
CONDUCTING CLOSE INTERVAL POTENTIAL SURVEYS

Presented by:
Dean Parsons



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CONDUCTING CLOSE INTERVAL POTENTIAL SURVEYS

- DEFINITION OF CLOSE INTERVAL SURVEYS (CIS)
- REASONS FOR CONDUCTING CIS
- TYPES OF CIS
- PRE-SURVEY CONSIDERATIONS
- DATA COLLECTION CONSIDERATIONS
- POST SURVEY PROCESSING AND ANALYSIS
- CONCLUSIONS



DEFINITION OF CLOSE INTERVAL SURVEY

- **NACE DEFINITION – SP0207-2007**
 - A potential survey performed on a buried or submerged metallic pipeline, in order to obtain valid DC structure-to-electrolyte potential measurements at a regular interval sufficiently small to permit a detailed assessment.

- **PHMSA MANDATES**
 - **§192.455 External corrosion control: Buried or submerged pipelines installed after July 31, 1971.**

 - **§192.465 External corrosion control: Monitoring.**

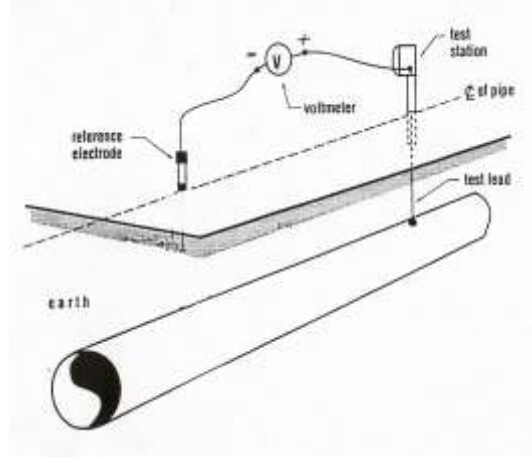


REASONS FOR CONDUCTING CLOSE INTERVAL SURVEYS

COLLECT BASELINE PROFILE DATA
 TESTING FOR ADEQUATE LEVELS OF CATHODIC
 PROTECTION OVER ENTIRE LENGTH OF STRUCTURE
 TROUBLESHOOTING KNOWN CP DEFICIENCIES
 INTERFERENCE TESTING
 CURRENT PICK-UP / DISCHARGE POINTS
 DETERMINING SPHERE OF INFLUENCE
 IDENTIFYING SUBSTANTIAL COATING HOLIDAYS/DAMAGE



Schematic Of A Close Interval Survey



TYPES OF CLOSE INTERVAL SURVEYS

- NATIVE SURVEY
- CURRENT APPLIED OR ON SURVEY
- ON/INTERRUPTED SURVEY
- DEPOLARIZED SURVEY

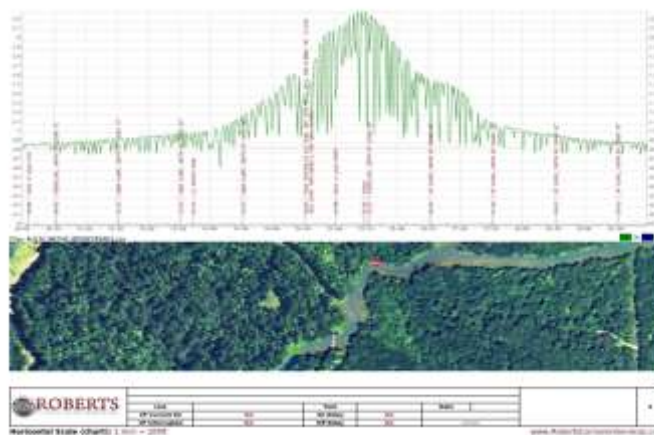


NATIVE SURVEY

- A Native pipe-to-soil survey is used to establish a base-line profile of the pipeline system, before designed CP is ever applied
- Can help to determine if foreign or interference currents are present before CP is applied.
- Often used in conjunction with On/Interrupted surveys to establish 100mv polarization shift.
- Can create future cost savings and minimize risks associated with de-energizing facilities to obtain depolarized potentials.



