APPLICATION GUIDE

DECOUPLING TANK GROUNDING SYSTEMS

DAIRYLAND ELECTRICAL INDUSTRIES

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INTRODUCTION

Above Ground Storage Tanks (AST) are structures used to store liquids that typically are filled through an incoming pipeline system and distribute liquids through an outgoing pipeline system. Through this system, ASTs may have a variety of appurtenances connected to them such as monitoring equipment, motor operated valves (MOV), gradient control mats (GCM), measurement tubing, isolation flanges, ground rods, etc. Each of these items alone may have an adverse effect on cathodic protection (CP) voltage levels. However when they are combined they can present a complex network of potential short circuits to ground.

All metallic structures and the electrical equipment must be grounded to comply with electric codes to provide safety grounding. As a result of these connections, the CP system is not only attempting to protect the intended structures, but could also be protecting the user's grounding system, and possibly even the power utility grounding system. The other consideration is that there may be multiple CP systems designed to protect the specific structures and it is important to ensure proper isolation to prevent an inadvertent bond that may unintentionally create a connection between the different CP systems.

Installing a solid-state Dairyland device in series between the tank grounding lug and the grounding conductor will provide an effective ground-fault path to ground, while simultaneously isolating CP to the tank. This can be accomplished by installing either a Dairyland Over-Voltage Protector (OVP) if there is no steady-state AC induction on the structures (normally not present on tanks),a Solid State Decoupler (SSD) or Polarization Cell Replacement (PCR) if there is the possibility of steady state AC, or if higher AC fault capability is required. Some sites may have hazardous location classifications that require the user to use other Dairyland products – see the table below. For the sake of simplicity, all of these devices will be referred to as decouplers, because the purpose of this application is to isolate the CP system to the AST while maintaining safety grounding under all conditions.

The decoupler can be installed to the tank through the various hardware options that are available at www.dairyland.com as per operator preference. These accessories help to physically mount the device or assist in limiting conductor length for best over-voltage protection.

Welding a tab directly on the tank and fastening the decouplers negative terminal to the welded tab and the positive terminal connects to the grounded conductor to remote earth.

Pin brazed studs connected to the Hex coupling Nut (HCN) accessory allows for the closest connection to the tank possible. For this application, it is necessary to request the rotated terminal configuration in order to have the terminals facing in the right direction

Common Misconceptions

One of the misconceptions when looking at this application is the idea that a decoupler can be used for more than one grounding conductor on an AST (remembering that grounding conductors and rods may be spaced up to 100' apart). This is a common question, and in many instances a decoupler can be used to protect multiple connections. However, due to the spacing involved in this application, the length of the conductor is too great and could cause an excessive amount of inductance during a lightning event. In the event of a lightning strike the voltage that could be generated, whether direct or indirect, could prove to be catastrophic. Therefore, for each grounding connection to the AST, there should be a corresponding decoupler in series in the conductor to the grounding system.

Addressing Multiple Cathodic Protection Systems

Of course, for electrical grounding safety, all structures should be referenced to each other in the case of an over-voltage event. However, when considering the AST application, it is common to have multiple CP systems involved in this scenario. The AST will have a CP system protecting the tank bottom. There may also be separate impressed current systems (ICCP) systems for the inlet piping coming into the station, and the outlet pipeline exiting the station. There may also be additional CP for piping within the station, or other nearby ASTs. These could be impressed current systems, galvanic systems, or a combination of the two. The problem with this is that one system may unintentionally protect a structure it was not designed to protect and present difficulties trying to achieve CP levels per criteria for that structure. The challenge is to isolate each CP system to its respective structure it was intended for and to address all of the connections that could create a bypass or even cause the CP system to be short-circuited to the ground grid. Decoupling devices can address bonds to ground that affect CP. Regarding piping that affects tank CP levels, simply installing isolation flanges may provide CP current isolation but may present a new over-voltage risk with resulting arcing. Installing a decoupler at each isolation flange will not only maintain CP isolation but will also provide protection from arcing in the case of an overvoltage event.

