PACIFIC GAS AND ELECTRIC COMPANY

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

Procedure for External Corrosion Direct Assessment

Procedure No. RMP-09

Integrity Management Program

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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*. It provides instructions, guidance, and requirements to assure and document that ECDA assessments are in compliance with the recommended practice. 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 are, but not limited to, sufficient data analysis, ECDA Region Designation, indirect inspection results, and remaining strength evaluations. This procedure has response time requirements for some of these analyses. The project engineer as well as the PM will be responsible to meeting those scheduling requirements.

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.

2.4 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 a minimum of 5 years of experience (or equivalent) with corrosion control in the pipeline industry. The engineer shall have taken the CGT Corrosion Control training and be formally trained on this procedure, RMP-09. 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".

2.5 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 does not have to be documented or approved.

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."

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 it's 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 data base.

Covered Pipeline: Is a High Consequence Area that meets the characteristics specified by the Office of Pipeline Safety requiring it to be included in the company Integrity Management Plan.

N-Segment: For the purpose of this document, the definition of the term N-Segment 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"

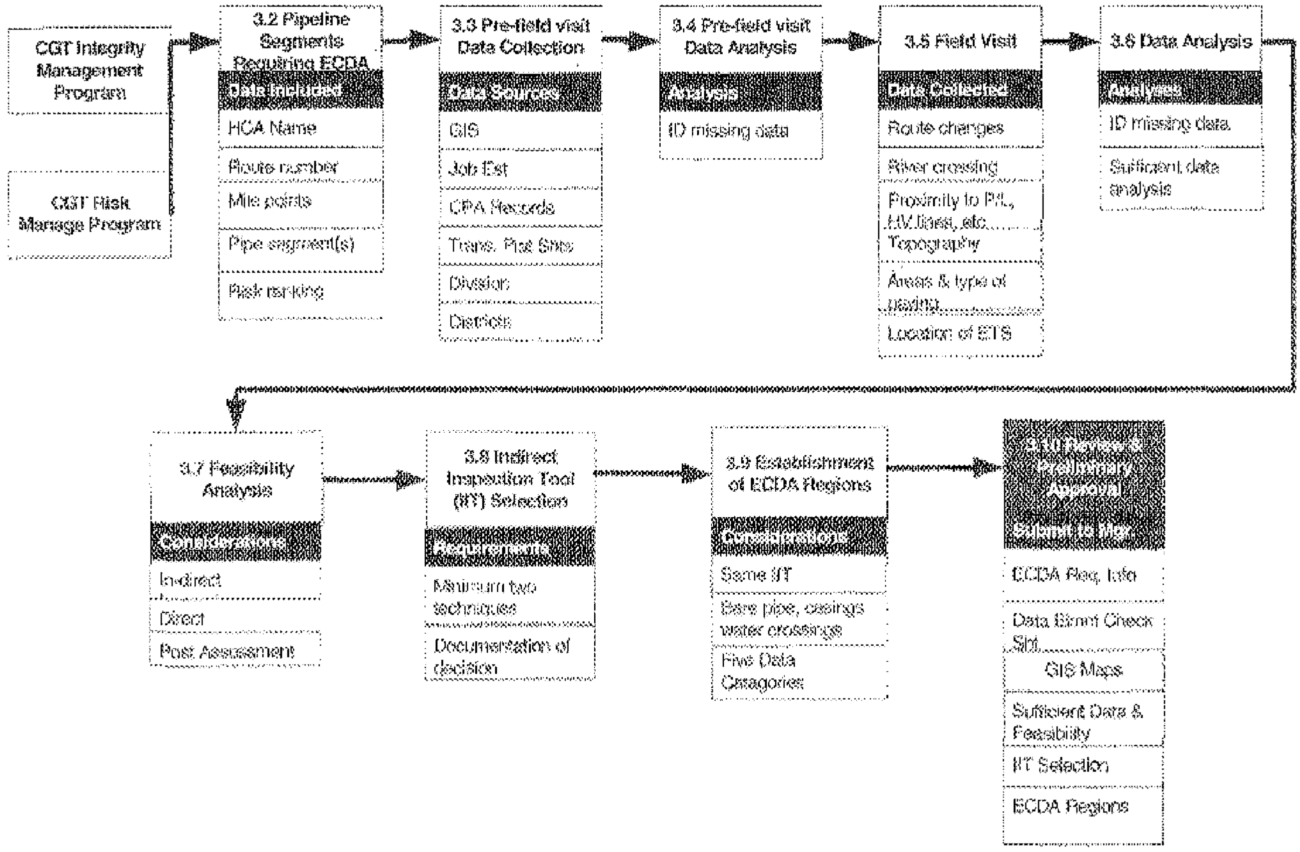


Figure 3.1 Pre-assessment Work Flow

3.0 PRE-ASSESSMENT

3.1 Objectives

The objectives of the pre-assessment process is 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** have the following information:

- Integrity Management (SEGMENT) Name (If applicable)
- SEGMENT Number
- Starting and end points of SEGMENT's
- Route number
- Starting and ending mile points of requested ECDA
- Risk Ranking
- 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

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

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".

3.3.3 **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						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	Drawings or Records	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 the 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 detectability
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	C	C	X	X				
1.6	Bare pipe	Limits ECDA application. Fewer available tools	CIS 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

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[3]	Interpretation/ Analysis[2]	GIS	Job Est.	Field	Districts or Division	Other	Comments
2.0 Construction Related														
2.1	Year installed			Impacts time over which coating degradation may occur, anomaly population estimation, and corrosion rate estimates	S	N/R	N/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			Does GIS have this level of detail?
2.5	Locations of casings	May preclude the use of some indirect inspection tools	Requires separate ECDA regions	May require operator to extrapolate nearby results to inaccessible regions. Additional tools and other assessment activities may be required	S	R	S	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	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[3]	Interpretation/ Analysis[3]	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 weights 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 crossings	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 Soil/Environmental														
3.1	Soil characteristics & types. Refer to Appendix B and D	Some soil characteristics reduce the accuracy of the of 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	D	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.			D	C	C	N/R			X			

