UNDERSTANDING AC INTERFERENCE and MITIGATION SOLUTIONS

NACE Atlanta Section

Pipeliner's Club of Atlanta

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Bass Engineering Company

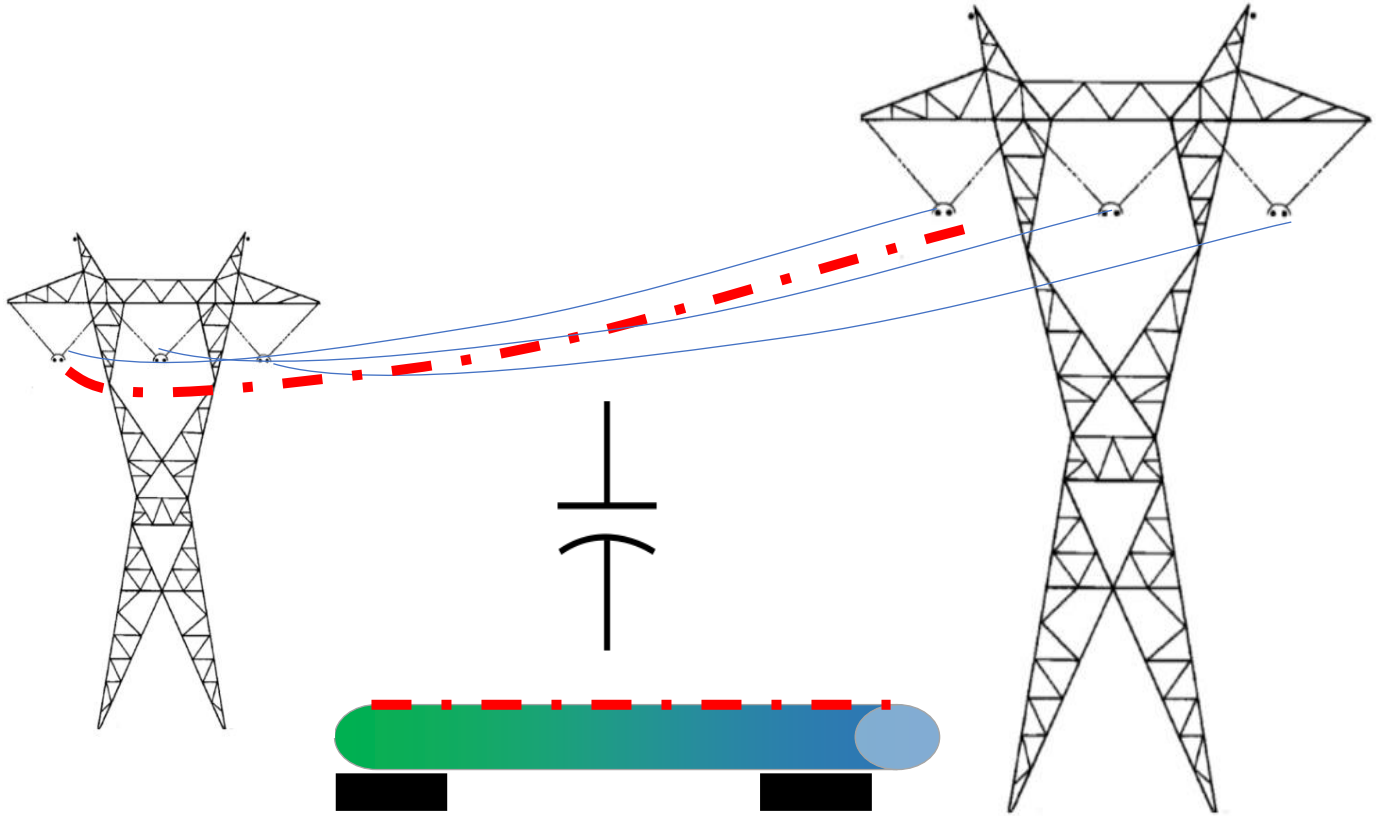
AC Interference

- Collocation
  - Pipelines
  - HVAC Power Systems
- Creates complex electro-magnetic interaction
- Introduces risk
  - Personnel
  - Assets

