

PHMSA-Corrpro Web Based Workshop

“IMPROVEMENTS TO THE ECDA PROCESS”

August 24, 2010

Project Partners

- ◆ El Paso
- ◆ ExxonMobil Pipeline Company
- ◆ Southern Union Gas – Panhandle Energy
- ◆ Texas Gas Association

- ◆ PHMSA

Project Team

- ◆ Program Manager: David Kroon, P.E.
- ◆ Principal Investigator: Olagoke Olabisi, PhD
- ◆ *9:00 a.m. Severity Ranking*
Co-Principal Investigator: James Carroll
- ◆ *10:00 a.m. Potentials on Pavement*
Co-Principal Investigator: Dale Lindemuth, P.E.
- ◆ *11:00 a.m. Cased Pipes*
Co-Principal Investigator: Larry Rankin



PHMSA SPONSORED RESEARCH
Improvements to the ECDA Process

ECDA for Cased Pipes

Larry G. Rankin

PHMSA-Corrpro Web Based Workshop
August 24, 2010

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PHMSA Project Goals

- **Identify, analyze and determine applicability of existing and emerging technologies for assessing cased pipes for external corrosion damage**
- **Develop new assessment methodology that makes use of existing ECDA methodologies, existing and emerging technologies, and best practices of pipeline operators**
- **Convey new methodology and application guidelines to industry organizations for development into consensus standards**

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PHMSA Project Drivers

- **Deadline for assessing all Gas Transmission pipe, including cased pipe, is December 17, 2012 – 2-1/2 years from now.**
- **Pipeline operators are faced with tremendous challenges with assessing cased pipe than cannot reasonably be assessed using pressure testing or in-line inspection.**
- **Emerging cased pipe assessment technologies are very promising, but will likely take years to develop into acceptable assessment techniques.**
- **ECDA methodology that is now accepted for uncased buried pipe can be developed, improved and/or augmented to be an acceptable assessment technique for cased pipe where pipe and casing conditions allow its use.**

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PHMSA Cased Pipe Research Project Work Elements and Milestones		Completion Dates
1	Perform Literature Search for Existing Assessment Technologies and Develop Field Testing/Inspection Protocol	September 14, 2008
2	Determine Success Rate and Reliability of Existing Assessment Technologies and Participate in PHMSA Advisory Committee	December 14, 2008
3	Analyze Effectiveness of Existing Assessment Technologies for Detecting External Corrosion Damage	March 14, 2009
4	Determine Ease of Use, Reliability, Accuracy, and Advantages/Disadvantages of Existing Assessment Technologies	June 14, 2009
5	Develop New Assessment Methodology	September 14, 2009
6	Implement, Verify and Apply New Assessment Methodology	December 14, 2009
7	Prepare Draft Report	March 14, 2010
8	Prepare Final Report and Recommendations for Standards Organizations	June 14, 2010
9	Make Presentations to PHMSA and at Industry/Public Events	Numerous Presentations Made During Project

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Applicability of ECDA Indirect Inspection Surveys on Cased Pipes

- **It has long been the pipeline industry consensus that standard coating and cathodic protection surveys can not be applied to cased pipes because casings and/or lack of continuous electrolyte in casing annuli prevent electrical measurements.**
- **Both past and current research and testing has demonstrated that, if there is electrolyte in casing annuli, cathodic protection can reach cased pipes even if the casing is electrically shorted to the pipe (GRI-05/0020 and other research).**
- **If cathodic protection current can reach cased pipes, standard coating and cathodic protection surveys can be applied to cased pipes (application may be limited if casing is electrically shorted to pipe, if casing is coated or if no electrolyte is present in casing annulus).**
- **As a minimum, ECDA can be used to prioritize cased pipe segments for additional inspection and/or remedial work.**

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Format and Content of New Assessment Methodology

- **A 4 Step process like all other DA methodologies**
- **Based on evaluations of information obtained during the PHMSA project (previous research, industry surveys, operator data, operator procedures and best practices, and laboratory and field testing)**
- **Identifies appropriate assessment technologies and/or methodologies for various cased pipe parameters/situations**
- **Makes use of ECDA Indirect Inspection surveys being used on uncased, buried pipe as part of the process for identifying and ranking Direct Examination priorities and selecting the most effective Direct Examination tools**

