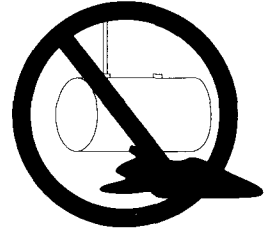


L.U.S.T.LINE



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

"We Hope LUSTLine Will Be Useful..."

by Ellen Frye

LUSTLine Bulletin #1
August 1985

Leakin' out, mixin' up, leakin' out—oopy oop.
Mixin' up, leakin' out, mixin' up—uppy up.
Gasoline, groundwater
Drinking water, gas.
Mixin' up, leakin' out. Buried tank. Alas!

Whoa, man! No man! Dis is profound!
Gotta get that BTEX outta the ground!
Whoa man! Hey man, what's goin' down?
Gotta KEEP that gasoline outta the ground!
Subtitle I is passed.
Gotta stop the leakin' fast.

Chug Chug Chug Chug
Chuggie Chuggie Chuggie.
Notification
Interim prohibition
Technical standards
Financial responsibility
Inspection and enforcement
Corrective action.
Ruba dub dubby!

Marchin' words, big job—sis boom bah.
Everybody tool up.
Rah, rah, rah.
Strategize, franchise, harmonize, analyze!
Build a better leaky trappy.
Clean up all the petro crappy.
Make the rules.
Spread the word.
We're gonna try.
LUSTLine LUSTLine
Keepin' LUST bustin' alive!



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Humor me. I haven't written any "poems" since, oh, *LUSTLine* #12 in 1990. But, recognizing that sometimes art must trump enlightened discourse to "soothe the savage beast," I thought, okay, *LUSTLine* #50 would be as good a time as any to insert a poem...for old time's sake. Humor me, also, as I trip the leak tank-tastick and reminisce, touching on the timeline of tank issues, and commenting on (with a little help from my friends) where we are now and where we might be going. Why? Because August 2005 marks the 20th anniversary of *LUSTLine*!

In 1985, U.S. EPA awarded the New England Interstate Water Pollution Control Commission (NEIWPCC) a grant to publish and distribute five issues of a bulletin that would inform and update state and federal regulatory agencies across the country on topics related to the new RCRA Subtitle I requirements. This legislation called for U.S. EPA to pro-

mulgate regulations to prevent, detect, and correct the problem of leaking underground storage tanks. We decided to call our new bulletin *LUSTLine*.

Staying on top, if not a few steps ahead, of tank-related issues is what we've tried to do for the past 20 years. We started out with baby steps and Pablum, because the magical world of UST and LUST regulation was as new to us as it was to many regulators. Early *LUSTLine* issues were only about 12 pages long. Now that we're nearly legal age for fine wine and oysters on the half shell, it's hard to imagine producing a *LUSTLine* as short as 12 pages. We've tried to meet the technical level of the majority of our readers. In essence, we've all smartened up together—we hope.

did available leak-detection and corrosion-protection technologies work... to begin with? Is secondary containment an option? How will states fund their UST programs...permit fees? registration fees? How does petroleum behave when it leaks into the environment? What cleanup technologies work best? Oh, and who's in charge? Oy!



L.U.S.T.Line

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LUSTLine is a product of the New England Interstate Water Pollution Control Commission (NEIWPCC). It is produced through a cooperative agreement (#1-830380-01) between NEIWPCC and the U.S. Environmental Protection Agency.

LUSTLine is issued as a communication service for the Subtitle I RCRA Hazardous & Solid Waste Amendments rule promulgation process.

LUSTLine is produced to promote information exchange on UST/LUST issues. The opinions and information stated herein are those of the authors and do not necessarily reflect the opinions of NEIWPCC.

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NEIWPCC was established by an Act of Congress in 1947 and remains the oldest agency in the Northeast United States concerned with coordination of the multi-media environmental activities of the states of Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont.

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LUSTLine is printed on Recycled Paper



"I can supply nothing but kudos to *LUSTLine* and what the editorial staff has accomplished over the last 20 years. I have been an avid reader of each bulletin for just over half of that time span.

Thanks to my predecessor, I have a nearly complete set, which I still reference from time to time. Thank you."

Walter Nagel,
PA DEP, UST Program

Tripping the Leak Tank-Tastick

In our first issue, we described U.S. EPA's initial game plan, explained requirements for owners/operators to notify states of their tank ownership, and shared examples of state UST efforts already underway. By September 1985, EPA had created the Office of Underground Storage Tanks (OUST). Ron Brand was named Director. We were truly off and running. OUST quickly promulgated rules for UST Notification, but they really had to put the pedal to the metal to tackle corrective action, new tank standards, leak detection, tank closure, and financial responsibility.

State and federal regulators embarked on fact-finding missions. How did UST systems work? How



"As a young federal employee, I cut my teeth on EPA's NPDES Wastewater program, and eventually I migrated to the RCRA Subtitle C Hazardous Waste program. In November 1984, I was asked to help start up this new program in EPA - New England to try to control LUST in America. How could I resist a job like that?!

But I learned very early that this new program would be different from the others. Our founder [first OUST Director], Ron Brand, had a vision that states should run this program and the EPA region's job was to help make the state programs successful. Franchising and TQM were our mantras. The rest is history... and, gosh darnit, it worked! At a meeting I attended when the Superfund program was starting up, one of my senior EPA regional managers was discussing CERCLA priorities with our states. He said the agency wanted to work in partnership with the states but that they had to realize that EPA would be the senior partner! If the UST/LUST program had tried to establish itself with that level of arrogance, it would have been impossible to achieve the true working partnership we've had over the past 20 years. In partnering with the states, I also got to work with a venerable organization called NEIWPCC. They'd been bringing the New England states and



In the early days of the UST program, when tanks were being yanked at unprecedented rates, the dangers associated with tank removal and disposal were a big concern. While health and safety will always be a concern, improved monitoring, inerting, cleaning, and dismantling of tanks has minimized accidents. The days of finding tanks lying on the side of the road are mostly in the past. However, you might find a bear or three calling a tank "home," as some of us did at an animal farm on the Olympic Peninsula in Washington State.

New York together for many years to protect water quality, including groundwater. Through this NEIWPCC connection I was drafted to write an article with a regional perspective for the first issue of this new publication called LUSTLine. That was 20 years ago. It's been covering all the bases since then. Happy 20th, LUSTLine."

William Torrey, UST/UST Regional Program Manager, U.S. EPA – New England

To Thine Own Tank Be True

At the risk of subjecting readers to a huge "Duh" moment, the only way we can prevent a petroleum release from an UST system is by ensuring that all aspects of that system, including product-delivery and -dispensing operations, are designed, installed, operated, and maintained such that a release cannot occur. *LUSTLine* has covered the gamut of technical issues associated with petroleum storage, including installer certification, product delivery, facility inspection and enforcement, and the 1998 deadline for upgrading, replacing, or removing tank systems.

We've also covered related issues such as abandoned tanks, health and safety, heating-oil and other tanks not regulated under the federal program, the future of "mom and pop"

facilities, UST facility siting, product compatibility with system components, owner/operator training and certification, and most recently, vapor releases from UST systems.

The people who know those topics best have written most of the articles on the many subjects we have covered. *LUSTLine* would not be what it is were it not for its contributors! And I thank you one and all. I am particularly grateful to a core group of contributors on whom I rely not just for articles but also for advice and content review. At the top of this list is Marcel Moreau, author of our "Tank-nically Speaking" column.

I met Marcel in 1984, when he was a geologist at the Maine Department of Environmental Protection. The New England states and New York had been meeting at NEIWPCC two or three times a year to discuss concerns about impacts on groundwater from UST-system releases. Marcel, who attended these meetings, clearly had a leg up on the subject. During his tenure at Maine DEP and in his current role as an UST-system consultant, he has served the cause of release prevention with dedication and integrity and has been an invaluable friend, advisor, and *LUSTLine* contributor—authoring or co-authoring about 40 articles on all aspects of USTs, including the human element. His articles add up to a solid body of work that should be required reading for anyone involved with USTs.

In 1989, Bob Renkes, Executive Vice President of the Petroleum Equipment Institute (PEI), initiated his column "Field Notes," giving *LUSTLine* readers an industry perspective on UST-related issues. Through the years, Bob has provided concise and timely information on the issues that most closely intersect the interests of *LUSTLine* readers and PEI members. He has also been a very sensitive sounding board at times when I have been flummoxed by a particular topic.

Since 1992, David McCaskill of Maine DEP (originally from Mississippi) has provided us with his inimitable insight into tank issues in his column "Tanks Downeast." Like Marcel, David has a knack for choosing topics that resonate nationwide. He has covered a range of themes including aboveground storage tanks, heating-oil tanks, secondary containment, waste-oil tanks, and UST facility siting. For years, he's been working (unsuccessfully) to get me out in a sea kayak.

Thanks also to Marshall Mott-Smith (Florida Department of Environmental Protection), Ernest Roggelin (Florida's Pinellas County Health Department), Kevin Henderson (Mississippi Department of Environmental Quality), Ben Thomas (Ben Thomas Associates, Inc.), and Shahla Faranak and Erin Ragazzi (formerly with the California tank program) for their bounteous input over the years.

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Taking Aim at Site Cleanup

One driving theme from OUST in the early stages of the UST/LUST program was the need to work toward continuous improvement. Looking back at early *LUSTLine* articles, one quickly realizes that our comfort zone with cleaning up LUST sites was quite narrow, but there was, and still is, continuous improvement.

One of my early articles referred to contaminated soil as the "new kid on the block of national environmental concerns." But we've come a long way. We learned that without adequate site characterization, cleanup strategies are essentially hit or miss. Seems obvious to many of us now, but maybe not so much once upon a time. Over the years, cleanup technologies went from classic muck-and-truck and pump-and-treat to in situ approaches, such as air sparging, air stripping, soil vapor extraction, and even monitored natural attenuation.

And, by the way, how clean is clean? In January 1994, I wrote a cover article called "Stop the World...It's Time to Step Off and Regroup," which was our first serious look at the subject of risk-based corrective action (RBCA, now known as risk-based decision making (RBDM)). Despite our growing understanding of the nature of the corrective-action beast, there was a growing backlog of LUST sites and a lack of a commensurate number of LUST site closures. Conditions were ripe for RBCA. From what I can gather from NEIWPC's 2003 survey on "State Experiences with MtBE and Other Oxygenate Contamination at LUST Sites," about 44 states now use some form of RBDM in their corrective-action protocols.