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[3]	GIS	Job Est.	Field	Districts or Division	Other	Comments
3.4	Land use (current/pass)	Paved roads, etc., influence indirect inspection tool selection	Can influence ECDA applications and selection		S	C	C	N/R	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 affect ECDA tool selection		Localized use of sacrificial anodes within impressed current systems may influence indirect inspection. Influences current flow interpretation	R	C	N/R	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, Fast 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	S	N/R	C	C					CPA Records, Paradigm	
4.6	Years without CP applied		May make ECDA more difficult to apply.	Negatively affects ability to estimate corrosion rates and make remaining life predictions	D	N/R	C	N/R		X				
4.7	Coating type-pipe	ECDA may not be appropriate for coatings that cause shielding (coatings with high dielectric constants)		Coating type may indicate time at which corrosion begins and estimates of corrosion rate based on measured wall loss.	R	R	C	C	X	X				
4.8	Coating type-joints	ECDA may not be appropriate for coatings that cause shielding		Shielding due to certain joint coatings may lead to requirements for other assessment activities	D	C	N/R	C		X		X		Can CIS, DCVG detect changes between tape and non-shielding coatings

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	Reqd[1]	Inspection Tool[2]	Region Selection[2]	Interpretation Analysis[2]	GIS	Job Est.	Field	Districts or Division	Other	Comments
4.9	Coating condition	ECDA may be difficult to apply with severely degraded coatings			D	C	C	N/R	X			X	Direct Assessment	
4.10	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	
4.11	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 system reports		Consider within 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 (Courses, patrol leak surveys etc.)		May provide input when defining ECDA regions	May impact repair, remediation and replacement schedules.	D	N/R	C	N/R				Corrosion 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 affect 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		C	C	N/R	X			X	Form A's	
5.6	Leak rupture history (BC)		Can indicate condition of existing pipe		R	N/R	C	N/R	X	X				
5.7	Evidence of external MIC			MIC may accelerate external corrosion	D	N/R	N/R	C					Corrosion records	

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[3]	Interpretation / Analysis[2]	GIS	Job Est.	Field	Districts or Division	Other	Comments
5.8	Type and frequency of third party damage			High third party damage areas may have increased indirect inspection coating fault defects.	R		C	N/R	X					
5.9	Data from previous over the ground surveys			Essential for pre-assessment and region selection	R	N/R	C	N/R	X					
5.10	Hydro test [illegible]			Influences inspection interval	D	N/R	C	C	X					
5.11	Other prior integrity related activities – CIS, ILI runs, etc.	May impact ECDA tool selection: isolated vs. larger corroding areas		Useful post assessment data	R	C	N/R	C	X				Corrosion Group	

3.4 Data Analysis (Pre-field visit)

3.4.1 **Identification of Missing Data:** Once the Pre-field Visit data is collected the PM 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:

<u>TABLE 3.5.1: TYPICAL FIELD COLLECTED DATA</u>

ID	Description	ID	Description
2.5	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
2.7	Dramatic changes in the depth of cover.	3.4	Land use where the of the pipeline area. 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, location of rectifiers, ETS stations
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

3.5.2 **Documentation Requirements:** All data collected in the field that will be used in the ECDA shall be documented and stored in an organized manner in the project file.

3.6 Data Analysis

Once the Field Visit data is collected the PM shall analyze the data to identify missing REQUIRED and DESIRED data elements, and conduct a SUFFICIENT DATA ANALYSIS.

3.6.1 **Missing Data:** The PM 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 the data shall be identified. If another list(s) is developed it shall have the following information documented in it:

- GIS pipe segment ID
- Data Element number
- Data Element Description
- Required or Desired data category
- Why the data element was not available

3.6.2 **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 than the reason it is not necessary **shall** be explained in the SUFFICIENT DATA ANALYSIS REPORT (FORM B).
- **Missing Desired Data:** The PM 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 it should be identified in the analysis.
- **Report:** The PM **shall** prepare a Sufficient Data report concluding there is sufficient data to conduct an ECDA. This report **shall** have the analyses described in the two paragraphs above and be signed and dated. The SUFFICIENT DATA & FEASIBILITY ANALYSES REPORT Form B of this procedure can be used for this reporting. The report shall be reviewed and approved by the project engineer.

3.7 Feasibility Analysis

3.7.1 Analysis: The PM **shall** integrate and analyze the data collected on the pipeline segments and determine whether conditions for indirect inspections can be used and that the application of the ECDA is appropriate. The framework for this analysis is that the PM **shall** examine the existing data in each of the five 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?
- **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?

3.7.2 Report: The PM **shall** prepare a report on the feasibility analysis. Form C FEASIBILITY ANALYSIS REPORT can be used to present the following information:

- Are there adverse conditions that may make the ECDA infeasible?
- Any special considerations or techniques that need to be incorporated in conducting the ECDA to over come 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 project engineer.

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 **shall** 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. The Form D IN-DIRECT 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	Yes
Shield corrosion activity	No	No	No	No	Yes
Adjacent metallic structures	Yes	Yes	No	Yes	Yes
Near parallel pipe lines	Yes	Yes	No	Yes	Yes
Under HVAC electric transmission lines	Yes	Yes	Yes	No	Yes
Shorted casing	No	No	No	No	Yes
Under paved roads	Possible	Possible	No	Yes	Yes
Uncased crossings	Yes	Yes	Yes	Yes	Yes
Case crossings	No	No	No	Yes	Yes
Wetlands	Yes	Yes	Yes	Yes	Yes
Rock terrain, ledges or backfill	No	No	No	Yes	Yes

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 2 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 precisely locating holidays on the pipeline and for determining if they are actively corroding.	Generally used to precisely locate large and small coating 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 buried 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 quickly locate defects and corrosion 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 hole.	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 have the same first and second IIT.

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 used in establishing ECDA regions. For example all cased GIS pipe segments **shall** be in ECDA regions with other cased GIS pipe segments. If the PE considers it prudent to not group GIS pipe segments with the same REQUIRED data element he may do so in accordance with the Exception Process described in Section 7.0 of this procedure.

