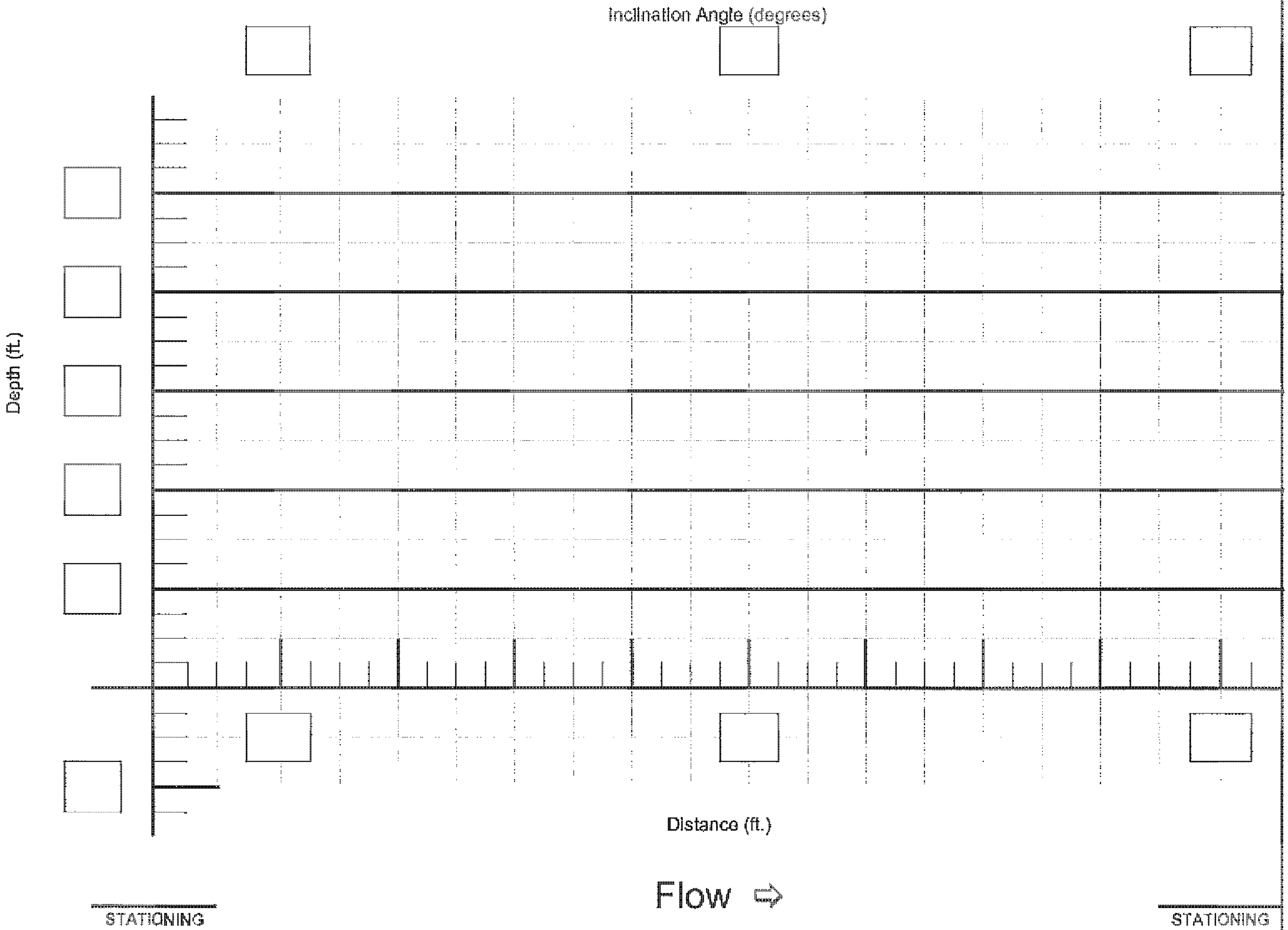
material redacted

FORM H: 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	DA	ILI
ROUTE NUMBER:	N-SEGMENT:	ILI LOG DISTANCE:
DATE OF EXCAVATION:	IMA NUMBER:	RMP-11 REF. SECTION: Table 5.6.2
MILE POINT:	REGION NUMBER:	REFERENCE GIRTH WELD:
EXCAVATION PERFORMED BY:	SUBREGION # (ICDA):	DISTANCE FROM GIRTH WELD:
PG&E PROJECT MANAGER:	STATIONING:	
APPROVED BY:		
ORDER NUMBER:		
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	14	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