Capacitive Coupling

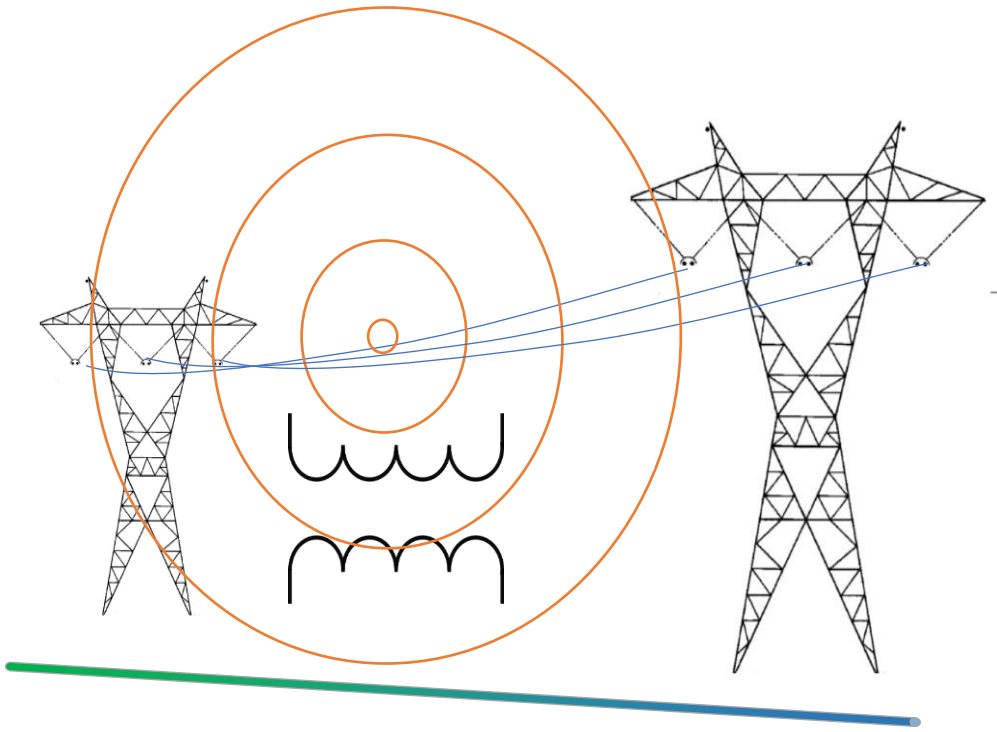
Electric Field Influence

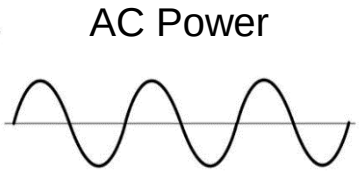
Proportional to HVAC Voltage

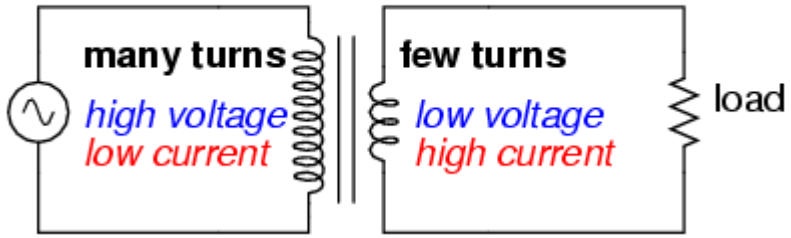


Inductive Coupling

Magnetic Field Influence
Proportional to HVAC Current





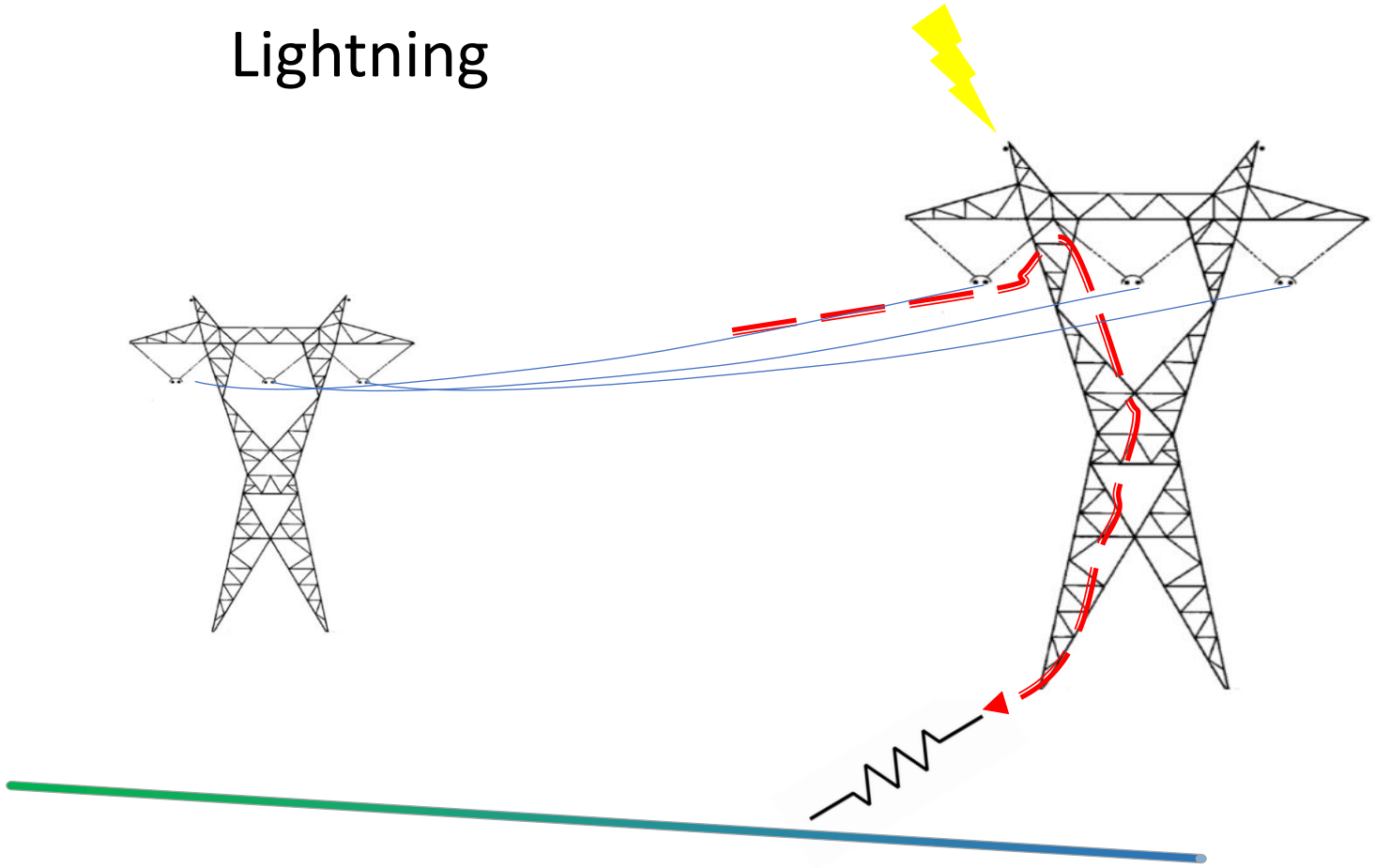


Resistive Coupling

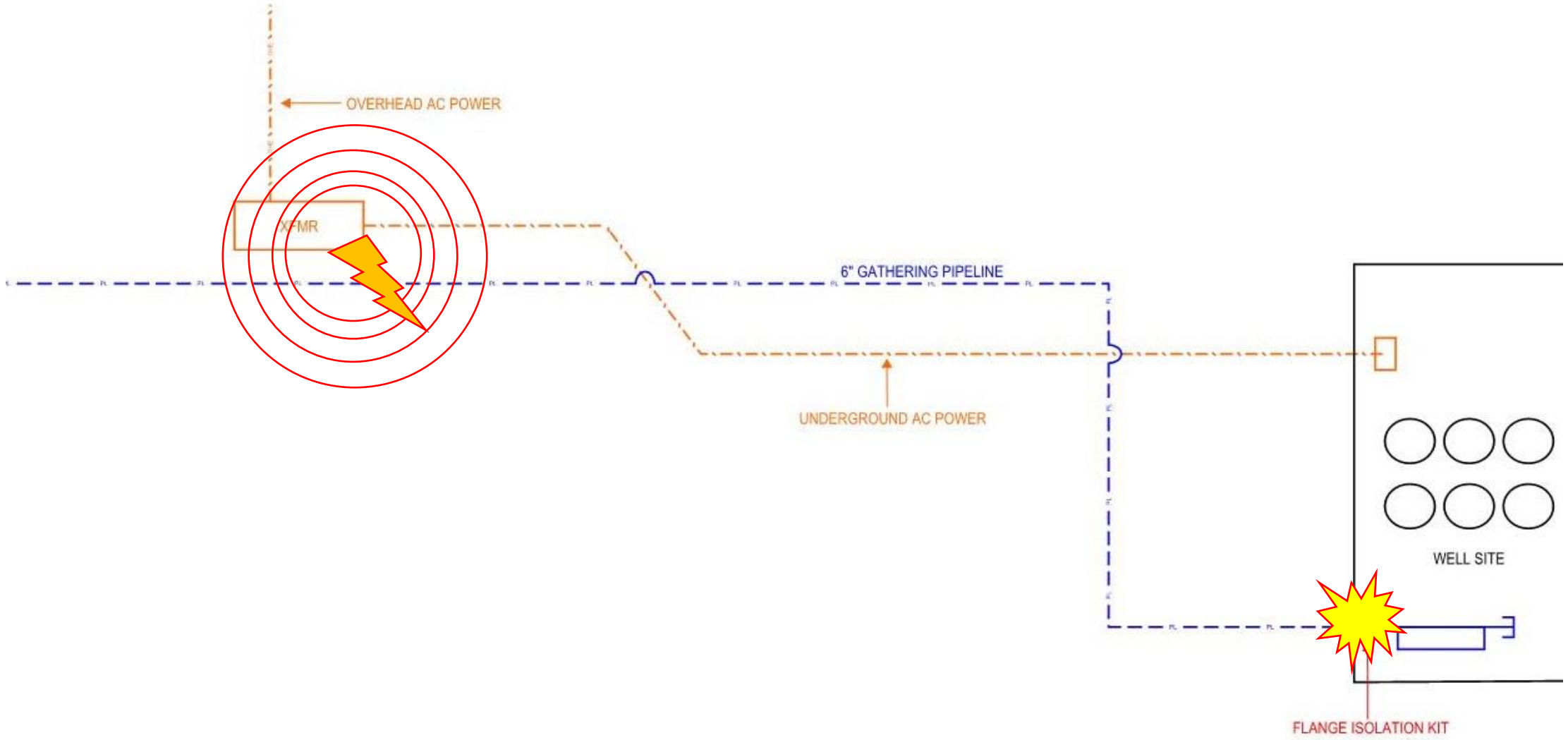
Shared Conductive Path

Faulted HVAC Condition

Lightning

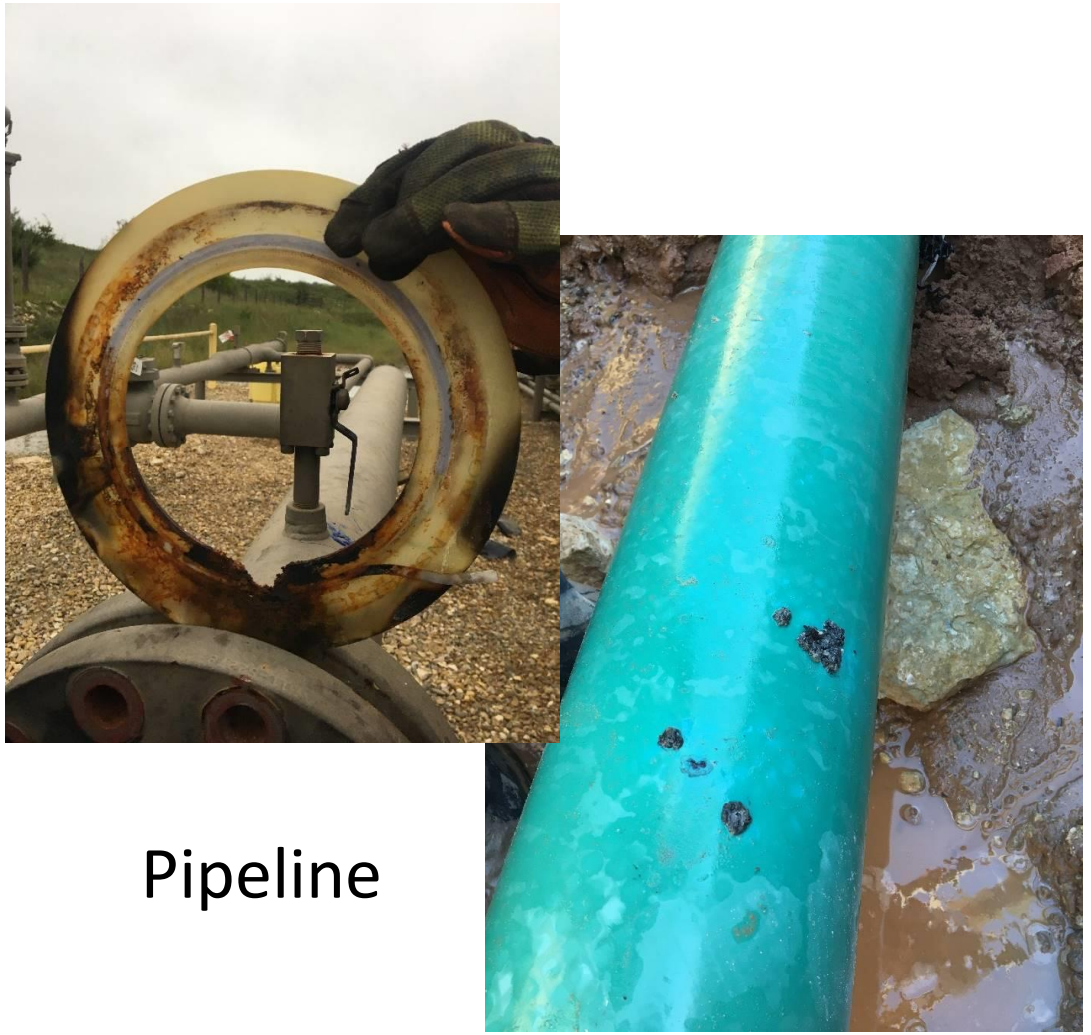


Faulted AC Event



Faulted HVAC Condition

