Decoupler Interactions W/CP Systems AUCSC 2019

Tim Bechtel

Dairyland Electrical Industries Inc.

DAIRYLAND ELECTRICAL INDUSTRIES

ISOLATE. GROUND. PROTECT.

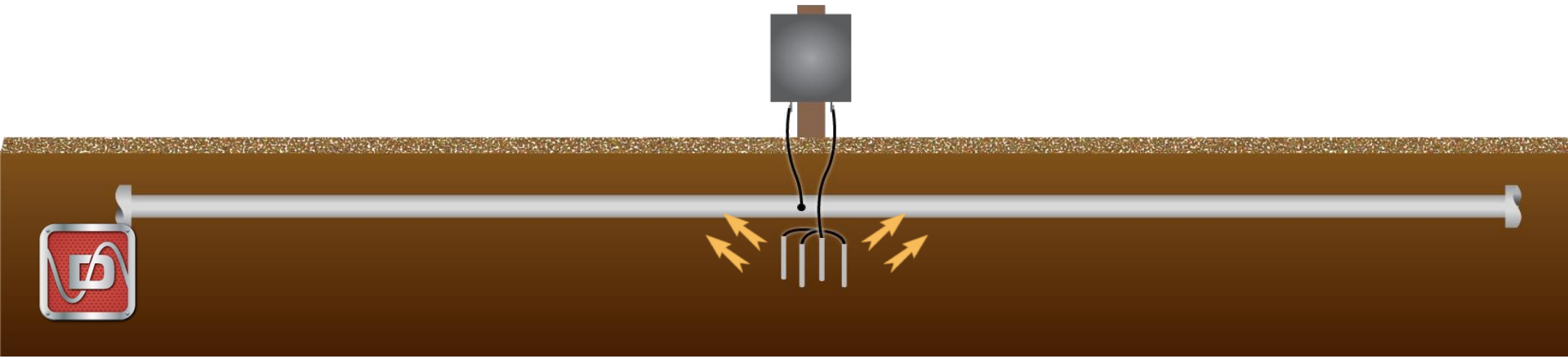
Outline

1. Why are decouplers needed?
2. What is a decoupler, and an OVP and how do they work? Similar Devices
3. Where are decouplers and OVP's used?
4. CIS and Decouplers
5. Exposure, risks, and station features
6. How to select the right decoupler for the application

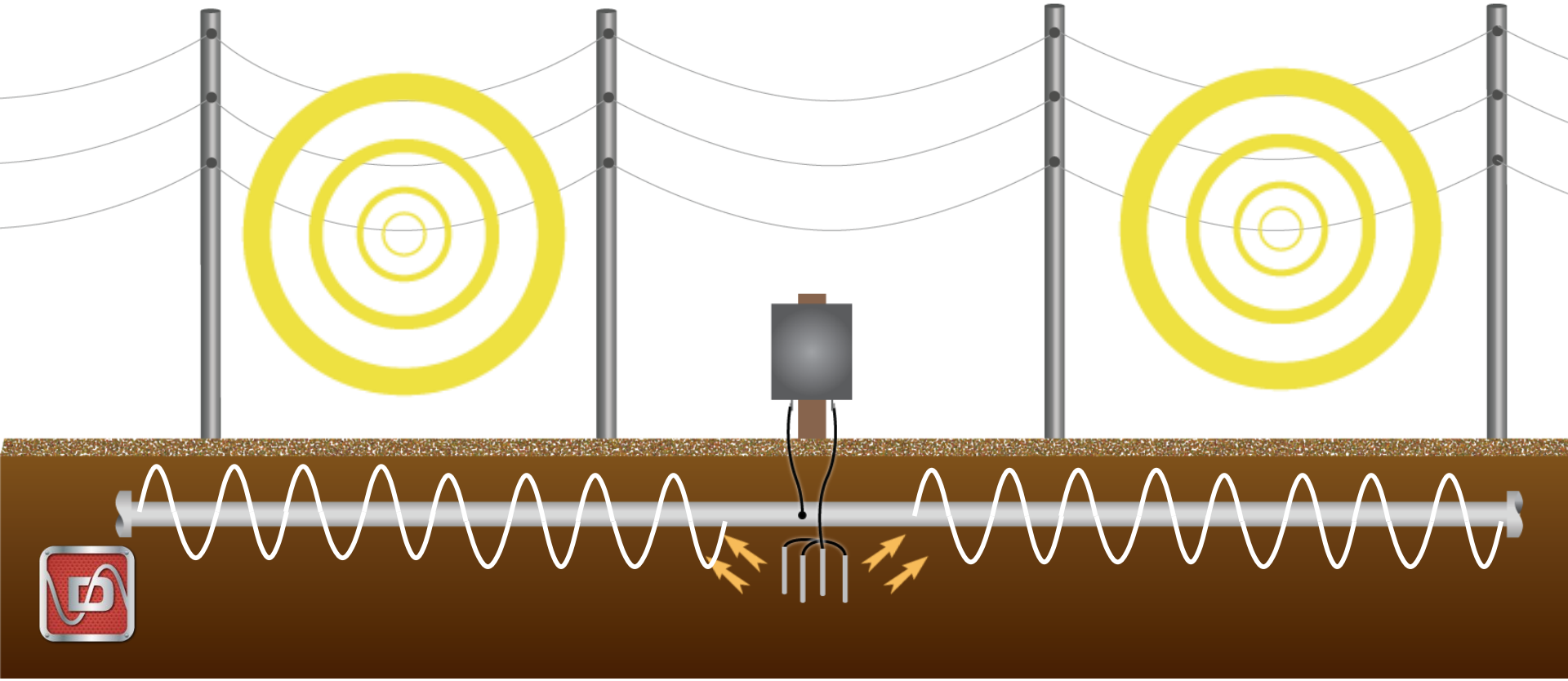
Outline

1. Why are decouplers needed?
2. What is a decoupler, and an OVP and how do they work? Similar Devices
3. Where are decouplers and OVP's used?
4. CIS and Decouplers
5. Exposure, risks, and station features
6. How to select the right decoupler for the application

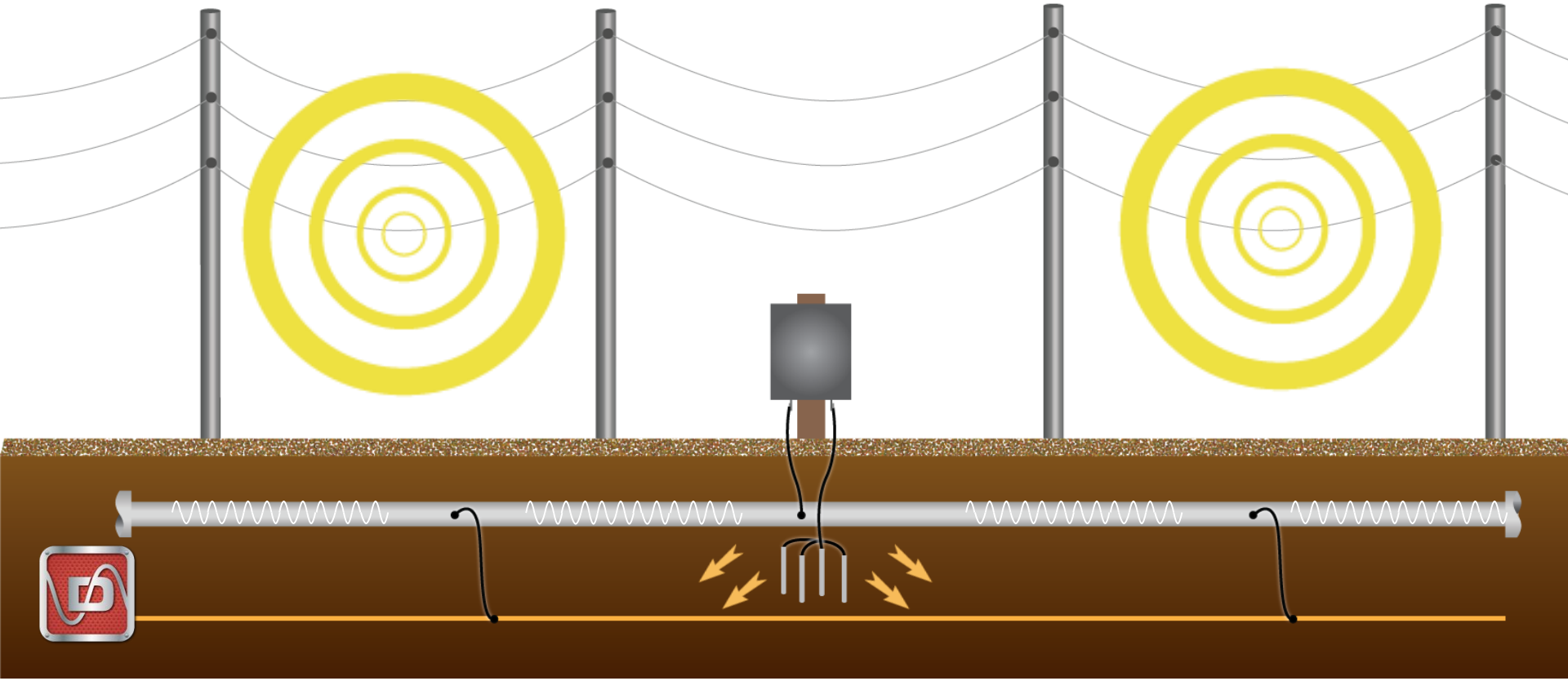
Why Use a Decoupler?