NATIVE SURVEY W/FOREIGN CURRENT

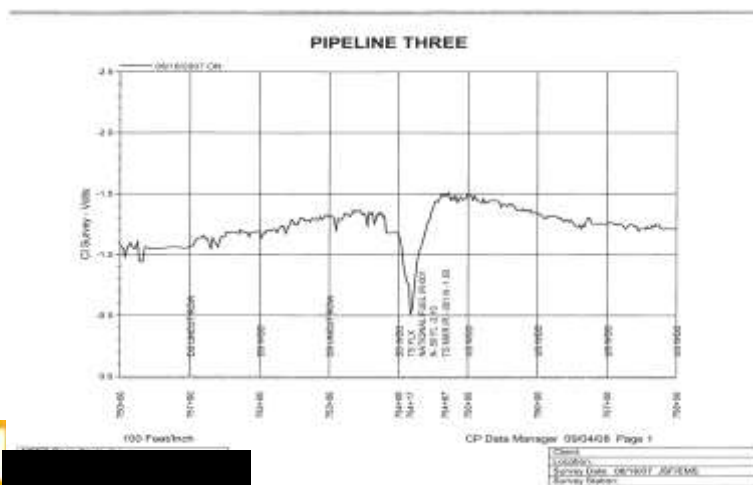


CURRENT APPLIED OR “ON” SURVEY

- The On/only survey is normally conducted on legacy structures that have magnesium anodes directly attached to the structure, where it's not practical to obtain IR Free potentials.
- An on survey does not take into account “IR drop”.
- Sometimes used in conjunction with IR drop coupons to confirm levels of cathodic protection.
- These surveys are performed to help verify cathodic protection levels and coating efficiency.



Current Applied “On” Survey

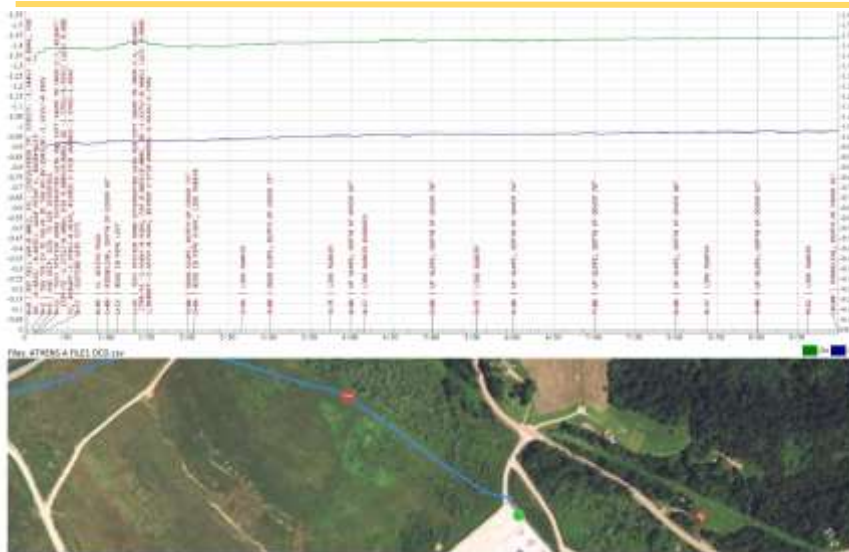


ON/INTERRUPTED SURVEY

- This is the most common type of CIS used on impressed current systems and galvanic systems where current sources can be interrupted.
- Requires “all” influencing current sources to be interrupted using synchronized current interrupters.
- Instant-off potentials provide an IR free reading of polarized pipe potentials.