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. The Form E: ECDA REGION REPORT, maybe used for this documentation. Each ECDA region shall have at the two IIT's and at least one other characteristic to describe the ECDA Region. 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 F (completed). The report shall be in the form of a binder, and shall also include other supporting data, such as GIS maps, leak data, etc.

3.10.3 **Approval:** The binder **should** be reviewed with the Manager of System Integrity. Recommendations **shall** be incorporated into the report and the manager **shall** sign the report indicating preliminary 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 or may be occurring.

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

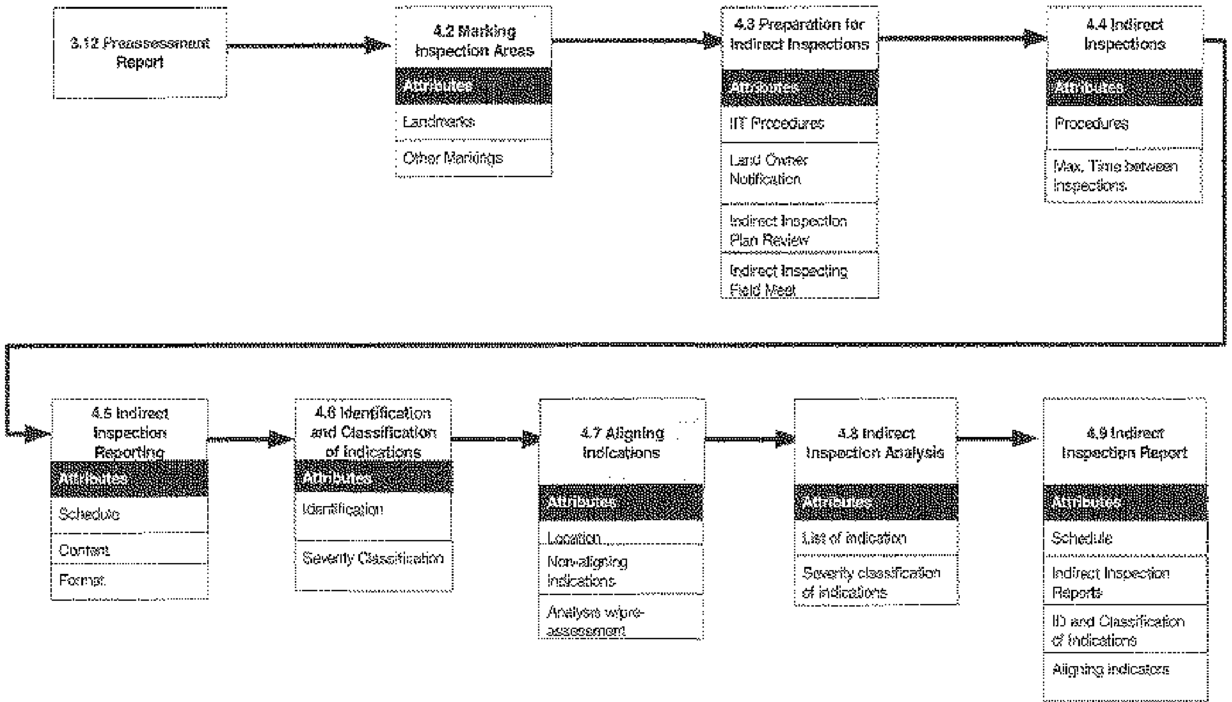
4.1.3 Align and compare the results from the inspections

4.1.4 Identification and classification of indications

4.1.5 Analyze and report results for the Direct Assessment 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 (these regions exceed the length of the ECDA Region) identified 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 SEGMENT number on them and an arrow pointing to the center of the SEGMENT region

4.2.3 **Documentation:** The beginning and end locations of each SEGMENT Region shall be indicated on the Indirect Inspection Tool Form D.

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 documents 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, 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 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 PM or his designate shall have a field meet with the vendor or people that will be conducting the surveys. At this meeting they should cover the following while referring to the IIT Selection and the ECDA Region Forms, 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. Additional tests for special circumstances

4.3.3.4 **Access to ECDA Regions:** How should the vendor 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 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.

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 IIT Form D

4.4.1.2 **Station Numbering:** Each corrosion survey area 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 100 feet*	• Roadway description*
• Type Pipeline markers*	• Topographical features*

*GPS readings 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 shall endeavor to have the two indirect inspections conducted as close in time as reasonably possible. In no case shall the inspections occur longer than 60 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 test data shall be submitted to the PM no later than 180 days after the completion of the last test indirect inspection test.

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 dept 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. 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. 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 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.

4.6.4 **Analysis Time Requirements:** The analysis of indications shall be completed no later than 30 days after receipt of the data. The analysis shall include all paragraphs up through paragraph 4.9 of this procedure.

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	All of the following must exist: • Less than 600 mv off • 200 mv depression over baseline • Convergence of cathodic potential – 10 mv or less constitutes convergence • Other condition that the PE wants to document • <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
PCM	Greater than 20% change in 100 feet	Between 10 and 20% change in 100 feet	<10 %	No significant change
DCVG/ACVG	6 or more indications in 100 ft.	3 – 5 indications in 100ft.	2 or less indications in 100ft.	Zero indications
Other				

4.6.5 **Documentation:** The severity of the indications shall be documented on the Indication Classification and Alignment 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 discrepancy in alignment has not been resolved shall be classified as severe.