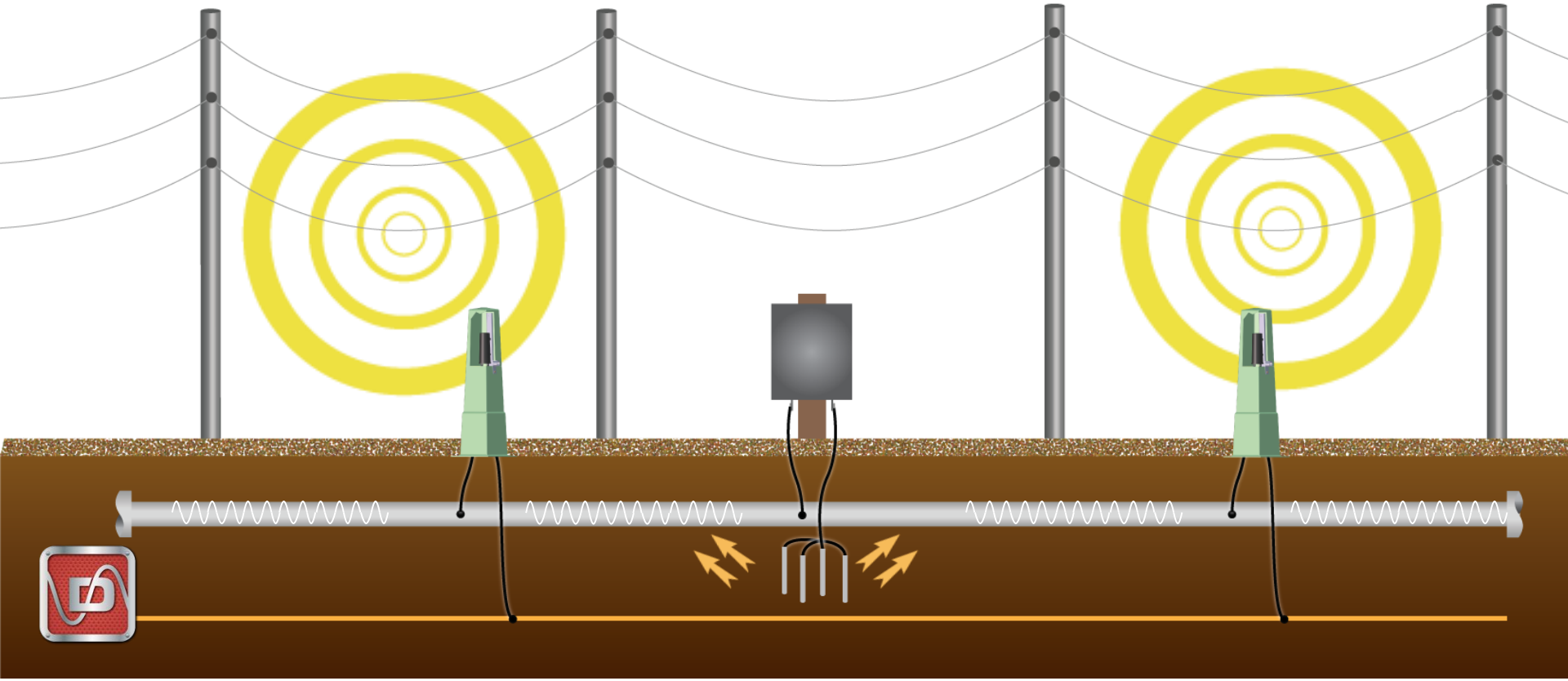
Why Use a Decoupler?



Why Use a Decoupler?



Why Use a Decoupler?



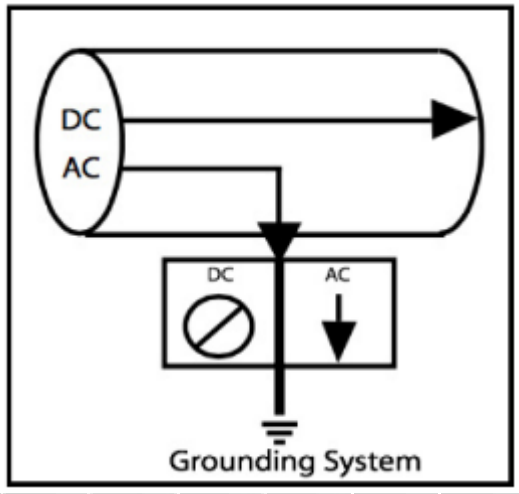
Outline

1. Why are decouplers needed?
2. **What is a decoupler, and an OVP and how do they work?**
3. Where are decouplers and OVP's used?
4. CIS and Decouplers
5. Exposure, risks, and station features
6. How to select the right decoupler for the application

What is a Decoupler?

A device that acts as an open switch for low voltage DC and a closed switch for AC signals

- Blocks DC up to a predetermined voltage threshold typically 2 to 3 volts
- Very low impedance to AC
- Device switches to shorted mode when voltage reaches threshold, normal mode after the event



Solid State Decoupling Devices

- Rated for AC faults & lightning
- Continuously pass steady state AC current induced from nearby power transmission lines
- Provide lowest clamping voltages feasible
- Automatically reset after fault event
- “Fail-safe” design
- No maintenance – solid state design
- 3rd party certified for hazardous locations use and safety grounding/bonding

Solid State Decoupling Devices

PCR

SSD

Solid State Over-Voltage Protectors

A derivative of the Decoupler

- Provide simultaneous DC isolation and AC fault/Lightning grounding
- Solid State design
- **Not** for use where steady state AC voltage is present

OVP

OVP2

Outline

1. Why are decouplers needed?
2. What is a decoupler, and an OVP and how do they work? Similar Devices.
3. **Where are decouplers and OVP's used?**
4. CIS and Decouplers
5. Exposure, risks, and station features
6. How to select the right decoupler for the application

Where Decouplers & OVPs are Used

Where Should Decouplers Be Used?

Insulated Joint Damage

Insulation Joint Damage From Arcing

Where are Decouplers Used?

Insulated Joint Protection

- Best practice is to install a decoupler device at insulated joints to prevent arcing.
- Minimize conduction path length – bus bar mounting
- Use decouplers instead of Over-Voltage Protectors if steady-state AC is present

Where are Decouplers Used?

Pipeline AC Mitigation

As part of an effective AC mitigation system decouplers …

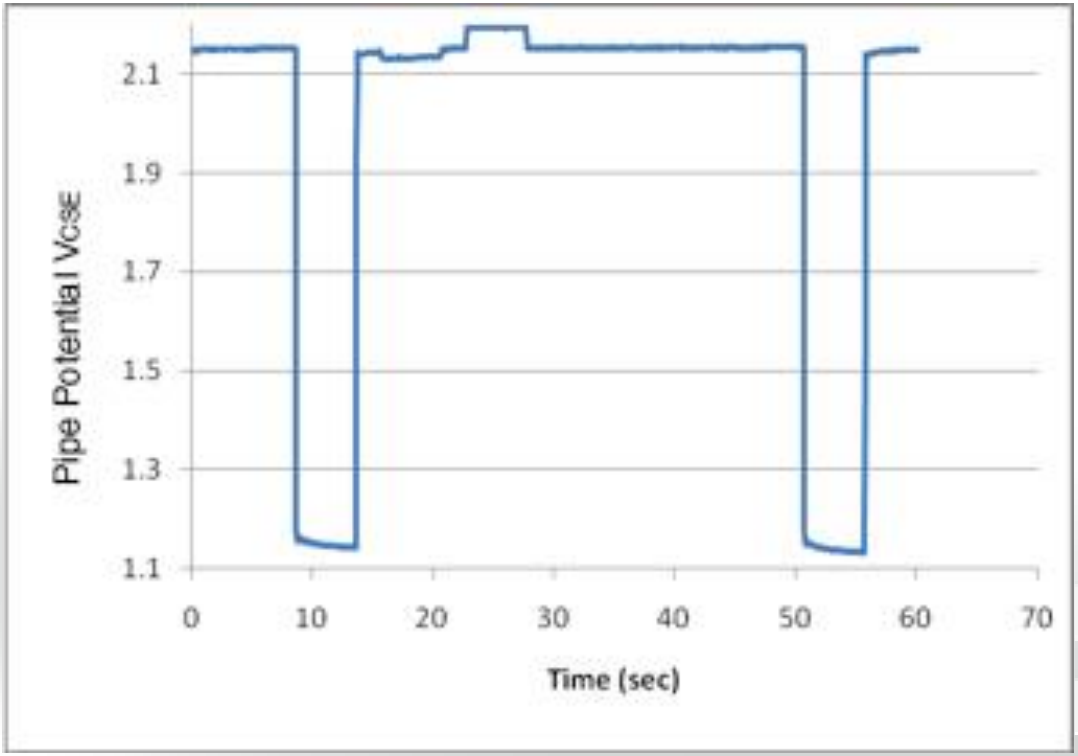
- Create a low impedance AC path to ground
- Provide safety during abnormal conditions
- Reduce the risk of AC corrosion

- Any grounding material may be used, since decoupled and not part of the CP system
- Decouplers have no detrimental effect on the CP system
- Any cathodically protected pipe-to-ground connection should use a decoupler

