

DC INTERFERENCE TESTING CASE STUDIES USING RECTIFIER INFLUENCE TOOLS

PPUC- PIPELINE SAFETY SEMINAR

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SAFETY MOMENT



DC INTERFERENCE TESTING TOOLS

- Pipe-to-Soil Potential and Cell-to-Cell Measurements
- Close Interval Survey
- Current spans
- In Line Inspection (ILI) Data Analysis
- Rectifier Influence Testing
- Corrosion Correlating Committees and NPMS
- Pipeline Current Mapper



SOME THEORY AND SOME CASE STUDIES

- What is Polarization and Cathodic Protection?
- Pipe-to-soil potentials- 4 components
- Case studies-
 - Pipe to Soil- Influence verses interference
 - What does interference look like
 - To Bond or Not to Bond
 - Case Study- Water line meets stray current corrosion
 - Rectifier influence results
 - Pipeline Current Mapper results



DEFINITION OF CATHODIC PROTECTION

- Polarize a structure to a potential that is equal to, or more negative than it's most active anode

Richard Patterson

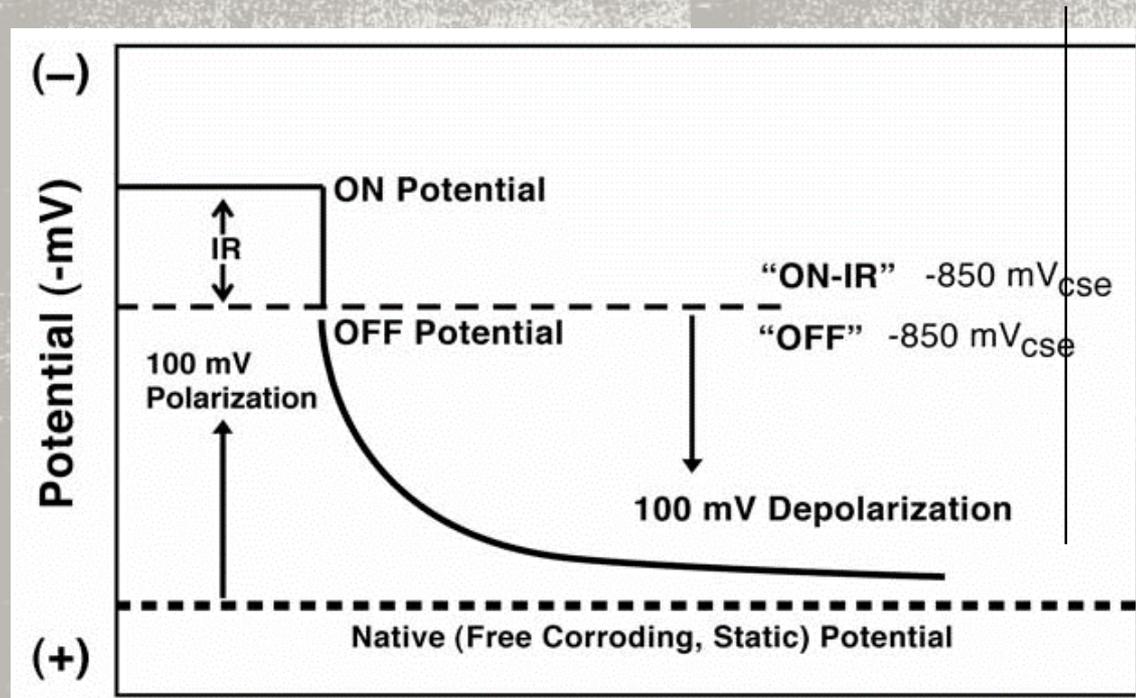
- Cathodic protection is complete when the corrosion cell cathodes are polarized electro-negatively to the open circuit potential of the most electronegative anode site on the structure

R. B. Mears and R. H. Brown, A theory of cathodic protection, Trans. Electrochem. Soc. 74, 519 (1938)

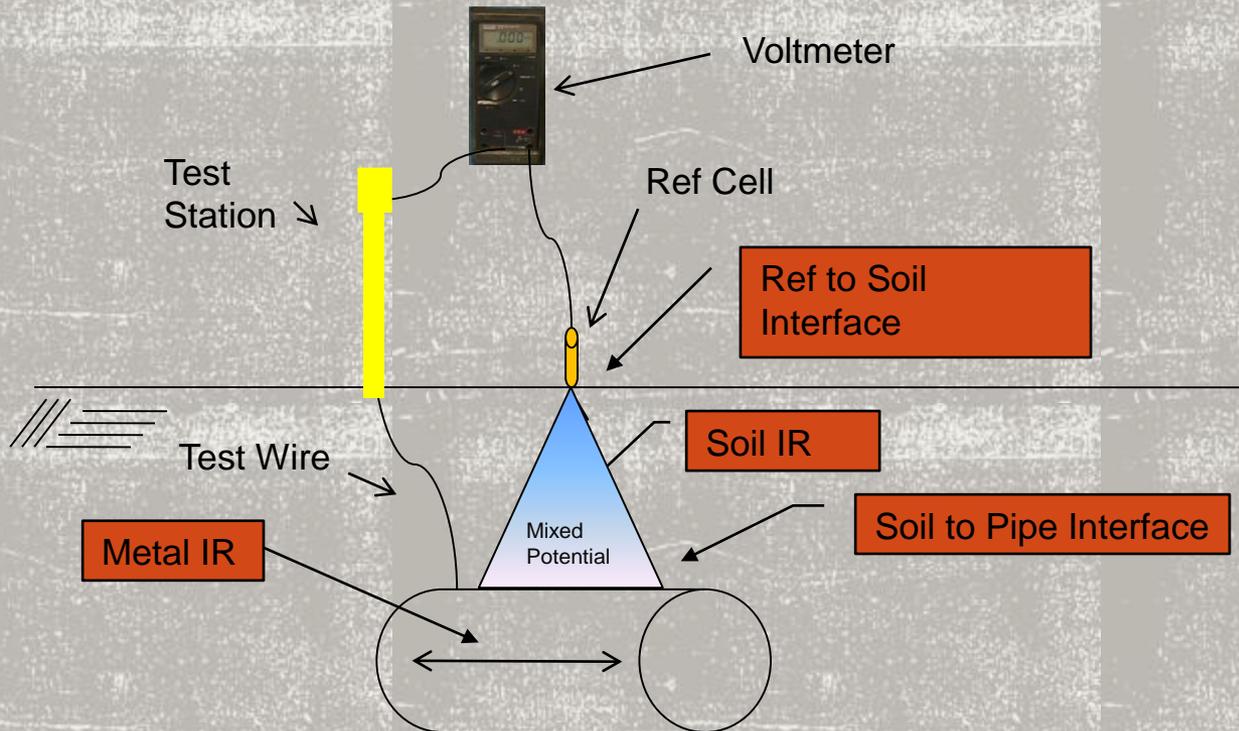


POLARIZATION GRAPH- AND GENERALLY ACCEPTABLE AND USED CP CRITERION

- **-850mV “ON”**
 - With CP applied
 - Knowing which CP systems have influence on this number is helpful
- **-850mV “IRF”**
 - Synchronous current interruption is generally required
 - Knowing and understanding which CP Systems and current sources have an influence on this number is necessary
- **100mV Polarization**



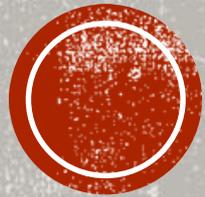
PIPE-TO-SOIL POTENTIAL COMPONENTS



DEFINITIONS- WHAT IS DC INTERFERENCE?

- There are a lot of definitions but.....What Does NACE say?
- In SP0169 NACE has the following definitions:
 - Interference- Any electrical disturbance on a metallic structure as a result of stray current.
 - Stray Current- Current through paths other than the intended circuit.
- Basically, an industry accepted standard may be simply stated as “a foreign current getting On and Off an unintended structure electrolytically (through the soil or water)





DC INTERFERENCE TESTING USING RECTIFIER INFLUENCE STUDIES

DETERMINING IF YOU HAVE DC INTERFERENCE

1. Identify location of low pipe-to-soil potentials for an unexplained reason.
2. Identify if foreign pipelines or tanks are in the area. CC committees and NPMS.
3. The traditional test for interference is to cycle a foreign rectifier and measure the effect on the pipe-to-soil potential at the low location.
4. As a guideline..... if you have influence ($>100\text{mV}$) from the foreign CP system there “may be” interference.



