iuth • Anniversary • Issue

**New England Interstate** Water Pollution Control Commission

255 Ballardvale Street Wilmington Massachusetts 01887

January 1996

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



Rust Thou Art And

Inless...

orrosion costs us billions of dollars every year; industrial machinery. bridges, water and sewer piping all corrode and, in time, must be replaced or repaired. Steel underground petroleum storage tanks corrode too, and when corrosion perforates these tanks, the product in the tanks escapes into the environment. In the late 1970s, the American Petroleum Institute conducted a study to determine the causes of underground tank

> failures; the results indicated that corrosion was the culprit in over 92 percent of steel tank failures.

Methods for protecting steel against corrosion have been known for a long time. Paint and other coatings have long been used to combat corrosion. Cathodic protection, another technique for corrosion control, has been used since at least 1824, when Sir Humphrey Davy used cast iron anodes to protect the copper bottom on His Majesty's man-of-war "Sammarang."

#### **Corrosion Fundamentals**

While we would like to think of steel as a durable, long-lasting material, deep down inside, it wants to be iron ore; it wants to go back to its origins; it wants to be able to rust. The fact is that the iron ore that we convert to steel will revert to iron ore whenever conditions are appropriate—rust thou art and to rust thou shalt return. This process of reverting to iron ore is called corrosion.

Corrosion is an electrochemical process which involves both the transfer of electrons (an oxidation/reduction reaction) and a change in physical properties. For corrosion to occur, four components must always be present: an electrolyte, an electrical pathway, an anode, and a cathode.

In the case of a steel tank that is corroding underground, the electrolyte is water. Even damp soil contains sufficient water for corrosion to occur. The electrical pathway is a means for electrons to travel easily between the anode and

continued on page 2

### Inside Tanknically Speaking-Upgrade Now... Compliance Checklists O Tearraind Transling in SignLand. Tanks Down Fast Contractor This <u>্র্তিন্</u>সভাতের চিত্র করেন্দ্র নির্ভাগ করেন্দ্র Sere zeries Athriery force Texaso Jens in Oleanup Eupid Marke Dispusion and Sever en longinger explained Alexan dego zesprejuk villoki kelorek Barkers

#### ■ Rust Thou Art... from page 1

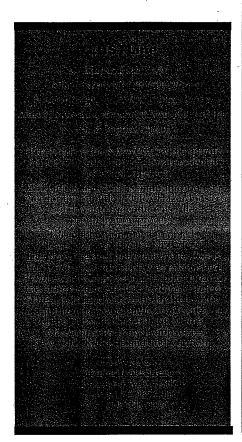
cathode. The metal itself usually serves as the electrical pathway. The anode is any place on a metal where electrons are leaving the metal via the electrical pathway and corrosion is occurring. The cathode is any place on the metal where the electrons are arriving from the electrical pathway and corrosion is not occurring.

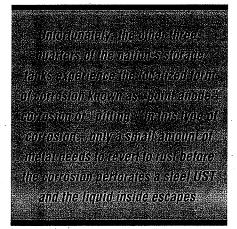
Anodes and cathodes can be quite close together on the same piece of steel, or they can be on different metallic structures. All that is required is that an electrical pathway exists between the anode and the cathode and that they are in the same electrolytic environment. Just as every night has its day, every anode has its cathode. In other words, whenever there is a place on a metal that is corroding, there is a place elsewhere that is not corroding.

#### **Corrosion on the Attack**

There are two ways that corrosion can attack a metal: Over the entire surface of the metal so that it corrodes uniformly, or on a very small area so that corrosion is localized.

When corrosion attacks the entire surface of a metal uniformly, a structure, such as an underground





tank, can last for a long time because a lot of metal must be converted to rust before the tank becomes structurally unsound enough to fail. Estimates indicate that about a quarter of underground tanks that do not have corrosion protection experience uniform corrosion.

Unfortunately, the other threequarters of the nation's storage tanks experience the localized form of corrosion known as "point anode" corrosion or "pitting." In this type of corrosion the anodic area of the steel (the area where corrosion happens) is very small (the size of a dime or even less); only a small amount of metal needs to revert to rust before the corrosion perforates a steel UST and the liquid inside escapes.

A tank suffering from point anode corrosion can look as good as new except for a place (or places) that looks like a bullet hole where the point anode corrosion has attacked. The average life expectancy of a tank that is experiencing point anode corrosion is about 15 years; in particularly corrosive conditions, point anode corrosion can perforate a tank in 4 or 5 years.

#### **Combating Corrosion**

If any one of the four corrosion components listed above is eliminated, corrosion will not occur. The question is: Can we eliminate any one of these components from an UST system? Consider each of the four elements:

Electrolyte - There isn't any practical way to remove all moisture from the ground, but it is possible to keep the moisture off the metal. Coating performs this function, but the coating has to be perfect. The asphalt coat-

ings that were put on tanks in the past were never carefully applied and were often damaged during tank transportation and installation. (The standard method of delivering a tank was to roll it off the delivery truck.) As a result, asphalt coatings did not do a very good job of keeping moisture away from the steel. In fact, because asphalt coatings covered much of the tank while leaving relatively small areas of metal exposed, they created ideal conditions for point anode corrosion.

For coatings to be effective, they must be durable, carefully applied, and the finished tank must be carefully handled so that absolutely no metal is exposed to moisture. Historically, paint and asphalt coatings have not met these criteria. In recent years, fiberglass cladding has filled this bill; about an eighth-of-an-inch thick layer of resin and fiberglass is applied to the exterior of the tank to isolate the metal from soil moisture and, thus, prevent corrosion from occurring.

Electrical Pathways - In some instances, electrical pathways can be obstructed by separating, or isolating, buried metallic structures so they aren't all electrically connected. Isolation reduces the opportunity for creating anodes and cathodes on adjacent tanks or other storage tank system components. Pipe fittings that incorporate plastic parts can effectively isolate the components of underground storage systems so that electrons cannot flow between tanks, piping, pumps or any other component of the system. Anodes and cathodes can still occur within a single tank or length of pipe. So, reducing electrical pathways is not a standalone method of corrosion protection.

Anodes and Cathodes - These elements of corrosion come with the metallic territory, and there is no way to eliminate them. But, corrosion engineers have figured out how to use anodes and cathodes to beat corrosion at its own game. Keeping in mind that anodes corrode and cathodes do not, it is possible to create a situation where the tank and its piping become the cathode. This situation is the principle behind cathodic protection.

#### **Cathodic Protection**

#### • Galvanic

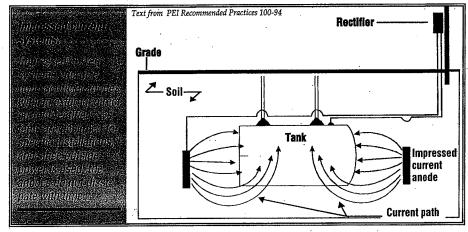
"Galvanic" or "sacrificial anode" corrosion protection is a predictable and effective way of creating anodes and cathodes by using different kinds of metals; one corrodes, acting as an anode, and the other does not, acting as a cathode. In the case of steel USTs, corrosion engineers have learned that they can connect either zinc or magnesium to the tank to protect it. Either of these metals can serve as the anode and corrode; the tank becomes the cathode and is protected against corrosion. Eventually, the anode will corrode away (hence the term "sacrificial anode") and will need to be replaced if this method is to continue to provide corrosion protection. But, as long as the anode is replaced as required, the tank will continue to be corrosion free.

This method of corrosion protection works well because it is simple and requires little maintenance. But it does have limitations. First and foremost, it is only cost-effective when used to protect relatively small areas of exposed metal. This limitation is usually overcome by using sacrificial anodes only on wellcoated structures that are electrically isolated so that they protect only small nicks and scratches (corrosion engineers like to call these coating defects "holidays") in the coating rather than the entire surface of the tank or piping.

As a practical matter, sacrificial anode cathodic protection is most useful for new underground tanks that are well coated (with epoxy or urethane-based compounds, not asphalt) such as the sti-P3<sup>®</sup> type of tank.

#### • Impressed Current

Impressed current cathodic protection is the most practical and eco-



nomical method for protecting existing poorly-coated or uncoated steel underground structures from corrosion because it can protect large areas of exposed metal from corrosion. Impressed current works like galvanic corrosion protection in that it sets up a situation where the tank and piping become a cathode; however it does it through a different process.

Impressed current cathodic protection uses anodes that are connected to an external DC power source. That source is typically a "rectifier," a device that converts AC power to DC at a desired voltage. The positive terminal of the rectifier is electrically connected via cables to the anodes, and the negative terminal is connected to the structure to be protected, in this case the UST system. The UST system is protected because the current going to the UST system overcomes the corrosioncausing current normally flowing away from it.

Materials typically used as anodes for impressed current systems include graphite, high silicon cast iron, and titanium coated with a metal oxide. Anodes used in impressed current systems must be highly corrosion resistant, because the external power supply would

otherwise cause them to corrode rapidly.

The main advantage impressed current systems is that they are not limited by the surface area of metal that is to be protected. Even a completely uncoated storage system can be protected from corrosion by merely adjusting the amount of electricity produced by the rectifier and the number and location of the anodes. Furthermore, because the DC voltage is adjustable over a wide range, this type of system can be used in various soil conditions and where large amounts of protective current are required.

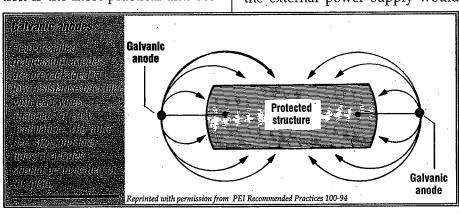
Impressed current cathodic protection systems are much more sophisticated than the galvanic type; they must, therefore, be carefully designed by personnel who know what they are doing. (See article on page 4.) An improperly designed impressed current cathodic protection system can cause an increase in the amount of corrosion on a storage system rather than protect it. Be sure the people you hire are qualified.

# Monitoring Cathodic Protection

Monitoring is a critical factor in ensuring the long-term performance of a cathodic protection system. Federal and state regulations include cathodic protection system monitoring and recordkeeping requirements.

Galvanic system monitoring involves checking the voltage of the storage tank system relative to a reference cell. This measurement must be conducted by a qualified cathodic protection tester who is familiar with the basics of corrosion protection. UST systems incorporating

continued on page 4



#### ■ Rust Thou Art... from page 3

a galvanic corrosion protection system must be monitored within 6 months of installation and every 3 years thereafter. Galvanic systems must also be monitored within 6 months after any repair or construction activity has taken place at a facility to ensure that anode wires are okay and that the cathodic protection system hasn't been affected.

The federal rule requires that records of the last two of these measurements be kept on file. States may have more stringent recordkeeping requirements. In general, all monitoring information can be very useful when a corrosion engineer is trouble-shooting a system, so it is a good idea simply to hold on to this information as long as the cathodic protection system is operational.

Impressed current systems require two types of monitoring: A voltage measurement relative to a reference cell, as described above for galvanic monitoring, and an additional measurement of the electrical output of the rectifier. The requirements for the first type of monitoring are identical to those for galvanic systems.

The requirement for the second type of monitoring involves checking the rectifier every 60 days to be sure it is operational. Usually this means keeping a log of the voltage and amperage output of the rectifier. In most cases, this information can be read from meters that are built into the rectifier. The readings, which can be recorded by on-site personnel, should stay relatively constant over time. If there are any changes in the readings, then it is likely that something has affected the system and the corrosion engineer who designed the system should be notified immediately.

The federal rule requires that, for this type of monitoring, records of the last three inspections of the system be kept on file. State recordkeeping requirements may be more stringent. Again, for purposes of trouble-shooting, all of these readings should be kept on file indefinitely.

#### **Corrosion Savvy**

Ever since Jake Gumper buried the first steel tank 110 years ago, corrosion has been the inexorable enemy of our steel underground tank stor-

age systems. While corrosion-resistant tank technology has been readily available for 30 years, it is only since the advent of federal regulations that corrosion-protected storage tanks and piping have come into widespread use.

We've relied on steel to do a lot of important things for us, and we'll continue to do so. When it comes to burying steel tanks for the purpose of storing petroleum product, we must use our corrosion savvy; we must

ilv as corresion exact

make certain the tanks won't heed their primal urge to return to rust. We must be sure that both tank and piping are protected for now and for the long run. So, read on about upgrading now or repenting later.

Special thanks to Joram Lichtenstein, P.E., Corrosion Control Specialist, and NACE member, who provided us with the benefit of his expertise in our efforts to construct this series of corrosion protection articles.

#### Effective Corrosion Control Calls For Qualified Personnel

In ensure successful corrosion protection, it is important that you use qualified. Framed personnel to design, install, and monitor your progretion with its property of a constant of their responsibilities and legal hisbilities. It is a constant that you want to be a constant to be a constant.

The constant that you want to constant the constant to be a constant to be a constant. The constant the constant to be a constant to be a constant to be a constant.

It had person is certificated by NACE International (the National Associated that person is certificated by NACE International (the National Associated in on Corrosion Engineers) as either a Corrosion specialist and for all Eath Plate from Specialist NACE International is the world stargest to essional society dedicated exclusively to the prevention and control of materials corrosion. The association has more than 15,500 members world with and has led the corrosion field in training programs, standard safely 12 spins of and information dissemination for more than 504 years.

Et A regulations require that a corrosion expert to be used to design and install cathodic protections (except for pre-engineered systems) in a stall cathodic protections (except for pre-engineered systems) in as stall cathodic protection bester, be used to inspect the as stall 50 and that a cathodic protection lester, be used to inspect the as stall 50 and that a cathodic protection lester, be used to inspect the as stall 50 and that a cathodic protection lester, be used to inspect the as the 150 and that a cathodic protection lester, be used to inspect the association who has an appropriate background and training in earlies of the person who has an appropriate background and training in earlies of the corresponding to certified by NACE (excluding protessional materials delimino to say that only persons having NACE are thickness.)

While EPA does not specifically require NACE certification for called the projection testers NACE has suggested that persons with NACE of which there is senior Corrosion Technologist, Corrosion Technologist, Corrosion Technologist, Corrosion Technologist, Corrosion Technologist, Corrosion Technologist, Corrosion Tester should be able to do the job effectively.

assettier Comosion Specialists and Aor Cathodic Protection Specialists qual-

NACE has also established consensus criteria which can help tank.

Syners, and operators comply with EPA's, 1998 corrosion protections

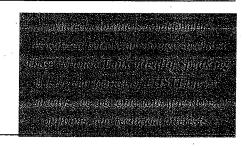
comprehenses Those standards include:

NACE RP0285-95, Corrosion Control of External Corrosion on Metallic Burged Partially Burged, or Submerged Liquid Storage Systems [provides criteria for protecting UST systems and for testing cathodic protection systems).

NACE RP0169-92, Control of External Corrosion on Submerged Metallic Lipung Systems (provides criteria for protecting steel piping with cathodic

er furthing programment about NACE in equationals standards certification programs and services vall (713) 492-0535. NACE headquarters are served as the continuous form of the contin

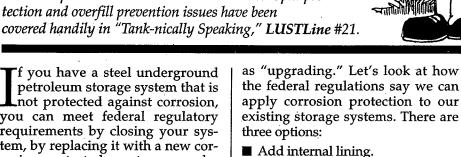




**Upgrade Now...or Repent Later** 

Corrosion Waits For No One

With the leak detection and financial responsibility compliance deadlines behind them, tank owners and operators who haven't already upgraded, closed, or replaced their tanks now face one final, but critical, deadline: They have until December 22, 1998 to comply with federal corrosion protection and spill and overfill requirements. With only 3 years to go, over half a million storage systems have yet to meet these requirements. If you are planning to upgrade your system, this article is for you. If procrastination is your game, if ignorance or confusion about the requirements is your plea, or if you've got a bare steel tank rotting away in the ground, this article is for you. This article is about corrosion protection vis à vis the '98 deadline. Spill protection and overfill prevention issues have been



- Add cathodic protection to the outside of the tank.

