Water Leaks and Corrosion Interference Currents

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Mark Voigtsberger – Utility Testing & Geographic Systems LLC

Track II Sewer/Water

March 4, 2025

Introduction to Presenters

- Mike Ames – President of Corrground Consulting LLC
- Cathodic Protection Specialist CP4, Senior Corrosion Technologist, Bsc Electrical Engineering, Asc Business Admin
- Over 45 years experience in oil/gas/water pipeline systems around the world
- Mark Voigtsberger – President of Utility Testing & Geographic Systems LLC
- Port St. Lucie, Florida

A question from the blue: Could water leaks be caused by current from nearby light poles?

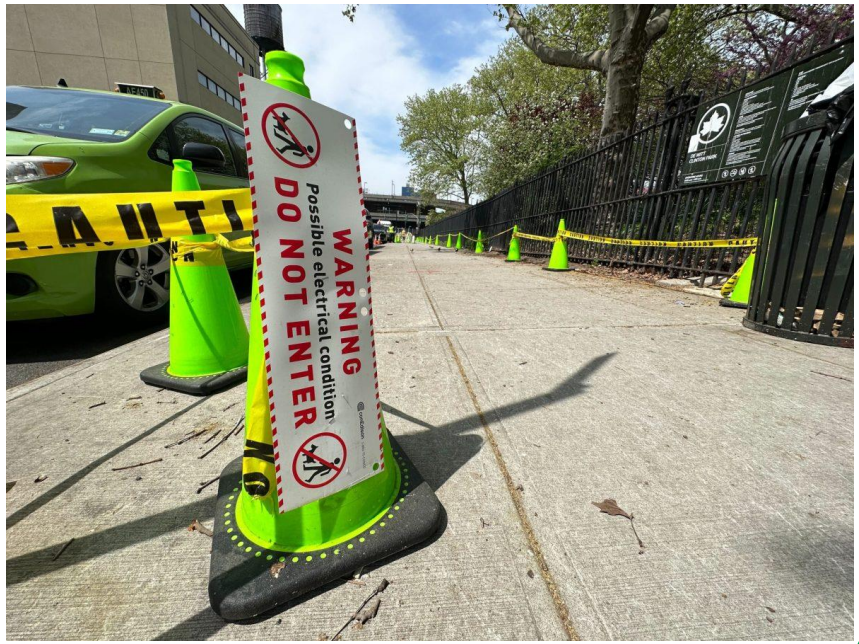
- Mr. Voigtsberger contacted me asking this question in 2023. My immediate response was any metallic pipeline can be corroded by stray currents in the soil environment.
- He had been inspecting public water systems for years and began to notice that where he was seeing a lot of leaks, there were nearby electrical systems of some sort. Power poles, light poles, transformer substations, and the like. He pondered if there was a relationship and began to take electrical measurements on these structures to ground.
- What he found was when a water leak was found, there was a high relationship with AC flowing to the electrical structure to the ground.

January 6, 2025

- Two dogs electrocuted in Washington DC
  - Happened while owners were walking dogs along city sidewalks
  - Events occurred hours apart, same location
    - “Chili” was killed in the afternoon at @4pm
    - “King” killed at @7pm
  - Sunset was at 5:01pm
  - What is the likelihood that fault started exactly at 4pm on that day?

W52nd St, NYC, DeWitt Clinton Dog Park

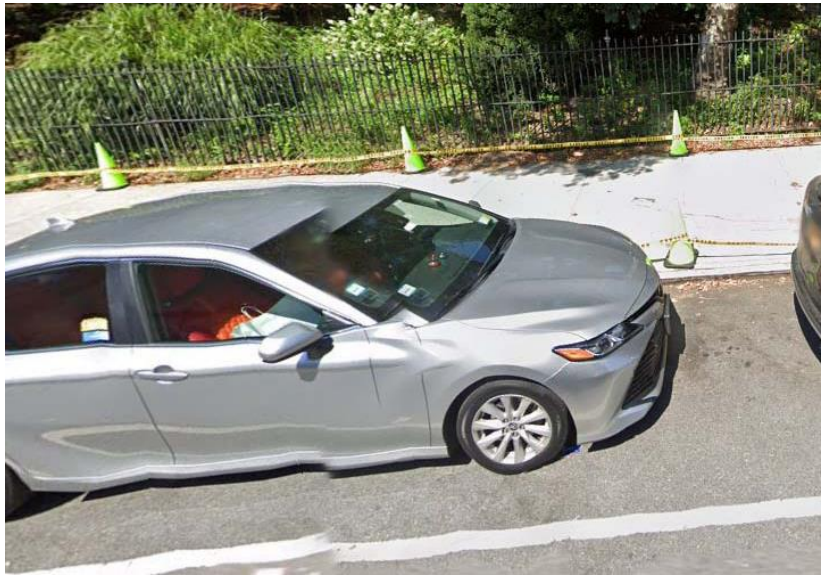
- Image is from 26 Apr 2023 (courtesy W42NDST.com)
- Entire city block electrified with <5vAC
- Google street view shows it has been there since before Aug 2022- 24 months.



