Decoupler Interactions W/CP Systems
AUCSC 2019

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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
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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
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Where Decouplers & OVPs are Used
Where Should Decouplers Be Used?

Insulated Joint Damage
Insulation Joint Damage From Arcing
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
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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
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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

Div 1/Zone 1 or Div 2/Zone 2?
Station Exposure Addressed

DECOUPLERS APPLIED TO ADDRESS VOLTAGE AT ISOLATION JOINTS
Additional Exposures

NO CP – CAN DIRECT BOND

MAY RECEIVE PROTECTION FROM PARALLEL DECOUPLER?
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

MEASUREMENT TUBING OR TRANSDUCER SHIELDS

CP BONDED TO OTHER STRUCTURES
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

MEASUREMENT TUBING OR TRANSDUCER SHIELDS

I J

NO CP

I J

ONLY SENSOR ON UPPER MAIN LINE HAS CP AND NEEDS DECOUPLING. OTHER CAN BE GROUNDED.
Sensing and Measurement Lines
Equipment Grounding Conductors

AC EQUIPMENT GROUNDING CONDUCTORS

CP BONDED TO OTHER STRUCTURES

Electric Valve

Meter
Equipment Grounding Conductors

Decoupling equipment grounding conductors


• Decoupling with listed devices allowed per NEC 250.6(E) and CEC 10-806(1)
Equipment Grounding Conductors

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

- Neutral bonds to station ground
- Both bond to tank
- Customer neutral
- Power company neutral
- Power company neutral grounded once every several poles
Utility Decoupling at a Transformer

Where are Decouplers Used?
Utility Decoupling at the Transformer

Diagram showing the placement of decoupler in a transformer setup, including primary neutral, fuse, arrester, distribution transformer, service entrance, neutral, grounding conductor, primary ground, and also applicable to three-phase installations.
ALL DIRECT BONDED STRUCTURES IN STATION ARE CONNECTED TO POWER CO GROUNDING SYSTEM BY DEFAULT. CAN BE DECOUPLED IF NEEDED AT CUSTOMER 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
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