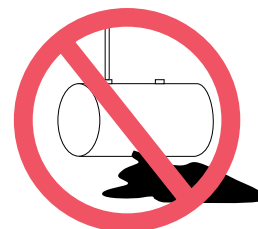


L.U.S.T.LINE



A Report On Federal & State Programs To Control Leaking Underground Storage Tanks

A Criminal Before Breakfast

For Many Petroleum Marketers, It's Just Plain Hard to Keep Up

by Ann Hines

It's 7:15 am on a Monday morning and Sam has just opened the doors to the petroleum distributorship he and his wife, his father and mother, and his son and daughter have built over the years. It's a multistate operation; not a large company, but it's located in an area where the borders of the adjoining states make it necessary for him to operate in more than one state if the company is going to survive.

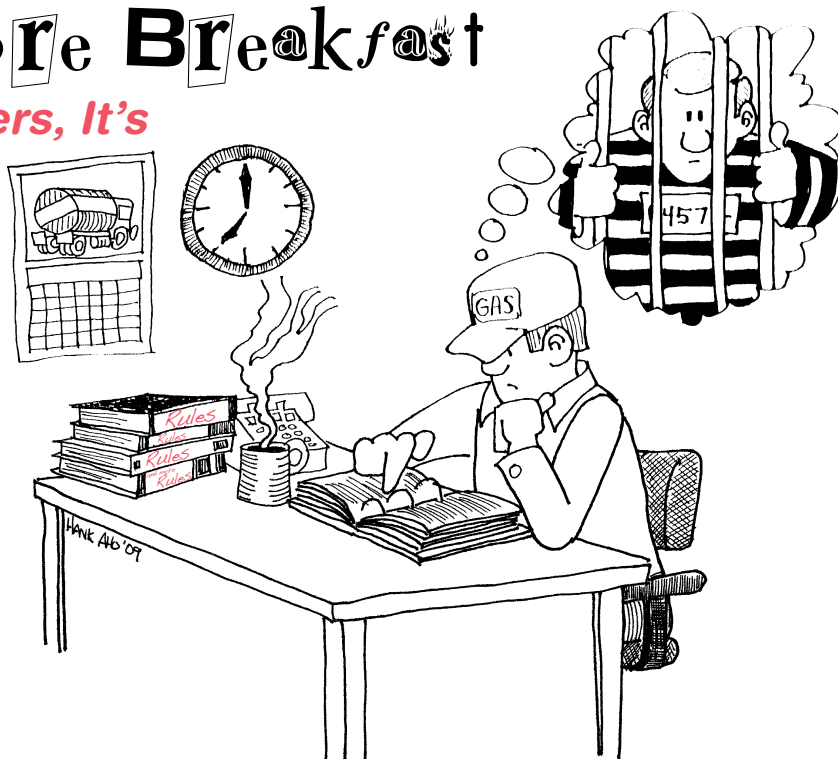
By the time Sam gets the doors open and the lights turned on, and before he has even made it past the receptionist's desk, he figures he has already violated three rules, regulations, or laws—and he hasn't done anything productive yet. By the time he gets the coffee going and checks his e-mail, he's probably run up at least two more violations.

Sam doesn't look like a criminal. He lives in a small town and epitomizes the model citizen—attends church regularly, belongs to several civic organizations (including the Chamber of Commerce) and makes every effort to keep his camouflage in place. He also provides jobs for 25 people, pays his taxes, and tries to do what is right. He sponsors the local pee-wee football and baseball and basketball teams. He lets the cheerleaders and the band set up car-wash fundraisers on his lot and, in general, tries to be a good citizen.

But his conscience bothers him enough that he does not sleep well, fearing that it's just a matter of time before he is unmasked as a raging felon. Sam is not a bad guy, at least not by design, and he really wants to comply with the applicable laws. He also wants to leave his children and grandchildren a viable business. But Sam is in an extremely regulated industry and is having a hard time keeping up with all the laws and rules and regulations he has to deal with on a daily, weekly, monthly, and annual basis.

Round and Round and Round It Goes

Sam is actually a good steward of the environment and tries to make sure his company complies with the rules



and regulations...as he understands them. But that's where he hits a snag—interpretation, not to mention the different regulations for the states in which he operates. Consider his regulated storage tank systems, for example, a huge responsibility for a petroleum marketer. State A says he has to have secondary containment on his pipes and tanks if they were installed after a certain date. State B says he doesn't have to have secondary containment, but

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the company that does his installation and the company that manufactures the installed equipment must assume financial responsibility for both the installation and the equipment for the next 30 years. State C says he has to have secondary containment, but the rules are different from those in State A.

Are you confused yet? Sam is. He is in the business of selling petroleum products, and he certainly doesn't want to lose product into the environment or anywhere else. It will cost him way too much to have a leak. His business isn't big enough to have a full-time environmental engineer on staff, so he has to make do. Hopefully, the tank regulators can help him out.

One of the states in which Sam operates has an excellent tanks program. Close to the first of the year he receives information on the specific testing requirements for his locations and when the results are due. On top of that, he receives a 60-day notice to remind him of the testing due date.

**L.U.S.T.Line**

Ellen Frye, *Editor*

Ricki Pappo, *Layout*

Marcel Moreau, *Technical Adviser*

Patricia Ellis, PhD, *Technical Adviser*

Ronald Poltak, *NEIWPCC Executive Director*

Deb Steckley, *USEPA Project Officer*

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NEIWPCC

116 John Street

Lowell, MA 01852-1124

Telephone: (978) 323-7929

Fax: (978) 323-7919

lustline@neiwpcc.org



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He would be extremely happy if all three states in which he operates had such a program.

In another state he gets a lot of help from the state environmental agency's UST inspector. As far as Sam is concerned, he and the other tank owners in his area are blessed. They have an inspector, let's call him "Archie," who is an extremely hard-working public servant...with an emphasis on servant. Sam welcomes Archie into his office and knows he is going to be treated fairly. Sam will drop everything else to meet Archie at a location because of the respect he has for him and the job he does. He also knows they have the same goal—keeping petroleum product out of the environment. Sam is a big duck hunter and fisherman and doesn't want anything contaminating the waters he loves.

Archie is fair and knowledgeable, and has a regular UST inspection route. Sam and everyone else in the regulated community welcome him and look forward to his visits. He performs his inspection and tells Sam if he sees a potential problem, and, likewise, Sam addresses any concerns Archie might have. While Sam keeps his equipment in good repair and has not had a release in recent years, he welcomes any and all help he can get. He is not asking for leniency.

One piece of equipment that Sam is keeping a watchful eye on as a result of a conversation with Archie is keeping his spill buckets clean and free of water so they will serve their function. He has not had a problem but he wants to make sure he doesn't develop one. The inspections have evolved into an effective partnership between Sam and Archie. And it works well. Sam appreciates the help he receives and always tries to get everything done correctly and on time.

In another state, however, Sam has a more dismal set of circumstances. The inspector in that area, let's call him "Al," has an adversarial, or "gotcha," mentality. While Sam tries to treat each of the inspectors the same, with Al it's been difficult. The first time Al walked into one of Sam's locations, he laid his clipboard on the counter and said, "Good morning, my name is Alan Kapone, and I am here to fine you."

Sam tends to go into protective mode the minute he hears Al is going to be at one of his locations. He is scared to death of what Al is going to find. To compound the problem, Sam has noted that Al is not as knowledgeable about the requirements as he should be. But Al has the hammer, and he's determined that the regulated community will do as he says...even if it's wrong.

Sam has the ongoing uneasy feeling that it is just a matter of time until the forces of righteousness, in the form of this inspector, descend on him with a vengeance. He knows that despite the fact that this champion of truth, justice, and the American Way is loaded with enforcement authority, he lacks compassion and any concept of the problems that Sam faces on a daily basis and would think nothing of issuing ruinous penalties that could put Sam and his family out of business on the spot.

Again, Sam is not asking for leniency, he is asking for help...and to be treated with respect as an owner who is trying very hard to comply with all the rules and regulations he deals with on a daily basis.

Where Does It Stop? Anybody Know?

If the UST laws and regulations were all Sam had to deal with and he had inspectors like the Archie, then the brass ring on his daily merry-go-round ride might be within reach. But that's not the case. Sam is also dealing with another environmental agency division in efforts to develop his spill-prevention control and countermeasure plan. Since the engineer he's used for years retired, Sam has been looking for another qualified engineer to handle this. In a small town, registered engineers are few and far between, and inasmuch as this is Sam's business and livelihood, he wants the plan done right.

He'd heard about a slippery character who came through the area a few years ago. The guy wrote up some seemingly great plans but had the cheek to forge a registered engineer's name to the plans. While this guy is now in jail, Sam is very aware that he needs to make sure the engineer he hires has the right credentials and knows the petroleum industry.

Sam is also trying to make a decision on whether to close his

bulk plant before the Stage I Vapor Recovery requirements go into place. While he needs the bulk plant to meet his customers' needs, he is not sure he can afford the upgrades that will be required, and he doesn't think he can raise the price of the gasoline and diesel enough to pay for the upgrades.

On top of all of this, the Department of Transportation (DOT) has extensive rules and regulations regarding his trucks. When he hires a driver, he has to undertake a 10-year background check, have a drug test administered to the applicant, do a road test, check the applicant's driving record, and make sure the applicant has all the necessary licenses and endorsements. For example: Does the applicant have a hazmat endorsement on his license? How long has it been since he had hazmat training? (This has to be done within 90 days of hire unless the applicant can prove he has had the training in the last three years.) How long is it until another background check will be required? Does he have a transportation worker identification card (TWIC) for certain fuel pick-up areas where it is required? New loading cards for all the terminals have to be arranged.

A lot of this information is confidential and can be handled only by certain trusted people in Sam's company. Each of Sam's tractors and trailers has to have a maintenance file that must be kept up to date. His company's security plan needs to be checked periodically and updated as needed. The dreaded DOT audit is always hanging over his head. Missing the training for even one employee can be very costly—fines can run into the thousands of dollars. And not having a security plan is even worse. Sam knows that safe handling of hazardous materials is important, but when can he find time to sell some gas and make the money to pay for all this regulation?

Later in the day, the drug-testing company that handles his compliance program calls. One of his employees has been picked for a random drug test tomorrow. Now all the loads for tomorrow have to be rescheduled and the employee must go to the specimen collection site.

When he opens the mail, he learns that one of his employees has

filed for unemployment insurance... after he walked out in the middle of a shift at one of the stores. More time is taken by having to file a reply, and Sam knows he is going to have at least one telephone interview on this issue. But, he can't just let it go. It's too costly.