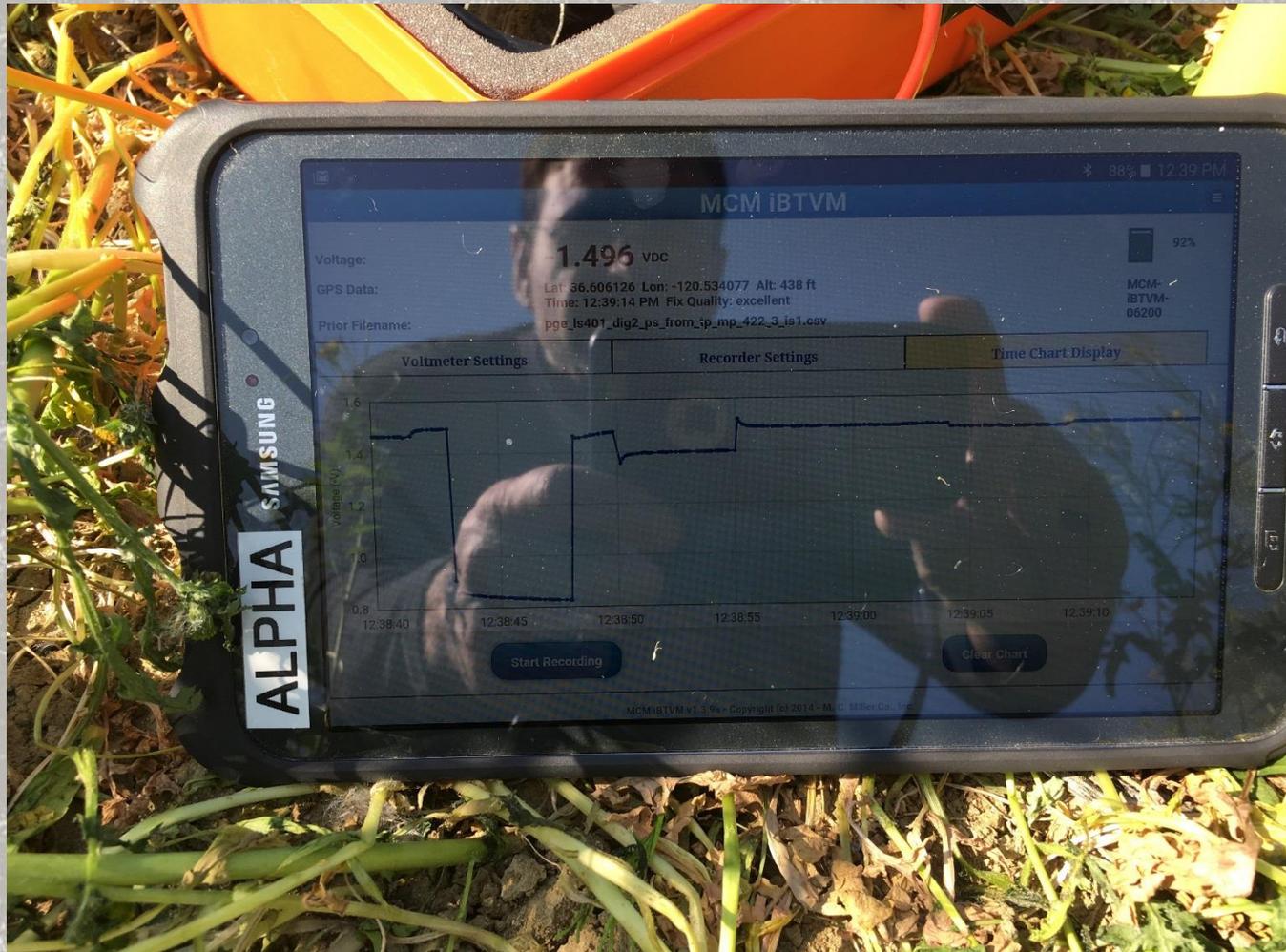
INSTALL PORTABLE GPS CURRENT INTERRUPTERS WITH RECTIFIER INFLUENCE PROGRAM



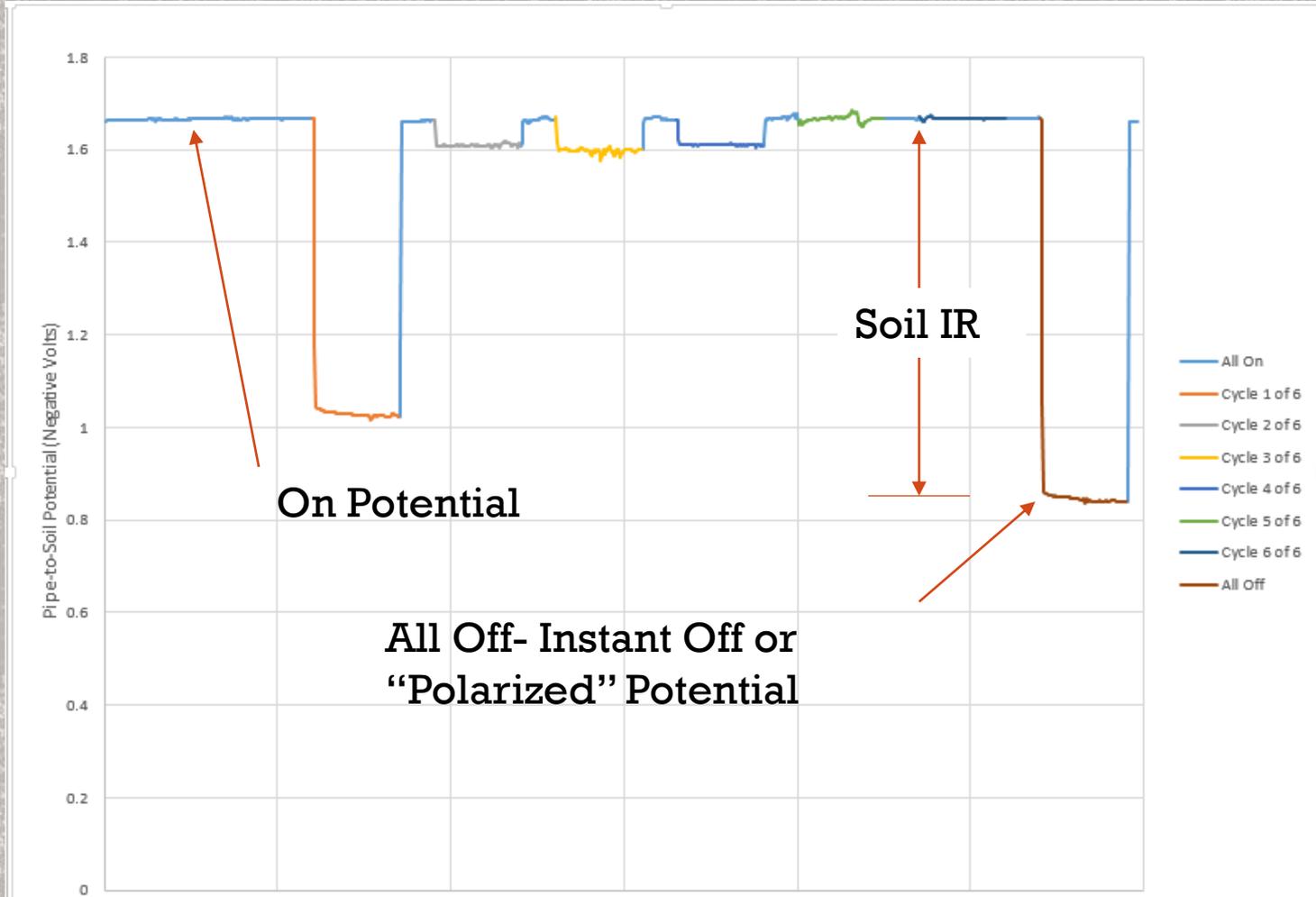
BLUETOOTH VOLTMETER WITH TABLET SETUP AT TP TO RECORD PIPE TO SOIL POTENTIAL WAVEFORM



PIPE TO SOIL WAVEFORM RECORDING IN THE FIELD



PIPE-TO-SOIL WAVEFORM- P/S MEASURED OVER 60-SECONDS WHILE INTERRUPTING



EXAMPLES AND BASIC DATA INTERPRETATION

- **Where to Collect Data**
 - Locations of known growing metal loss
 - Locations of large dips in CIS potential profile (Unexplained low potentials)
- **Types of Waveform Data**
 - Pipe-to-Soil
 - Current Span
 - Cell to Cell (surface potentials are an “indication”)
- **Data Interpretation Definitions and Case Studies**
 - Pipe to Soil- Influence verses interference
 - What does interference look like
 - To Bond or Not to Bond
 - Case Study- Water line meets stray current corrosion
 - Rectifier influence results
 - Pipeline Current Mapper results



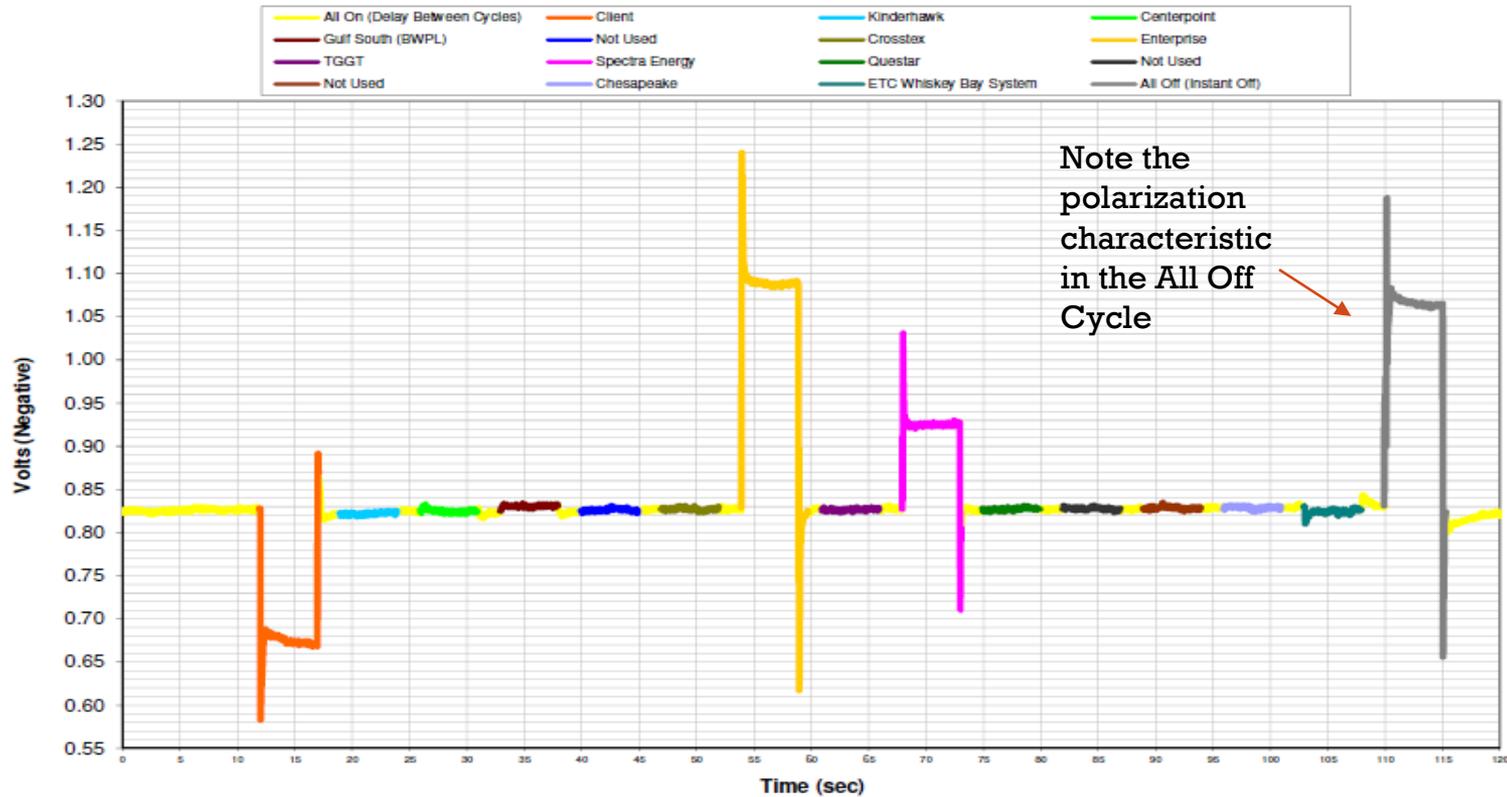
CASE STUDIES WHERE IT LOOKS LIKE STRAY CURRENT INTERFERENCE BUT IS ONLY SOIL GRADIENT INFLUENCE

1. On Potential is being suppressed by foreign operator at a crossing. Rectifier Influence Study (RIS) performed and followed up with a soil tube
2. RIS performed at riser in a station where On potential is being suppressed.
3. Crossing with foreign line where On potential is being suppressed