W52nd St, NYC,
DeWitt Clinton Dog Park

Images from Google StreetView

August 2022



September 2024

External Voltages- Interference Currents- Are Much More Common Than Previously Known

- New York City averages over 2,000 streetlight faults per year
- Buffalo NY averages over 1,000 streetlight faults per year
- Baltimore MD averages over 600 streetlight faults per year

Many of these faults are multi-year events!

External Voltages- Interference Currents- Are Much More Common Than Previously Known

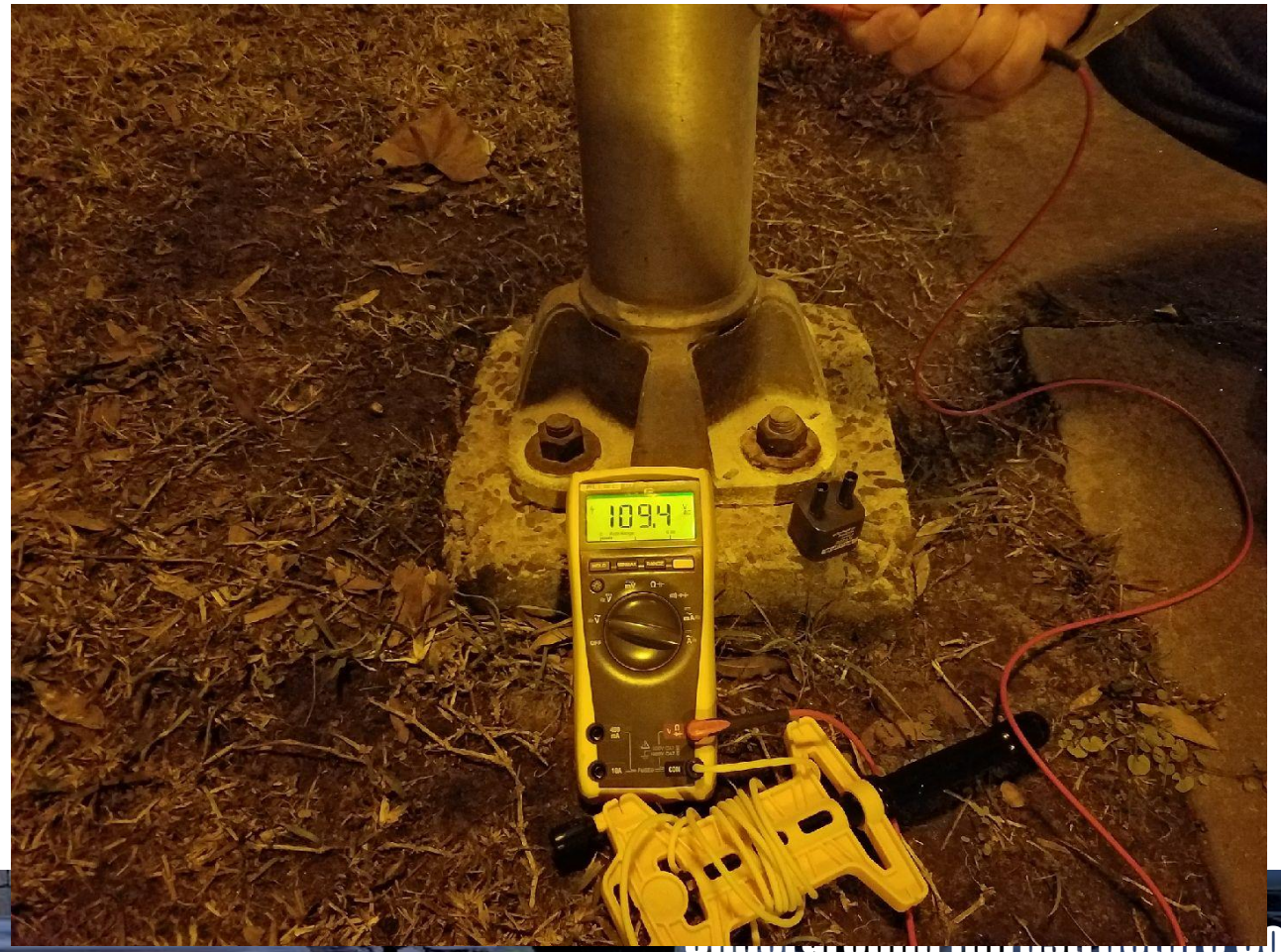
- Studies by the American Water Works Association and others find that external voltages are a leading cause of buried pipeline corrosion
- Pipeline workers and meter repair technicians frequently report being shocked while performing their duties

Streetlight electrical faults have never been considered a source for interference currents. It is a new and emerging issue!