SECONDA

VENTORY CON

CATHODIC PROTI

■ Add cathodic protection and internal lining.

Let's look at each of these upgrading options.

#### **Internal Lining**

The process of adding a coating to the inside of a tank is called internal lining. The procedure involves emptying the tank of all liquids, freeing the tank of explosive vapors, excavating to the top of tank, and cutting a hole about two feet square in the tank top for a person to enter.

This person then cleans any sludge out of the tank and carefully sandblasts the entire inside surface of the tank. The tank is then structurally assessed by: Visually checking for corrosion holes and split welds; determining the thickness of

the tank wall, either ultrasonically or by banging on the tank walls with a hammer (not very sophisticated but, I am told, effective); and measuring the tank diameter to determine whether the tank is still reasonably

If the tank has a few holes, they can be plugged and patched and the tank can still be lined. If the tank has too many holes, the walls are too thin, or the tank is too out of shape (an oval-shaped tank indicates that the tank is collapsing) the tank cannot be lined and it must be properly closed. If the tank is determined to be sound, a lining of epoxy or polyester resin with a nominal thickness of 1/8 inch is applied.

The entry hole in the tank is then sealed, and the tank is considered to be upgraded. The lining inside the tank has not stopped any external corrosion from occurring, but the theory is that the lining will not allow liquid to leak out even if point anode corrosion does perforate the tank shell. The assumption is that it will be a long time before uniform

**■** continued on page 6

f you have a steel underground petroleum storage system that is not protected against corrosion, you can meet federal regulatory requirements by closing your system, by replacing it with a new corrosion-protected system, or by upgrading your existing system. If storage system replacement is your strategy for meeting the '98 deadline, you have a few options. Steel tank technologies such as the sti-P3® and fiberglass clad steel tanks are available with factory-applied corrosion protection. Fiberglass piping and the newer flexible piping systems are also resistant to corrosion.

If you already have these types of systems in the ground, you can rest easy. If you plan to add corrosion protection to your existing systems, you can save some money, but you have more homework to do in figuring out which corrosion protection alternative is right for you and what the requirements are for each method.

The federal regulations refer to the addition of corrosion protection to storage systems that are not presently protected against corrosion

#### ■ Tanknically Speaking from page 5

corrosion reduces the overall structural integrity of the tank to a point where it is no longer serviceable.

Internal lining contractors generally provide a 1-year warranty on workmanship and materials and a 10-year warranty against corrosion-induced leaks. The warranty covers fixing the hole, but not cleaning up the leak. There is no warranty against leaks resulting from structural failure such as failed welds.

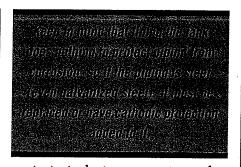
While a simple internal lining is all that is required to meet the regulations, some companies also offer a secondary containment retrofit option. There are three techniques:

- Lining the tank as usual and then inserting a flexible bladder in the tank that becomes the primary container for the liquid in the tank. The space between the bladder and the lining is monitored with a vacuum so that the integrity of both the bladder and the tank wall can be verified.
- Lining the tank as usual, then applying a thin layer of a porous material to the inside of the tank, followed by a second layer of the lining material. This second layer of lining material then becomes the primary container for the liquid in the tank. Again, a vacuum can be maintained in the porous material that is sandwiched between the lining layers, thus verifying the integrity of both lining layers.
- Building a fiberglass tank inside an existing tank by inserting prefabricated panels into the tank and fastening them together with fiberglass cloth and resin.

These techniques present costeffective ways of gaining the added security of secondary containment without replacing existing tank systems. But, these retrofit secondary containment technologies are still relatively new, so be sure your contractor gives you a solid guarantee that the system will work as promised.

#### **Cathodic Protection**

Corrosion engineers generally agree that impressed current cathodic protection (see cover article, "Rust Thou Art...") is the only reliable way to



protect steel storage systems that were originally installed without cathodic protection. The asphalt coating that may have been applied to the tank originally is virtually worthless as far as cathodic protection is concerned; the tank is considered "bare" and has too much metal exposed for galvanic cathodic protection to work effectively. (Beware the snake oil salesperson who tells you that a couple of magnesium anodes will make your tanks as good as new...)

The installation of an impressed current cathodic protection system requires the services of a certified corrosion engineer. The job generally involves boring test holes at the site so that soil properties can be measured to determine site corrosivity. An assessment is also made of the number of tanks and length of piping that are to be protected, the amount of electrical current that will be required to protect the storage system, and where impressed current anodes should be located. The corrosion engineer puts all this information together in order to design a system that will protect the buried storage tank system(s).

The heart of an impressed current cathodic protection system is the rectifier, which is usually installed somewhere near the facility's electrical panel. Wires are run between the rectifier and the anodes and storage system. Where these wires leave the building, they are generally installed in saw grooves that are cut into the pavement of the facility. The grooves are then filled with a sealing compound.

Corrosion engineers generally provide a 1-year warranty on materials and workmanship, but there is no warranty against corrosion-induced leakage or structural failure of the tank.

Cathodic protection can protect a tank and piping from corrosion attack on the outside, but it does not

provide protection against corrosion occurring on the inside of the tank. While internal corrosion is generally less severe than external corrosion, it is a concern. The best way to protect your tank from internal corrosion is to make certain that no water gets into the tank. Take steps to ensure that your fill pipe caps are liquid tight and that water that accumulates in spill containment manholes around fill pipes does not drain into the tank. Check the bottom of the tank for water at least weekly, and remove any water that you find as soon as it is detected.

Impressed current cathodic protection is usually applied to metallic tanks and piping as part of the same process, so there is little added cost in protecting both tanks and piping at a facility.

# Internal Lining and Cathodic Protection

You may also choose to add both a lining and cathodic protection to your tanks. When doing so, the requirements for each method must be met. While this may seem like overkill, there are some long-term financial benefits where monitoring requirements are concerned. Read on for more information.

# What Do The Rules Say About Upgrading?

No matter how an existing non-corrosion protected storage system is upgraded, there are regulatory requirements to consider. In general, regulatory requirements parallel good industry practice. There are two basic types of requirements:

- Tanks must be determined to be structurally sound before they are upgraded, and
- Once upgraded, storage systems must be monitored to ensure that the upgrade is working.

## Determining Structural Soundness

Because upgrading costs money, it makes sense to invest money in upgrading only tanks that still have some life left in them. So how do we make this assessment?

#### ...When lining a tank

Determining the structural soundness of a tank is usually incorporated as part of the tank lining process

(remember the description of internal lining above). Because a person is inside the tank anyway, the procedure can be direct and straightforward. If the tank meets the industry criteria with regard to number of holes, wall thickness, and roundness published in a standard industry practice such as the American Petroleum Institute's Recommended Practice 1631 Interior Lining of Underground Storage Tanks or the National Leak Prevention Association's Standard 631 Entry, Cleaning, Interior Inspection, Repair and Lining of Underground Storage Tanks, then the tank is considered sound, and the process of lining proceeds.

...When adding cathodic protection Determining the structural soundness of a tank that is to have impressed current added is more indirect than for lining because the cathodic protection process does not involve sending a person into the tank. Also, inasmuch as tank structural assessments for cathodic protection cannot fix holes that already exist in tanks, it is important to know that a tank has no perforations prior adding cathodic protection. Because, typically, most tanks do not fail from corrosion until they have been in the ground for 10 years or more, the regulations set up a twotiered system based on tank age for structurally assessing tanks that are to be upgraded using cathodic protection.

If a tank is less than 10 years old, it is not likely to be leaking or to be structurally compromised, so the assessment can be relatively simple. There are two options in the rule:

- Having tightness tests done both immediately before and 3 to 6 months after the cathodic protection is installed, or
- Conducting monthly leak detection described in the rules (such as automatic tank gauging, groundwater or soil vapor monitoring, but NOT inventory control) after the cathodic protection is added.

The basic difference between the two options is that the first one allows the owner to use inventory control and tightness testing for leak detection after the upgrade, while the second option does not.

For tanks 10 years old or older, there is a greater likelihood that cor-

rosion has already seriously impaired the integrity of the tank, so the rules require a more detailed assessment of the tank's condition. The September 1988 federal rule mentioned only internal inspection as a suitable method for structural. assessment of older tanks, although the door was left open for other methods to be approved by implementing agencies. This reliance on internal inspection placed upgrading by cathodic protection at a competitive disadvantage, because by the time the internal inspection was completed (i.e., entering, cleaning, and sandblasting) the lining proce-

Conosion enimeers nenerally arrest thatampressed content eathortic nateston is the only retable way to noteksteel storage systems that were commally installed without ealinoille mroleolion

dure had basically been done, except for the actual application of the lining. The original procedure also made upgrading tanks prohibitively expensive for some owners.

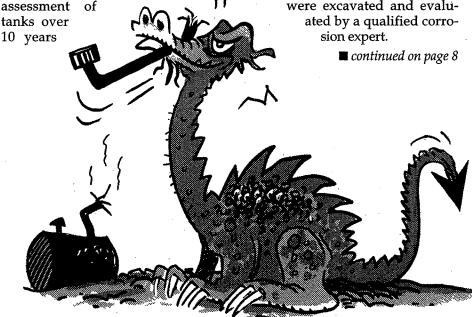
So, the EPA, state regulators, and members of the cathodic protection and lining industries got together and set up a committee within the American Society of Testing and Materials (ASTM) to produce a "standard practice" for conducting a structural

old that did not involve actually sending a person inside to conduct an inspection. The ASTM standard thus increased safety (i.e., no tank entry by personnel) and encouraged compliance by providing economic alternatives to tank entry. In the fall of 1994, the ASTM published an emergency standard (ASTM ES 40-94) that describes three assessment alternatives.

All of the alternative assessment methods have some common elements. They all begin with a tightness test or other leak detection methodology certified in accordance with EPA requirements to ensure that the tank is tight before much money is invested in the procedure. They also involve drilling holes, taking soil samples, and making measurements of the corrosive properties of the soil around the storage systems. The data gathered from these boreholes are also used in the design of the cathodic protection system, as well as in the structural assessment, so this information has multiple uses.

In the first ASTM procedure, the soil data are fed into a statistical program that calculates the time to corrosion failure for the storage systems at the site. If the probability of pitting corrosion failure is greater than 5 percent, then the tank is not a candidate for upgrading with only cathodic protection. Companies selling this type of service must have derived their statistical program by investigating at least 100 sites

> where a minimum of 200 tanks were excavated and evaluated by a qualified corrosion expert.



#### ■ Tanknically Speaking from page 7

The second method utilizes a small robotic probe that is inserted through the fill pipe and then guided around the inside of the tank to measure the wall thickness. The tank wall thickness and the soil chemistry data are used to determine whether cathodic protection should be applied. This technology is still being developed, but the manufacturer expects it to be available in mid-1996.

In the third method, a compact video camera and lighting system are inserted into the tank through the fill opening and the inside of the tank is inspected for holes remotely. This method is extremely dependent on getting the tank scrupulously clean, especially along the bottom where sludge and scale are most likely to settle and corrosion holes are most likely to occur. The standard explicitly states that "any sludge, thick oxides, or other dense residual material" must be removed from the tank. Finally, let's hope the person reviewing the video tape of the tank has eagle eyes so that he or she can spot pinhole sized perforations.

For tanks 10 years or older, the first and third ASTM alternatives require that the tanks be determined to be leak free approximately 6 months after the application of cathodic protection. A tightness test or other leak detection method that is certified in accordance with EPA can be used.

These ASTM alternative assessment methods have been blessed by the EPA (guidance memoranda from Lisa Lund to state UST contacts dated May 18, 1995 and September 14, 1995), but they must be approved by individual state implementing agencies before they can be used in a particular state. States may have specific documentation or reporting requirements that are to be used with these assessment methods, so be sure to check with your state agency before using these methods.

Also, because of the rapidly approaching '98 deadline, these alternative assessment methods were approved by ASTM as an "emergency standard." This means that the standard will remain in effect for only 2 years, after which it must be reviewed and re-accepted as a for-

mal standard. EPA is currently funding a research project that will independently evaluate how well each of these alternative assessment methods works. The results of this research project will likely influence whether the emergency standard becomes a permanently accepted standard.

FPA state regulators and members of the cathodic protection and things industries of together and space as committee within the Americal Society of Testing and Materials (ASTMATO Incommercial Standard practice for conductions). Standard practice for the conduction of the conduction

# Monitoring Requirements For Upgrading

...When lining a tank

For the first 9 years after lining a tank, there are no monitoring requirements. But on the tenth year and every 5 years thereafter, the tank must be internally inspected to ensure that the lining still meets original design specifications and that the tank is still structurally sound. The internal inspection procedure involves a visual inspection, as well as measurement of the lining thickness, hardness, and integrity. The wall thickness of the tank must also be surveyed ultrasonically to ensure that uniform corrosion is still within acceptable limits.

To facilitate re-entry into the tank for future inspections, some lining contractors offer the option of retrofitting a tank manway onto an existing tank at the time the tank is lined.

A record of the inspection results should be retained by the storage system owner or operator to document compliance with the internal inspection requirements.

...When adding cathodic protection Once impressed current cathodic protection is added, the 60-day checks of the rectifier and the 3-year checks of the voltage relative to a reference cell must be conducted. (See "Rust Thou Art..." for details.)

About Leak Detection After Upgrading

In terms of leak detection monitoring, EPA guidance suggests that storage systems that are structurally assessed using any of the ASTM methods must do leak detection, but may not use inventory control and tightness testing to meet leak detection requirements after the cathodic protection upgrading is completed. Internally lined tanks and tanks that are internally inspected by a person inside the tank prior to the addition of cathodic protection, may continue to use inventory control and tightness testing for leak detection for 10 years after the upgrade is completed. After 10 years, another method of leak detection must be used.

For Those Who Prefer to Wear a Belt and Suspenders

A third option for upgrading was mentioned above: Adding both internal lining and impressed current cathodic protection to a storage tank system. If you choose to do both lining and cathodic protection at the same time, the structural assessment part of the regulatory requirements is taken care of by the internal lining process. The monitoring requirements for the cathodic protection system are the same as for the standalone cathodic protection. The longterm financial benefit of choosing this option comes from not having to inspect the internal lining at 10 years and every 5 years thereafter.

Internal lining and cathodic protection have both been around for a long time, and there are many existing tanks where one of these upgrading techniques has already been applied. Some questions have arisen about regulatory requirements in the case where lining is added to a tank that had cathodic protection installed some time ago or where cathodic protection is added to a system where the tank was lined some time ago. A recent memorandum from Lisa Lund, Acting Director of OUST, to Regional Program Managers ("Technical Interpretation and Guidance Regarding the Combination of Cathodic Protection and Internal Lining," dated December 4, 1995) clarifies the structural assessment and monitoring requirements for these specific cases.