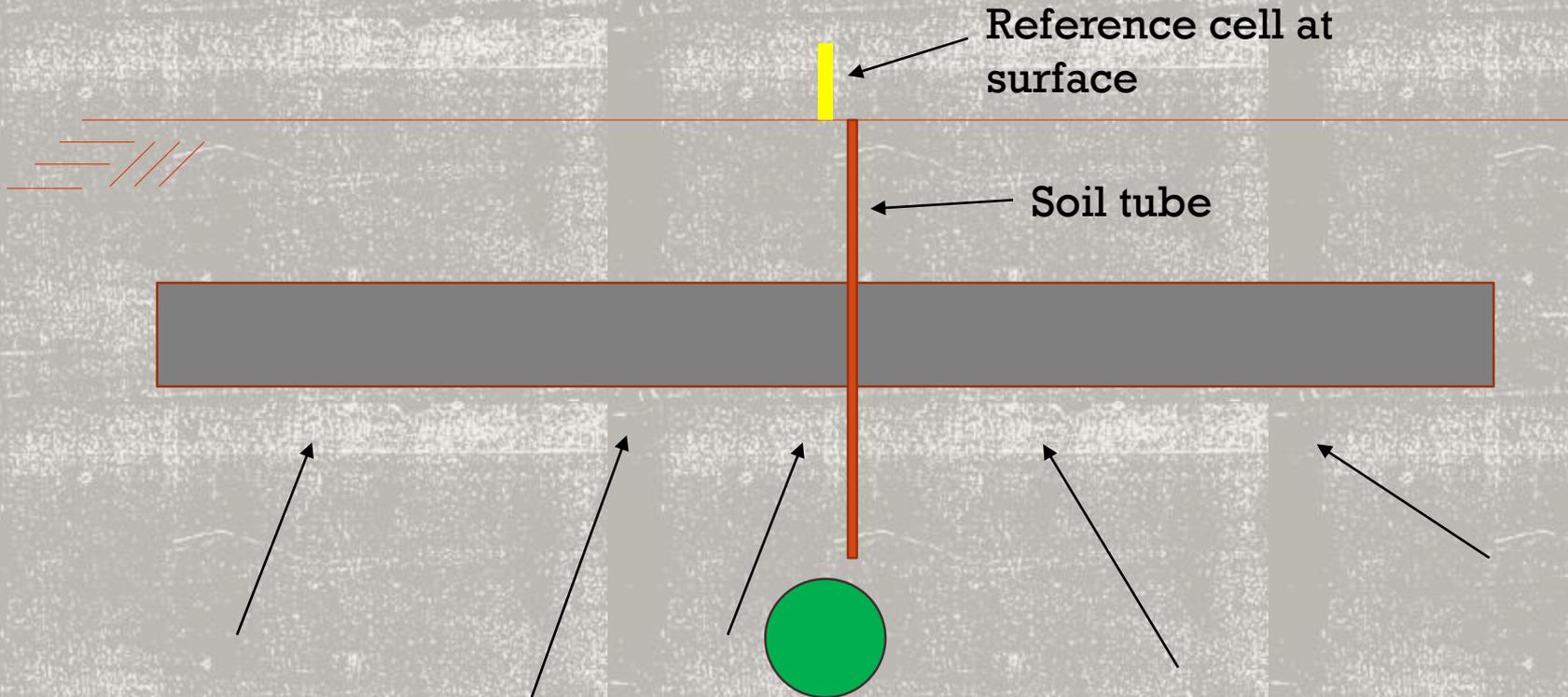


INFLUENCE ONLY- POLARIZED POTENTIAL MORE NEGATIVE THAN -1000MV

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PIPELINE CONFIGURATION AT CROSSING

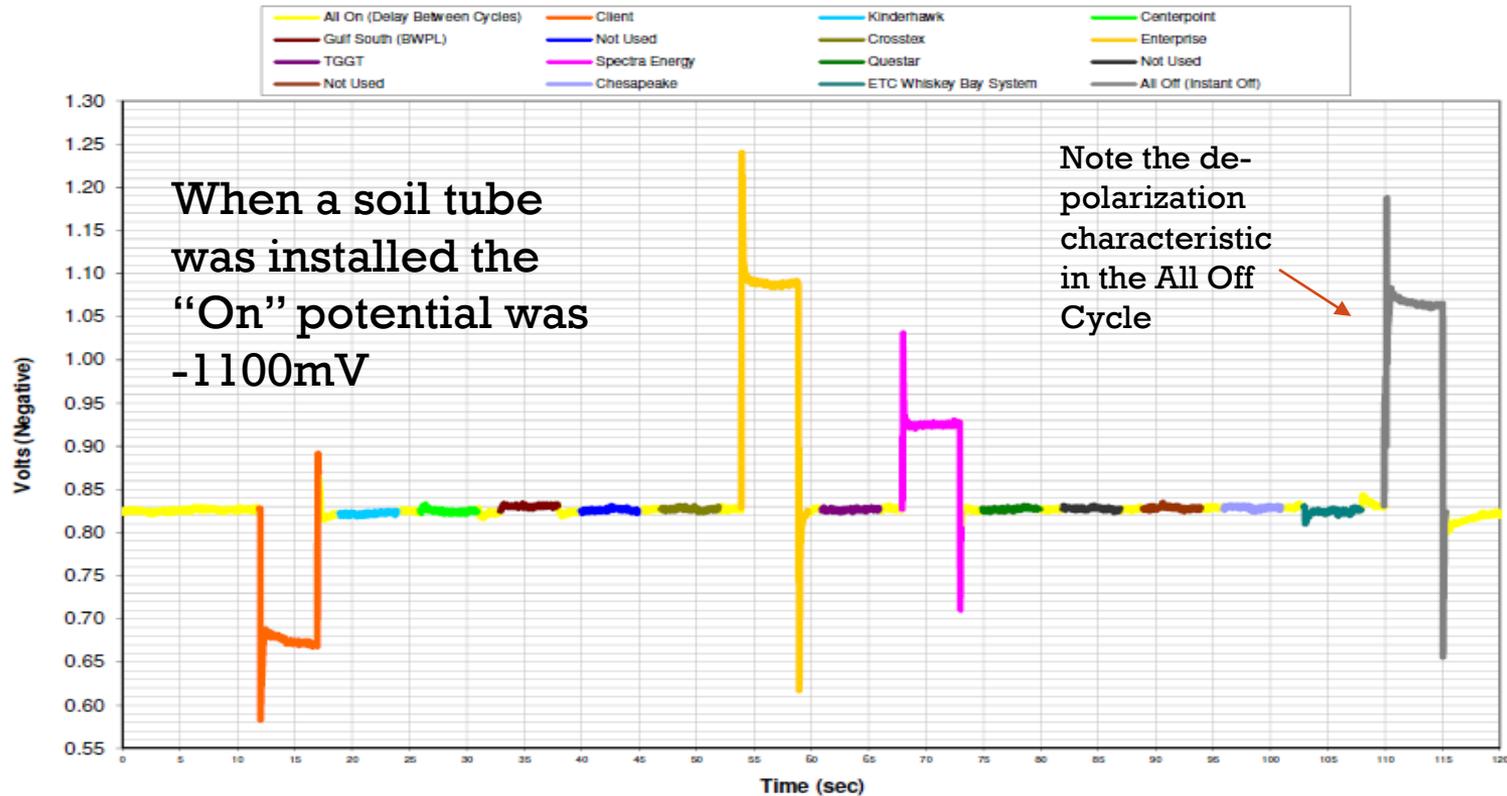


Well coated line bored under poorly coating line. Soil IR from foreign line is a large component of the surface P/S

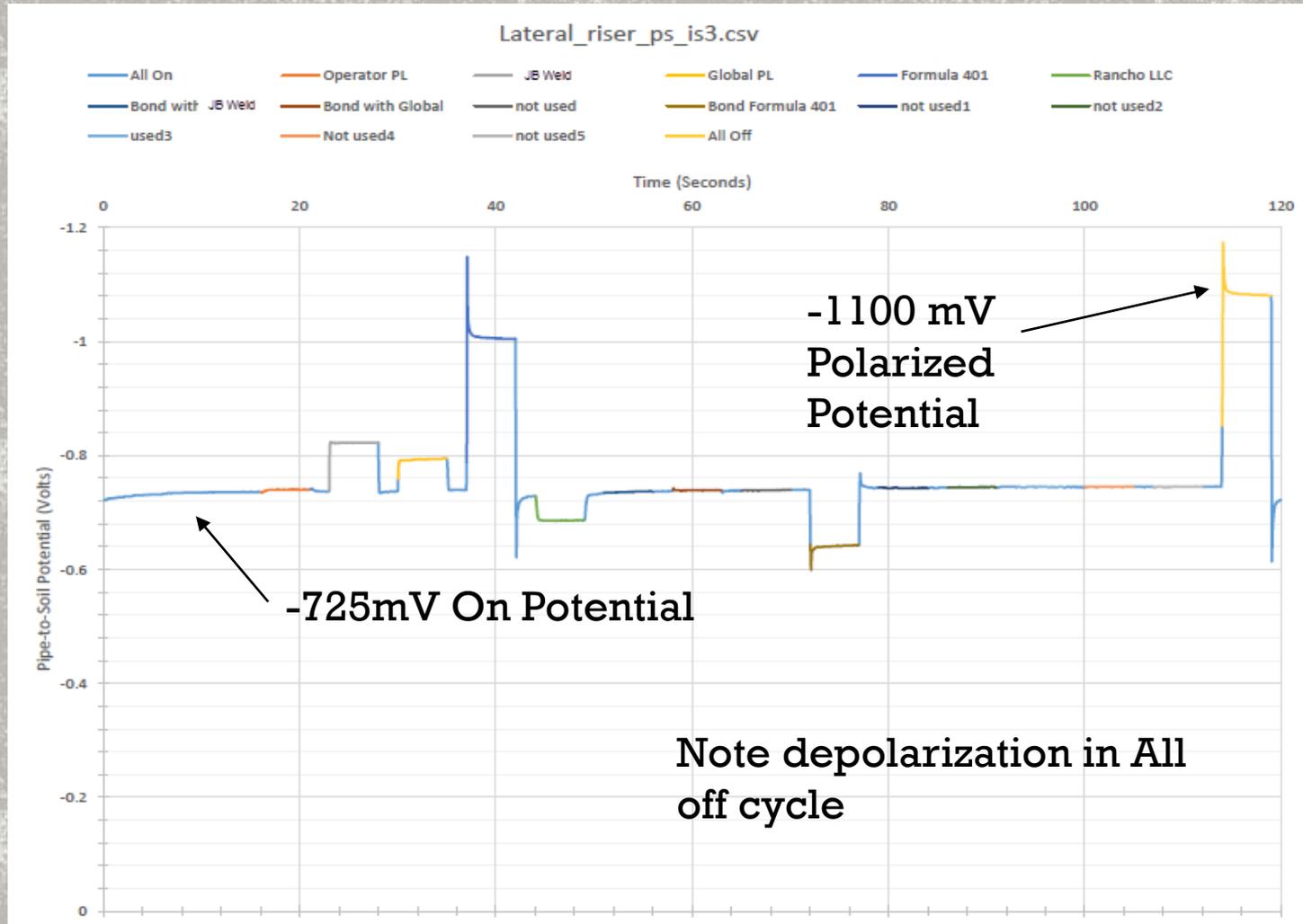


CONCLUSION- NO STRAY CURRENT INTERFERENCE (INVALID "ON" POTENTIAL)