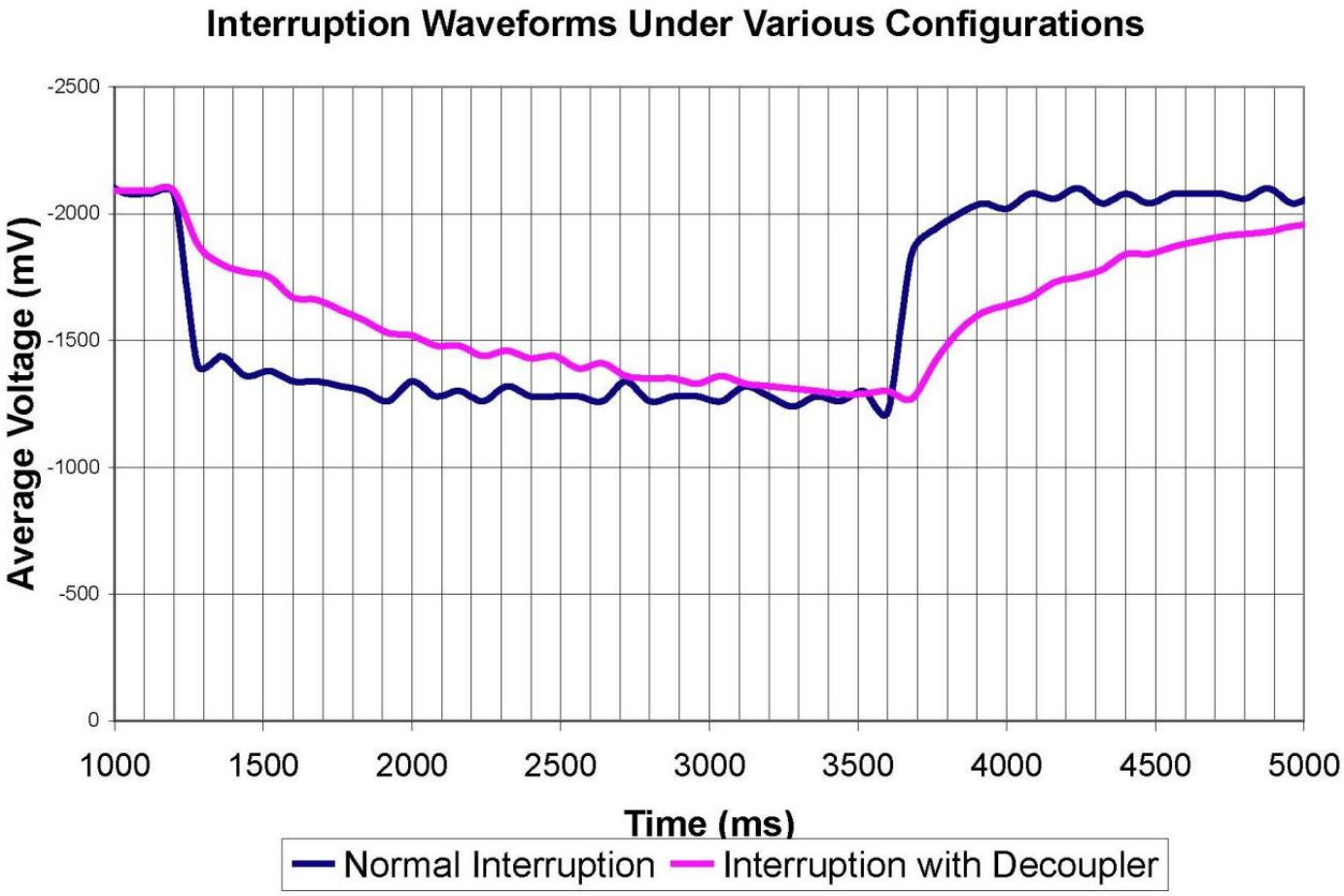
Outline

1. Why are decouplers needed?
2. What is a decoupler, and an OVP and how do they work? Similar Devices.
3. Where are decouplers and OVP's used?
4. **CIS and Decouplers**
5. Exposure, risks, and station features
6. How to select the right decoupler for the application

Waveform Example



Waveform Example



Measurements on a 6”- 40 mile, 16 mil FBE well coated pipeline

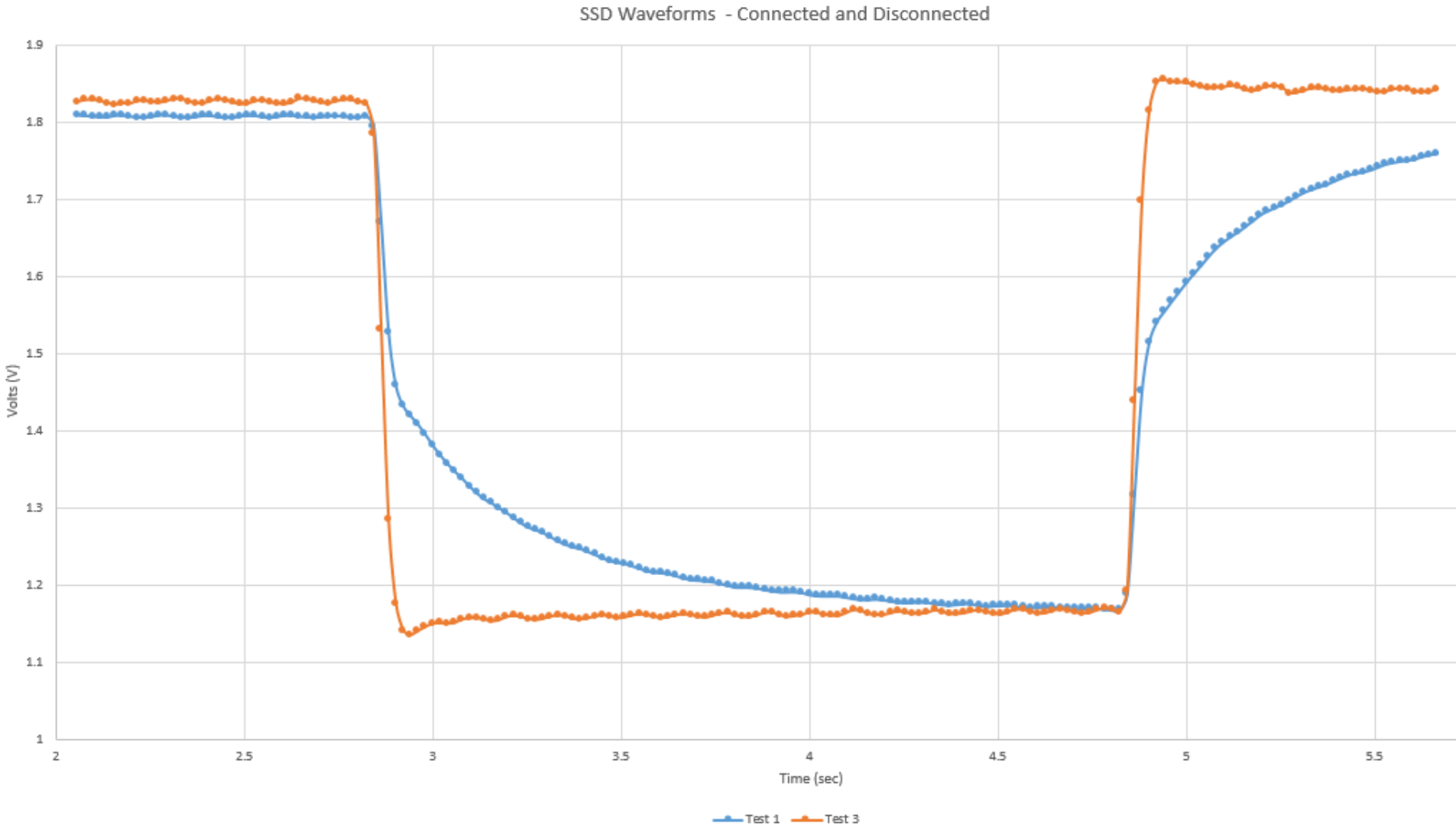
Why a Waveform is Irregular during a CIS?

- Excessive AC mitigation
- Excellent pipeline coatings
- Length and diameter of pipeline
- Decoupler capacitors

How to Solve CIS/Decoupler Waveform?

- Lengthen the ON & OFF potential reads
- Delay the OFF potential read
- Use IR free coupons
- Install isolation switch
- Run CIS without decoupler connected

Waveform Example



Isolation Switch with SSD inside Pedestal

Dead-Front Isolation Switch

Outline

1. Why are decouplers needed?
2. What is a decoupler, and an OVP and how do they work? Similar Devices.
3. Where are decouplers and OVP's used?
4. CIS and Decouplers
5. **Exposure, risks, and station features**
6. How to select the right decoupler for the application

Exposure and risks

Generally easy to identify:

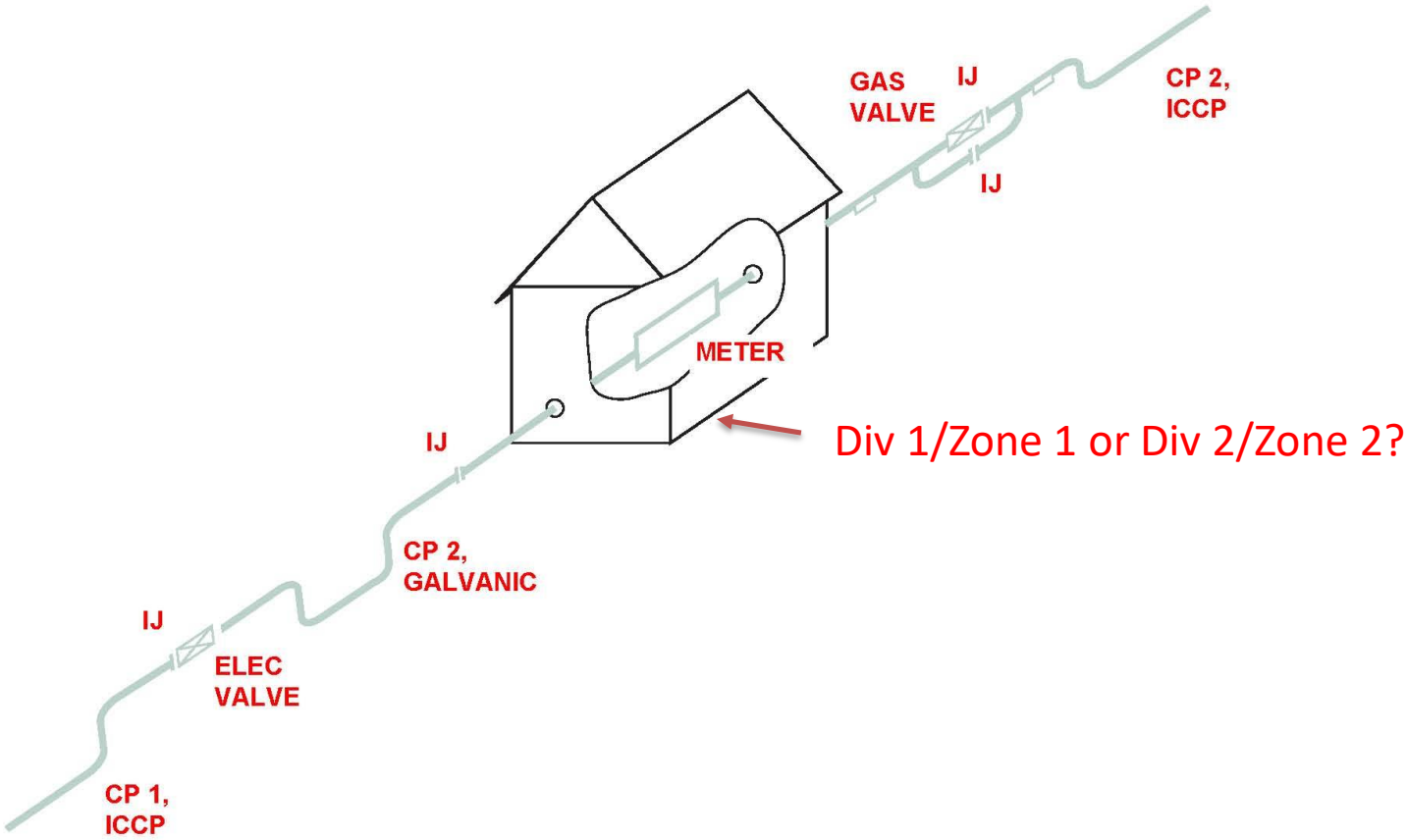
- Structures are referenced, but create dissimilar metal bonds, affect CP.

