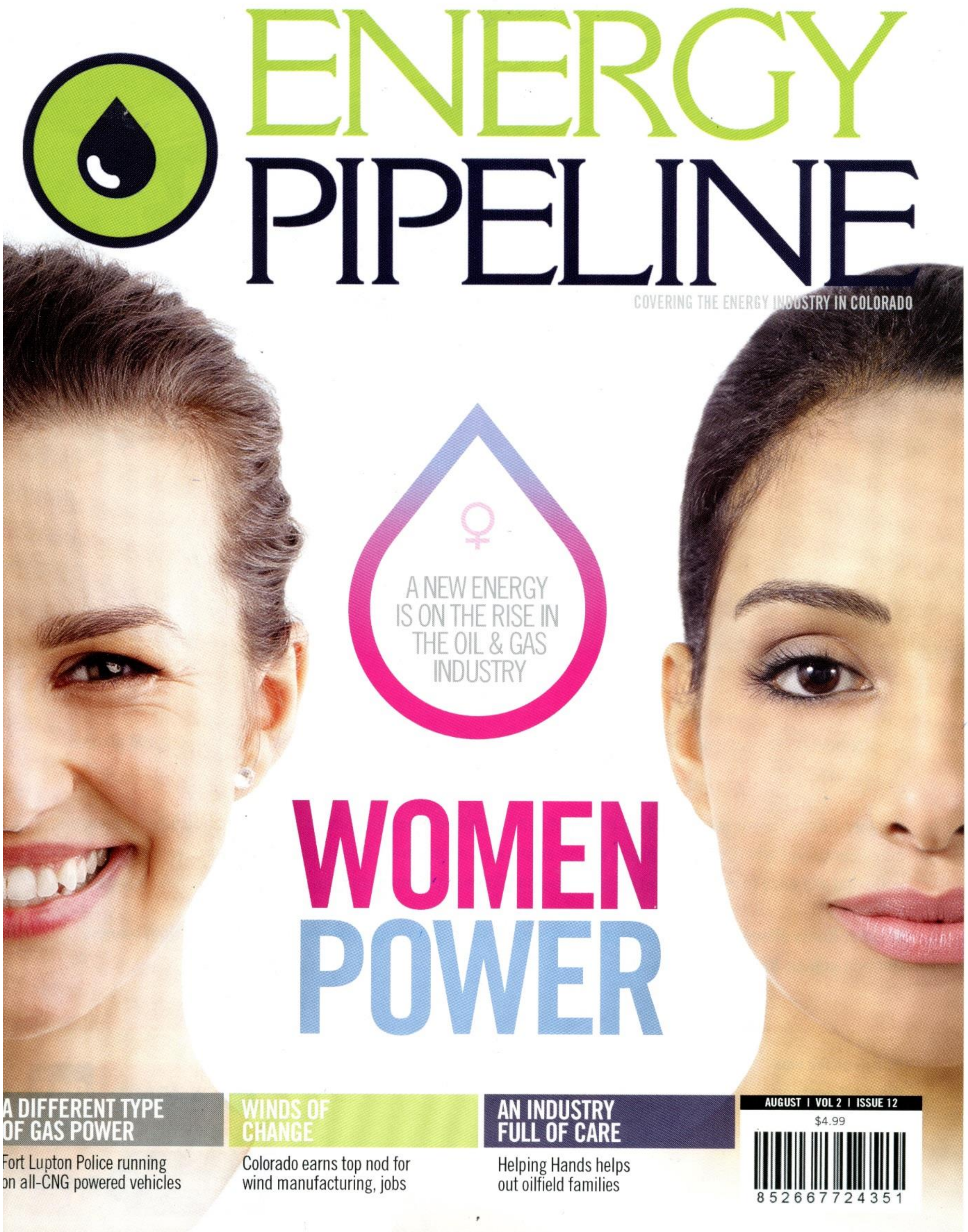
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TECH TALK

EXPOSURE TO LIGHTNING STRIKES AT INJECTION WELL FACILITIES

BY GARY BEERS • FOR ENERGY PIPELINE

In April 2015, a commercial, produced-water, injection well facility adjacent to the Greeley-Weld County Airport was struck by lightning. It exploded and continued to burn for several hours (Graphic 1, Source: Greeley Tribune). Several days later, 18 miles southeast of the Denver International Airport, a smaller IJ well facility operated by an oil company was struck by lightning and a fire resulted. This northeast region of Colorado experienced an abnormal number of severe thunder and lightning storms during April but why did these water-related facilities experience lightning strikes and resulting fires when there were no instances of fires involving oil storage tanks due to lightning strikes?

Apparently, this is not a rare event. Oilfields in several states have experienced fires caused by lightning strikes at injection well facilities since 2013: North Dakota (3), Texas (4), and Colorado (2). For Colorado since 2013, there have been 27 instances of fire-related accidents in oilfields and only three of these were caused by lightning strikes. However, during January to June 2015, two of the seven incidents were caused by lightning strikes at injection well facilities

Given the above, this month's Tech Talk answers the following questions:

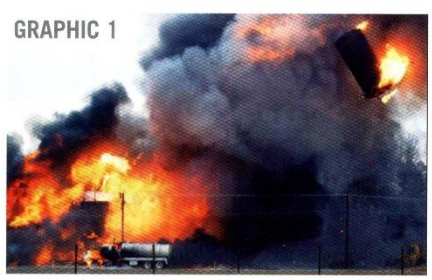
- Why are lightning strikes causing fires at injection well facilities?
- How can this risk be minimized?
- What are the regulatory requirements for protection from lightning at injection well facilities?