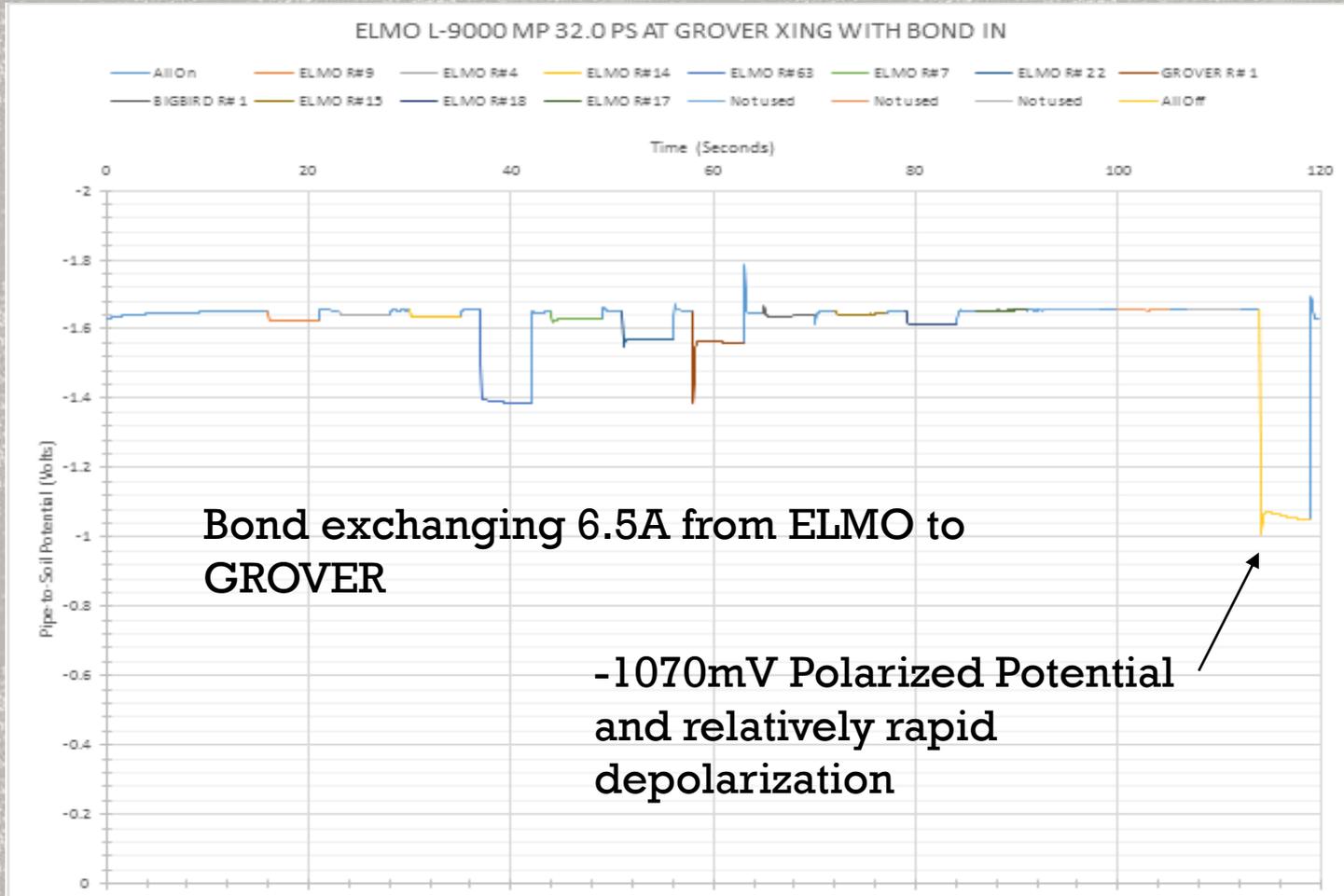
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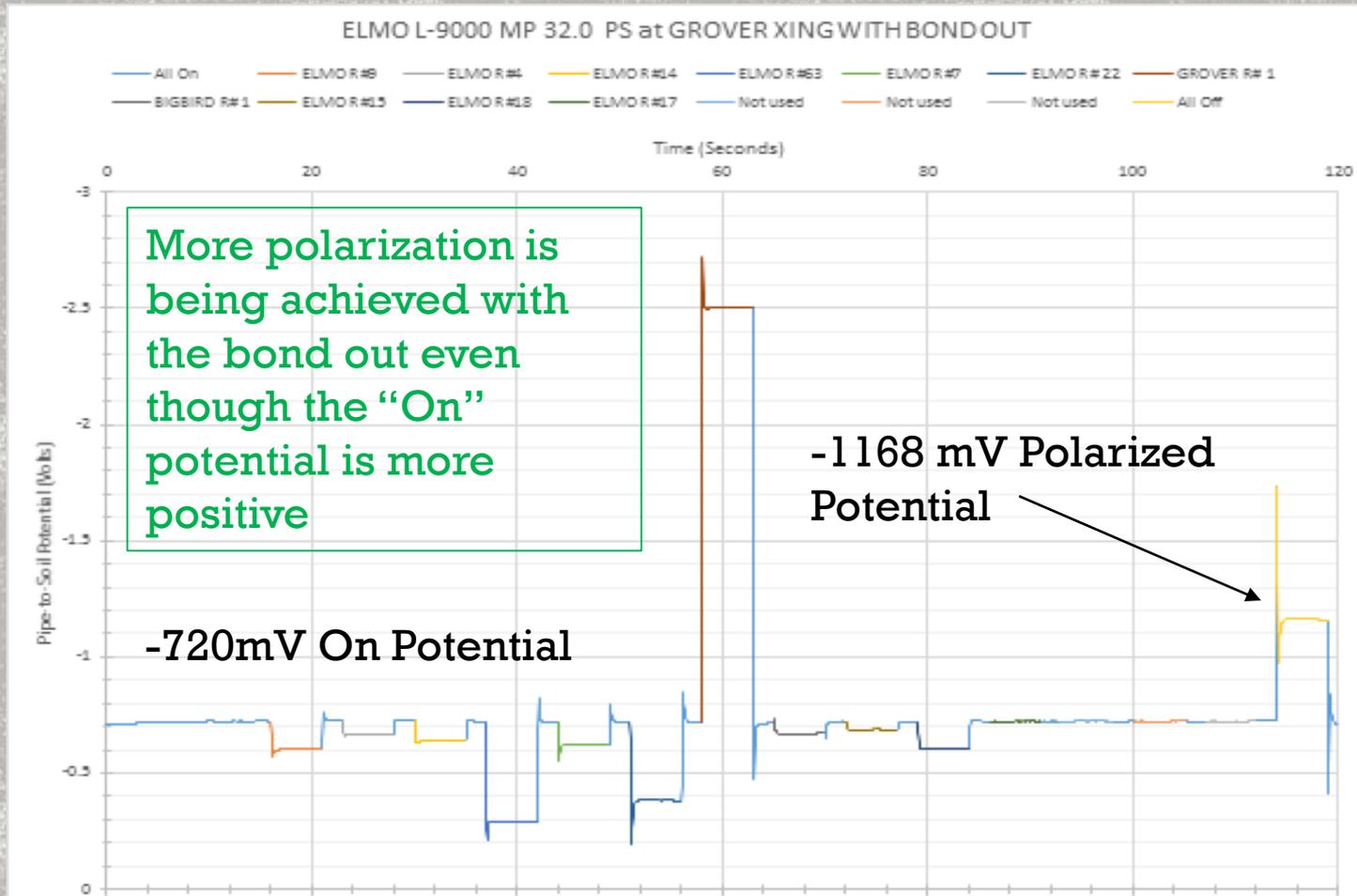
P/S WAVEFORM AT RISER IN STATION- INVALID "ON" POTENTIAL. NO INTERFERENCE



P/S WAVEFORM AT CROSSING WITH BOND IN PLACE (AS FOUND)



P/S WAVEFORM AT CROSSING WITH BOND REMOVED (AS LEFT)



TAKE AWAY INFORMATION

- If you are not interrupting all current sources you may not be measuring an accurate polarized potential.
- Most Operators only interrupt their own rectifiers while performing annual surveys and while conducting Close Interval Surveys.
- When performing interference testing, all influencing current sources should be included in the testing to measure the “polarized” potential. A suppression caused from a foreign operator is not necessarily interference. The “On” potential may just be influenced by soil gradient.

