

Interference: DC & AC

Detection and Mitigation



16th Annual
March 19, 2024

Christopher R. McKinley, P.E.
Chief Operating Officer



Southern Cathodic Protection Company
780 Johnson Ferry Road NE Ste. 225
Atlanta, GA 30342
Office: (404) 252-4649 • Fax: (404) 252-1824
www.cathodicprotection.com

Interference:

When Things don't go Our Way

Interference Defined

- *How does Interference Happen?*
- *What are the sources?*

AC Interference

- *How do I determine the pipeline has AC Interference?*
- *How bad is the Problem?*
- *What can be done?*

DC Interference

- *How do I determine the pipeline has AC Interference?*
- *How bad in the Problem?*
- *What can be done?*



Interference Defined

**Currents that follow
paths other than those
intended**

Southern Cathodic Protection Company
780 Johnson Ferry Road NE, Ste. 225
Atlanta, GA 30342
Office: (404) 252-4649 • Fax: (404) 252-1824
www.cathodicprotection.com



DC Interference vs AC Interference

A Brief Distinction

DC

When any net discharge of current leaves the pipeline, corrosion necessarily occurs

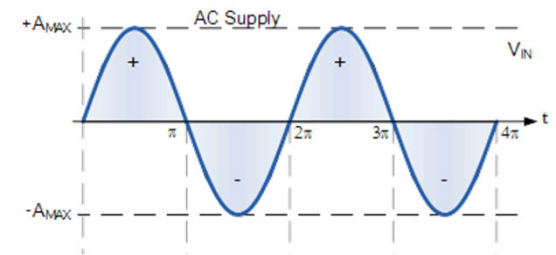
AC

The presence of AC potential and associated current discharge does not necessarily cause corrosion

Alternating Current – A.K.A. “AC”

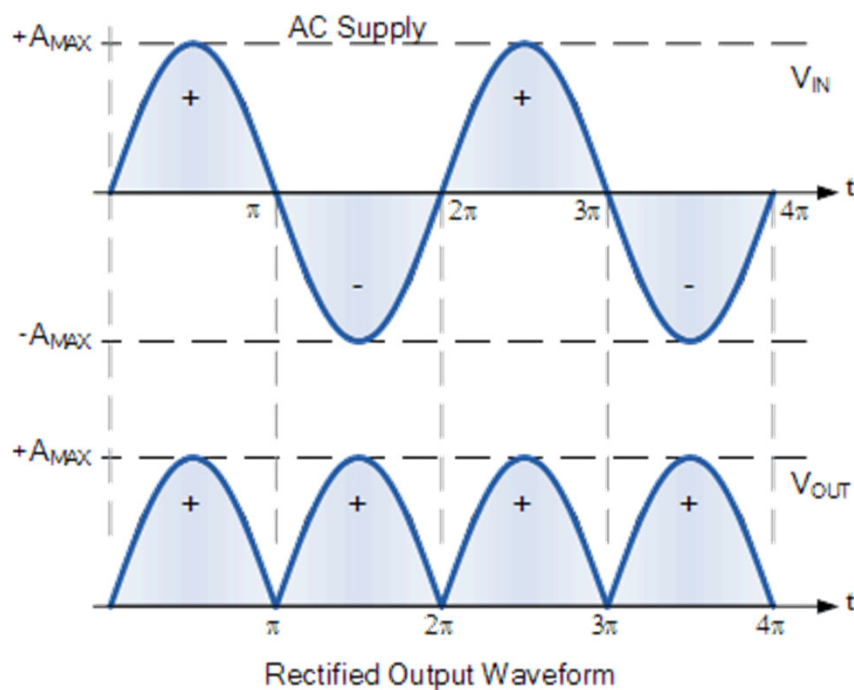
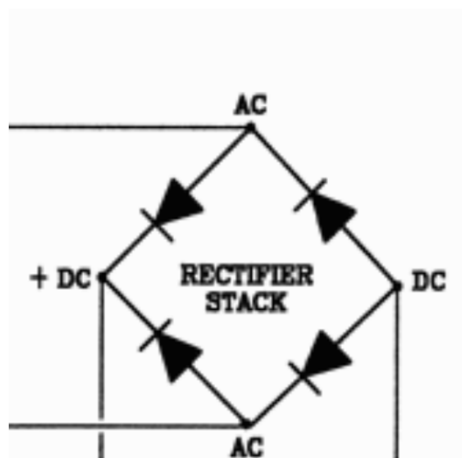