4.7.3 **Documentation:** The PE shall complete the Indication Classification and Direct Examination Form G to document any discrepancy and its resolution. The PM and the Project Engineer 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

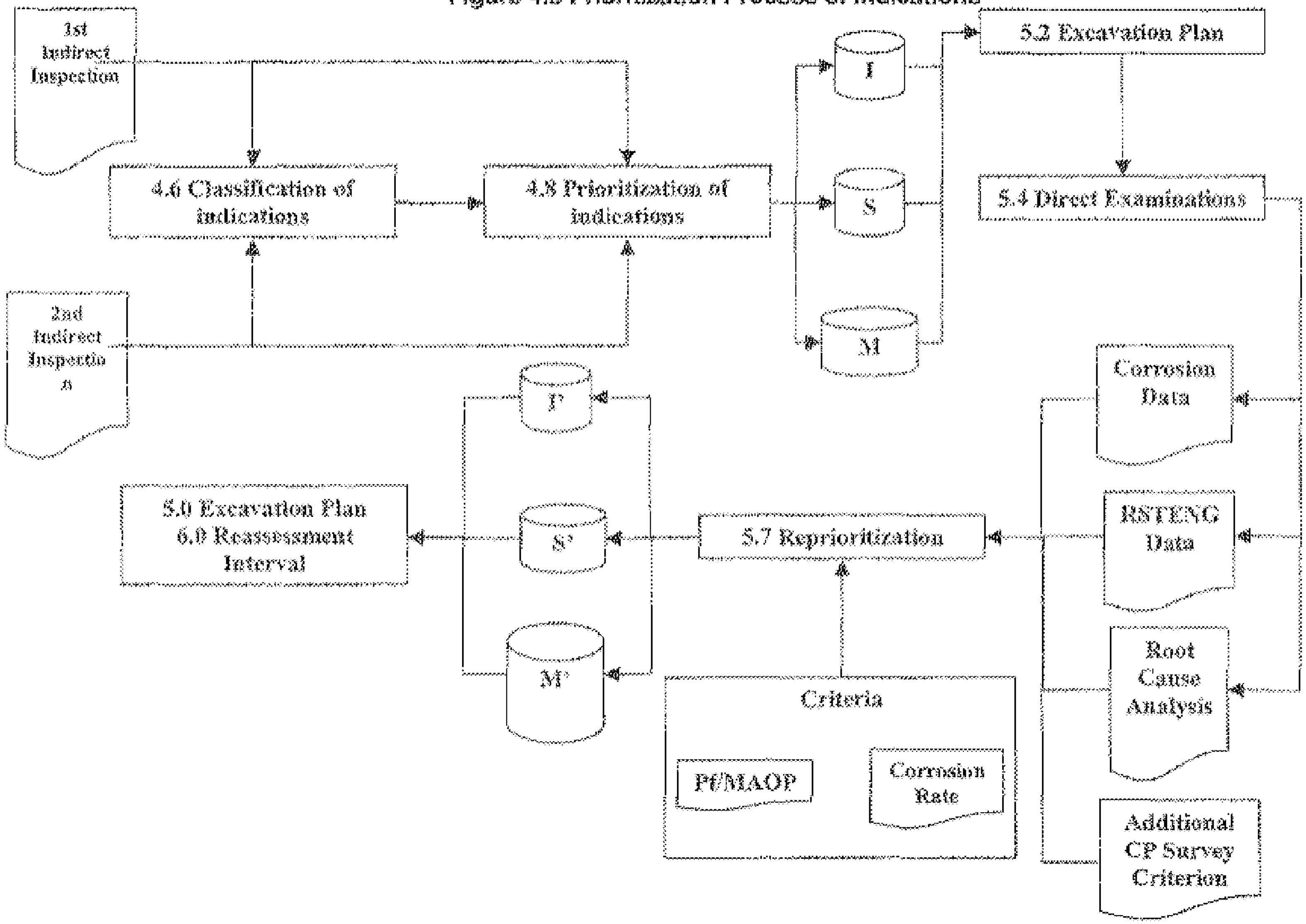
4.7.3.3 **Re-classification:** The non-aligning indications are reclassified as severe.

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).

4.8 **Prioritization of Indications**

4.8.1 **Objective:** Prioritization is the process of prioritizing the indications based on the need of direct examination. Prioritization is a two-step process where indications are initially prioritized by integrating the data from the individual indirect inspections. The prioritization is then updated or changed with the integration of data and analysis results from the indirect examination with the indirect inspections. Figure 4.8 shows the prioritization process from the Indirect Inspection step to the Post Assessment step.

Figure 4.8 Prioritization Process of Indications



4.8.2 **Initial Priorities:** The indications shall be initially prioritized in the following categories:

4.8.2.1 **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 follow in this priority are:

4.8.2.1.1 **Isolated Indications:** Indications that were prioritized as severe by two IIT inspections as shown in Table 4.8.1.

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

4.8.2.1.3 **Discrepancies Between IIT:** Indications that seem to have discrepancies between different IIT techniques.

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

4.8.2.1.5 **Difficult to Characterize Indications:** Indications where the likelihood of ongoing corrosion cannot be characterized such as indications that are a result of interference with CP current

4.8.2.2 **Scheduled:** This priority should include indications that may have on-going corrosion activity but when coupled with prior corrosion history does not pose a threat to the pipeline segments. See Table 4.8.1.

4.8.2.3 **Monitored:** These indications are minor and have the lowest likelihood of being active. See Table 4.8.1.

<u>TABLE 4.8.1 PRIORITIZATION OF INDICATIONS</u>

[illegible]		CIS			
		Severe	Moderate	Minor	NRI
PCM	Severe	I	S	S	M
	Moderate	I	S	M	NRI
	Minor	I	S	M	NRI
DCVG	Severe	I	S	S	M
	Moderate	I	S	M	NRI
	Minor	I	S	M	NRI
	NRI	I	S	M	NRI