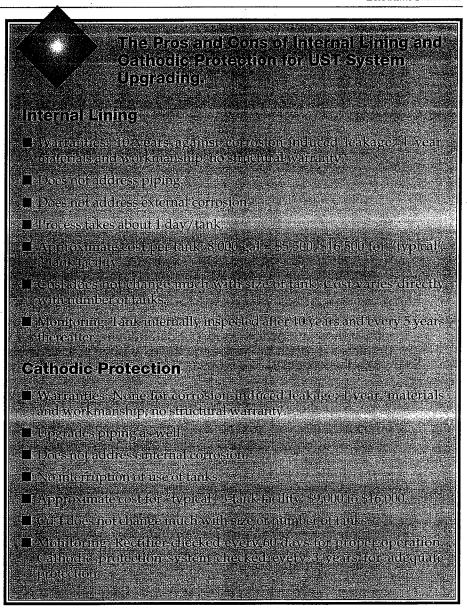
In brief, the memo states that when lining is added to a tank with previously installed cathodic protection, the structural assessment requirement is met by the preparatory phases of the lining procedure. The monitoring requirements are met by conducting the cathodic protection monitoring, with no additional requirement for periodic internal inspection of the tank.

For the case where cathodic protection is added to a tank with previously installed internal lining, a structural assessment (which may consist of an internal inspection or one of the ASTM methods described above) immediately prior to the addition of the cathodic protection is required in order to avoid the periodic internal inspection (10 years and every 5 years thereafter) required if the lining is used alone. Cathodic protection added to a lined tank without the benefit of a structural assessment at the time of adding the cathodic protection would require that periodic inspections of the lining still be conducted. The monitoring of the cathodic protection system is required under all circumstances.

#### What Does It Cost?

Now that we've attempted to shed light on your upgrade options, what do they cost? Well, numbers are going to vary across the country, but average numbers run about like this:

- Lining of an 8,000-gallon tank runs about \$5,500 per tank, or about \$16,500 for a three-tank facility. The cost varies slightly, depending on the size of the tank. The cost figure cited here includes structural assessment, but it does not upgrade any metallic piping. The secondary containment option mentioned above costs more—about \$13,000 for an 8,000-gallon tank.
- Impressed current cathodic protection (including structural assessment) will run from \$9,000 to about \$16,000 for an "average" three-tank (8,000 gallons) facility. This cost includes protecting both tanks and metallic piping at the facility. The lower price includes a very simple rectifier, inexpensive anodes, and a bare bones wiring system. The higher price will buy



a more efficient and sophisticated rectifier that automatically adjusts to changing site conditions (e.g., rainy versus dry seasons), has longer lasting anodes, and a more reliable wiring system. It may also include remote communications so that the required monitoring can be conducted from the corrosion engineer's desktop computer.

Remember, these numbers are generic, so be sure to check with local contractors to see what it will really cost you. Look in the yellow pages of your phone book under "tank lining" or "corrosion control" to see who does this type of work in your area, or call NACE at (713) 492-0535 for a listing of contractors.

There is another factor to consider when calculating costs. Keep in mind that tank owners and operators are required to have some form of "financial responsibility" to ensure

that any contamination from the storage system can be cleaned up. Many states have set up cleanup funds to help meet this requirement. In time, however, some of these funds will phase out with the idea that after '98, UST systems should be in good enough shape for the private insurance market to take over the costs of cleaning up contamination.

In the insurance industry, premiums paid by tank owners reflect environmental risks. Insurance companies are likely to charge higher premiums for storage systems that have been upgraded, as opposed to those that have been replaced with brand new systems. If you are planning on keeping that upgraded tank in the ground for a while, it may be worth investigating your long term insurance costs to see if upgrading is really the most cost-effective way for you to do business.

# Cathoole Protection Complance Checklist

#### TO BE IN COMPLIANCE, ALL APPLICABLE REQUIREMENTS MUST BE MET

Cathodic protection is a method of protecting buried steel from corrosion.

The method may be used to protect tanks and piping.

The f	ollowing are requirements for all cathodic protection systems:
	QUALIFIED PERSON CONDUCTS MONITORING  Monitoring of cathodic protection systems is necessary to determine that the corrosion protection system is meeting design specifications. For galvanic cathodic protection systems (the sti-P3® tank uses this form of cathodic protection), determining that the voltage of the tank or pipe that is cathodically protected relative to copper is greater than .85 volts is a way of being sure that the cathodic protection is working. For impressed current cathodic protection systems, a similar measurement is used, but determination of whether the tank or piping is adequately protected is made by comparing the difference in voltage between times when the rectifier is on and when it is turned off.
	MONITORING CONDUCTED INITIALLY WITHIN SIX MONTHS OF INSTALLATION. In most instances, the monitoring should be conducted immediately upon installation of the cathodic protection. Six months is allowed because there are circumstances (very dry soils, for example) where it may take some time for the cathodic protection to be fully effective.
	MONITORING CONDUCTED EVERY THREE YEARS AFTER INITIAL MONITORING.  Monitoring performed after the initial monitoring should be done at 36 month intervals.
	MONITORING CONDUCTED WITHIN SIX MONTHS OF ANY REPAIRS TO STORAGE SYSTEM.  Construction or repair activities may accidentally interfere with cathodic protection systems. It is important to be sure the cathodic protection is working after any work that disturbs any portion of the storage system is completed.
	RECORDS ON FILE OF LAST TWO MONITORING RESULTS.  Records may be kept at a central office rather than the facility itself. Although regulations only require that the last two monitoring results be kept, keeping these records indefinitely will greatly facilitate trouble-shooting of the system should anything ever go wrong.
The f	ollowing are requirements for impressed current cathodic protection systems only:
	SYSTEM VOLTAGE AND AMPERAGE READINGS RECORDED EVERY 60 DAYS. Impressed current systems tap into the facility's electrical supply to provide cathodic protection. The amount of electricity being used must be monitored to ensure that the system is working properly. With a few minutes instruction from the person who designed the system, the facility manager should be able to perform this monitoring.
	RECORDS ON FILE OF LAST THREE VOLTAGE AND AMPERAGE READINGS. Records may be kept at a central office rather than the facility itself. Although regulations only require that the last three readings be kept, keeping these records indefinitely will greatly facilitate trouble-shooting of the system should anything ever go wrong.
	CATHODIC PROTECTION SYSTEM DESIGNED BY A CORROSION EXPERT. Impressed current systems are tricky and can damage a storage system rather than protect it if they are not properly designed. They must be designed by a knowledgeable person.
Prenar	ed by Marcel Moreau

# Storage System Upgrading Compliance Checklist

By December 22, 1998, all storage systems must be closed unless they meet regulatory requirements. There are three categories of standards that must be met: corrosion protection, spill containment, and overfill prevention. Refer to the EPA booklet "Don't Wait Until 1998 - Spill, Overfill, and Corrosion Protection for Underground Storage Tanks" for more details on these requirements.

CUK	ROSION PROTECTION				
To AD	D CATHODIC PROTECTION TO A TANK:				
	Cathodic protection system must be designed by a qualified corrosion engineer. And,				
One	of the following four items is required:				
If the	e tank is less than ten years old:				
	the tank must use automatic tank gauging, soil vapor monitoring, groundwater monitoring, interstitial monitoring, or statistical inventory reconciliation for leak detection after the addition of the impressed current cathodic protection. Note that this list does NOT include inventory control or manual tank gauging. Or,				
	the tank must be tested for tightness prior to installing the cathodic protection and between three and six months following the first operation of the cathodic protection. Or,				
If the	If the tank is ten years old or older:				
	the tank must be assessed and found to be structurally sound and free of corrosion holes before cathodic protection is added. Or,				
	in addition to cathodic protection, the tank must also be internally lined as specified in the rules.				
To ad	D CATHODIC PROTECTION TO PIPING:				
	Cathodic protection system must be designed by a qualified corrosion engineer. And,				
	The work must be done according to nationally recognized standards. No assessment of the condition of the piping is required; there are no age requirements for the piping. E: Once cathodic protection is installed, the requirements listed in the cathodic protection compliance checknust be followed.				
To ad	D INTERIOR LINING TO A TANK:				
	The work must be done according to nationally recognized standards. And,				
	Within 10 years after the lining is installed and every five years thereafter, the tank must be internally inspected to evaluate the structural soundness of the tank and the condition of the liner.				
To ad	To add both cathodic protection and interior lining to a tank:				
	Cathodic protection system must be designed by a qualified corrosion engineer. And,				
	The work must be done according to nationally recognized standards. There is no requirement for periodic inspection of the lining after ten years, but cathodic protection monitoring (see Cathodic Protection Compliance Checklist) must be performed.				
SPILL CONTAINMENT					
TO ADI	O SPILL CONTAINMENT TO A TANK:				
	A liquid-tight "bucket" or "spill containment manhole" must be installed around the fill pipe to contain small drips and spills that may occur when the delivery hose is disconnected. There are no size or capacity requirements for the spill containment manhole.				
OVE	RFILL PREVENTION				
TO ADI	OVERFILL PREVENTION TO A TANK, ONE OF THE FOLLOWING MUST BE INSTALLED:				
	A device that shuts-off the flow of product into the tank. These are usually installed in the fill pipe and are often called "flapper" valves.				
	A device that restricts the flow of product into the tank. These are usually installed in the tank vent line and are typically called "float vent valves" or "ball float valves".				
	A high level alarm that alerts the operator. These are typically added to automatic tank gauges. The delivery person must be able to hear the alarm.				
	E: Spill containment and overfill prevention devices are not required when the tank is filled by transfers of no that the tank is filled by transfers of not that 25 gallons at one time.				
Prepa	red by Marcel Moreau.				

#### **Leak Prevention**

#### Letters From Our Readers

We received the following letter from Dr. Warren F. Rogers in response to two articles we published in LUSTLine Bulletin #22 on Statistical Inventory Reconciliation (SIR): "Laying Down the Law on SIR," by Marcel Moreau, and "A Regulator's Concerns With SIR," by Lamar Bradley. Dr. Rogers, who might aptly be dubbed the "father of SIR," is president of Warren Rogers Associates, Inc., a statistical consulting and tank management firm in Rhode Island. In 1979, he was principal investigator for a study of UST failures commissioned by the American Petroleum Institute. As a result of this work, he developed the first reliable procedure for estimating the expected life of bare steel tank systems. In 1981, his firm developed and implemented a procedure—Statistical Inventory Reconciliation Analysis for UST Monitoring—which conforms with EPA leak detection requirements.

# Fear and Trembling in SIR-Land

It may very well be that Marcel Moreau and Lamar Bradley have greater insights into the minds and psyches of UST regulators than I do. Nonetheless, I find their comments as to the reactions of such people to SIR startling to say the least.

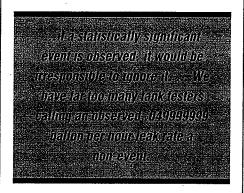
Marcel: "There is no UST leak detection method that provokes more confusion, controversy, curiosity and incredulity..."

Lamar: "...skepticism, fear, confusion, anger, curiosity..."

I have lectured extensively on the subject of SIR since I first developed the method in 1981. I have also provided testimony based on SIR results on numerous occasions in both state and federal courts. I cannot ever recall encountering the gamut of emotions these authors describe. Curiosity, yes, perhaps some initial confusion before the method is fully explained, but anger, fear, incredulity? No, that has not been my experience, even when I lectured in the states of Maine and Tennessee.

Having said all that, however, I must admit that to the extent such emotional reactions exist, Marcel and Lamar have probably gone a long way toward allaying them in what are two remarkably well written, clear, and largely correct articles on the subject of SIR. I find very little to disagree with in either article. To the extent that I do, my disagreement is more in matters of emphasis than content.

It is gratifying that both authors endorse the necessity for computing and reporting minimum detectable leak rates. That requirement had always seemed so trivially obvious to me that I was astonished when EPA did not require it and, in fact, endorsed a SIR evaluation protocol which did not address it.



Marcel refers to the EPA SIR evaluation protocol as "a dud." He is too kind. At the time of its publication, I submitted an extensive critique pointing out what to me were obvious flaws in the protocol. At the time, and for some considerable time thereafter, my comments were dismissed as either harmless eccentricities or as self-serving pleading for a particular proprietary technology on my part. So was my insistence that in the absence of minimum detectable leak calculations, SIR results were meaningless, which is true of all other means of leak detection as well.

The fact is, there is nothing in any way mysterious about SIR. As I developed it, though not necessarily as some choose to practice it, SIR is a straightforward application of standard mathematical statistics. "Minimum detectable leak" is what is referred to in the literature as a "P value". A P value is the magnitude of a difference, in this case from zero, at which such difference would be declared to be statistically significant.

Marcel and Lamar choose to differ on the application of minimum detectable leak rate. Lamar, while acknowledging that leak rates smaller than a performance standard (i.e., .2 gph) may prove to be statistically significant, nonetheless argues that the use of a variable threshold determined by data quality may be unduly confusing to regulators. I think the use of a variable threshold presents more of a conundrum than confusion, because using a variable threshold lays open the issue that a monthly monitoring procedure may, under certain circumstances, be more sensitive than the final test, (i.e., a tightness test) which would serve to confirm the suspected release. However, if a statistically significant event is observed, it would be irresponsible to ignore it. To mandate otherwise would be to contribute to the further dumbing down of a population which already needs to elevate its intellectual sights somewhat above the kindergarten level. We have far too many tank testers calling an observed .049999999 gallon per hour leak rate a non-event.

Both authors clearly understand and articulate the concept of minimum detectable leak very well. However, they do not take the concept to its logical conclusion. If minimum detectable leak is computed

correctly whenever data are analyzed, then tank size, throughput, manifolding, and other such considerations should be irrelevant. What matters is whether a leak rate of an acceptably small magnitude would have been detected if, in fact, it existed, regardless of the tank configuration.

Requiring inclusion of larger tanks or throughput in the certification process will not result in more reliable certification results, because the current process does not require the calculation of minimum detectable leak by either the applicant or the certifier. This essential component is completely ignored. Even worse, under the current system, an applicant who reported correctly that the data were such that minimum detectable leak exceeded compliance would be standards penalized for doing so.

The same reasoning applies in determining the quantity of data required for analysis. The quantity of data should be sufficient to generate an acceptable minimum detectable leak, but the frequency of analysis should be such as to ensure detection of emergent leaks in an acceptable time. If appropriate statistical methods are applied to the data typical of most responsible operators, thirty observations over a thirty-day period are more than adequate in both regards.

If, as Marcel states, some SIR providers require data gathered over longer periods and are certified accordingly, then they are not doing monthly monitoring. This is clear evidence of statistical incompetence, though not for the reason Marcel cites. If the methods of analysis are so insensitive as to require unduly extended time to identify leakage, even when the leakage existed from the outset of the data, it would clearly be impossible to identify those which emerge during the period covered by the data.

When I first developed SIR, I made two assumptions, one of which proved partially justified, the other entirely unjustified. I assumed that statistical methods could be understood in sufficient detail to make SIR understandable if clearly explained. That proved to be correct, but only to those who chose to listen. I also assumed, however, that others who

chose to engage in this endeavor would have some minimal level of statistical training. That proved to be totally incorrect. A properly conceived evaluation protocol could have ensured this, but that, unfortunately, was not produced.

In that regard, however, and in our coverage of this topic, we should perhaps broaden our focus to examine other means of leak detection and the protocols used to evaluate them. Several of the protocol I have examined are as flawed and, in come cases more so, than the SIR protocol. As Marcel states, we should have a level playing field.