- Constantly changing + to -



- Frequency of the change is 60 times/sec

•Making DC: Rectifier Function



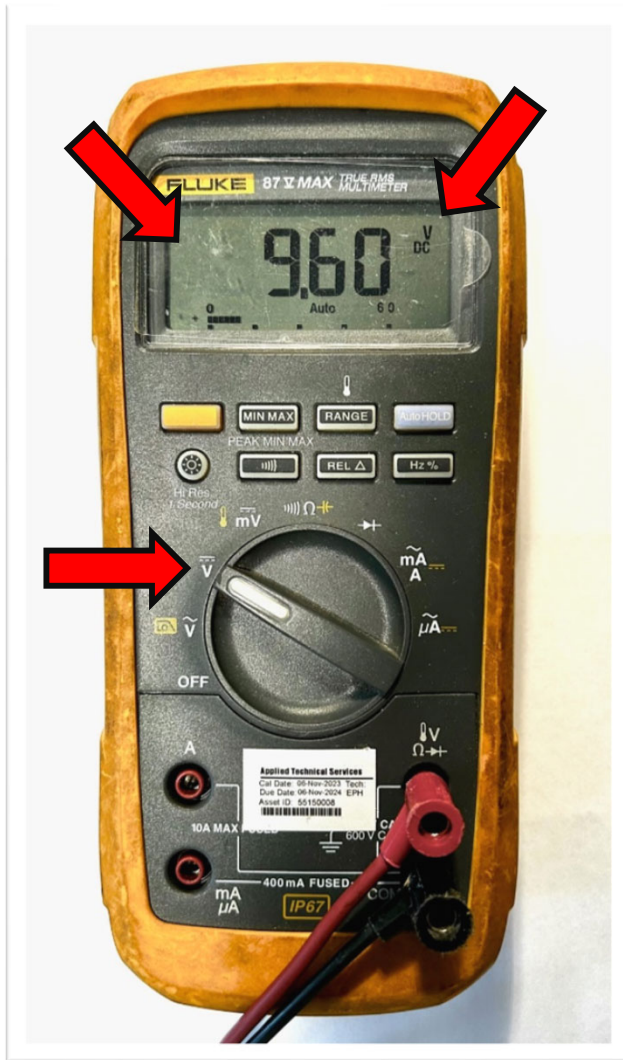
A Rectifier Makes DC...sort of

Setting the Stage



Southern Catholic Protection Company
780 Johnson Ferry Road NE Ste. 225
Atlanta, GA 30342
Office: (404) 252-4649 • Fax: (404) 252-1824
www.catholicprotection.com

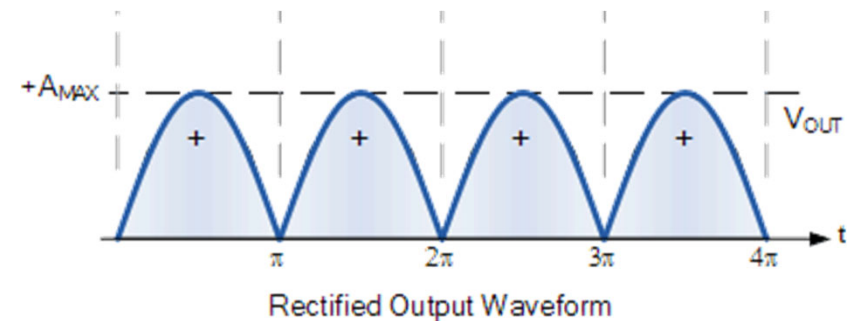
Direct Current – A.K.A. “DC”



- Current flows in one direction – Think Battery



- If a Rectifier made the DC, What is the Frequency?



AC Induction Effects



The Four Risks

- Safety, Arc Fault, Coating Stress, Corrosion

Caused by:

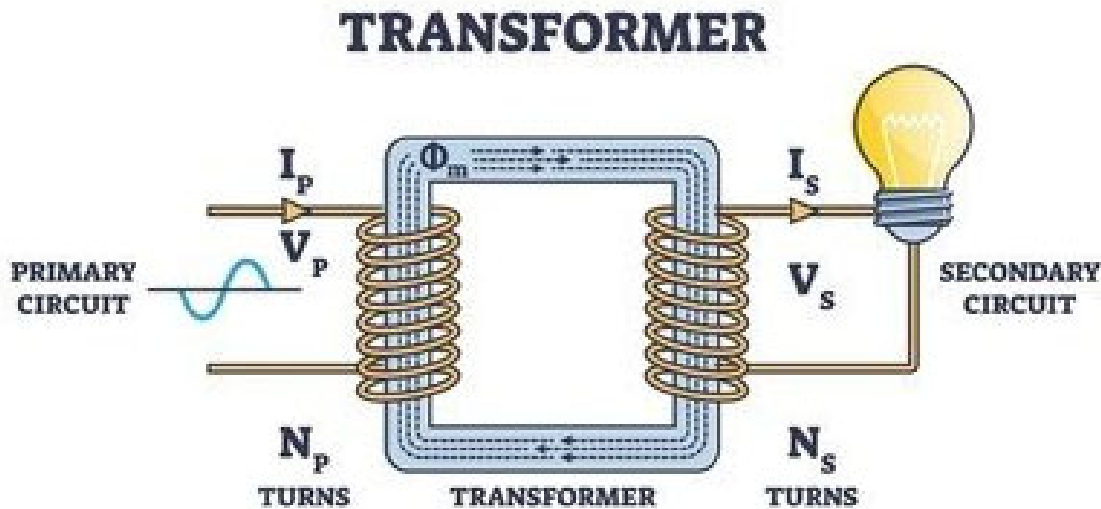
- Inductive, Resistive, Capacitive

Back Feeding AC Current through the Rectifier

AC Mitigation

- Problems Measuring the Instant-Off

AC Induction – a Simple Model



- No moving parts
- All wires are insulated
- Primary & Secondary wires never touch electrically