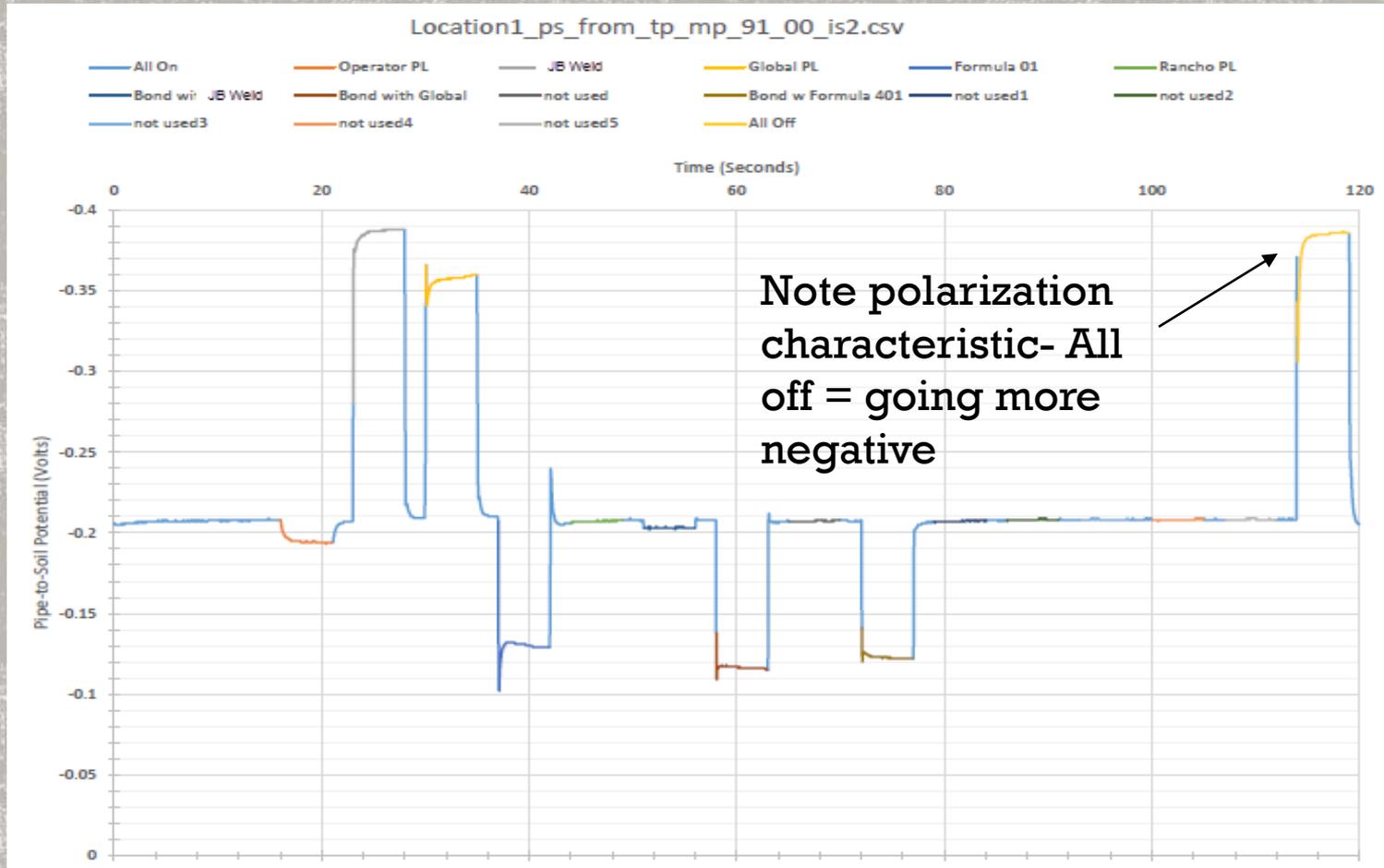


CASE STUDIES- SO WHAT DOES INTERFERENCE LOOK LIKE IN A PIPE-TO-SOIL POTENTIAL WAVEFORM?

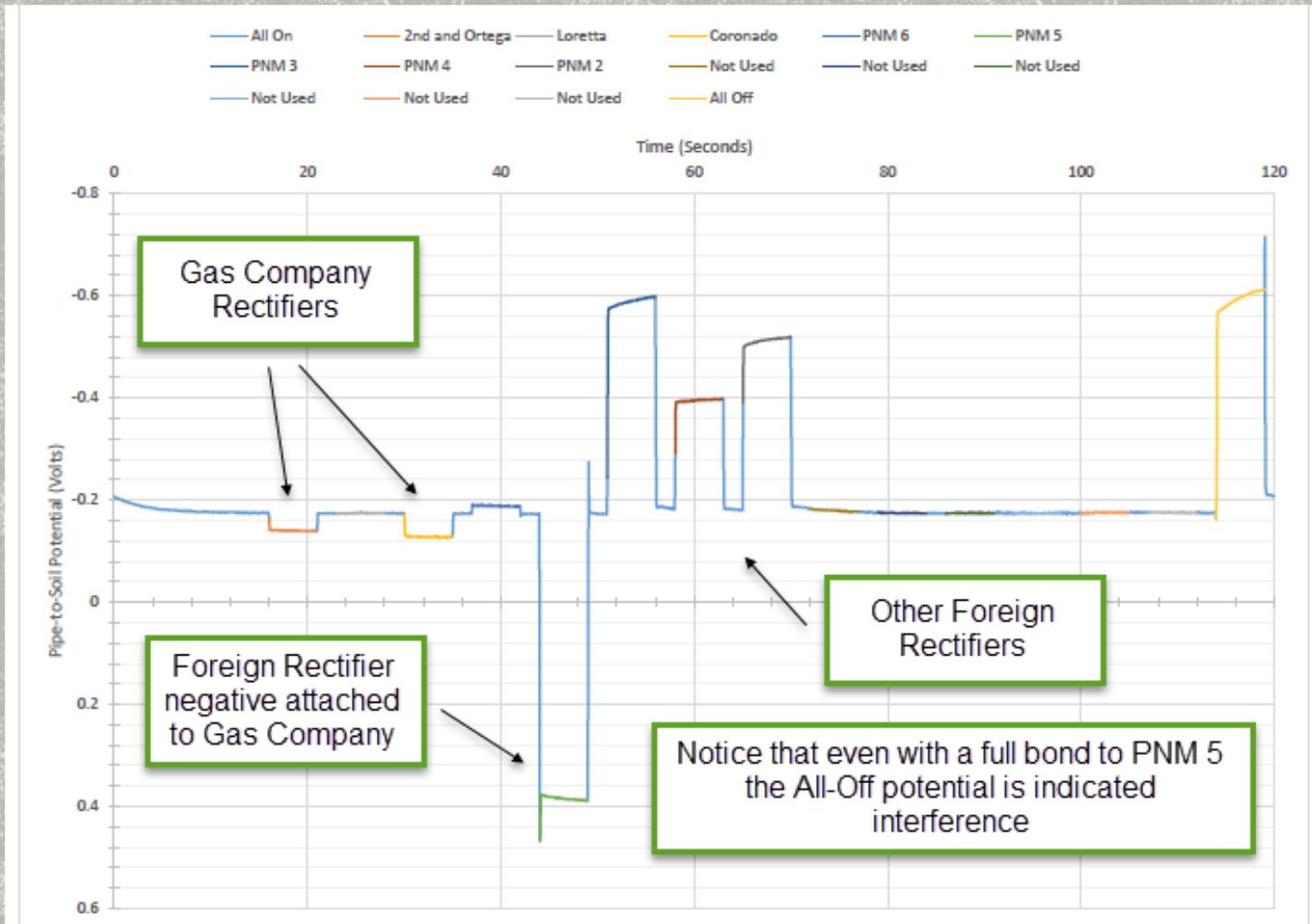
1. Investigation of a location of increasing metal loss identified during an ILL run
2. Investigation of a positive potential at a gas line riser that feeds a power plant