SIR, properly executed, is an extremely powerful leak detection tool. It has unique capabilities not shared by any of the alternatives. They are:

- It tests the entire system including parts not accessible to other approaches, for example, in the dispenser housing.
- It is replicable. The data are available for re-analysis.
- It explicitly documents the sensitivity of every test conducted by deriving the minimum detectable leak rate.
- It requires the operator to behave responsibly in maintaining inventory data of sufficient quality to permit analysis that meets regulatory standards and informs him when he has failed to do so. It also provides him with the steps necessary to rectify his data problems if he has them.

Lamar is troubled that some regulators may view SIR as overly abstract. Admittedly SIR lacks the superficially reassuring concrete presence of a tester's van on the site or a black box on the wall, and therein may lie the source of the fear and trembling among his colleagues.

My counter to Lamar's fear would be that regulators and, indeed, operators are at considerably greater risk from an emotion, which I fear, is more common than those to which Lamar and Marcel allude. I refer to the euphoria induced by the presence of such concrete devices when there is substantial empirical evidence that they may be incapable of detecting leaks.

# New EPA Publication on SIR

EPA's Office of Underground Storage Tanks (OUST) has prepared a short booklet, Introduction to Statistical Inventory Reconciliation for Underground Storage Tanks, for UST owners and operators. The booklet provides basic information on the leak detection methodwhat it is, how it works, facthat impact data quality—to assist UST owners and operators in determining if SIR is appropriate to their needs. Even those already using SIR will find the booklet provides useful information on a variety of topics, including what to look for in the SIR vendor's monthly analyses, how to respond to the vendor's monthly reports, and meeting recordkeeping requirements. The booklet also provides a section on 'answers to frequently asked questions."

Introduction to SIR is the latest in OUST's series of publications on leak detection methods, which includes Doing Inventory Control Right and Manual Tank Gauging. To order copies of Introduction to SIR (EPA-510-B-95-009),

contact EPA's RCRA/Superfund Hotline at (800) 424-9346; for orders of more than 30, contact Jay Evans at (703) 308-8888. The booklet is also available on CLU-IN, in Directory (EPA/OUST Publications) as the file called "SIRWORD.EXE."

#### **Leak Prevention**

# Tanks Down East

by W. David McCaskill

David McCaskill is a petroleum storage specialist with the Maine Department of Environmental Protection. **Tanks Down East** is a regular feature of LUSTLine. As always, we welcome your comments.

# Picky, Picky, Picky

Contractor Bids Should be Apples to Apples and Crystal Clear

In the last installment of *Tanks Down East* ("How to Pick 'Em"), I attempted to impart some hard-learned wisdom on how to locate ethical and competent installers. Now that you've found some potential installers who are certified (if your state has a certification program), qualified, properly trained, and insured, it's time to discuss what you want your contractor to install, the kind of work you expect, and how to communicate all of this to potential contractors so that their bids reflect your requirements. This can be accomplished by providing each of the bidders with a pre-bid checklist which lists the requirements each must take into account in preparing his or her proposals.

I've seen contractor bids that contain little more information than the flavor of the tanks and piping, a list of basic equipment, and a lump sum labor cost. But a good bid agreement should include more than just the current fashion in tanks and piping; it should also include requirements for proper installation procedures, specifications for proven and hasslefree spill/overfill/leak detection equipment, and site-specific details.

Needless to say, in order to clearly spell out your pre-installation, hardware selection, installation, and post-installation requirements, you must have a basic understanding of petroleum equipment and construction requirements—which calls for some serious homework on your part. (The Petroleum Equipment Institute's Recommended Practices for Installation of Underground Liquid Storage Systems (PEI/RP100-94) is a great place to start.)

Now you may say, "Whoa, that's a lot of work and overkill, to boot!" But consider this, if you don't get the job done properly to begin with, you may end up spending extra money and/or not be happy with the results when all's said and done. I've heard enough stories about settling pavement, cracking concrete, inoperative or ineffective leak detection, inaccurate or improperly calibrated tank gauges, leaking systems from day 1, spill containment manholes filled with water...to write a book. In other words, "A stitch in time saves nine."

To give you a "leg up" in setting up your pre-bid requirements, I, with the help of some of Maine's stellar installers, have prepared some of the top questions that you should ask prospective contractors, as well as yourself, prior to signing a contract. Many of these items should be very familiar to the contractors; hence, they should have no problem discussing the importance of these items with you—if they stumble, beware. But note, this list is aimed primarily at installations using secondary containment, so if you are contemplating other alternatives, you are on your own.

# A Pre-Bid Checklist for UST Installation

#### **Pre-Installation**

- **Permits** Who is responsible for securing all state and local permits? Some towns and counties require permits. All permits should be posted prominently at the job site.
- Underground Utility Checks Is it safe to dig? Will utilities need to be re-routed? One of Maine's well known outdoor equipment mail order retailers lost its telephone service for several hours because of tank-related utility damage.
- Shoring Evaluation Are the soils unstable? If they are, expensive shoring may be needed to protect workers and/or any adjacent buildings. Shoring expenses are not something you want to find out about in mid-excavation.
- **Backfill Specification** Require the contractor to provide written documentation ensuring that the backfill material meets both tank and piping manufacturer's specifications.
- Tank Anchoring The excavation must be evaluated for tank anchoring. Unless it doesn't rain where you are, you should always anchor. Also require documentation that anchoring meets manufacturer's specifications or that "float out" calculations, which can be found in PEI/RP-100, have been made.
- Material Storage and Inspection - The contractor should determine an on-site location,

convenient to you and your customers, where materials can be safely stored and inspected.

• Health and Safety Plan - This plan must be included to protect the contractor's employees, you, and your customers from physical and chemical hazards (e.g., traffic, slips, trips and falls, chemical exposure).

#### **Hardware Selection**

- User-Friendly Spill Buckets -Many contractors install grade-level spill buckets that are raised up slightly from the pad to keep surface water out; however, water often gets in there anyway. When there is water in the spill bucket, and when delivery drivers drain their hoses and accidentally spill oil into the bucket, you end up with an oil/water mixture which must be disposed of properly. If this cycle continues, you end up with an ongoing maintenance cost. There are below-grade spill containment buckets that allow water to drain away from the fill pipe. They are more expensive but more effective in keeping water out of the bucket.
- **Proper Overfill Devices** Specify drop tube shut-off devices for gravity delivery or high level alarms for pressure delivery (heating oil) rather than less effective ball-float valves. (See *LUSTLine* Bulletin #21.)
- Water-Tight Containment Sumps These piping sumps are more expensive, but they eliminate water management and possible oil/water mixture disposal costs.
- Manageable Manway Covers Decide whether you prefer heavy, tamper-resistant manway covers, if vandalism is a problem, or more manageable, light weight fiberglass covers, if monthly self-inspections are planned. All covers should be properly marked, especially monitoring well covers. (See LUSTLine Bulletin #19.)
- **U.L.-Listed Piping -** Be sure all your piping has a U.L. label on it.
- **Piping Flexibility** Flexibility is inherit in new "soft piping"; however, rigid piping systems, such as fiberglass, should have flexibility built in where the piping connects to the tanks and dispensers, otherwise frost movement or vehicle damage to the dispensers may crack the pipe. For fiberglass, flexibility is usually



accomplished by using a flexible connector which consists of a hose with stainless steel fittings and a stainless steel mesh that protects the hose. Buried flexible connectors must be protected from corrosion by using cathodic protection or isolation boots; exposed connectors should be U.L. listed for non-buried use. In Maine, leaving isolation boots out of the bid has made the difference between a contractor's winning and not winning a bid. Swing joints are no longer used to provide flexible joints in steel piping or any other piping.

#### **Installation Procedures**

- Photographic Documentation Require that the contractor make photographic documentation of all major aspects of the installation, including tank testing, backfilling, piping layout, and testing. These pictures should be labeled, and copies should be turned over to you at the end of the job. Most good installers keep a picture file of all their jobs.
- Manufacturer's Checklist Most tank manufacturers require that their checklists be completed to ensure proper pre-installation air/vacuum testing, handling, and backfilling. Checklists should be sent to the manufacturers for warranty validation. One of the most important phases of tank installation is the placement and compaction of the first couple of lifts, or layers, of backfill under the tank. In addition, the manufacturers of fiberglass tanks require that high in groundwater conditions, excavation be lined with filter fabric prior to tank placement and backfilling. Filter fabric prevents finer soils from washing into and displacing specified backfill, which could lead to tank wall flexing (which has been observed here in Maine) and possible tank failure.

- Continuous Piping Air Test Maintain an air test on all piping after installation and during the completion of site construction. Air testing will alert installers to any physical piping damage (e.g., grade stakes driven into piping) that may occur for the duration of construction activity.
- Accessible Equipment Leak detection probes and overfill devices must be readily accessible for maintenance and testing.
- Visible and/or Audible Alarms -All leak and overfill alarms should be located where they can be heard or seen readily by facility attendants.
- Properly Anchored Crash **Valves -** Pressurized pumping systems are required to have crash valves anchored to the concrete pump island at the base of the dispenser to protect the dispenser from direct vehicle impact. Crash valves are designed so that the top of the valve breaks away while a shut-off poppet valve in the base stops the flow of product. The newer crash valves with two poppets reduce spillage, in case of an accident, to a few tablespoons or less. Make sure that these crash valves are firmly anchored and operational.
- Hose Break-Away Devices -These devices should be installed on all hoses to protect your dispensers, as well as to prevent spillage. Occasionally a forgetful motorist will drive away from the fuel island with the nozzle still in his or her gas tank, pulling the dispenser off the island and severing the piping in the process. While the notion of a car with a gasoline dispenser in tow has its humorous side (to someone other than the station owner), remember, the submerged gas pump in the UST is still pumping product through the line. Break-away connectors in the nozzle hoses are designed to break away and seal off the flow of product before the dispenser is pulled off its base. Be sure the devices are installed with a short length of hose between the dispenser and the break away.
- Pump Island Apron and Paving Make sure that the concrete apron or pad around the existing pump island is included in your bid list. Although they are not directly related to a

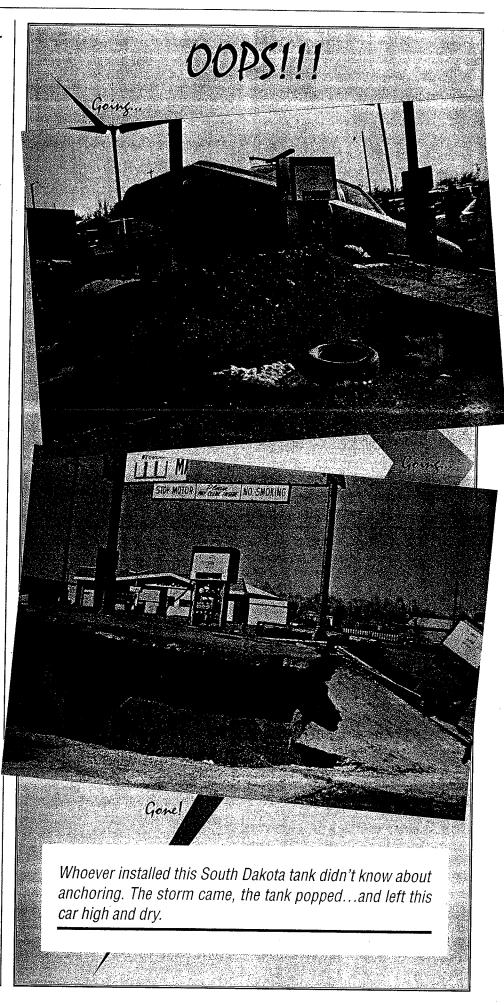
**■** continued on page 16

#### ■ Tanks Down East from page 15

properly operating UST system, the pad and paving can become a point of contention between owners and contractors. The amount of post-construction paving necessary is variable because it is often dependent upon the amount of contaminated soil that is removed from the site. Many contractors leave paving out of the bid or include it as a non-bid add-on.

#### **Post Installation Procedures**

- Landscaping Unless you specify sod, trees, and bushes that you want replaced, they will not show up in the bid price.
- **Site Cleanup** Cleanup after construction should go without saying, but you must play it safe and make sure you include cleanup in your bid.
- **As-Built Drawings** These drawings should include items such as the location of buried tanks, piping, electrical conduits, and leak detection sensors, as well as the locations of instrument panels, junction boxes, and alarms.
- Manufacturer's Warranties Make sure that the contractor provides all necessary warranty documentation and requirements.
- Operation/Maintenance Plan and Owner Training - The contractor should supply you with written information, such as checklists on how to operate, inspect, and maintain the new equipment. Be sure you get the manufacturers' instruction manuals for all your leak detection equipment.
- Final Punch List and Walk-Over - Require the contractor to provide a "punch list" of construction items that both of you can use to determine that the job has been completed properly during the final site walk-over.
- Installer Certification of Installation Federal rule requires that the owner certify that the installation has been done properly. Play it smart, and pass this responsibility on to your installer by requiring him to certify that all regulatory requirements have been met and that all manufacturers' recommendations have been followed.



# Field Notes 2

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

#### **Aboveground Storage Tank Book Reviews**

I istorically, petroleum products at service stations and other motor vehicle fueling sites have been stored in underground tanks. In response to environmental concerns and emerging technology, however, a trend toward the installation of aboveground storage tanks (ASTs) has evolved over the last 7 years. In fact, some industry experts believe the number of ASTs in service in the United States will soon exceed the number of USTs.

As the number of ASTs increases, so does the number of publications on the subject. There are two recently released publications dealing with the subject of aboveground storage tanks that I believe should be in the reference library of companies involved with ASTs. Let me say up front that I have a natural and admitted bias toward the one published by the organization that pays my salary. Thus, in an effort to achieve balance, I have chosen to begin by reviewing the publication with which PEI had very little involvement.

The Aboveground Steel Storage Tank Handbook, written by Brian D. DiGrado and Gregory A. Thorp, contains information on both field-erected and shop-built ASTs. This 350-page book, written in easy-to-understand language, is divided into four sections: the AST market, regulations, standards, and products.

The AST market section provides an overview of the aboveground steel storage tank market by analyzing the statistics related to the industry. The authors cite different surveys and studies that suggest the total AST population is somewhere between 950,000 and 1,100,000 tanks,

The regulations section of the book discusses the major federal regulations governing ASTs, including the Clean Water Act, the Clean Air Act, the Resource Conservation and Recovery Act (RCRA), and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Occupational Safety and Health Administration (OSHA) rules and fire code guidelines relating to ASTs are also fully reviewed.

The AST manufacturing and fabricating standards section of the book reviews five standards and two recommended practices published by the American Petroleum Institute, national design standards of field-erected tanks published by the American Water Works Association and the American Society of Mechanical Engineers Pressure Vessels, two standards for shop-built ASTs by Underwriters Laboratories, and four publications of the Steel Tank Institute.

The final section on products deals with new and existing field-erected ASTs; shop-built ASTs; and

installation instructions for shop-built ASTs. The book also contains seven useful appendices on various topics and a glossary of industry acronyms and abbreviations.

To me, the primary appeal of *The Aboveground Steel Storage Tank Handbook* is that it contains most everything the majority of us need to know about ASTs. Unfortunately, the book has a limited shelf life because the rules, codes, regulations, and products mentioned in the publication are so dynamic. The book is published by Van Nostrand Reinhold, New York City, and is available at scientific and technical bookstores nationwide.

The Petroleum Equipment Institute's Recommended Practices for Installation of Aboveground Storage Systems for Motor Vehicle Fueling (PEI/RP200-96), has been revised and is now available to firms and individuals interested in the preferred practices and procedures for installing aboveground storage systems at refueling sites.