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Pre-Assessment Requirements

- **Construction, operation and maintenance information collection and evaluation is very rigorous**
- **Includes a thorough identification and evaluation of possible external corrosion mechanisms**
- **ECDA Region identification and assignment is very rigorous**
- **Feasibility assessment includes a very critical determination of conditions that prevent electrical measurements on cased pipes such as casings electrically shorted to pipe, coated casings and lack of electrolyte in casing annuli**
- **ECDA Indirect Inspection survey tools selected for use must accommodate casing and pipe conditions**

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Indirect Inspection

- **Tools are to be same Indirect Inspection surveys being used for ECDA on uncased, buried pipe**
- **Surveys are to include a minimum of 2 tools, one that addresses coating condition and one that addresses effectiveness of cathodic protection**
- **As much as practicable, surveys are to be performed over entire length of cased pipe including cased pipe directly under pavement and railroad padding**
- **Where possible, surveys are to be performed over a minimum of 300 feet of uncased, buried pipe adjacent to both ends of the cased pipe**
- **Other testing is to include electrical isolation tests and others as appropriate for conditions**

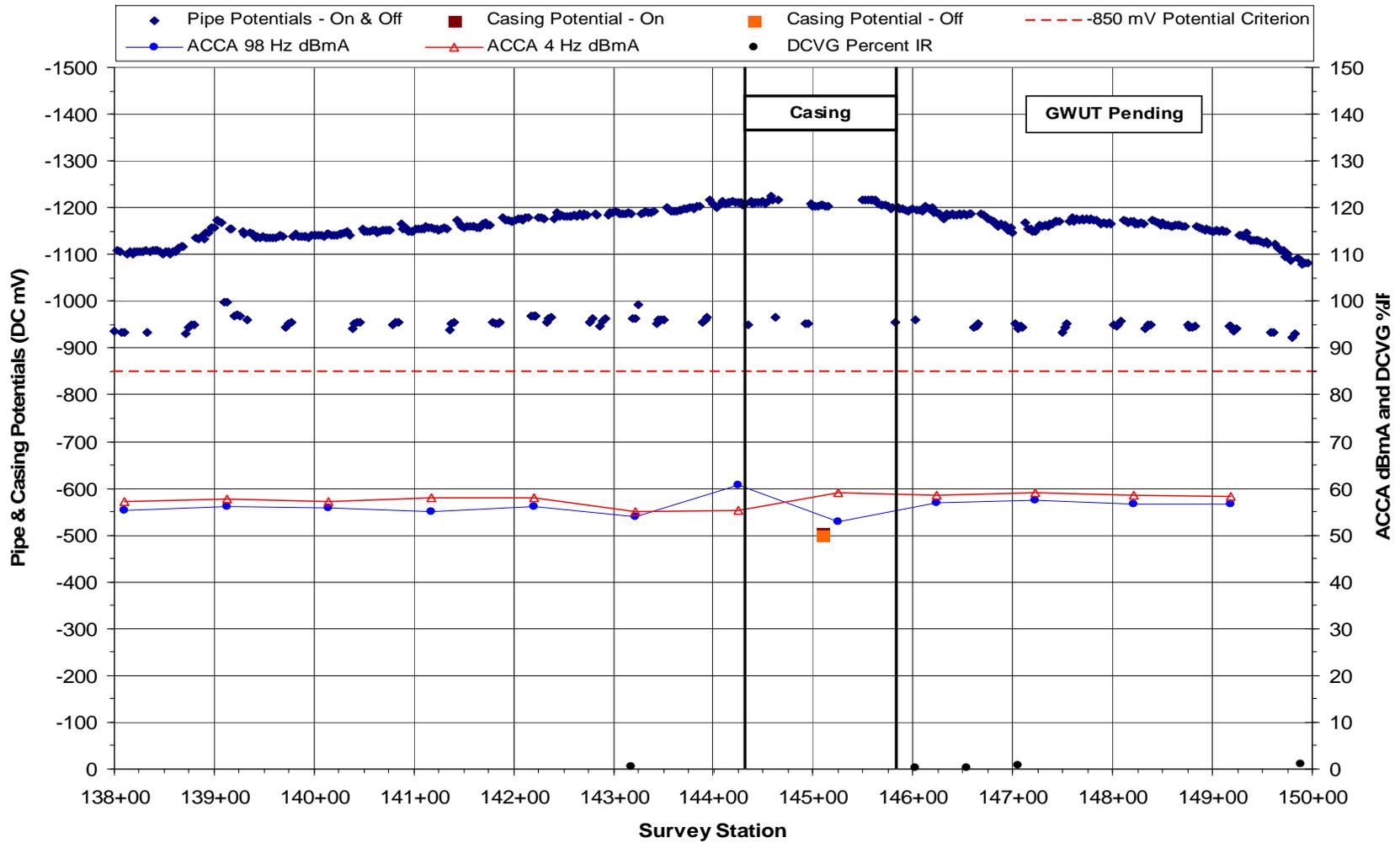
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Project Indirect Inspection Survey Data