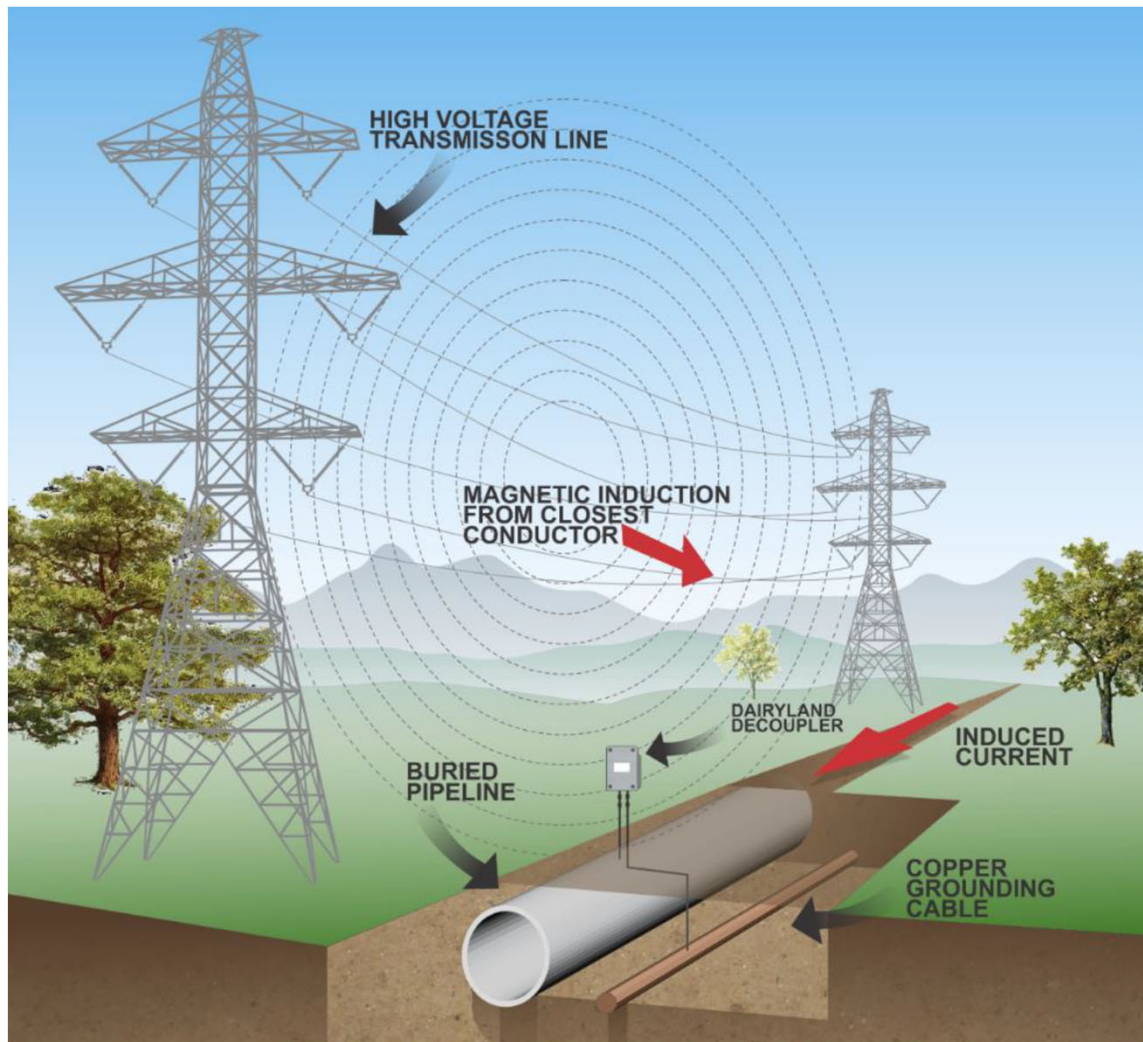
Electromagnetism

In Action



Southern Cathodic Protection Company
780 Johnson Ferry Road NE Ste. 225
Atlanta, GA 30342
Office: (404) 252-4649 • Fax: (404) 252-1824
www.cathodicprotection.com

AC Induction – an Introduction



- Induction due to parallel or Near parallel paths
- Inductive coupling for buried pipelines

•Corrosion Risk is Worse When:

Soil Resistivity is Low



Pipeline Coating is Excellent



Distance to Power Lines is Small



Cathodic Protection is Outstanding



Conductor Current is High



Collocation Angle is <60 degrees



The Problem

•AC Corrosion



$<20 \text{ A/m}^2$

No Corrosion

$>100 \text{ A/m}^2$

Definitely Corroding

$<30 \text{ A/m}^2$

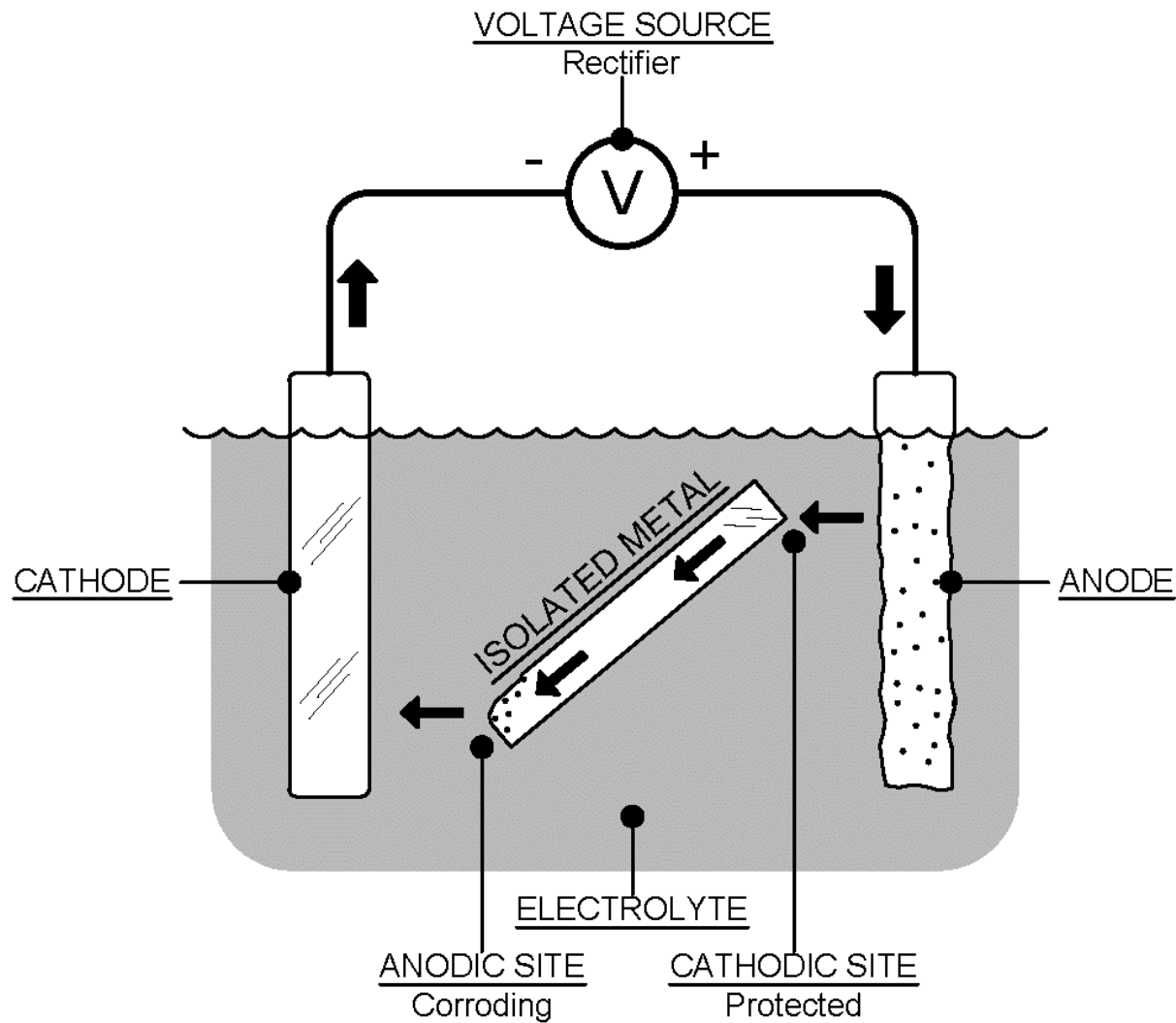
And DC $>1 \text{ A/m}^2$

$<100 \text{ A/m}^2$