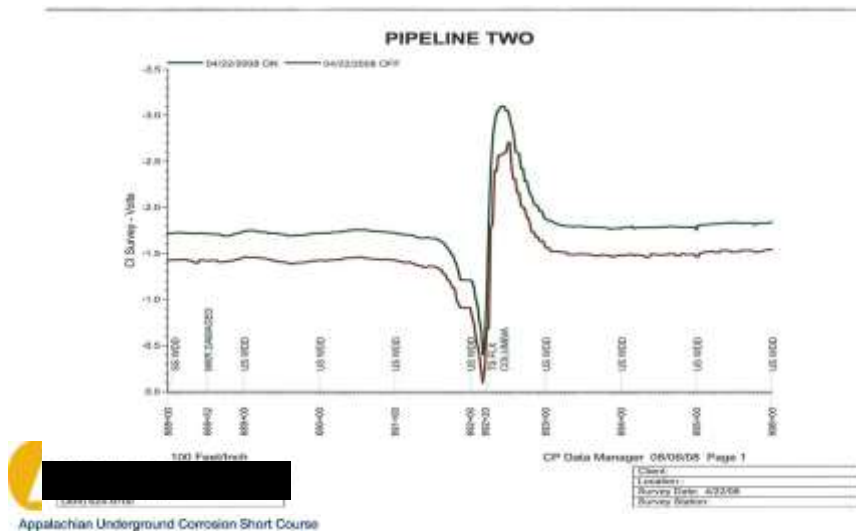


On-Interrupted Galvanic Survey



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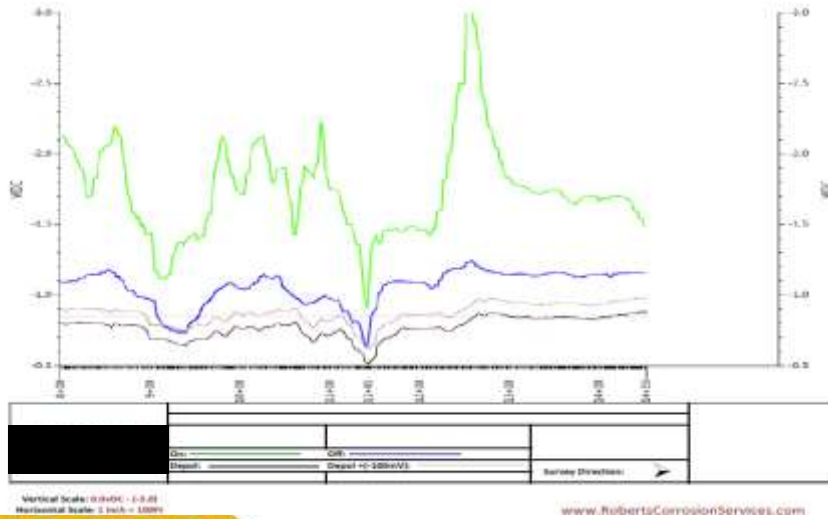
On/Interrupted Survey



DEPOLARIZED SURVEY

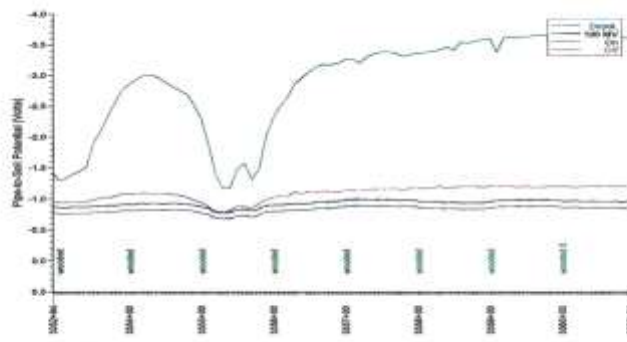
- A depolarized survey is used in conjunction with an On/Interrupted survey to verify 100mV polarization.
- The pipeline must have all influencing sources of current turned off and be allowed to depolarize sufficiently before conducting the survey.
- It is necessary to survey as accurately as possible to the original On/Interrupted survey to be able to overlay potentials.
- The Depolarized Data is then graphed against the On/interrupted data to determine if the 100mV polarization has been achieved.
 - Graph includes calculated line Depolarized Potential + 100mv