P/S WAVEFORM IN A PIPELINE CORRIDOR- AT WALL LOSS FOUND WITH ILI



EXAMPLE- EVEN WITH A BOND INTERFERENCE NOT MITIGATED

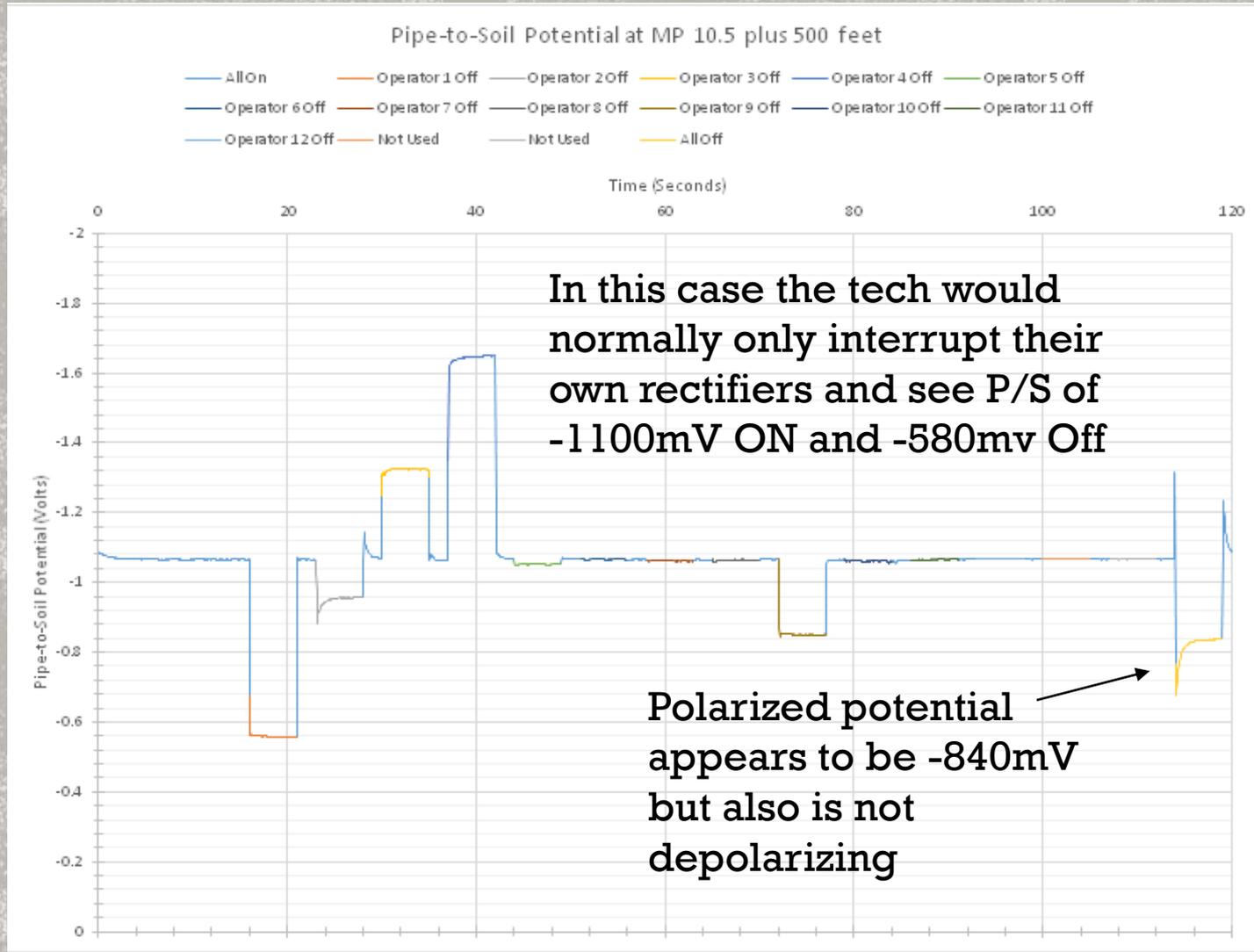


CASE STUDY- TO BOND..... OR NOT TO BOND

That is the question



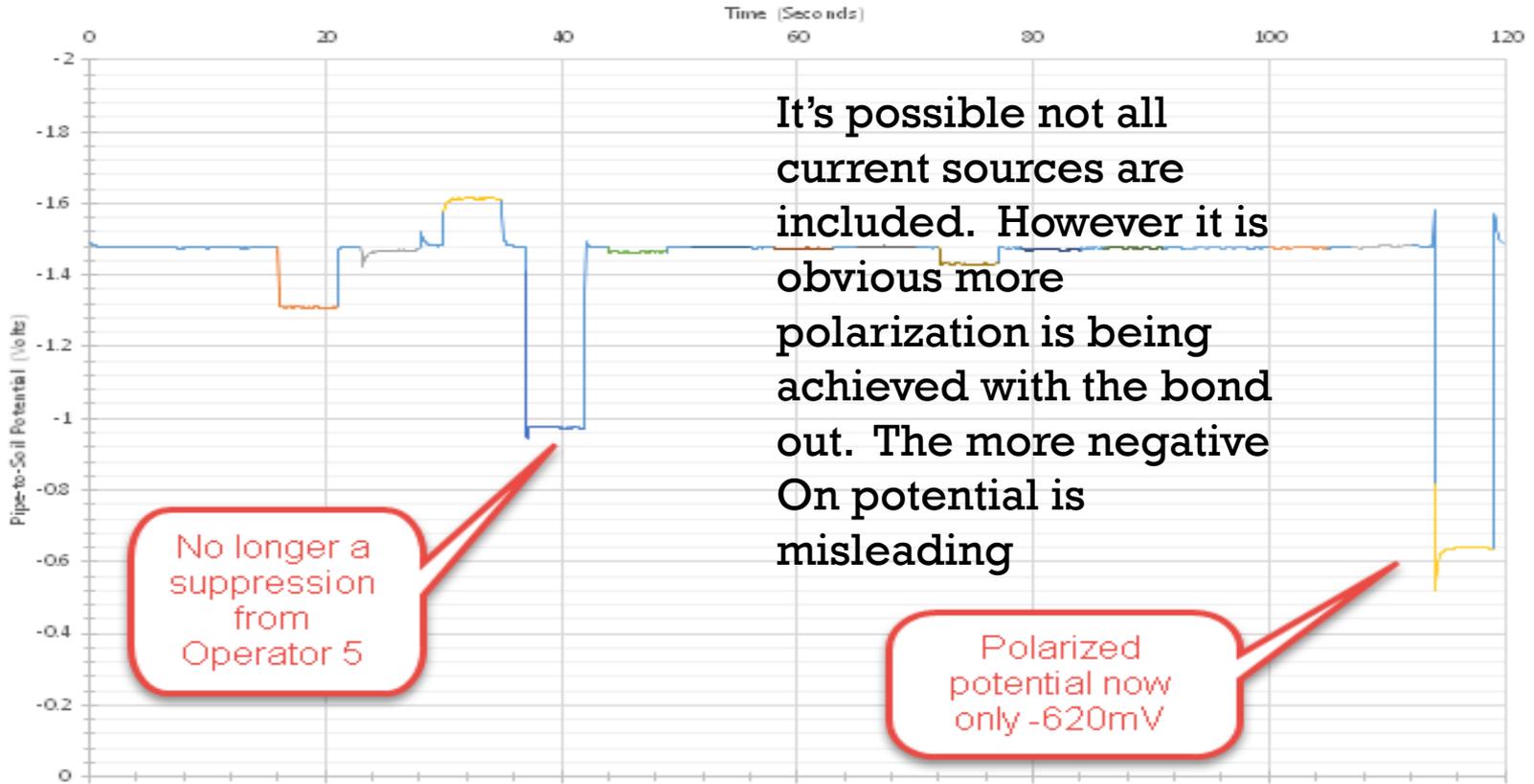
AS FOUND P/S WHERE I/O IS < -850MV



P/S WAVEFORM AT THE SAME TP WITH A TEMP BOND INSTALLED

Pipe-to-Soil Potential at MP 10.5 plus 500 feet with Temp Bond in to Operator #4

- All On — Operator 10ff — Operator 20ff — Operator 30ff — Operator 40ff — Operator 50ff
- Operator 60ff — Operator 70ff — Operator 80ff — Operator 90ff — Operator 100ff — Operator 110ff
- Operator 120ff — Not Used — Not Used — All Off



It's possible not all current sources are included. However it is obvious more polarization is being achieved with the bond out. The more negative On potential is misleading

No longer a suppression from Operator 5

Polarized potential now only -620mV

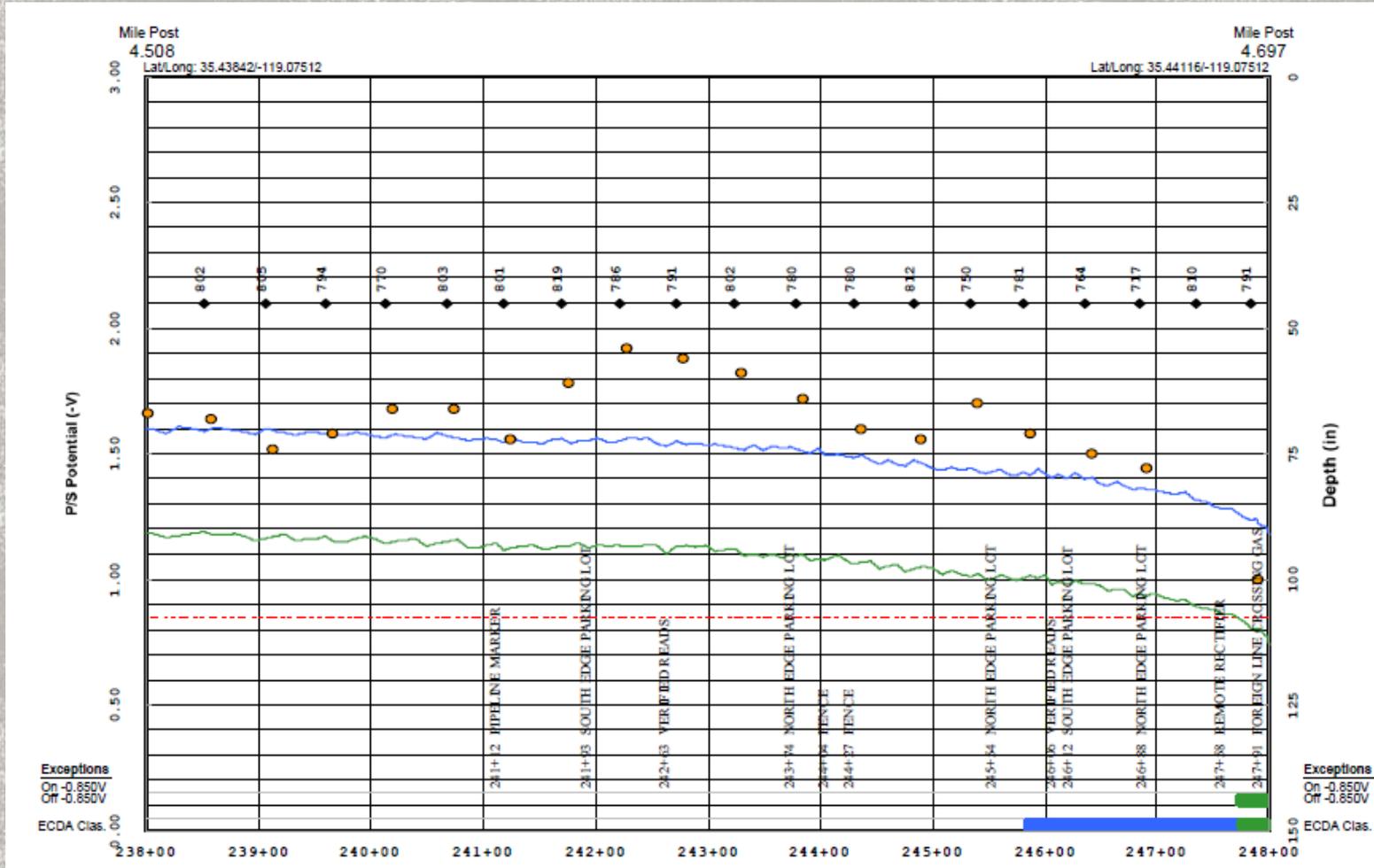


CASE STUDY- INVESTIGATION OF CIS INDICATING POSSIBLE INTERFERENCE

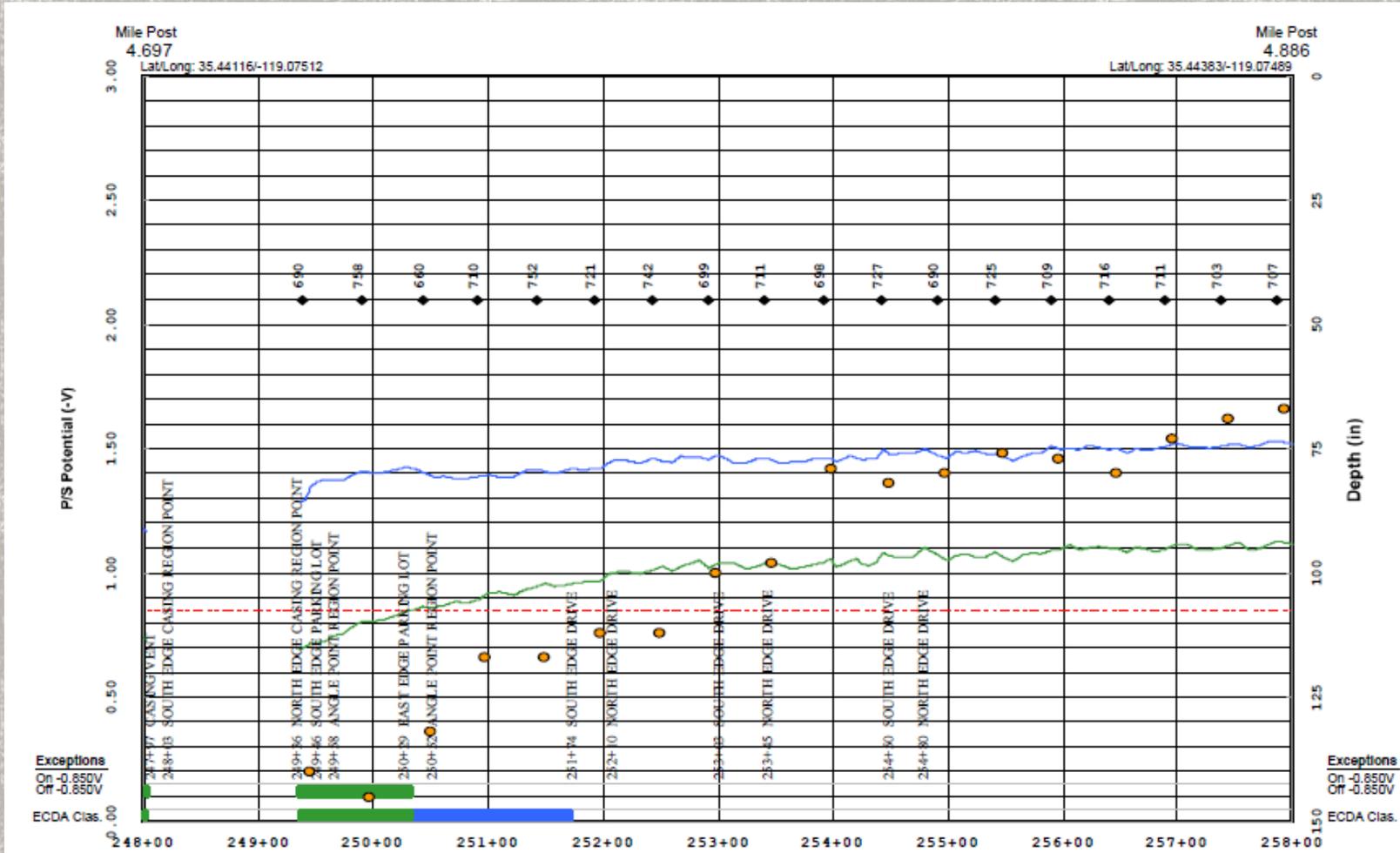
- **A CIS was performed and the following location has a dip in potentials below criteria at a foreign line crossing.**
- **This was flagged as possible static DC interference requiring additional investigation**