Then, just when it seemed like we were getting the hang of cleaning up the BTEXs, the TPHs, the PAHs, the tra las, along came the gasoline oxygenate methyl tertiary butyl ether (MtBE), and new challenges emerged. MtBE behaved differently from the other contaminants of concern—it's more soluble and mobile, seemingly less degradable and treatable, and has no MCL. As it turns

out, we are recognizing that since we don't want to be finding fuel-contaminant surprises in our drinking water, we should probably be looking a bit more closely at a wider selection of gasoline components, such as TBA, ethanol, TAME, DIPE, and EDB.



"Congratulations to LUSTLine on its 20th anniversary and on this milestone 50th issue! EPA appreciates the integral role LUSTLine has played in reaching out to underground storage tank partners over the history of the national tank program. LUSTLine has provided timely, accurate, and useful information about tank systems to many stakeholders. EPA is proud to have been a supporter of LUSTLine over these many years, and we look forward to our continued partnership in providing a forum to share information about tank issues."

Cliff Rothenstein, Director - Office of Underground Storage Tanks, U.S. EPA

As OUST Director Cliff Rothenstein reminded us in *LUSTLine* #49, "Our bottom-line job, day after day, is to protect the environment and human health from underground storage tank releases and keep America's land and water clean and safe for all citizens and future generations."

Once again, I want to thank the many contributors who helped spread the word as we grew in our collective understanding of such corrective-action enigmas as site characterization, soil and water cleanup technologies, RBCA, and MtBE and other oxygenates. I've known Pat Ellis (Delaware Department of Natural Resources and Environmental Control, Tank Management Branch) for many years. As I got to know her, I found myself calling her more and more with questions about corrective issues, until she finally agreed to be my official LUST technical adviser. Once she finished serving on EPA's Blue Ribbon Panel on MtBE, she knew more than she ever hoped to know

about that subject. She wrote her first *LUSTLine* article in March 2001.

Which brings me to my learned friend Hal White at EPA OUST, with whom I have had many thoughtful discussions on anything and everything related to LUST remediation. Hal waded into the *LUSTLine* waters in March 2002 with the article "Do Monitoring Wells Monitor Well?" He eventually wrote his own thought-provoking column called "Wander-LUST." When he bowed out, Pat Ellis graciously picked up the column and continued to run with it.

Two other people who have been there for *LUSTLine* over the years, writing and reviewing articles and answering questions, are Bruce Bauman, Soil and Groundwater Research Program Coordinator at the American Petroleum Institute, and Blayne Hartman, a soil vapor methods and analysis specialist.

The USTfields Renaissance

It seemed perfectly obvious to me waaay back in graduate school, when I was writing papers on reusing abandoned mill buildings, that reusing an existing property made a heap more sense than taking a backhoe to a verdant copse. Likewise, ignoring abandoned or idle petroleum-contaminated sites 'cause it's too much trouble to deal with the issues and easier to move on to a pretty little "greenfield," smacks of hubris—the telltale mark of a throw-away society.

Many state LUST programs and communities are seeing the benefits of reusing these properties by uniting economic development with site cleanup efforts. *LUSTLine* first covered the subject of LUST sites in brownfields in 1997, a time when the federal Brownfields program did not include petroleum contamination, and state LUST programs were more concerned with having to deal with additional hurdles to clean up these sites. But times, they are a changin'. Now we hope to demonstrate that our efforts to protect human health and the environment from petroleum releases also have a socioeconomic benefit.

Special thanks to Gary Lynn, New Hampshire Department of Environmental Services, who, among

other things, has helped keep me up to speed on USTfields, and Steve McNeely, EPA OUST's USTfields/Brownfields marriage broker.

As Steve once mused, "Hopefully, LUSTLine will be able to entice those champions of change to share their challenges, lessons learned, and accomplishments so we're better equipped to highlight our role in the grand scheme of things." Yes, Steve, LUSTLine will be there to help point the way to good sense.

Taking Aim at Paying for Site Cleanup in Order to Expedite Site Cleanup!

It's so good to know that so many sharp people are out there making sure you get things right...like the author of the next section, Chuck Schwer, Vermont Department of Environmental Conservation. I've known Chuck since the wee hours of the program, and I knew that all I had to do was ask and he would help me out with the state fund part of this article. Each year, Chuck and his staff conduct and summarize a state fund survey, the results of which Chuck presents at the Annual State Fund Administrators Conference. Take it away, Chuck.

It's hard to believe that the UST program and LUSTLine have been around for 20 years. There have been so many challenges over those years: more than a million unprotected tanks, contamination everywhere, programs understaffed and underfunded, and my favorite, the concept of financial responsibility (FR). It was this FR requirement that set the stage for the birth of state funds, as tank owners were unable to secure private insurance or find other means of financial surety. By the end of 1990, 38 states had established state cleanup funds, and by 1997, there were 48. Only Hawaii and Oregon chose not to create state funds.

For the 48 state-fund managers, funds presented unprecedented challenges. But with the help of LUSTLine, states worked together to develop tools and strategies to take on those challenges. One of the first grim facts we all faced was the reality that the cost of cleaning up all the contamination caused by leaking USTs was far greater than the funds available. To respond to this reality,

states developed strong, enforceable cost-control measures. These included allowable costs, preapproval, and limits on markups and overhead. Site cleanups also needed to be prioritized, and RBCA was born.

And then there were those nearly-impossible-to-prevent legislative raids on the funds. Despite our best efforts to put strong language into our rules to prevent such action, legislative raids still present an ongoing challenge.

Claims, claims, and more claims—would they ever stop? States had to develop streamlined claims-processing systems to survive. But what about all that fraud and abuse? This became a real threat to many state funds. Even with high-profile cases being won against perpetrators in Florida and North Carolina, state-fund managers continue to battle fraud and abuse on a daily basis. Then came pay-for-performance (PFP). Could this be a way to stop fraud and abuse, speed up site cleanup, and reduce paperwork? Fifteen states have implemented PFP programs.

And what about the reemergence of private insurance? For some states this has become a reality. Eleven states have transitioned to FR mechanisms other than state funds. Some "sunsetted" funds are still paying for the cleanup at older sites, while others are entirely done. One fund, Michigan, declared dead when it was deemed insolvent in 1995, has been reborn to help with the challenges of cleaning up contamination at older sites.

As we look to the next 20 years, we know that many of the issues we deal with today will no longer exist. However, we also know that to get there, we will have to continue to work to complete the many tasks set out by state funds. There are still more than 125,000 backlogged UST sites yet to be cleaned up. We are also discovering new sites every day—more than 1,500 nationally in the last six-month reporting period.

Vapor releases and flexible piping issues are new challenges to keeping upgraded UST systems from leaking petroleum into the environment. We all know prevention is the key. But what's the best way to get at this prevention? Third-party inspection programs? Environmental

results programs? Making compliance a condition of fund coverage? As we take on our upcoming challenges, it is comforting to know that LUSTLine will be there with tools and ideas to help state-fund managers work through these many difficult issues.



"Congratulations on your 20th anniversary. Thought you might like the contribution of a photo of a gas station in Cyprus from about the time your publication first started. It was situated close to a place called Lara Beach where the turtles go to lay their eggs. You can see that I was impressed by the storage and dispensing arrangements...and used it to refuel my rental car. Much has happened to this station in 20 years—it is now very smart. Cyprus is in the European Union and the storage tanks are now underground and double-walled steel with leak detection, thus protecting the turtles on the nearby beach!"

Jamie Thompson, Chair of the European Standards Committee for Gas Station Equipment, former regulator for London, and LUSTLine friend and contributor

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The LUSTLine Team

The *LUSTLine* team is all of you who work with us to get appropriate and timely information into each issue. We really and truly value all feedback, and we depend heavily on your input in the way of suggested stories, topics to explore, and article and photo contributions. And, we always welcome new contributors.

Our core team consists of Ricki Pappo, Hank Aho, our NEIWPCC reviewer, Kara Sergeant, and our EPA OUST project manager, Lynn DePont.

Ricki, who designs and lays out each issue, always, always goes the extra mile. She tries to keep the bulletin looking light, often in the face of

pages of weighty and lengthy written material. She is a skilled professional with a great sense of humor. Needless to say, Ricki and I welcomed our cartoonist, Hank Aho, on board with open arms. Hank is Maine's Uncontrolled Hazardous Substance Sites Unit Supervisor and an artist. It was truly a miracle to meet up with a cartoonist who actually understands the quirky world of regulators and petroleum storage systems. There's nothing like a Hank



LUSTLine Production Team: Ellen Frye, Hank Aho, and Ricki Pappo

cartoon to get us in the right frame of mind to crank out a new issue.

LUSTLine is a wonderful partnership among many people. We thank you all. See you next time. ■



California's Designated UST Operator Program's Lookin' Good

by Scott Bacon

As of January 1, 2005, each of the 15,000+ UST facilities in California was required to have a Designated UST Operator (D.O.) who is responsible for conducting monthly UST-system inspections and providing basic on-the-job training for facility employees. This requirement is in addition to the annual facility compliance inspection conducted by the local UST regulatory agency. To serve as a D.O., an individual must pass a standardized certification exam demonstrating that he or she has knowledge of UST laws, regulations, and management practices that minimize the risk of release to the environment. The D.O. certification must be renewed every two years.

Our UST System Operator Exam is based on the International Code Council's (ICC's) National UST System Operator Exam, with minor changes incorporated to address

California-specific regulations. ICC developed the exam with the assistance of the California Water Resources Control Board (CWRCB). ICC offers the exam at approximately 40 test centers throughout the state. Information on ICC's various UST-related exams can be found on its website at <http://www.iccsafe.org/certification/>.

Although exact figures are currently unavailable, regulatory inspectors throughout California are reporting that most UST facilities have assigned D.O.s and are complying with the monthly inspection requirements. Many UST owners have become certified and are serving as their own D.O.s, while others have chosen to contract with qualified third parties to provide this service. Nearly 3,500 individuals have passed the California ICC D.O. certification exam since it was first offered in August 2003, and the number of certified D.O.s continues to grow.

Our D.O. program is still relatively new, but it already appears to

be improving UST compliance in the state. D.O.s are identifying deficiencies during their monthly inspections, and working with owner/operators to make the necessary corrections. D.O.s are also implementing facility employee-training programs and helping to ensure proper responses to spills, overfills, and alarms from monitoring systems. In the coming months, CWRCB and local regulatory agencies will continue education and enforcement activities in an effort to achieve 100 percent compliance with D.O. requirements. ■

For more information on California's Designated UST Operator Program, visit the California Water Board's website at <http://www.waterboards.ca.gov/ust> or contact Scott Bacon at (916) 341-5870 or sbacon@waterboards.ca.gov.