How Do You Know It Is An Issue For **YOU?**

- Failure of metallic pipelines much, much, sooner that the expected life span
  - Water and gas leaks can be indicators
- Electrical shocks while working on pipes or swapping out meters
- Close proximity to overhead power lines and traction systems
- Abnormal voltage in CP systems

How To Check for Streetlight Interference Current



Streetlight Interference Current Testing

- MUST be performed at night to ensure electrical power is being supplied to the pole
  - Some poles use photocell to control power
  - Some poles are on a circuit with other poles and are controlled by a service panel
- MUST use a quality volt/multimeter to avoid false readings
- MUST use a half cell electrode to avoid false readings, especially if measuring DC voltages

Streetlight Interference Current Testing

- In general, start by testing streetlights and traffic signals closest to the damage and then working away in a logical pattern
  - Do **NOT** ask me what is logical!!!! I have many amusing stories from my military days on how I would handle a problem and how others handles the same problem ☺
- You may need to also test on opposite side of the street or median
- Observe roadway safety work precautions
  - High visibility vest
  - EH rated work boots

Streetlight Interference Current Testing

- Place half cell about 6’ away from object under test. Some cells can be used on pavement, some can be used on soil
- Turn on voltmeter to the proper voltage type, meaning AC or DC
- Touch the other test probe tip to object under test and read the display.
- When measuring DC, make sure you observe polarity
- Take corrective action if needed
  - You will need to develop your own policy on this. In the stray voltage testing world, we always document 1 volt or greater. Emergency action level is often 25v, but NACE/AMPP uses 15v. C[illegible] volts

Questions/Comments?

I am here until Thursday

(425) 381-7265 cell/text Mark.Voigtsberger@utgis.com

Thank you!

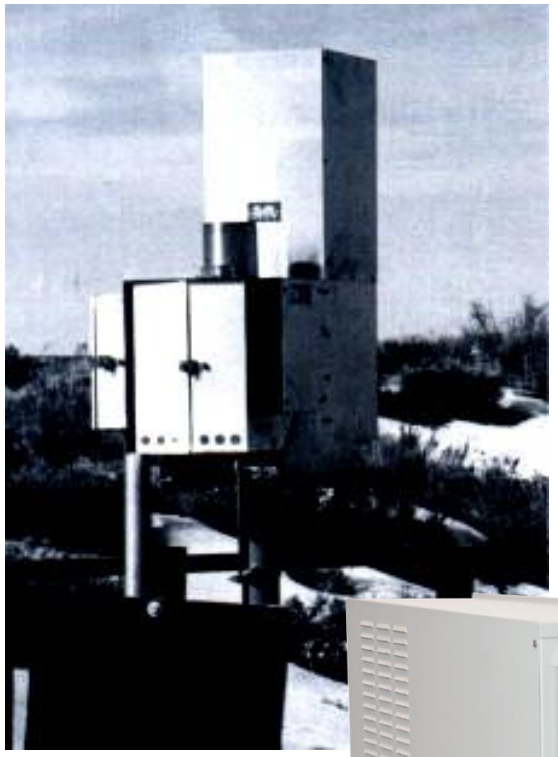
How Interference Currents Corrode Pipes

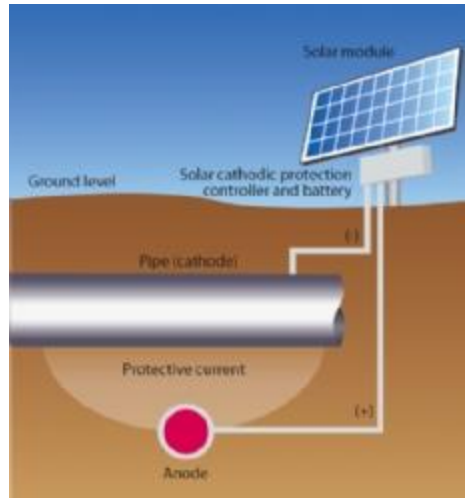
- Stray current can be from many sources.
- Between AC and DC currents in the soil, DC can corrode most rapidly and remove 17 pounds of iron per DC Amp of current flow.
- AC interference can corrode metal through small coating holidays.
- Oil and Gas pipelines near water lines can produce “Stray DC” on to a water line that at the collection area becomes cathodic and does not corrode, but at the return site to the pipeline rectifier the pipe surface becomes and anode and corrodes.