And DC $<1 \text{ A/m}^2$

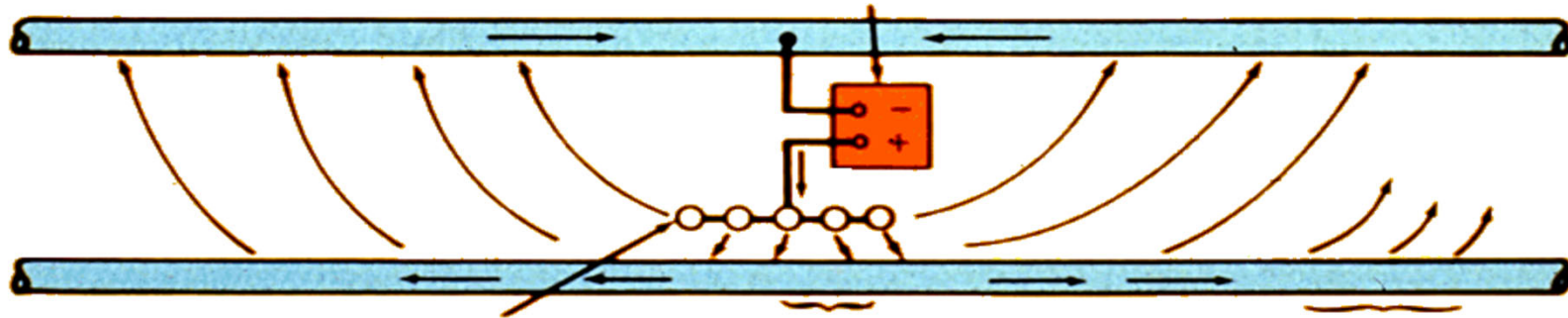
Criteria – Old & New

•A Look at Fundamental DC Interference



Interference Defined

•Geometry of the Problem – DC



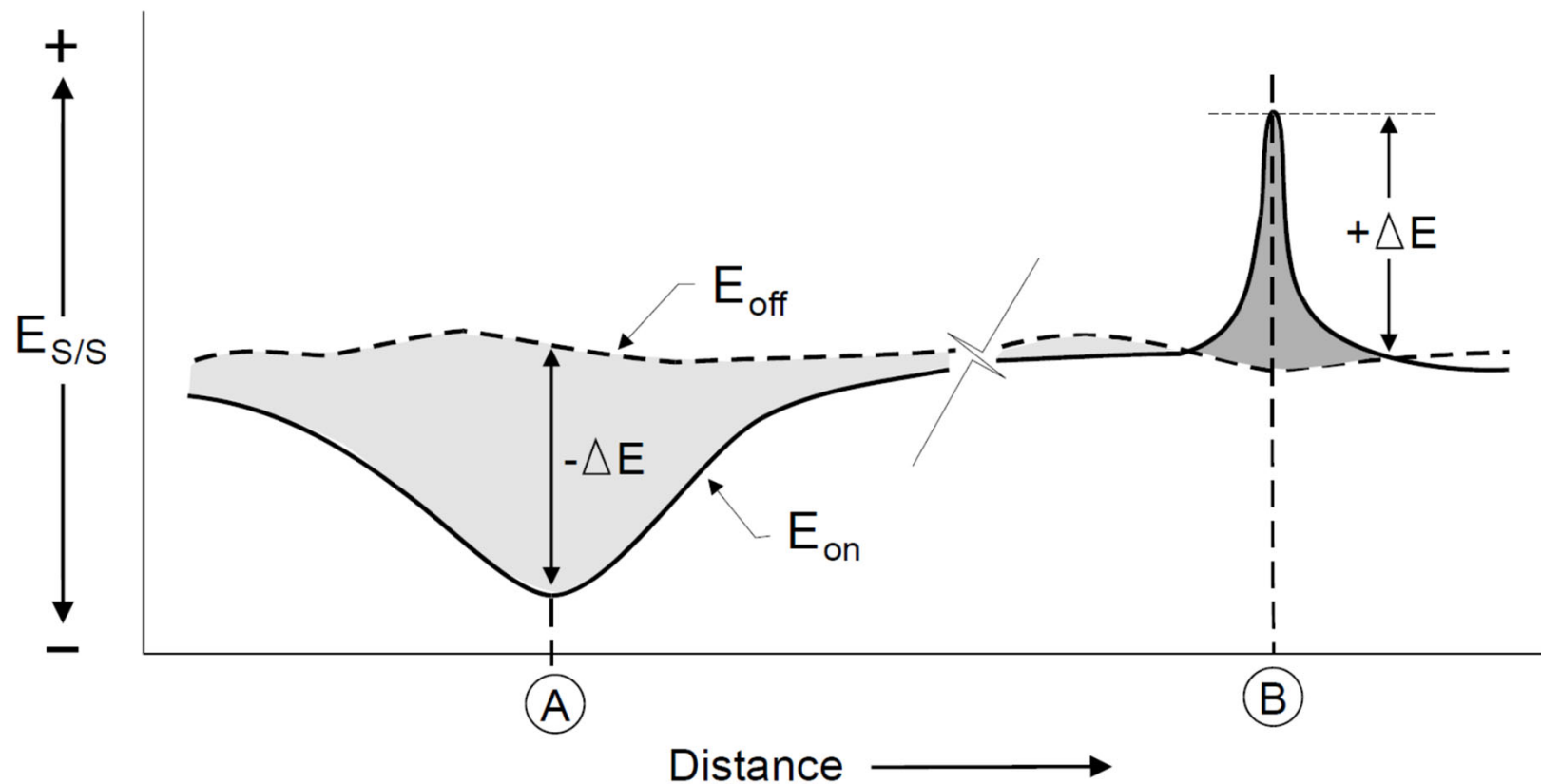
Static Stray Current

Interference Defined

Southern Cathodic Protection Company
780 Johnson Ferry Road NE, Ste. 225
Atlanta, GA 30342
Office: (404) 252-4649 • Fax: (404) 252-1824
www.cathodicprotection.com