TANKS ON TRIBAL LANDS

With this issue of LUSTLine we are delighted to introduce a new column, "Tanks on Tribal Lands." The column will provide tribal members and all of our readers with insight into the unique logistical and geographic issues, activities, solutions, and successes associated with USTs and LUSTs on tribal lands. We are honored to have Henry Haven, Jr. launch this column. Henry has served the Navajo Nation's UST/LUST program with great purpose and dedication. Following Henry's article, "T'o Iina At'eeh," Mimi Newton, U.S. EPA Region 9, discusses U.S. EPA's new memorandum clarifying its position regarding the use of federal LUST Trust Fund money at abandoned UST facilities in Indian Country.

T'O INA AT'EEH - WATER IS LIFE

by Henry Haven, Jr.

Ya'a't'eeh means "greetings" in the Navajo language. I want to introduce the Navajo people, briefly describe their traditional beliefs on the environment, and then end with a report on the UST and LUST programs in the Navajo Nation.

The Navajo Nation encompasses portions of Arizona, New Mexico, and Utah, covering more than 25,000 square miles of land—nearly the size of West Virginia. In my view, the Navajo Nation is the eighth wonder of the world. I assert this because, among other things, it is home to Monument Valley and Shiprock. Monument Valley is a scenic area in Utah with dramatic landscapes, where you'll find red mesas and towering, ancient red sandstone formations that seem to defy gravity. In the northern part, near Shiprock, New Mexico, is an igneous intrusion that towers hundreds of feet above the surrounding landscape. In Arizona, grays and purples represent ancient deposits of volcanic ash and petrified wood, well preserved in the Chinle Formation. Recent flows of black lava and red cinder cones cover the landscape in the southern parts near Flagstaff.

Navajo Traditional Beliefs

According to our traditional beliefs, the Holy People laid down the laws for the Navajo people, endowing them with sophisticated healing ceremonies for their well-being. The Navajo creation story informs us of a

series of emergence and progression through different worlds. The first world was "dark world" and was inhabited by insects. The second world was "white as light" and was bestowed to people. Then there was "yellow world." Each world underwent destructions and renewals. "The 'fifth world,'" as an old Navajo said, "would not come for thousands of years. Man does not know of its coming. As long as the plants and animals continue to live and grow, we are in the 'fourth world.' When they are gone, we will be somewhere else."

We were given sacred ceremonies with songs, prayers, and poems to maintain our health and harmony with Mother Earth, as we are all a part of her. This means living in balance with all living things, elements of the universe, and our environmental surroundings. Our language perpetuates the Navajo healing ceremonies that protect the health of Mother Earth, Father Sky, and the Navajo people.

Navajo Environmental Viewpoint

In April 1995, the Navajo Nation Tribal Council passed a resolution, a part of which said, "*In the Navajo way, the Earth is our Mother, the mountains are part of her sacred body, the water courses are veins and arteries. When the Earth is injured, the resultant instability, imbalance, and disharmony bring illness to life on Earth including humankind.*" These Navajo beliefs hold as strong as

when the Holy People first bestowed healing ceremonies on the Navajo people to maintain and protect the environment.

Water, or "to'" in the Navajo language, is one of the three most important elements for growth, nourishment, and perpetuation of all living things. Rivers, streams, springs, and all other natural sources of water are sacred. Water plays an integral role in all healing ceremonies. Air, or "nilchi," like water, is another sacred element. Air sustains all living things. The third element, sunlight, or "adinidiin," is required for the growth of plants, animals, and people.

Our UST Program

The Navajo Nation Tribal Council passed the Underground Storage Tank Act in October 29, 1998, when they saw the need to protect precious groundwater resources and to regulate the USTs located on the Navajo Nation.

In 1999, I began work with Navajo EPA to further focus the work plans for the Navajo LUST and UST program and to start the enforcement of the Navajo Nation UST Act of 1998. In the last couple of years, using grants from U.S. EPA, our program hired additional staff to become UST inspectors. Currently, there are four certified UST inspectors. Previously, the program averaged 1.6 persons to conduct UST inspections and LUST site assessments.

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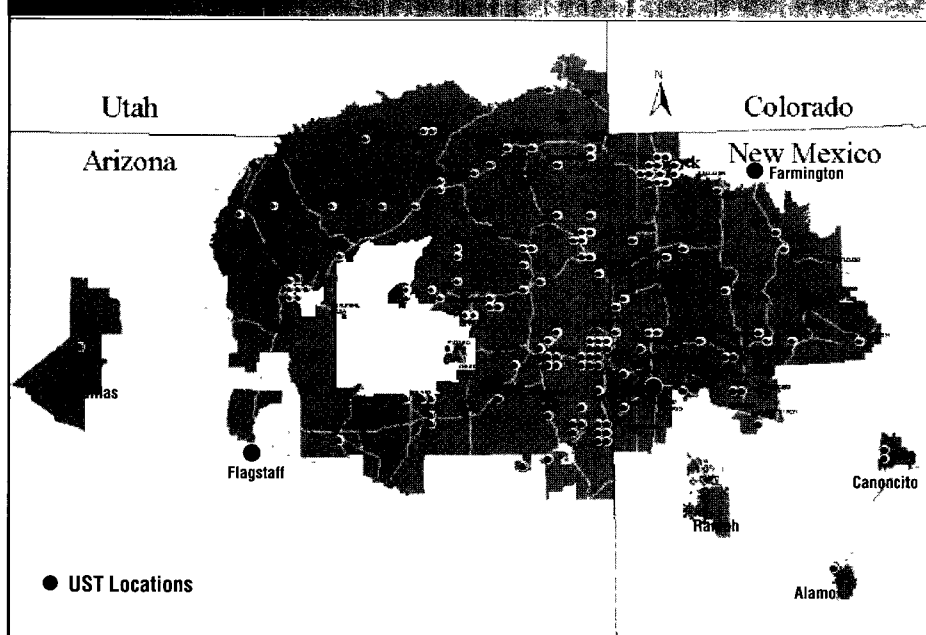
I undertook my first UST-inspection training program with U.S. EPA in 1999 and realized for the first time how huge the UST universe was on the Navajo Nation. (See Figure 1.) My initial training period consisted of observing the U.S. EPA inspector during joint U.S. EPA and Navajo Nation EPA (NNEPA) inspections. Later, I obtained an UST inspector credential from the Inter-Tribal Council of Arizona. I became the first UST inspector for the Navajo UST program office in November 2002.

I started by building an UST database to identify operating, leaking, abandoned, and questionable Navajo UST sites in Arizona, New Mexico, and Utah. With the help of summer students, we prepared files for all sites and ordered new filing cabinets to start a filing system. We ordered equipment such as a global positioning system (GPS), explosimeter, compass, and topographic maps for our program. We obtained GPS data and plotted operating UST sites on maps. We conducted field site assessments to determine how many tanks were operating and how many were abandoned in place. We compiled data on inspected UST sites for each year and recorded violations to aid the program in targeting sites for follow-up inspections.

There are approximately 1,200 USTs on the Navajo Nation; this includes operating, permanently closed, temporarily closed, abandoned, and questionable sites. There are approximately 142 operating sites on the Navajo Nation, with approximately 550 tanks in place. This number does not include Bureau of Indian Affairs facilities. Our operating UST sites include privately owned or operated service stations, Navajo Nation government refueling stations, state school bus barns, and state Department of Transportation and Navajo Housing Authority facilities.

In 2001, 45 joint U.S. EPA and NNEPA inspections were conducted. After 2001, the agencies averaged approximately 53 UST inspections per year on government-owned and privately owned service stations. In 2001, U.S. EPA and NNEPA joint UST inspections showed a compliance rate of only 2 percent. By 2004, the compliance rate had risen to 53

FIGURE 1. UST Universe of the Navajo Nation



percent as a result of the partnership, outreach, and increased inspection rates.

Our LUST Program

Since 2001, approximately 40 USTs have been closed and removed each year. In 2004, 60 USTs were removed and assessed for contamination at 24 sites. Six sites had USTs that leaked and had shallow groundwater contamination. Also in 2004, the Navajo LUST program removed 46 abandoned USTs from 16 sites and provided further assessment of several leaking UST sites. Approximately 86 abandoned UST sites remain with about 200 USTs still in place.

Section 703 of the Navajo Nation UST Act of 1998 established a Leaking Underground Storage Tank Fund for corrective actions, removal of abandoned tanks, and cleanup of contaminated sites. The program receives the proceeds of 1 cent from every gallon of gasoline sold on Navajo Nation lands.

In 2004, the NNEPA LUST program set out for the first time to use the \$1.3 million of tariff fees collected on gasoline sold on the Navajo Nation. Navajo environmental contractors were hired to go to 19 sites that had been abandoned since the 1960s to remove USTs and remediate where necessary. Navajo contractors drilled monitoring wells to assess the lateral and vertical extent of groundwater contamination and remove

petroleum-contaminated soil. Of the 19 sites addressed by NNEPA in 2004 with remedial action, 17 will be closed with no-further-action status.

The majority of our LUST sites are located in Arizona and New Mexico. Tuba City, Window Rock, and Shiprock are the communities with the most LUST sites. There are approximately 43 leaking sites on the Navajo Nation that have not been addressed with aggressive cleanup measures. Over 50 percent of the UST sites on the Navajo Nation pose a threat to shallow groundwater resources at approximately 20 feet.

Recently, the Navajo LUST program drafted preliminary groundwater and soil cleanup standards, which are stricter than those of U.S. EPA and the State of Arizona, to start addressing contaminated groundwater resources.

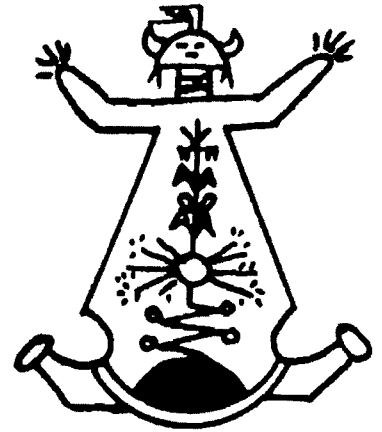
Looking to the Future

In recognition of the Navajo Nation's UST/LUST program's phenomenal success during the past five years, U.S. EPA Region 9 awarded and recognized the Navajo program with a national environmental award. The future holds great promise, as U.S. EPA and the Navajo Nation join efforts this year to begin the cleanup of contaminated groundwater sites. This year the Navajo LUST program will address seven sites to remove abandoned underground storage tanks.

