PROGRESS IN LIGHTNING AND STATIC PROTECTION

What have the latest revisions to NFPA 780 and API RP 545 achieved and how much work still needs to be done?

Whereas lightning protection for external floating roof tanks formerly centered around shunts, recent scientific research has shown that another type of contact, the bypass conductor, is equally or more important than the shunt. Actu-ally, it has been a pretty bad time for shunts, as primary metallic shoe seals may be substituted for shunts under certain conditions.

TROUBLE SPOTS

One of the more surprising things that has emerged is that openings, such as thief hatches, are much more likely sources of ignition than originally imagined. Field testing has revealed that the resistance between the hatch and collar is much higher than predicted. That resistance can be the source of ignition producing arcs when poten-tial must equalise across them. This caution does not apply to the dogged-down hatches normally found on storage tanks.

There have also been multiple fires at site protected with overhead wire (catenary) systems. This technology is used extensively to protect commercial power transmission and distribution lines. In that application, it works acceptably well and is really the only game in town. However, it does not export well to tanks. Many tank ignitions are caused by secondary effect arcing from nearby lightning strikes. If the catenary system works exactly as designed, it intercepts a direct or nearby strike and brings it to ground immediately adjacent to the protected tank, producing maximum possible secondary effect arcing. That is assuming that the catenary system is able to intercept the strike to begin with, as there is no technical reason for lightning to preferentially attach to the catenary wire other than it is in the way.

One of the reasons that catenary systems may have found pop-ularity for use in the protection of tanks was that their de-scription was originally found in NFPA 780, Chapter 7. With this revision, the description of catenary systems has been moved to chapter 4, where all other types of systems are described.

Specific to external floating roof tank bypass conductors, retractable reel type bypass conductor systems may not be suitable for use in Class I, Division 1 areas. Reels systems have overlapping and sliding contacts, both of which can produce arcing and sparking when they conduct current. According to the literature provided by a manufac-turer of such systems, explo-sive gasses must not be present imme-diately around the reel during regular use. That explosive gasses may be present during normal operations is the definition of Class 1, Div 1, and the roof area of an external floating roof tank is a Class 1, Div 1 area. Therefore, it appears that reel systems may not be used in their intended application.

MAGS (moveable arm grounding system) for EFR tank bonding

STANDARDS AND RECOMMENDED PRACTICES (RPS)

National Fire Protection Association (NFPA 780), Chapter 7, covers tanks. It is reaching the end of its revision cycle, and has come a long way. First of all, it is much better organised.

Regarding external floating roof (EFR) tanks, the require-ments have changed from shunts and by-pass conductors to sliding and fixed contacts. This is a more accurate overall description of these ap-pliances by function. It also allows for the inclusion of future developments in each

area. Under sliding contacts, the use of primary metallic shoe seals is allowed, with shunts as an option or if required for static control over the secondary seals.

The remainder of the chapter was reordered so it flows better, makes more sense, and is easier to find specific subjects.

Unfortunately, there are a few things that have still been missed out. Section 7.4.3.2.3.1 addressing non-fully submerged seal assembly components should have been changed to require their bonding rather than their insulation. This bonding is also addressed under section 7.4.3.2.1.1, regarding the bonding of primary metallic shoe seals, so it may be redundant.

Same with 7.4.3.2.4.1 addressing gauge or guide poles. This section may be eliminated entirely as it solves a problem that may not exist (when was the last time you heard about a gauge well or guide pole fire? Ditto for legs and dogged down hatches, as opposed to thief hatches).

Section 7.4.3.2.1.2 (l) requires removal of above-deck shunts when retrofitting with submerged shunts. This should have required approval of the seal manufacturers, as the shunts are sometimes required for static control.

Missing these changes was a function of the NFPA process. Many on the Chapter 7 task group and the committee as a whole assumed that, as the whole chapter had been changed, all of it would be fair game for change throughout the process. However, at the recent NFPA 780 meeting in Charlotte, much of the 'new material' was now considered off limits. This highlights a shortcoming in the overall process. The task group members knew several sections were wrong and wanted to change them, but were unable to. Now they cannot be changed through the normal process for at least three years, until the next revision cycle. However, there is a vehicle called a Tempo-rary Interim Amendment (TIA). This allows emergency changes to an existing standard. There is no point in changing the current 2014 edition as it is about to expire, but we may look at submitting such a request after the 2017 edition is adopted. This assumes that the overall committee agrees and will accept these changes as 'emergency' in nature.