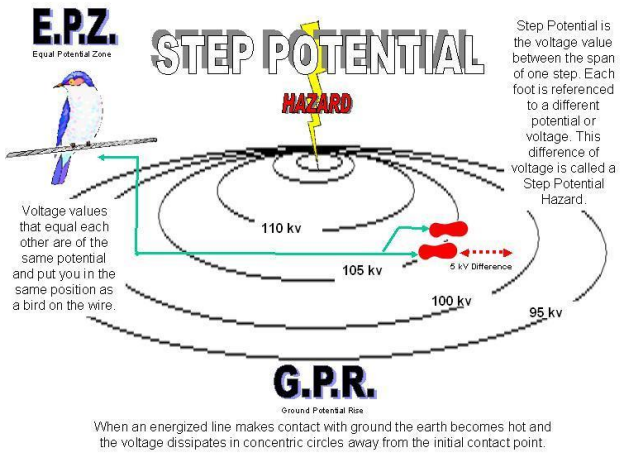
Pad Mounted Xformer

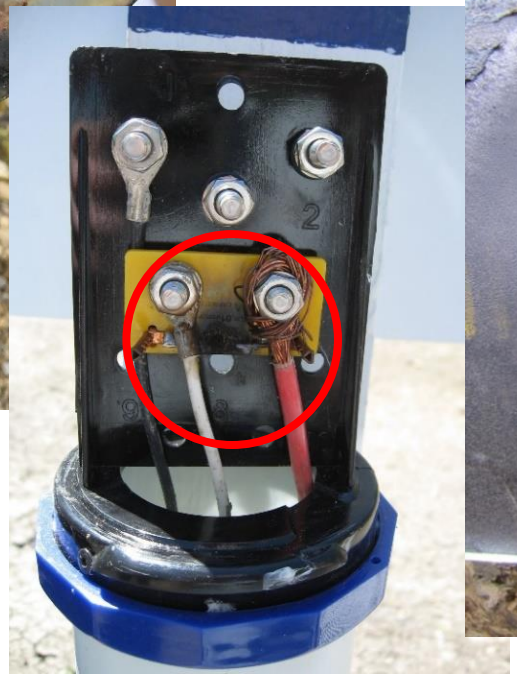


Pipeline

AC Interference = Risk

- Personnel
  - Step-Step Potential
  - Step-Touch Potential
- Pipeline Equipment
  - Metering
  - Electrical Isolation
- CP Systems
- Pipeline





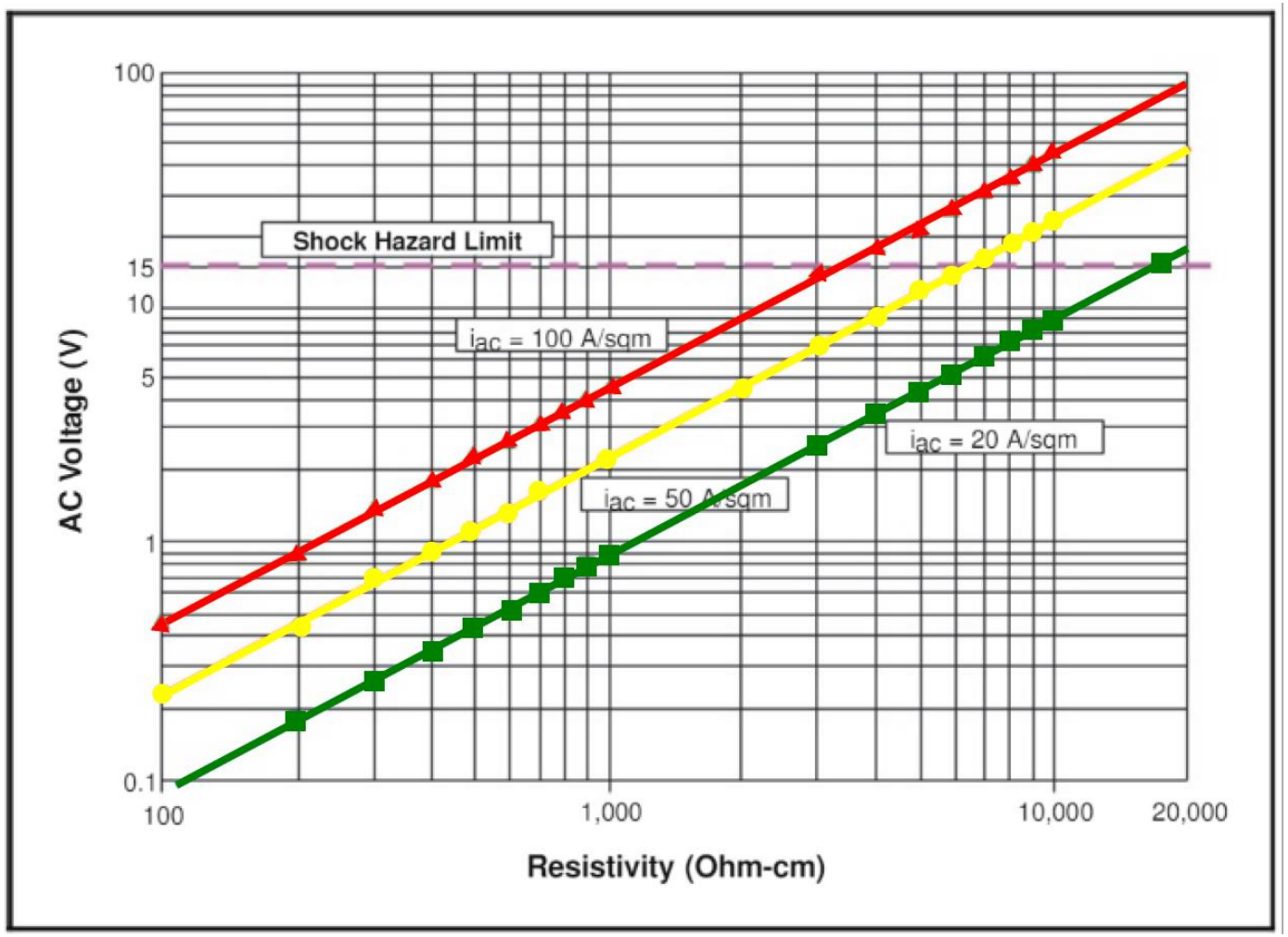
Risk Influenced by *Design* Conditions

- Pipeline/HVAC Collocation
- Pipeline System Design Characteristics
- HVAC System Design Characteristics
- CP System Design Characteristics
- Environmental Conditions