Stray Current DC Sources

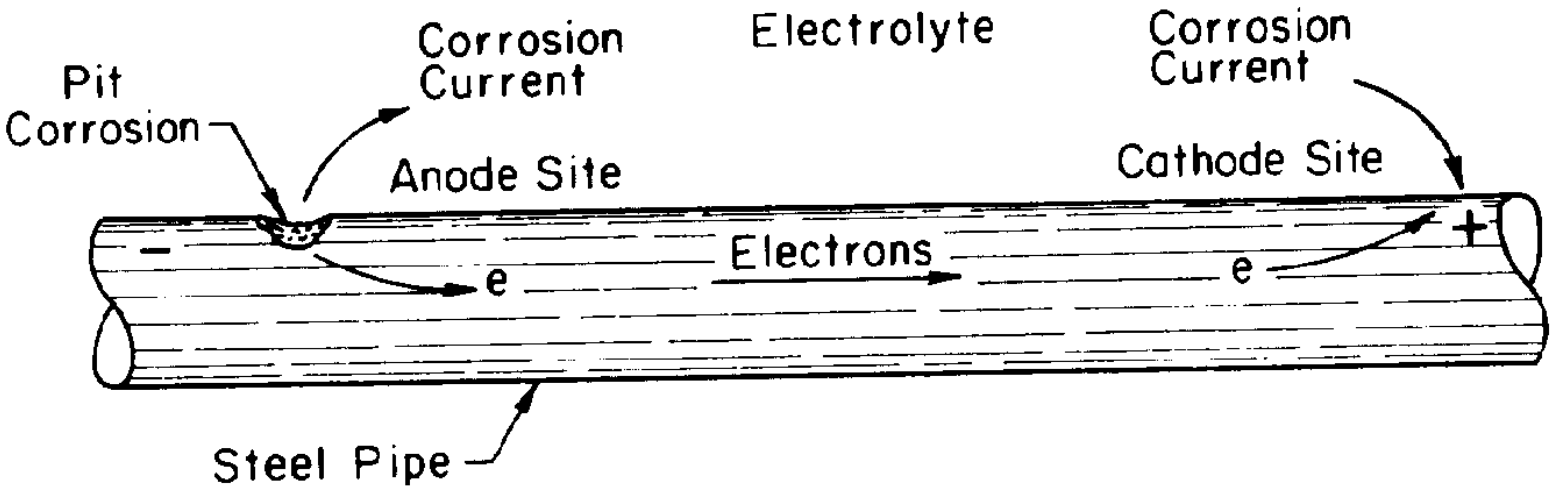
- Pipeline Rectifiers
- They pass current from anodes to protect long pipelines everywhere to protect against corrosion.
- This injected current can stray to other buried facilities, including water pipe and cause them to corrode and leak.