I am honored to have been given the privilege to write an introductory article for *LUSTLine's* new column, "Tanks on Tribal Lands." I thank Lillie Lane, Public Information Officer with the Navajo Nation EPA, for her assistance and U.S. EPA Region 9 for

their continued assistance in developing the LUST program for the Navajo Nation. ■

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U.S. EPA Clarifies Circumstances Where LUST Trust Funds May Be Used in Indian Country

by Mimi Newton

On February 24, 2005, the U.S. EPA Offices of Underground Storage Tanks and Site Remediation Enforcement issued a memorandum clarifying the agency's position regarding the use of federal LUST Trust Fund money at abandoned UST facilities in Indian Country. As a result of the clarification, U.S. EPA Regions with jurisdiction over USTs on tribal lands may find it easier to investigate and remediate abandoned USTs with LUST Trust Fund money.

Prior to the February 24 memo, U.S. EPA guidance regarding the use of federal LUST Trust Fund dollars focused principally on LUST sites outside of Indian Country, where states are usually the implementing agencies and typically take the lead at LUST sites. At those sites, the use of LUST Trust Fund money should be limited to emergency situations, because U.S. EPA is not the implementing agency. However, the Interim Final National Corrective Action Policy for USTs in Indian Country (EPA OSWER Directive 9610.9A, Oct. 26, 1995) established that all sites in Indian Country—where U.S. EPA is the implementing agency—are eligible for LUST Trust Fund money so long as they meet the statutory criteria.

The federal Resource Conservation and Recovery Act (RCRA Section 9003(h)(2)(A)–(D)) allows the use of federal LUST Trust Fund money in four situations: (1) where no owner or operator can be found who is capable of carrying out corrective action properly; (2) where a situation exists that requires prompt action to protect human health and the environment; (3) where corrective-action costs at the facility exceed the amount

of coverage required for the facility; and (4) where the owner or operator has failed to comply with a corrective-action order.

The primary focus of the February 24 memo is USTs abandoned on tribal lands with known, suspected, or possible contamination, where the original UST owners/operators are unidentified, have not been located, or are not financially viable. The memo clarifies that federal LUST Trust Fund dollars may be used at such sites if they meet each of the following conditions:

- The United States is the trust owner of the property for the benefit of an Indian tribe or individual.
- The Indian tribe or individual did not operate or manage the UST.
- If lease documentation can be located,
 - there is evidence that the Bureau of Indian Affairs negotiated the lease on behalf of the Indian tribe or individual and
 - there is no evidence that the Indian tribe or individual actively participated in the lease-negotiation process or that any such participation went beyond minimal involvement (such as lease approval or concurrence).

The memo provides guidance to the Regions on the use of LUST Trust Fund dollars to address potential or confirmed releases from USTs on tribal lands "if the Region determines that the situation requires prompt action" to protect human health and

the environment. The memo also provides some factors the Regions may consider in determining whether a situation requires prompt action. These factors include determining whether contamination has been discovered or is suspected and the extent of the negative impact on human health or the environment from an abandoned UST that has remained unremediated for an extended period of time.

The memo also makes it clear that the Regions may take into account a number of considerations relevant to trust-land ownership in determining whether or not to pursue cost recovery against a tribe or individual trust beneficiary after LUST Trust Fund money has been expended. The memo sets forth three examples of such considerations: (1) the inability of the tribe or individual to divest itself of land ownership; (2) the nature of the leasing documentation; and (3) the participation or lack of participation of the tribe or individual in the negotiation of the lease (if any).

Shortly after the issuance of the memo, U.S. EPA's Pacific Southwest Region (Region 9) obtained approval from EPA headquarters for the use of LUST Trust Fund money at nine abandoned UST facilities. These nine facilities are located on trust lands of the San Carlos Apache and the Hopi. ■

Mimi Newton works as a RCRA attorney with EPA Region 9. She began her legal career as a RCRA enforcement attorney at EPA Headquarters in Washington, D.C. The views expressed in this article do not necessarily represent the views of U.S. EPA.

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A MESSAGE FROM CLIFF ROTHENSTEIN

Director, U.S. EPA Office of
Underground Storage Tanks

Got Water?

With the lazy days of summer upon us, water becomes a bigger part of our lives as we move our activities outside. We drink more than a half gallon of water a day, especially on a hot summer afternoon; and we each use about 50 gallons a day for cooking, bathing, and keeping our lawns green and our cars clean. On average, the typical family uses more than 100,000 gallons of water during a year. Our businesses, factories, and farms also depend on water. It takes almost 40,000 gallons of water to manufacture a car; 60,000 gallons to produce a ton of steel; and 1,500 gallons to process a barrel of beer.

Most of the time, we take our water for granted, and for good reason—it's readily available and doesn't cost much. The fact is water's a bargain, costing on average only about \$2 for every 1,000 gallons of water supplied to a home. And most of the time we assume that our water will always be available, plentiful, and clean.

But we all know that when gasoline leaks from an underground tank it can easily contaminate the surrounding groundwater. In fact, some states have identified USTs as the leading threat to groundwater, the source of drinking water for half of all Americans. And when a water source is contaminated, a lot of time, effort, and money go into cleaning it up, treating the groundwater, rehabilitating the aquifer, or finding an alternative water supply.

Prevention Is Essential

We know that preventing a release by making sure petroleum does not contaminate soil and groundwater in the first place costs much less than cleaning up a leak after it has polluted the environment. I'm pleased that we've seen confirmed releases drop significantly—approximately 35 percent over the last year. So, we need to continue that trend and heed Ben Franklin's byword—"An ounce of prevention is worth a pound of cure"—and do everything possible to prevent releases and detect them early.

In the United States, we have a universe of about 660,000 federally regulated tanks. It is important to inspect these tanks on a routine basis to ensure that they are operated and maintained correctly and that the tank systems are in compliance with release-prevention and leak-detection requirements. Inspections are an important tool in determining whether owners and operators are operating and maintaining their systems correctly.

Yet inspection rates vary greatly across the United States—from once every year in some states to no more than once every ten years in others. I know it takes more resources—people and money—to increase inspections, but that investment will pay off manyfold.



I urge you to make prevention a priority and use some of the creative prevention approaches we've developed together. Consider taking the following actions:

- Adapt the environmental results program (ERP) to help improve owner and operator compliance with tank regulations.
- Target UST facility inspections in source-water protection areas.
- Use our recently released *UST-LUST Virtual Classroom* to more efficiently train inspectors (<http://www.epa.gov/oust/virtual.htm>).
- Implement a third-party inspection program.

Cleanup Is Our Responsibility

Together we've accomplished much—over the past 20 years, more than 323,000 cleanups have been completed. And just this past year, more than 14,000 contaminated sites were cleaned up. Nonetheless, we're seeing a decrease in the pace of cleanups. Over the past year, the cleanup pace has fallen by 22 percent from 18,518 in 2003 to 14,285 in 2004.

Although the cleanup backlog—currently at 125,000—is at its lowest level since 1992, we still need to aggressively tackle the backlog and each year do our best to achieve our cleanup goals. I understand that some of the remaining cleanups are those that are more complex and may require lengthier cleanup processes because of complications, including contamination from MtBE.

But we know it is important for our country's environment and America's citizens that we work diligently to clean up sites. I urge you to apply some of the creative approaches we've jointly developed. Consider taking the following steps:

- Target source-water areas to make the best use of resources to reduce the risks UST releases pose to drinking-water sources.
- Streamline cleanups to complete them faster and cheaper by:
 - Developing multi-site agreements
 - Using the Triad approach where stakeholders evaluate sites and make cleanup decisions collaboratively
 - Applying lessons learned from optimizing cleanups at difficult sites in pilot states
 - Using pay-for-performance contracting.
- Apply some of the lessons learned from existing MtBE sites.

And through petroleum Brownfields grants, we need to facilitate cleanups in order to foster productive reuse—as parks or recreation centers or municipal buildings—of sites that previously blighted the surrounding communities.

We're Partners in This Work

Together states, tribes, local governments, and industry—along with EPA—have done a great job of protecting America's precious water resources. I thank each of you for your determination and tenacity and willingness to tackle this huge job. And I remind you that we still have so much more to do to ensure that future generations of Americans can continue to drink, use, and play in clean water. ■

South Carolina

What South Carolina Is Learning About Ethylene Dibromide (EDB) at LUST Sites

by Read Miner

On a daily basis, each state routinely reviews numerous reports documenting assessment and corrective-action activities at UST sites. Commonly, project managers review the projects and make decisions based on the needs of each individual project. Staff rarely have the time or resources to compile the data from numerous sites in order to look for common trends among sites, or to understand the behavior of a particular chemical such as ethylene dibromide (EDB or 1,2-dibromoethane). Because of EDB's toxicity and prevalence, the South Carolina Department of Health and Environmental Control (DHEC) UST program determined that an in-depth inquiry was necessary to evaluate policies regarding the chemical.

EDB and 1,2-dichloroethane (1,2-DCA) were both part of an antiknock additive package used in leaded gasoline from the 1920s through the 1980s. (See "Leaded Gasoline?" on page 15 to learn how leaded gasoline and these additives are used today.) Although approximately 90 percent of the EDB in the United States was used in leaded gasoline during that time period, it was also used as a pesticide until approximately 1984.

The DHEC UST program first started testing for EDB at LUST sites in the early 1990s. Initially, we requested that U.S. EPA analytical methods 8260 and 8260B be used. However, because of the toxicity of EDB and its corresponding maximum contaminant level (MCL) of 0.05 µg/L, these methods were found to be insufficient since their reporting limit was 5 µg/L. EPA analytical method 8011, with a lower reporting limit of 0.02 µg/L, is now our standard. Last year, 1,2-DCA was added to the list of analytes using EPA method 8260B.

Our database allows us to electronically track the concentrations of chemicals of concern at specific UST sites. During 2003, Nimeesha Bul-

sara, a Clemson University graduate student, queried the database to determine the occurrence of EDB at UST facilities in South Carolina as part of her thesis. The results were later published (Falta and Bulsara 2004 and Bulsara 2004).

Additional database queries by Clemson University students James Henderson and Richard Mayer were conducted in December 2004 to build on Bulsara's research. They found that approximately half of the UST sites assessed to date in South Carolina contain EDB in the groundwater (R. Falta et al. 2005). These findings prompted UST program staff to conduct a random survey of 104 of the confirmed EDB sites to better quantify the magnitude of the EDB problem.