AC Corrosion & AC Current Density

ACCD		AC Corrosion Risk
< 20 A/M^2		Low Risk
20-100 A/M^2		Medium Likelihood
> 100 A/M^2		Very High Likelihood

Expressed as a Function of AC Voltage & Soil Resistivity

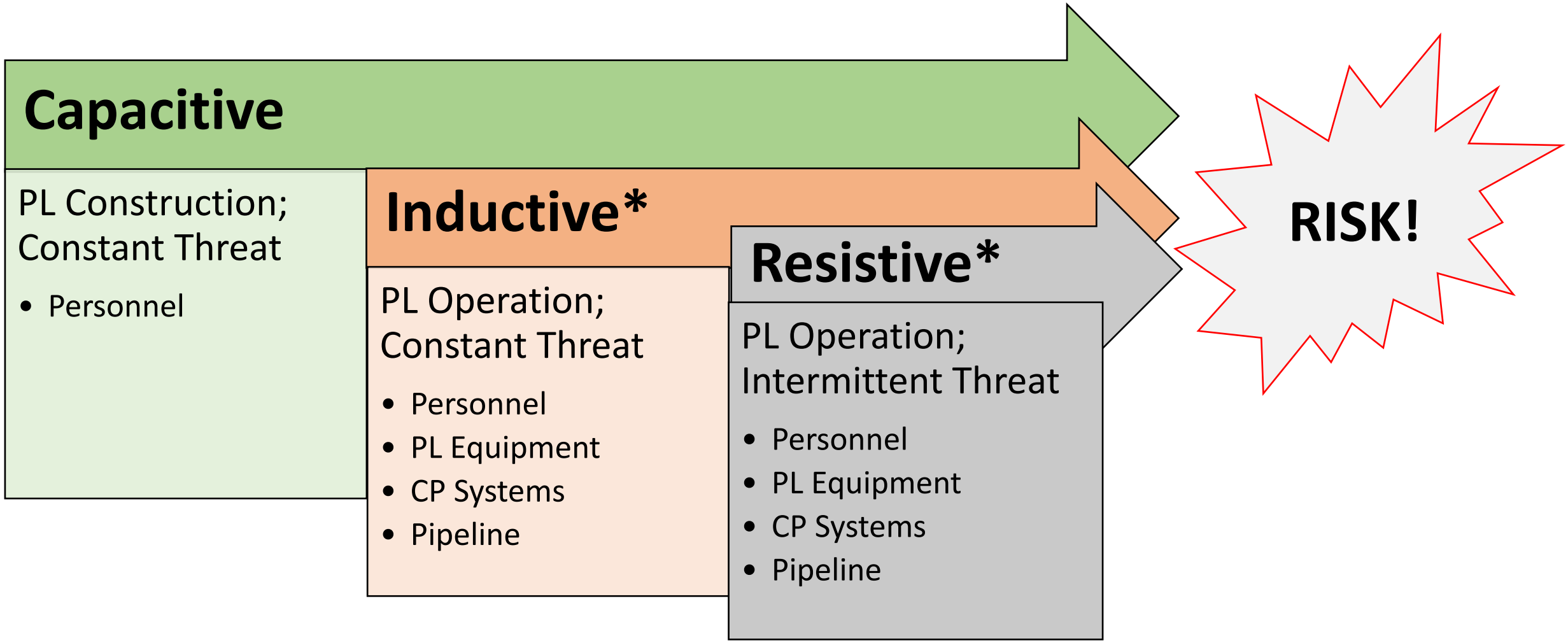


Risk Varies w/ Operating Conditions

- PL in construction
- PL in-service

- HVAC in normal condition
- HVAC in ‘faulted’ condition
  - Short duration; 60 Hz
- Lightning event
  - Short duration; ? Hz
  - Precipitate ‘follow-on’ 60 Hz

Complex Electro-magnetic Interaction



* Primary focus of mitigation design

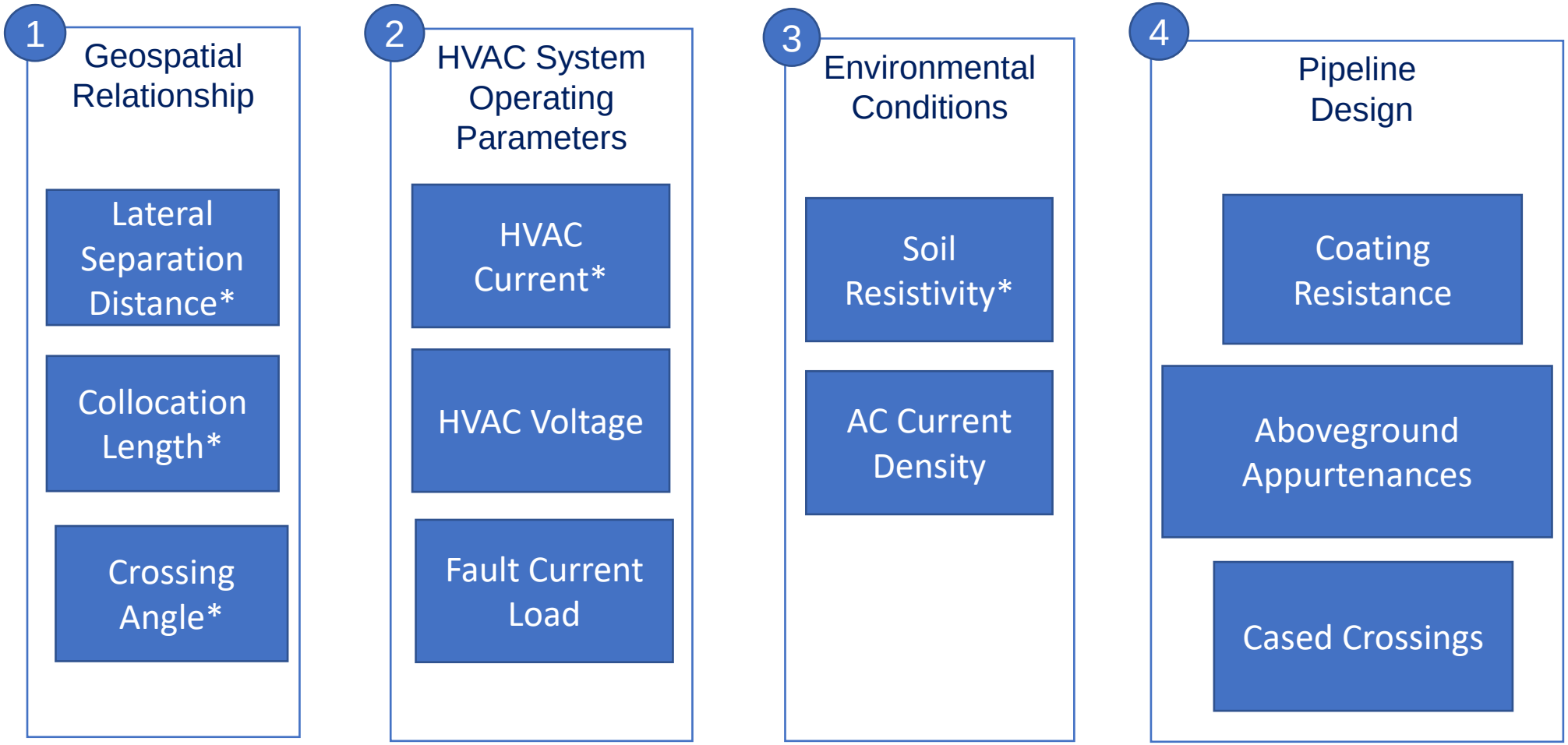
Standards

- NACE SP0177-2014
  - Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems
- NACE SP21424-2018
  - Alternating Current Corrosion on Cathodically Protected Pipelines: Risk Assessment, Mitigation, and Monitoring

More?