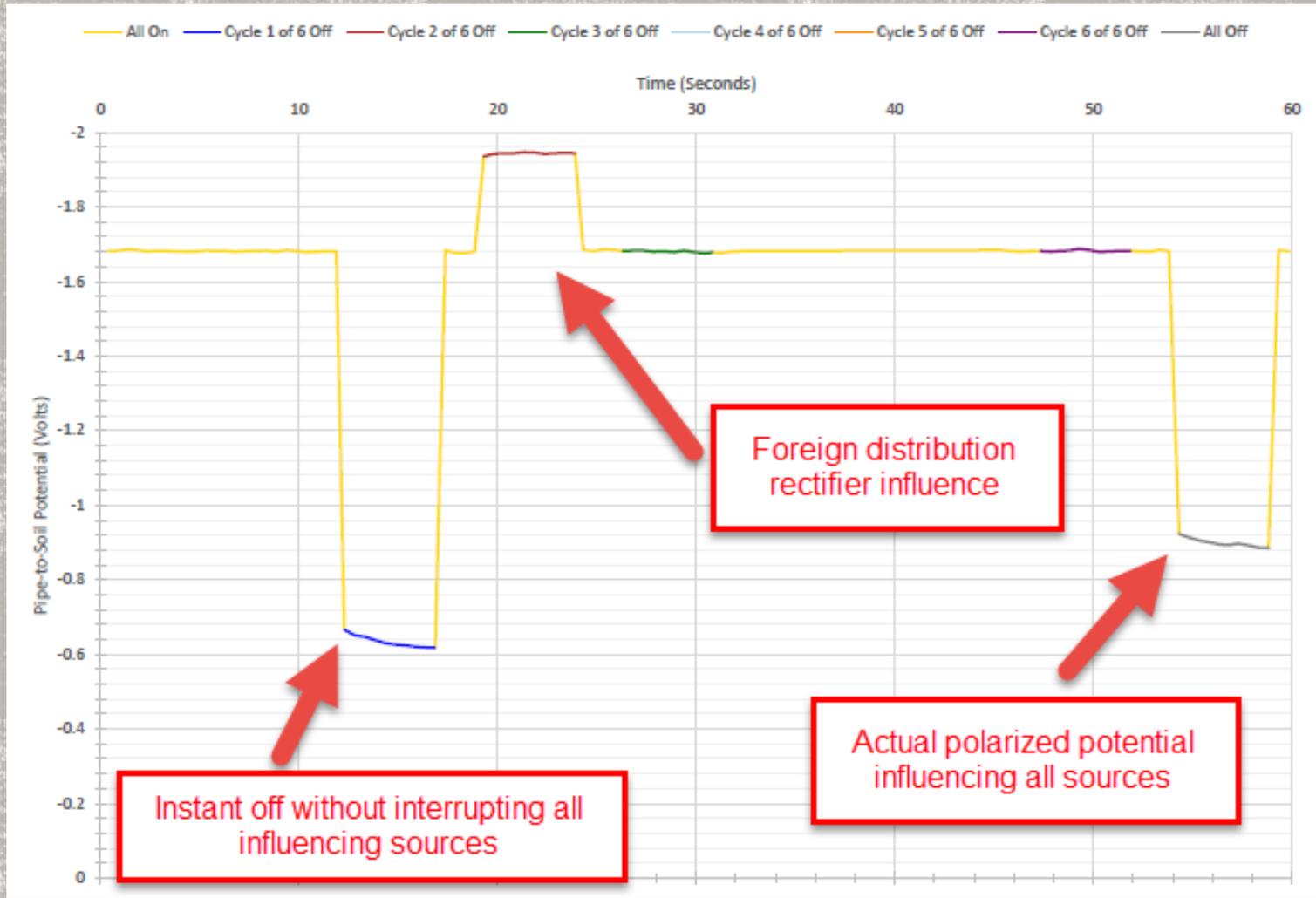
CIS WITH LOW P/S AT FOREIGN LINE XING



NEXT PAGE GRAPH



P/S WAVEFORM AT LOW READ LOCATION



CASE STUDY- 30" CCP WATER LINE MEETS STRAY CURRENT CORROSION

Information:

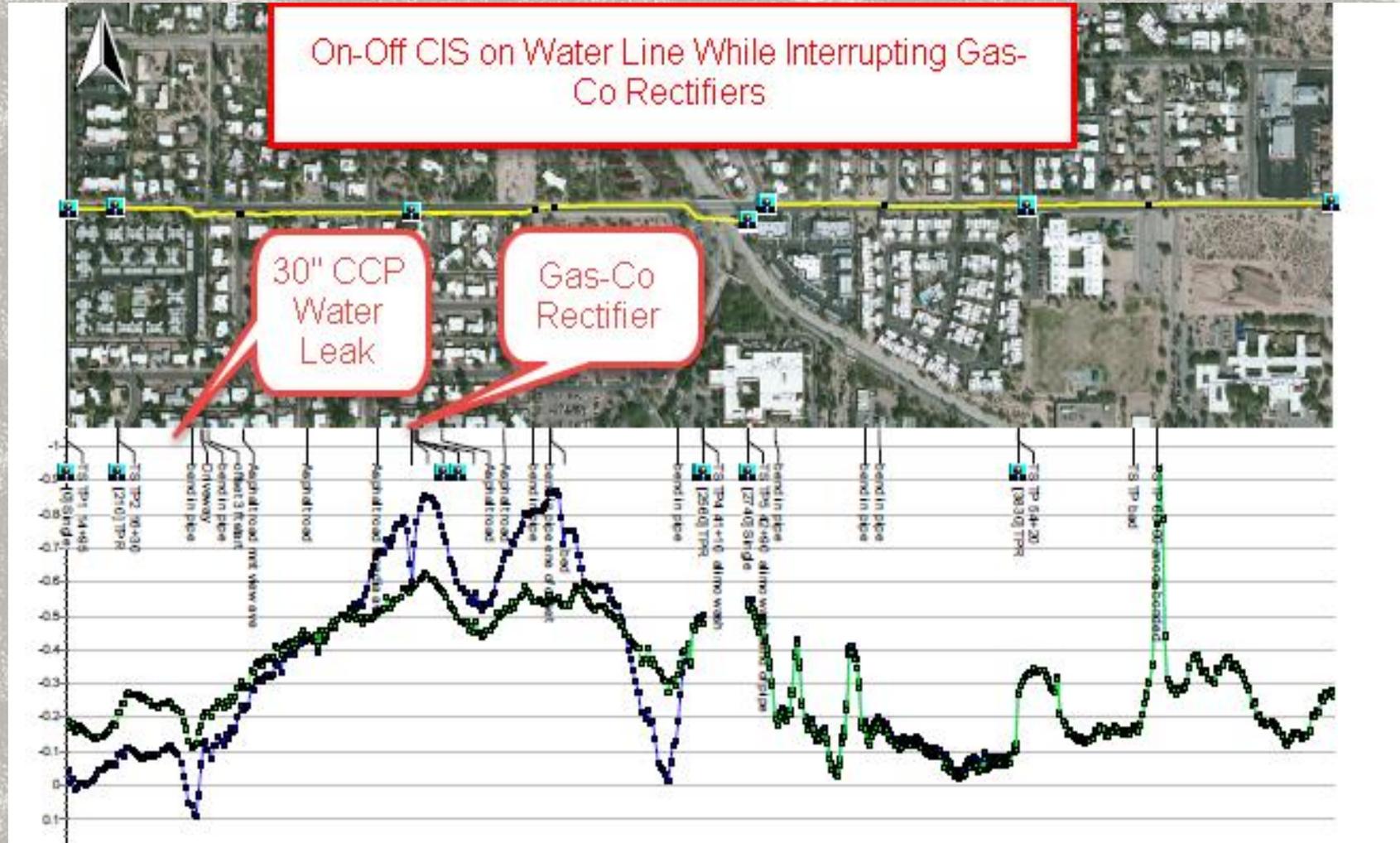
- At failure the Pipe-to-soil was + potential
- Test points at aprox. 1000-foot intervals
- “Bonded joints”
- No CP installed on water line
- Water Line runs parallel to Gas Line with CP in the road.
- Multiple Gas Line Rectifier/Deep Anodes are in the area