And, in that same mail pile, the dreaded census report arrives. He has been filling this out for the last two years, and while it was supposed to be sent to someone else this year, guess what? He has it again. The information is difficult to compile because the government wants information he normally doesn't track. It won't help him sell another gallon of gas, but it has to be done. The fine if he doesn't comply is staggering.

And now there is the credit card encryption business. Sam doesn't want to think about the amount of time and money he is going to have to spend in the next few years if he wants to continue to take credit and debit cards at his locations—and he can't just quit taking them if he wants his company to survive. The credit card companies are demanding that he make his locations Payment Card Industry (PCI) compliant if he wants to continue to accept credit cards. This is to cut down on credit-card fraud, and while Sam supports the idea, he just doesn't know where he is going to find the money to make the upgrades. Does anyone have a spare \$1 million that he could use?

So, How Can UST Regulators Help Sam and Others Get a Crack at the Brass Ring?

Sam desperately needs a tax department, a human resources officer, an environmental engineer, a safety director, and a compliance director to oversee all the departments. That's not going to happen. There are, in fact, tax credits and other programs that would help Sam with some of these problems, but he and his staff are so inundated with all of the other demands that they don't have time to learn about them and fill out the paperwork to receive the credits.

Sam doesn't have the time or the legal expertise to study the thousands of pages of regulations and determine what he might be entitled to receive. The regulations are written in a language that appears to be English, but is as inscrutable as Man-

darin, at least to a layman. So, Sam needs help from the people who handle the regulations of this industry.

What kind of help? Well, as mentioned earlier, it's really helpful when state UST programs send out notices of when tests are needed and certain information is due. It's really helpful when an UST inspector sees an inspection as an opportunity to teach, to make sure owners/operators know such things as what records they must keep maintain; to make sure they understand that when the ATG light is flashing, they should actually read the display—and if it says change paper, they change the paper; or if it is saying leak alarm, they call the regulatory agency immediately. Ideally, an inspection becomes a partnership where both parties benefit from the outcome.

And, of course, things in this industry can be fraught with complicating factors, such as employee turnover, owner/operator turnover, and even inspector turnover. State inspectors may also be overwhelmed with their own workloads. So we all need some mutual consideration in our efforts to keep our tanks up to snuff. There is a Native American proverb that says before we judge someone we ought to "walk a mile in his moccasins."

So, from the marketer's perspective, if Sam tells you he can't see you next week because the DOT or the IRS or OSHA or the Labor Department or the Highway Department has scheduled a visit, cut him a little slack. He can only handle so many things at one time. Most petroleum marketers want to do what is right, but we could use a little help. You are dealing with one set of regulations, and Sam is dealing with dozens. Please keep that in mind when dealing with a small businessman like Sam.

So my wish for the new year? Make that beloved phrase "I'm from the government, and I'm here to help you" a reality. I can't think of any tank owner or operator who wants their merchandise leaking into the environment. ■

Ann Hines is Executive Vice President of the Arkansas Marketers Association, Inc. She can be reached at Ann@AOMA.org.

Sustainable Remediation at the Massachusetts Military Reservation

by Rose Forbes, P.E.

When does remediation do more harm than good? After conducting a sustainability analysis on a large pump-and-treat site at the Massachusetts Military Reservation (MMR), the Air Force Center for Engineering and the Environment (AFCEE) found evidence suggesting that the remediation systems were creating more pollution than they were remediating.

For several years AFCEE/MMR has had a robust optimization program intended to improve the operations of Air Force remediation systems. An initial sustainability analyses in 2005 identified a concern regarding the indirect generation of air emissions from fossil-fuel-based power plants used to power the remediation systems. In addition to the environmental impact of the air emissions, the cost of electricity continued to climb. AFCEE/MMR evaluated options for addressing both of these concerns and opted to employ renewable energy technology in the form of a utility-scale wind turbine. The selected wind turbine is expected to reduce air emissions and electrical costs by approximately 30 percent. (See Figure 1.)

This LUSTLine article discusses AFCEE's optimization efforts at MMR combined with sustainability analyses to further a "better, cheaper, faster" approach to remediation. This approach, in more formal terms, is referred to as the Environmental Restoration Program Optimization (ERP-O) process. AFCEE headquarters, located at Brooks Air Force Base in San Antonio, Texas, formed ERP-O teams consisting of Subject Matter Experts (SMEs) in science and engineering disciplines to conduct a systematic planning approach for evaluating remediation programs at Air Force bases.

The Massachusetts Military Reservation

The Massachusetts Military Reservation (MMR) covers approximately 21,000 acres of the upper western portion of Cape Cod, immediately south

of the Cape Cod Canal in Barnstable County, Massachusetts. It includes parts of the towns of Bourne, Mashpee, and Sandwich and abuts the Town of Falmouth (Figure 2).

MMR is located over the recharge area of the Sagamore Lens, a sole-source aquifer that supplies drinking water for the Upper Cape.

The Sagamore Lens is a large, 300-foot-thick layer of saturated sand from which groundwater is extracted

for drinking water. In general, soils in the vicinity of MMR are permeable and permit rapid groundwater movement (1 to 2 feet per day). The Sagamore Lens is recharged by precipitation that seeps through the sandy soil into the aquifer (Figure 3).

Portions of the MMR have been used for military purposes since 1911. Since 1935, the base has been used for training and maneuvers, military aircraft operations, maintenance, and support. The industrial area has been the most actively used part

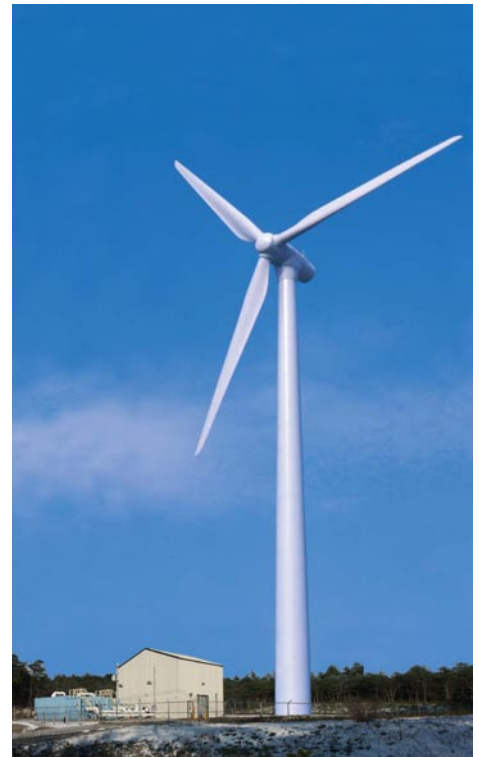


Figure 1. Wind turbine coming soon (artist's rendering).



Figure 2. MMR is located over the recharge area of the Sagamore Lens, a sole-source aquifer that supplies drinking water for the Upper Cape.

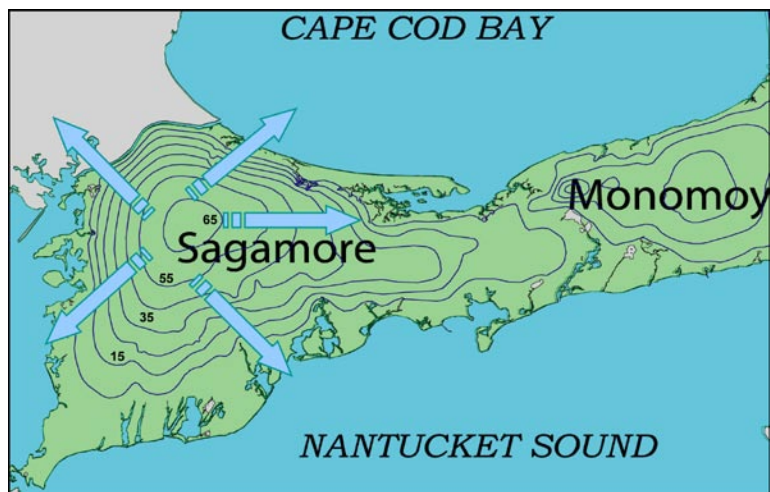


Figure 3. Sagamore Lens.

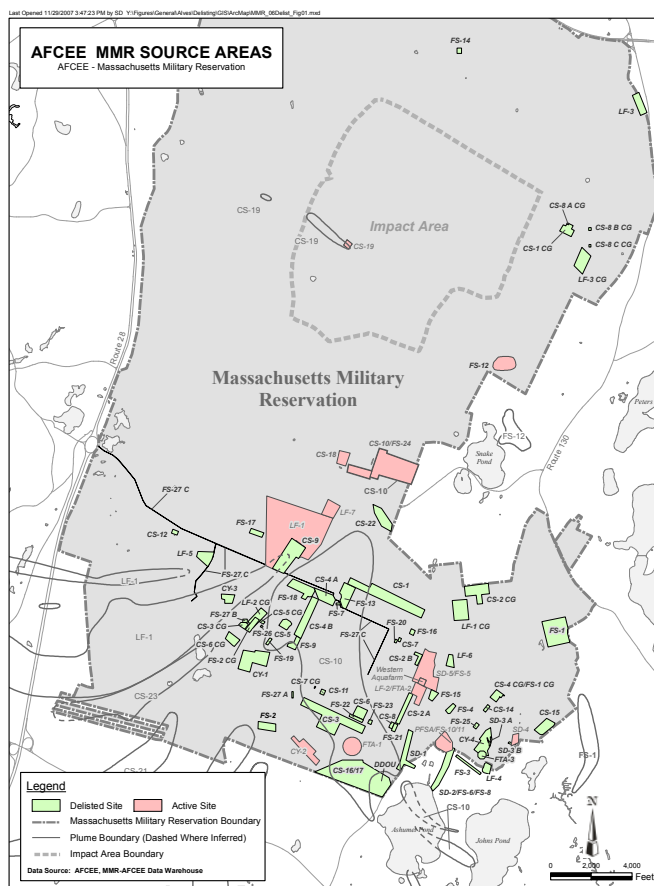


Figure 4. Source areas.

of the MMR. During World War II, Army operations in this area included numerous motor pools, where activities such as vehicle repairs, parts cleaning, oil changes, body work, and repainting were performed. Between 1955 and 1972, Air Force operations included the use of petroleum products and other hazardous materials such as fuels, motor oils, and cleaning solvents that were often stored in underground storage tanks that leaked. These activities have resulted in impacts to the Upper Cape's groundwater resources.

The Contamination

Eighty contamination source areas (e.g., fuel spills, chemical spills, landfills) have been identified, 61 of which were delisted from the National Priorities List in 2007 (Figure 4).