4.9 Indirect Inspection Analysis

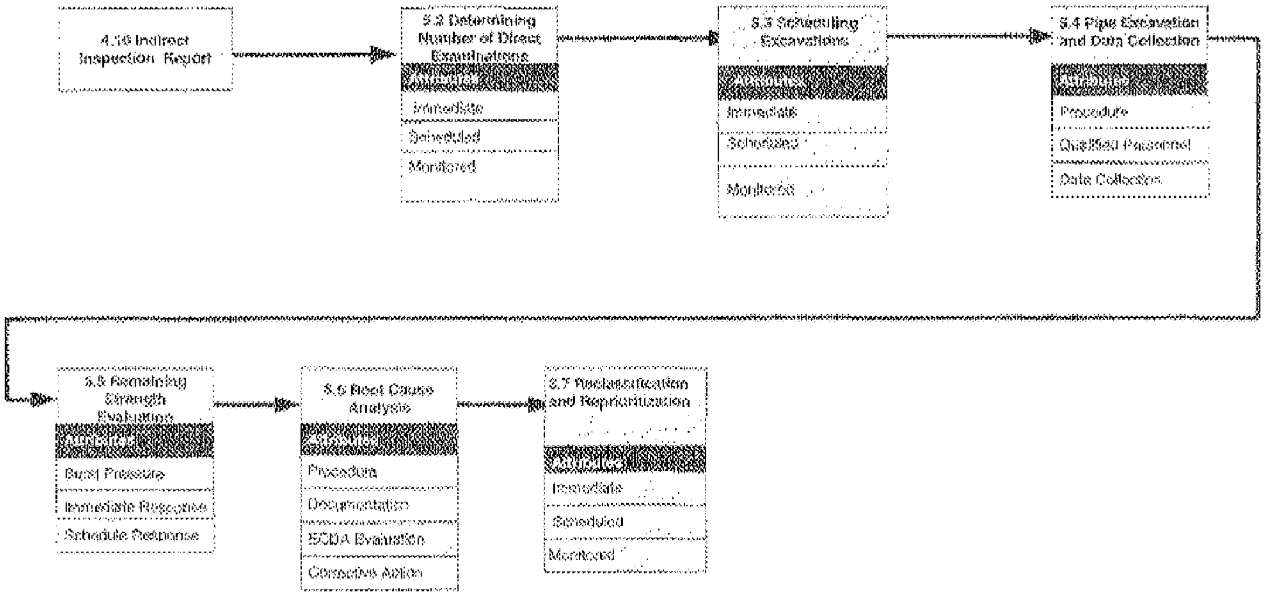
4.9.1 The PE shall compare the results of the indirect inspections with the pre-assessment results and prior history for each ECDA region to see if they rationalize each other. If the assessment results are not consistent with operating history, the PM must reassess the feasibility of the ECDA.

4.10 Indirect Inspection Report

4.10.1 The PE shall complete Form G, Indication Classification & Direct Examination, documenting the analysis of the incorrect inspection data.

4.10.2 Form G shall be completed no later than 30 days after the receipt of the IIT results. A copy shall be kept in the project file.

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 prioritization of indications and their severity.

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

5.1.2.1 Scheduling the excavations

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

5.1.2.3 Measurement of coating damage and corrosion defects

5.1.2.4 Evaluation of remaining strength of the GIS pipe segment

5.1.2.5 Root cause analysis

5.1.2.6 Re-prioritization of priorities and reclassifying 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 ECDA project conducted. 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 they shall follow the excavation criteria 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:** A minimum of one Scheduled indication shall be excavated per ECDA region. A minimum of two Scheduled indications shall be excavated per ECDA region for the first ECDA project.

5.2.3.1 **20% Wall Loss Criteria:** If 20% or more wall loss is found at a Scheduled indication then Scheduled indications must continue to be excavated in order of priority until at least two Schedule indications exhibit less than 20% wall loss.

5.2.3.2 **Reprioritization:** If Scheduled indications are reprioritized as described in Paragraph 5.7 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 of pipe to be excavated, and can be either monitored, or reprioritized, as described in Paragraph 5.7. However, if an ECDA Region did not have any Immediate or Scheduled indications, then at least one Monitored indication shall be excavated.

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 excavation are applied per segment surveyed.

5.2.5.1 Initial ECDA Projects: Two additional excavations shall be conducted on initial ECDA projects. 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 assessement 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			Required Excavations			Trigger of additional excavations	Additional Excavations			Effectiveness Digs
I	S	M	I	S	M		I	S	M	
X			All							1
X	X		All	1		Scheduled priority to Immediate		1		1
X	X	X	All	1		Scheduled priority to Immediate		1		1
	X			1		Scheduled priority to Immediate		1		1
	X	X		1		Scheduled priority to Immediate		1		[illegible]
		X			1					
No Indications			1 Excavation based on Pre assessment			1st ECDA	1 Excavation based on Pre-assessment			1

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

5.3.1 Schedule: All excavations required by this procedure shall be complete within 180 days of the date the indirect inspection test results are received. .

5.3.2 **Order of Excavations:** The PM shall determine the order of the excavations with the consideration as to the severity of the indications.

5.3.3 **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.

5.3.4 **Exceptions:** Excavations that do not meet the schedule requirements described in paragraph 5.3 shall be documented in accordance with the exception policy described in Section 7.0 of this procedure.

5.4 Pipe Excavation and Data Collection

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

5.4.1.1 **Location and Size of Excavation:** The location and size of the excavation site shall be identified and recorded on Form H, Excavation Data Sheet. The center 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.

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

5.4.2 **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 Excavation Data Sheet.