Form H
Page 5 of 10

EXTERNAL PIT DEPTH MEASUREMENT GRID SHEETS

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:		REGION NUMBER:		REFERENCE GIRTH WELD:	
EXCAVATION PERFORMED BY:		SUBREGION # (ICDA):		DISTANCE FROM GIRTH WELD:	
PG&E PROJECT MANAGER:		STATIONING:			
APPROVED BY:					
ORDER NUMBER:		ANOMALY #:		GRID #:	

GRID SIZE = _____ INCH x _____ INCH (SPECIFIY 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																								
L																								
M																								
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 5.6.2
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.)

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 5.6.2

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 5.6.2
Mile Point:				Reference Girth Weld:	
Examination Performed By:		Region Number:		Distance From Girth Weld:	
PG&E Project Manager:		Subregion # (ICOA)			
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: ______

Form I: Remaining Strength Evaluation and Root Cause Analysis (Page 1 of 3)

DATE OF EVALUATION:______ REGION NUMBER:______
INDICATION STATION POINT:______ ROUTE NUMBER:______
PRIORITY:______ PM:______
N-SEGMENT # ______ PROJECT ENGR.:______

PIPE DATA FROM FORM H

DIA.:______ WALL THICKNESS:______ MATERIAL:______ SMYS:______ MAOP:______ CLASS LOCATION:______

AREA OF CORROSION WITH LOWEST BURST PRESSURE

LENGTH______ WIDTH______ MAX PIT DEPTH = ______ RSTRENG BURST PRESSURE = ______

PREDICTED BURST PRESSURE DETERMINATION (*Pf*):

PF:______ SF_{CORR} (PF/MAOP):______ SF_{DR}: ☐ 1.39 ☐ 1.67 ☐ 2.00 ☐ 2.50 PIPE REPAIR REQUIRED: ☐ YES ☐ NO

Comments:______

ANALYST:______ DATE:______ DATE OF NOTIFICATION:______

PEOPLE NOTIFIED:______

Form I (2 of 3): Root Cause Analysis Report

ECDA/ILI		ECDA		ILI	
Route Number:	______	IMA Number:	______	ILI Log Distance:	______
Date of Excavation:	______	Region Number	______	RMP-11 Ref. Section	______
Mile Point:	______	Date Required:	______		
Examination Performed By:	______				
Project Manager:	______				
Approved By:	______				

Description and Extent of Damage:
☐ Coating Damage ☐ Pitting ☐ Gen. Wall Loss ☐ Dent ☐ Gouge ☐ Other ______

Rocks in Coating: ☐ Yes ☐ No **Evidence of Shielding:** ☐ Yes ☐ No

Coating Type: ☐ HAA ☐ Somastic ☐ Plastic Tape ☐ Wax Tape ☐ FBE ☐ Other-Epoxy ☐ Bare/None
☐ Paint ☐ Other ______ Comments: ______

Extent of Coating Degradation: ______

______

Max. Depth of Corr.: ______ **Max Length of Corr.:** ______
Comments: ______

______

______

______

Matrix of Testing Performed:
Soil Resistivity: ☐ Yes ☐ No Result: ______
Lab Soils Protocol: ☐ Yes ☐ No Results: ______
MIC Testing Performed: ☐ Yes ☐ No Results [Log (counts/ml)]: SRB ____ APB ____ AERO ____ ANA ____
pH of Water Under Coating: ______ CIS Over Bell Hole: ☐ Yes ☐ No
CIS Result: ______ P/S Spot Reads in Trench: ☐ Yes ☐ No Result: ______
Additional Testing: ______

______

______

Comments: ______

______

______

Review of CP Maintenance History:
Summary Review of Compliance Reads: ______

______

______

______

______

IIT Results Before Excavation: ______

______

______

CIS or P/S Results or P/S After Burial: ______

______

______

Other Information: ______

______

______

Review of Existing Damage Mitigation Measures:

______

______

______

______

______

7/20/2005

Form I (3 of 3): Root Cause Analysis Report

ECDA/ILI		ECDA		ILI	
Route Number:	______	IMA Number:	______	ILI Log Distance:	______
Date of Excavation:	______	Region Number	______	RMP-11 Ref. Section	______
Mile Point:	______	Date Required:	______		
Examination Performed By:	______				
Project Manager:	______				
Approved By:	______				

Analysis of Data for Root Cause:

Root Cause of Damage:

Additional Testing, Mitigation and/or Analysis Needed For Long-Term Pipeline Integrity:

Lessons Learned:

Incorporate Into Procedure? ☐ Yes ☐ No Date: ______

Incorporate Immediately to Future Root Cause? ☐ Yes ☐ No Date: ______

Actionable Items:

Is ECDA well suited to identify damage from the cause described above? ☐ Yes ☐ No

Does Root Cause require reprioritization of indications? ☐ Yes ☐ No

Does Root Cause require repeat indirect inspections? ☐ Yes ☐ No

ECDA Project Engineer: ______ Date: ______

Approved: ______ Date: ______

Manager, System Integrity

Form J: Reprioritization

DATE OF EVALUATION:______________

ECDA REGION NUMBER:______________
ROUTE NUMBER:______________
PM:______________

Prioritization Evaluation

MP or MP Range of Indication	IIT Priority Form G	Region #	SF_{corr}	Class Location	SF_{DR}	Max Corrosion Depth	Actual Priority	Reprio. Yes/No	New Priority	Compliance Criteria Met	Comments

Project Engineer:______________ Date:______________

Reprioritized Indirect Inspection Indications From Above Analysis

MP or MP Range of Indication	Original Priority	New Priority	Comments	Range of Reprioritization	Affected Regions	Comments

Project Engineer: ______________ Date: ______________

Project Manager: ______________ Date: ______________

Form K: Remaining Life Determination

DATE OF EVALUATION: ____________________
INDICATION MILE POINT: ____________________
REPRIORITIZATION PRIORITY: ____________________

N-SEGMENT #: ____________________
ROUTE NUMBER: ____________________
PM: ____________________
PROJECT ENGINEER: ____________________

PIPE DATA:
DIA.:________ WALL THICKNESS:________ MATERIAL:________ SMYS:________ MAOP:________ CLASS LOCATION:________

REMAINING LIFE CALCULATION:

MP	Priority	Yield Pressure	Pf	SF_{DR}	MAOP	t	CR	RL	Reassess Interval

Comment: ____

PROJECT ENGINEER: ____________________ DATE: ____________________

PROJECT MANAGER: ____________________ DATE: ____________________

PROGRAM MANAGER: ____________________ DATE ____________________

MANAGER SYSTEM INTEGRITY: ____________________ DATE ____________________

$$RL = \frac{0.85}{YP}\left[Pf - MAOP\right]\frac{t}{CR}$$ where:

RL = Remaining Life (years)

YP = Yield Pressure

Pf = Burst Pressure by RSTRENG (psi)

SF_{DR} = Design Requirement Safety Factor (Table 5.5.1)

$MAOP$ = Maximum Allowable Operating Pressure (psi)

t = Thickness (inCR = Corrosion Rate (inches/years)

Form L: ECDA Performance Report

DATE OF REPORT:______________

ECDA REGION:______________

ROUTE NUMBER:______ MP START:______ MP FINISH:______

PM:______________

INDIRECT INSPECTION:	**CIS**	**DCVG**	**PCM**	**Other**
Length (ft)	______	______	______	______
	Immediate	**Scheduled**	**Monitored**	**NRI**
Number of indications (After Reprioritization)	______	______	______	______
DIRECT EXAMINATION:				
Number of Excavations	______	______	______	______
Remaining Life	______	______	______	______
Safety Factor Responses	______			
Number of Reprioritizations	Higher Priority______	Lower Priority______	M to NRI______	

Number of Repairs ______

Length and coordinates for Pipe to be replaced ______________

POST ASSESSMENT:

Reinspection Interval: ______

Exceptions: ______

Project Engineer:______________

Project Manager:______________

DA Program Manager:______________

Manager, System Integrity:______________

Form M: Exception Report

DATE OF REPORT:__________

ROUTE NUMBER:__________

PM:__________

Paragraph Number of Exception:__________

Requirements of paragraph (Your own words): __________

Alternative Plan: __________

Reason for Exception: __________

Recommendation: Should the procedure be changed? ☐ YES ☐ NO

COMMENTS: __________

Project Engineer:__________ **Date:**__________

Project Manager:__________ **Date:**__________

APPENDIX B

Appendix B
Data Requirements and Dictionary for Survey Contractors

Below is a list of data and their descriptions that shall be collected during the IIT's inspections in addition to the corrosion survey data.
Data Dictionary: CIS

- **Line_No** (text)
- **Flag number** (text)
- **DCVG mV** (numeric)
- **Pipe_Line** (menu)
  Angle Point
  Point on Line
- **Depth inches** (numeric)
- **PL_Marker** (menu)
  Slash
  Composite
  Aerial
  Plastic Post
- **CP** (menu)
  Rect
  Anode
  ETS
- **Land Use** (menu)
  Plowed Field
  Road ROW
  Vineyard
  Pasture
  Park
  Res yard (Residential)
  Schoolyard
  Commercial yard
  Other
- **Valves** (text)
- **Roads** (menu)
  Edge of Road
  Centerline
- **Topo** (menu)
  Fence
  Water
  Other
- **Name** (text)
- **Pin_space** (numeric)
- **R1** (numeric)
- **R2** (numeric)
- **Current (mA)** (numeric)
- **PCM Location** (text)
- **Notes** (text)

APPENDIX C

Appendix C

Soil Collection Process

Subject: Collecting Soil Samples - **Revised June 15, 2004**

The following general guidelines apply to the collection, transport, storage, and identification of soil samples. This revision addresses the need to increase the size of samples submitted to our office for testing to a minimum of 1 liter and the need to minimize the time the sample is held, before delivery to the laboratory for testing.

1. When collecting grab samples from an open trench using a shovel, cut away any oxidized material, which may have been exposed to the atmosphere for more than a few minutes. If the trench has been opened for more than a day, at least 6 in. of surface material should be removed before collecting the sample. Do not allow material from other areas in the trench to fall into the container. Transfer the sample with the least amount of disturbance as possible.
2. Fill the sample container completely and consolidate (compact) by hand to exclude as much air as possible, before sealing the container. Two (2) one half liter rigid plastic sample containers with screw on cap are the acceptable minimum size for this purpose.
3. Place the filled sample container in a cool, protected cooler (with ice) for delivery to the shipping company or delivery directly to our laboratory. While most test results will not change significantly with time and temperature, others will and being in the habit of maintaining good sample handling procedures will improve correlation with actual conditions in the field. If the sample will not be delivered in less than 5 days, freeze the sample and ship it frozen, in an insulated container.
4. Permanently mark the sample in accordance with client instructions. The marking should included the date, job name, structure ID, sample depth, pipe stationing or other reference to the location along the pipe alignment.
5. Samples collected for redox (oxidation-reduction potential) should be taken as undisturbed (confined) samples, if possible. Material that will stand vertically a few inches high can be properly collected by simply cutting out a 2 in. by 2 in. by 2 in. (approximately) block of soil, quickly placing it in a plastic bag, and then squeezing the air out of the plastic bag before closing the seal. The sample should be placed in a more secure rigid plastic container for transport to the lab. The samples can also be collected properly using any type of tube sampler, typically used for geotechnical exploration. The sample should come out in a tube and remain effectively undisturbed. Plastic caps are placed over the ends to avoid exposure to the air. **Field conditions may not permit either of these two types of sampling techniques and we should to refer back to the best collection techniques we can utilize, as presented above.**
6. Keep sampling tools clean and always use new or acid cleaned sampling liners and containers.
7. The same sampling protocol is required when collecting soil samples from an auger hole, except the sample is collected directly from the flight or cup of the auger for all tests, except for the confined sample. A core sampler should be used to collect confined sample using extensions in the sampler handle to reach the desired sample depth.