Sixteen groundwater plumes have also been identified; however, through natural attenuation and/or remediation, four of these plumes are no longer delineated (Figure 5). Plume contaminants primarily include chlorinated solvents such as trichloroethene (TCE), perchloroethene (PCE), carbon tetra-

chloride, and ethylene dibromide (EDB), a fuel additive. Most of the plumes have migrated beyond base boundaries and have threatened drinking water supply wells in the surrounding towns. In addition, several of the plumes interact with freshwater ponds, rivers, cranberry bogs, and ocean harbors. The plumes are typically large (up to four miles long and over a mile wide), deep (over 100 feet deep), thick (between 100 to 200 feet), and have relatively low contaminant concentrations ($\mu\text{g}/\text{L}$ range).

The Cleanup

Investigation and/or cleanup (e.g., soil removal, in situ air sparging/soil vapor extraction) has been completed at 71 source areas; six source areas have cleanup in progress; and three source areas are in the long-term monitoring phase.

To address the groundwater contamination, AFCEE has connected

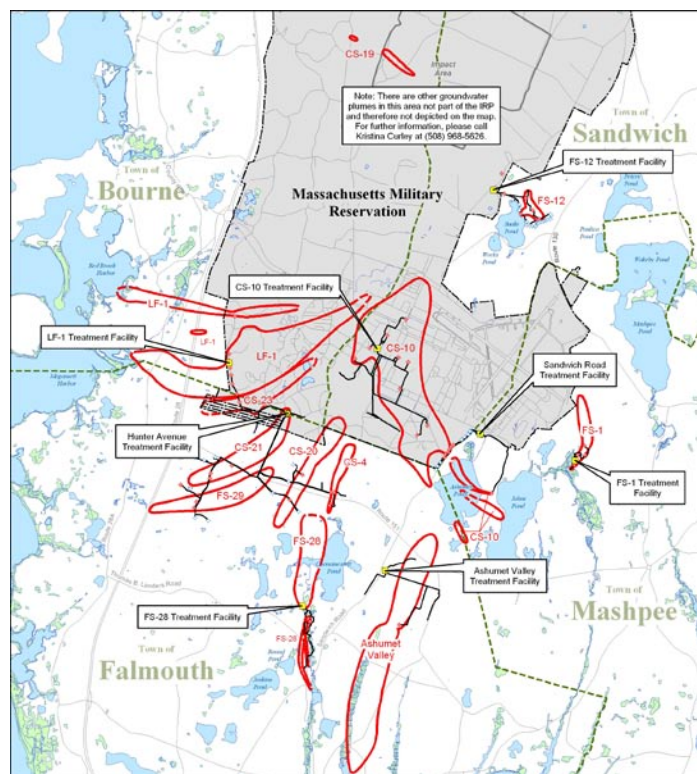


Figure 5. Groundwater plumes.



Figure 6. Treatment plant under construction.

residents to municipal water supplies, constructed eight treatment plants (Figure 6) pumping between 15 to 16 million gallons per day, and installed more than 100 extraction and reinjection wells, over 27 miles of pipeline, and thousands of monitoring wells to track the systems performance and plume changes over time. The treatment systems use granular activated carbon to remove the fuels and solvents from the groundwater. After the carbon is spent, it is reactivated and reused at MMR.

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■ MMR from page 5

System Issues

Undoubtedly, the pump-and-treat systems are restoring the aquifer by removing contaminant mass, but there are negative impacts associated with the construction and operation of the systems. These impacts include: land clearing and fuel use for construction; fuel used in transportation associated with carbon exchanges, monitoring, and operations and maintenance (O&M); fuel used in reactivating the spent carbon; wastes generated through cleanup activities; risks to construction and O&M workers.

Impacts of Electricity Generation

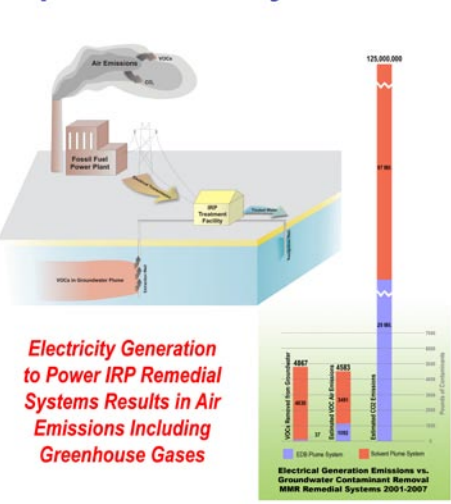


Figure 7. Indirect production of air emissions from AFCEE/MMR remediation systems.

The most pronounced measurable negative impact is production of air emissions by the fossil-fuel power plants that provide energy to operate the pump-and-treat systems (Figure 7). A comparison between the mass of volatile organic compounds (VOCs) removed by the pump-and-treat systems to mass of VOCs discharged to the air by the power plants producing energy for the systems showed the numbers to be almost the same. If carbon dioxide, sulfur oxides, and nitrogen oxides are included, the mass of air emissions outweighs the mass of contaminants removed from the groundwater by orders of magnitude.

In addition to the air emissions issue, there is also a high cost associated with the energy use. The cost to power the AFCEE cleanup program

Program Electricity Consumption

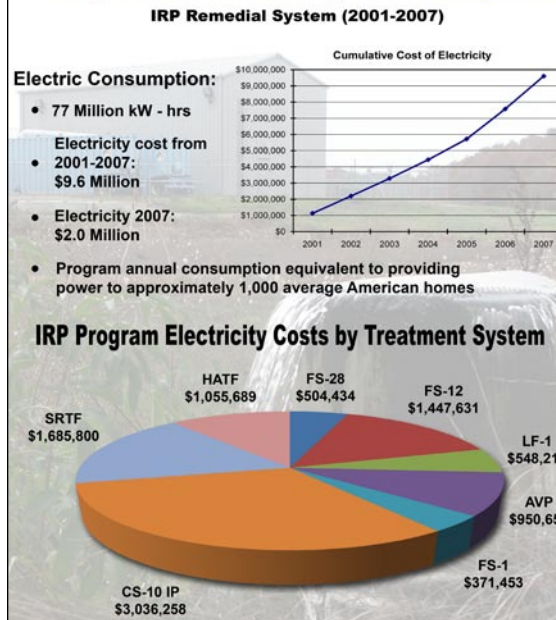


Figure 8. Electric utility costs associated with AFCEE/MMR remediation systems.

is in excess of \$2 million dollars per year (Figure 8).

The Solutions

AFCEE has put a robust optimization plan in place to run the cleanup program as efficiently and sustainably as possible. The following are examples of MMR optimization activities:

- Systems and monitoring networks are continuously adjusted as necessary.
 - Flow rates at extraction wells are modified; packers are installed to focus extraction stress on changing contaminant distribution; in the absence of variable frequency drives (VFDs), pumps are matched to modified flow rates, and extraction wells are taken out of operation once the portion of aquifer is cleaned up.
 - The number of monitoring locations, frequency of sampling, and analytes are adjusted in the program as the remediation requirements are refined.
- Energy conservation measures such as efficient lighting, occupancy sensors, and programmable thermostats are used.
- High-efficiency pumps and VFDs are used in the wellfields and treatment plants.

- Alternative in situ treatment technologies, such as zero-valent iron barriers or in situ chemical oxidation are used when applicable.
- Biodiesel fuel and vegetable-based hydraulic oil are used to the maximum extent possible.
- Pumped sampling has been switched to low-impact passive diffusion sampling.
- Direct-push technology is used instead of auger/sonic well drilling when viable.
- Alternatives involving power purchase agreements, purchasing green energy, and load-reduction programs are being evaluated.

The most significant optimization activity, however, is the use of renewable energy to offset the production of air emissions and reduce the cost of remediation associated with the cleanup program. In 2007, AFCEE awarded a contract for construction of a wind turbine at MMR. The selected turbine, a Fuhrländer 1.5 MW, (Figure 1) is expected to offset the air emissions and energy costs of the program by approximately 30 percent. All approvals have been received, and the wind turbine is scheduled for delivery and installation in the summer of 2009.

Hopefully, the lessons learned from the MMR's approach to contamination remediation will have a role in moving many other projects, large and small, to find better, cheaper, faster ways to get the job done. While remediation may be necessary to clean up contamination, there are negative impacts associated with aspects of the activity itself. These impacts must be evaluated and mitigated in order to make remediation sustainable and truly protect human health and the environment. ■

Rose Forbes is a Project Manager working for the Air Force Center for Engineering and the Environment at the Massachusetts Military Reservation. She can be reached at: rose.forbes@brooks.af.mil.

EPA Report Provides Needed Information on Natural Attenuation of EDB and 1,2-DCA at Motor Fuel Release Sites Plus Implications for Risk Management

by Ellen Frye

For several years, *LUSTLine* has run stories on detections of the lead scavengers ethylene dibromide (EDB) and 1,2-dichloroethane (1,2-DCA) at LUST sites, primarily in South Carolina (EDB) and Minnesota (1,2-DCA). The following article presents findings from a new USEPA report, *Natural Attenuation of the Lead Scavengers 1,2-Dibromoethane (EDB) and 1,2-Dichloroethane (1,2-DCA) at Motor Fuel Release Sites and Implications for Risk Management* (EPA 600/R-08/107 | September 2008 | <http://www.epa.gov/ada/pubs/reports.html>). Much of the following discussion is taken from the Executive Summary.

The Problem

In the past, lead scavengers were added to leaded motor gasoline to prevent the buildup of deposits of lead oxide inside internal combustion engines. Recent studies demonstrate that lead scavengers often persist for long periods of time in certain groundwater environments. Although lead and lead scavengers were phased out in conventional motor fuel by the end of the 1980s, at old release sites they may continue to contaminate groundwater. In addition, aviation gasoline (Avgas) still contains lead scavengers and gasoline containing lead scavengers is still used for certain off-road applications such as automobile racing. In effect, it has become evident that lead scavengers from releases of leaded gasoline may well pose an ongoing risk to groundwater quality. Of particular concern should be domestic groundwater wells and certain small public water supply wells that are in close proximity to sites where leaded gasoline may have been released. These wells often produce groundwater from shallow aquifers, making them more vulnerable to contamination than larger municipal water supply wells, which usually produce water from deeper aquifers.

Delving into the Matter

USEPA formed a team with members of the Association of State and Territorial Waste Management Officials to determine the scope and magnitude of the occurrence of lead scavengers at leaking UST sites. The team

developed a three-phased approach: Phase 1—develop an understanding of the magnitude of the potential problem by compiling existing background information; Phase 2—assess gaps in current knowledge, based on the findings of Phase 1, and implement appropriate measures to fill the gaps; and Phase 3—determine an appropriate response based on evaluation of the results of Phases 1 and 2. Phase 1 culminated in development of a document titled *Lead Scavengers Compendium: Overview of Properties, Occurrence, and Remedial Technologies* (<http://www.epa.gov/oust/cat/PBCOMPND.HTM>).