Another change desired by the industry, but not included in the final wording, was working risk assessment into the chapter. While hav-ing no problem with spending money to protect a tank in a high-light-ning area, an owner/operator sees little need or return for installing other than basic lightning protection on a tank in a low-light-ning area. In early versions of Chapter 7, there are provisions for levels of protection escalating with exposure, or risk. However, they were eliminated by the overall committee. Although risk assessment is included in several other NFPA standards, the committee did not see fit to allow its inclusion in Chapter 7. This is an important failing in 780. As this is a philosophical leap, it would not be passed as a TIA. Perhaps this will be more successful in the next revision cycle, but, for now, the standard calls for full protection on all tanks.

American Petroleum Institute API RP 545 has been somewhat of a disappointment. Several years ago, API commissioned and paid a lot of money for a scientific study of lightning as it affects storage tanks. This report is known as API 545A, or the Culham Report (actually a series of reports). Several of the recommendations included in this report were essentially ignored.

One of the new areas identified in 545A was the need for bypass conductors. These are continuous, low resistance conductors between the edge of the floating roof and the tank shell. Their purpose is to quench arcing at sliding contacts, such as shunts, lowering the likelihood of ignition. 545A calls for multiple bypass conductors. NFPA 780, Chapter 7, calls for one bypass conductor run along the rolling ladder, if installed, and supplemental bypass conductors at 100' intervals around the tank perimeter.

In order for the bypass conductor run along the rolling ladder to meet the resistance requirements contained elsewhere in the RP and in NFPA 780, Chapter 7, it must be a continuous conductor run from the rim of the tank shell to the floating roof. As it is run along the ladder, it must also be electrically bonded to it. This may be accomplished by simply stripping the insulation off the conductor and clamping the conductor to the rolling ladder. Care must be taken to prevent the bottom section running from the rolling ladder to the roof from becoming fouled on tank appurtenances or being severed by the rolling ladder.

Sadly, the final version of 545 ignores the recommendations of 545A, and will probably require only one bypass conductor along the rolling ladder. According to 545A, and also according to the existing RP 545 and NFPA 780, Chapter 7, this is inadequate.

Another area where the final version of 545 will probably not follow the recommendations of 545A is the need for additional protection of aluminum geodesic dome fixed roofs. At several points in 545A, Culham Labs stresses the need for additional study of these roofs, as they are subject to burn through. The final version of 545 appears to ignore these recommendations.

The only apparent advantage to the final draft of 545 is that it requires owner/operators to do very little in the way of lightning protection, thereby incurring little expense. The flip side of that coin is that they will secure very little, if any, protection from the problems the RP is intended to address.

Among the improvements needed to the proposed new 545 are the following:

- Re-order the RP so that users are able to read it, and use it.
- Establish a trigger-point for implementation, such as major repair, major roof repair or complete seal replacement.
- Eliminate cures for which there is no problem, including bonding or insulation of components, such as guide poles and gauging wells that have historically not been a problem.
- Provide a usable and logical risk assessment guide. Create a chart using lightning strike density information that provides a guide for owner/operator to select the level of protection his geography dictates. Provide additional risk factors that guide him in adding additional protection, such as the product stored level of flammability, proximity to populated areas, availability of fire-fighting capability or any other risk factors deemed appropri-ate.
- Offer technically effective and commercially reasonable fixes for geodesic dome roofs.

There may be an opportunity to improve the RP in this revision cycle. If not, the best option is to vote to defeat this fatally flawed RP, and to revert to the existing RP 545. The RP may then be opened in a future revision cycle where a more scientific approach, tempered by the needs of the industry, may be applied.

CONCLUSION

Overall, great strides have been made in the protection of tanks from lightning. New developments have been successfully combined with existing technology, and the governing standards and RPs are being updated to more accurately describe and require their application. There may have been more revision cycles of NFPA 780 to correct a few shortcomings, and one more cycle of API RP 545 to correct its basic flaws, but the industry is now one step closer to its goal of providing useful, effective and universal documents to implement best practices.

FOR MORE INFORMATION:

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