Depolarized Survey



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Depolarized Survey Graph

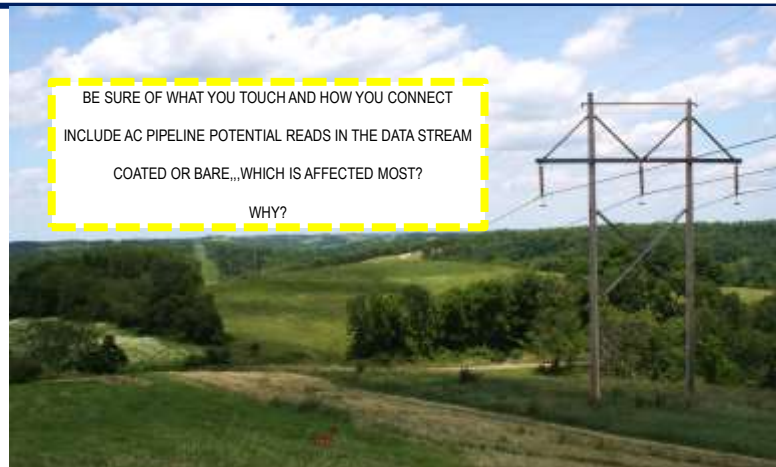


PRE-SURVEY CONSIDERATION

- DO YOUR HOMEWORK!!!!
- SPECIFICATIONS:
 - Payment Schedule and Conditions
 - Job Delays
 - Inclement Weather
 - General Requirements
 - Operator / Contractor
 - Personnel Qualification
 - Safe Work Practices
 - PPE Requirements
 - Daily Safety Meetings (TSM's / JSA's)
 - Right-of Way / Geographical Challenges
 - Nearest Medical Facilities



Paralleling AC Corridors? Safety is Paramount



ROW Mowed or Not?



Pre Survey Consideration

- Specifications Cont'd
 - Historical Data
 - Type of CP applied
 - Annual Test Point Inspections
 - Bi-monthly Rectifier inspections
 - Previous CIS data
 - Known out of circuit Influence
 - Mapping and Alignment Sheets:
 - Test Point / Rectifier location and ID.
 - Tie-in points and Isolation