The culmination of Phase 2 is represented by the new report. Phase 2 consisted of collecting and analyzing groundwater samples from 102 old gasoline release sites spread across the 19 states that chose to participate in the investigation.

To develop information on the distribution of EDB and 1,2-DCA in groundwater at LUST sites in states that did not routinely monitor for these contaminants, USEPA offered to provide free analysis of samples collected by the states (or their contractors) from sites that met the following criteria:

- Sites used for storage and/or dispensing of leaded gasoline whether or not they were cur-



rently in use (i.e., sites where USTs were located in 1989 and earlier)

- Sites where leaded AvGas or leaded racing fuel was or is still being used (i.e., airports, automobile race tracks)
- Sites with existing monitoring wells on-site and regularly scheduled for monitoring (this was done to minimize the burden on states and their contractors; however, all samples from sites offered as candidates for sampling were accepted and analyzed).

■ continued on page 8

■ EDB/1,2-DCA from page 9

Findings

The report fills some of the data gaps on the expected distribution of lead scavengers at gasoline release sites, discusses mechanisms for abiotic transformation and biodegradation of EDB and 1,2-DCA, and provides new tools to recognize and use natural transformation and degradation of EDB and 1,2-DCA as part of a risk management strategy.

The report explains that although it is theoretically possible that anaerobic biodegradation or abiotic degradation will remove EDB at a particular site, it is frequently difficult to prove that degradation is occurring based on conventional monitoring data. Compound-specific isotope analysis (CSIA) can be useful for recognizing biodegradation and abiotic transformation of EDB in groundwater. Degradation is recognized and documented by a change in the ratio of stable isotopes of carbon in the molecules of EDB that remain in the groundwater after degradation. The change in the ratios can put a conservative boundary on the extent of degradation that has occurred in the groundwater sampled by a particular well. This makes CSIA a useful tool to prove that degradation has happened at field scale at a particular site.

The investigation found that significant concentrations of EDB continue to persist at many old leaded-gasoline spill sites. Both EDB and 1,2-DCA were present at concentrations above their respective maximum concentration level (MCL) at a significant number of sites; EDB was detected above its MCL of 0.05 µg/L at 42% of the sites sampled, and 1,2-DCA was detected above its MCL of 5.0 µg/L at 15% of the sites sampled. Benzene (MCL - 5.0 µg/L) was present at 100% of the sites sampled and was the primary risk driver at 75% of the sites where both benzene and EDB were present in groundwater; EDB was the primary risk driver in the remaining 25% of sites.

Implications for Risk Management

The persistence of EDB at UST spill sites is consistent with its expected behavior in groundwater. Simple

physical weathering of EDB and 1,2-DCA from residual gasoline is a slow process that may require decades to centuries to reduce high concentrations of EDB or 1,2-DCA to their MCLs. At some sites, anaerobic biodegradation can provide substantial reductions in the concentrations of EDB and 1,2-DCA. At some sites, abiotic degradation caused by reaction with iron (II) sulfide minerals in aquifer material can also produce substantial reduction in the concentration of EDB, particularly in groundwater at neutral pH.

If the concentrations of EDB and 1,2-DCA in groundwater in the source area of plumes do not attenuate, the hazard associated with these contaminants will persist indefinitely. Monitored natural attenuation (MNA) is the most cost-effective remedy when the concentrations of contaminants attenuate to their MCLs in a reasonable period of time. The concentrations of EDB and 1,2-DCA that would be expected in groundwater in contact with unweathered leaded automobile gasoline are 1,900 and 3,700 µg/L, respectively.

To bring these initial concentrations to their MCL within 20 years, the first order rate of attenuation in concentration in the most contaminated well at a site should be 0.5 per year or greater for EDB and 0.33 per year or greater for 1,2-DCA. At certain sites, and under some circumstances, rates in excess of 0.5 per year for EDB or 0.33 per year for 1,2-DCA can be attained through anaerobic biodegradation or by abiotic reactions. To apply MNA at a specific site, rate constants for attenuation over time should be extracted from site-specific data and should be verified and validated by continued long-term monitoring.

The MCL for EDB is a hundred-fold lower than the MCLs for benzene or 1,2-DCA. Because of this, not all analytical methods can detect EDB when it is present at its MCL. The EPA method most commonly used to analyze for gasoline constituents in groundwater (Method 8260B) has a detection limit for EDB of approximately 3.0 µg/L, which is sixty fold higher than the MCL. For this reason Method 8260B cannot be used to document that groundwater is free of contamination from EDB. In contrast, EPA Method 8011 has a detection

limit for EDB of approximately 0.01 µg/L, which is sufficiently sensitive to measure EDB at its MCL.

Method 8260B would have only discovered 40% of the survey sites with concentrations of EDB above its MCL. At sites where benzene is the primary risk driver, Method 8260B would be appropriate to monitor the quality of groundwater during active remediation. However, to determine if the site has reached the MCL for EDB, it is necessary to use Method 8011 or its equivalent.

Analysis of EDB can be included in the routine analysis of BTEX compounds by Method 8260B at minimal extra cost. In contrast, monitoring for EDB by 8011 and monitoring for the BTEX compounds by Method 8260B can essentially double the total cost of analysis. Because monitoring for concentrations of EDB in groundwater can be a major cost of risk management at gasoline spill sites, the selection of one method over the other should depend on the goals and priority in risk management.

Unanswered Questions

While the investigation so far has answered many questions, at least three remain:

- What is the magnitude of the potential problem posed by lead scavengers? EDB was found to be the risk driver at approximately 25% of the sites sampled in the 19 states that participated in the study. How does this compare to other states that did not participate?
- What hydrogeological factors control the transport and fate of EDB in groundwater? EDB was found at relatively high concentrations at some sites and not at other sites. Does EDB preferentially degrade at some sites or did the existing monitoring system miss the plume?
- What remediation technologies are effective for lead scavengers? Benzene is the remediation driver at 75% of the sites where EDB co-occurs, but there is little data available to evaluate whether or not EDB is adequately remediated by the same technologies that are effective for BTEX. ■

Tank-nically Speaking

by Marcel Moreau

Marcel Moreau is a nationally recognized petroleum storage specialist whose column, *Tank-nically Speaking*, is a regular feature of LUSTLine. As always, we welcome your comments and questions. If there are technical issues that you would like to have Marcel discuss, let him know at marcel.moreau@juno.com.

A Primer for the Next Generation of Tank People

Part 1 – Tank and Pipe Technology

While teaching a class for UST inspectors recently, I was struck by how incredibly young some of the new inspectors were. It occurred to me that for these new inspectors, the tank world, as I knew it when I first started in the tank business over a quarter century ago, has changed quite a bit. While, for some strange reason, the history of tank-system technology is not taught in history books, it is a very relevant subject for today's new generation of tank workers and tank inspectors, who ought to have some sense of where and how far we have come to get to today. So I decided it might be useful to those who are new to the business, as well as those who just like to reminisce, to take a brief stroll through the life and times of UST-dom in two parts. In this stroll we'll look at tanks and pipes. Next time, the other stuff.

Although underground petroleum storage systems are a ubiquitous and critical component of our nation's infrastructure, they are for the most part invisible. Outside the petroleum marketing and associated service and manufacturing industries, few people have given any thought to their existence...except when there is a release. So let's begin our stroll with a look at the tank and piping components of underground petroleum storage systems to gain a fundamental understanding of their construction, operation, and modes of failure.



How many of today's UST inspectors can remember seeing a bare-steel UST being installed – legally?

The Tank

Underground storage tanks (USTs) are large cylinders installed horizontally in the ground. In physical size, the tank is the largest component of most underground petroleum storage systems. In general, typical UST sizes have grown from around 4,000 gallons in the 1950s and 1960s, to 8,000-10,000 gallons in the 1990s. Today, 12,000- to 15,000-gallon USTs are not uncommon, and 20,000-gallon USTs are sometimes seen. This increase in tank size has been accompanied by an increase in the amount of fuel sold each month. Increases in tank size, and especially

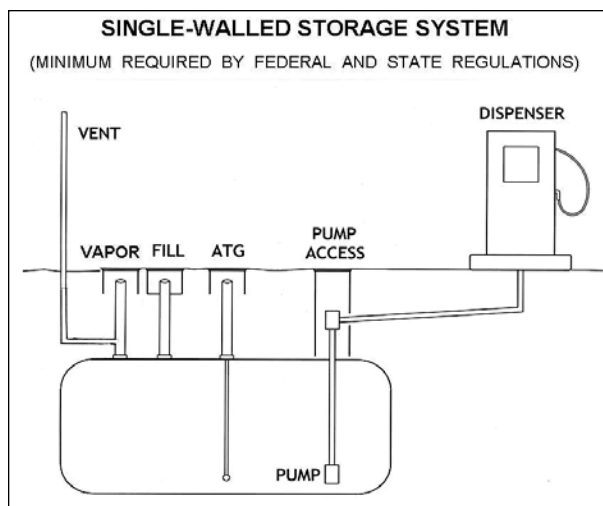


Figure 1. Schematic diagram of the typical components of a single-walled underground storage system.

tank sales volume, have created a very challenging environment in which to conduct leak detection.

A typical 4,000-gallon tank is approximately 6 feet in diameter and 19 feet long. A typical 8,000-gallon tank is approximately 8 feet in diameter and 21 feet long, a 10,000-gallon tank is 8 feet in diameter by 27 feet long, and a 15,000 gallon tank is 8 feet in diameter and 40 feet long.

Steel Tanks

Steel was the dominant material of construction for tanks from the early 1900s until the 1980s. Steel was readily available, easy to fabricate into tanks, structurally sound, and compatible with petroleum products, so it seemed an ideal material to use for underground petroleum storage.

Corrosion was the major weakness of steel tanks in the underground environment. Reaction of the steel with moisture in the environment outside the tank produced

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■ Tank-nically Speaking

from page 9

perforations in the tank wall. The tanks were typically coated with asphalt, which did little to mitigate corrosion. This type of tank was commonly known as a “bare” steel tank. Less frequently, small amounts of water inside the tank could also bring about corrosion on the inside surface of the tank. According to a study conducted by the American Petroleum Institute during the late 1970s and early 1980s, some 90 percent of steel tanks failed due to corrosion.

The typical life expectancy for bare-steel tanks was about 15 years before perforation from corrosion would occur, although some tanks failed sooner than this and others lasted for much longer. The proliferation of service station construction after World War II led to a “boom” in storage tank failures 15 years later in the 1960s and again in the 1980s.