Note:

Samples that contain bacteria may be propagated at higher than natural rates when exposed to temperatures not found in the original setting. Volatile materials can be off-gassed at elevated temperatures, which can change the test results significantly. All soil samples should be kept in an insulated, ice containing, cooler until tested as noted above. Freezing is required for long-term storage when organic carbon or anaerobic bacteria may present in the sample. Since we do not know what is in the soil until it is tested, we must treat them all as if there is organic carbon or bacteria present.

APPENDIX D

Appendix D

CASING INSPECTION PROCESS

Purpose:

The purpose of this inspection process is to specify how the pipeline will be inspected using the minimum of two IIT inspection techniques, and to specify how to perform direct examinations.

Indirect Inspection Techniques

For purposes of performing indirect inspections of cased pipeline crossings, the IIT inspection techniques shall be the "Casing Short" test procedure specified in CGT Engineering Guideline EG4126.1 "Investigation of Suspected Pipe-to-Casing Contact," and remote video inspection (Attached). Minimum requirements for performing these tests are that there shall be at least one vent present and one ETS present on the carrier pipe. The ETS shall be within 50 feet of the end of the casing. If an ETS is not present it is acceptable to drag wire from the nearest ETS to within 50 feet of the end of the casing. If present the vent and the ETS shall be on the same end of the casing.

Procedure:

The casing short tests shall be performed at the same time as the uncased pipeline is interrogated with the IIT selected for it (CIS, DCVG, PCM, etc.). It is preferable to inspect **both** ends of the casing annular area with both remote video and the casing short procedure. The video testing can be performed at a later date if need be (see ECDA Procedure RMP-09). To facilitate the video inspection the casing vents shall be cut off approximately 2 feet above the ground, and threaded couplings shall be installed. All video inspection shall be recorded on tape, DVD, etc., or other suitable media. The video probe shall be inserted into the casing vent. It is preferable to use a guide tube, as that will facilitate insertion and also minimize wear on the probe itself. The goals of the video inspection are itemized below:

- Determine the general condition of the annular area.
- Document the condition of the coating on the carrier pipe.
- Determine if corrosion damage to the carrier pipe has occurred.
- Determine if the annular area is filled with a foreign substance (presence or absence of soil, water, or other foreign substance, etc.)
- Determine the location of the short.

Information on these variables shall be used to select the appropriate casings to be excavated according to the following guidelines:

IIT SEVERITY GUIDE

Indirect Inspection Tool	Severe Indication	Moderate Indication	Minor Indication
Casing Electrical Tests	Metallic Short	Electrolytic Short	Intermittent Electrolytic Short
Remote Video Inspection	All of the following must exist: • Evidence of pipeline corrosion • Casing filled with or containing water • Other condition that the PE wants to document	Any of the following can exist: • Casing filled with or containing soil • Other condition that the PE wants to document.	Any of the following can exist: • Casing annular area contains no soil or water • Other condition that the PE wants to document.

Once the severity of indications has been determined then their priority shall be set according to the following criteria. The priorities shall set the location and number of excavations per ECDA Procedure RMP-09.

PRIORITIZATION OF INDICATIONS

	Casing Electrical Test **Severe**	Casing Electrical Test **Moderate**	Casing Electrical Test **Minor**
Remote Video Test Severe	**IMMEDIATE**	**SCHEDULED**	**MONITOR**
Remote Video Test Moderate	**IMMEDIATE**	**SCHEDULED**	**MONITOR**
Remote Video Test Minor	**SCHEDULED**	**SCHEDULED**	**MONITOR**

Direct Examination

For all casings selected for excavation per RMP-09, at least one end of the casing/pipeline shall be exposed. After exposure the direct examination of the carrier pipeline inside casings shall be performed in two ways.

- The first shall be to inspect the carrier pipeline using the guided wave technology. This technology uses surface ultrasonic waves to inspect for wall loss. The results are an average wall thickness – it is not possible to pinpoint specific deep wall loss with this technique. With this technology it is possible to inspect in a qualitative way deep into the casing. The specific procedure used for this direct inspection is specific to the technology used by the vendor. As such the inspections will follow the specific procedures developed by those individual vendors. The vendors will follow their own procedures. Since there are several (3) differing inspection technologies referred to under the "guided wave" family umbrella, we will review and modify them as appropriate prior to acceptance.