SCP
Southern Cathodic
PROTECTION

• Potential Profile of Typical DC Interference



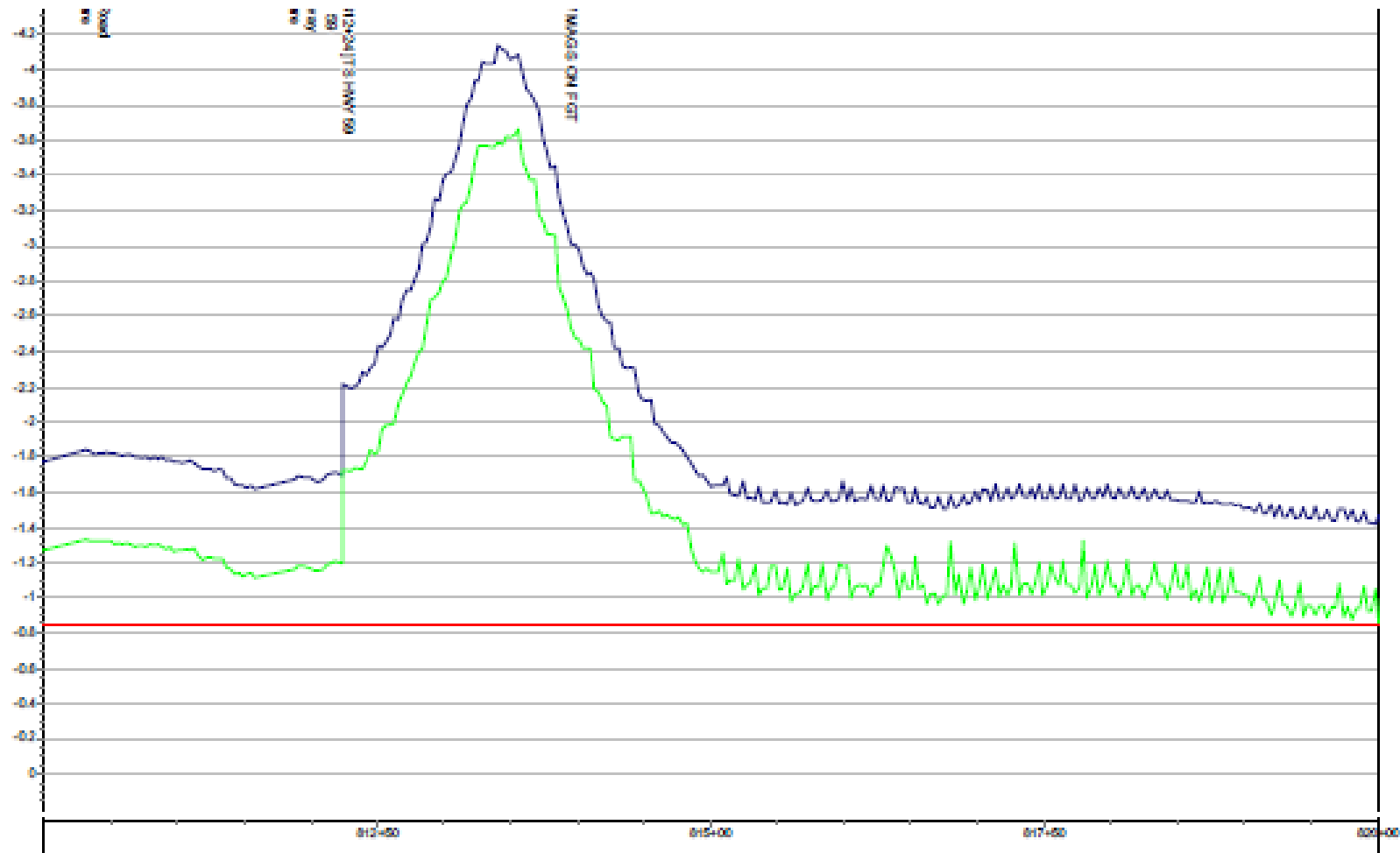
Source: AMPP Interference Course Manual

Interference Defined

Southern Cathodic Protection Company
780 Johnson Ferry Road NE, Ste. 225
Atlanta, GA 30342
Office: (404) 252-4649 • Fax: (404) 252-1824
www.cathodicprotection.com