This “boom” in leaks helps to explain why the 1960s saw the introduction of several improved UST-system technologies, including fiberglass tanks (1965), fiberglass piping (1968), corrosion-protected steel tanks (1969), and the first specially designed tank-tightness testing equipment (1965).

In 1969, steel tank manufacturers introduced a corrosion-protected steel tank equipped with a durable, effective coating and cathodic protection, a technology for corrosion protection that was first developed in about 1824 by Sir Humphrey Davy. (See *LUSTLine* #23, Jan. 1996 – “Rust Thou Art and to Rust Thou Shalt Return, Unless...”.) Coatings and cathodic protection had been used for many decades to protect the nation’s network of buried steel pipelines, but these techniques had been little used to protect buried storage tanks.

Another corrosion protection technique developed during this time period was the “clad” tank. These tanks were protected from corrosion by the application of a thick coating of resin reinforced with glass fibers. The cladding isolated the steel from the moisture in the soil, thus preventing external corrosion.

Although available, corrosion-protected tanks were more expensive than bare-steel tanks and saw

relatively little use until federal law prohibited the installation of bare-steel tanks in 1985. The federal law included an exemption that allowed bare-steel tanks to be installed in soils with high resistivity, but this exemption was rarely used.

The federal law was known as the “interim prohibition” because it was designed to prevent the installation of more bare-steel tanks between the time when Congress initiated the federal tank program by passing Subtitle I of the Resource Conservation and Recovery Act (RCRA) in 1984, and the time when USEPA would promulgate the tank regulations, which turned out to be 1988.

Cladding and the combination of coatings plus cathodic protection applied to the outside surface of new steel tanks have been quite successful in preventing corrosion on the external surfaces of these tanks. However, little has been done to address internal corrosion issues resulting from moisture that may be present inside the tank. Though the failure rates are still low, internal corrosion is often a factor in the failure of steel tanks today.

Fiberglass Tanks

Underground tanks made of fiberglass were first introduced in 1965. Fiberglass tanks are not subject to corrosion, are chemically compatible with petroleum-based fuels, and are structurally sound when properly installed. However, they rely heavily on the support of the backfill material around the tank to maintain their structural integrity. In

the early years following their introduction, there were a number of fiberglass tank ruptures attributable to improper installation techniques. Training programs for tank installation contractors by the tank manufacturers eventually overcame this weakness. Today, problems associated with structural failure stemming from improper installation are infrequent.

Like corrosion-protected steel tanks, fiberglass tanks were initially more expensive than bare-steel tanks

and saw relatively little use until federal law prohibited the installation of bare-steel tanks in 1985. Many major oil companies adopted fiberglass tanks as their standard for new installations beginning in the early 1980s.

Double-Walled Tanks

Double-walled fiberglass and steel storage tanks (Figure 2) were introduced in the United States in the middle 1980s. These tanks consist of a tank within a tank and are designed to prevent releases by containing leaks in the “interstitial space” created between the two walls. Double-walled tanks in the United States were modeled after similar tanks that had been in use in Europe since the mid 1960s. Double-walled tank technology is generally acknowledged as the most secure form of storage for petroleum fuels. Releases from double-walled tanks are uncommon as long as the problem is promptly identified and addressed.

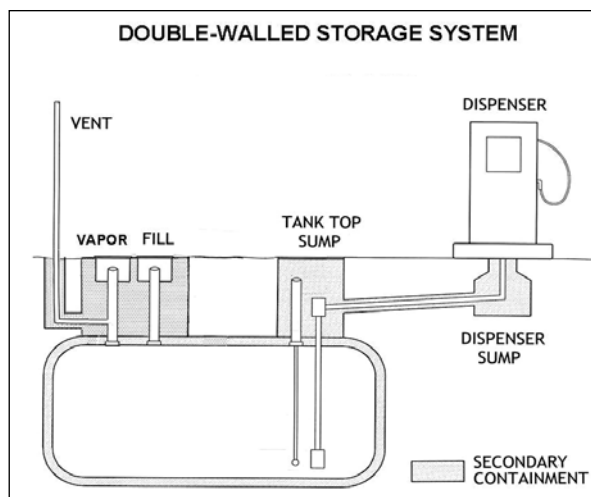


Figure 2. Schematic diagram of the typical components of a double-walled underground storage system.

Double-walled tanks can be fashioned with both walls made of either steel or fiberglass, but there are also hybrid tanks consisting of an inner steel tank and an outer containment vessel constructed of fiberglass or polyethylene plastic. These hybrid double-walled tanks are generically known as “jacketed” tanks.

Jacketed tanks tend to suffer from the same issues as corrosion-protected steel tanks. The outer wall has generally proven effective in preventing external corrosion, but

internal corrosion can still cause tank failures. However, the presence of the external wall should prevent releases to the environment if a failure of the inner wall is promptly detected and addressed.

The Product Piping

Underground piping buried approximately two feet below the ground surface is used to transport petroleum products from the storage tank to the dispenser island. Although much attention has been focused on leaks from USTs, the leaking tank problem has largely been resolved by the widespread use of fiberglass and corrosion-protected steel technologies. Piping, however, has been and continues to be a much more intractable problem. Today's piping materials and technologies are much improved over what they were 20 years ago, but the basic fact remains that regardless of the quality of the piping materials, piping must be assembled in the field by personnel with varying levels of competence and varying standards of quality. The result is that releases today are much more likely to involve some component of the piping than the tank.

Steel Piping

From the early 1900s through the mid 1980s, UST system piping was typically constructed of 1.5- to 2-inch-diameter galvanized steel. Steel piping was assembled by cutting threads in the pipe and screwing it together using galvanized-steel fittings. Like steel tanks, steel piping was structurally sound and compatible with petroleum products, but it was susceptible to corrosion. In addition, threaded-steel joints were a frequent source of leaks because of improper assembly or subsequent ground movement that loosened the joints. (See *LUSTLine* #7, "An Emphasis on LUPs—The Weak Spots in Piping," December 1987.) Steel pipe is rarely used today as a primary piping material, but threaded fittings are often utilized at the tank top and inside of dispensers as a means of connecting various piping components. These threaded fittings can still be a source of leaks.

Fiberglass Piping

Piping made of fiberglass and resin was introduced to UST systems in

1968. The piping consisted of a great many strands of very thin glass fibers held together by a petroleum-compatible resin. Fiberglass piping is lightweight and capable of withstanding internal pressures of 2,000 pounds per square inch or more, but it is somewhat fragile and can be damaged by improper handling. Fiberglass piping consists of rigid lengths of pipe and various fittings that are glued together using epoxy-type adhesives. Like the fiberglass tank and the corrosion-protected steel tank, it was rarely used until federal law required the installation of corrosion-protected storage systems in 1985.

Fiberglass piping releases can often be traced to improperly assembled joints, though mechanical damage resulting when piping is struck during excavation activities or stakes are driven into the ground accounts for a fair number of failures as well. Releases resulting from mechanical damage are often catastrophic in nature, so they are usually discovered in a relatively short time.

Flexible Piping

In the late 1980s, flexible piping constructed of various thermoplastic materials was introduced. "Thermoplastic" means that the material will melt if heated. Because both steel and fiberglass piping were essentially rigid, numerous fittings and joints were required to distribute fuel to all the fueling positions at a facility. It was these joints, in both steel and fiberglass systems, that were seen as most troublesome in terms of leaks. The use of long lengths of flexible piping allowed the piping to be run in continuous lengths from the tank top to the fueling islands, eliminating a great number of field-assembled joints and greatly reducing the opportunities for piping leaks to occur.

Unfortunately, the materials used by some flexible-piping manufacturers have proven to degrade over time, and a number of flexible piping failures due to incompatibility of the materials, improper design or construction, and/or improper operation began to occur in the late 1990s. Most flexible-piping installations, however, have been of double-walled construction, so as long as the integrity of the outer wall was maintained and the problem promptly detected and addressed, releases

could be minimized. Standards for flexible-piping systems have recently been upgraded in hopes of improving their long-term performance.

Double-Walled Piping

Since the mid 1980s fiberglass-piping systems have been available in single- and double-walled varieties. Fiberglass piping can be made double-walled by building a larger diameter piping system over the primary pipe. Fiberglass double-walled piping systems have proven to be durable and reliable, but they require a considerable amount of skill on the part of the installer and are fairly labor-intensive to construct.

Double-walled flexible piping systems have been available since the introduction of flexible piping in the late 1980s. There are two varieties of flexible double-walled piping systems: ducted and coaxial. Ducted piping consists of a large-diameter outer containment pipe (typically 4 inches in diameter) and a smaller diameter (typically 1.5 inch) inner pipe. The outer containment pipe and the inner product pipe are manufactured separately, and the inner pipe is installed within the outer pipe in the field. Coaxial piping consists of an outer containment wall that fits snugly over the inner product pipe. The two walls of coaxial pipe are manufactured together at the factory and installed as a unit.

One of the "features" of the ducted pipe is that the inner product pipe can be removed and replaced without excavation. In practice, this is a somewhat difficult operation, but it can be done. Not to be outdone, the coaxial flexible-piping manufacturers also offer a 4-inch diameter "chase" pipe. The coaxial pipe can be installed within the chase pipe in the field, thus allowing the coaxial pipe to be pulled out and replaced without excavation. The coaxial piping manufacturers call this large-diameter pipe a "chase" pipe rather than a containment pipe because of patent issues. To further avoid patent infringement claims, this outer pipe is sometimes perforated or else terminated just outside the tank-top containment sump so that it does not function as a containment pipe.

In addition to the actual piping, complete secondary containment of

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From Our Readers

Thoughts on "UST Rules for a New Century" by Marcel Moreau

Tennessee

I just read your article in the November, 2008 *LUSTLine*. I agree with you and feel that EPA would benefit from making your recommended changes to the federal rules. We have seen some of the problems you pointed out and have taken steps in state rules to address them. Tennessee has changed its rules to sunset both groundwater monitoring and inventory control as leak-detection methods, effective December 31, 2008. Vapor monitoring will likely be sunsetted effective December 31, 2009. We are also dealing with upgraded tank concerns and have proposed a rule that tanks upgraded by lining only must be closed by December 22, 2012. We require continuous sensors at sumps where secondary containment is required, and we do not accept visual inspections as a method of leak detection for pressurized piping. We do not accept sump sensors in lieu of automatic line-leak detectors (ALLDs), and we require ALLDs for all pressurized systems. We discourage the use of ball-float valves, but haven't gone so far as to eliminate their use; we will be exploring that in future rule changes. We have rules for SIR that define pass, fail, etc., and set the monthly leak threshold at 0.1 gph. We currently require monthly visual inspections of all spill buckets.

We think we have been progressive, and we feel fortunate not to have been trapped by that "no-more-stringent-than-the-federal-rule" predicament that some states have had to deal with. Good article.