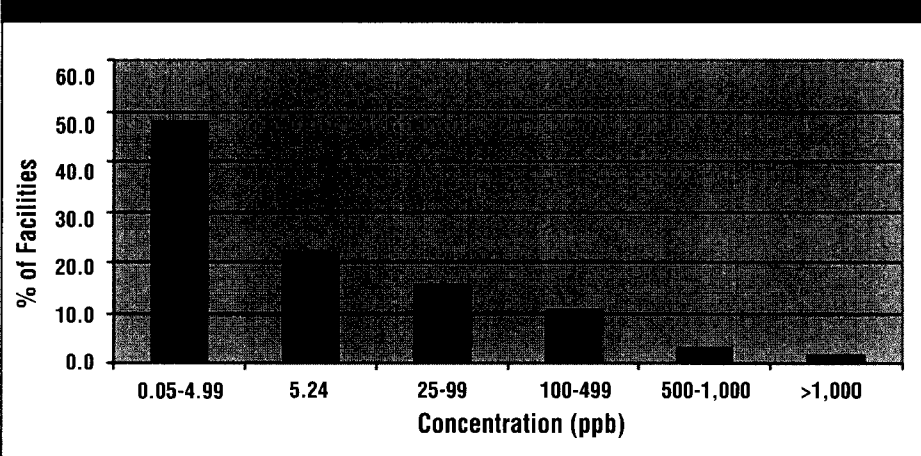
Distribution of EDB in South Carolina

The 104 facilities included in the random survey are located in 14 coun-

We reviewed the technical files for each facility and recorded the following information: permit number, county, UST installation date, number of wells in the monitoring network, number of monitoring wells containing EDB, highest benzene and EDB concentrations, length of the BTEX and EDB plumes, and seepage velocity.

The data were evaluated and several summary figures were prepared. Figure 1 depicts the percentage of sites where EDB was detected within a given range of concentrations, reflecting the highest concentrations detected at each facility. The highest concentration of EDB detected to date in groundwater at a South Carolina UST site was 6,550 µg/L. Approximately 1 percent of facilities with EDB had concentrations exceeding 1,000 µg/L. Almost half of the sites had EDB concentrations of less than 5 µg/L. This is an important finding, as concentrations

FIGURE 1. EDB concentrations at UST facilities.



ties. Nine of the counties are in the coastal plain (primarily sedimentary surface lithologies), and five counties are in the piedmont province (composed primarily of metamorphic rock and saprolite). Sediments at the facilities range from relatively clean sands to silty sands, sandy silts, and clays with a full range of seepage velocities.

are routinely found at levels below the reporting threshold of some analytical methods.

If an analytical method such as EPA method 8011 or an equivalent method that can achieve a reporting limit of <0.02 µg/L were not used, approximately half of the EDB

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■ **EDB at LUST Sites** from page 11

plumes in excess of the federal MCL would go undetected.

Figure 2 plots benzene versus EDB concentrations. The benzene concentration was assumed to be 40,000 µg/L for each site containing light non-aqueous-phase liquids (LNAPL). Benzene and EDB concentrations do not appear to be correlated. This lack of correlation could reflect many possible factors, including, but not limited to, unknown release dates, multiple superimposed releases at each facility, and differential degradation rates for each chemical.

Figure 3 depicts the percentage of sites in the survey with EDB plume lengths falling within a given range. Although EDB plumes as long as 2,800 feet have been confirmed at UST facilities in South Carolina, approximately 87 percent of the EDB plumes appear to be limited to within 250 feet of the USTs, lines, and dispensers. At about half of the EDB sites, the length of the EDB plume approximates the dimensions of the BTEX plume. Approximately 44 percent of the sites have longer BTEX than EDB plumes and approximately 6 percent of EDB plumes exceed the length of the BTEX plumes.

Unfortunately, EDB's fate and transport mechanisms are not very well understood. Based on EDB's low Henry's constant, low retardation, and recalcitrance to biodegradation, one would expect most EDB plumes to exceed the length of the BTEX plumes. That the opposite was found may be a direct result of the limitations of typical assessment techniques.

In South Carolina, petroleum plumes are typically defined using direct-push equipment and the semi-quantitative analysis of organic concentrations using field-screening methods capable of producing real-time field data. The results of the field screening are then used to determine the optimum number and location of monitoring wells and appropriate screened intervals to define the BTEX and MtBE plumes in three dimensions. Unfortunately, typical field-screening methods, such as PID, FID, Immunoassay, and HACH Test Kits, do not achieve the required reporting limit for EDB of .02 µg/L. Further-

FIGURE 2. Benzene concentrations in relation to EDB concentrations.

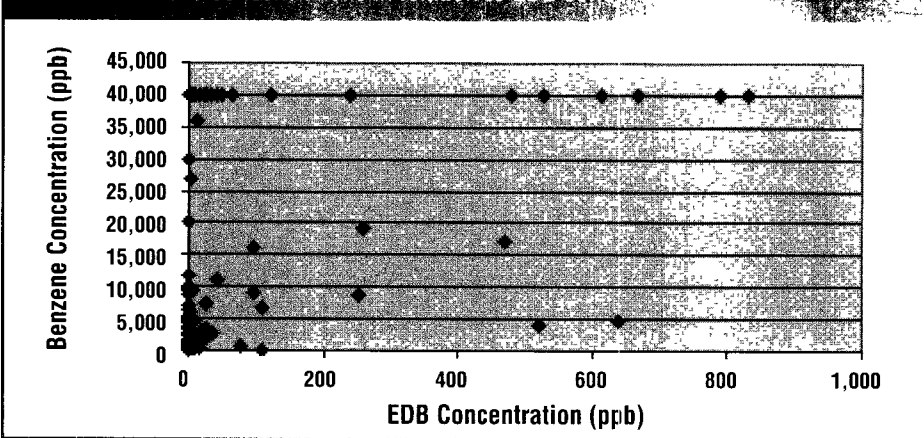


FIGURE 3. Lengths of EDB plumes at UST facilities.

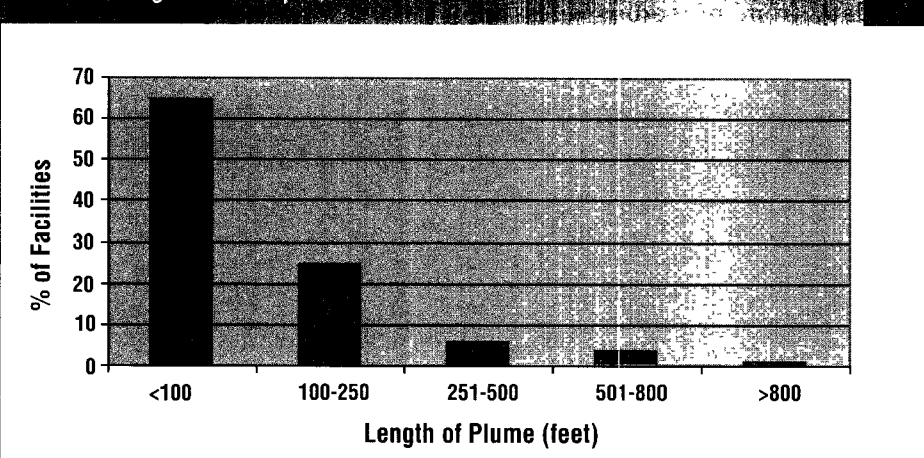
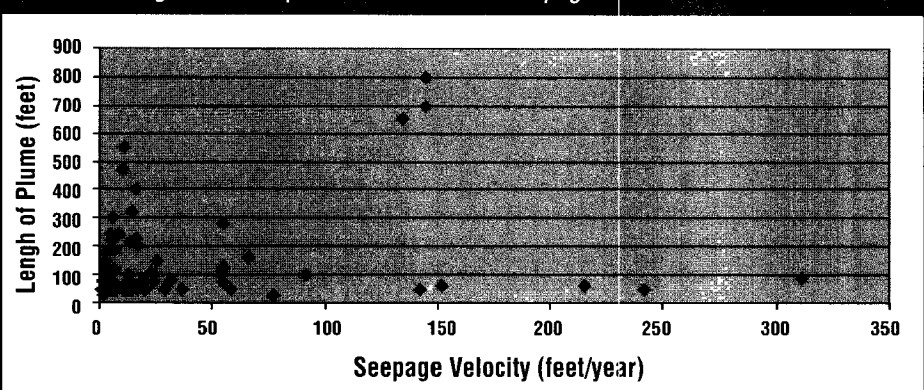


FIGURE 4. Lengths of EDB plumes in relation to seepage velocities.



more, PIDs and FIDs only look at volatiles.

Based on a review of numerous maps, the longer EDB plumes are commonly very narrow, cigar-shaped features. In addition, EDB commonly dives with increasing distance from the source. Many cases were also noted where EDB was present in the deep monitoring wells but was no longer present in the shallower water table bracketing wells. Because of these behaviors, it is likely that an EDB plume may be missed by

a monitoring well network designed for BTEX or MtBE. Field-screening methods and monitoring networks may need to be modified to better address EDB.

Figure 4 plots the length of each EDB plume against its corresponding seepage velocity. Facilities with high seepage velocities but very short EDB plumes cannot be explained with the available data. A short plume may be caused by factors other than the seepage velocity, such as biodegradation, or could indicate that the main EDB

plume may be detached from the source area. The facilities with very low seepage velocities but long EDB plumes could represent releases that occurred more than 50 years ago. This is an important finding because it implies that EDB at these sites is very recalcitrant to biodegradation.

Natural Attenuation

Further evidence of EDB's possible recalcitrance to biodegradation emerged when a large number of additional UST releases were evaluated for evidence of natural attenuation. For each site, the data collected during the assessment and subsequent monitoring phases were compiled and plotted against time. Each facility showed evidence of benzene degradation (some much more than others).

Although the dimensions of the EDB plumes appeared to be stable, clear evidence of any EDB biodegradation was not observed in monitoring programs lasting as long as three to four years, where groundwater samples were analyzed using EPA method 8011. Thus, we can reasonably conclude that if EDB biodegradation is taking place, verification may require much longer monitoring programs.

Treatment of Sites Containing EDB

The DHEC UST program establishes site-specific target levels or cleanup goals for each facility using a risk-based corrective action (RBCA) approach. Because of its toxicity, mobility, and persistence, EDB was identified as a chemical of concern many years ago. Approximately 3 percent of the releases of EDB have impacted water supply wells. In order to restore or protect water supply wells, approximately 6 percent of the corrective actions currently in progress at UST facilities in the state require treatment of EDB.