- Canadian Standard
- CAN/CSA – C22.3 No. 6-13
  - Principles and Practices of Electrical Coordination Between Pipelines and Electric Supply Lines
- European Standard
- BS EN 15280:2013
  - Evaluation of AC Corrosion Likelihood of Buried Pipelines Applicable to Cathodically Protected Pipelines

AC Threat Risk Factors



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The INGAA Foundation, Inc.

AC Threat Risk Analysis

Import GIS Data into RIPL

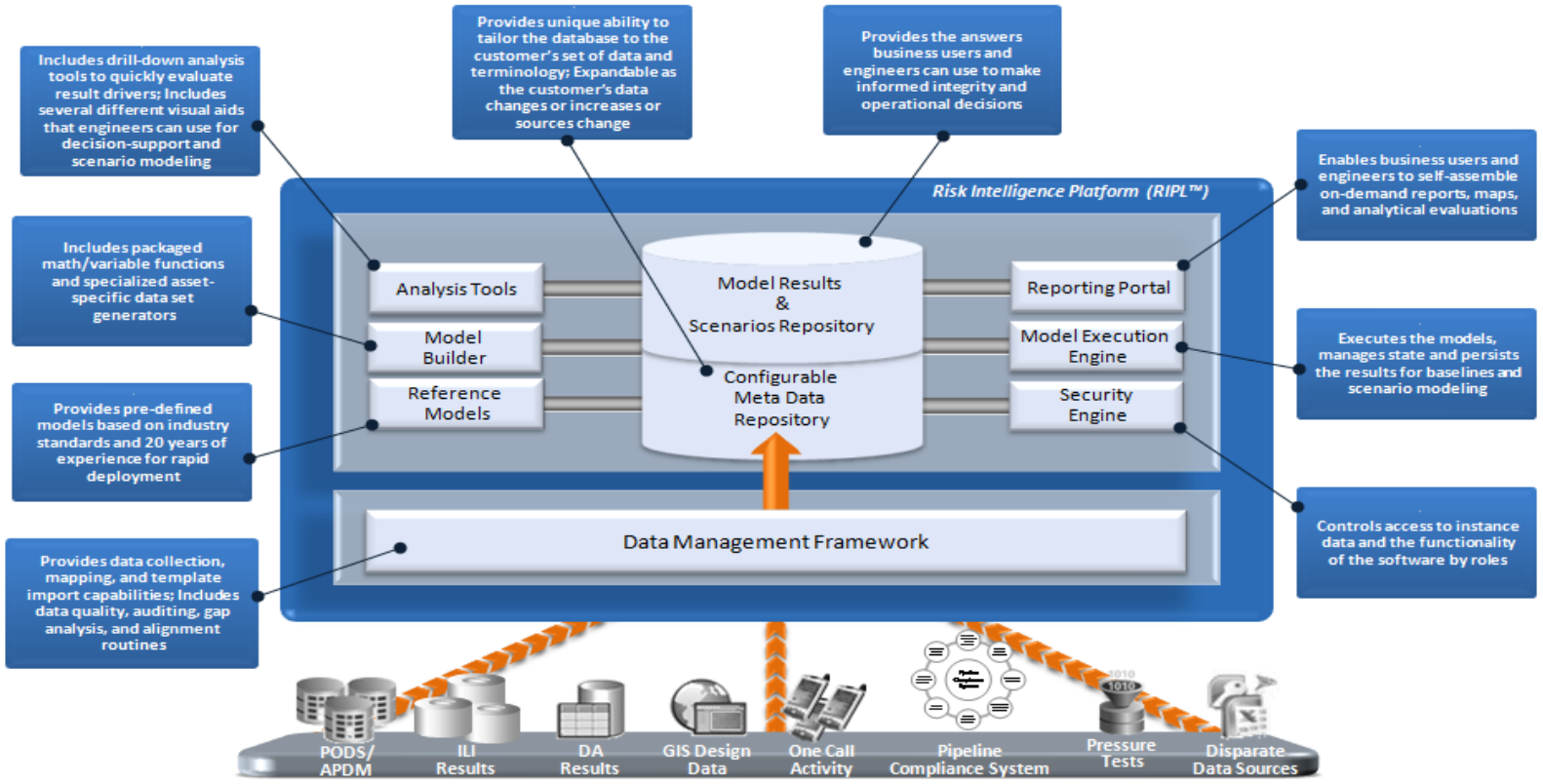
Separation Distance
Co-location Length
Co-location Angle
Crossing Angle
HVAC Voltage
HVAC Current
Soil Resistivity

Combined with Existing:

Pipeline Data

Create Threat Ranking

Analysis dynamically segmenting and ranking PL based on specific factors combined into a threat score



Engineered Field Analysis

- Differentiate above & below ground assets
  - Design gradient control mats
- Identify electrical isolation locations
  - Design decoupler installations
- Design engineered grounding system locations
  - Incorporate “natural” grounding
- Address lightning mitigation
- Address safe arc distance
  - Substations, guy anchors, etc.
- Incorporate AC mitigation system monitoring

AC & Lightning Mitigation Tools

- Engineering Controls
- Decoupling Devices
- Engineered Grounding Systems
- Gradient Control Mats
- Coupon Test Stations

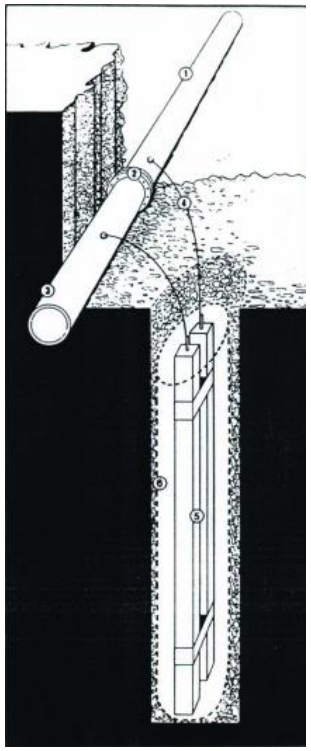
Signage


WARNING!
AC VOLTAGE MAY
BE PRESENT
ON THE FENCE
AND/OR
PIPELINE


DANGER
Electrical hazard.