Non-obvious:

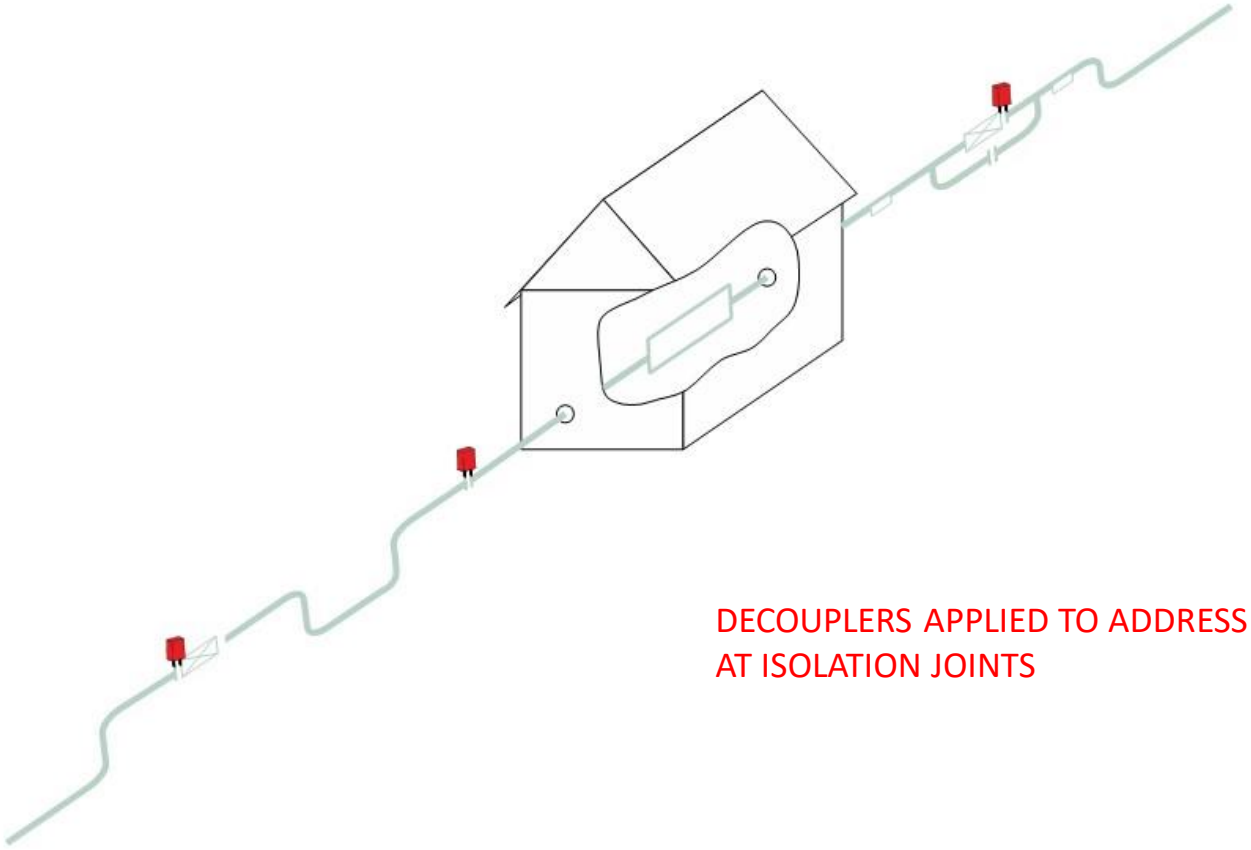
- Structures unreferenced to ground
- Structures unreferenced to each other
- Is this a classified hazardous area?