To further our understanding of EDB, we reviewed the progress of EDB remediation. The corrective actions that were reviewed for this purpose may or may not have been geared to EDB remediation. Our general observations, which are summarized below, are related to EDB and should in no way be misconstrued to be a detailed analysis of site-specific

FIGURE 5. Temporal change in EDB concentrations near the UST basin.

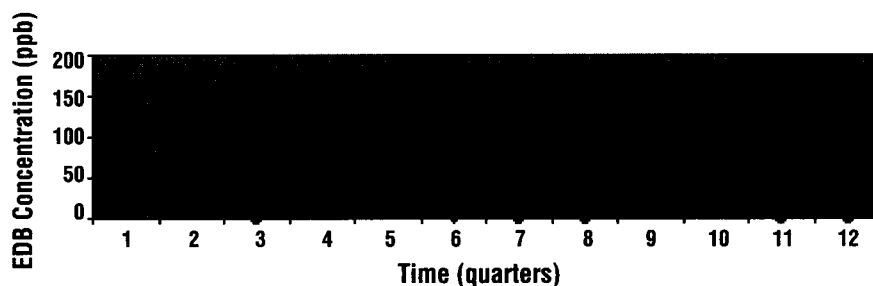


FIGURE 6. Temporal change in EDB concentrations 80 feet downgradient from the UST basin.

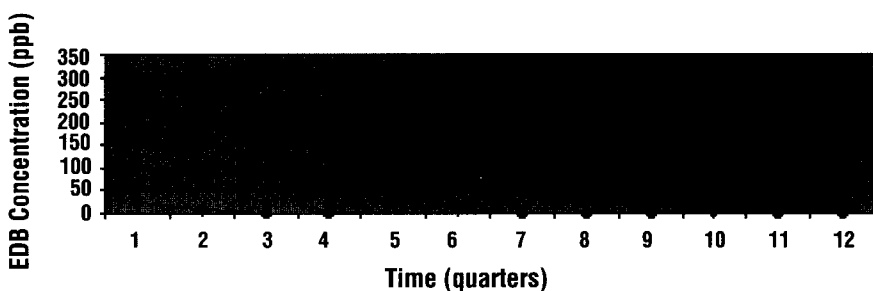
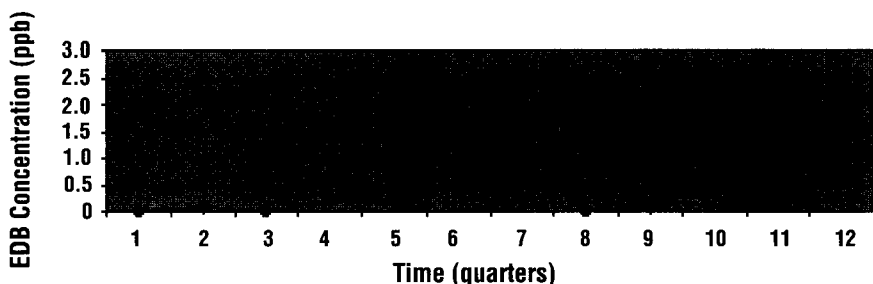


FIGURE 7. Temporal change in EDB concentrations 140 feet downgradient from the UST basin.



cleanups or the effectiveness of cleanup technologies.

For each corrective action, monitoring wells are sampled every three months (quarterly) to track the effectiveness of the corrective-action system. Since the treatment technologies examined utilize injection and recovery wells, the monitoring wells are used solely to measure groundwater quality. For each monitoring well containing EDB, we plotted the concentrations of benzene and EDB against time.

■ Air Sparging

Air sparging has shown mixed results for treatment of EDB. In one case, where the EDB plume was confined to the permeable UST basin,

and the air-sparge wells were installed with overlapping radii of influence, the EDB rapidly attenuated to below laboratory detection limits. In all other cases, the measured concentrations of EDB increased in the vicinity of the USTs subsequent to the initiation of air sparging. Figure 5 depicts the changes in EDB concentration after air sparging began at a site located in Jasper County, South Carolina. In this example, EDB concentrations increased in the UST basin two quarters after air sparging commenced. *Because EDB has a fairly high vapor pressure and a very low Henry's constant, it is possible that the air sparging*

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■ EDB at LUST Sites from page 13

may evaporate EDB from the LNAPL, but the vapors may then partition into the pore water, resulting in elevated EDB concentrations in the groundwater (R. Falta, personal communication, 2005).

Figure 6 depicts the concentrations of EDB through time at a point located 80 feet hydraulically down-gradient from the UST basin. A large increase in EDB concentration was seen five quarters after air sparging began. Figure 7 shows a large increase in EDB 140 feet hydraulically down-gradient from the UST basin during the seventh and tenth quarters after air sparging started. Although it is clear that air sparging is remobilizing some of the EDB, it is unknown to what extent the EDB may be volatilized or bioremediated.

■ Chemical Oxidation

At some EDB sites treated with hydrogen-peroxide injection, EDB concentrations have increased (two years into cleanup) above precleanup levels with subsequent erratic concentration fluctuations. At other sites, EDB degradation is suggested. In all cases, remobilization of EDB is indicated.

■ Enhanced In Situ Bioremediation

In the enhanced in situ bioremediation cases that were observed, EDB concentrations in the source area increased by one to two orders of magnitude subsequent to injection of the mixtures, and either continued to increase or fluctuated significantly during the first two to three years of corrective action. No verifiable attenuation of EDB was observed at any of the enhanced in situ bioremediation sites. *Note: Although it has not yet been proven, research suggests that EDB may degrade better in highly anaerobic settings. If this is true, the addition of oxygen to enhance BTEX degradation may hinder the EDB breakdown process (R. Falta, personal communication, 2005).*

■ Phoster II™

Phoster II, a patented technology whereby air, nitrogen, and phosphorous are injected into the ground as a vapor to make the nutrients more readily available to the microorganisms, has shown positive results at one site where EDB was present. At this site, the EDB concentration

increased from 31 to 49 µg/L one year after treatment began. However, during the subsequent two years of treatment, EDB has shown an overall reduction to 1 µg/L. Additional monitoring of the ongoing corrective action will be necessary to determine whether this technology can reduce EDB to less than 1 µg/L.

Because of these behaviors, it is likely that an EDB plume may be missed by a monitoring-well network designed for BTEX or MtBE. Field-screening methods and monitoring networks may need to be modified to better address EDB.

■ Pump-and-Treat/ Bioremediation Combination

EDB reduction has been favorable at two sites where a combination of pump-and-treat and bioremediation is being used. The cleanup strategy at each of the facilities is to pump the groundwater from the ground, treat the water aboveground using an air stripper, treat the water in a bioreactor, and subsequently polish the water using granular activated carbon. Nutrients are then added to the treated water prior to subsurface reinjection into the plume.

This treatment successfully reduces EDB concentrations from as high as 1,100 µg/L to less than 0.02 µg/L a majority of the time. However, sporadic breakthrough of EDB at concentrations less than 1 µg/L has been noted. While concentrations of benzene and EDB have decreased favorably in monitoring wells located in the near-source portion of the plume (within the capture zone of the pumping wells), monitoring wells located on the perimeter of the plume (outside the capture zone of the pumping wells) that were historically clean are now showing low concentrations of EDB. Although pump-and-treat/bioremediation appears to be an effective combination for treatment of EDB, complete containment of the plume is still critical given EDB's high mobility.

Can We Afford to Ignore EDB?

Although a lot of work is still needed to understand EDB at UST sites, it is imperative that we expend time and effort to quantify its presence at each release where it is likely to have been present and make appropriate risk-based responses to protect human health and environmental receptors. EDB is found at approximately half the releases that have been assessed in South Carolina. It is toxic, mobile, and persistent. Natural attenuation of EDB is very slow and cannot be relied on in time-sensitive cases with threatened receptors.

The cleanup of EDB is necessary at some sites. The available data from South Carolina sites currently in corrective action suggest that the commonly employed technologies for benzene treatment may not work as effectively for EDB.

Research Needs

EDB presents many research needs. A better understanding of the distribution of residual EDB in the source areas is critical to developing a good corrective-action strategy. We need to better understand EDB's fate and transport properties as well as its degradation pathways and processes. Once these factors are better understood, treatment techniques need to be adapted accordingly to maximize the removal efficiency for BTEX, MtBE, and EDB. ■

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He can be reached at miners@dhec.sc.gov. For more information on EDB in the environment, see LUSTLine #47, "Lead Scavengers: A Leaded Gasoline Legacy?" by Ron Falta and Nimeesha Bulsara.

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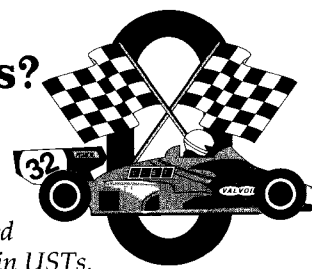
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Leaded Gasoline?

Hmm, What's in Those Underground Storage Tanks?

by Steven Burton

A common misperception today is that leaded gasoline no longer exists. To most people, leaded gasoline is a relic of the past—gone with the wind. In reality however, leaded fuels are still produced today and used primarily in small-aircraft aviation and certain off-road vehicles. These leaded fuels are sometimes stored in USTs. As I have learned, determining the specific constituents of leaded gasoline presents a challenge.



Lead Lives!...Off Road

Leaded gasoline was widely produced and used throughout the United States from the early 1920s until the phase-out of leaded gasoline began in 1973 and was finalized in 1996, when the Clean Air Act banned the sale of leaded gasoline for "on-road" vehicles. Generally, for the purpose of the ban, all cars, trucks, and buses that are driven on streets and highways are considered on-road vehicles.

Most people today assume that leaded gasoline no longer exists because it's not usually available for sale at most gasoline refueling stations. However, pilots of small-piston-engine-powered aircraft and drivers of off-road vehicles, such as racecars and racing boats, are well aware of the existence of leaded fuel. The types of piston-driven engines found on small, general-aviation aircraft, racecars, and the like have higher performance requirements due to their high compression ratios.

Leaded fuels found today usually contain much higher amounts of octane-enhancing antiknock additives than normal unleaded fuels and, as a result, leaded fuels are the fuels of choice for use in high-performance, piston-powered engines. The Clean Air Act did not ban the use of leaded fuels in aviation and off-road vehicles.