The 37-page manual, written in response to the environmental considerations and emerging technology that have prompted the industry to use ASTs for motor fuels, covers only stationary, shop-fabricated tanks used at commercial and retail service stations and marinas. Both horizontal and vertical aboveground storage tanks are addressed.

Recommended Practices... contains chapters and drawings on all phases of proper AST installation, including site planning, foundations, support and anchorage, dikes, vaults and special enclosures, tanks, pumps and valves, fills, gauges and vents, pipe and fittings, corrosion protection, environmental protection, electrical installation, and testing. In addition, Recommended Practices... contains appendices describing size calculations for dikes and venting, fire code requirements, and documents used for reference.

Work on this particular revision began last summer when PEI solicited comments to the original *Recommended Practices*, PEI/RP200-92. Material was submitted by PEI members, oil company engineers, regulators, and oil marketing trade associations. In all, over 70 comments were received and reviewed by PEI's Aboveground Storage Tank Committee. As a result of both the comments and the committee's own action, changes were made to over a sixth of the document's 143 sections and half of its figures.

Copies of PEI/RP200-96 are available for \$15 (includes shipping and handling. Contact PEI, P.O. Box 2380, Tulsa, Oklahoma 74101. Phone: (918) 494-9696. Fax: (918) 491-9895. ■

#### State Funds

# State Funds: A Bumpy Road

**T**ho knew-when state legislatures, one after another, set in motion the "cleanup fund" phenomenon-what the reality of such an undertaking would be? The funds began around the turn of the decade as formless answers to anxious prayers. They were the last best hope for tank owners who couldn't get or couldn't afford insurance, couldn't pay for cleanups, and essentially, had no means for complying with federal financial responsibility requirements. They were the last best hope for getting contaminated sites cleaned up. The state cleanup funds took off like riderless horses set loose in the prairie. They were off-with or without clear goals-on missions that had no precedent. The funds had to become...Something.

It didn't take long before many of the nation's 46 state fund programs galloped headlong into thorny terrain. Some of the funds were underfunded to begin with. Many of the funds were left in the dust by runaway claim reimbursements. Some hemorrhaged internally. To stop the bleeding, many applied cost controls, streamlined their reimbursement processes, and revisited their basic corrective action assumptions and processes. Some programs shifted into corrective measures early enough to avoid serious setbacks. A few needed major transfusions. And, yes, some funds are doing just fine, thank you.

The state funds are not alone: They've organized a task force through ASTSWMO. They, in conjunction with EPA's Office of Underground Storage Tanks, hold an annual state fund administrators conference. Conference participants talk of political uncertainty, cost control, risk-based corrective action, solvency, fraud detection and prevention, claims tracking, the future of their funds. They share a determination to make their funds work.

#### **Funds in Transition**

One truly unique aspect of many state funds is that they are temporal; set up to fill a "temporary" insurance gap. As the tank universe forswears its foolish ways and reduces its risk factors, state funds, at least in their current incarnation, may want to think in terms of whether or not they will need to make a transition. If change is inevitable, state fund programs will need to decide how they will make their transitions—whether they get out of the business altogether, phase themselves out, or plan for a long-term fund. The state fund administrators took up this theme, "Funds in Transition," last June at their annual meeting in Colorado Springs.

Lisa Lund, Acting Director of the EPA Office of Underground Storage Tanks, asked conference participants to consider the "big picture" as they continue to shape their funds. "Know where it's [the fund] going and what it's supposed to do," she said. "This message should be clear, not only to fund staff, but also to the stakeholders, or vested interests. When stakeholders and fund administrators work together to build effective fund programs, state legislatures are more likely to support recommendations for change."

Lund reminded the group that the funds exist because of the regulations. "State funds must further regulatory goals, not impede them," she said. "Make sure the funds and the regulations work together to move corrective action forward. Tie the funds to the '98 deadline so that both purposes are well served."

#### Oh No, the '98 Deadline!

State funds that haven't considered their programs in context of the 1998 deadline for compliance with corrosion protection and spill and overfill requirements could be in for a rude awakening 'round about December 1998. Just as a lot of people wait until the last minute to do their Christmas shopping, a lot of tank owners, unless motivated to take another tack, will wait until the last minute to upgrade their tanks.

How will owner/operator procrastination impact state funds? As everyone knows, most leaks are disWhen Statemonters and fund antimustrators work together of public Educative fund programs, state depistatores are more likely to support recommendations togetheries.

covered during replacement or closure, when tanks are removed. If, in response to the '98 deadline, tank owners choose to replace or close their tanks, and if they discover that they need to take corrective action at the eleventh hour, state cleanup funds will be expected to cough up a significant chunk of change all at once. Such a run on funds could cause healthy funds to teeter and lesser funds to fall.

State fund administrators can either sweat beads of apprehension and let fate play its hand, or they can take proactive precautions such as:

- Encourage tank owners and operators to upgrade early;
- Ensure that the risk-based corrective action (RBCA) process is up and running before '98;
- Strengthen the financial position of the fund in anticipation of high demand; and
- Tighten up cost control measures that will curtail unnecessary expenses associated with cleanup work.

It's been a bumpy road for state funds and the trip isn't over, but, like we said, there's a lot of folks out there who want to make them work. The Texas Petroleum Storage Tank Remediation Fund ran into some tough times. In getting the fund back on its feet, the Texas Natural Resource Conservation Commission, the stakeholders, and the legislature took the big picture approach that had been missing when the fund was instituted. The '98 deadline now plays a key role in the grand scheme. Check out what happened in the Lone Star State in the following story.



#### State Funds

# The Lone Star State Reins-In A Runaway Cleanup Fund

**Program Tied to EPA's '98 Deadline** 

#### Part 1 - Stakeholders and Regulators Rally Round the Fund

by Scott Fisher and Dan Neal

n 1992, it became painfully obvious that Texas' Petroleum Storage -Tank Remediation (PSTR) Fund was in deep trouble. In the short term, there were many unpaid bills: incoming reimbursement claims of approximately \$170 million had exceeded the fund's annual income by a factor of three. In the long term, the fund was underfunded. The Texas Natural Resource Conservation Commission (TNRCC), the state legislature, the regulated community, and other interests, or stakeholders, all agreed that the system was broken and needed to be fixed.

Such a fix clearly meant changing the legislation governing the fund. However, as one can imagine, initiating legislative change does not happen overnight; several factors come into play. First, the Texas Legislature meets biennially, in odd-numbered years. Thus, nothing could be done legislatively until 1993. Second, the majority of the stakeholders had to be convinced to support the change. Finally, and most importantly, the Governor and members of the legislature had to agree that the change is warranted.

During the 1993 legislative session, however, the "fund fix" movement presented itself as a disjointed force; the various stakeholders came up with their own unique solutions to the problem. In view of this apparent discord, the legislators deemed it prudent to study the issue themselves and make their own determination at a later date. At the same time, in an attempt to eliminate the existing fund obligations, the legislature applied a temporary fix or "band-aid" to the problem in the form of a cash infusion—a \$120 million loan to the TNRCC. At the close of the legislative session, the Lt. Governor and the Speaker of the House

established a Joint Interim
Legislative Committee to
evaluate the storage tank
program and provide a
report that identified
problems and potential
solutions.

steps to slow

# TNRCC Takes It's Bull by the Horns

On a parallel track, the TNRCC began an internal analysis of the problem to determine what administrative actions could be taken. It didn't take long for the agency to determine that the funding issue was symptomatic of a much larger problem. The underlying cause of the fund's shortfall was the corrective action side of the program, which was issuing directives on leaking storage tank sites, one and all, with little regard to cost. Somehow or other, common sense, which dictates that you need to know how much your directives cost so that you can operate within your means, had been missing from the big picture.

The TNRCC quickly implemented two measures to provide relief to the problem, in the short run. First, they implemented a process by rule, whereby all corrective action activities must be preapproved to be eligible for reimbursement. Preapproval allows the TNRCC to budget limited reimbursement dollars. Second, they took

down corrective action activities at all but high priority sites. Both measures were put into effect in late 1992 and early 1993. The slowdown of cleanup activities not only had a dramatic impact on the number and amount of reimbursement requests, it also gave the TNRCC time to reevaluate the corrective action program and implement needed changes.

# The Lone Star State is Not Alone

As part of its research, the Joint Interim Committee held hearings to seek input from the regulated community as to how they viewed the problem. The committee also collected information from the TNRCC and sent a committee staff member to the annual State Fund Administrators Conference in June 1994. At that conference, the staff members discovered that Texas' problems were not unique. As many in the business have discovered, state funds may differ from state to state, but they share many of the same problems.

As a result of this concerted effort to understand the fund conun-

■ continued on page 20

#### ■ Texas CLeanup Fund from page 19

drum, the TNRCC, Joint Interim Committee, and the regulated community realized how large and complex the leaking petroleum storage tank program is. Furthermore, it was overwhelmingly evident that the PSTR Fund did not have a sufficient funding source to underwrite cleanups as they were currently being managed.

#### Solidarity

The first hurdle to realizing the legislative changes necessary to revitalize the fund was convincing the legislature during the 1995 legislative session that the TNRCC had indeed implemented the changes necessary to correct the problems that had plagued the program. While these changes had been made back in 1993, the legislature had to be convinced that the changes would prevent the fund from being misused and that the administrating agency had control of expenditures.

This point was successfully

argued throughout the debate by industry representatives—yes, industry representatives! It is one thing for a government bureaucracy to say, "We've corrected our mistakes!" It is quite another to have the industry affected by the changes say, "The agency has made the necessary changes, and we believe the problems have been resolved."

Another key element to the successful passage of a bill that would double the existing bulk delivery fee was to bring everyone affected to the table and convince them that raising the fee was in their best interest. This was done by forming a coalition of trade and professional associations that represented tank owners. Each group was asked to "sign on" early in the process to alleviate any internal disagreement amongst the groups. The fund fix movement now had a unified voice.

The last, but perhaps most important, ingredient for success was to make the effort totally bi-partisan. This step, which was accomplished by getting Republican and Democratic chairmen from a number of influential legislative committees to sign on as bill sponsors, was crucial because the Governor had pledged no increase in taxes and the fee increase was viewed by many legislators as a tax increase.

At the conclusion of the 1995 legislative session, a bill was passed that addressed many of the problems and provided new revenue for the reimbursement fund. What truly made this legislative session a success for both the fund and the stakeholders, was the willingness of the stakeholders to lay down some of their differences and work for a unified solution—a solution which was also in the best interests of the environment.

Scott Fisher is Vice President of Government Relations for the Texas Oil Marketers Association. Dan Neal is Manager of the Petroleum Storage Tank Reimbursement Section of the Texas Natural Resource Conservation Commission.

#### Part 2 - Beefing Up the Fund

by Dan Neal

The 1995 legislative session was an exciting time for Texas' Petroleum Storage Tank Program. A number of bills were filed in both the house and the senate; each one had the potential to significantly impact the whole tank program and, more significantly, impact the state's reimbursement fund program. Ultimately, the house bills were combined into one omnibus bill, which was amended by the senate and passed by the legislature. The bill was signed into law by the governor on June 5, 1995.

Although the bill made sweeping changes to the entire Petroleum Storage Tank Program, for the purposes of this article, let's focus on the changes that directly affect the Petroleum Storage Tank Remediation (PSTR) Fund.

Those changes include:

 A funding increase and a general revenue loan;

- New deductibles based on meeting corrective action milestones;
- A new deductible for occurrences after receiving a closure letter;
- Fund eligibility based on tank registration;
- A requirement that releases discovered and reported after December 22, 1998 are no longer eligible for the fund;
- The requirement for an alternative financial assurance mechanism after expiration of fund eligibility;
- Requirements for a professional engineer's seal on corrective action plans;
- A sunset provision for the PSTR

For those of us who are responsible for seeing to it that the PSTR Fund does what it's supposed to do, these legislative changes provide a bright light at the end of what had been a long, dark tunnel. Let's look at some of these changes in more detail.

#### The Funding Increase

This September, the Petroleum Stor-Tank Remediation Fund received a \$120 million dollar general revenue loan to address the existing backlog by reimbursing claims that were received prior to September 1, 1995. The loan repayment schedule requires that \$80 million be repaid during fiscal year 1996 and \$40 million repaid during fiscal year 1997. The legislation also authorizes the doubling of the bulk delivery fee, the only source of revenue for the Petroleum Storage Tank Remediation Fund, which currently generates approximately \$5.5 million per month.

The bill also raises the unobligated balance cap on the fund from \$100 million to \$125 million. The cap acts to limit collections from the fund when the unobligated balance reaches the cap. When the cap is reached, the bulk delivery fee is suspended and not reinstated until the unobligated balance drops to \$25

million. However, when the bulk delivery fee is reinstated and collections begin again, it will be at the pre-September 1, 1995 rate.

#### **Registration Requirements**

After December 31, 1995 all underground and aboveground tanks must be registered with the Texas Natural Resource Conservation Commission (TNRCC) to be eligible for reimbursement, unless the tank was unknown and discovered while upgrading or during a site assessment, unknown and found during construction in the right-of-way, or unknown because the title search and previous property use did not indicate a tank on the property. To be eligible for the fund, new tanks installed on or after December 31, 1995 must be registered with the TNRCC no later than 30 days after the installation of the new tank is complete.

# The December 22, 1998 Deadline

The legislature took a big step in advancing the state's progress in meeting the federal 1998 deadline for corrosion protection and spill and overfill prevention. The new legislation says that costs for corrective action taken in response to releases discovered and reported to the TNRCC on or after December 22, 1998, the federal deadline, will no longer be eligible for fund reimbursement. After December 22, 1998, the PSTR Fund will cease to be a financial assurance mechanism; it will, however, continue to cover releases discovered, confirmed, and reported prior to that date.

This move on the part of the legislature provides a powerful incentive for getting tank owners and operators to move any corrective action forward—releases discovered after December 22, 1998 will not be covered under the fund. Inasmuch as most releases are discovered at the time a tank is removed, it behooves all who need an upgrade to do so well before December 1998, while there is still a fund.

After this deadline, any facility not covered under the fund must have an alternative mechanism, such as pollution insurance, for financial assurance. Failure to have and maintain proper financial assurance may subject a tank owner to 1) administrative and civil penalties, 2) risk of court-ordered closure of the tank system, and 3) in extreme cases, possible criminal prosecution.

#### The New Deductibles

The legislation establishes a new deductible system which is based on the applicant's meeting the following series of corrective action milestones.

- To remain under the current deductible configuration—\$10,000 for the owner of 1,000 or more tanks; \$5,000 for the owner of 100 to 999 tanks; \$2,500 for the owner of 13 to 99 tanks; and \$1,000 for the owner of less than 13 tanks—the applicant must submit a site assessment report prior to December 23, 1996. Failure to have this site assessment will result in the doubling of the deductible.
- Failure to have a corrective action plan submitted and approved prior to December 23, 1997 will double the doubled deductible.
- The goals outlined in the approved corrective action plan must be met by December 23, 1998, otherwise the deductible will again be doubled.

For example, if an applicant owns 1,000 tanks or more and has a deductible of \$10,000, a deductible of \$20,000 will be assessed for missing the December 23, 1996 deadline, a \$40,000 deductible will be assessed for missing the December 23, 1997 deadline, and an \$80,000 will be assessed for missing the December 23, 1998 deadline. If the applicant meets the first two deadlines, but misses the last deadline, he or she will still be required to pay the higher deductible of \$80,000.

For sites that have received a closure letter and have a subsequent release, the deductible will be \$50,000 after September 1, 1995.