Unreferenced = not bonded, open circuit, can support voltage difference

Pipeline Station Features

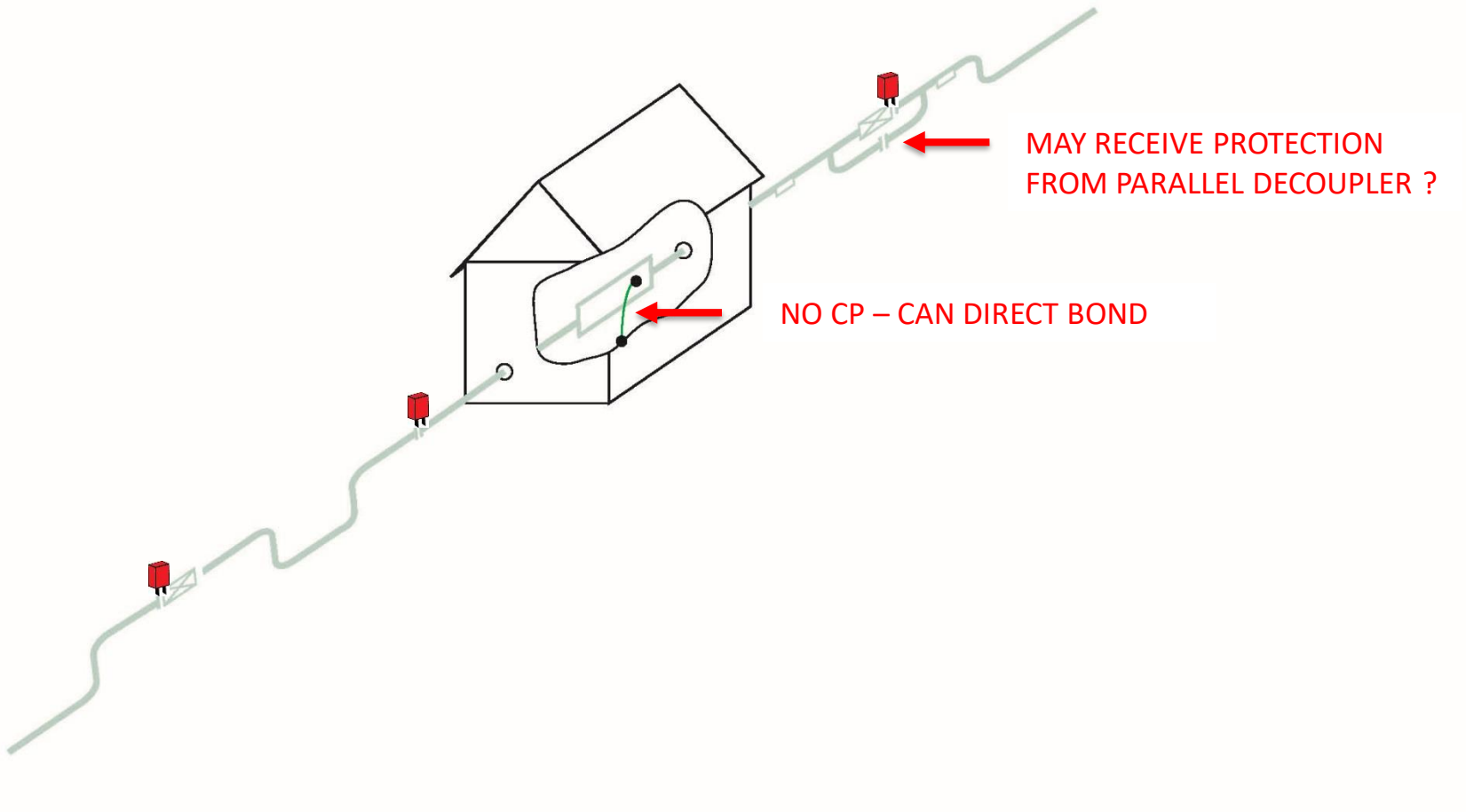


Station Exposure Addressed

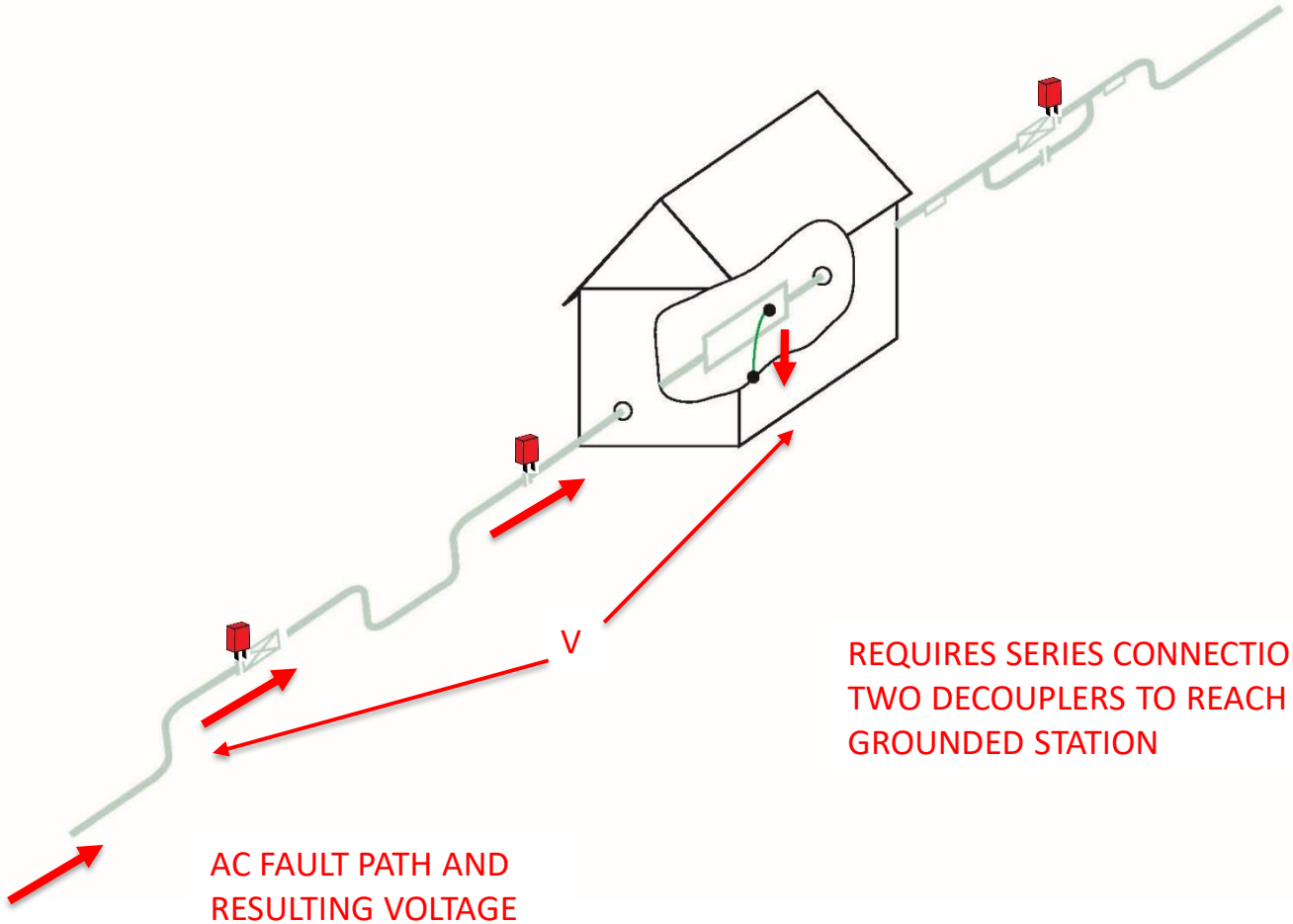


DECOUPLERS APPLIED TO ADDRESS VOLTAGE
AT ISOLATION JOINTS

Additional Exposures



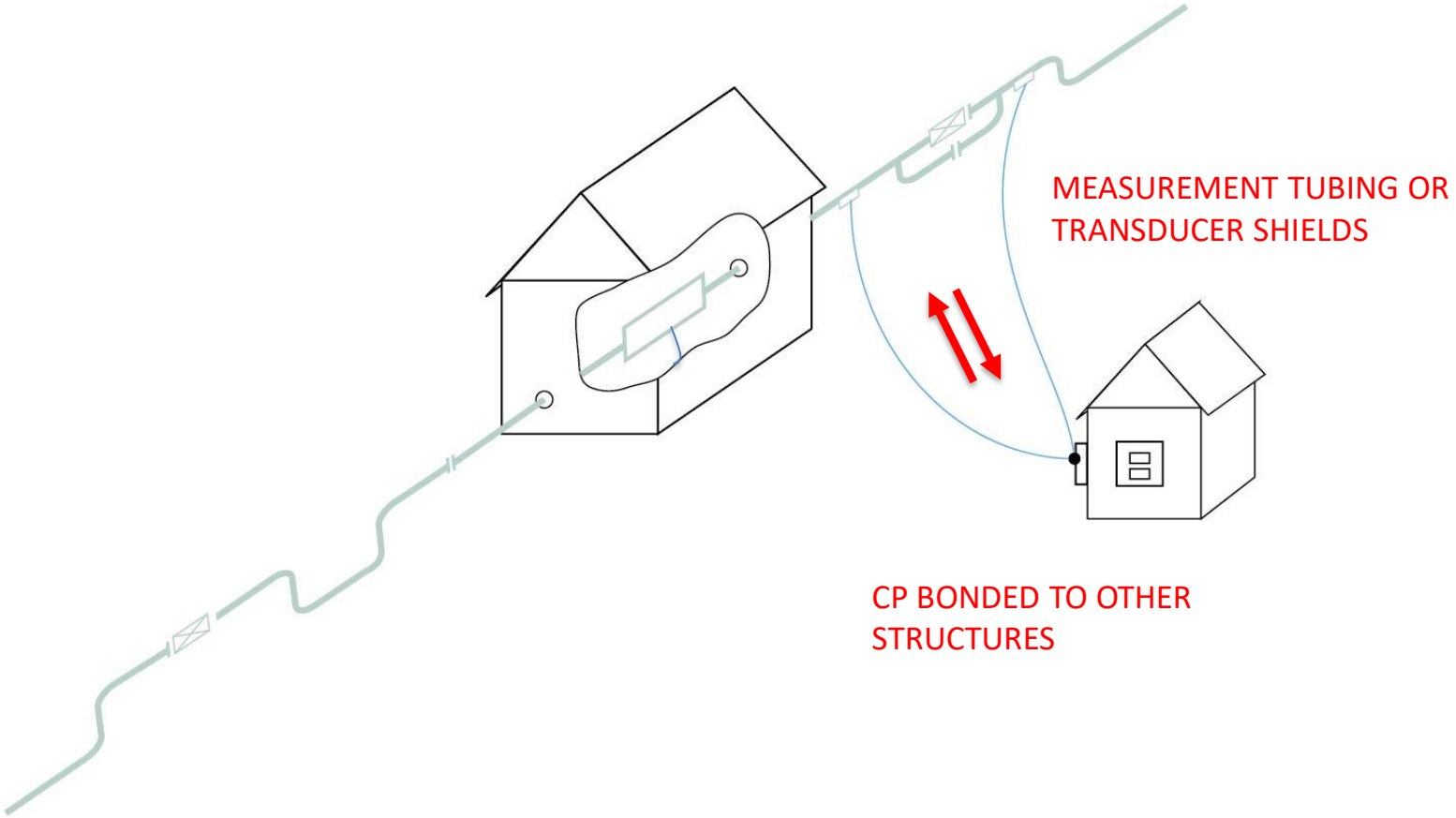
Total Path to Ground



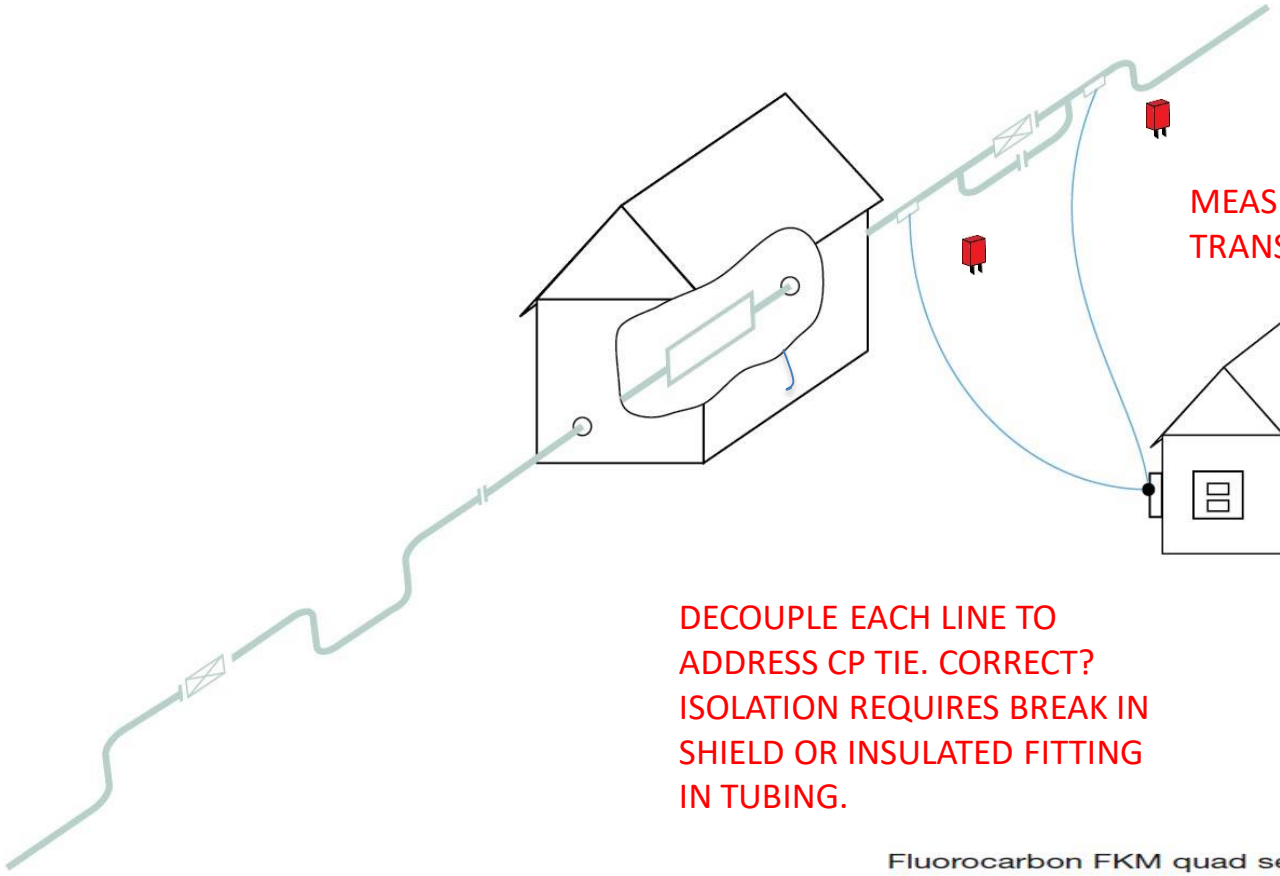
AC FAULT PATH AND
RESULTING VOLTAGE

REQUIRES SERIES CONNECTION OF
TWO DECOUPLERS TO REACH THE
GROUNDED STATION

Sensing and Measurement Lines