- **Have collected and analyzed data for more than 200 cased pipes and adjacent uncased, buried pipe from 6 natural gas and hazardous liquid transmission operators and natural gas distribution operators**
- **Indirect Inspection surveys are primarily AC Current Attenuation, DC Voltage Gradient and Close Interval Potential surveys**
- **Additional testing included casing electrical isolation tests**
- **Recent surveys include survey over cased pipes except where cased pipes were directly under hard surface roads or railroads (could not justify expense of drilling through hard surface roads or railroad bed padding)**

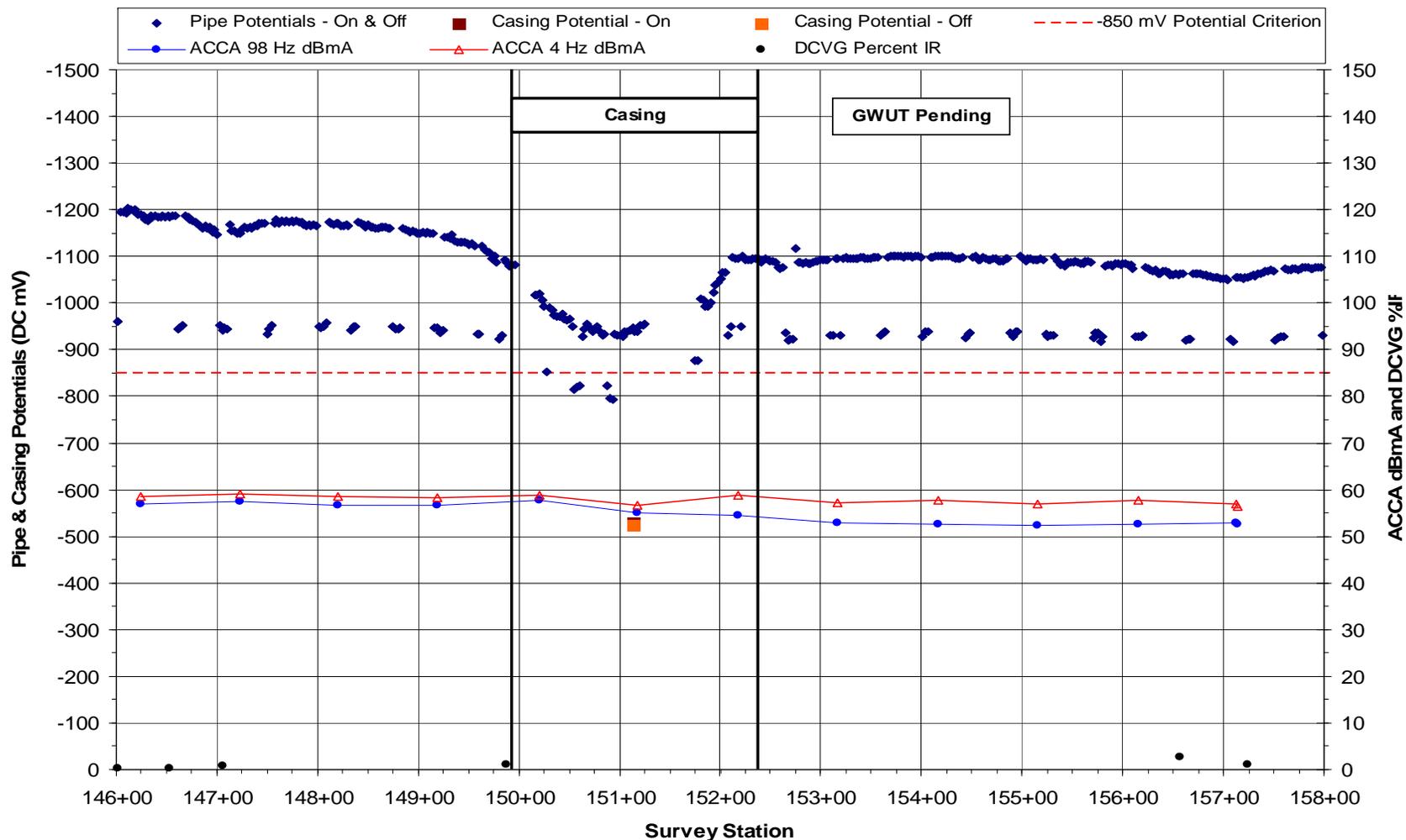
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Figure 1: ECDA Survey Data - Reference No. 14 - Pipeline 11 - Casing 1