Alternative DC Power Sources



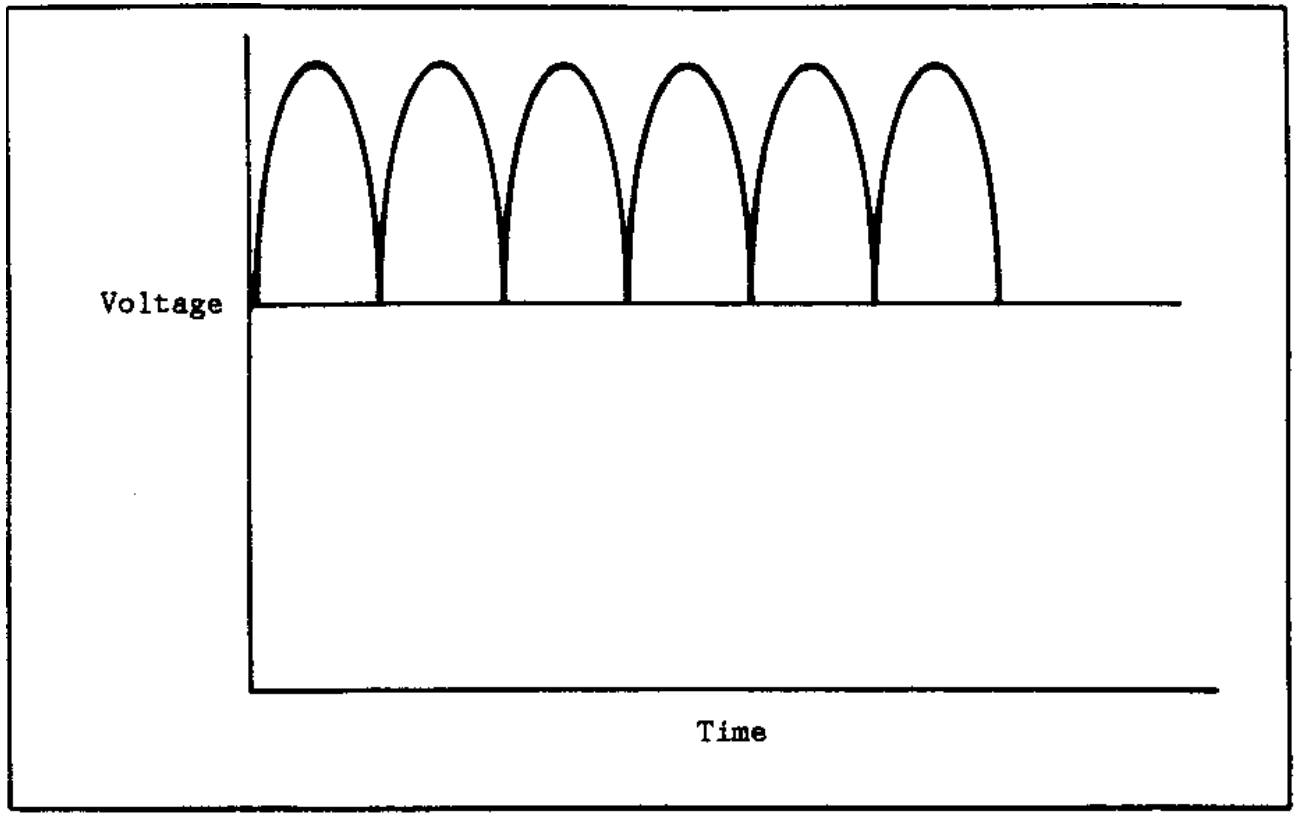


Stray Current DC Corrosion Cell

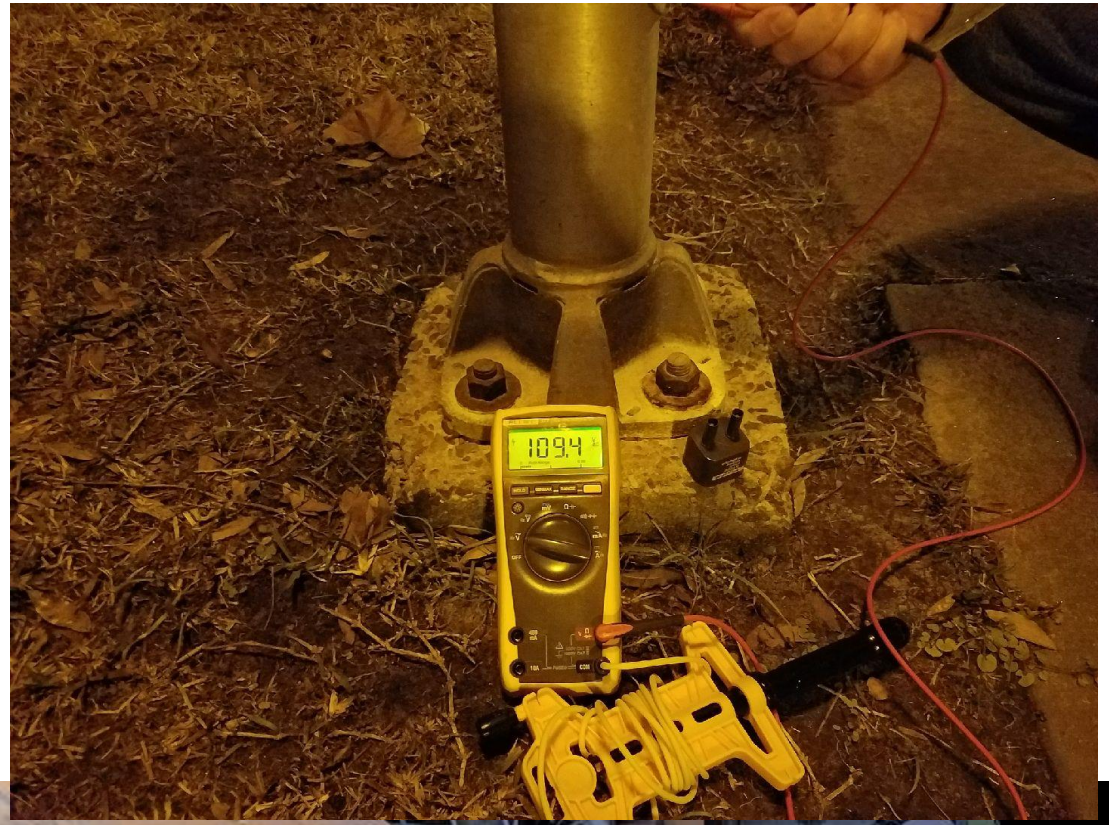


Reprinted from Cathodic Protection, L.M. Applegate, 1960, with permission of Mc Graw - Hill Book Company

Type of DC Output – DC Ripple Cathodic Protection Systems



You tested and you found no DC Voltages or Current!