What's in Leaded Aviation and Racing Fuels?

In an attempt to determine what is present in various leaded-gasoline formulations, I conducted a limited search on the Internet for publicly available Material Safety Data Sheets (MSDS) from the websites of various suppliers and manufacturers of leaded aviation and racing fuels. I needed this information to support comments I was preparing for a draft

document being compiled on the lead scavengers ethylene dibromide (EDB) and 1,2-dichloroethane (1,2-DCA).

I obtained four MSDS from the websites of four different suppliers of leaded aviation fuels. The leaded aviation fuel most commonly used in reciprocating piston-engine aircraft is known as Avgas, and it is usually found in two main grades—Avgas 100 and Avgas 100LL (low lead). The number 100 represents the octane rating of the fuel.

Avgas 100 has a high lead content and is dyed green for identification purposes. Avgas 100LL is the low-lead version of Avgas 100 and is dyed blue. Avgas is available in a variety of other octane ratings, but the Avgas 100 octane rating appears to be the most common. I also found out that Avgas fuels should not be confused with other aviation turbine fuels, such as jet fuels, as these fuels are unleaded. Both Avgas 100 and 100LL grades contain tetraethyl lead (TEL), chemical abstract service (CAS) number 78-00-2, which is used as an anti-knock additive.

I also obtained a number of MSDS from the websites of two racing-fuel suppliers. All of these MSDS also indicated that TEL was a constituent in the fuel formulations.

All of the MSDS had the standard laundry list of CERCLA hazardous substances that are usually and customarily found in gasoline, such as benzene, toluene, ethyl benzene, and xylene (BTEX). But I discovered something was apparently missing in all of the MSDS except one of the Avgas 100LL MSDS.

Where There Are Leaded Fuels, There Must Be Lead Scavengers!

Recent articles by Dr. Ron Falta of Clemson University have covered a

considerable amount of information on EDB and 1,2-DCA, and I will not duplicate all of that information here. (See *LUSTLine* #47, "Lead Scavengers: A Leaded Gasoline Legacy?") But as a quick refresher, both EDB and 1,2-DCA are synthetic organic chemicals used as lead scavengers in leaded gasoline to prohibit the formation of lead oxides on spark plugs and exhaust valves in piston engines during combustion.

Recently, I was involved in an enforcement action and subsequent court case involving USTs at an airport that stored Avgas. The enforcement action required that the contents of the tanks at the airport be sampled and analyzed. One of the tanks stored viable Avgas 100LL fuel. The volatiles scan of the Avgas 100LL sample indicated that EDB was present in the fuel at 460 milligrams per kilogram (mg/kg). The amount of benzene detected in the sample was 120 mg/kg. My experience on this enforcement case alerted me to the fact that EDB was a constituent in Avgas. I wondered why only one of the Avgas 100LL MSDS listed EDB as a constituent of the leaded gasoline's formulation and the other Avgas MSDS did not.

The Quest for More Knowledge

I contacted one of the Avgas suppliers whose 100LL MSDS did not list any lead scavengers and inquired about the apparent omission of EDB. At the outset, a number of representatives denied that EDB was an ingredient in the company's Avgas formulations in accordance with its MSDS. Not satisfied with these answers, I inquired further until I made contact with an engineer who was knowledgeable about the company's aviation fuels and their formulations.

■ continued on page 16

■ **Leaded Gasoline** from page 15

At first, he also denied that EDB was contained in the company's Avgas 100LL fuel. I then asked, if EDB was not a constituent in the Avgas 100LL, then what substance was being used to prevent the formation of lead oxides on the spark plugs and exhaust valves during combustion? He replied that he did not know but would find the answer. Later, he contacted me and revealed that EDB was, in fact, a constituent in the Avgas 100LL. He further explained that EDB was apparently an additive in the TEL package the company purchased from a foreign supplier. The contents of the TEL package are blended in during the production of the Avgas 100LL fuel.

Later, I contacted a supplier of leaded racing fuels whose MSDS I obtained from the Internet did not list any lead scavengers and inquired about what substances were being used as lead scavengers in the company's racing fuels. Again, I was transferred a number of times within the company in an attempt to find someone who could answer my questions. Finally, I made contact with a knowledgeable company representative who informed me that the company's leaded racing fuels did indeed contain both of the lead scavengers EDB and 1,2-DCA.

The TEL Tells

In subsequent discussions with these leaded-fuel suppliers, I was informed that two suppliers provide TEL anti-knock-compound packages that are used in the production of Avgas and leaded racing fuels in the United States. I also discovered that both TEL suppliers obtain their product from the only remaining site in the world that actually manufactures TEL. This manufacturing site is located in Europe.

I contacted both TEL suppliers and obtained copies of the MSDS for their respective TEL packages. All of the MSDS listed either 1,2-DCA and/or EDB as an ingredient in the TEL package formulations. Representatives from the TEL suppliers informed me that generally two TEL packages are produced, one for Avgas and another for racing fuels.

Only EDB is used as a lead scavenger in Avgas. Both EDB and

1,2-DCA are usually included as lead scavengers in racing fuels, but some racing fuels may contain only EDB. After further examination of the TEL MSDS, I found it interesting that the concentration of EDB in the TEL package for Avgas is 35.73 percent by weight as compared to 17.86 percent in the TEL package for racing fuels. 1,2-DCA is also found in leaded racing fuels at 18.81 percent by weight.

Be Aware

I have learned a couple of valuable lessons thus far from this exercise. First, lead scavengers are not to be found just at older UST release sites; they are still key ingredients in Avgas and racing gasolines. Second, MSDS do not necessarily list all of the environmentally significant ingredients found in leaded fuels. So, when responding to releases from tanks storing these products, be aware that the MSDS may not identify all of the chemicals of concern, such as EDB or 1,2-DCA. Because of the extremely low MCL for EDB in drinking water,

this could be especially critical information at sites where direct exposure is a concern.

Stay Tuned

The Occupational Safety and Health Administration (OSHA) within the Department of Labor is the federal agency responsible for setting the standards for MSDS. Copies of the various MSDS I obtained from the Internet have been forwarded to OSHA's Atlanta Regional Office for assessment regarding compliance with OSHA's rules and requirements. The results of their review may be discussed in a future *LUST-Line* article. ■

Steven Burton is an Environmental Scientist with U.S. EPA Region 4 and manages the Region's LUST Trust Fund. He can be reached at burton.steven@epa.gov. For more information about lead scavengers, visit EPA's Lead Scavengers website at <http://www.epa.gov/oust/pbscavms.pdf>.

NEIWPCP Publishes Source-Water Protection Guide

by Kara Sergeant, NEIWPCP

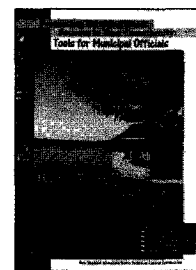
What steps can municipal officials take to protect public drinking water supplies? NEIWPCP provides the answers in *Water Today... Water Tomorrow? Protecting Drinking Water Sources in Your Community: Tools for Municipal Officials*, a new 52-page guide funded by U.S. EPA. The target audience of municipal officials includes town employees and volunteers on planning boards, conservation commission members, and other related positions. These are the people with the power to make decisions at the community level, such as enforcing a new protective zoning ordinance or starting a septic-tank registration database.

For the most part, states have already begun the protection process by developing useful Source Water Assessment Program (SWAP) reports that assess potential threats to public water supplies for each area in the state. NEIWPCP created the guide and a companion series of fact sheets to help officials understand these reports and identify ways they can implement protection at the municipal level. The guide even provides useful ideas for towns with mostly private wells.

The guide focuses on five key areas of vulnerability as identified by state groundwater and source-water protection managers—local regulations and ordinances, underground storage tanks, on-site sewage disposal systems, hazardous materials storage, and stormwater runoff. The guide features background materials for those who want to learn the basics of source-water protection, and specific strategies for action on each of the five topics. The guide is color-coded, so it is easy to find information on septic systems, for example, if that is the main concern in a community. Each of the five topic chapters contains several case studies showcasing ways other towns and communities have addressed those problems.

Written and designed for NEIWPCP by Enosis—The Environmental Outreach Group, the guide and fact sheets have been widely distributed, and only a limited number of printed copies remain. At this time, we must limit orders to one set of materials. The shipping charge for one set of fact sheets and a guide is \$2.50. To order a copy, send your name, address, and phone number to NEIWPCP at the address on the back of *LUSTLine*. The guide and fact sheets can also be downloaded for free at our website (www.neiwpcp.org/sourcewateroutreach).

For more information about the project, contact Kara Sergeant at ksergeant@neiwpcp.org.





10,000 Facilities to Inspect!

GIS Shines a Light in the Long, Dark Tunnel

by Rebecca Jamison

Problem #1: More than six million people depend on groundwater as a source of drinking water in New York State (NYS) (NYSDEC, 1986; NYSDEC, 1987). Many of these drinking-water source areas are underlain by highly permeable aquifer systems that are vulnerable to contamination.

Problem #2: U.S. EPA Region 2 Ground Water Compliance Section (GWCS) (<http://www.epa.gov/docs/Region2>) extensively supports the UST programs of New York, New Jersey, the Virgin Islands, and Puerto Rico and directly implements the Underground Injection Control (UIC) programs in New York and the Virgin Islands. With a staff of 12 inspectors (five UST and seven UIC), GWCS faces a huge challenge in implementing the programs. With a potential 120,000+ UIC locations in NYS alone, and hundreds of UST referrals, our inspection staff faces a daunting task in determining where to go. Which areas are most vulnerable to contaminants and which communities should we focus on first?

The Risk Focus

As a response, the Region began utilizing a groundwater-endangerment-risk analysis approach in 2002. Charles Hillenbrand, of U.S. EPA Region 2, laid the groundwork by creating a regional Groundwater-Endangerment-Risk Map for New York State in 2001. This map considers the following key factors:

- Risk of introducing contaminants at or near the surface of the earth as a function of land use
- Susceptibility of aquifer systems to contamination, which is a function of vertical linear velocity of the unsaturated zone and the depth to the water table
- Human use of groundwater as a source of drinking water.¹

To utilize Hillenbrand's hydrogeological analysis, the following map layers are imported:

- State/federal facility information
- Dunn and Bradstreet commercial listings
- North American Industry Classification System (NAICS) data
- Land-use information from the USGS
- Census data on sewerage/non-sewered communities.