*Lamar Bradley, Assistant Director,
Tennessee Department of Environment
& Conservation, Division of USTs*

Wyoming

I agree with your article in most respects. Regarding what Wyoming has done to deal with some of these issues, we adopted various rules over the years. For example, in 2005 we passed a rule with the following features:

- Requirement for operators to have an annual inspection, designed to ensure that equipment is maintained according to manufacturers specifications.
- Removal of the exemption for emergency power.
- Removal of groundwater monitoring and vapor monitoring as acceptable leak-detection methods for any new tank, unless they are used as a secondary method. We could not eliminate the few that were already using those methods unless the federal rules are changed. In any case, there are only about 20 tanks being monitored that way.
- Definition for a passing result on inventory control, which includes the use of trend analysis as a failing method. I am not sure how successful we are in getting anyone to report based on the trend lines, but the wording is there. We are adamant that operators with automatic tank gauges must do inventory control; we find about as many leaks that way as any other method.
- Removal of all of the references to the 1998 deadline. By that I mean that we no longer refer to a failed CP system as a violation of the upgrade requirement, we call it a violation if it is not immediately repaired.

In our 2007 statute change, we convinced the legislature to require cathodic protection on all lined tanks, effectively phasing out any lined tank

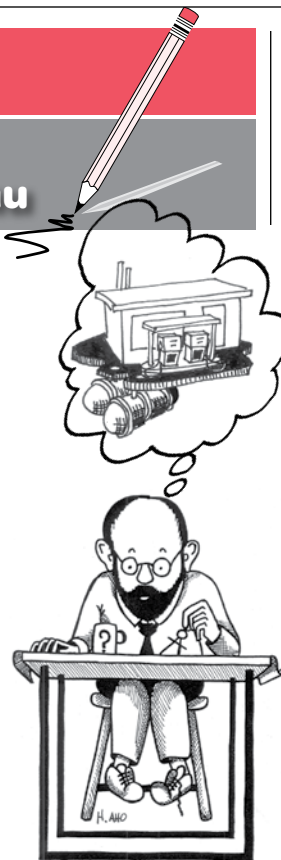
that did not already have cathodic protection. We required internal inspections of the liner within a year or two before the CP was added.

In our 11/10/08 rule we state that a failing CP test is a reason for a red-tagging if the failed system is not repaired within 3 months. We also have a requirement for installers, testers, and CP testers to be licensed. They have until August 1, 2009, to obtain those licenses. All CP testers are required to either pass the STI or the NACE course. Those who fail only the written test can retake the test and receive a certification. We also added a requirement for every Class A or B operator to pass a test administered by the International Code Council.

Here are a few more thoughts:

Regarding sump sensors, I think they should be required on all double-walled systems and that they can even be used in a line-leak-detection system. However, the rules should require that they be coupled with either mechanical or electronic line-leak detectors and that the sump sensors should shut down the pumping system if they go off. We have one chain store that put in that type of system, and we never find any problems on their systems. We require that they functionally test the sump sensors just like any other leak-detection system.

High-throughput stations are a real problem. We have one here in Cheyenne that sells 4 million gallons per month and uses mechanical line-leak detectors on double-walled pipe. The problem is, the mechanicals fail every year almost without exception, and are just replaced with new ones. A new one probably lasts about a month before it too fails. I think we need a uniform definition of what "high throughput" means. I think, within the limits of technology, that all high-throughput stations should be required to have everything double-walled, they should be required to pass an automatic tank gauging test every month; pass SIR once a month; and have sump sensors that shut everything down along with electronic line-leak detectors that shut everything down. The automatic shut-down feature is the only thing that will force facility managers to take note of these systems. SIR providers should be required



to report a failing test whenever the inventory control fails to balance within about .75%. There needs to be some form of mandatory fine for any high-throughput station that fails to report and follow-up on every suspected release. High-throughput stations should be required to have overfill valves in the drop tubes and overfill alarms at the tank basin.

I agree with you that ball-float valves should be illegal. One of our

better chain stores actually installs overfill valves in the drop tubes and ball-float valves and overfill alarms. They don't, however, have the alarm sound outside the building. I think the ball-float valves pose a danger if they are closed and fail to open. For them to work, everything has to be vapor tight. Assuming that a vapor-tight condition can be achieved, a ball-float valve that is frozen closed could cause the tank to collapse when

product is withdrawn.

When I wrote our rules, I did one other thing. For each leak-detection method I provided a definition for a "failing" result. I find that the federal rules do not define what a failing result is, and the operators never seemed to understand when they have to report a suspected release. ■

Robert Lucht, Storage Tank Compliance Supervisor, Wyoming DEQ

From Our Readers

Questions on the "Oldie Moldies" by Pat Ellis

The Delaware LUST sites you described in your recent *LUSTLine* article, "Dealing with the Oldie Moldies," are very similar to old sites in Washington State—either there is not enough information about these sites or there is no information available at all. Some of the Washington sites date back to the start of the federal UST/LUST program, administered by the state's Department of Ecology (Ecology). In Ecology's eastern region, most of the sites have undergone an initial investigation, allowing a number of them to be removed from the active list. Some investigations have been relatively simple because a site report was available. To obtain the reports from several site owners, we were required to submit a formal, written request for information. Some of the responses to our requests have been interesting, such as "I didn't know this was a LUST site," and "You're telling me this was an old gas station?" Other site owners were able to supply additional information and reports documenting the removal or remediation of the petroleum contamination at the site, and yet other owners, as you indicated in your article, simply did not respond to our request.

In your article, you indicate that the Delaware RPs are required to do additional investigation and/or cleanup when warranted. I have several questions about this. How are site managers implementing the requirement? Is the state requiring additional cleanup through enforcement if the RP does not voluntarily

perform it? Has this prevented the signing of the access agreement? Is funding available to help the owner complete the additional work being required? And finally, was competing with private consultants and contractors an issue? In Washington State, a licensed driller is required to perform any drilling. Additionally, investigations and sampling reports concerning groundwater and geology have to be signed by a licensed geologist. I believe Ecology would have to ensure that we are not competing with private consultants and contractors.

Douglas Ladwig, LUST Site Manager, Washington State Department of Ecology

Pat Ellis' Response:

We're able to compete with private consultants and contractors because we work cheap (our salaries aren't counted as part of the costs of investigation because we'd be getting paid whether we're in the office reading reports or having a great day out of the office doing field work), so we're not paying a someone else \$80/hour to do the work. We own our own Geoprobe, so there are no rental costs. We are required to have a licensed driller on site, which costs \$400–500 per day, but we can often get several sites done in a day. Also, one of the hydrologists in our Superfund program is a licensed driller, so we can use his services if he isn't too busy. Sometimes we swap for some of his time by allowing the use of our



Geoprobe and our staff to operate it on a state-level Superfund project. Of the seven hydrologists in the Tank Branch, four of us are registered professional geologists, so we can supervise and sign off on reports. I believe there has been only one site so far where we actually hired a consultant to do the work, rather than doing it ourselves.

We've had a few cases where an RP has balked at signing the access agreement because of the condition that any additional investigation and cleanup will be their responsibility, but not very many. In a few cases, the RP went ahead and hired someone to do the initial investigation instead of having us do it. In a few cases, the RP took over after our initial investigation without major complaints. On some cases, our letters rattled out reports that were done years ago and never submitted.

We have two or three cases that look like they may go to enforcement, in which case we could send out a Notice of Intent (NOI) to take over the release and then hire a consultant to complete the investigation and/or do remediation. If we do that, the NOI states our intention to cost-

■ *continued on page 19*



A MESSAGE FROM CLIFF ROTHENSTEIN

Director, USEPA Office of Underground Storage Tanks

25 Years of Progress Through Strong Partnerships

In 1983, *60 Minutes* aired a story titled, "Check the Water" that brought national attention to families suffering from the effects of a gasoline leak. Less than a year later, Congress

passed and the President signed a new law directing USEPA to protect our nation's land and water from underground storage

tank releases. At the time, USEPA and states regulated two million underground storage tanks (USTs). Today, 25 years later, two-thirds of these tanks have closed, leaving approximately 620,000 tanks at 230,000 gas stations and other facilities still operating.

Preventing new releases from these underground tanks and cleaning up existing releases have been key to the UST program's success and are important to protecting our environment. Even a small amount of petroleum released from an underground tank can contaminate groundwater, the drinking water source for nearly half of all Americans. Even more alarming, states have reported that petroleum released from underground tanks is the greatest threat to our country's groundwater.

For the past 25 years, USEPA, states, tribes, and regulated industry have been working together to protect our land and water by preventing and cleaning up releases from USTs. Because of this strong partnership, built over a quarter century, the nation's tank programs have:

- Properly closed almost 1.7 million substandard USTs, which now pose little, if any, threat
- Reduced the number of UST releases from almost 67,000 in 1990 to fewer than 7,500 in 2008
- Cleaned up over 377,000 releases, more than 80 percent of all reported releases

Despite this great progress, we still have plenty of challenges for the foreseeable future. We must inspect all 620,000 federally regulated tanks every three years, boost compliance

rates to minimize future releases, and clean-up old and new tank leaks. Beyond these core activities, we must encourage sustainable reuse of thousands of abandoned gas stations, ensure

safe storage of ethanol-blended fuels and biofuels, update our 20-year-old regulations, and solve new problems that have yet to emerge.

I want you to know how proud I am of the work we've collectively done and how much I believe we've accomplished in protecting our nation's land and water from petroleum underground tank releases.

These are difficult challenges, but with a quarter century of experience, progress, and partnerships, I am confident the next 25 years will be just as successful.

Farewell And Thanks

On a personal note, in mid-February I am departing USEPA to begin work as director of the Legislative Affairs and Communication Office in the Federal Highway Administration. As I reflect back on my 8 1/2 years as head of the national tank program, I want you to know how proud I am of the work we've collectively done and how much I believe we've accomplished in protecting our nation's land and water from petroleum underground tank releases. Although I am sad to leave, I go with a sense of satisfaction in our accomplishments and good will for all my friends and colleagues—in USEPA's regions, states, territories, tribes, industry, and environmentalists. I will miss you, but am certain that you will continue the strong partnerships we've built and that you will work together to meet the new tank program challenges that lie ahead in the next quarter century. ■

Carolyn Hoskinson has been named as the Acting Director of USEPA's Office of Underground Storage Tanks (OUST) to replace Cliff Rothenstein, who departed the agency in mid-February. Carolyn has been OUST's Deputy Office Director since August 2006 and has worked at USEPA for almost 18 years. You can reach Carolyn at hoskinson.carolyn@epa.gov or 703-603-9900.