#### **Claims Processing and Payment**

During the "band-aid" period of the fund's operation, discussed in Part 1 of this article, the legislature had directed the TNRCC to adopt a multi-tiered priority system for reimbursement. The system was based on the size of the owner—the bigger they were, the more money they had, the longer they had to wait for reimbursement. The 1995 legislation

brought the agency back to its original, first claim in/first claim out approach. This approach provides claimants with a greater incentive to prepare their paperwork properly so that they will be reimbursed sooner than later.

# Professional Engineer Requirements

The existing statute provides the TNRCC with the authority to register individuals who perform corrective action. Only those activities performed by registered individuals are eligible for reimbursement. The new legislation clarifies the registration requirements for professional engineers and further requires the use of a registered professional engineer.

If site remediation involves the installation or construction of on-site equipment, structures, or systems that are used in the extraction or management of wastes (except for soil excavation and landfill disposal) or well sampling and monitoring, the owner or operator is not eligible for reimbursement unless the plans and specifications have the seal of an appropriately licensed or registered professional engineer. Furthermore, the equipment, structures, or systems must be constructed under the supervision of an appropriately licensed or registered professional engineer.

#### **Preapproval of Activities**

Since March 1993, the TNRCC has by rule required all corrective action activities, except for emergency actions and free product removal, to be preapproved before it can be considered an allowable activity. The new legislation modifies this approach by requiring that preapproval activities performed since September 1, 1993 be preapproved. Failure to obtain preapproval for an activity can postpone processing and payment until all claims with preapproval have been processed and paid.

#### Sunset of the Fund

One of the most significant additions to the 1995 legislation is its sunset provision. As of September 1, 2001, the TNRCC can no longer pay any corrective action costs, nor can the bulk delivery fee be collected any more. Simply put, on September 1, 2001 the Texas reimbursement program will cease to exist.

### **LUST Investigation & Remediation**

# The WanderLUST of RBCA

# **Evaluating Exposures and Petroleum Fate and Transport**

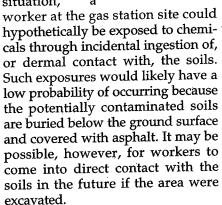
by Stephen T. Washburn and Patrick Witkowski

he Risk-Based Corrective Action (RBCA) program was developed by ASTM (American Society for Testing Materials) to encourage health-protective, costeffective remediation of petroleum hydrocarbon sites. To accomplish this goal, ASTM's RBCA framework relies on risk assessment as a tool to assist in the remediation decision-making process.

In evaluating risk at leaking underground storage tank (LUST) sites, we need information not only on the toxicity of the chemicals that are present, but also on the nature and potential magnitude of exposures to these chemicals. If we significantly underestimate exposures, the corrective actions taken at a site may not be sufficiently protective. If we significantly overestimate exposures, expensive and overly stringent corrective actions may be taken, wasting valuable resources with little or no risk reduction benefit. To make a more accurate assessment of potential exposures, we need to understand the different fate and transport processes that determine contaminant concentrations at the point of exposure.

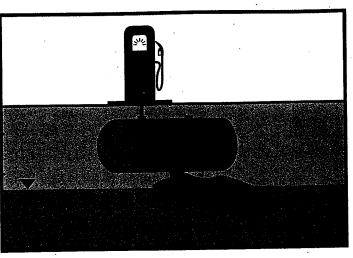
Let's examine how exposure assessment is incorporated into the corrective action procedures through the different tiers of ASTM's RBCA framework. Consider a hypothetical gasoline station site where an underground storage tank leak has resulted in the release of chemicals such as benzene, toluene, ethylbenzene, and xylene (BTEX) into the subsurface soil. In order for these chemicals to pose a risk to human health, a potential for exposure must exist. The primary routes of potential exposure are ingestion, inhalation, and dermal contact. The process of evaluating the dose that an individual might receive through each of these routes is known as an "exposure assessment." Exposure assesstypically considers both current and reasonable future exposure scenarios. Such exposures can be divided into the following two categories:

• Direct exposures to chemicals at the location of the release. In this situation, a



• Indirect exposures to chemicals after migration through environmental media (i.e., soil, ground water, air) to locations away from the source of the release. In this situation, chemicals could leach down through the soils into underlying groundwater and then move downgradient to a domestic well. Ingestion or other potable use of the groundwater represents a current or future exposure pathway for the chemicals originally released to the soil. In addition, chemical vapors may move up through the soil into air, where exposure might occur by inhalation. Other "indirect" exposure pathways may also exist, depending on the site conditions.

At LUST sites where underlying groundwater could potentially be used for drinking water, soil cleanup targets are often driven by potential impacts on the quality of the groundwater, rather than on the



risks posed by dermal contact or incidental soil ingestion. Concern for potential impacts is particularly true for compounds that are relatively mobile in the environment (e.g., BTEX) and are often found in groundwater at sites where petroleum releases have occurred.

#### **Attenuation Mechanisms**

Many physical, chemical, and biological processes can affect the migration of chemicals through soil and groundwater and, thus, the chemical concentration and risk at the point where exposures may occur. Processes that tend to reduce chemical concentrations as the contaminant moves from the source to the point of exposure are referred to as "attenuation mechanisms." For groundwater transport, significant attenuation mechanisms include the following:

• Degradation Many of the organic chemicals commonly detected at petroleum hydrocarbon release sites (e.g., BTEX) are known to degrade under both aerobic (oxygen-rich) and anaerobic (oxygen-limited) conditions. The degradation can be both chemical and biological. Chemical degradation involves the reaction of the contaminant with energy and/or another substance to break down the petroleum hydrocarbons into smaller compounds, such as carbon dioxide. Biological degradation

involves the digestion of a contaminant by microorganisms which may be either indigenous to the soil or added to enhance attenuation. While general statements regarding the extent of degradation can be made, the rate of chemical degradation at the site is a function of several site-specific conditions, such as the availability of oxygen and other nutrients. Degradation results in a reduction in both the mass and the concentration of a chemical in groundwater or soil.

- Dispersion This mechanism involves the micro-scale mixing and dilution of chemicals in water as the individual molecules of contaminant move through porous media along with the bulk flow of groundwater. Dispersion results in a three-dimensional spreading of the dissolved hydrocarbons and thus an overall reduction in concentration, but it does not result in a reduction in contaminant mass.
- Diffusion This is the process by which chemicals move from areas of high concentration to areas of low concentration, in the absence of bulk flow. Diffusion is driven by the chemical concentration gradient; the rate of diffusion increases with an increase in the magnitude of the concentration gradient. As with dispersion, diffusion results in a reduction in chemical concentration but not in contaminant mass.
- Sorption Chemicals with low water solubility and high affinity for organic matter will tend to sorb, or adhere, to soil particles rather than remain dissolved in the groundwater. For example, chemicals like polynuclear aromatic hydrocarbons (PAHs) tend to sorb tightly to solids in the soil or groundwater system, reducing their mobility and retarding the rate at which they will move relative to the bulk fluid. Other chemicals, such as MTBE, are highly water soluble and do not sorb strongly to solids; thus they move downgradient much more quickly than PAHs. Sorption can reduce chemical concentrations in the water column, but it does not directly reduce mass. However, by slowing down chemical transport, sorption can provide more time for degradation to occur and, thus, indirectly result in a reduction in chemical mass.

#### **Mathematical Models**

One approach for incorporating attenuation mechanisms into the exposure assessment process is through the use of mathematical "models." Each model is a conceptual representation of the environment and consists of equations, assumptions, and parameter values. Simple models that are used for initial site evaluation are generally based on algebraic equations, conservative assumptions, and generic parameter values. These models are inexpensive to apply, include few attenuation mechanisms, and tend to calculate relatively stringent cleanup targets.

At the other end of the spectrum are complex numerical models, which typically require the use of complex computer programs. These models can incorporate many attenuation mechanisms, take into account more site-specific information, and more accurately predict chemical behavior in the environment. As a result, conservative assumptions can be relaxed to be more realistic, and the same level of risk protection can be achieved with higher cleanup targets. While the complex models can provide greater accuracy, they are usually more expensive to apply and require the collection of more site-specific data.

The decision on how to select the most appropriate modeling technique is best evaluated through a phased, or tiered, approach, such as the ASTM RBCA process. Each RBCA tier incorporates a cost-benefit analysis before proceeding to the next tier. For each tier, the cost of remediation at the current cleanup level is compared to the cost of using more complicated models and approaches to derive site-specific cleanup levels and cost-reducing remediation at the higher site-specific levels. The RBCA approach allows the user to determine which attenuation mechanisms are important, how they can be incorporated into the exposure assessment, and how much effort should be invested in an accurate model.

#### **The Tiered Framework**

The RBCA process incorporates the concepts of exposure assessment and the basic principles of chemical fate

and transport throughout its tiered framework for corrective action. In the initial phases of evaluation (i.e., Tier 1), exposure pathways must be identified so that the appropriate generic risk-based standards (derived from conservative scenarios) can be compared to site concentrations. If subsequent phases of evaluation are required using more realistic site-specific conditions (i.e., Tier 2 and Tier 3), modeling of chemical transport through soil, air, groundwater, or other media may be necessary to better assess the potential for human exposure. The elements of exposure assessment in each tier are described briefly below:

**TIER 1:** Comparison of Chemical Concentrations Measured in Relevant Site Media to Risk Based Screening Levels (RBSLs). Under RBCA, regulatory agencies must develop a set of generic "screening level" concentrations that can be compared against site data. If site concentrations are lower than the screening levels (known as RBSLs), then active remediation at the site is typically unwarranted. If the site concentrations are higher than the RBSLs, then some type of active remediation, or more refined Tier 2 evaluation, is necessary. In Tier 1, regulatory agencies must determine which exposure routes and pathways to include in developing RBSLs. If more complex pathways involving the migration of chemicals from one environmental medium to another are included in developing RBSLs, appropriate fate and transport models for assessing chemical transport in the environment must be selected. These models allow the agencies to relate the RBSL developed for one environmental medium (e.g., groundwater) to an RBSL in a second medium (e.g., soil). Because Tier 1 RBSLs are generic (i.e., do not consider site-specific conditions), simple algebraic models and conservative assumptions are typically used to evaluate the extent of possible exposure, resulting in stringent RBSL values.

TIER 2: Comparison of Measured Media Concentrations to Site Specific Target Levels (SSTLs). If chemical concentrations in one or more media exceed the RBSLs and remedi-

**continued** on page 31

#### **LUST Investigation & Remediation**

# The Use of Alternative Technologies Skyrockets to More Than 50,000 LUST Sites

By Debby Tremblay, Dana Tulis, Paul Kostecki, and Kate Ewald

tate regulators and consultants have long bemoaned the pitfalls of using pump-and-treat and landfilling to remediate leaking underground storage tank (LUST) sites. Pump-and-treat can spread contamination, rarely achieves cleanup levels, and is costly to operate and maintain. Landfilling merely moves contaminated soils from one location to another. In their search for new solutions, regulators and consultants have dramatically increased their use of "alternative" technologies (alternatives to landfilling and pump-and-treat), which have the ability to produce faster, more effective, or less costly cleanups. The use of alternative technologies has grown significantly from 3,000 sites in 1993 to more than 50,000 sites in 1995.<sup>1</sup>

Trends toward innovation have skyrocketed, in part, because of the proactive efforts of state agencies and EPA's Underground Storage Tank (UST/LUST) program at both headquarters and the regions. The UST/LUST program and state and local agencies have encouraged the use of alternative technologies by creating demonstration projects, facilitating workshops, and providing technical guidance. As a result of these activities, improvements in the engineering and application of alternative technologies have abounded. In contrast, the shortcomings of landfilling and pump-and-treat have become more apparent.

To determine the extent to which the use of alternative technologies changed between 1993 and 1995, the University of Massachusetts (UMass), supported by EPA's Office of Underground Storage Tanks (OUST), set out to learn more about current technology use and technology trends. Forty-nine state

LUST programs provided information. The findings, which are reported in this article, will be used by the UST/LUST Program and UMass to promote better decision making about the selection and use of alternative technologies.

#### A Variety of Alternatives In Use

The results of the 1995 UMass study indicate increased use of every available alternative technology. (See Definitions Alternative Of LUST Technologies For Soil And Groundwater Cleanups on page 28.) Exhibit 1 indicates the number of states that noted increased use during the last 2 years. While the use of alternative technologies increased, the use of traditional technologies decreased. Thirty states reported decreased use of pumpand-treat; twenty-eight states

reported decreased use of factoring. The decreased use of these technologies is encouraging given their many disadvantages.

Landfilling, the traditional option for removing contaminated soils, does not permanently reduce pollution, it merely moves the contamination from one location to another. In addition, landfilling is becoming increasingly expensive because of the rising costs of transportation and landfill space. Costs can multiply further when one considers the potential liability associated with landfilled soils and associated legal issues.

Alternative soil remediation technologies, such as soil vapor extraction, can cost-effectively treat large volumes of soil in situ near or under fixed structures with minimal

# 

Remediation Method		Number of States
Soil Vapor Extraction	Soil	45
Air Sparging	Groundwater	43
Bioventing	Soil	35
Natural Attenuation of Groundwater	Groundwater	33
Dual Phase Extraction (Bioslurping)	Groundwater	31
Natural Attenuation of Soil	Soil	30
Biosparging	Groundwater	27
In Situ Bioremediation of Groundwater	Groundwater	19
Biopiles	Soil	17
Landfarming	Soil	14
Low-Temperature Thermal Desorption	Soil	14
Incineration	Soil	6
Soil Washing	Soil	4

**<sup>1.</sup>** These figures are approximate and were collected through EPA information compiled in 1993 and 1995.

disruption of business operations. Another soil remediation alternative—on-site thermal desorption—can minimize long-term liability, has 99-percent removal efficiency, and can typically be completed within a few days.

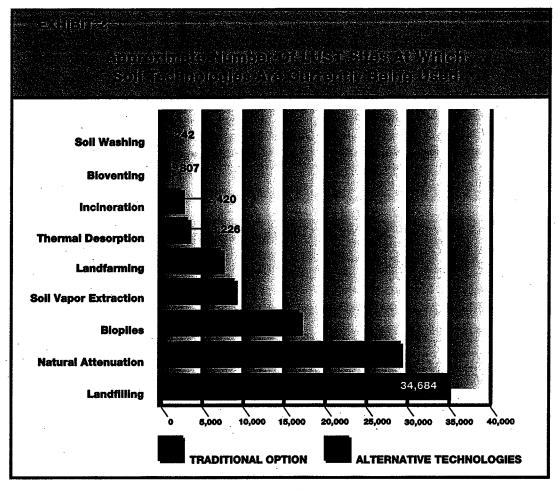
Even when they are operated properly, pump-and-treat systems have inherent limitations. Contaminant mass removal rates often flatten out and may never achieve cleanup levels. When the systems are operated after recovery rates plateau, operating costs continue, but the site does not become cleaner. Even worse, pump-and-treat syscan actually tems smear or spread contamination when water table levels fluctuate.

Fortunately, dual phase extraction (an alternative technology for groundwater) increases recovery rates by 3 to 10 times and can achieve cleanup goals in 6 to 24 months. Another alternative, air sparging, can generally yield a 90-percent reduction in volatile constituents in 6 to 24 months.

# **Soil Remediation Alternatives** Flourish

According to study participants, about 96,000 sites are currently undergoing remediation. Exhibit 2 displays the approximate number of sites at which soil remediation technologies are currently being used. Because each technology may be implemented in conjunction with one or more other technologies, the total number of sites in the exhibit is greater than 96,000 sites.

