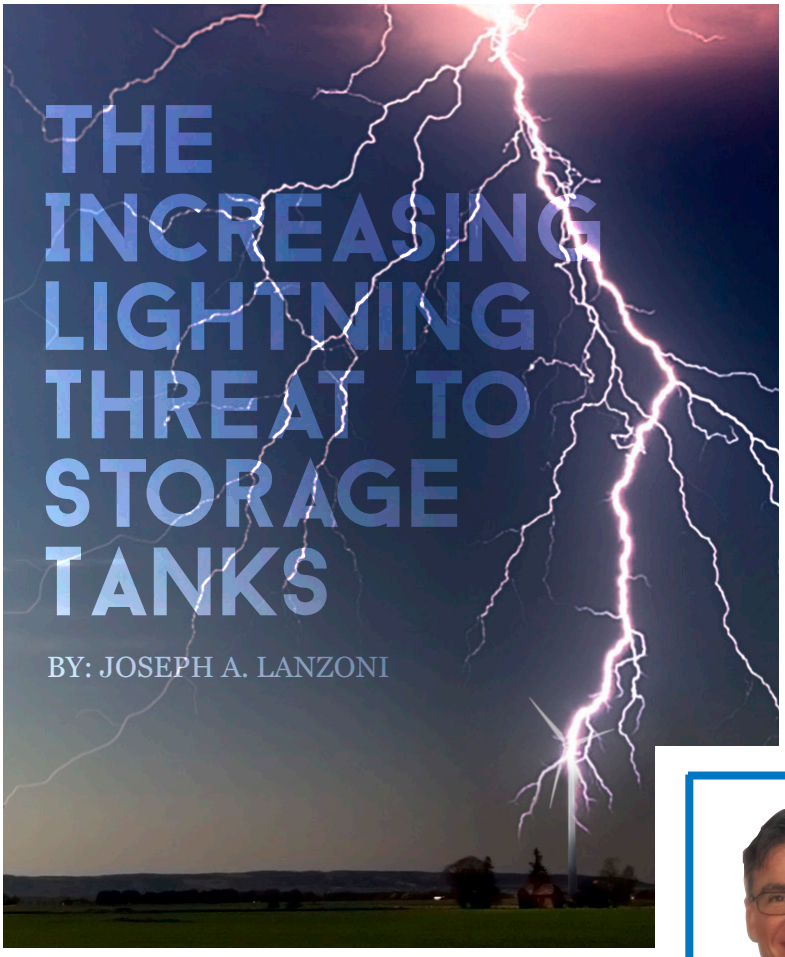


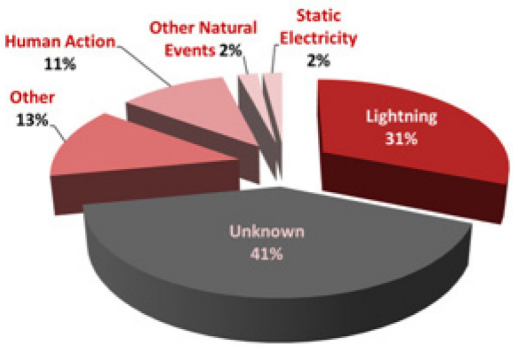
THE INCREASING LIGHTNING THREAT TO STORAGE TANKS

BY: JOSEPH A. LANZONI

Lightning-related petroleum storage tank fires are more common than most people think. Prior to the widespread development of the Bakken and other new energy regions, the number of reported tank fires was in the range of 15-20 fires per year. For example, the Brandsforsk study [Ref. 1] covered a period from 1951 to 2003 and tallied reports of 480 tank fires, with about one-third being attributed to lightning. Another study (sponsored by 16 oil companies) found that 52 of 55 rim seal fires were caused by lightning and concluded that "lightning is the most common source of ignition." [Ref. 2]

The number of lightning-related tank fires is most likely greater than 20 per year owing to a confluence of factors: (1) Due to the development in the Bakken, Denver-Julesburg and other similar regions, the number of tanks in service has greatly increased; (2) the product from these new energy fields is more volatile than conventional crude oil; and (3) not all tank fires are officially reported by a government or public agency. So it is quite likely the actual number of tank fires is underreported and that the actual number is greater than 20 per year.

Several recent climatology studies, including those by NASA, Stanford University, the University of California at Berkeley and Purdue University, have reached similar conclusions about future rates of lightning activity: They all predict an increase in the global rate of lightning activity. For example, NASA researchers have predicted a 5-6% increase in lightning for every one degree Celsius rise of global surface temperature. Researchers from the University of California at Berkeley predict a 7-19% increase in lightning for every one degree Celsius rise of global surface temperature. Taken as a



Causes of tank fires [Ref. 1]

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whole, these studies suggest that due to a changing climate there is more evaporation and more moisture in the atmosphere, thus leading to a greater number of thunderstorms.