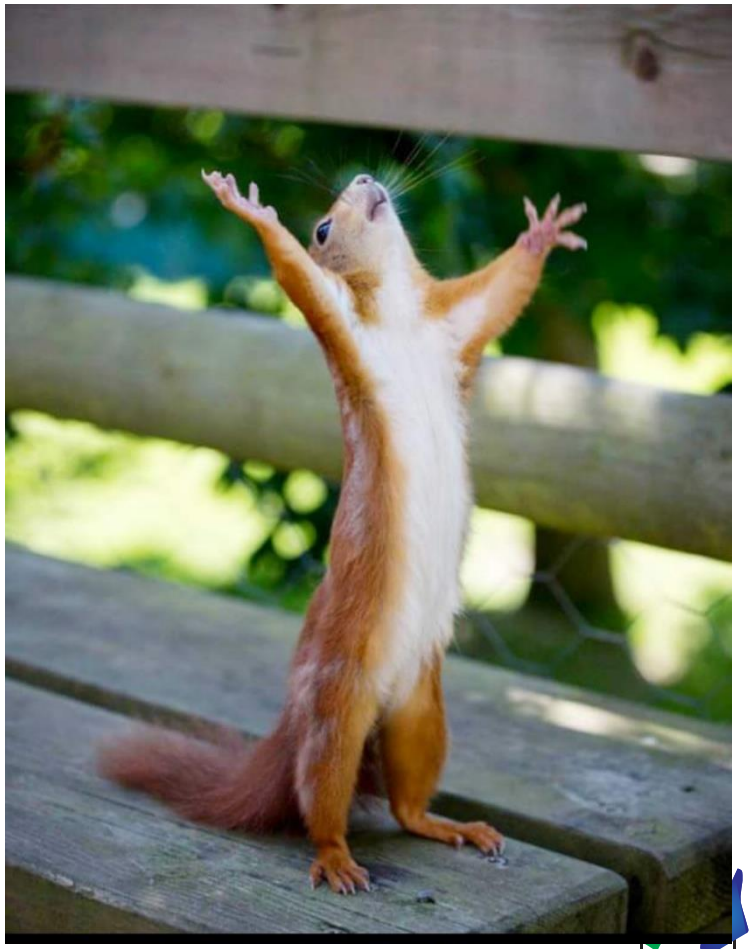


- Using a copper/copper sulfate reference cell your voltages are gaged against a standard.
- If wired correctly the measurement should always be a negative number i.e. -0.450V
- If it is a positive number, it is an instant indication that the structure is corroding.

So, you have no DC Interference, is that the end of your problems?

- Unfortunately, No!

- Remember AC Stray Currents?
- They can be from 3 causes
- Induced Current
- Capacitive Interaction
- Fault Currents/Soil Resistance



Common ROW Today – What About AC?

Types of AC Power Line/Pipeline Involvement

- **Inductive Coupling**

The process is one where the nearby parallel power line induces magnetic fields in the pipeline, opposite to those in the power line.

The model is a power transformer, with the power line the primary winding, the pipeline as the secondary.

This process causes the flow of high current levels in the pipeline, that need to be returned to the power line.

- **Capacitive Coupling**

This process creates charges on the pipeline as the opposite plate of a leaky capacitor and the power line as the other capacitor plate.

Normally the current accompanying this coupling is low, but an unburied pipeline can be a shock hazard.

Normally when buried there is much less capacitive coupling.