Pre-Survey Test Point Information

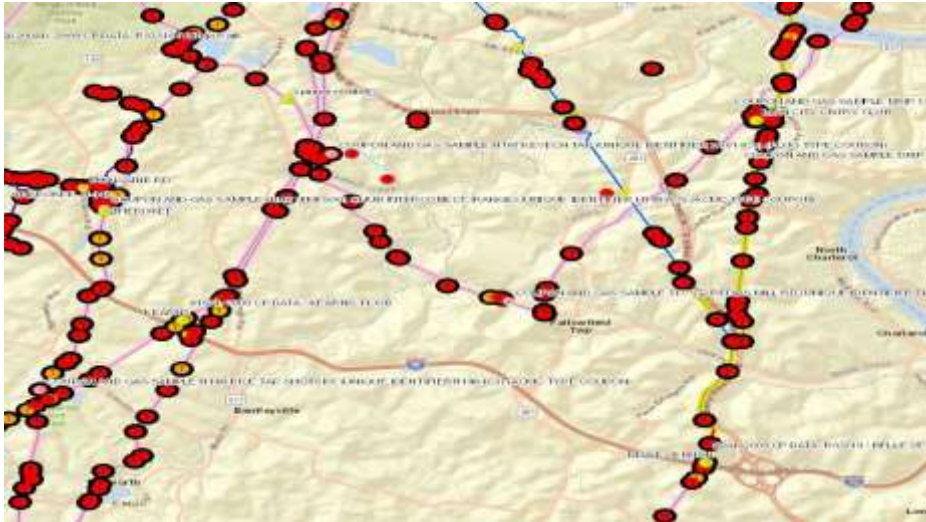
Facility	AssetNumber	InspectionDate	StructurePS	StructureRF	CasingPS	ForeignPS	ForeignRF	Technician	Latitude	Longitude
Pipeline-1	P1-TP10	9/18/2014	-2.672	-1.476	-0.529			DLR	39.94716	-80.13893127
Pipeline-1	P1-TP10	7/22/2015	-2.466	-1.099	-0.539			BRS	39.94716	-80.13893127
Pipeline-1	P1-TP10	7/18/2016	-2.423		-0.559			RJS	39.94716	-80.13893127
Pipeline-1	P1-TP11	9/18/2014	-2.235	-1.47		-1.314	-1.273	DLR	39.95998	-80.13088989
Pipeline-1	P1-TP11	7/23/2015	-2.228	-1.099		-1.472		BRS	39.95998	-80.13088989
Pipeline-1	P1-TP11	7/21/2016	-2.13			-1.41		RJS	39.95998	-80.13088989
Pipeline-1	P1-TP12	9/18/2014	-2.402	-1.581		-1.363		DLR	39.96117	-80.13009644
Pipeline-1	P1-TP12	7/22/2015	-2.162	-1.119		-1.337		BRS	39.96117	-80.13009644
Pipeline-1	P1-TP12	7/21/2016	-2.073			-1.921		RJS	39.96117	-80.13009644
Pipeline-1	P1-TP13	9/18/2014	-2.364	-1.535		-1.38	-1.378	DLR	39.96346	-80.12945557
Pipeline-1	P1-TP13	7/23/2015	-2.129	-1.039		-1.389		BRS	39.96346	-80.12945557
Pipeline-1	P1-TP13	7/21/2016	-2.024			-1.349		RJS	39.96346	-80.12945557
Pipeline-1	P1-TP14	9/18/2014	-2.115	-1.407		-2.175		DLR	39.96681	-80.12885284
Pipeline-1	P1-TP14	7/23/2015	-2.032	-1.039		-1.3		BRS	39.96681	-80.12885284
Pipeline-1	P1-TP14	7/18/2016	-1.933			-1.323		RJS	39.96681	-80.12885284

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Pre-Survey Influencing Rectifier Information

Facility	AssetNumber	FacilityID	Latitude	Longitude	Inspection Date	Tap Settings	Rectifier Output Found	Volts Found	RectifierOutput Found	Current Found	Tech
Pipeline - 1	Pipeline1-RT01	A1	39.96685791	-80.1112442	5/1/2017	B-4	27.69		10.2		RJS
Pipeline - 1	Pipeline1-RT02	WARD	40.0201683	-79.9968338	5/1/2017	D-3	36.18		14.53		RJS
Pipeline - 1	Pipeline1-RT03	THOMPSON	40.03536606	-80.05788422	5/1/2017	C-1	39.66		7.69		RJS
Pipeline - 1	Pipeline1-RT04	HUD M-82	39.90620422	-80.14971161	5/1/2017	C-4	38.33		10.08		RJS
Pipeline - 1	Pipeline1-RT05	M78 - RT 221 RUFF CK	39.94706345	-80.13899994	5/1/2017	B-3	17.68		3.06		RJS
Pipeline - 1	Pipeline1-RT06	PRATT STATION #47	39.912323	-80.12850952	5/1/2017	C-2	27.08		9.47		RJS
Pipeline - 1	Pipeline1-RT07	EDGAR #1 PRATT	39.95070267	-80.12539673	5/1/2017	A-2	4.86		0.61		RJS
Pipeline - 1	Pipeline1-RT08	HAWKINS #1 - H-106	39.94681931	-80.11604309	5/1/2017	A-3	14.55		4.04		RJS
Pipeline - 1	Pipeline1-RT09	CASTILE RUN #1	39.9718895	-80.10402679	5/1/2017	A-3	14.36		3.53		RJS
Pipeline - 1	Pipeline1-RT10	PYLES	39.96728516	-80.10668182	5/1/2017	A-6	17.98		3.65		RJS
Pipeline - 1	Pipeline1-RT11	VRBANIC	39.9522934	-80.07000732	5/1/2017	A-6	23.68		13.63		RJS
Pipeline - 2	Pipeline2-RT01	JEFFERSON H-111	39.92829895	-80.06137085	5/1/2017	A-3	4.86		0.57		RJS
Pipeline - 2	Pipeline2-RT02	REESE - H109	40.03881454	-80.15016937	5/1/2017	B-2	15.2		5.58		RJS
Pipeline - 2	Pipeline2-RT03	JEFFERSON COMP STA	39.90927505	-80.07463074	5/1/2017	B-4	26.08		11.49		RJS
Station - 1	Station1-RT01	IO COMP STATION	39.95553207	-80.13075256	5/1/2017	A-4	5.09		5.18		RJS
Station - 2	Station2-RT02	JUPITER CS 2	39.96892929	-80.11095428	5/1/2017	B-4	15.06		12.29		RJS
Foreign Operator - 1		MOWL RD	40.11929	-80.18359	4/10/2017	A-2	13.14		10.4		