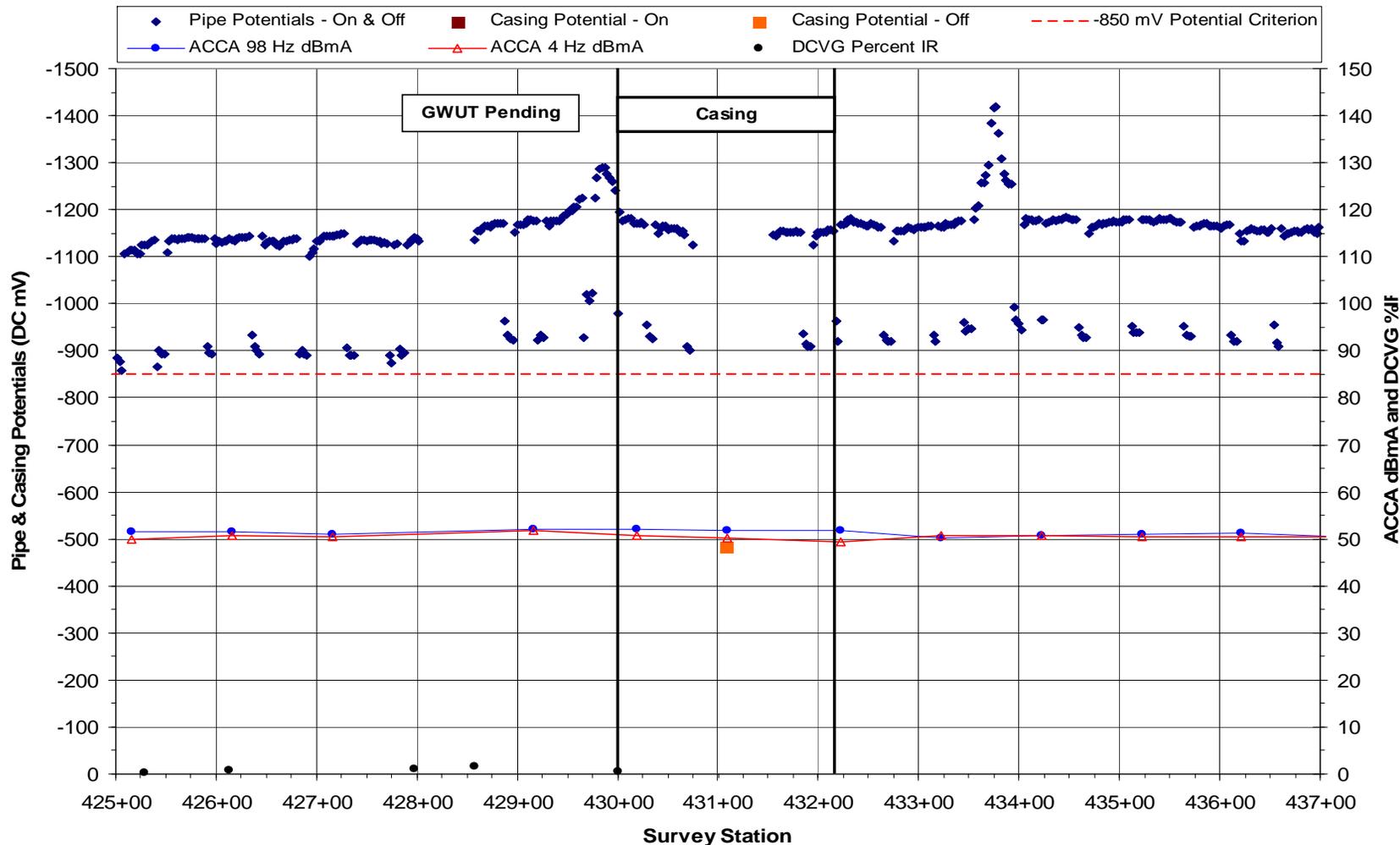
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Figure 2: ECDA Survey Data - Reference No. 15 - Pipeline 11 - Casing 2