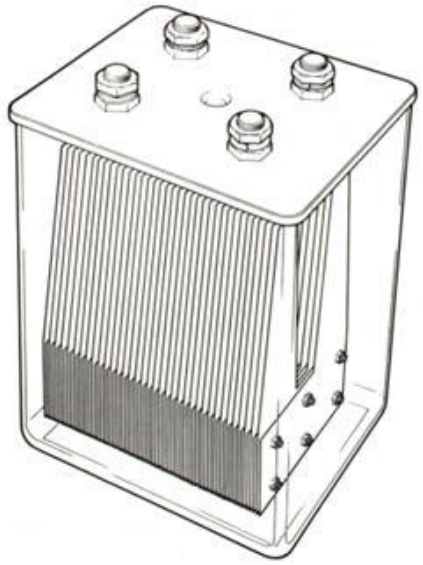
Dead Front Test Stations

Decoupling Devices



Zinc Anode Pair

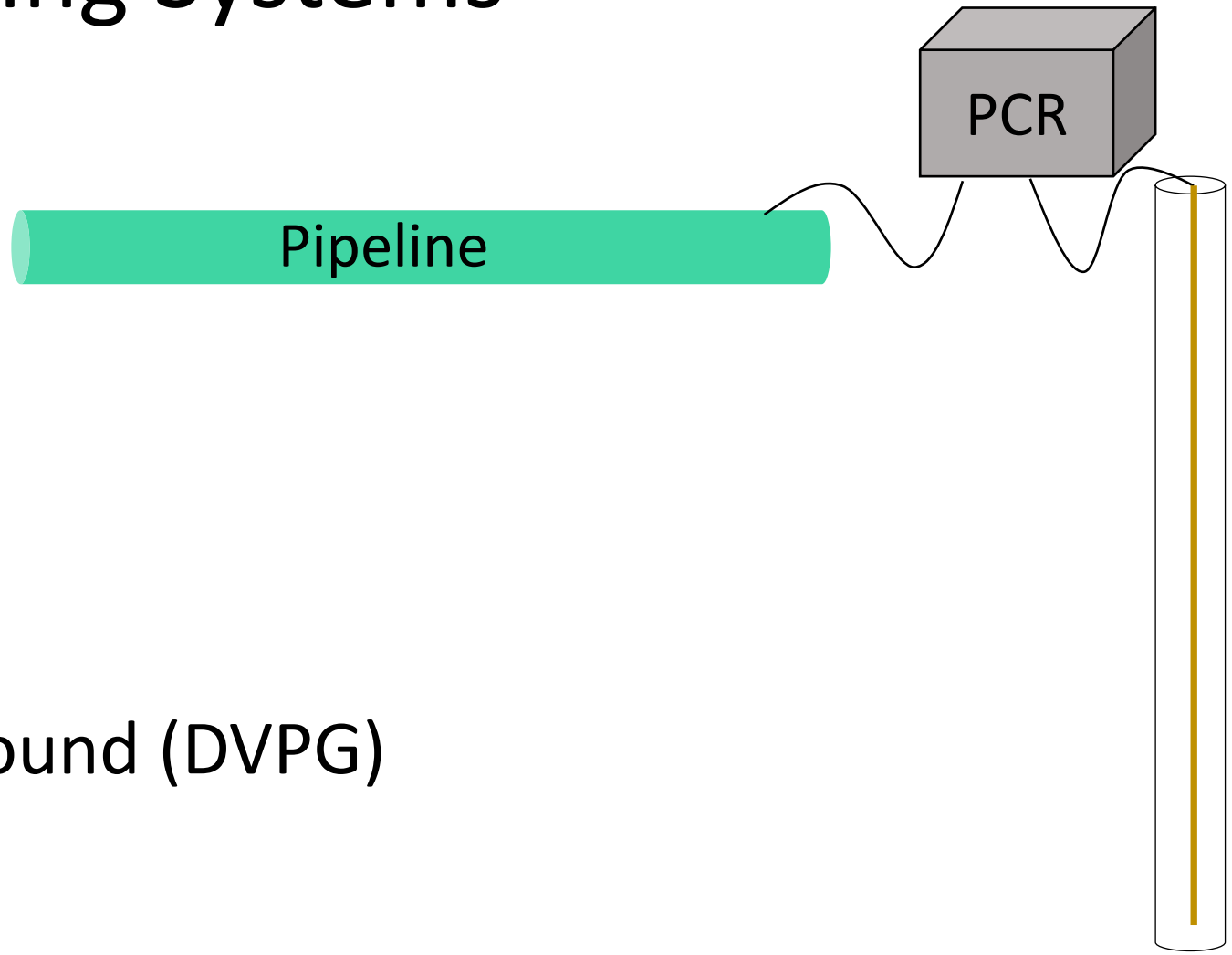
Polarization Cell



Polarization Cell Replacement (PCR)

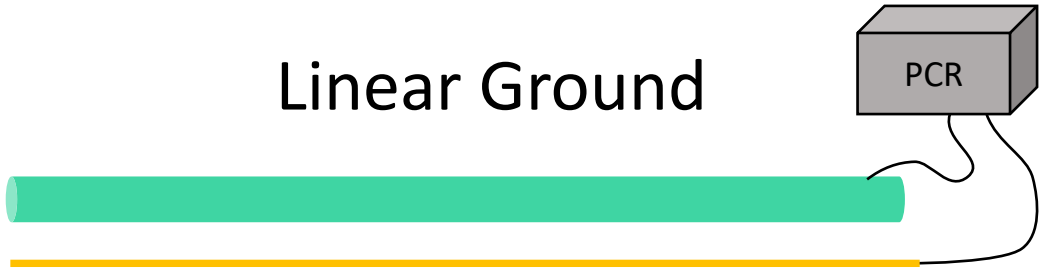
Solid State Decoupler (SSD)

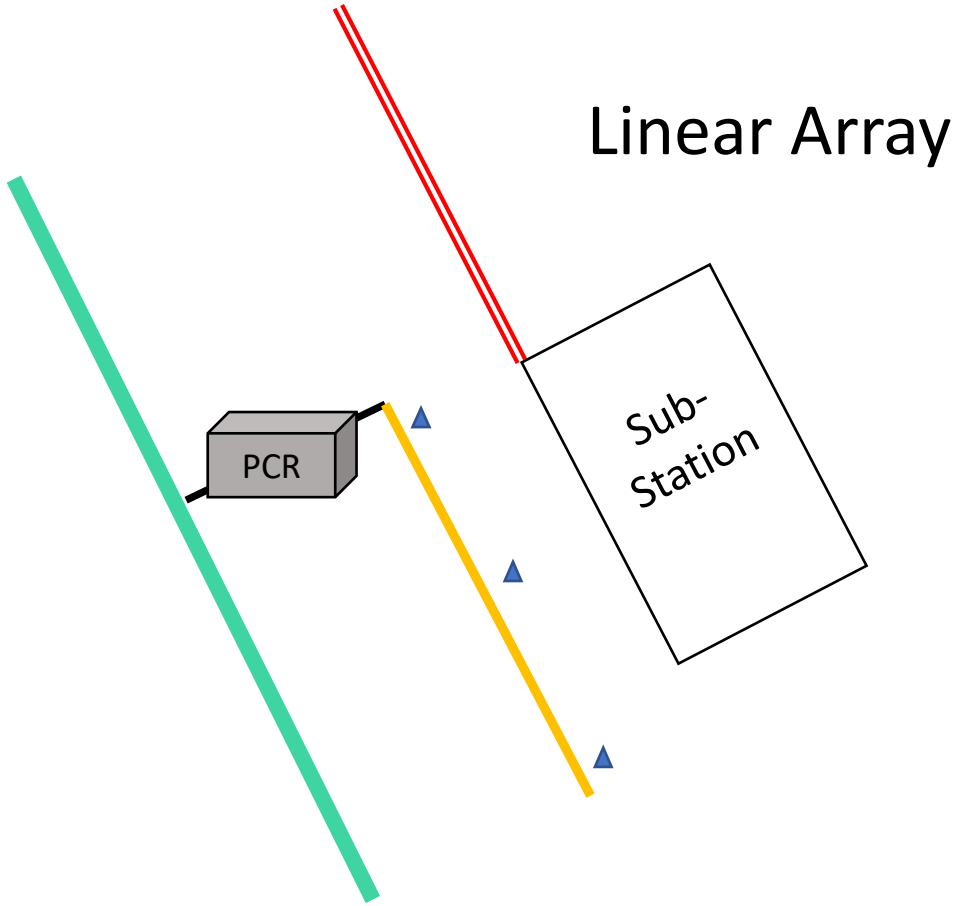
Engineered Grounding Systems



Deep Vertical Point Ground (DVPG)