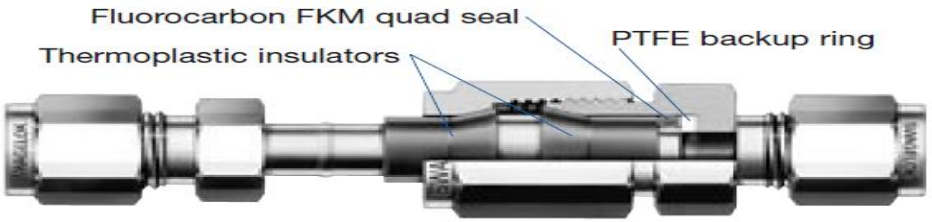


Sensing and Measurement Lines

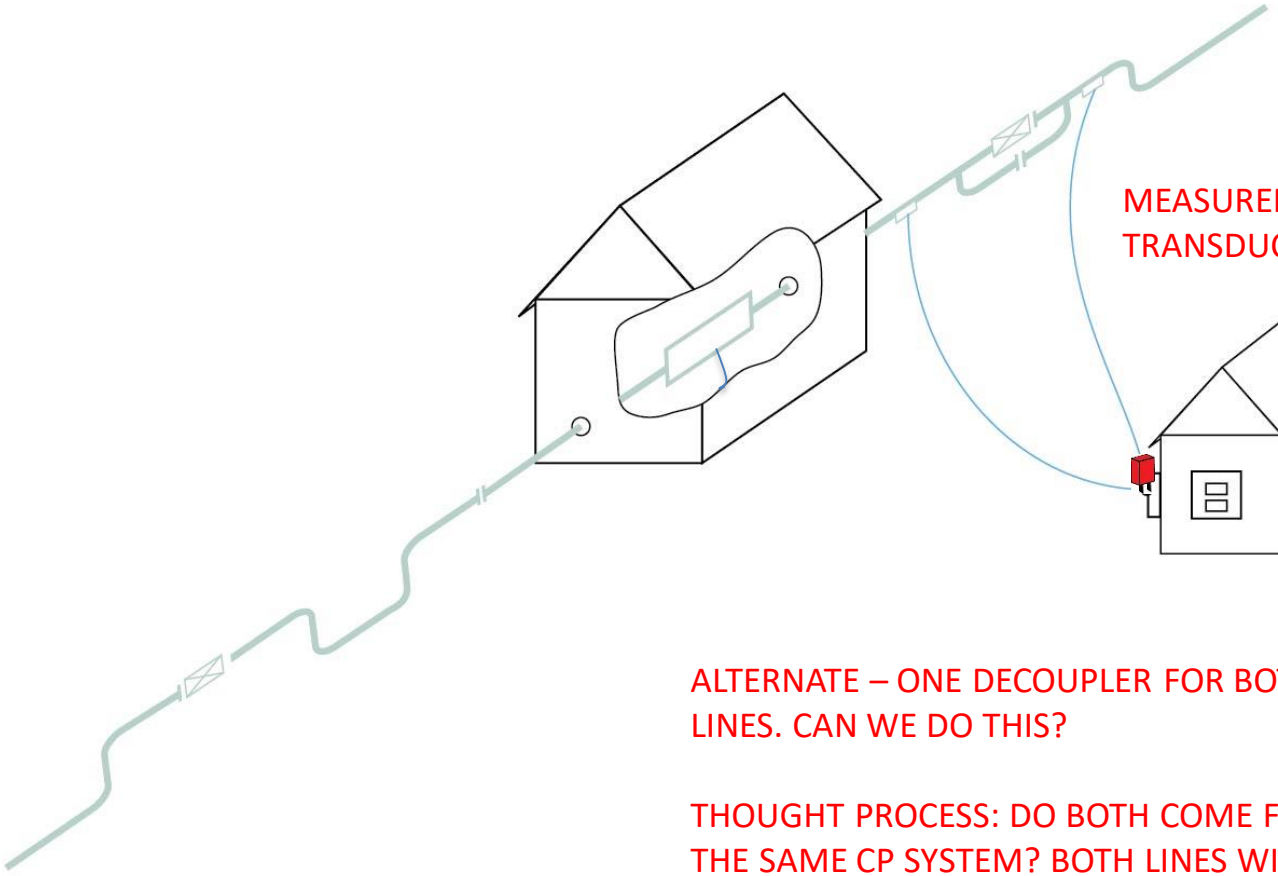


MEASUREMENT TUBING OR TRANSDUCER SHIELDS

DECOUPLE EACH LINE TO ADDRESS CP TIE. CORRECT? ISOLATION REQUIRES BREAK IN SHIELD OR INSULATED FITTING IN TUBING.



Sensing and Measurement Lines

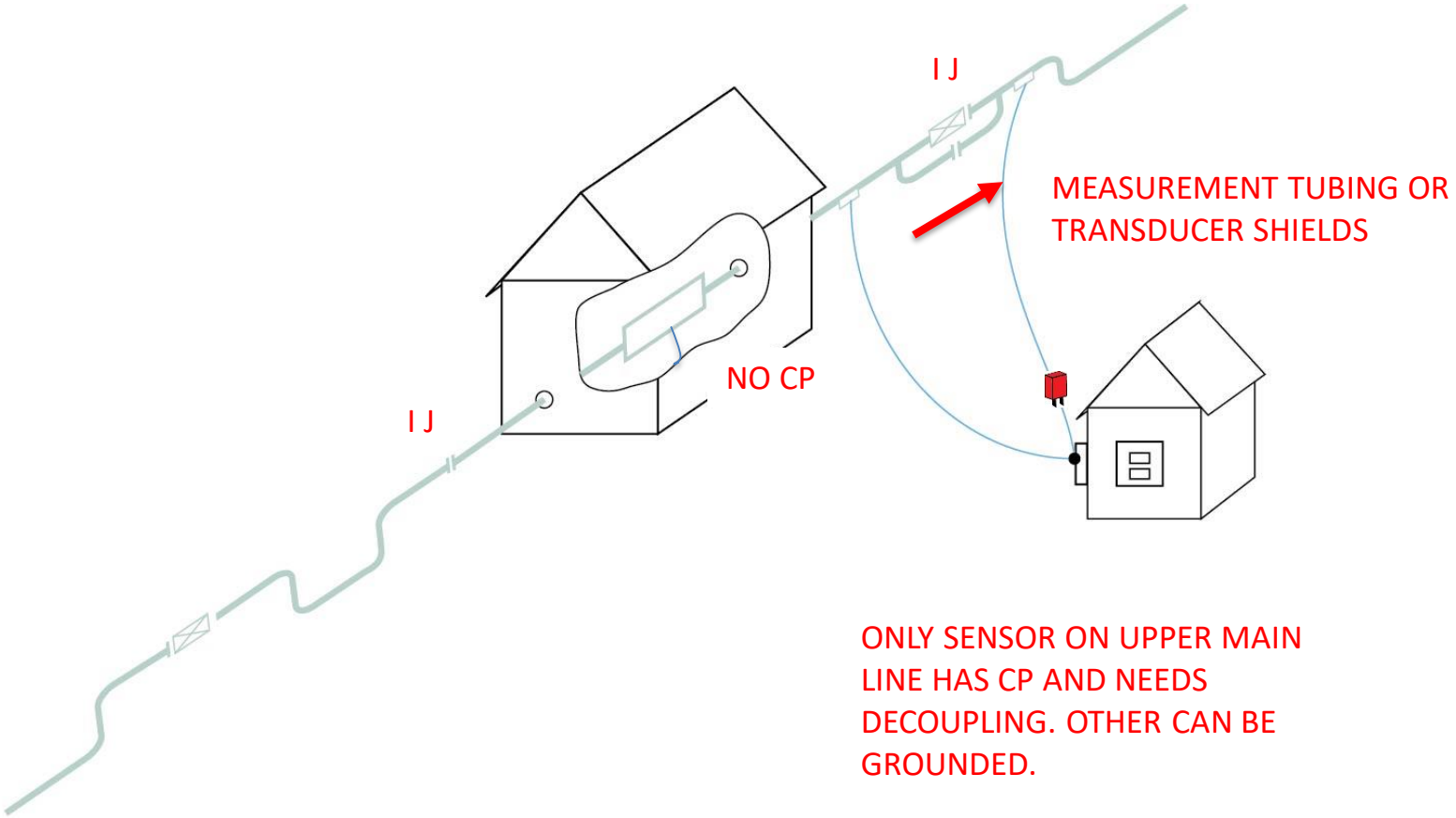


MEASUREMENT TUBING OR TRANSDUCER SHIELDS

ALTERNATE – ONE DECOUPLER FOR BOTH LINES. CAN WE DO THIS?

THOUGHT PROCESS: DO BOTH COME FROM THE SAME CP SYSTEM? BOTH LINES WILL END UP BONDED, IF CONSTRUCTED THIS WAY.