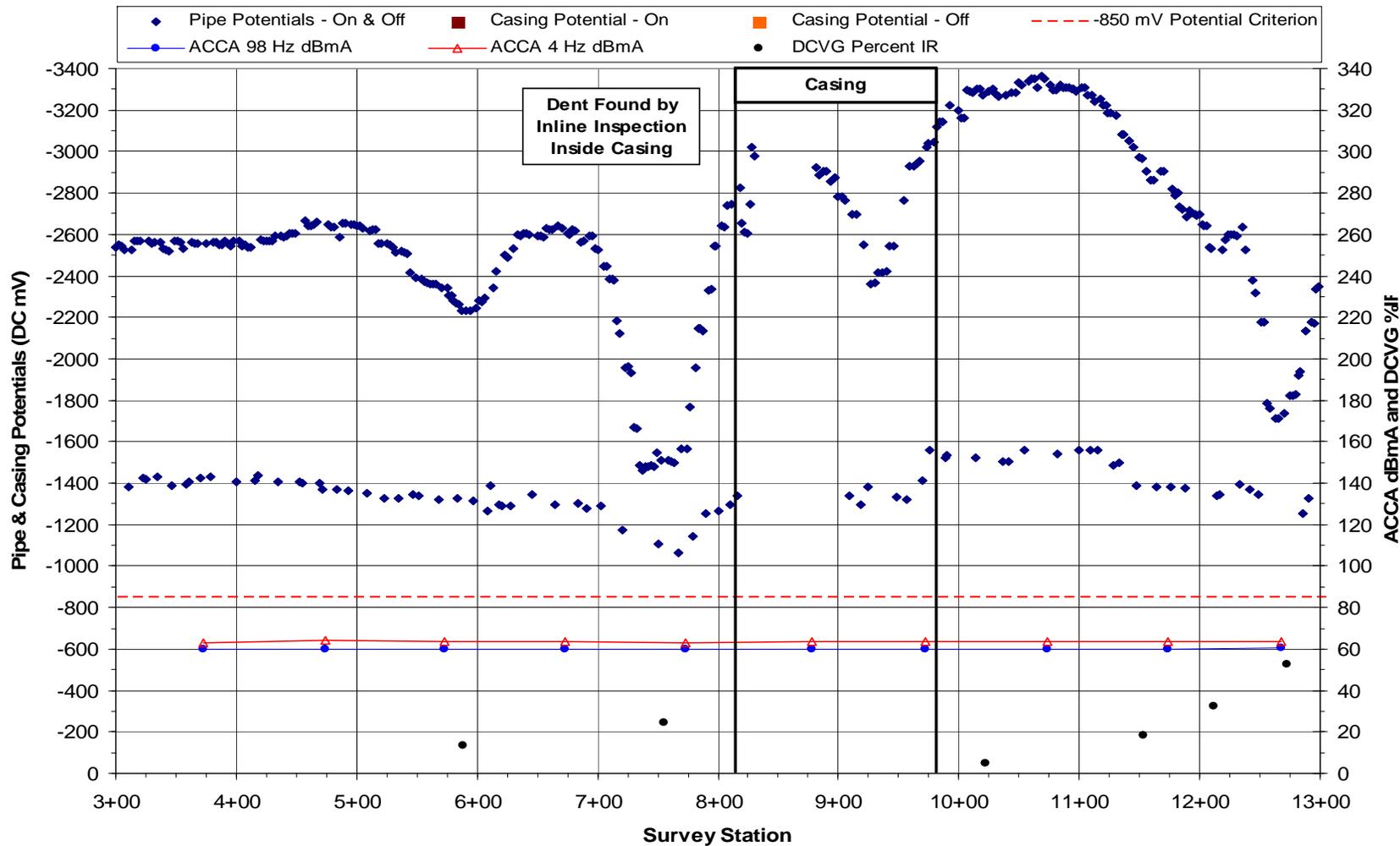
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Figure 4: ECDA Survey Data - Reference No. 26 - Pipeline 15 - Casing 5