SCP
Southern Cathodic
PROTECTION

•Current Pick-up

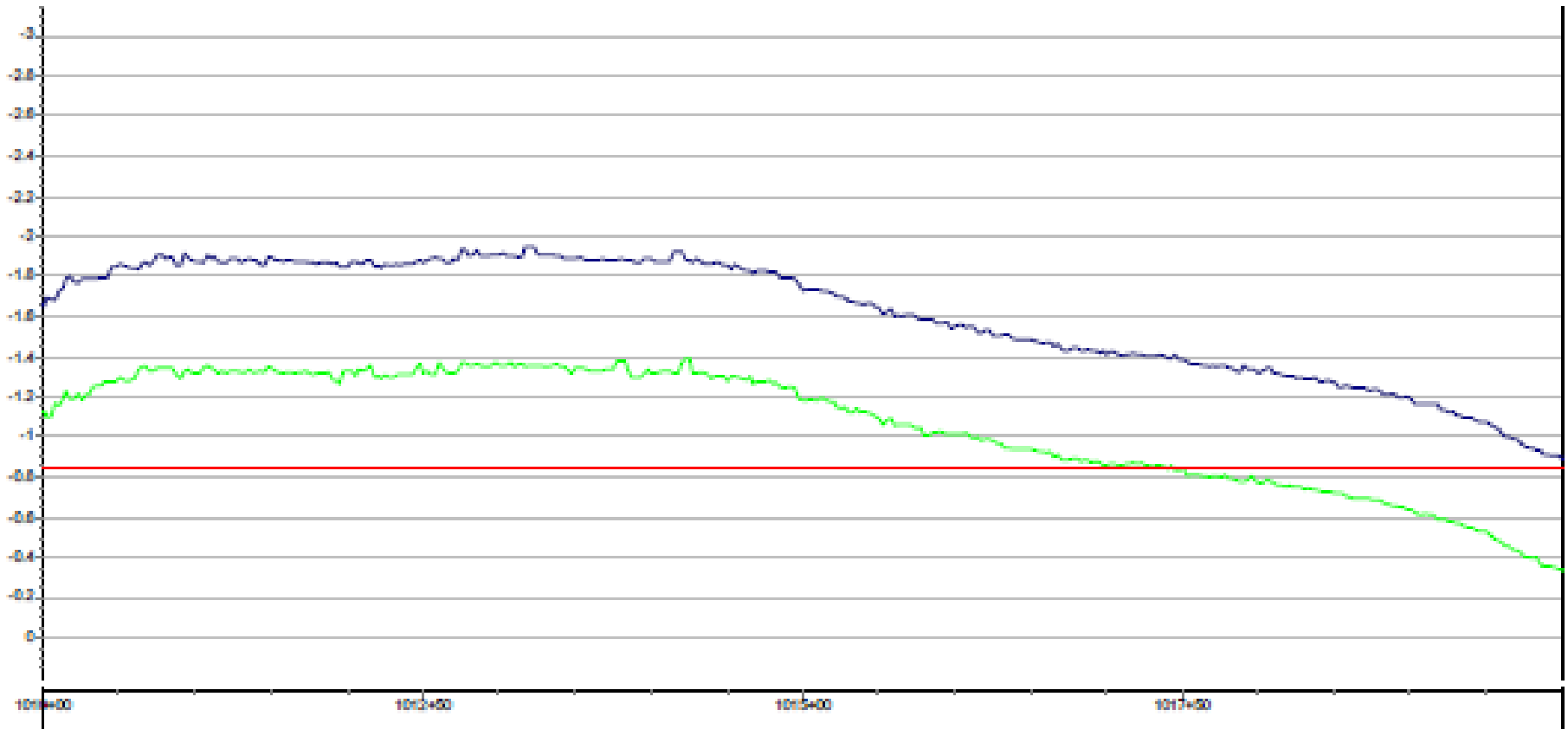


Identifying Interference

Southern Cathodic Protection Company
780 Johnson Ferry Road NE, Ste. 225
Atlanta, GA 30342
Office: (404) 252-4649 • Fax: (404) 252-1824
www.cathodicprotection.com



•Current Discharge



Identifying Interference

Southern Cathodic Protection Company
780 Johnson Ferry Road NE, Ste. 225
Atlanta, GA 30342
Office: (404) 252-4649 • Fax: (404) 252-1824
www.cathodicprotection.com



•What Happens to Our Potentials?

Foreign Pipeline is Interfering

Foreign Pipeline

ON -1250mV

OFF -900mV

Our Pipeline

ON -850mV

OFF -1150mV

Foreign rectifier interrupted

Identifying Interference

Southern Cathodic Protection Company
780 Johnson Ferry Road NE, Ste. 225
Atlanta, GA 30342
Office: (404) 252-4649 • Fax: (404) 252-1824
www.cathodicprotection.com



•AC Interference - Mitigation



Fixing the Problem

•DC Interference – Mitigation

What are our Options?