When a tank fire occurs, many large costs result, including costs due to lost product; damage to the physical plant; interruption of customer service; environmental harm; firefighting, cleanup and rebuilding; EPA, OSHA and regulatory fines and increased oversight; loss of community goodwill, etc. Therefore, it is imperative that lightning-related tank fires be prevented.

Several national technical standards address the topic of lightning protection for tanks, including NFPA 780, NFPA 77, API 545 and API 2003.* As more is understood about the lightning phenomenon and how industrial equipment and processes react to lightning, these standards are revised to expand their scope and/or revise their recommendations. To reduce lightning-related risks and increase community safety, it is imperative for tank owners and operators to bring storage tanks into compliance with the latest versions of these standards.

For example, both API 2003 and NFPA 77 recommend against using non-conductive tanks to store flammable and combustible materials. In spite of these recommendations, many non-conductive tanks, including fiberglass tanks and lined steel tanks, are being used in the new energy areas like the Bakken and Denver-Julesburg Basin. From an electrical viewpoint these tanks are unsafe because electrical charges can accumulate on the tanks' contents, but the charges are not equalized with ground potential as they would be in a steel tank.

As a working example, let's examine a typical storage tank used in a petroleum-related field operation, such as one used for saltwater disposal. If the tank is partially full, the space above the fluid typically contains a combustible vapor. In a grounded conventional steel tank, the conductive steel allows for charge equalization between the tank's contents, the tank itself and the ground. However, for a non-conductive or lined tank, there is no charge transfer and equalization, thus a differential between the combustible vapor and the ground could occur. A direct or nearby lightning strike will cause a rise in ground potential and all grounded objects. If the potential difference between a grounded object or surface exposed to the vapor and the vapor reaches the electrical breakdown strength of the vapor space, an arc will form and disaster will follow.

In acknowledgement of this situation, both NFPA 77 and API 2003 recommend a grounding conductor inside all non-conductive or lined tanks. To neutralize any charge differentials that may exist between the tank contents and ground, this internal grounding conductor must be connected to the earth. In addition, all metal tank fittings, such as flanges, hatches, etc., must also be bonded and grounded. Ironically, NFPA 77 goes on to state

➤ continued, pg 50

➤ continued from pg 35

THE INCREASING LIGHTNING THREAT TO STORAGE TANKS

that non-conductive tanks "are not permitted for storage of Class I, Class II or Class IIIA liquids."

In another example, both API 545 and NFPA 780 recommend installing multiple roof-to-shell bypass conductors on floating roof storage tanks. The bypass conductors will ensure that the roof and shell stay at the same potential during thunderstorms, thus mitigating the risk of an arc between the roof and shell. Today, thousands of floating roof storage tanks are in use, however the majority of them lack sufficient bypass conductors, thus increasing their risk of lightning-related fires.

Lightning Eliminators & Consultants, Inc. (LEC) manufactures a wide line of grounding and lightning protection equipment that is designed to eliminate the risks associated with static accumulation and lightning strikes. They manufacture the In-tank Potential Equalizer (IPE), which is an internal grounding conductor made specifically for insertion into non-conductive or lined tanks in oilfield operations. LEC also manufactures the Retractable Grounding Assembly (RGA), which is a self-retracting bypass conductor made specifically for floating roof petroleum storage tanks. LEC can be reached at 800-521-6101 or www.LEC-global.com. ■

* NFPA 780 is the Standard for the Installation of Lightning Protection Systems; NFPA 77 is the Recommended Practice on Static Electricity; API 545 is the Recommended Practice for Lightning Protection of Aboveground Storage Tanks for Flammable or Combustible Liquids; API 2003 is the Recommended Practice for Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents

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Mr. Lanzoni has over 22 years of experience in the lightning protection, electrical grounding and surge protection industries. He has conducted numerous site inspections of industrial and commercial facilities, for the purposes of evaluating lightning protection, grounding and surge protection systems. These sites have included chemical production plants, refineries, petroleum storage facilities, water treatment plants, data centers, power generating stations, broadcasting and cellular tower sites, substations and NASA facilities. Mr. Lanzoni has published and/or presented several technical papers regarding electrical grounding and lightning protection, such as Improving Lightning Safety of Petroleum Storage Tanks, Electrical Grounding in Mountainous Regions and Enhancement of Lightning Performance of Transmission and Distribution Lines. He is also an active or past member of the following national technical committees:
American Petroleum Institute committee for RP 545, Lightning Protection of Aboveground Storage Tanks for Flammable or Combustible Liquids
National Fire Protection Association committee for standard 780, Installation of Lightning Protection Systems
American Petroleum Institute committee for RP 2003, Protection Against Ignitions Arising Out of Static, Lightning and Stray Currents
National Fire Protection Association committee for the National Electrical Grounding Research Project
Mr. Lanzoni has over 28 years of experience with manufacturers of engineered equipment. He has an Engineering degree from Lehigh University, a Masters degree from University of San Diego and is a member of Institute of Electrical and Electronics Engineers.