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Figure 5: ECDA Survey Data - Reference No. 29 - Pipeline 18 - Casing 1



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Indirect Inspection Step Tasks

- **Perform surveys**
- **Evaluate survey data to identify individual survey indications**
- **Classify severity of individual survey indications
(Severe, Moderate, Minor, None)**
- **Integrate indications from all surveys**
- **Prioritize actions for integrated survey indications
(Immediate, Schedule, Monitor, No Action Required)**

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Severity Classifications for Indirect Inspection Survey Indications				
Survey (Type)	Severity Classifications			
	None	Minor	Moderate	Severe
AC Current Attenuation (Coating)	Uniform Profile With No Significant Profile Changes	Small Profile Changes	Moderate Profile Changes	Large Profile Changes
DC or AC Voltage Gradient (Coating)	No Indications on Adjacent Buried Pipe – and – No Indications on Cased Pipe	A Few Indications on Adjacent Buried Pipe – but – No Indications on Cased Pipe	Several Indications on Adjacent Buried Pipe – but – No Indications on Cased Pipe	Numerous Indications on Adjacent Buried Pipe – or – Indications on Cased Pipe
Close Interval Potential (CP)	Uniform Potential Profile With No Depressions – and – All Potentials More Negative Than -850mV	Small Potential Depressions – but – All Potentials More Negative Than -850mV	Moderate Potential Depressions – but – All Potentials More Negative Than -850mV	Large Potential Depressions – or – Any Potentials Less Negative Than -850mV

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Severity Classifications for Indirect Inspection Survey Indications				
Survey	Severity Classifications			
	None	Minor	Moderate	Severe
Electrical Isolation Status	Electrically Isolated	Electrolytically Coupled	Possibly Shorted or Status Unknown	Electrically Shorted
Meets Cathodic Protection Criteria	Yes	-	Marginal	No

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ECDA for Cased Pipe Segments - Summary of Results for 200 Cased Pipe Segments Numbers of ECDA Severity Classifications by Indirect Inspection Test or Tool									
Numbers by Electrical Isolation		Numbers by AC Current Attenuation Severity Classification		Numbers by DC Voltage Gradient Severity Classification		Numbers by Close Interval Potential Severity Classification		Numbers Meeting Close Interval Potential Cathodic Protection Criteria	
Isolated	136	Severe	3	Severe	77	Severe	34	Yes	160
Shorted	9	Moderate	23	Moderate	6	Moderate	16	Marginal	11
Possibly Shorted	7	Minor	43	Minor	49	Minor	44	No	29
Unknown	48	None	131	None	68	None	106		
Total	200	Total	200	Total	200	Total	200	Total	200