Pre-Survey Corrosion Asset Mapping



PRE-SURVEY CONSIDERATION

- Specifications Cont'd
 - Instrumentation and Equipment
 - Volt Meter / Data Loggers
 - High Input Resistance – 10 Mega-ohm or greater
 - Reference Electrode
 - Type – Saturated Copper/Copper Sulfate
 - Reference Cell Balance/Calibration Intervals
 - Pipeline Location
 - Measurement Techniques – GPS / Slope Chain
 - Depth of Cover
 - Survey Wire
 - Type and Gauge

Close Interval Survey Equipment



SURVEY CONSIDERATON

- Survey Specifications
 - Interruption
 - Cycle Time – On: Off ratio
 - Interruption Starting Position – “On” or “Off”
 - GPS Synchronized
 - Pipe-to-Electrolyte Potentials
 - Potential Measurement Interval and Range
 - Survey Lead Connections – (-)Ref. Electrode (+)Structure
 - Field Data Collection
 - Environmental Conditions – Heat / Cold / Foliage.
 - Electrolyte Contacts – Concrete/Asphalt/Casings/Bores
 - Far Ground / Structure IR Drop / Near Ground Potentials
 - Foreign / Casing / Points of Isolation / AC Potentials

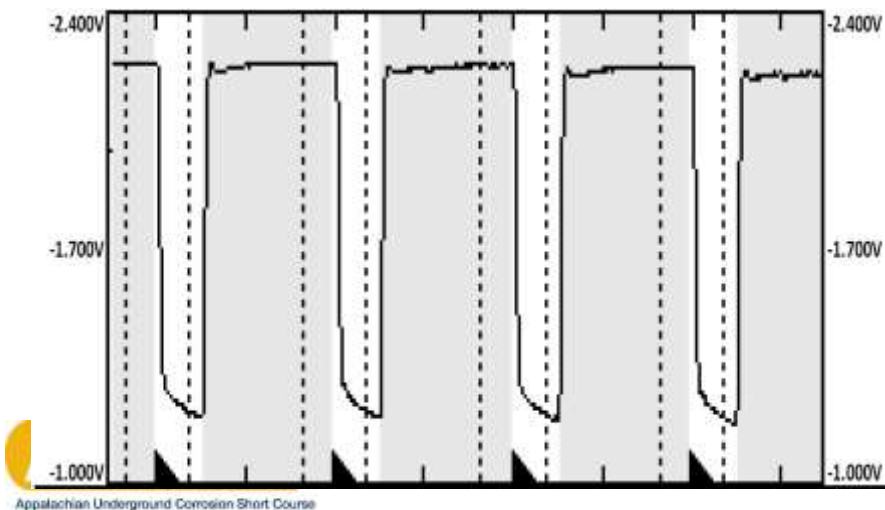


SURVEY CONSIDERATON

- Survey Specifications cont'd:
 - Data Integrity
 - Survey Equipment Continuity
 - Reference Electrode Balance/Calibration
 - Proper Contact to Structure
 - Reconnection Points
 - Measuring and Stationing
 - GPS / Slope Chain / Wire Counters
 - Permanent Landmarks / Appurtenance
 - Wave Prints
 - Predetermined specified intervals / Survey Irregularities
 - Used to help filter “spiking” and identify Interrupter Sync Issues.
 - Continuous Survey Data Logging