- The second technique is that we will directly view the pipelines surface and assess the condition of the coating, the contents of the annular area, and assess any corrosion that may be present. This may entail removal of a short section of the casing to view the coating directly under the casing, which can be done with a pipe cutter (oxy) or a portable lathe.

DJAguiar
Corrosion Engineer
ECDA Casing Procedure, 10/2003
7/20/2005

APPENDIX E

Appendix E

PIPELINE & STATION INSPECTION CHECKLIST
EXPOSED PIPING IN HCAs
(MANDATORY INTEGRITY INSPECTION)

PIPING (Including appurtenances such as valves, regulator, monitors, filters, meters, supports)
Is there evidence of external corrosion on any exposed piping with heat or noise containment insulation?
Yes______ No______

Comments____

Follow guidance in Pipe Inspection Training Handbook (Exposed Pipe Inspections).

Is there evidence of external corrosion on any exposed and painted piping?
Yes______ No______

Comments____

Follow guidance in Pipe Inspection Training Handbook (Exposed Pipe Inspections).

Is there evidence of external corrosion at any soil-to-air interface?
Yes______ No______

Comments____

Follow guidance in Pipe Inspection Training Handbook (Exposed Pipe Inspections).

Is there evidence of external corrosion on any pipe support or hanger?
Yes______ No______

Comments____

Follow guidance in Pipe Inspection Training Handbook (Exposed Pipe Inspections).

Is there any evidence of ground settlement affecting piping and/or supports/hangers?
Yes______ No______

Comments____

Look for improper contact of pipe to support.
Look for lack of contact of pipe to support.
Look for supports that are not plumb.
Look for support pads that are not level.

Is there any evidence of cyclic fatigue (wear or damage to pipe and/or supports/hangers)?
Yes______ No______

Comments____

Look at pipe-to-support contact points for loss of paint or metal.
Look at pipe-to-support contact points for loss of wear pad material.
Look for improper contact of pipe to support.
Look for lack of contact of pipe to support.

VESSELS (dehydrators, separators, silencers)

Is there evidence of external corrosion on any vessel?
Yes______ No______

Comments____

Follow guidance in Pipe Inspection Training Handbook (Exposed Pipe Inspections).

Is there evidence of corrosion on any vessel hold downs?
Yes______ No______

Comments____

Follow guidance in Pipe Inspection Training Handbook. (Exposed Pipe Inspections)

Is there evidence of chipping or cracking of any vessel concrete support pad?
Yes______ No______

Comments____

Look at the support pad concrete for flaking and/or cracks or chunks broken off.

Is there evidence of any loose vessel holddowns?
Yes______ No______

Comments____

Look at holddown bolts/nuts and clips for gaps.
Check for looseness of holddown clips and bolts/nuts.

Is there evidence of ground settlement affecting any vessel support pad?
Yes______ No______

Comments____

Look for improper contact of vessel to support.
Look for lack of contact of vessel to support.
Look for vessels that are not plumb.
Look for vessel pads that are not level.

THIRD PARTY DAMAGE PREVENTION AND MITIGATION

Is there any evidence of vehicular traffic damage?
Yes______ No______

Comments____

Look at piping for dents, gouges, or grooves.
Look at piping for misalignment.
Look at fencing for stretched fabric and/or damaged holding clips/brackets.
Look for damage to protective bollards.

Is there any evidence of damage from a nearby railroad (traffic and/or track maintenance)?
Yes______ No______

Comments____

Look for damage to fencing or protective bollards.
Look for railroad materials near or in the facility.

Is there any evidence of vandalism?
Yes______ No______

Comments____

Look for tampered locks or locking devices.
Look for breaches of fencing.
Look for missing or graffiti painted signage.
Look for graffiti inside secured areas.
Look for unexplainable damage to pipe, tubing, and equipment.

Is the facility secured in accordance with the requirements of UO Standard S4050?
Yes______ No_____

Comments____

Review facility for compliance with this Standard.

Bob Becken
File: PIPELISTEXP.DOC 7/6/2004

APPENDIX F

Appendix F: Pre-Assessment Interview
DATE: ______
STARTING MILE POINT: ______
ENDING MILE POINT: ______

N-SEGMENT NUMBER: ______
ROUTE NUMBER: ______
PM: ______

People to interview:
PLE's, LT Supt., Corr. Mechanic, T&R Supvr., Dist. Supt. Environmental/Land Dept., Div Engineers, GC Gas

Pipeline maintenance history from Division perspective. You may also want to interview some retirees.