OBLIGATORY PHOTO OF CORROSION

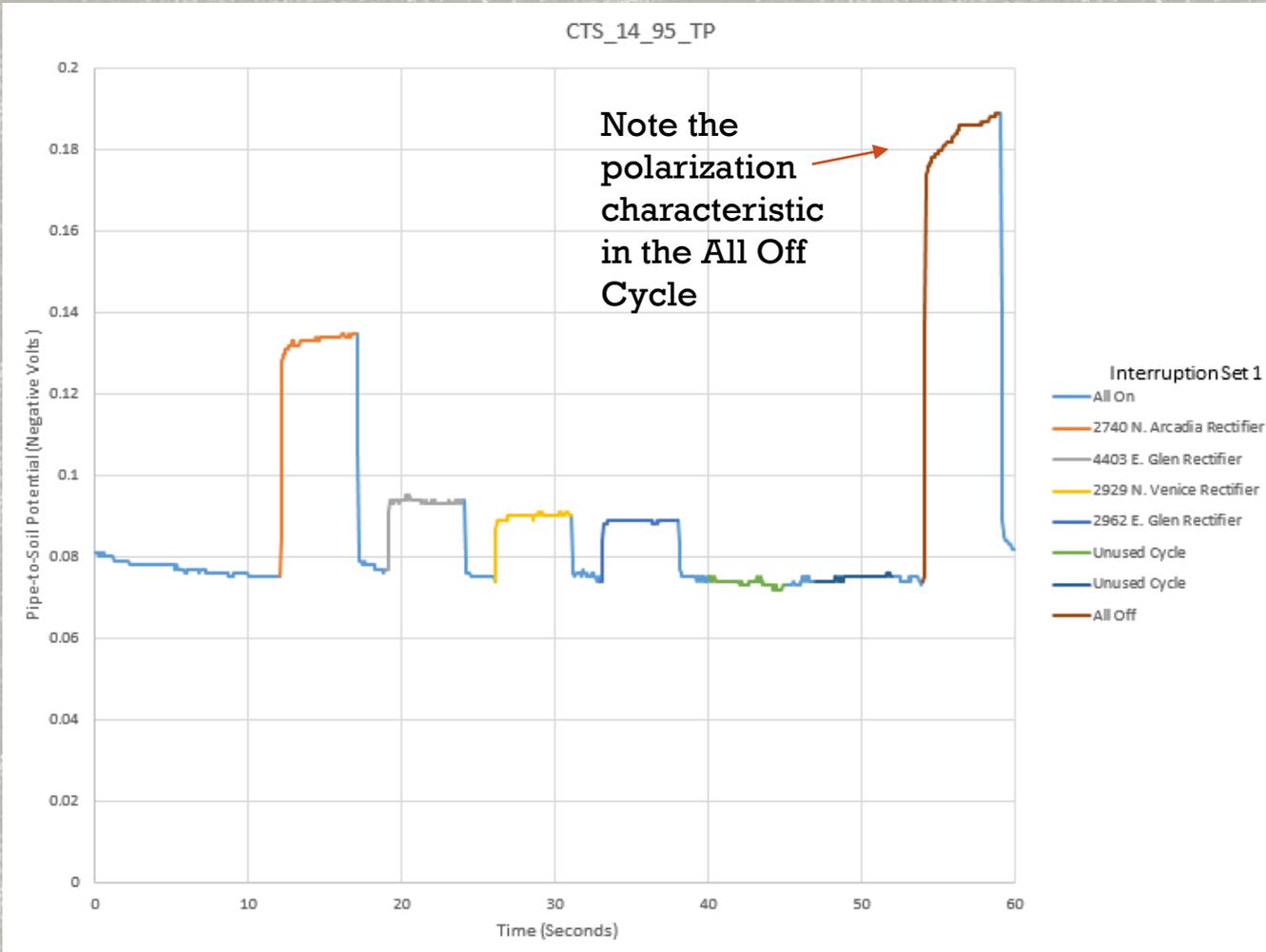


IDENTIFYING LOCATION OF INTEREST USING CIS

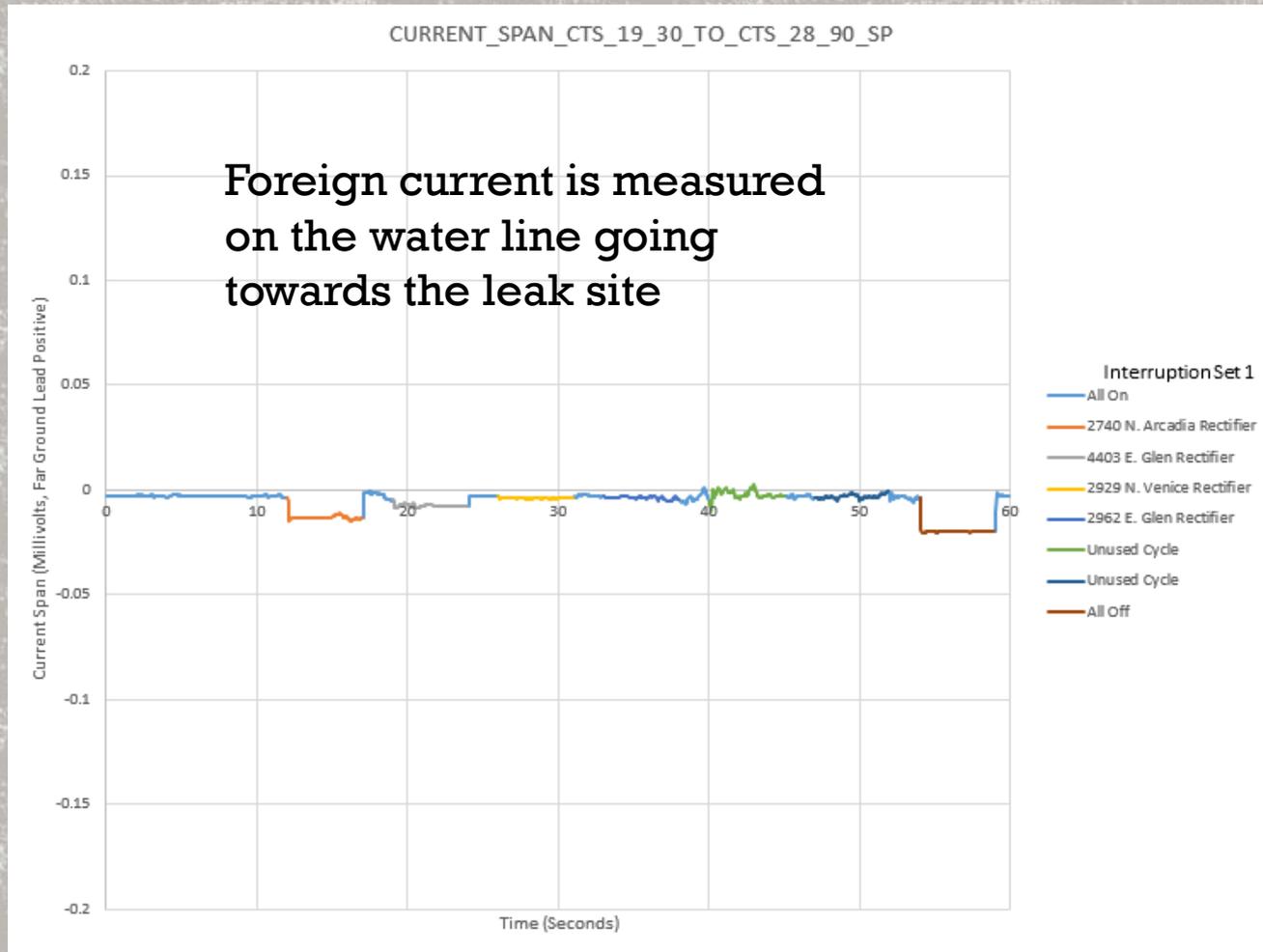


PERFORMING R.I.S. AT LEAK SITE

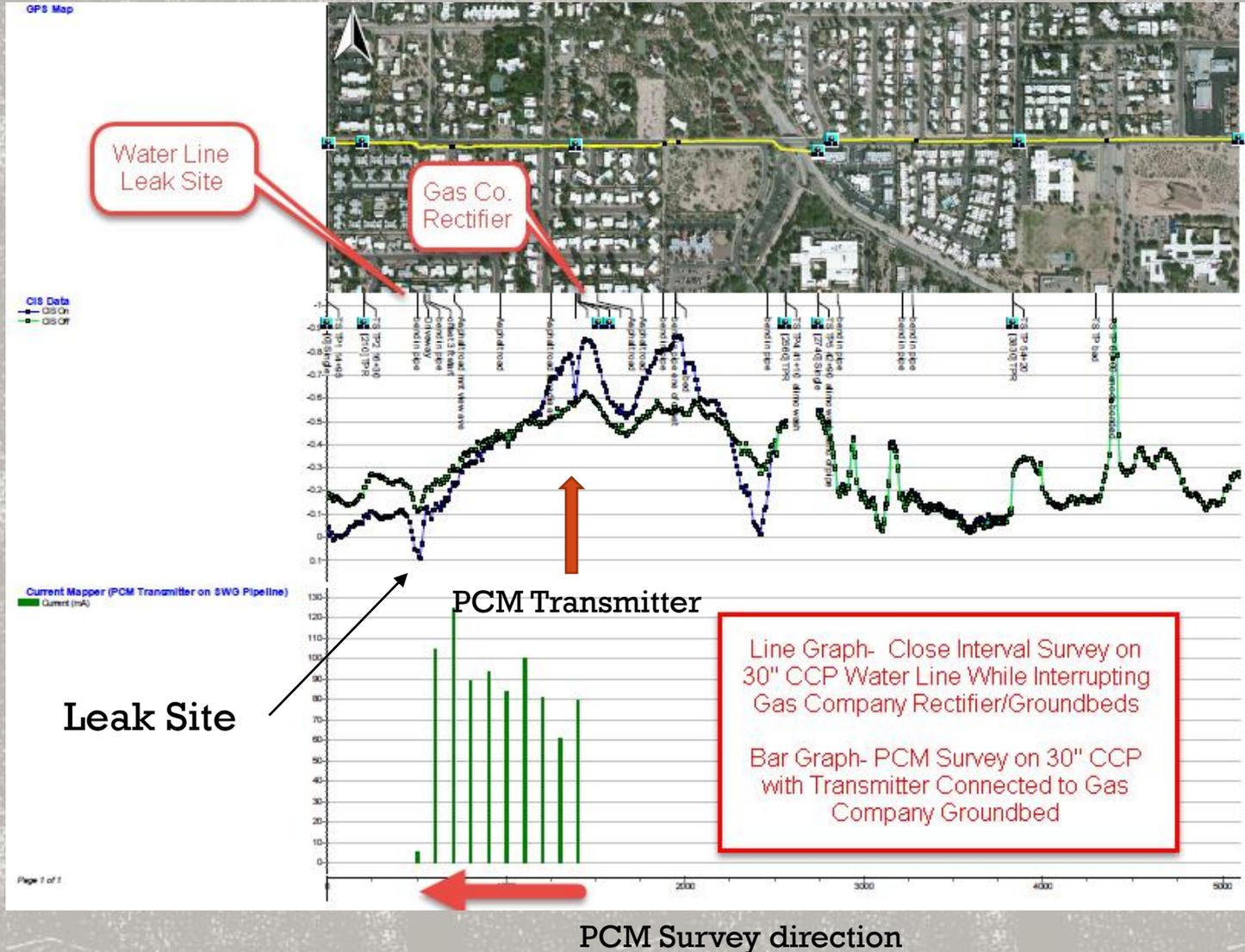
P/S POTENTIAL WAVEFORM



WAVEFORM ON CURRENT SPAN NEAR PREVIOUS LEAK SITE



USING THE PIPELINE CURRENT MAPPER TO VALIDATE THE STRAY CURRENT



TAKE AWAY FROM THIS CASE STUDY

- The PCM validated the results of the Rectifier Influence Study. With the PCM transmitter installed on the Gas Company ground bed with return to the Gas Company pipeline, we were able to pick up current on the water line with the PCM receiver. As we took current measurements on the water line, the magnitude of current increased as we approached the leak site. One step past the leak site and the current could not be measured on the water line. We conclude that the PCM current was being discharged from the water line at this location.



QUESTIONS AND DISCUSSION