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TEL: 705-733-3307 FAX: 705-733-1218
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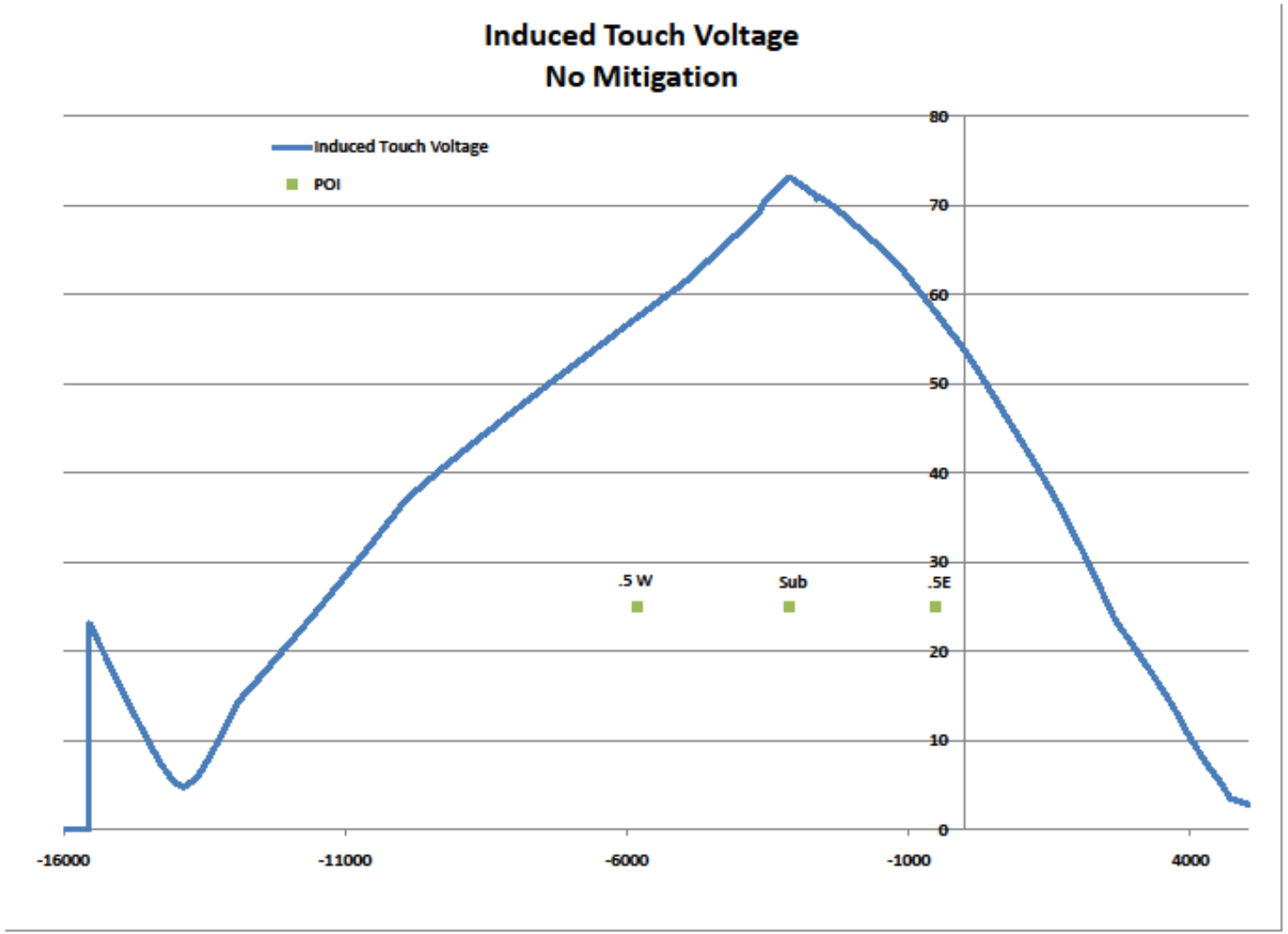
Drawing Title:

AC Mitigation Plot Layout

Location:
159TH STREET WEST
OLATHE, KANSAS

Client:
ATMOS ENERGY

Scale: Not to Scale


Induced Touch Voltage
No Mitigation
Induced Touch Voltage
POI
.5 W
Sub
.5E
80
70
60
50
40
30
20
10
0
-16000
-11000
-6000
-1000
4000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Capacitive Impact on a Pipeline

Pipeline/Power Line Interaction

- **Resistive Coupling/Faults**

A rare condition normally associated with a short from the power line to the ground, or to the pipeline directly.

The coupling can happen from a power line contacting a tree, a bad insulator allowing contact between the tower and a phase line, a line falling to equipment in the area or to ground.

The currents coupled to the pipeline can be very large, and normally of short duration as switchgear is oriented to disconnect lines that have this situation.

The major issue of this type of coupling may be significant coating damage from the high voltages and currents involved

- **Power Arc, and Lightning**

Power arcs can happen during fault currents, where the soil is ionized to allow an arc to the pipeline or soil near the pipeline. Lightning can be similar but is normally of less an issue on coating damage than arcs and faults may be.

Lightning can ionize the soil and penetrate to the pipeline, even to the point of burning holes in the pipe wall. Normally this would be in an area of higher soil resistivity with an area of less cover over the line. Lightning can also cause coating damage but may be less of an area of damage than an arc or fault.

AC Corrosion - Summary

- Induced AC voltage may be a cause of corrosion at coating defects where AC current escapes the pipe wall into the soil.
- Small rather than large coating defects are susceptible to AC corrosion effects.
- The surface area of the pipe at a coating holiday is important since the corrosion rate increases with increasing current density.
- Large holidays would have a lower current density than small holidays if both were exposed to the same soil conditions.