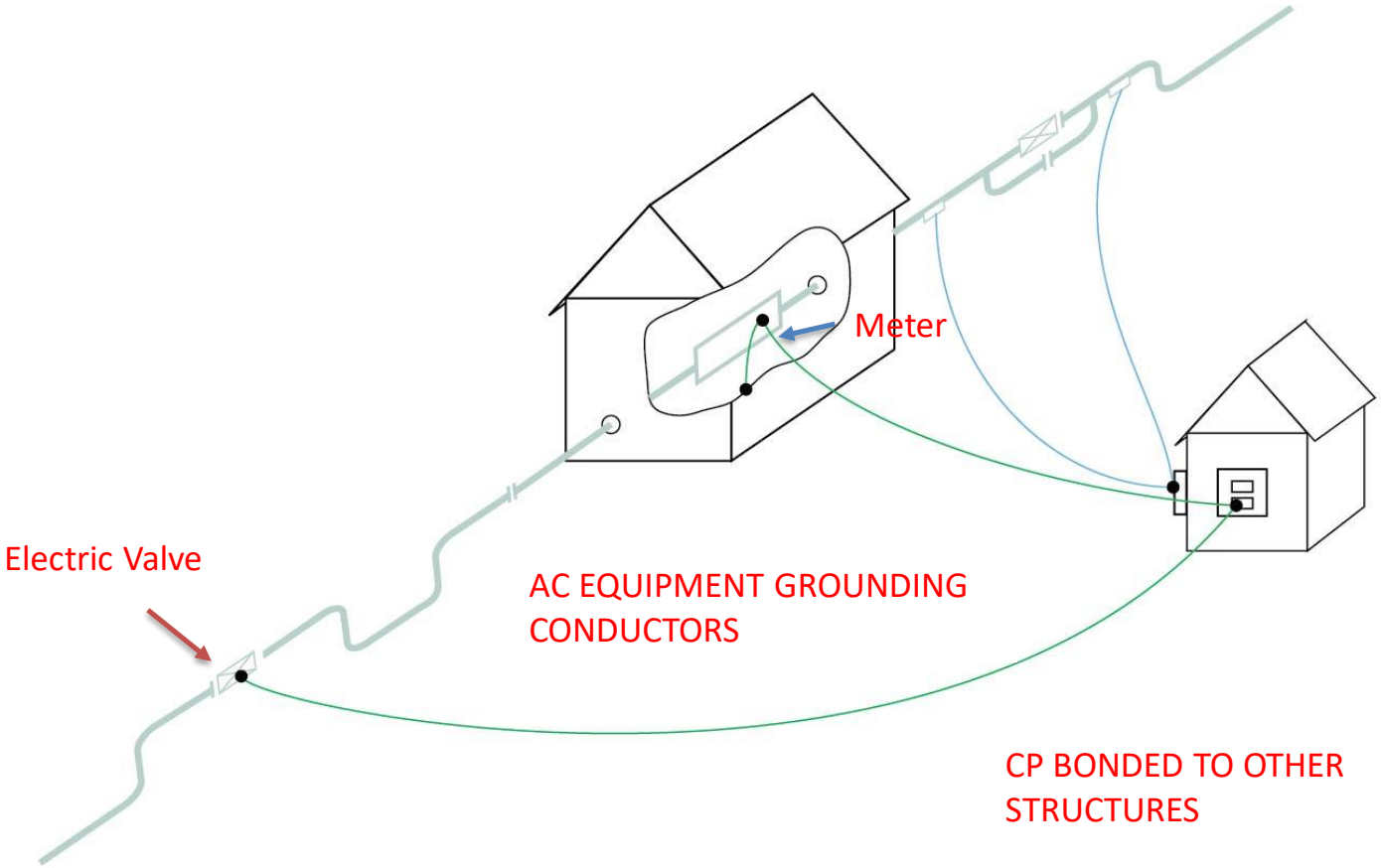
Sensing and Measurement Lines



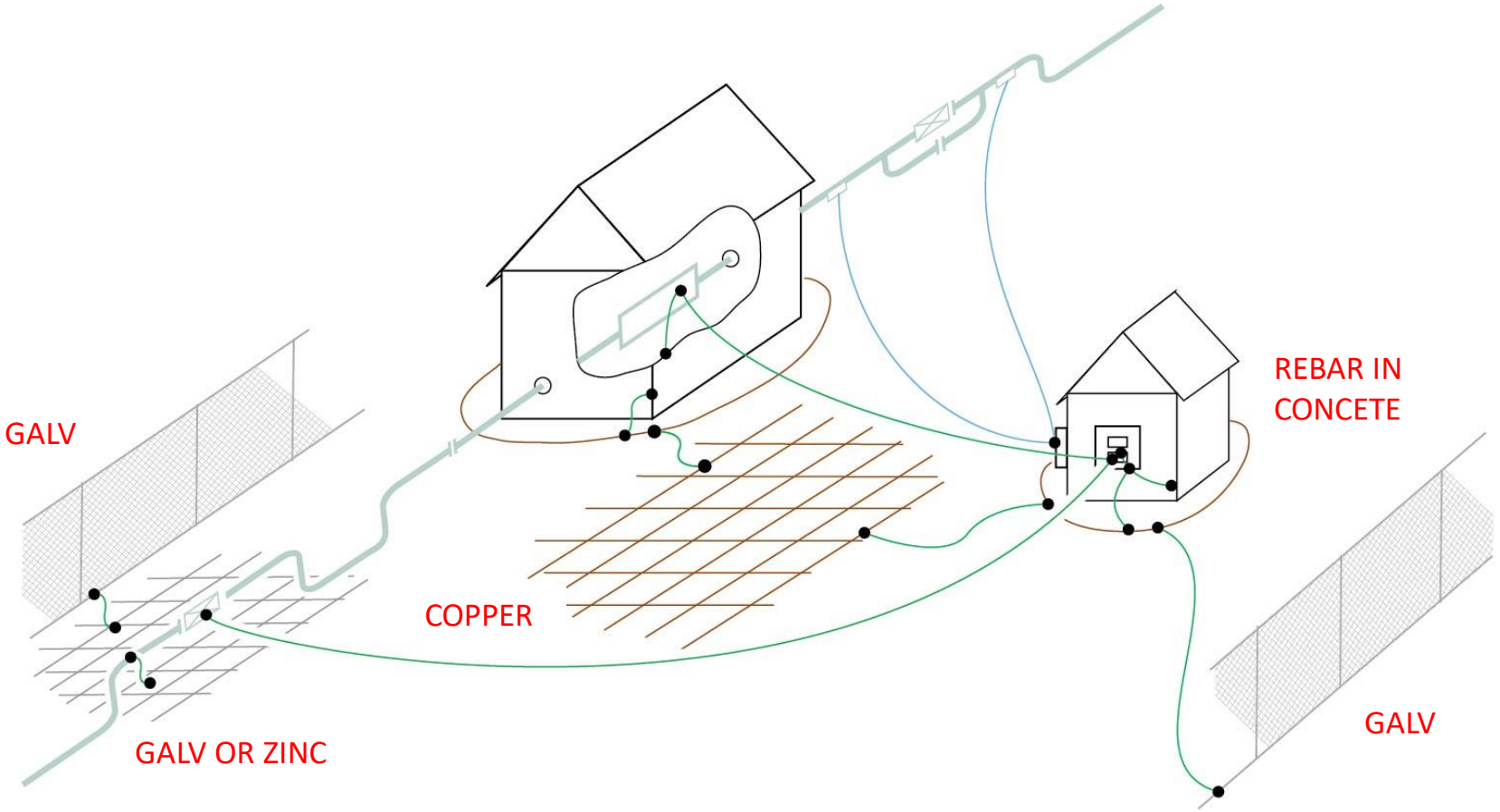
ONLY SENSOR ON UPPER MAIN LINE HAS CP AND NEEDS DECOUPLING. OTHER CAN BE GROUNDED.

Sensing and Measurement Lines

Equipment Grounding Conductors



In Earth Materials

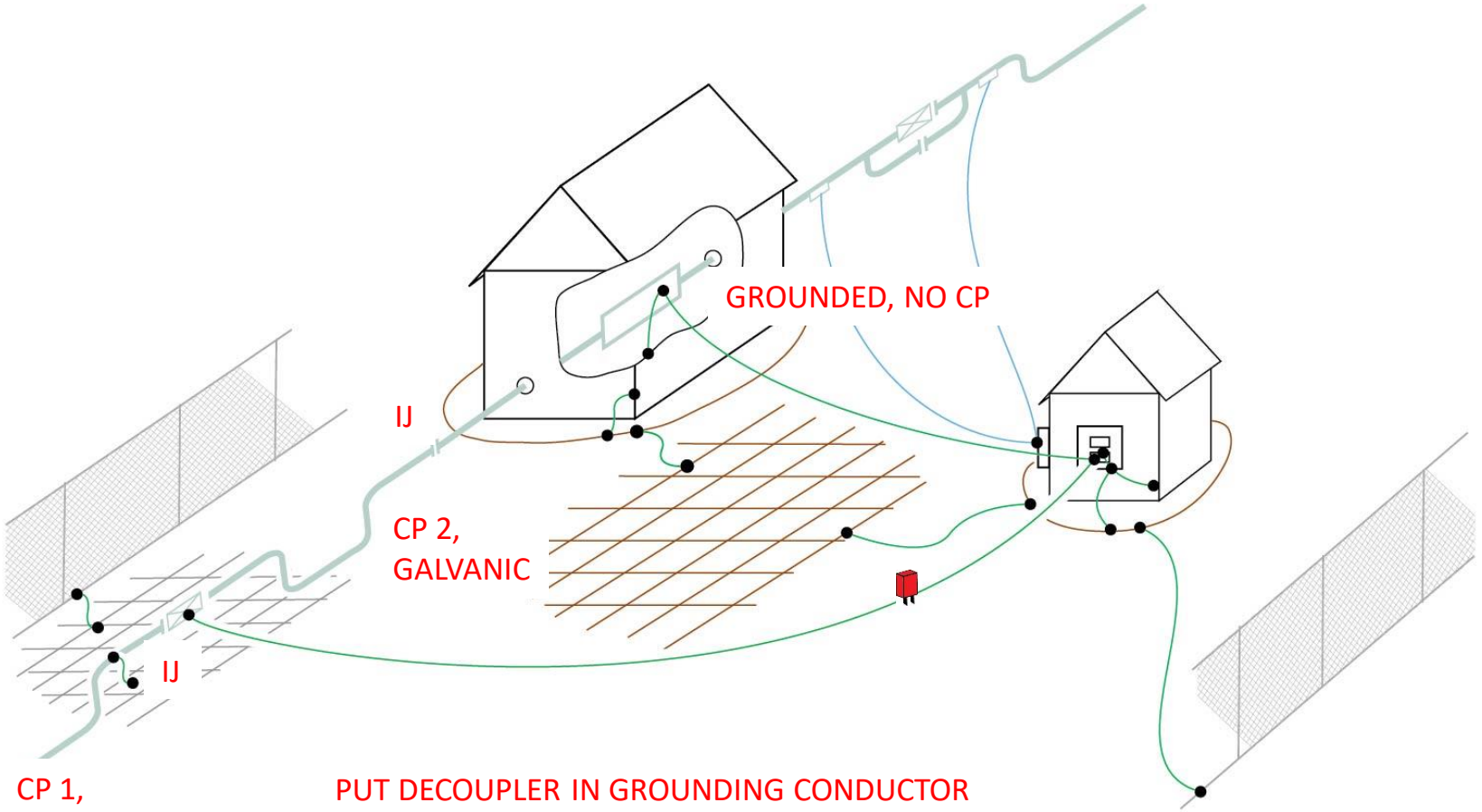


Equipment Grounding Conductors

Decoupling equipment grounding conductors

- Grounding conductors covered by US NEC – NFPA 70 - section 250 and Canadian Elec Code CSA C22.1-15 section 10
- Decoupling with listed devices allowed per NEC 250.6(E) and CEC 10-806(1)