5.4.3 **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 5.4.3

TABLE 5.4.3 DIRECT EXAMINATION DATA COLLECTION REQUIREMENTS

Data Element	DATA Type	Required	Description
6.0 Before Coating Removal			
6.1	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 back of the excavation and/or at the ground surface. These potential may help identify dynamic stray currents.
6.2	Soil Resistivity	R	Soil resistivity measurements shall be taken near the pipe but no closer than half of the pin spacing on the soil resistivity measurement device
6.3	Soil Sample	O	If required by the PE, soil immediately adjacent to the pipe surface shall be collected with a clean spatula or trowel and placed in an 8 oz. plastic jar with a plastic lid. 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 to record the sample location on both jar and lid.
6.4	Ground Water Samples	O	If required by the PE, take ground water sample if water is present in 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.
6.5	Coating Condition	R	Documentation of general coating condition. Three conditions could exist 1) Coating is in excellent condition and completely adhered to pipe. 2) Coating partially disbonded and/or degraded. 3) The coating is completely missing the pipe surface is bare
6.6	Photo Documentation	R	Document the coating condition with digital camera. Photos shall have ruler or other device to determine magnification of photographs showing details of the pipe and coating condition. Macro as well perspective views shall be recorded.
6.8	Coating Sample	O	If required by the PE, a sample of the coating shall be obtained if the coating is partially or fully disbonded. This sample will be used to determine the electrical and physical properties of the coating as microbial tests.
6.9	Under coating liquid pH analysis	R	If any liquid is detected underneath the coating the pH shall be determined with pH litmus tape
6.10	Corrosion Product Removal	R	Carefully remove any corrosion deposit for analysis
7.0 After Coating Removal			
7.1	Pipe Temperature	O	Measure the bare pipe surface temperature
7.2	Weld Seam Identification	O	The type of weld seam shall be identified and recorded
7.4	Identification of External Corrosion	R	Careful examination of the corrosion surface shall be conducted to collect data to assist the PE in determining if corrosion is active or inactive.
7.5	Other Damage	R	Other damage to the pipe surface that can be visual detected shall be recorded. Examples of such damage would include gouges, cracking, dents and out of roundness
7.6	UT Wall Thickness Measurements	R	Ultrasonic wall thickness shall be taken at every quadrant on the pipe to establish original nominal wall thickness.
7.8	Photographic Documentation of Corroded Area	R	The corroded surface shall be photographed, preferable with a digital camera to document the morphology
7.10	Mapping and measurement of corrosion areas	R	Corrosion damage shall be measured sufficiently 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 to 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 than a one-inch mesh.
7.10*	Pit Depth Map	R	Record the pit depths of the corroded area in a grid format for small corrosion areas (less than 2" in length), use ½" grid spacing. For larger corroded areas, grid spacing shall be designed to obtain approximately 10 axial measurements along the length of the corroded area.

5.5 Remaining Strength Evaluation

5.5.1 **Objective:** The objectives of the remaining strength calculations are three fold:

- **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.

5.5.2 **Predicted Burst Pressure Procedure:** The following procedure shall be used to calculate the failure pressure for each corroded area. 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.

5.5.2.1 **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 (Data Element 7.7). The RSTRENG analysis results shall also be documented on this form.

5.5.2.2 **Predicted Burst Pressure (*Pf*):** The predicted pressure shall be calculated for each corroded area that has been excavated using RSTRENG calculation methodology.

5.5.2.2.1 Analyst: A qualified individual to use RSTRENG shall make these calculations. The qualification records shall be maintained in the Integrity Management Program file.

5.5.2.3 **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.

5.5.2.3.1 **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

5.5.2.3.2 **Comparison to Class Design Requirements:** The safety factor shall be compared with the safety factor for the class location of the evaluated area. Table 5.5.1 provides the corresponding safety factor for each class location.

TABLE 5.5.1 DESIGN REQUIREMENTS BY AREA CLASSIFICATION

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

5.5.2.3.3 **Notification of Scheduled Response:** If SF_{corr} is less than SF_{DR} specified in Table 5.5.1 for the given class location the **PM or analyst shall immediately contact the following people:**

- Responsible Pipeline Engineer
- Manager of Pipeline Engineering
- Manager of System Integrity

The date that this determination is made shall be documented on Form I.

5.7.2.3.4 **Reduction in Pressure:** Pressure shall be reduced in accordance with UO 4134/ASME B31.8S, Gas Pipeline Repair Methods.

5.7.2.3.5 **Remediation:** The PM shall arrange to have the damage remediated in order to restore the pipe to the MAOP with the appropriate safety factor specified in Table 5.5.1 or reduce MAOP to establish the safety factor

5.6 Root Cause Analysis

5.6.1 **Procedure:** The PM shall assure that a root cause analysis is performed for each area of corrosion found during any of the direct examination.

5.6.2 **Objective:** The analysis is to determine the likely causes for the corrosion to 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.

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

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

5.6.3.2 **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.

5.6.3.3 **Corrosion Mechanism:** Identify the main drivers for corrosion in the area including soil chemistry, pH, moisture, corrosive microbes, rock shielding, etc. Is the corrosion active or historic?

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

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

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

5.6.4 **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 "Remain 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 the paragraphs 4.8.3.1 through 4.8.3.6.

5.6.5 **ECDA Evaluation:** If the root cause analysis identifies 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.

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

5.7 In Process Evaluation

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

5.7.2 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.

5.7.3 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.

5.7.4 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.

5.8 Reclassification and Reprioritization of Indications

5.8.1 **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 it's <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.

5.8.2 **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 5.8.1 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 5.5.1.

5.8.2.1 **Immediate:** Indications in this category have a SF_{corr} less then 1.05 SF_{DR} given in Table 5.5.1.

5.8.2.1.1 **Additional Requirement:** If any Immediate indications in an ECDA region are validated from direct examinations to meet the criteria in Table 5.8.1 then, all remaining immediate indication footage of the specific indication must be directly examined, smart pigged, or hydro tested.

5.8.2.2 **Scheduled:** Indications in this category have an SF_{corr} of greater then 1.05 SF_{DR} and have evidence of inactive or active corrosion greater then 20% wall loss.

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

5.8.2.4 **Non-Reportable Indications (NRI):** Indications in this category have no sign of active or inactive corrosion, and meet a code compliance criteria.

TABLE 5.8.1 REPRIORITIZATION CRITERIA BY AREA CLASS

Area Class	SF_{corr} Requirements for Priority Categories			
	Immediate	Schedule	Monitored	NRI
1	<1.46	>1.46 w/corrosion > 20% wt	No corrosion > 20% wt	No corrosion w/850 "on" or 100mV
2	<1.75	>1.75 w/corrosion > 20% wt	No corrosion > 20% wt	No corrosion w/850 "on" or 100mV
3	<2.10	>2.10 w/corrosion > 20% wt	No corrosion > 20% wt	No corrosion w/850 "on" or 100mV
4	<2.63	>2.63 w/corrosion > 20% wt	No corrosion > 20% wt	No corrosion w/ 850 "on" or 00mV

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

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

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

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

5.8.4.1 Reprioritization is required if the above methodologies shows that the corroded area is worse than it's assigned Priority.

5.8.4.2 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.

5.8.4.3 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 5.8.1 is found.
- Adequate CP has been restored

5.8.4.4 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_{ps}.

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

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: The corrosion rates based on soil resistivity in Table 6.2.1 may be used.