WHY ARE LIGHTNING STRIKES CAUSING FIRES AT INJECTION WELL FACILITIES?

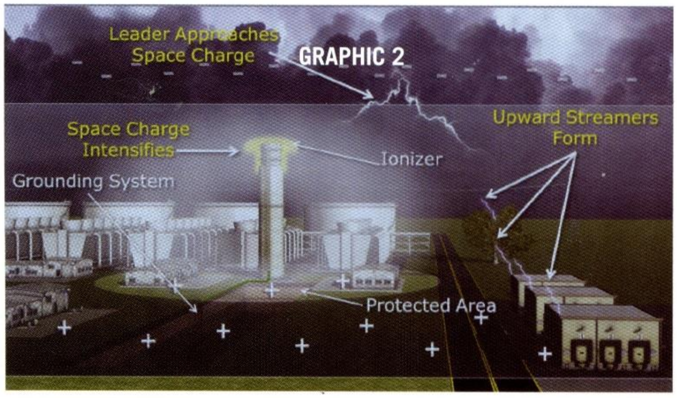
A typical injection well facility consists of three types of tanks. Incoming produced water is received in a steel tank where oil and water are separated. Oil from this operation is then routed to storage in steel tanks, while the produced-water (brine) is routed to storage in fiberglass tanks and then injected into geologic formations at depths of several thousand feet. During the storage of both liquids, volatile gases are released and usually found in vent valves and within the tanks above the fluid.

While the chances of lightning striking a steel or a fiberglass tank are essentially the same, fiberglass tanks are more prone to ignition - if stuck by lightning. The steel tanks are considered inherently grounded. The fiberglass tanks typically do not have protection from lightning strikes, and strikes can ignite accumulated volatile gases and result in fire spreading to other areas containing volatile gases and/or other flammable products. This ignition can occur even with a lightning strike within 300 feet of an injection well facility, which creates a ground potential rise that can lead to a spark at the facility.

GRAPHIC 1



For over 50 years, **GARY BEERS**, has worked in numerous fields of environmental science as a consultant, regulator and educator. This career included senior management position with major consulting, nonprofit and public organizations. He has founded several successful firms to capture emerging resource management markets. One of his latest ventures, EnviroScienceINFO, provides content for public media.



CHANCES OF LIGHTNING STRIKING A STEEL OR A FIBERGLASS TANK ARE ESSENTIALLY THE SAME, FIBERGLASS TANKS ARE MORE PRONE TO IGNITION

HOW CAN THIS RISK BE MINIMIZED?

The obvious answer would be to replace the fiberglass tanks with steel tanks. However, the fiberglass tanks are used because they do not corrode as quickly as steel tanks when exposed to the corrosive nature of the brine (produced water) and, thus, last longer. It may be assumed that use of steel tanks to store produced water is not viewed as cost effective under the operator's cost/benefit analyses.

There are two state-of-the-art practices for lightning protection of fiberglass tanks at injection well facilities.

The first approach is to modify the fiberglass tank to reduce the potential of an arc or spark igniting the volatile gases. Simply put, isolated metallic components on the tank should be "bonded" to connect to the other structures, including equipment, that are already grounded. In addition, an internal grounding conductor should be installed outside the tank from top to bottom, and bonded to this same grounding system. To increase the efficiency of grounding, grounding electrodes can be added to enhance the unified ground system.

The second and more unique approach was developed in the early 1970s a chief engineer at NASA to address potential lightning strikes at space launch facilities and is called the Dissipation Array System. The scientific concept for DAS, as explained by this engineer, Roy B. Carpenter Jr, is as follows:

"The cause of lightning is atmospheric electricity, specifically the accumulation of potential between a thundercloud and the earth's surface to the magnitude where the air between the thundercloud and the earth is no longer an insulator and begins to breakdown, ultimately resulting in a lightning strike. To prevent the strike from terminating on the facility, the protective system must dissipate the site on the site to lower its potential and prevent the formation of upward streamers from the site. The Dissipation Array System does just that, not necessarily by significantly affecting the cloud charge, but rather by reducing the charge on the site and making the facility a non-target for the incoming lightning strike."

In layman terms, DAS is implemented by installing a very large, custom-designed ionizer on the facility to prevent it from becoming a lightning strike target. Graphic 2 (Source: Lightning Eliminators and Consultants) provides a visual portrayal of this protective concept.

In the 1980s and 1990s, electric utilities installed DAS at eight locations in Colorado, while none were installed at oilfield facilities. However, since 2008 DAS has been installed at 16 oil-related facilities located in oilfields of Weld County. These facilities include injection wells, oil storage tanks, pipeline and structures housing other operations. Since DAS installation, there have been no incidents of lightning strikes to these protected facilities.

REGULATORY REQUIREMENTS FOR PROTECTION FROM LIGHTNING AT INJECTION WELL FACILITIES

The Colorado Oil and Gas Conservation Commission does not have rules or policies that address measures that are required to reduce this lightning risk. This regulatory position prevails in most, if not all, oilfields.

While the National Fire protection Association and the American Petroleum Institute have developed national technical standards and risk assessment programs for lightning protection (i.e., NFPA 780, NFPA 77, API 545, and API 2003), these only serve as recommendations and guidance.

The extent and degree of lightning protection at injection well facilities as well as at other oilfield facilities is the choice of the owner. The prevailing practice by most owners is to self-insure and accept the total expense when lightning strikes. Consequently, there is no requirement by any authority to install lightning protection on any facility in Colorado, or anywhere in the United States for that matter.

Perhaps the authorities having state or local jurisdiction should re-examine this position with the objective of reducing lightning-related risks and fires at specific, oilfield facilities located near important infrastructure and/or outdoor cultural activities.