As Exhibit 2 shows, landfilling is the most frequently selected



option for soils remediation with use at almost 35,000 sites. However, overall alternative technologies for soil remediation are being used almost twice as often as landfilling. Natural attenuation and biopiles are the most commonly selected alternative options with use at more than 45,000 sites.

According to representatives from the thermal desorption industry, thermal desorption was used on a limited basis four years ago. Today, however, thermal desorption is being used at over 3,000 sites located in almost every state.

#### The Use of Natural Attenuation Exceeds Pump-and-Treat

In 1993, pump-and-treat was the most commonly used groundwater remediation method.<sup>3</sup> However today, as Exhibit 3 ( see page 26) indicates, the use of pump-and-treat

lags significantly behind natural attenuation.

When natural attenuation is used appropriately (the data do not reveal whether or not use is appropriate), it can be a welcome, cost-effective alternative to pump-and-treat. Natural attenuation can be especially cost-effective at the end of a cleanup after significant results have been achieved and after other options produce asymptotic reductions in contaminant levels.

However, natural attenuation, which should always include monitoring, should not be viewed as a default option, a "walk away" opportunity, or a means to avoid remediation. It should be carefully selected based on a thorough evaluation of site-specific conditions, characterization of the nature and extent of contamination, and identification of potential threats to environmental and human receptors.

Another option that has seen increased use is air sparging. About 4 years ago, air sparging was used at only a handful of sites according to

**<sup>2.</sup>** Study participants provided approximations or ranges (in which case the median value was used) for the data presented in Exhibit 2. These data should be considered only semi-quantitative and approximate.

**<sup>3.</sup>** This information was collected through the "1993 National Conference Admission Ticket," which requested data on technology use, technology barriers, and state needs.

**continued** on page 26

# ■ Alternative Technologies from page 25

discussions with state and federal regulators. Today it is used at almost 5,000 sites.

#### On-Site Methods Are Selected More Often

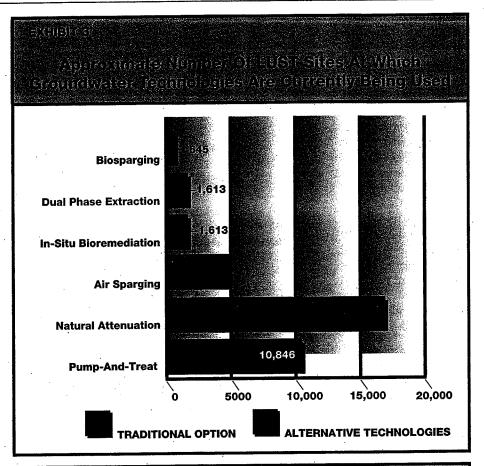
Exhibit 4 illustrates the change in onsite versus off-site technology use since 1993. Since that time, the use of on-site technologies has increased and the use of off-site technologies has decreased. Greater use of natural attenuation, soil vapor extraction, bioventing, air sparging, in situ bioremediation, and dual phase extraction account for most of the increased use in on-site technologies.

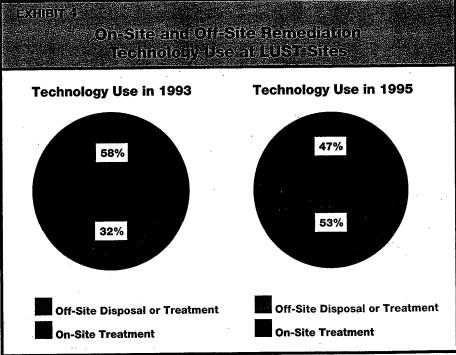
# Opening Doors to Real-World Solutions

While advances have clearly been made in alternative technologies, much work remains. State and federal agencies must continue to encourage better decision making about the selection and use of technologies and stimulate cross-fertilization from other environmental fields. Consultants and industry representatives, in turn, must continue to be open to using alternative technologies. And most importantly, all of the stakeholders involved must make greater efforts to work cooperatively together. Only then will real-world solutions to the problems caused by leaking USTs be achieved. ■

4. For the purpose of this article, landfilling, incineration, thermal desorption, biopiles, and landfarming were placed in the off-site technology category because they are usually implemented off-site. However, these options are sometimes used on-site as well, which should be taken into consideration when viewing Exhibit 4. All other technologies were placed in the on-site category.

See pages 27 and 28 for more information on Alternative Technologies 4





Debby Tremblay is the national team leader for EPA-OUST's corrective action technology team. Dana Tulis is Acting Division Director for EPA-OUST's Implementation Division. Paul T. Koslecki, PhD., is Associate Director of the Northeast Regional Environmental Public Health Center and Associate Research Professor in the Environmental Health & Sciences Department at the University of Massachusetts at Amherst and also serves as Executive Director of the Association for the Environmental Health of Soils. Kathryn Ewald, M S., is a Research Assistant and Ph.D. candidate in the Environmental Health & Sciences Department at the University of Massachusetts.

#### **Alternative Technology Products and Services**

To encourage continued use of alternative technologies and to promote better decision making about the selection and use of all technologies, OUST and UMass have made available the following products and services.

- How To Evaluate Alternative Cleanup Technologies For Underground Storage Tank Sites: A Guide For Corrective Action Plan Reviewers. This user-friendly, 420 page guide provides step-by-step instruction on how to review a corrective action plan for ten different alternative technologies. The guide is extremely useful for both regulators and consultants. To order the guide, which costs \$28.00, call the Government Printing Office at 202-512-1800 and request document number 055-000-00499-4.
- The UST/LUST Special Interest Group (SIG) on EPA's Cleanup Information Bulletin Board System (CLU-IN). The UST/LUST SIG on CLU-IN contains up-to-date information on all areas of the UST/LUST program. CLU-IN contains publications, databases, and relevant information from many sources, and its screens can be downloaded to your computer. Current users include state and federal personnel, consultants, vendors, researchers, and private citizens. To access CLU-IN, use your modem to dial 301-589-8366. The communications parameters are 8 data bits, 1 stop bit, and no parity. If you have trouble logging on call 301-589-8368 to speak with a system operator.
- Vendor Information System for Innovative Treatment Technologies (VISITT). VISITT is PC software that contains information provided by companies that offer innovative technologies for petroleum and hazardous waste remediation. VISITT 4.0 contains data on 325 technologies offered by 204 companies. The VISITT software can be downloaded from CLU-IN (see above). The VISITT software (EPA-542-C-95-001) and user manual (EPA-542-R-95-007) are available free of charge from EPA's National Center for Environmental Publications and Information by calling 513-489-8190.
- **Risk-Based Corrective Action (RBCA) Training.** Forty-three states are currently enrolled in some phase of RBCA training. The training will enable states to develop state-specific processes for risk-based decision making that can be put into practice. The training will eventually be offered to the consulting community and others to ensure widespread understanding of the RBCA approach.
- University of Massachusetts Contaminated Soils Conferences. These conferences combine a strong technical program with a variety of educational opportunities ranging from focused workshops to live equipment demonstrations to an applied exhibition area. The conferences are developed in coordination with the regulated community and state and federal regulators to provide a well-balanced perspective of state-of-the-art technology. For information on the next conference write to: Linda Rosen, University of Massachusetts, N344 Morrill, Amherst, MA 01003.
- The Association for the Environmental Health of Soils (AEHS). AEHS, which is made up of almost 400 environmental professionals from both the public and private sectors, conducts national and international workshops, hosts seminars and conferences, publishes technical books, and produces a newsletter entitled MATRIX as well as the Journal of Soil Contamination. To learn more about AEHS activities, call 413-549-5561.

#### **Products and Services Coming Soon**

In addition to the products and services that are currently available, EPA/OUST has scheduled the following items for release in the next 9 months:

- TANK RACER: Cost Estimation Software For LUST Cleanups. This software will produce fast, accurate, and comprehensive cost estimates for LUST closures, site assessments, and corrective actions on a site-specific basis. Users will be able to vary site parameters or technology components at a site, and TANK RACER will quickly calculate "new" costs. TANK RACER will be available in March 1996.
- How To Effectively Recover Free Product At LUST Sites: A Guide For State Regulators. In collaboration with EPA's National Risk Management Research Laboratory in Edison, New Jersey, OUST is preparing an easy-to-understand guidance on the current options available for free product removal. The guide should be available through the Government Printing Office in February 1996.
- Expedited Site Assessment Tools For Underground Storage Tank Sites: A Handbook For Regulators And Consultants. OUST is preparing this handbook to help regulators and consultants oversee expedited site assessments. The handbook will discuss the applicability, advantages, and limitations of various expedited site assessment tools, the expedited site assessment process, and the data evaluation criteria. The handbook will be available in summer 1996.

#### Alternative Technologies Definitions

#### ■ Soil Remediation Technologies

**BIOPILES**, also known as biomounds, biocells, and compost piles, are excavated mounds of soils. Aerobic microbial activity is stimulated in the mounds through the addition of air and, if necessary, minerals, nutrients, and moisture via aeration and irrigation conduits.

**BIOVENTING** is an in situ method for enhancing biodegradation of organic contaminants from unsaturated soils. Oxygen and nutrients are injected into the soils through injection wells.

**INCINERATION** is an ex situ technology that uses heat to volatilize and combust organic constituents. Soils are heated at high temperatures ranging from 1,600 - 2,200°F.

LANDFARMING, also known as land treatment or land application, involves spreading excavated soils in a thin layer aboveground. Microbial biodegradation of the contaminants is enhanced by aerating the soils (by tilling or plowing) and, if necessary, adding nutrients and moisture.

LOW-TEMPERATURE THERMAL DESORPTION, also known as low-temperature thermal volatilization and thermal stripping, is an exsitu technology that uses heat to physically separate petroleum hydrocarbons from excavated soils. The vaporized hydrocarbons are treated in a secondary treatment unit (e. g., afterburner prior to atmospheric discharge). Soils are heated at low temperatures ranging from 200 - 1,200°F.

NATURAL ATTENUATION, also known as passive bioremediation or intrinsic remediation, is an in situ approach which relies on naturally occurring microorganisms to remove biodegradable contaminants without added oxygen or nutrients.

SOIL VAPOR EXTRACTION (SVE), also known as soil venting or vacuum extraction, is an in situ method for removing volatile and semi-volatile contaminants from unsaturated soils. A vacuum pump is applied to extraction wells causing movement of vapors toward the wells. Extracted vapors are treated and discharged aboveground.

SOIL WASHING is an ex situ process for mechanically scrubbing soils to remove contaminants. Soil particles are separated from soil in an aqueous-based system. The wash water may be augmented with leaching agents, surfactants, pH adjustment, or chelating agents.

#### ■ Groundwater Remediation Technologies

AIR SPARGING, also known as in situ air stripping and in situ volatilization, involves injecting air into the saturated zone through injection wells, thus enabling a phase transfer of hydrocarbons from a dissolved state to vapor phase. The vapors are then vented through the unsaturated zone and, in some applications, captured by soil venting systems.

**BIOSPARGING** is similar to air sparging, however, the primary objective of biosparging is to promote biodegradation through the use of lower flow rates and the addition of nutrients.

DUAL PHASE EXTRACTION, also known as vacuum-enhanced extraction, is an in situ technology that uses pumps to remove ground-water, free product, and vapors from the subsurface. Extracted liquids and vapor are treated and collected for disposal or reinjected into the subsurface, sometimes after being aerated and augmented with nutrients and microbes.

IN SITU GROUNDWATER BIOREMEDIATION involves the extraction and reinjection of groundwater mixed with oxygen and/or other electron acceptors, nutrients, and additional microbes (if necessary). The technology remediates groundwater by promoting growth and reproduction of microorganism populations that biodegrade the contaminants.

NATURAL ATTENUATION, also known as passive bioremediation or intrinsic remediation, is an in situ approach which relies on naturally occurring microorganisms to remove biodegradable contaminants without added oxygen or nutrients.

EPA Plans Demonstration Project for Methods of Assessing UST Suitability for Upgrading with Cathodic Protection:

**QUALIFIED COMPANIES SOUGHT** 

If EPA/NRMRL, supported by International Technologies Corporation (IT) and its subcontractor, Midwest Research Institute (MRI) is conducting research into state-of-the-art (SOTA) technologies for determining if steel underground storage tanks (USTs) qualify for upgrading with cathodic protection. EPA is seeking companies with the qualifications and experience to test the integrity of steel USTs by determining and predicting a tank's condition and stillability for upgrading by adding cathodic protection. The test methods must be commercially available.

EPA is seeking test methods that assess the tank's structural integrity (e.g., remaining wall thickness, depth of corrosion pitting)—both invasive and non-myssive Examples of such technologies include, but are not limited to, use of remotely operated or robotic sideo cameras or ultrasound probes, as well as mathematical models based on environment and soil measurements. EPA, with assistance from MRI and IT, will conduct qualitative and quantitative engineering analyses of subject tanks to assess the accuracy, performance capability, and reliability of each testing methodology demonstrated.

All qualified testing companies will be considered for invitation to demonstrate their technology and methodology at sites selected by EPA. The agency anticipates that up to 100 tanks divided among 5 geographic regions of the U.S. will be used as evaluation sites. The field demonstrations are planned to begin in March of 1996. Companies must be willing to participate in the full program and commit to conducting tests at each field site. Participating companies costs for demonstrating their technologies will be the responsibility of the participating company and not that of EPA, IT, or MRI. IPA plans to publish the results when all test demonstrations and performance evaluations are completed.

All interested and qualified companies are invited to submit a capabilities package for consideration. Packages should include, at a minimum, a detailed description of the technology, specifications, reports, test protocols, and any testing results indicating performance and accuracy. After review of the capabilities packages, vendors of selected methods will be asked to submit any additional information via a questionnaire that they will receive from IT. Following this assessment process, selected companies will be requested to demonstrate their respective technologies at the various field sites.

Interested firms should submit their initial capabilities packages to Carolyn Esposito at USEPA/NRMRL, 2890 Woodbridge Ave. (MS106), Edison, New Jersey 08837. Phone: 908-906-6895 or FAX 908-906-6990. Questions may be submitted in writing, or by fax to the above address.

#### EPA's Lender Liability Rule Expected to Ease Credit Barriers for Tank Owners and Operators

On September 7, 1995, EPA published its final UST-specific lender liability rule in the *Federal Register*. The new rule limits the regulatory obligations of financial institutions and others who hold security interests in property on which petroleum USTs are located. "We hope that with this rule in place, banks will be more willing to make money available to UST owners and operators who need to make improvements to their tanks in order to meet environmental regulations," says Lisa Lund, Acting Director of EPA's Office of Underground Storage Tanks.

According to Lund, EPA is particularly concerned about the ability of small UST owners and operators—the "mom and pop" businesses—to meet federal UST upgrading and replacement requirements. In the past, lenders have been extremely reluctant to make loans to small businesses such as gas stations for fear of becoming liable for cleanup costs in situations where the business goes bankrupt and the lender takes possession of the property through foreclosure.

Until now, lenders have been uncertain about the extent of their liability for UST-related problems. Subtitle I of the Resource Conservation and Recovery Act (RCRA) contains a "security interest exemption" that explicitly exempts lenders from liability for cleanup of releases from petroleum USTs. However, many lenders don't know about this exemption, and many others don't know exactly what it covers.

The UST lender liability rule clears up this confusion. Under the rule, a lender is eligible for an exemption, both prior to and after foreclosure, from compliance with all Subtitle I requirements as an UST "owner" and "operator" if the lender:

- Holds an ownership interest in an UST, or property on which the UST is located, in order to protect its security interest (a lender typically holds property as collateral as part of the loan transaction);
- Does not engage in petroleum production, refining, and marketing; and
- Does not participate in the management or operation of the UST.