6.2.2.1 Exceptions: 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[3]

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)

[3] ASME B31.8S 2001, *Supplement to B31.8 on Managing System Integrity of Gas Pipelines*, pg. SP-34, Table SP-III

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6.2.3 **Predicted Burst Pressure:** The Pf used in this methodology shall be the "Predicted Burst Pressure" calculated in 6.5.2.2.

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

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

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:** In no case shall the reassessment interval be longer than 10 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.

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 Manage of System Integrity.

6.5.1 **Contents:** The report shall contain the following information in the suggested order:

- Cover Letter requesting approval
- 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.

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.

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:________________ ROUTE NUMBER:________________

ENDING MILE POINT:________________ PM:________________

ID #	Data Element Description	Requirements				Data Location					Sign Off	Comments
		Need[1]	Inspection Tool[4]	Region Selection[4]	Inter-prediction Analysis[4]	GIS	As-built Job file	Field	District or Division	Other		
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	X			Trans. Plat Sheet		

---

[1], [3] R = Required, D = Desired (See paragraph 2.3 for definitions)

[4] R = Required, C = Considered

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FORM A: DATA ELEMENT CHECK SHEET

DATE:____________________
STARTING MILE POINT:____________________ ROUTE NUMBER:____________________
ENDING MILE POINT:____________________ PM:____________________

		Requirements				Data Location						
ID #	Data Element Description	Need[1]	Inspection Tool[2]	Region Selection[3]	Interpretation/ Analysis[3]	GIS	As-built Job file	Field	Districts or Division	Other	Sign Off	Comments
2.7	Depth of cover	D	C	C	C			X	X			
2.8	Underwater sections and river crossings	R	R	R	C	X	X	X				
2.9	Locations of river weights and anchors	D	C	C	C		X	X		As builts		
2.10	Proximity to other pipelines, structures, HV electric transmission lines and rail crossings	R	C	C	C	X		X				
3.0 Soil Environment												
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/past)	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		

FORM A: DATA ELEMENT CHECK SHEET

DATE:________________
STARTING MILE POINT:________________ ROUTE NUMBER:________________
ENDING MILE POINT:________________ 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
4.6	Years without CP applied	D	N/R	C	N/R		X					
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 Readings		
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		

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[3]	Interpretation/ Analysis[3]	GIS	As-built Job file	Field	[illegible]	Other	Sign Off	Comments
5.8	Type and frequency of third party 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 [illegible] pressures	D	N/R	C	C	X						
5.11	Other prior integrity related activities - CIS, DJ maps, etc.	R	C	N/R	C	X				Corrosion Group		

Form B: Sufficient Data List

DATE:____________________

STARTING MILE POINT:____________________ ROUTE NUMBER:____________________

ENDING MILE POINT:____________________ 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:__________________ ROUTE NUMBER:__________________

ENDING MILE POINT:__________________ 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 3.5.1 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	**In-direct 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: In-direct Inspection Tool Selection

DATE:______________

STARTING MILE POINT:______________ ROUTE NUMBER:______________

ENDING MILE POINT:______________ PM:______________

GIS Pipe Segment Number	ECDA Section#	ECDA Start/Stop[3]	GPS Coord. UTM NAD83	Boundary Marking Type[4]	1st IIT	2nd IIT	3rd IIT	ECDA Region Number (Form E)	Coating Type	Comments

Project Engineer:______________ Date:______________

Project Manager:______________ Date:______________

[3] To assure the entire Integrity Management Area is inspected indirect inspections shall have sufficient overlap over the SEGMENT boundary or the ECDA Region.

[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:________________

ECDA SECTION 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 3.5.1) as well as the same first and second IIT's.

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 4.3.3 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:__________ ECDA SECTION NUMBER:__________
STARTING MILE POINT:__________ ROUTE NUMBER:__________
ENDING MILE POINT:__________ PM:__________

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

Project Manager:__________ **Date:**__________

Project Engineer:__________ **Date:**__________

[1] Severity classification Severe, Moderate, Minor in accordance with Table 4.5.1
[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 4.8.1 for Prioritization

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ROUTE NUMBER:________ IMA NUMBER:________
DATE REQUIRED:________ DATE OF EXCAVATION:________
EXCAVATION LOCATION:________ PROJECT MANAGER:________
ILI LOG DISTANCE:________ ON-SITE INSPECTOR:________
EXCAVATION PRIORITY: IMMEDIATE____ EXCAVATION REASON: ECDA____
SCHEDULED____ ILI ____
MONITOR____ RECOAT____

Planned Excavation Details: CENTERLINE GPS COORDINATES: PLANNEDEXCAVATIONLENGTH(FT.):________
NORTHING:________
EASTING:________ ACTUAL EXCAVATION LENGTH (FT.):________

ACTUAL CENTERLINE GPS COORDINATES: PIPE DIAMETER (IN.):________
NORTHING:________ CENTERLINE DEPTH OF COVER (FT.):________
EASTING:________
COATING TYPE: HAA____ TAPE____ FBE____ BARE/NONE____ PAINT____ SOMASTIC____

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

6.0 DATA BEFORE COATING REMOVAL:
HOLIDAY TESTING PERFORMED? Yes____ No____ VOLTAGE USED:____
6.1 PIPE-TO-SOIL POTENTIALS IN DITCH (-mV):
COMMENTS:________