Attending: ______
Absent: ______

	Questions	Responses
General Maintenance Practices		
1.	Past Repair History – Any history of questionable repairs or decisions not to repair? Need to listen for story and then check A-form/pipe inspection forms.	
2.	Records or oral history of shorted pipes?	
3.	Past Operating History – Check with Gas Control for operating history with regard to pressures and outages that were taken for repairs.	
External Corrosion Control Issues		
1.	Type of CP protection (rectifier or galvanic anodes, bonds, current sources). How do you interrupt?	
2.	Past CP history – Where are the protection problems, if any? Have compliance points been added or deleted over the years? If so, where?	
3.	Stray Current issues/history. Where are the areas believed to be influenced by foreign DC current sources or pipelines? What is the evidence to support that possible influence?	

	Questions	Responses
4.	Are there any insulators on the subject lines? Which ones are operational, which ones have bonded, and which ones have failed? What is the history in terms of known failed insulators?	
5.	Very Important -- Where have we sustained corrosion damage on the subject lines? What was believed to be the cause? A-forms must be gathered.	
6.	Very Important – Are there any galvanic anodes on the lines? If so, where are they located and for what reason were they installed? Are they interruptible?	
7.	Has there been any depolarization testing in the past? Are there any areas that have been put on the 100 mV shift criteria?	
8.	Has there been any previous survey work, either test station or CIS?	
9.	Are there any areas where the current requirements are adjusted for seasonal variations? If so, are rectifiers adjusted automatically or do we wait for potentials to drop below 850?	
10.	Is there any history of MIC?	
11.	Is there any history of SCC?	
12.	Any shorted casings? If so, where?	
13.	Any known AC influence? What locations? If so, what is the evidence?	
14.	Are there any creek or other water crossings in the survey area? If so, are they concrete or earthen lined? If concrete lined, is the concrete extensively cracked or is it in good condition?	
15.	Are there any water table issues?	
16.	Any areas where the right of way may contain large numbers of trees? Any information or history of root damage to pipeline coatings?	

	Questions	Responses
Internal Corrosion Issues		
1.	Known liquids or history of liquids or sand in the pipeline?	
2.	Where are the drips located? Please provide the drip logs so that volume history can be computed.	
3.	Has any liquid chemical analyses or MIC testing been done? If so please provide records.	
4.	Where are the low points in the pipeline?	
5.	Are there any Corrosometer probes installed? If so where are they?	
6.	Are inhibitors being injected? If so where, how much, and which chemical?	
7.	Any evidence of CO2 or H2S in the gas stream?	
8.	Historical line pressure and flow rates are needed.	
9.	Are there any dew point or temperature records?	
10	Has the line been previously pigged?	
Land/Permit Issues		
1.	Access issues – At the monitoring locations (above/below ground, etc.), are there vaults that need Division to access for contractor?	
2.	Access to rectifiers - Will Division or District personnel need to stand-by for interruption of rectifiers?	
3.	What are the soil types?	
4.	History of Land Use (horses or cattle ranches).	
5.	Are there any areas along the pipeline right of way that have environmental concerns (CNDDB)?	
6.	Any known locations where hazardous waste may have been dumped along the right of way?	

	Questions	Responses
7.	Are there any areas with private property access issues such as belligerent dogs or owners, locked gates, etc.?	
8.	Any areas with permitting issues/concerns?	
Construction-Related Issues		
1.	Are there any concrete caps installed over the pipelines other than the roadways themselves?	
2.	Are there any areas where the pipeline is known to be shallow (<36")?	
3.	Are there any known fault crossings or any other type of active or recent ground movement history?	
4.	Any history of scouring or erosion in the right of way?	
5.	What is the 3rd party damage history?	
6.	Any recent construction activity?	
7.	Any reinforced concrete coated pipe, saddle anchors, river weights?	
8.	Any areas with excessively deep cover?	
9.	Any history of implementation of creative, cost saving designs?	
10.	Anecdotes about the operation of the pipeline.	
11.	Contact information – name, number, etc.	