#### **EPA HQ UPDATE**

The rule lists certain actions, including foreclosure, that lenders can take to manage and protect their collateral and still not be held responsible for meeting the federal UST regulations under RCRA Subtitle I. For example, without incurring liability under the federal regulations, a lender can:

- Perform environmental inspections or audits;
- Arrange for cleanup of leaking tanks; and
- Close USTs temporarily or permanently.

In addition, lenders will be able to regularly monitor or investigate the borrower's collateral, business condition, and financial health; require that the property be maintained in an environmentally sound manner; and advise the borrower to clean up the property if it is contaminated.

Under the rule, a lender can foreclose on and sell its UST collateral without incurring Subtitle I liability if there is a current operator at the site who can be held liable for compliance. Otherwise, the lender must:

- Empty the UST(s) within 60 days after foreclosure; and
- Either temporarily or permanently close the UST(s).

The rule also describes activities that the lender cannot undertake without becoming responsible for cleanup costs. For example, a lender who chooses to operate its USTs is not eligible for the regulatory exemption. The lender could be required to clean up any contamination if the tank leaked and may be responsible for meeting the UST technical standards and financial responsibility requirements of Subtitle I.

For additional information on the UST lender liability rule or for a copy of the *Federal Register* notice, contact EPA's RCRA/Superfund Hotline at (800) 424-9346.

#### Final List of Leak Detection Evaluations

The final List Of Leak Detection Evaluations For Underground Storage Tank Systems, a regulators' review of third-party evaluations, has been distributed to vendors, EPA regions, state UST managers, and other interested parties. The list is also available on CLU-IN in the UST/LUST SIG File Directory #11

(Tanks & Piping: Installation, Upgrading, Leak Detection, and Closure) filename "LEAKDET.EXE". The files are in WP 5.1 format; they have been compressed to save space and decrease the time required to download. The file is self-extracting (i.e., you download the file then type "LEAKDET" and press <Enter>. The result is eight files. (Note: This list replaces the Region 10 list which has been discontinued.) For a copy, contact Lillian Shelton (703/308-8859) or call the RCRA/Superfund Hotline\*.

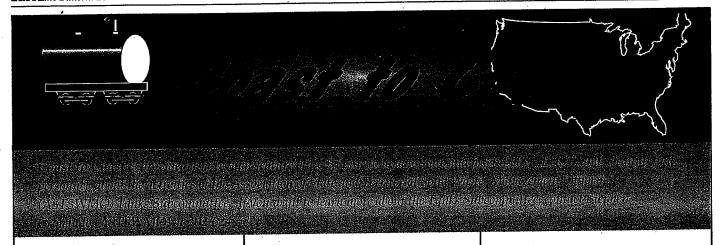
# New Booklet on UST Financial Assistance Programs Available

OUST has published a new, plain-English publication, Financing Underground Storage Tank Work: Federal and State Assistance Programs, to help UST owners and operators, particularly those with tanks on tribal lands, obtain loans or grants for financing corrective action and UST system upgrades to meet the 1998 requirements. The booklet describes 11 federal financial assistance programs that, while not designed specifically for UST work, can provide direct loans, loan guarantees, or grants to UST owners or operators who would like to upgrade or replace their tanks or clean up contaminated sites. A few of these programs are available only to Indian tribes and/or individuals on Indian lands. The booklet also provides a listing of states that offer UST financial assistance programs. Copies can be ordered through the RCRA/Superfund Hotline\*.

#### **RBCA Talk Bulletin**

To promote successful practices and foster information-sharing among states that are developing RBCA processes, OUST has produced *RBCA Talk*, a bulletin that briefly describes state RBCA development efforts and related issues. OUST has distributed the bulletin to state LUST program managers, state fund administrators, and EPA regional offices. The bulletin is also available on CLU-IN. For more information, contact Bob Greenfield at (703) 308-8871.

\* EPA's RCRA/Superfund Hotline is open Monday through Friday from 8:30 a.m. to 7:30 p.m. EST. The toll-free number is (800) 424-9346; for the hearing impaired, the number is TDD 800-553-7672.



#### **Tanks Subcommittee**

Over the past few months, the ASTSWMO Tanks Subcommittee has been active on a variety of general tank program issues of concern to state UST programs. The Subcommittee met in July in Washington, D.C., at which time Mike Kanner (MN) turned over his chairmanship to Tana Walker (OK). Tana has since accepted a position in private industry and has resigned her position as Tanks Subcommittee chairperson. This chairperson slot has not yet been filled.

**UST Task Force** 

The UST Task Force members are involved in two significant new activities. First, UST Task Force members were represented on a committee appointed by OUST's Acting Director, Lisa Lund, to make recommendations on facilitating state program approval (SPA) for states that don't yet have it. Currently, 31 states (including the District of Columbia) do not have SPA. Of the states without SPA, 19 have legislative obstacles, and 3 have "other barriers." Seven states (NE, AL, DE, MT, AK, TN, MO) and the District of Columbia and Puerto Rico are scheduled to receive SPA soon. In October, the committee presented Lund with a report containing a broad range of ideas and options for her consideration.

The task force also began work on developing a "report card on the Federal UST/LUST program." This project, which is is essentially an evaluation of the progress made to date in achieving compliance, involves gathering compliance and historical data and

assessing program accomplishments since the beginning of Subtitle I. This information can also be used to measure the status of compliance with the 1998 technical standards.

Two new members have joined the task force: Dale Marx (UT) and Laurie McCulloch (OR). For more information on UST Task Force activities, please call task force co-chairs Vickie Church (San Diego County, CA) at (619) 338-2243 or Paul Sausville (NY) at (518) 457-4351.

#### **LUST Task Force**

Members of the LUST Task Force held a conference call on August 31 to discuss membership status and future projects. Future projects that were discussed include: determining the goals for risk-based corrective action and the role of the task force; preparing for possible privitization of UST/LUST functions in some states; and exploring the use of bioremediation at LUST sites.

Task force member Richard Spiese (VT) developed an Administrative Toolbox Questionnaire to survey the states about their experiences with institutional controls for LUST programs (e.g., property liens, deed restrictions, deed notices). The questionnaire has been distributed to all state LUST contacts; results will be presented at the UST/LUST National Conference in March. Task force member Anna Richards (NM) is working with ASTM on a natural attenuation standard.

For more information on LUST Task Force activities, call cochairs Scott Winters (CO) at (303) 620-4008 or Kevin Kratina (NJ) at (609) 633-1415.

# State Cleanup Funds Task Force

The State Cleanup Funds Task Force co-chairs, Dan Neal (TX) and Christine Long (AZ) have been working to maintain and oversee the group's activities. Current task force projects include: A state funds resource manual, a transition white paper, a review of UST financial responsibility regulations, a fund solvency and insurance guide, and a cost control manual. Members are also working on the June 10-12 State Fund Administrator's Conference that will be held in Charleston, SC.

If you have questions or comments on State Cleanup Funds Task Force activities, please call either Dan Neal (TX) at (512) 239-2258 or Christine Long (AZ) at (602) 207-4327.

#### **TIE Task Force**

The Training and Information Exchange (TIE) Task Force continues to address the training and information needs of the state UST/LUST programs. Current TIE strategies include facilitating implementation and use of the CLU-IN Bulletin Board and facilitating the Peer Match program and directory. The task force has assigned its members to serve as liaisons to the UST, LUST, and State Cleanup Funds Task Forces. If you have questions or comments on TIE Task Force activities, please call task force co-chairs Gary Kulibert (WI) at (715) 365-8960) or Pat Jordan (WY) at (307) 777-7684.

#### ■ WanderLUST .from page 23

ation to the Tier 1 RBSLs is not practicable, SSTLs can be calculated in Tier 2. The Tier 2 evaluation is intended to take into account sitespecific considerations that affect the potential for exposure, resulting in SSTLs which are less stringent than the RBSL values. Tier 2 SSTLs typically achieve the same level of protectiveness to human health and the environment as Tier 1 RBSLs but at higher concentrations; the result of replacing conservative Tier 1 assumptions with more realistic site conditions. To facilitate the RBCA process, the Tier 2 evaluation should be relatively simple, relying on data and information that are readily available, and fate and transport models which are relatively straightforward to apply and review. Key differences between the exposure assessment in Tier 2 and Tier 1 often include the following:

- In Tier 2, site-specific data are used in place of standard defaults that were used in Tier 1 to develop the RBSLs. For example, site-specific information on soil characteristics (e.g., moisture content, porosity, organic carbon content) or source area dimensions could be used along with the simple algebraic models used to develop the RBSLs to calculate Tier 2 SSTLs.
- In Tier 2, alternative exposure and compliance points can be considered.

Tier 1 RBSLs generally assume that the potentially exposed individual could be located at, or very near, the source of contamination. In Tier 2, if exposure is unlikely to occur at or near the source of contamination, then an alternative exposure point can be considered for the exposure assessment. For groundwater, this alternative exposure point is often the property boundary (if on-site use of groundwater is not anticipated) or beyond the property boundary (if a "buffer zone" downgradient of the property boundary at the site exists, where off-site use of the groundwater is not expected). As in Tier 1, Tier 2 typically uses simple algebraic models to evaluate alternate exposure and compliance points.

- In Tier 2, a statistical evaluation of available media concentration data may be performed. In Tier 1, the maximum concentration detected in a medium is often compared to the RBSL for that medium. In Tier 2, a statistical evaluation of available data may be performed to develop a more representative concentration for comparison to RBSLs or SSTLs.

**TIER 3:** Comparison of Measured Media Concentrations to Refined SSTLs. Like Tier 2, site-specific conditions are taken into account in generating Tier 3 SSTLs. However, in Tier 3, it is anticipated that advanced statistical analysis and/or

fate and transport modeling will be used in place of the relatively simple methods used in Tier 2. Such evaluations can require considerable time and resources. Thus, a Tier 3 evaluation would typically only be performed if the costs of remediating to Tier 2 SSTLs are high and the costs of remediating to Tier 3 SSTLs are likely to be much lower.

Exposure assessment is a critical step in any RBCA site remediation. Without adequate information regarding the magnitude of possible exposures, it is not possible to identify the appropriate response at a site. To develop this information, it is often necessary to gather additional site-related data, and sometimes perform modeling of key fate and transport mechanisms. While this may require greater effort early in the corrective action process, it will help a state optimize its overall resources and provide a basis for ensuring that consistent risk-based remediation decisions are made.

Stephen Washburn is a Principal with ENVIRON Corporation in Princeton, New Jersey, and is one of nine scientists selected nationwide by ASTM to conduct RBCA training. Patrick Witkowski is a manager at ENVIRON and consults on issues related to the fate and transport of chemicals released into the environment.

New England Interstate Water Pollution Control Commission

E-mail: NEIWPCC@aol.com

255 Ballardvale Street Wilmington, MA 01887-1013 Phone: 508/658-0500

Fax: 508/658-5509



# L.U.S.T.LINE

To our Readers:

#### WE WANT TO HEAR FROM YOU...

If you have any mailing list business, please fill out this form and return it to us.

- Please add my name to your mailing list. (Fill out name and address below.)
- Please take my name off your mailing list. (Fill out name and address below...
- Change of address.
- Please send me back issues of LUSTLine. (Fill out name and address below no P.O. boxes.)
  Back issues now cost \$2.50 per issue or \$25.00 for a complete set.

Please enclose a check (drawn on a U.S. bank) and made payable to NEIWPCC.

Name		
Address		

City/Town

We welcome your comments and suggestions on any of our articles.

Street

State

ZIP



# ANGARAGADILEGARAGADILEGARAGADIA

#### File Directory 7 (Risk: Assessment, Modeling, Decision Making)

- TPH.EXE The Massachusetts Department of Environmental Protection's "Interim Final Petroleum Policy: Development of Health-Based Alternative to The Total Petroleum Hydrocarbon (TPH) Parameter." File is self-extracting and, when decompressed, in WordPerfect 5.1 format.
- TPH-APP.EXE Tables and figures from the appendices for Massachusetts DEP "Interim Final Petroleum Policy...." File is self-extracting and, when decompressed, in WordPerfect 5.1 format.
- TX-GUID.EXE Texas' guidance for risk-based corrective action. File is self-extracting and, when decompressed, in WordPerfect 5.1 format.
- TX-RULE.EXE Texas' rule regarding risk-based corrective action. File is self-extracting and, when decompressed, in WordPerfect 5.1 format.

#### File Directory 4 (EPA/OUST Publications & Program Information)

- USTFACTS.EXE UST Program Fact Sheets: Implementing Federal Requirements For Underground Storage Tanks. EPA-510-B-95-011. File is self-extracting and, when decompressed, in WordPerfect 5.1 format. (Also available in WordPerfect 6.1 format in the file USTFACT6.EXE).
- MUSTS.EXE Musts for USTs: A Summary of Federal Regulations for Underground Storage Tank Systems. EPA-510-K-95-002. File is selfextracting and, when decompressed, in WordPerfect 6.1 format.
- STOT.EXE Straight Talk On Tanks: Leak Detection Methods For Petroleum Underground Storage Tanks and Piping. EPA-510-K-95-003. File is self-extracting and, when decompressed, in WordPerfect 6.1 format.
- DOLLARS.EXE Dollars And Sense: Financial Responsibility Requirements For Underground Storage Tanks. EPA-510-K-95-004. File is self-extracting and, when decompressed, in WordPerfect 6.1 format.

#### File Directory 6 (Regulations and Requirements)

- LENDLIAB.EXE Text of the Lender Liability rule as published in the Federal Register dated September 7, 1995. This file is self-extracting and, when decompressed, in WordPerfect 5.1 format.
- LIABFACT.WP5 Fact sheet (EPA 510-F-95-004) on the Lender Liability rule. WordPerfect 5.1 format.
- TECHRULE.W51 Text of 40 CFR Parts 280.1 to 280-74, Technical Requirements for Underground Storage Tanks, as published in the *Federal Register*, Vol. 53, No. 185, September 23, 1988. WordPerfect 5.1 format.
- PREAMBLE.TEC Preamble to 40 CFR Parts 280.1 to 280.74, Technical Requirements for Underground Storage Tanks. WordPerfect 5.1 format
- **SPARULE.W51** Text of 40 CFR Parts 281.1 to 281.61, State Program Approval, as published in the *Federal Register*, Vol. 53, No. 185, September 23, 1988. WordPerfect 5.1 format.
- PREAMBLE.SPA Preamble to 40 CFR Parts 281.1 to 281.61, State Program Approval. WordPerfect 5.1 format.
- FRRULE.W51 Text of 40 CFR Parts 280.9 to 280.112, Financial Responsibility Requirements, as published in the *Federal Register*, Vol. 53, No. 207, October 26, 1988. WordPerfect 5.1 format.
- PREAMBLE.FR Preamble to 40 CFR Parts 280.9 to 280.112, Financial Responsibility Requirements. WordPerfect 5.1 format.
- CODIFIC.RUL Text of 40 CFR Parts 282.1 to 282.105, Approved Underground Storage Tank Programs, as published in the *Federal Register*, Vol. 58, No. 210, November 2, 1993. WordPerfect 5.1 format.

### L.U.S.T.LINE

New England Interstate Water Pollution Control Commission 255 Ballardvale Street Wilmington, MA 01887

Forwarding and return postage guaranteed. Address correction requested.



Non-Profit Org.
U.S. Postage
PAID
Wilmington, MA
Permit No.
200