\$200 Million For Cleaning Up UST Leaks Included In Recovery Act

The recently-enacted American Recovery and Reinvestment Act of 2009 provides USEPA with \$200 million to help clean up petroleum leaks from underground storage tanks in states, territories, and Indian country. The national UST program is primarily implemented by states and territories, so the vast majority of money USEPA receives will go to state and territorial underground storage tank programs through grant agreements. Because USEPA implements the underground tanks program in Indian country, money to clean up eligible tank leaks in Indian country will be distributed and managed by USEPA regional underground tank

programs. This money can be used either to:

- oversee cleanup of underground tank leaks, or
- directly pay for cleaning up leaks from federally regulated tanks where the responsible party is unknown, unwilling, unable, or the cleanup is an emergency response.

This influx of money to clean up UST leaks is intended to stimulate jobs such as those necessary to perform site assessments and cleanup activities. USEPA expects to provide the money to states, territories, and tribes shortly. ■


 CALIFORNIA

BUTANOL—Coming to a UST Near You!

by Robert Hodam

Just as some of us are getting comfortable with storing E85 in USTs (about 1,800 in the U.S.), there are several new fuels powering their way toward UST storage and one of them is butanol. But in California butanol will first have to pass a rigorous environmental and compatibility evaluation.

In the aftermath of the MtBE debacle, the State of California required all new fuels and fuel additives to pass a three-tiered “multimedia environmental evaluation” conducted by a MultiMedia Working Group (MMWG), comprising the regulatory boards and offices that make up the California Environmental Protection Agency (CalEPA). The multimedia evaluation includes tests of vehicle emissions, groundwater fate and transport, marine and freshwater aquatic toxicity, biodegradation (both aerobic and anaerobic), human health and toxicity, and UST material compatibility.

Recently the MMWG received an application for a multimedia evaluation of butanol, or more precisely, “biobutanol.” The applicant, which is currently producing butanol at a pilot plant, is also working to develop an enzymatic hydrolysis-fermentation process using waste cellulose as feedstock to produce biobutanol. The enzymatic hydrolysis step generates a sugar, which is fermented directly into a specific isomer of butanol using a proprietary genetically modified organism.

Okay, but What Is Butanol?...

And why do we need another new alternative fuel? Butanol is a four-carbon alcohol that shares some characteristics with ethanol but also offers some advantages. It is similar to ethanol in terms of biodegradability and toxicity. The FDA considers butanol safe enough for use in cosmetics. And, like ethanol, butanol is neither mutagenic nor carcinogenic.

However, the major similarities end there.

Butanol has the potential to be compatible with UST materials; it has lower solvent activity and is less corrosive than ethanol. It is also much less soluble in water than ethanol, thus reducing the likelihood of phase separation in the presence of water, a characteristic common to ethanol blends. The lower water solubility may also reduce transport in groundwater. Unlike E85, Bu85 (85% butanol-15% gasoline) works in conventional Otto cycle (spark ignition) car engines; it apparently does not require a “flex-fuel” vehicle.

Both butanol producers and tank and pipe manufacturers need to start now to coordinate their efforts with UL.

Butanol also appears to be more flexible in application. It is not only a substitute for ethanol as a gasoline oxygenate-blending agent; it could be a substitute for gasoline altogether. Yet its most surprising feature may be its ability to be blended with diesel in high concentrations. Argonne National Laboratory has conducted butanol/diesel performance tests and reported the following results:

“... butanol/diesel blends up to 20% butanol can be successfully operated in a diesel engine calibrated for 100% diesel fuel. In addition, the results showed the significant impact butanol can have on vehicle emissions, especially particulate matter, without significantly increasing NOx. A 40% blend of butanol with ULSD may be able to be operated satisfactorily with ECU recalibration and thus realize the full potential of the higher blends of butanol, not only from an emissions standpoint but from a petroleum diesel fuel displacement-blending agent as well. The potential exists to blend butanol with various base fuels, such as biodiesel and Fischer-Tropsch to produce blends with unique and favorable characteristics.” (Miers, Scott A., et.al. [2008] *Drive Cycle*

Analysis of Butanol/Diesel Blends In a Light-Duty Vehicle [SAE 2008-01-2381, not yet published].)

Unfortunately, there are few data on vehicle emissions from butanol use in contemporary engines. Consequently, the California Air Resources Board, as a member of the MMWG, will be overseeing extensive butanol vehicle-emissions testing. Likewise, the State Water Board will oversee additional material compatibility, aquatic toxicity, and fate and transport studies to fill gaps in existing data on butanol’s water quality impacts.

How soon can we expect butanol or butanol blends to be stored in USTs? The CalEPA multimedia evaluation process may take 18–24 months, so the earliest we could expect to see butanol in USTs in California is about two years—assuming UL approves/certifies underground storage tanks and piping for use with butanol.

Do any underground storage tanks or pipes have UL approval for storing butanol, butanol-gasoline blends, butanol-diesel blends, or biodiesel-diesel-butanol blends? In general, no. Butanol producers need to be aware that UST systems will need UL approval/certification to store these fuels. Likewise, UST-system manufacturers need to be aware that butanol will be part of the growing biomass-based low-carbon fuel mix. So both butanol producers and tank and pipe manufacturers need to start now to coordinate their efforts with UL.

Coordinated effort or not, expect butanol fuels coming to an UST near you. ■

Robert Hodam is a chemical engineer with UST Section of the California Water Resources Control Board. He is currently responsible for alternative fuels issues and represents the Board on the CalEPA Multi Media Working Group. He can be reached at RHodam@waterboards.ca.gov.

NOTE: In the next issue of LUSTLine we will address the changing world of vehicle fuels. Stay tuned.

FAQs from the NWGLDE

...All you ever wanted to know about leak detection, but were afraid to ask.

Questions About Sensors, Part II

In Part I of our FAQs about sensors, the following questions were answered:

- How can I find interstitial sensors on the National Work Group on Leak Detection Evaluations (NWGLDE) website?
- Why are some sensors listed with consoles and some listed without consoles, while others appear to be listed as part of a complete system?
- Are sensors and probes the same?
- How do the different interstitial monitoring methods shown on the NWGLDE List work?

This FAQ is broader in scope than the previous one. Because of the Energy Act of 2005, the previous FAQ addressed interstitial monitoring exclusively. In addition to addressing sensors related to monitoring UST-system interstitial spaces, this FAQ also discusses sensors used in vapor and groundwater monitoring applications. Although on the decline, as indicated by the rating in the "Estimate of Current Use" column in Table 1 (on page 17), many older systems are still in use today. These systems remain a concern to UST inspectors because they are still being used to comply with regulatory leak-detection requirements.

The NWGLDE recommends that you read the answers to the questions contained in LUSTLine Bulletin 59, (November 2008) before reading this FAQ because the answers contain information about sensors that will be helpful in understanding the information presented below. Also, USEPA's Office of Underground Storage Tanks is developing a "Leak Detection Sensors Manual" to assist UST operators and state inspectors with information on the operation, maintenance, and inspection of sensors. The manual is expected to be available in fall 2009. (Please Note: the views expressed in this column represent those of the work group and not necessarily those of any implementing agency.)

Q. What are the different ways that sensors work to detect pressure/vacuum changes, liquids, and vapors?

A. Sensors come in many different shapes and sizes and function under a number of different operating principles. Table 1 provides the operating principles used by the specified Test Method (sensor category), as listed by NWGLDE, a brief description of the operating principle, and a rough estimate of the likelihood of encountering the device being used in the field. (See Table 1.)

Q. What information is included in the NWGLDE sensor listings, and how can this information be used?

A. NWGLDE sensor listings provide beneficial evaluation results that can aid users of the list in determining whether sensors are suitable for use in a particular leak-detection application. These listings include the operating principle discussed above and, depending on the protocol under which the sensor has been evaluated, the listing might include the output type of the sensor, such as **quantitative** or **qualitative**, **discriminating** or **nondiscriminating**. **Quantitative** sensors provide an indication of the concentration of liquid or vapor; **qualitative** sensors simply tell you whether or not a liquid or vapor is present. **Discriminating** sensors distinguish between different liquids and actuate for only one specific liquid; **nondiscriminating** sensors activate in response to contact with any liquid.

The sampling frequency of the sensor is also indicated. Sampling frequency can either be **continuous**, where the sensor routinely performs leak detection on an uninterrupted basis, or **intermittent**, where the

sensor is used to periodically test for the presence of product.

Listings include other results from the third-party evaluation such as the **lower-detection limit**, **detection time**, and **fall time** of the sensor. The **lower-detection limit** is the smallest liquid concentration or level that a detector can reliably detect. The **detection time** is the time the sensor took to sense the liquid or vapor and send a signal. **Fall time** is the time it takes for the sensor to recover before it can again respond to a liquid or vapor. For detailed definitions of these terms, refer to the "Glossary of Terms" on the NWGLDE website at <http://www.nwglde.org/glossary.html>. Finally, these listings provide the types of liquids, and vapors that the sensor was able to detect during the evaluation.

About the NWGLDE

The NWGLDE is an independent work group comprising 10 members, including 9 state and 1 USEPA member. This column provides answers to frequently asked questions (FAQs) the NWGLDE receives from regulators and people in the industry on leak detection. If you have questions for the group, please contact NWGLDE at questions@nwglde.org.

NWGLDE's Mission:

- Review leak-detection system evaluations to determine if each evaluation was performed in accordance with an acceptable leak-detection test method protocol and ensure that the leak-detection system meets USEPA and/or other applicable regulatory performance standards.
- Review only draft and final leak-detection test-method protocols submitted to the work group by a peer review committee to ensure they meet equivalency standards stated in the USEPA standard test procedures.
- Make the results of such reviews available to interested parties.