Equipment Grounding Conductors



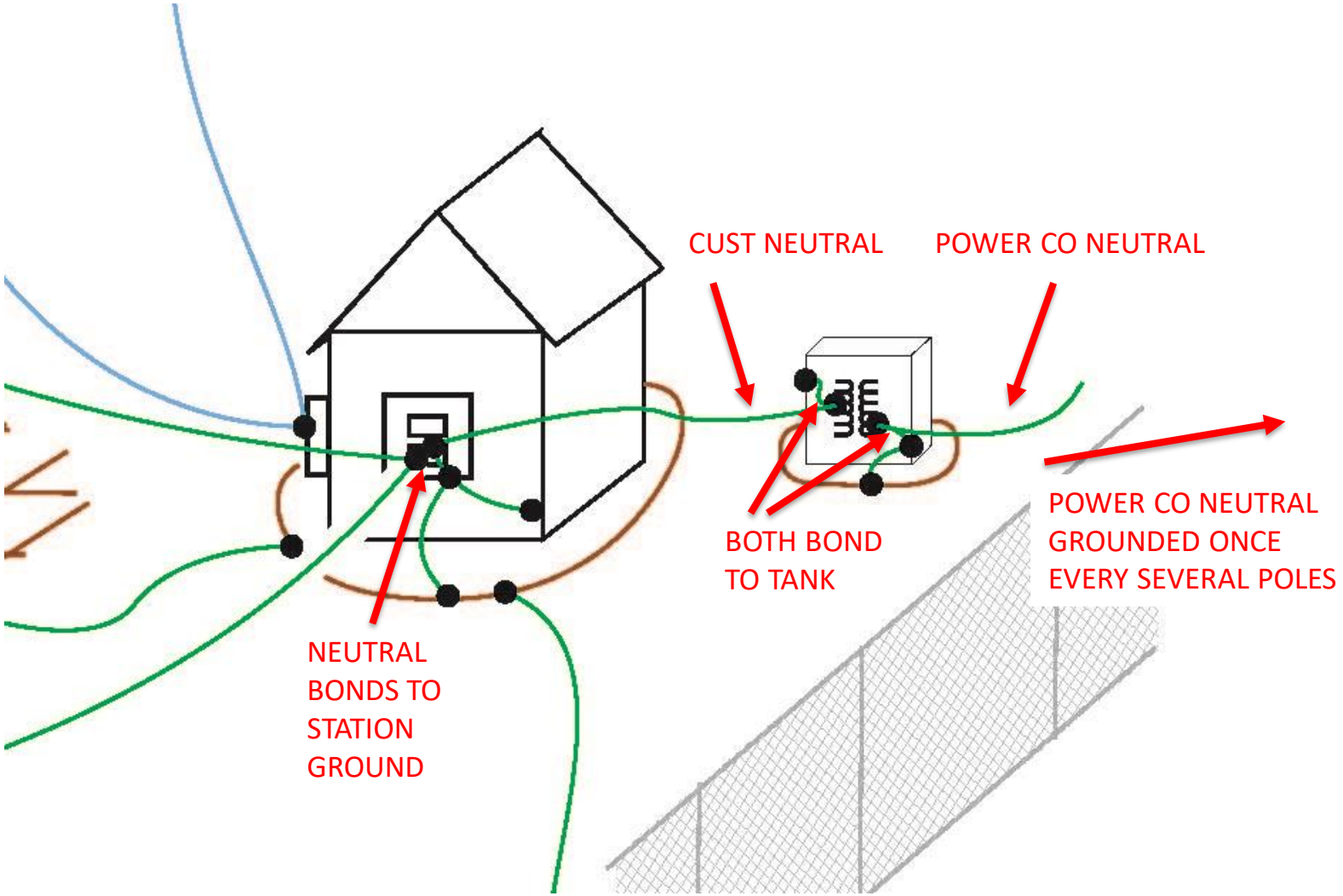
CP 1,
IMPRESSED

PUT DECOUPLER IN GROUNDING CONDUCTOR TO MOV ON CP2 ONLY. OTHER CONDUCTOR DIRECTLY GROUNDED. USE THIS ANALYSIS METHOD TO EVALUATE IF MULTIPLE GROUNDS CAN HAVE COMMON DECOUPLER.

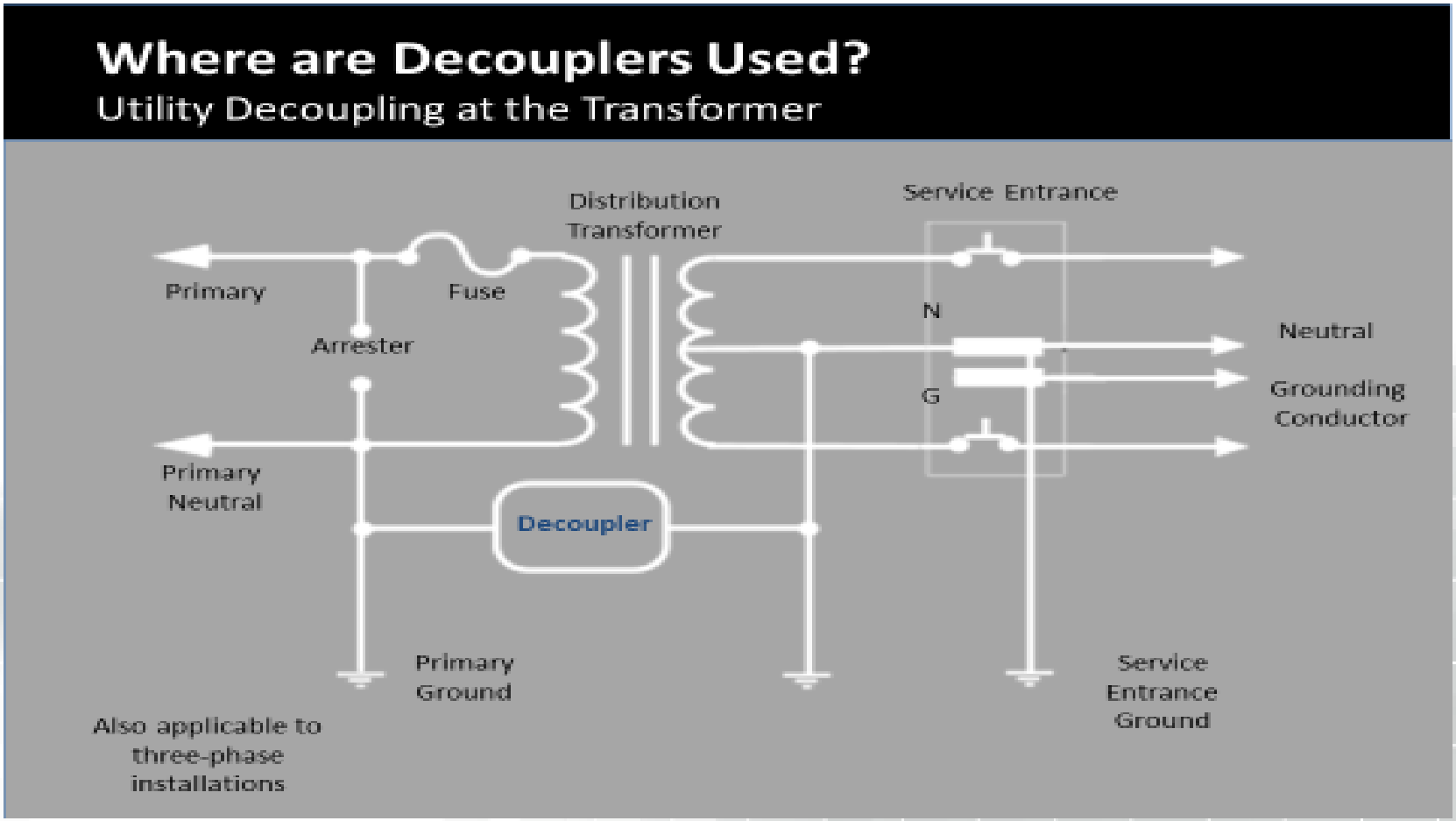
Direct vs Decoupled Bonds

REFERENCE MATS TO STRUCTURES AND PIPELINES TO CONTROL VOLTAGE AT CONTACT POINTS, BY DIRECT BOND OR DECOUPLER, AS APPROPRIATE.

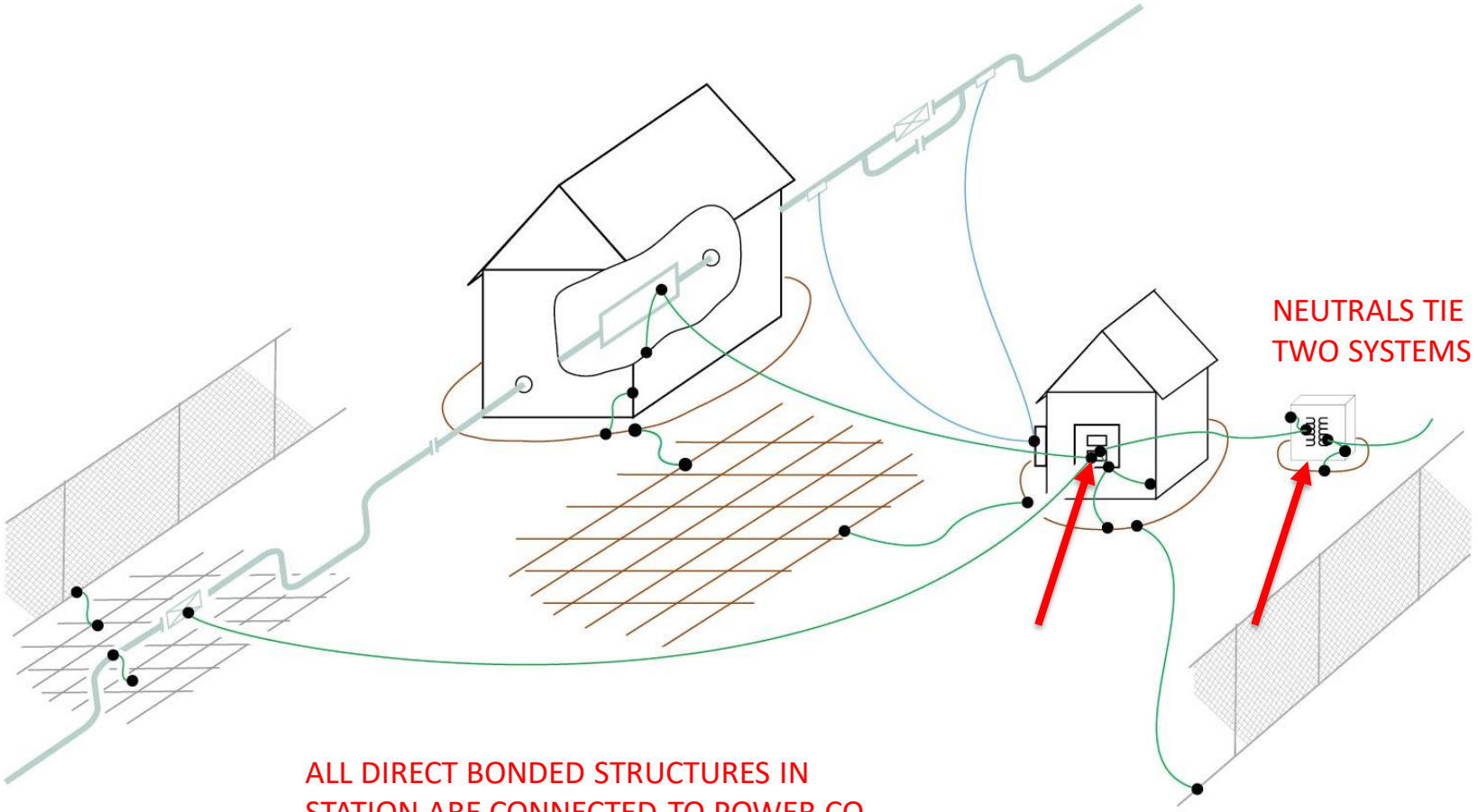
Power Utility Service



Utility Decoupling at a Transformer



Power Utility Service



ALL DIRECT BONDED STRUCTURES IN STATION ARE CONNECTED TO POWER CO GROUNDING SYSTEM BY DEFAULT. CAN BE DECOUPLED IF NEEDED AT CUST PANEL OR TRANSFORMER.

Things to Consider With Station Features

- Generally, your station is a galvanic stewpot of mixed metals. Balance life extension with complexity in your design efforts.
- Your neighbor's station on the other side of the fence, and effect of bonding/not on CP and safety.
  - May need to decouple your station from power co due to neighbor's problems, even if not for your own CP effectiveness.
- Hazardous areas and use of over-voltage products and methods – must be comply with codes.
  - May allow/affect location of products
  - Div 2 vs Div 1 product ratings, cost

Application Discussions and Questions

Dairyland Electrical Industries, Inc.
Stoughton, WI
www.dairyland.com
techsupport@dairyland.com
Phone: 608-877-9900

Support, meetings, trainings, lunch-and-learns, or presentations:

Tim Bechtel
tim@dairyland.com