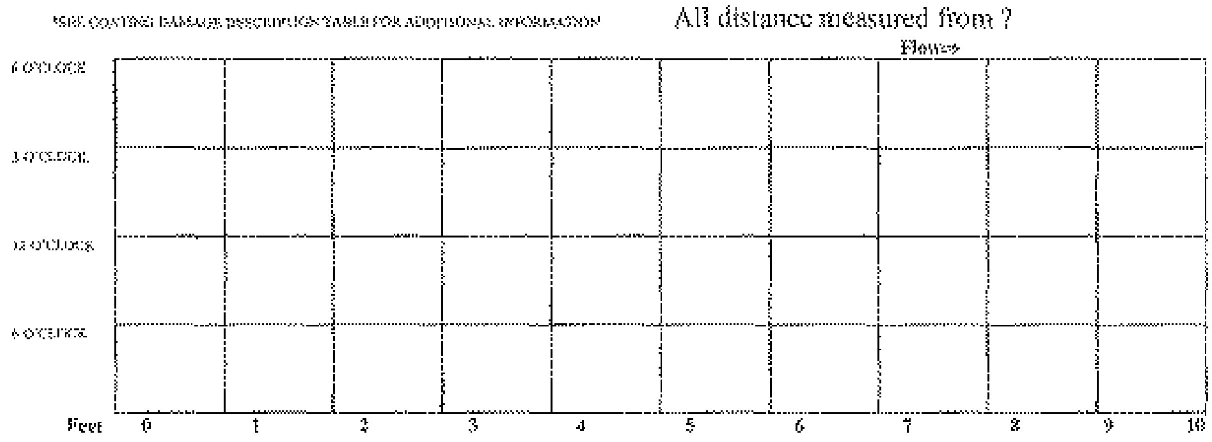
6.2 SOIL RESITIVITY IN DITCH (Ω-cm):________ 6.3 SOIL SAMPLE(S) COLLECTED? Yes____ No____

6.4 GROUND WATER PRESENT? Yes____ No____ SAMPLE(S) COLLECTED? Yes____ No____
COMMENTS:________

6.5 COATING CONDITION:
☐ EXCELLENT - ADHERED TO PIPE
☐ FAIR - COATING PARTIALLY DISBONDED OR DEGRADED
☐ POOR - COATING COMPLETELY MISSING, PIPE BARE
COMMENT: ________

6.6 PHOTOS TAKE? Yes____ No____
SEE PHOTO LOG FOR ADDITIONAL INFORMATION
6.7 MAP OF COATING DEGRADATION:

*SEE COATING DAMAGE DESCRIPTION TABLE FOR ADDITIONAL INFORMATION All distance measured from ?



6.8 COATING SAMPLE TAKEN Yes____ No____ LOCATION OF SAMPLE:________

IS THE COATING ADHERED WELL TO THE PIPE? Yes____ No____
COMMENTS:________

Form I: Remaining Strength Evaluation and Root Cause Analysis

DATE OF EVALUATION: ________ REGION NUMBER: ________

INDICATION MILE POINT: ________ ROUTE NUMBER: ________

PRIORITIZATION PRIORITY: ________ PM: ________

PROJECT ENGR.: ________

PIPE DATA

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

PREDICTED BURST PRESSURE DETERMINATION (P_f):

PIT DEPTHS

P_f: ________ SF_{calc} (P_f/MAOP): ________ SF_{req}: 1.39 1.67 2.00 2.50 PIPE REPAIR REQUIRED: YES NO

Comments: ________

____

____

____

ANALYST: ________ DATE: ________ DATE OF NOTIFICATION: ________

PEOPLE NOTIFIED: ________

____

____

____

Form I (1 of 2): Root Cause Analysis Report Date of Evaluation:__________

Route Number: Mile Post:______________

Note: In some cases, in order to perform effective root cause investigations, it will be necessary to perform limited CIS and/or DCVG prior to beginning excavation activities. Also, the minimum corrosion data requirement is recommended to be completion of ECDA Procedure RMP - 09 Form H.

Description of Damage: (For Example - Pitting, Wall Loss, Coating Damage, Dents, Gouges, etc.)

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Extent of Damage: (For pipe steel and coating determine extent of damage in depth direction as well as axial and circumferential directions).

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Review of CP Maintenance History (Review GIS and District or Division records and evaluate the historical maintenance and repair history to determine if there are trends that can be identified that may assist in the quantification & understanding of the extent of damage. Consider possible stray current form foreign pipelines, AC interference, etc.)

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Review of Existing Damage Mitigation Measures (Is the CP, Pipe Line Markers, Coating, etc. adequate? If External Corrosion, was it reviewed by a Corrosion Engineer? If Third Party Damage, was the PSIP Lead consulted? If Land Movement issues where involved with the damage does a Geologist need to be consulted activities) ______________________

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Form I (2 of 2): Root Cause Analysis Report Date of Evaluation:__________
Route Number: ______________ Mile Post:______________

Root Cause of Damage: (For Example Coating Damage, Inadequate CP, Low Soil Resistivity, Shielding, Third Party Dig-Ins, or a combination of these or other causes?)______________________________

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Review of Damage Mitigation Measures Taken

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Additional Testing and/or Analysis Needed For Long Term Risk Mitiation: (Did the Direct Examination results indicate that additional testing would be prudent to identify the extent of damage or better evaluate a damage condition for which the inspection method used is not the most appropriate? For example, if there damage to coating caused by Third Party Dig-Ins in an agricultural area, would DCVG testing be appropriate? Were hard spots identified and another inspection method would be more appropriate to evaluate the condition? Does the CP system need to be upgraded? Does a new CIS/DCVG or other survey need to be commissioned?)

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IS ECDA WELL SUITED TO IDENTIFY DAMAGE FROM THE CAUSE DESCRIBED ABOVE? YES NO
IS REPRIORITIZATIONOF INDICATIONS RECOMMENDED? YES NO
ARE REPEAT INDIRECT INSPECTIONS REQUIRED? 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	HT Priority Form G	Region #	SE_{max}	Class Location	SP_{ur}	Corrosion Present	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	MP or MP Range of Indication	Original Priority	New Priority	Comments

Project. Engineer:______________Date:__________

Project Manager:______________Date:__________

Form K: Remaining Life Determination

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

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

Comments:________

PROJECT ENGINEER:________ DATE:________

PROJECT MANAGER:________ DATE:________

MANAGER SYSTEM INTEGRITY:________ DATE:________

$$RL = \frac{0.85}{YP}\{Pf - MAOP\}\frac{t}{CR}$$ 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)

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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 (range of months)	______	______	______	______
Safety Factor Responses	______			
Number of Reprioritizations	Higher Priority______	Lower Priority______	M to NRI______	
POST ASSESSMENT:				
Reinspection Intervals:		______	______	
Missed Deadlines:	______			
Exceptions:	______			

Project Engineer:____

Project 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 Manager: ____________ Date: ____________

APPENDIX B

<u>Appendix B</u>

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)