- Provide a Low Resistance Path Back to the Source:
 - Bonds & Drains

- Increase Circuit Resistances:
 - Recoat at the Pick-Up Site
 - Add Shields
 - Recoat at Discharge, but Must add alternate Current Flow Path

- Fight Current with Current

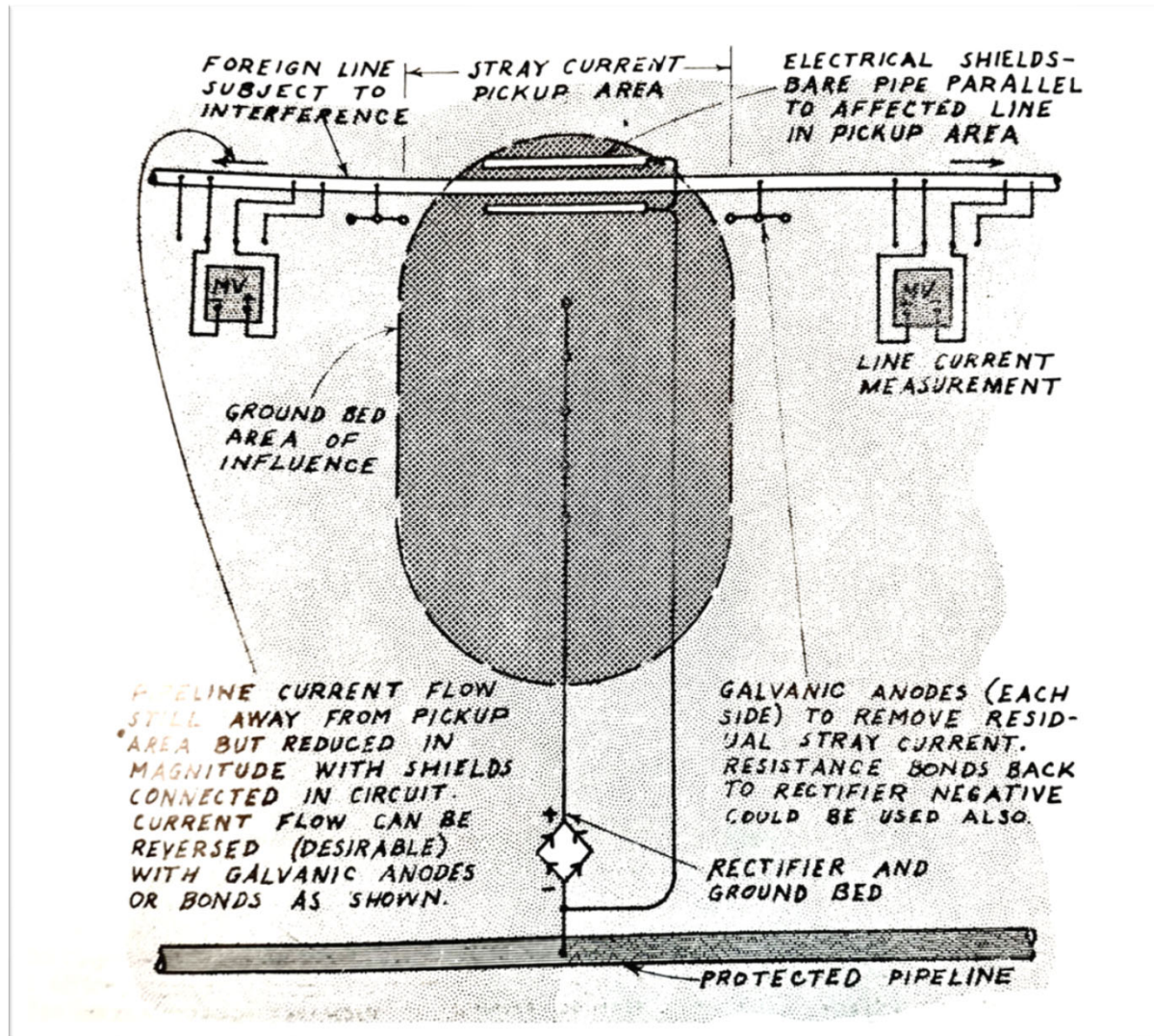


Fixing the Problem



Southern Cathodic Protection Company
780 Johnson Ferry Road NE Ste. 225
Atlanta, GA 30342
Office: (404) 252-4649 • Fax: (404) 252-1824
www.cathodicprotection.com

•DC Interference – Mitigation



Fixing the Problem



Southern Cathodic Protection Company
780 Johnson Ferry Road NE Ste. 225
Atlanta, GA 30342
Office: (404) 252-4649 • Fax: (404) 252-1824
www.cathodicprotection.com

Corrosion Coupons

So what things can we really do with coupons?

- On & Instant-Off Potentials
- IR drop
- Depolarized potentials
- Magnitude and direction of Current
- Detect Interference – AC and DC
- Detect shorted pipe
- Quantify dynamic interference with a data logger



Southern Cathodic Protection Company
780 Johnson Ferry Road NE Ste. 225
Atlanta, GA 30342
Office: (404) 252-4649 • Fax: (404) 252-1824
www.cathodicprotection.com

• Some Useful Resources

Association for Materials Protection & Performance (AMPP)

- **TM0497** Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems
- **SP0177** Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems
- **SP0169** Control of External Corrosion on Underground or Submerged Metallic Piping Systems
- **SP21424** Alternating Current Corrosion on Cathodically Protected Pipelines: Risk Assessment, Mitigation, and Monitoring

Standards

Questions