Questions About Sensors, Part II continued

Table 1. SENSOR DESCRIPTIONS			
Operating Principle	Test Method (Sensor Category)	Description of Operating Principle	Estimate of Current Use (High/Med/Low)
Liquid-filled interstitial monitoring	Continuous interstitial-monitoring method (liquid-filled)	A fluid reservoir containing brine, water, or propylene glycol is attached at the top of the tank and opens to the interstice. The reservoir is equipped with a dual-point float switch to provide for low-level and high-level alarms.	Low/Med (Varies with geography. Low in the mid-continent. Med in states where secondary containment is required.)
Pressure-filled interstitial monitoring	Continuous interstitial-line-monitoring method (pressure/vacuum)	Uses a pump to pressurize an inert gas to continuously maintain an overpressure using a pressure sensor within the interstitial space of double-walled piping. System is designed to activate a visual and acoustic alarm before stored product can escape to the environment and is capable of detecting breaches in both the inner and outer walls.	Low (Mainly found on newer installations in CA.)
Pressure-voided interstitial monitoring	Continuous interstitial-tank-monitoring method (pressure/vacuum)	Uses an integral vacuum pump and a vacuum sensor to continuously maintain a partial vacuum within the interstitial space of double-walled tanks. System is designed to activate a visual and acoustic alarm before stored product can escape to the environment and is capable of detecting breaches in both the inner and outer walls.	Low (Mainly found on newer installations in CA.)
Metal-oxide semiconductor	Interstitial liquid-phase & vapor-phase	Detects petroleum hydrocarbon vapors by monitoring for a change in electrical current in a cell inside the sensor.	Very Low
Float switch/ Reed switch/ Magnetic switch	Interstitial liquid-phase & out-of-tank liquid-phase	A device that monitors for a change in the level of a liquid. A float switch is made up of a reed switch activated by a magnet inserted in a float. These devices are generally specified as "normally open" or "normally closed," depending on how they are oriented. The switch completes a circuit or interrupts a circuit.	High (The most commonly used interstitial sensor.)
Polymer sensitive/Product solubility	Interstitial liquid-phase, out-of-tank liquid-phase, & vapor-phase	Uses a material that allows penetration of petroleum hydrocarbons but not water.	Low (Most often associated with discriminating sensors. More common in CA.)
Optical sensor/Refraction	Interstitial liquid-phase	Monitors a continuous light source such as an LED. A liquid (petroleum or water) will decrease the amount of light the detector receives and a signal is sent to the console.	Low
Electrical conductivity	Interstitial liquid & out-of-tank liquid-phase	Uses hydrocarbon-permeable coated wire that indicates a change in the resistance of the wire when the coating degrades as a result of contact with petroleum hydrocarbons.	Very Low (Old technology – late '80s to early '90s.)
Capacitance change/RF-attenuation/Proximity sensors (capacitive)	Interstitial liquid-phase, out-of-tank liquid-phase	Monitors for changes in capacitance.	Very Low
Thermal conductivity	Interstitial liquid-phase	Designed to respond to heat differences between air, water, and hydrocarbons. The temperature inside the sensor element rises and triggers a response at the console.	Very Low
Fiber-optic chemical sensor	Out-of-tank liquid-phase	Characterized by a chemically sensitive film deposited on the end of an optical fiber. Any change to the film results in a decrease of light being emitted, sending a signal to the console.	Extremely Low
Adsistor/adsorption sampling	Vapor-phase	Changes electrical resistance in the presence of petroleum hydrocarbon vapors.	Very Low (Old technology.)
Photo-ionization	Vapor-phase	Uses ultraviolet radiation to ionize and detect small concentrations of volatile organic compounds in ambient air.	Very Low
Chromatographic (i.e., color change)	Vapor-phase	A granular material that changes color in the presence of hydrocarbon vapors.	Low

USEPA's New Guide for Developing a Third-Party UST Inspection Program

USEPA has provided state and regional UST programs with an electronic version of its new publication, *Developing a Third-Party Underground Storage Tank Inspection Program: A Guide to Assist States* (EPA-510-K-08-001, September 2008). The guide provides states with information on how to develop a third-party inspection program or enhance an existing one. It summarizes USEPA's inspection grant guidelines and outlines steps states should follow in developing a third-party inspection program. It also includes examples of existing state programs. To access the guide, go to: <http://www.epa.gov/oust/pubs/thirdpartyinspection.htm>.

Field Notes

from Robert N. Renkes, Executive Vice President, Petroleum Equipment Institute (PEI)

Presenting...Online Tests for PEI Recommended Practices

PEI is now offering online tests for the recommended practices it produces. The most popular recommended practices produced for storage tank regulators by PEI include:

- *Installation of Underground Liquid Storage Systems* (RP100)
- *Installation of Aboveground Storage Systems for Motor-Vehicle Fueling* (RP200)
- *Installation and Testing of Vapor Recovery Systems at Vehicle-Fueling Sites* (RP300)
- *Inspection and Maintenance of Motor Fuel Dispensing Equipment* (RP500)
- *Overfill Prevention of Shop-Fabricated Aboveground Tanks* (RP600)
- *Installation of Bulk Storage Plants* (RP800)
- *Inspection and Maintenance of UST Systems* (RP900)

All tests are multiple-choice, and most contain about 70 questions. For each test, the program scrambles the questions, giving each user a unique test. The test questions, written by the committee that created the recommended practice, are designed to evaluate

knowledge gained from information contained in the particular document. PEI has not designated a "passing" grade for the exams, but provides the score as the number of correct answers. When a test is completed, the user immediately receives a score and a Certificate of Completion indicating the number answered correctly. Each question, with the correct answer provided, is available for review.

PEI staff monitor the test questions on a regular basis. Bad questions/or answers are replaced when necessary. All questions are based on material contained in the most current recommended practice. When recommended practices are revised, so are the questions, providing assurance that the tests are based on the most up-to-date information.

The tests are delivered online using any standard web browser. No software downloads or plug-ins are required. The Certificate of Completion requires Adobe Acrobat Reader to view and/or print.

Individual tests cost \$25 per test and can be purchased at www.pei.org/tests. Customized installations can also be configured for governmental entities that need full administration of a testing program or prefer to brand the test in some manner. For more information about any aspect of this program, contact Rex Brown at 918-494-9696 or jrbrown@pei.org. ■

SNAPSHOT FROM THE FIELD

A Quilted Gas Station

This abandoned gas station in Syracuse, New York, became the object of the International Fiber Collaborative's (IFC's) World Reclamation Art Project (W.R.A.P.), otherwise known as the Gas Station Project. Participants crocheted, knitted, stitched, patched, or collaged 3-foot square fiber panels that expressed each participant's concern about the world's extreme dependency on oil. All of the panels were then sewn together to completely cover the station. Artist Jennifer Marsh founded the IFC to give people from all countries and all walks of life and ages the opportunity to collaborate with other communities and countries worldwide on a single mission. The gas station is the first of such projects.



See colorful version of this photo at www.neiwpcc.org/lustline/

■ Questions on the “Oldie Moldies” by Pat Ellis from page 13

recover. If we don't send an NOI, we will send a Notice of Violation or a Secretary's Order with an administrative penalty (and usually include a threat to take over).

We do have a program called First Fund (named for the First State), where we can pay for investigation and remediation of sites that are considered orphan-tank sites. Some of the sites fall into this category because of the date the tanks were last used, or because of the details of ownership changes. We can also use LUST Trust money for some of the sites. Another option is a low-interest loan program that we have. I believe we've also managed to tap into some brownfields money on occasion.

I've been pleased with what we've managed to get done with this program, although I'll admit that it irritates me to offer free work to

someone who pretty much ignored our requests to do the work originally. On the other hand, it has gotten many of them off the books so we won't have to mess with them in the future. Now we're at full staff, the goal is to keep more sites from becoming “oldie moldies,” where they get handed off every time we get a new project officer. Every time we get a new hydrologist, we each get to hand off a few projects from our caseload. Last time we got a new hydrologist, our manager set a limit on how many oldies we could each dump...errrr... hand off to the new guy. At least some of the sites that we each handed off did not have mold on them! We're gearing up now to schedule a few sampling days when the weather gets warmer, and to get a new round of invitation letters sent out. ■

■ Tank-nically Speaking

from page 11

piping systems must include liquid-tight sumps that contain the connections between the piping, pump, and dispenser. These sumps are most often constructed of polyethylene plastics or fiberglass. Installation typically includes cutting a number of holes in the sumps to allow piping and electrical conduit to pass through. These field-cut holes must then be made liquid-tight using various fittings and seals.

Achieving leak-tight secondary containment for piping systems, however, has proven to be somewhat difficult (See *LUSTLine* #35, “The Problem with Sumps,” June 2000.) Because piping systems are assembled in the field, field conditions and quality-control issues along with inadequate testing at the time of installation have resulted in many secondarily contained systems that are not liquid-tight. As a result, secondary-containment systems often fail to capture liquids leaked from primary piping, thus falling short of their primary purpose: leak containment.

Well, that pretty much brings us up to date on UST-system tanks and pipes. In the next issue of *LUSTLine* I plan to describe pumping systems, vapor-recovery methods, fill pipes, deliveries, and maintenance. If there are any historical footnotes or anecdotes you'd like to add, send me an e-mail: marcel.moreau@juno.com. ■

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UST Insurance Matters.....

What Is a “Covered Storage Tank”?

by Chris Montgomery (CEI)

The storage tank policies currently available from insurance companies all contain a section called “Definitions.” This section lists all of the key words/terms used in the policy. Since the underground storage tank is the focus of these policies, the word “*storage tank*” or “*storage tank system*” is always one of the defined words in this section.

However, while one would think definition of a storage tank or tank system would be consistent among the available policies—nothing could be further from the truth. So—what is a “*covered storage tank*”? Note the two examples below:

Example 1

Storage Tank System means a stationary tank or tanks owned or operated by the Insured and shown in Item 5 of the Declarations. *Storage Tank System* includes any on-site integral piping or dispensing equipment, ancillary equipment, and containment system associated with the tanks.

Example 2

Underground Storage Tank (UST) means any UST on the Scheduled

Storage Tank & Location Endorsement (including underground pipes connected thereto) that is used to contain an accumulation of regulated substances, the volume of which is 10 percent or more beneath the ground.

In example 1, the policy defines the covered underground storage tank/system in a way that would encompass all equipment from the actual underground tank to the hose/nozzle used to dispense gas. It would include any sump pumps, oil/water separator, blending tank, and so on that is associated with the tank listed in the policy declarations.

In contrast, the second policy does not encompass the dispensing equipment, hoses, nozzles, or other ancillary equipment and containment systems. Furthermore, the actual policy that uses this definition goes on to say “this term does not include any farm or residential tank; or; tank used for storing heating oil for consumptive use on the premises where stored; or; flow-through process tank; or, ...a variety of other specific tanks/equipment.” This definition is clearly modeled after the definition of underground storage tanks

contained in USEPA’s rules, which is mirrored in many state regulations.

Needless to say, the definition of a storage tank in example 1 provides for far broader coverage than that in example 2. The first insurer would obviously consider coverage protection for a loss caused by a slow leak from a fuel filter contained in the product dispenser. However, an insurer using the second definition in its policy would very likely not cover such a claim.

Regulators—including those who use the second definition in their UST rules—typically expect the owner/operator to clean up a leak, regardless of whether it came from the fuel filter or another part of the equipment not covered by the more limited definition. Therefore, owners and operators, and the regulators who review these policies, need to understand the consequences of the Definitions. ■

Chris Montgomery is a principal with Custom Environmental Insurance. He can be reached at 877-TANKCOV (826-5268) or Chris@tankcov.com .

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