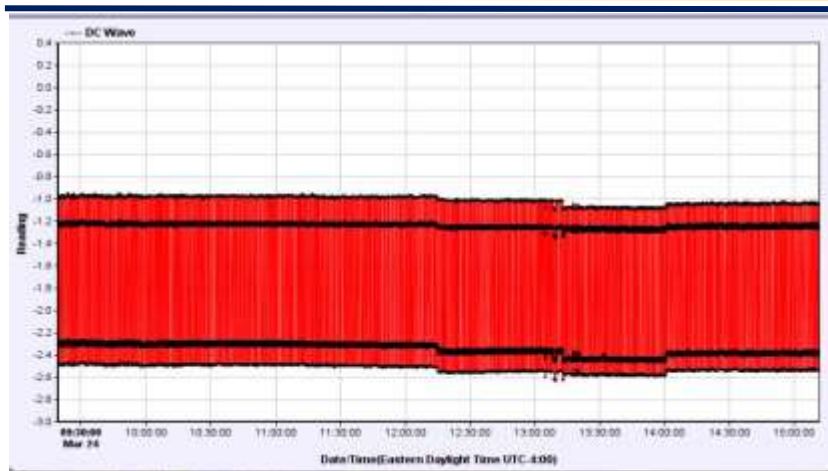


GPS SYNC'D CIS WAVEPRINT



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Stationary Logger Graph



Post Survey Considerations

- Final Reports:
 - Operator Qualification documentation
 - Depth of Cover and areas of exposure
 - Listing of all Rectifiers, Bonds, and Anodes interrupted during Survey
 - Rectifier Output and Tap settings – “As Found” and “As Left”
 - List of all permanent Test Stations with all data Information required
 - AC potentials, Far Ground, Structure IR, Near Ground
 - Foreign, Casing, Isolation Point Potentials
 - Damaged (No Contact)
 - Summary of areas not meeting the CP criteria being evaluated
 - Potentials < -0.850V “On” current applied surveys
 - Potentials < -0.850V IR Free “Instant Off” Interrupted
 - Areas not meeting 100mv Polarization with respect to Native or Depolarized Surveys.
 - Excessive negative Potentials per specification



Post Survey Considerations

- Final Report Cont'd:
 - Data Graphs
 - Each type of potential easily distinguished.
 - Usually Color coding
 - Legend may Include:
 - Client / Operator Name, Survey Date
 - Structure or Asset name
 - Interruption Cycle times
 - Surveyor Name
 - Survey measurement: GPS'd – Stationing
 - Test Stations and Above Ground Appurtenances
 - Areas of Skip Potentials – Public Roads, Casings, Bores, Exposures
 - Points of Intersections / Geographical Features



Post Survey Considerations

- Final Report Cont'd
 - Wave Prints
 - Continuous Logging
 - Deliverables:
 - Bounded Reports
 - Electronic Reports
 - File Formatting: (.pdf, .xls, .svy)
- Remedial Recommendations
 - Cathodic Protection Adjustments
 - Criterion change considerations
 - Additional Survey requirements – ACVG / DCVG
 - Confirmation / Repair Digs



SUMMARY

- A CIS PROVIDES A CONTINUOUS PIPE-TO-SOIL POTENTIAL PROFILE OF THE PIPELINE
- DETERMINES EFFECTIVENESS OF THE CATHODIC PROTECTION BEING APPLIED TO SYSTEM.
- A POWERFUL ANALYSIS TOOL
- DATA MUST BE TECHNICALLY ACCURATE TO ENSURE PIPELINE SAFETY.
- GARBAGE "IN" = GARBAGE "OUT"



Like a Walk in the Park





• QUESTIONS?