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Action Prioritizations for Indirect Inspection Survey Severity Classifications						
Action Prioritizations Based on Indirect Inspection Survey Severity Classifications			Cathodic Protection Survey Severity Classifications For Close Interval Potential Survey			
			None	Minor	Moderate	Severe
Coating Condition Survey Severity Classifications	AC Current Attenuation Survey	None	No Action	Monitor	Schedule	Immediate
		Minor	Monitor	Monitor	Schedule	Immediate
		Moderate	Monitor	Schedule	Schedule	Immediate
		Severe	Schedule	Schedule	Immediate	Immediate
	DC or AC Voltage Gradient Survey	None	No Action	Monitor	Schedule	Immediate
		Minor	Monitor	Monitor	Schedule	Immediate
		Moderate	Monitor	Schedule	Schedule	Immediate
		Severe	Schedule	Schedule	Immediate	Immediate

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Increasing Action Prioritizations

The Action Prioritizations on the previous slide are for cased pipe segments that do not have construction or operation characteristics that increase the likelihood for external corrosion. If a cased pipe segment has construction or operation characteristics that increase the likelihood for external corrosion, the Action Prioritization is to be increased to a higher Action Prioritization appropriate for the characteristic that causes the increase. Construction or operation characteristics that may require an increase include, but are not limited to:

- pipe electrically shorted to casing
- pipe exposed to high temperature
- pipe known to have coating damage under similar conditions
- pipe known to be essentially bare
- pipe at locations where likelihood for atmospheric corrosion is high
- older pipe
- pipe for which construction or operation characteristics are generally unknown.

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ECDA for Cased Pipe Segments - Summary of Results for 200 Cased Pipe Segments

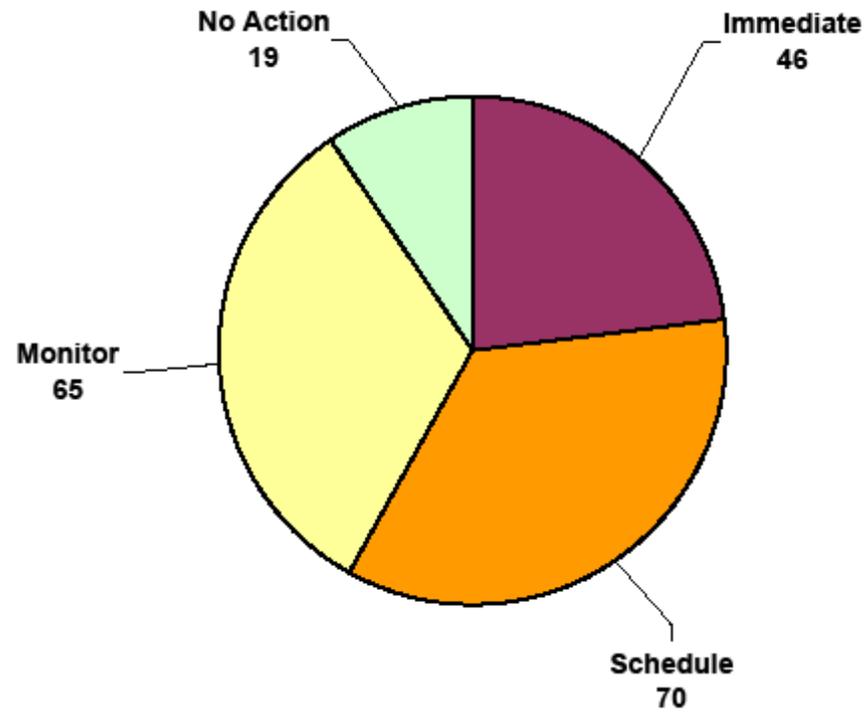
Numbers of ECDA Action Prioritizations by Indirect Inspection Test or Tool with Most Severe Results