Induced AC - Pipeline

AC Soil/Corrosion Accretion

Pipeline Damage 33% Wall Loss

Fault Damage - Pipeline

2011 Gas/Electric Partnership Conference XIX
Cypress, Texas
February 9th, 2011

Point Integrity

- Example of damage from medium voltage fault current on line

pointintegrity.com

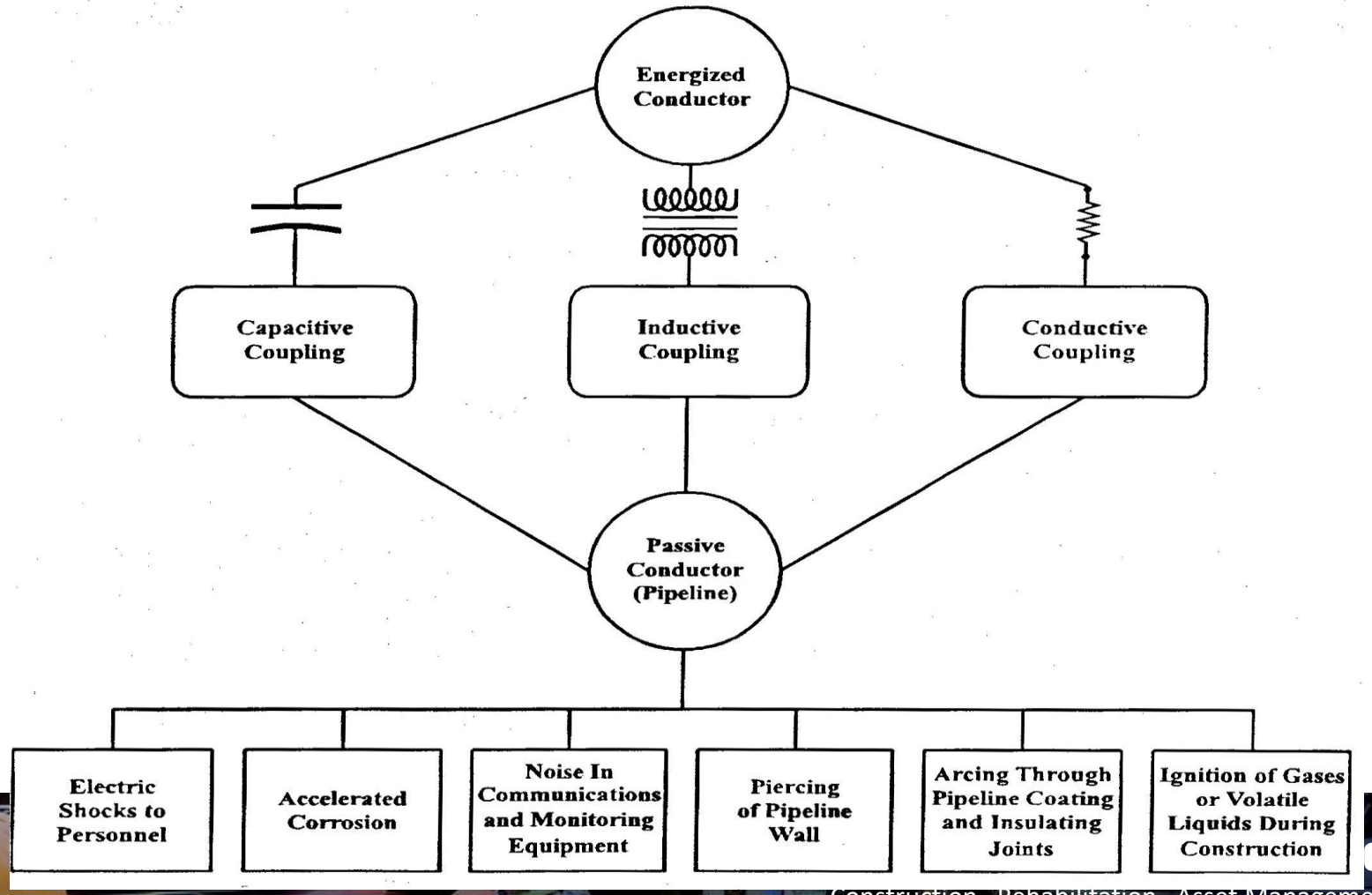
Fault Currents

- Fault currents can damage pipe coatings by causing them to disbond, or melt, or even penetrate them.
- Once the fault damage occurs to your pipe coating, corrosion processes will accelerate there and if any stray current is in the area, these rates can be very high.

Lightning

- Lightning has a similar effect as fault currents.
- Currents may be much higher but endure for less time than faults.
- Arcs in the soil can penetrate pipe wall and damage coatings for a long length of pipe.

HVAC/Pipeline Interactions



DC Interference

- Common from pipeline cathodic protection systems
- Modern lighting systems using DC.
- Solar Power systems
- Power Control Systems used in roadway lighting and switchgear.

- Finding AC or DC interference presence can be by taking AC and DC Voltage readings on your facility contact to a reference cell on the ground.
- Any positive DC current indicates rapid corrosion.
- All voltages should be evaluated for mitigation.

Summary

- Along with the driving force to place more infrastructures together in ROW corridors, interactions between these facilities will increase.
- Pipeline cathodic protection can cause water lines to leak.
- Power line AC systems can cause water pipelines to leak (those with good dielectric coatings even faster).
- Using a program to find and establish where stray currents exist may be a good addition to your maintenance and monitoring procedures.
- Once stray current interactions are found, there are many ways to mitigate the issue, but the first step is yours. Are you looking?

Any Questions and contact Information

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