Electric motors, measurement tubing, signal wire, and GCMs could short the CP system to ground. The CP system will protect everything that is connected to the intended structure. Therefore, if a motor-operated valve is connected to piping that is cathodically protected, then all of the structures that the motor-operated valve is connected to are also protected. This means the station grounding system may also be protected along with the utility grounding system. This could potentially create a tremendous drain on the CP system, causing it to be nearly impossible to protect the intended structures. As Dairyland devices meet NFPA 70 (US National Electrical

Code), for “Providing an effective ground-fault path,” including a explicit allowance in article 250.6(E), a decoupler is allowed to be placed in series in the grounding conductor to isolate the CP current to the structure while providing ac fault protection to ground.

Installing a Gradient Control Mat

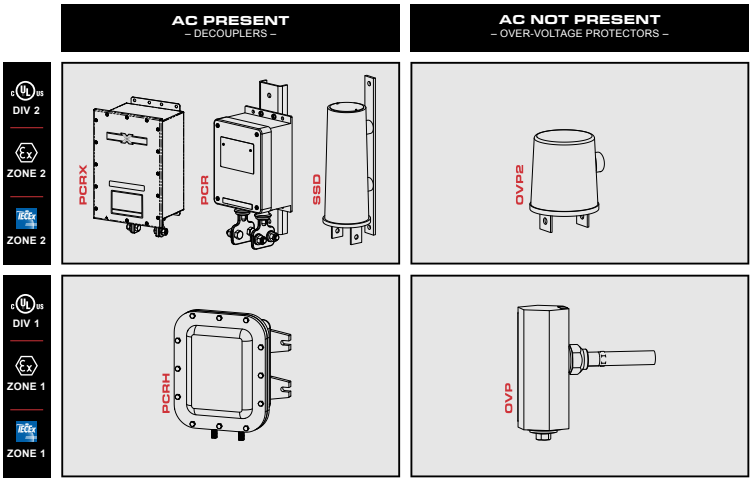
A gradient control mat (GCM) should be installed to address step and touch potentials for any above ground appurtenances in the event of an overvoltage or lightning event.

As described in other Dairyland documents, conductor (or lead) length plays a significant role in determining the touch potential between any two connected points; in this case, between a tank or piping and a gradient control mat. Lead lengths must be kept very short in order to achieve acceptable touch potentials - on the order of inches. This is due to the inductance added with increasing lead length, which can be controlled by shortening the length, and by adding an additional conductor in parallel. Because an additional conductor may be needed in parallel for ampacity or redundancy reasons anyway, this has a side benefit of lowering the inductance. Note that only touch potentials are affected by lead length, and step potentials remain unaffected, as this relates to properties of the mat alone. Contact Dairyland if additional information is needed.

Environmental Ratings

All Dairyland products for tank isolation are certified for use in hazardous locations. To address the worldwide use, products are certified to various international standards and have a Div1/Zone 1 rating, or a Div 2/Zone 2 rating, which should be selected to match the classification of the specific installation point. If the location is “ordinary” (non-hazardous), then select a Div 2/Zone 2 product by default.

Dairyland Product Families



Codes

NFPA 70 (US NEC), Article 250.2 and 250.4(A)(5) Providing an effective ground-fault path,” and 250.6(E) with allowance for Dairyland devices to be used in series in a grounding conductor. Likewise allowed per Canadian Electrical Code CSA C22.1 section 10-806(1).

API 650 Section 5.8.11.3 states that if required by the purchaser, a minimum of four grounding lugs (for connection to grounding rods) shall be equally spaced around the base of the tank with a suggested maximum spacing of 100’.

NFPA 780 – Section 7.4.1 Standard for the installation of lightning protection systems

All metal tanks must be grounded by one of the following:

1. Tanks connected without insulating joints to a grounded metallic piping system.
2. Vertical cylindrical tank shall rest on earth or concrete and shall be at least 20’ diameter OR rest on bituminous pavement and shall be at least 50’ diameter
3. Tank shall be bonded to the ground by a minimum of two grounding electrodes at 100’ maximum spacing
4. Tanks with insulating membrane underneath for environmental or other reasons shall be grounded as in (3)