ECDA Survey Action Prioritization	Electrical Isolation Status	AC Current Attenuation Severity Classification	DC Voltage Gradient Severity Classification	Close Interval Potential Severity Classification	Close Interval Potential Cathodic Protection Criteria	No Indications from any of the Tests or Surveys	Totals
Immediate	14	0	6	5	21	0	46
Schedule	21	0	43	3	3	0	70
Monitor	17	8	26	13	1	0	65
No Action	0	0	0	0	0	19	19
Totals	52	8	75	21	25	19	200

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ECDA for 200 Cased Pipe Segments

Numbers of Direct Examination Prioritizations by Severity Category



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Direct Examination (Examinations required for each Casing region)

- **All cased pipes with Action Prioritizations of Immediate are to be examined within periods of time appropriate for the indicated conditions.**
- **A sufficient number of cased pipes with Action Prioritizations of Schedule are to be examined before the next Integrity Assessment. The number to be examined is to be determined based of the findings of the examinations. All remaining Scheduled indications that are not examined are to be monitored until the next integrity assessment is performed. (See next item for Monitoring requirements.)**
- **All cased pipes with Action Prioritizations of Monitor are to be monitored at appropriate time intervals until the next Integrity Assessment is performed. Cased pipe monitoring is to include, but not be limited to, electrical isolation status, cathodic protection adequacy, product leakage, and changes in operation, environment, and public exposure. If monitoring indicates conditions or changes that could negatively impact the condition of a cased pipe, the cased pipe is to be examined within a period of time appropriate for the indicated condition.**

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Direct Examination Tool Selection Table							
Examination Technique	Cased Pipe Parameters						
	Age	External Coating	Annulus Environment	Cathodic Protection	Operating Temperature	Electrical Isolation	Casing Length
Visual Inspection	Any Age	Any Coating	Any Environment	Any Level Of CP	Any Temperature	Isolated Or Shorted	Any Length
In-Line Inspection	Any Age	Any Coating	Any Environment	Any Level Of CP	Any Temperature	Isolated Or Shorted	Any Length
Pressure Test	Any Age	Any Coating	Any Environment	Any Level Of CP	Any Temperature	Isolated Or Shorted	Any Length
Guided Wave Ultrasonic	Modern Pipeline	Good Coatings	Air Preferred	Any Level Of CP	Any Temperature	Isolated Preferred	Shorter Casings
Electromagnetic Wave	Modern Pipeline	Good Coatings	Air Preferred	Any Level Of CP	Any Temperature	Isolated Preferred	Shorter Casings

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Post Assessment

- **Results of Direct Examinations of cased pipes with Action Prioritizations of Immediate and Schedule are to be evaluated to determine the need to perform additional Direct Examinations of cased pipes with Action Prioritizations of Monitor. This evaluation is to be performed soon after completing examinations of Immediate cased pipes and periodically (such as annually) during examinations of Schedule cased pipes.**
- **Reassessment intervals for cased pipes are to be determined based on findings for cased pipes independently of findings for uncased, buried pipe.**
- **Actions performed to evaluate effectiveness of the ECDA process are to be very rigorous. These actions are to include additional examinations of cased pipes sooner than indicated necessary by the reassessment interval determination.**

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Summary

- **Guidelines for an effective ECDA Methodology have been drafted as another assessment option for cased pipes.**
- **The methodology makes use of ECDA Indirect Inspection surveys being used on uncased, buried pipe as part of the process for identifying and ranking Direct Examination priorities and selecting the most effective Direct Examination methods**
- **The guidelines include guidelines produced by the CASQAT committee, which was comprised of members from PHMSA, pipeline operators, industry organizations and service providers.**
- **The guidelines will be provided to industry organizations for development into consensus standards.**

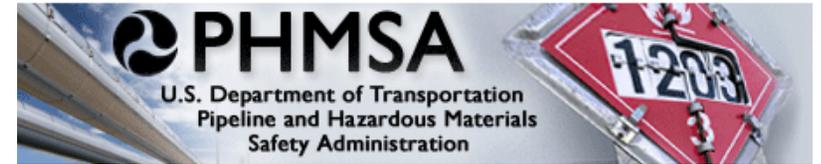


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Questions?

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