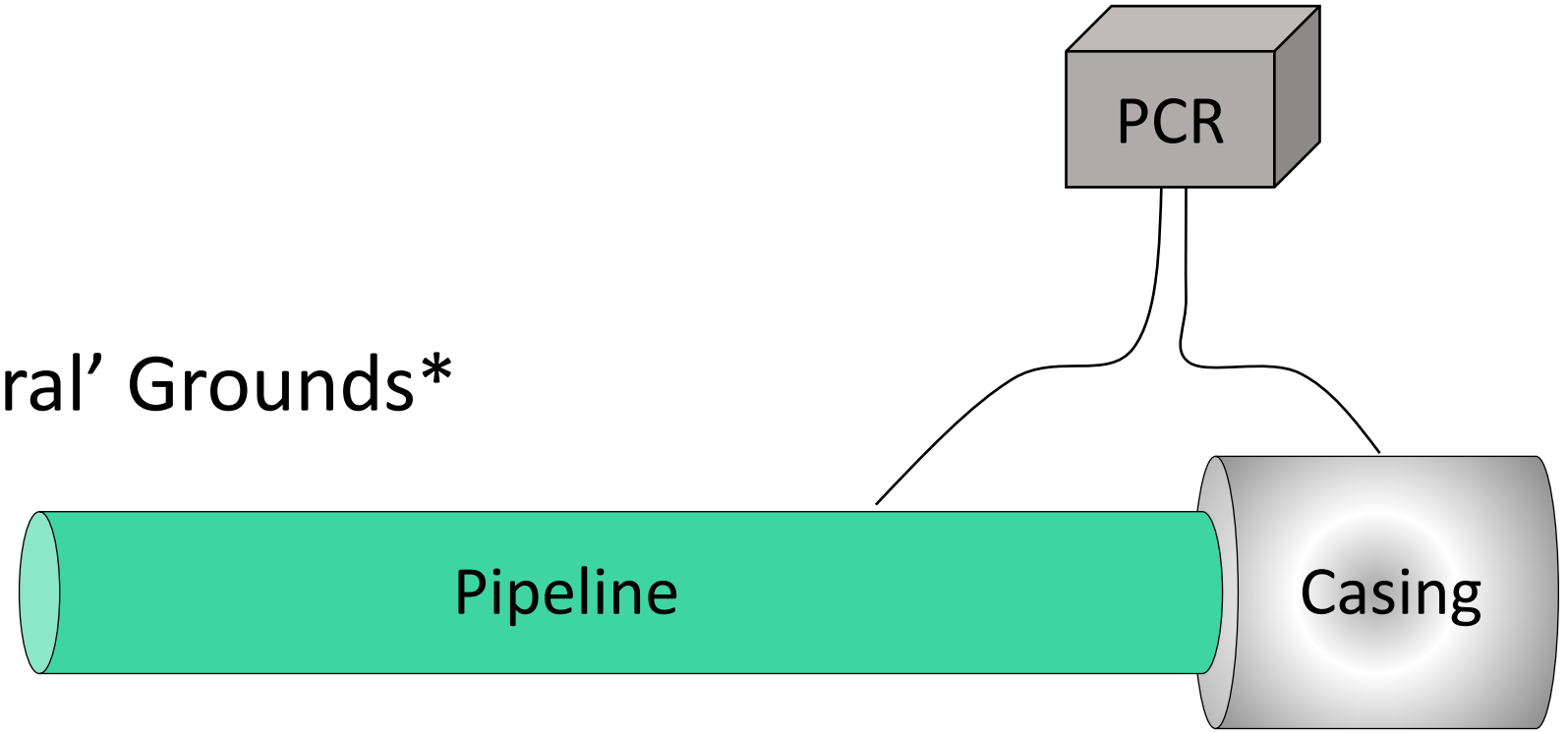
Engineered Grounding Systems





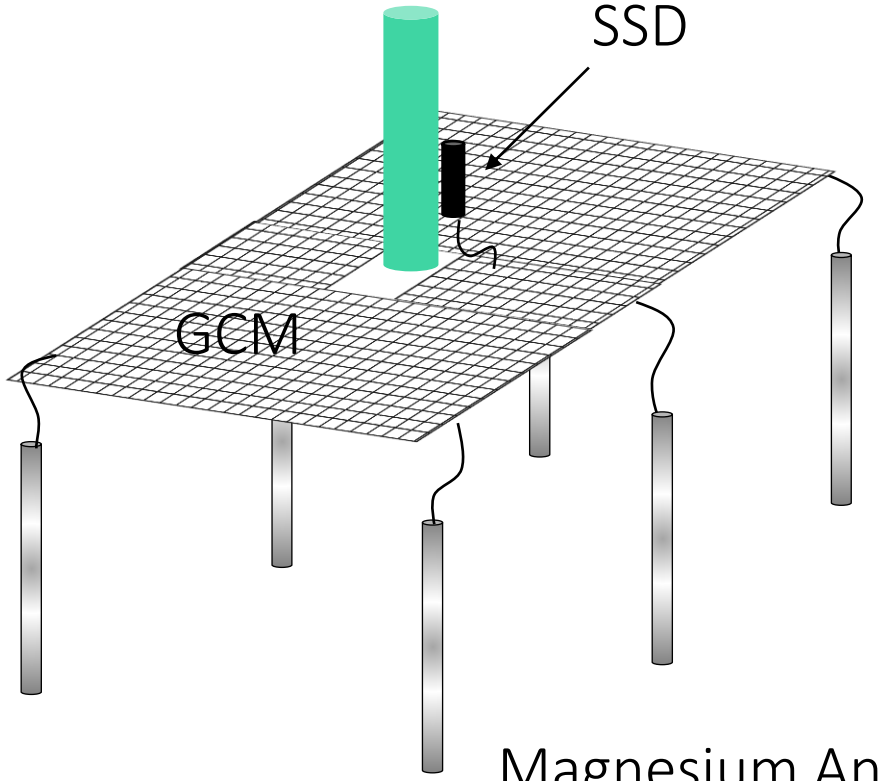
Engineered Grounding Systems

‘Natural’ Grounds*

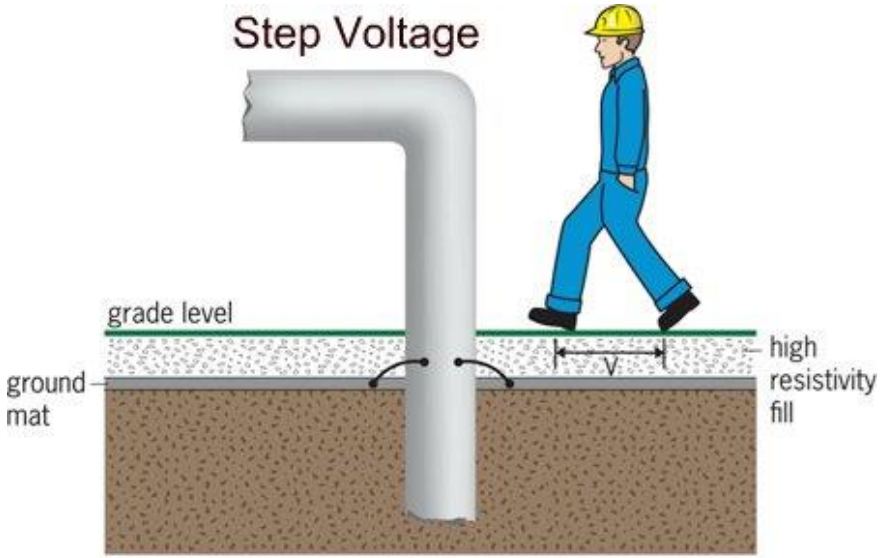


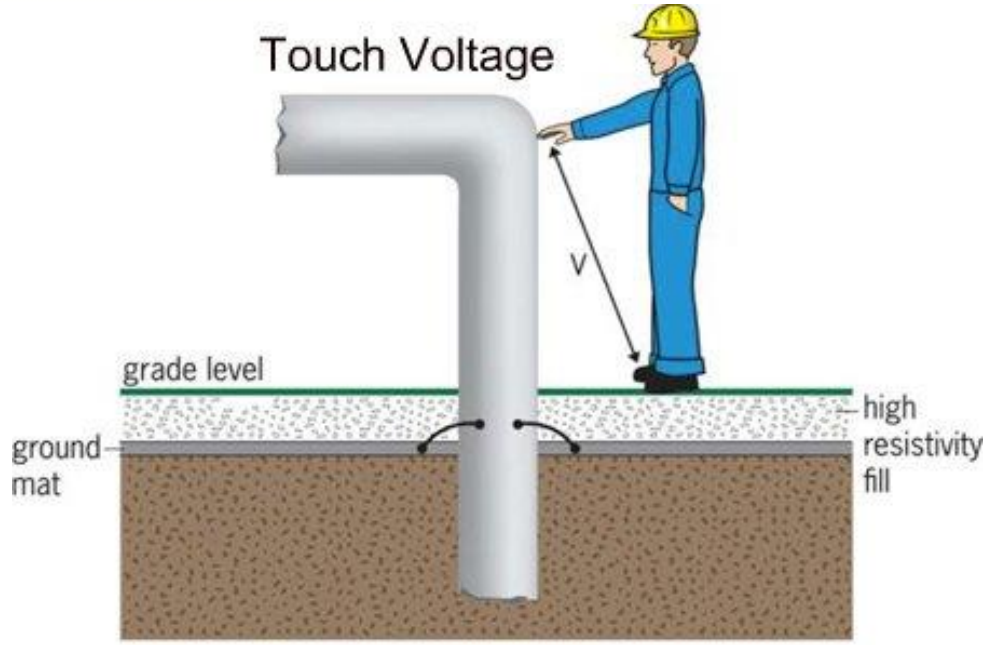
* Requires electrical isolation of casing/carrier & GCM consideration

Gradient Control Mats



Magnesium Anode





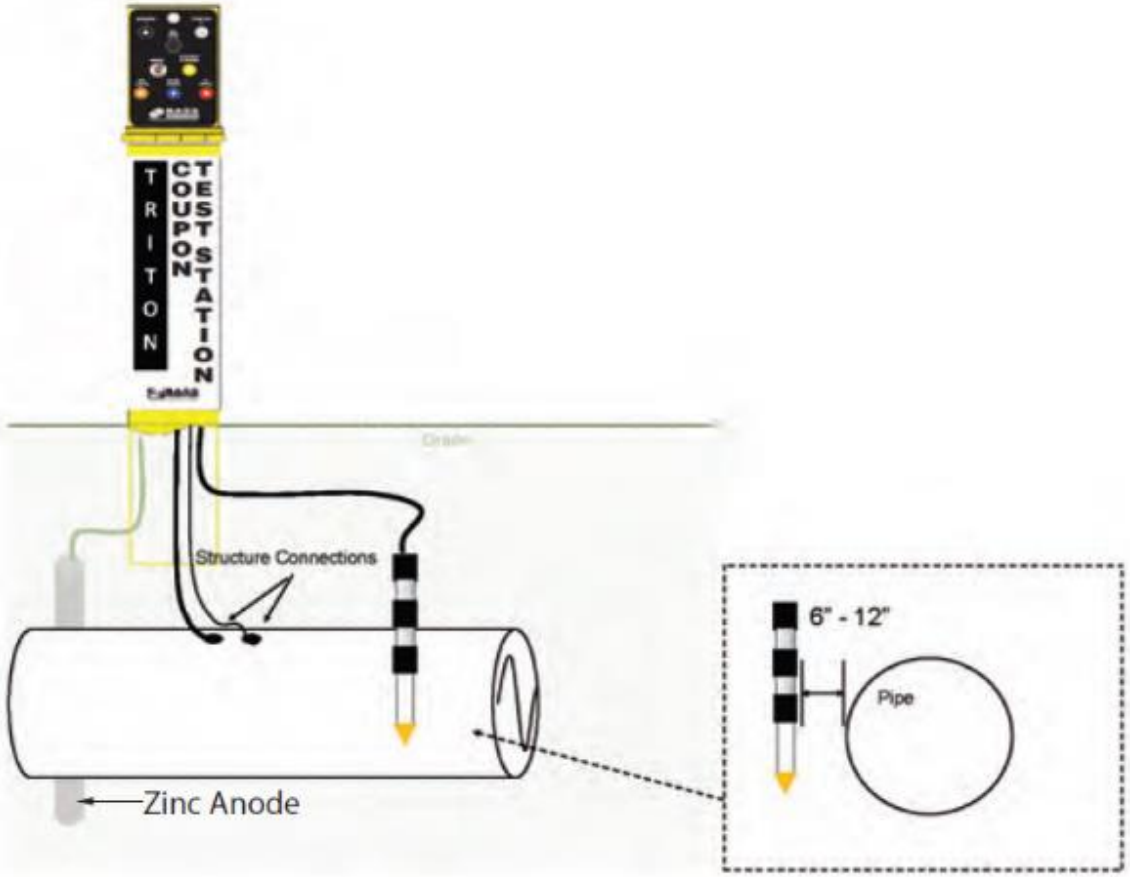
Gradient Control Mat Assembly

Exothermically Welded @ Seams on 18” Centers

Lead Length is Critical!

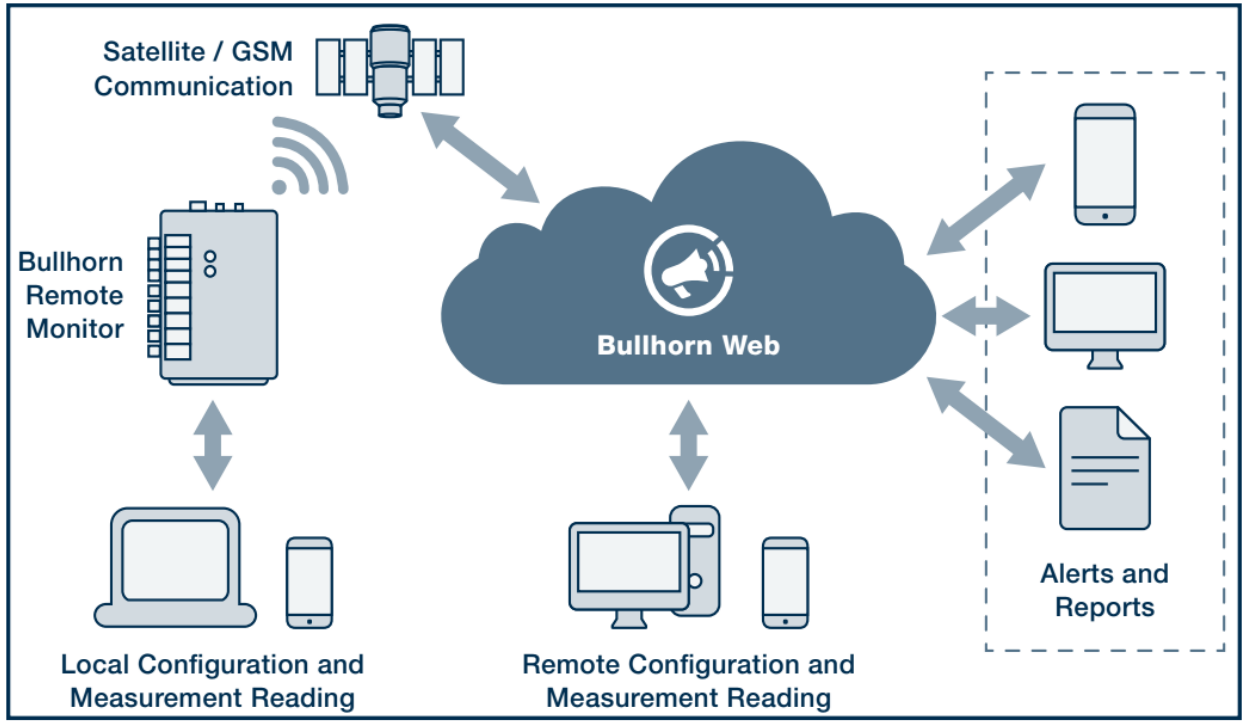
Pin Brazed Connections

Monitoring



- Measure PL AC & DC P/S Potentials
- Measure AC & DC Current
- Calculate PL AC & DC Current Density

Remote Monitoring w/ CTS



The RM4210 integrates with Bullhorn Web, allowing you to access your measurements or update configurations from nearly anywhere.

Summary

- AC Interference is Complex
- Influenced by Design & Operating Conditions…Dynamic!
- AC Threat Risk Analysis w/ Engineered Field Design
- Integrated ACLM Solution; Multiple AC Mitigation Tools
- Monitor!!

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