These combined data layers indicate the geographic regions with the greatest potential for rapid transport of contamination to drinking water—high-risk areas. With this information, the UST/UIC program then utilizes ArcMap 9.0 to review inspec-

tion referrals, decide on focus areas, and interpret and address agency priorities (e.g., Environmental Justice, Children's Health Initiative).

How Is the Risk Map Used?

With the information input into GIS, EPA focuses on facilities that typically use significant quantities of hazardous substances and that are located in areas with the following characteristics:

- relatively fast surface-to-groundwater travel rate
- groundwater serves as the primary source of drinking water (public and/or private)
- no public wastewater treatment systems (nonsewered).

than the largest surface dimension (length or width) of the disposal facility. UIC Class V wells are shallow wells that inject nonhazardous wastes. They are typically on-site disposal systems, such as floor and sink drains, leach fields, and similar types of drainage wells. This category includes the motor-vehicle waste-disposal wells that are the subject of this report.

Table 1 displays the results of UIC Class V well inspections performed during the first half of fiscal year 2003 as compared to UIC facility inspection results from the first half of fiscal year 1997. The table considers facilities that have been inspected and located by a global positioning system (GPS).

TABLE 1 SUMMARY OF UIC WELL IDENTIFICATION—1997 AND 2003.

Fiscal Year	Total GPSed UIC Inspections	Class V Wells Discovered	Percentage of Wells Discovered	Wells in High GER Areas	Percentage of Wells found in GER Areas
1997	185	29	16%	2	1%
2003	235	78	33%	78	33%

UIC Inspection-Targeting Results

In October 2002, the UST/UIC program began using the Risk Map for UIC Class V wells, targeting well inspections in NYS. The law defines an injection well as any bored, drilled, or driven shaft or dug hole used to discharge fluids underground, where the depth is greater

As shown in Table 1, of the 185 inspections performed in 1997, 29 UIC Class V wells were discovered. Of these wells, only two were located in areas of significant groundwater-endangerment risk (GER). The 1997 rate of UIC Class V well discovery per inspection was 16 percent, but only 1 percent of the inspections yielded UIC Class V wells in areas of significant groundwater-endangerment risk.

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■ GIS from page 17

Table 1 also shows that in 2003, 235 UIC Class V well inspections yielded the discovery of 78 UIC Class V wells in areas of significant groundwater-endangerment risk. In 2003, UIC Class V well inspections yielded a Class V well discovery rate of 33 percent; the rate of discovery of UIC Class V wells in areas of significant groundwater-endangerment risk was also 33 percent.

UST Inspection-Targeting Methodology

For UST inspection targeting, NYS UST registration data is used to post UST facilities in areas of significant groundwater-endangerment risk. The UST/UIC GIS liaison then identifies UST facilities for inspection based on (a) the risk rankings and (b) desired focus (e.g., location, sector). A map and a spreadsheet are created to reference pertinent UST data and information. Both are provided to the inspectors in advance of their deployment.

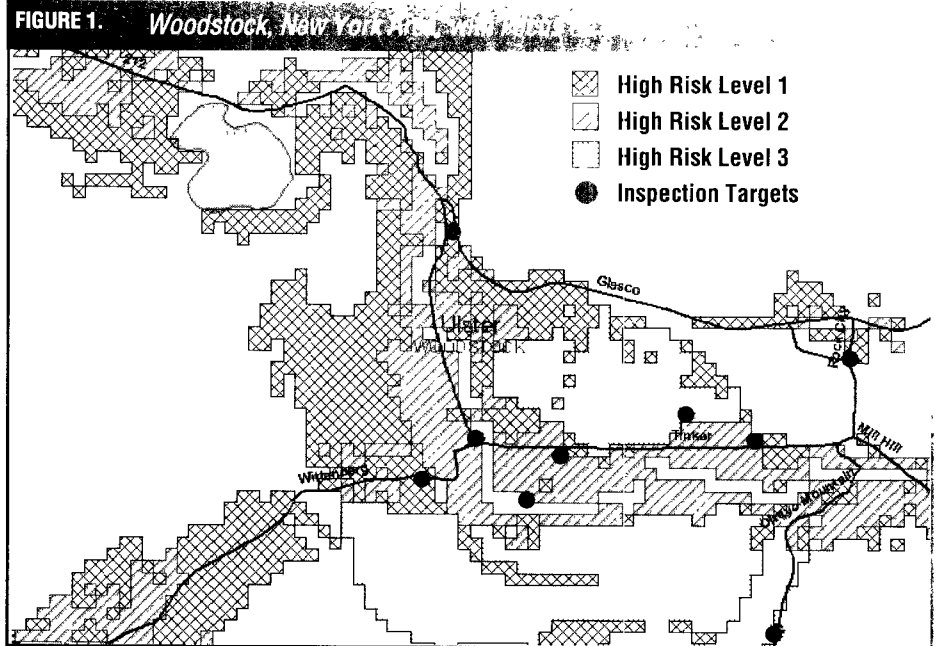
Another target that may be considered when conducting UST inspections is a location where vapor intrusion may be an issue. Vapor intrusion is the migration of volatile chemicals from the subsurface into overlying buildings. Volatile chemicals in buried wastes and/or in contaminated groundwater can emit vapors that may migrate through the subsurface and into air spaces of overlying buildings.²

Adapting for Changing Priorities

It is very easy to incorporate new and emerging policy areas into GIS for use in program planning and goal setting. Within the last year, we have smoothly integrated emerging agency priorities into our overall methodologies. Below are three examples.

■ Source Water Assessment Program

During the past few years, the national UST program has put an emphasis on conducting more frequent inspections in Source Water Assessment Program (SWAP) areas. A source-water assessment is a study and report that provides basic infor-



mation about the source used to supply drinking water to a particular water system. The assessment identifies drinking-water sources and the areas of land that most directly contribute the raw water for those sources. Assessments also identify the major potential sources of contamination of drinking-water supplies. This information is used to determine how susceptible a water system is to contamination.³

Region 2 has the ability and data to include NYS surface water areas (reservoirs and their drainage basins) in targeting analyses. Surface water is also used in heavily populated areas of New York, such as Syracuse (Hemlock and Candace Lakes), New York City (Croton Reservoir watershed), and Albany (Alcove Reservoir).

With our mapping work, EPA Region 2 is at the forefront of coordinating UST and SWAP information. Much of the GIS mapping done by the GWCS from 1999 to 2004 incorporated 500-meter buffers around public water supply wells. As the SWAP areas are officially defined by state and local agencies, EPA reviews New York's UST risk areas (ranked from 1 to 3) and incorporates them into designated SWAP areas. Currently, the NYS SWAP areas are in our highest risk categories, levels 1 and 2.

■ Environmental Justice

In 2004, Region 2 identified a potential Environmental Justice (EJ) area in Rochester, New York. All media pro-

grams were asked to participate in providing compliance assistance and enforcement to the community. Using the targeting methodology described earlier, we faced a challenge. Given that Rochester (a) is largely sewered, (b) has its source of drinking water located at two reservoirs south of the city, and (c) has no federally regulated UST facilities within the prescribed EJ area, *how could we support the Region's Rochester EJ initiative?*

Using our Risk Map, we focused on facilities around the two reservoirs south of Rochester as targets for UST/UIC inspections, and created buffer zones around the Genesee River on the western boundary of Rochester. The Genesee River originates in Pennsylvania and ends at Lake Ontario in Rochester. The upper Genesee River (southern New York) is a well-known destination for brown trout fishing, and in Rochester itself surprising catches of salmon have been noted. The east bank of the Genesee in Rochester proper has a history of heavy industrial usage.

Therefore, to support the Region's EJ initiative, we focused on the Monroe County portion of the source of water for the EJ neighborhood and on the urban Genesee River, which is still heavily fished. Then, utilizing Dunn and Bradstreet and the New York State Petroleum Bulk Storage databases, we targeted nearly 100 facilities for the initiative.

■ Changing Priorities and Addressing Public Concerns

When public concerns arise via the press, governmental leaders, or other avenues, the Risk Map has proven to be a very adaptable and flexible tool while still ensuring the program's focus on protecting groundwater. When a particular business sector is identified, by using an existent database, such as state or federal registration information (e.g., environmental or Department of Motor Vehicles) and/or commercial listings (e.g., Dunn and Bradstreet and North American Industry Classification System (NAICS) identification), data pulls can be undertaken to identify potential facilities for review, compliance assistance, and inspections.

The map can also focus in on particular geographic features, such as a river, lake, or pond, a watershed area, or a village, town, or county. A lot of this information is now readily available from commercial (ESRI), state (GIS programs), and federal sources (e.g., U.S. Geological Survey, U.S. EPA).

■ Cutting Down Hunting Time

The enormous amount of time invested in creating and organizing a groundwater protection mapping system has paid off in how expeditiously we are now able to handle successive projects. This approach has reduced the targeting process from a multi-day analysis to one that can be accomplished in less than an hour, which includes generating a complete list of facilities and a large map for the inspector. Providing a map to an inspector is a valuable time-saver, especially if the inspector is conducting routine inspections alone rather than as part of a team. Maps can be prepared that show the locations of targeted facilities, major transportation routes, nearby water bodies including rivers and lakes, public water supply wells, and any other information an inspector feels may be helpful. (See Figure 1.)

Overall, the use of GIS helps us to refine our focus through objective and measurable processes, assists us

in our endeavors to safeguard drinking-water sources, and affords us considerable time savings in targeting our compliance-assistance and inspection efforts. Using GIS has improved our ability to identify environmentally sensitive areas and specific or potential threats to those areas. Overall, our planning and efficiency in protecting the environment have been dramatically improved. ■

Rebecca Jamison is a UST and UIC Inspector at EPA Region 2. She also conducts targeting for the two programs using the Hillenbrand hydrogeological model in GIS. She can be contacted at

Jamison.rebecca@epa.gov.

Notes

- ¹ Hillenbrand, City University of New York, 2002
- ² Evaluating the Vapor Intrusion into Indoor Air. United States Environmental Protection Agency. November 2002, EPA530-F-02-052 <http://www.epa.gov/correctiveaction/eis/vapor/f02052.pdf>
- ³ EPA Source Water Assessment Program website, <http://www.epa.gov/safewater/protect/assessment.html>

Methodology: Groundwater-Endangerment-Risk Analysis

by Charles Hillenbrand

The use of GIS technology has allowed U.S. EPA Region 2 to prioritize areas for inspection in New York State (NYS). A groundwater-endangerment-risk (GER) grid was devised based on a modified Human Health Risk Index (HRI) formula (Carney 1991). A GER value is the result of dividing a land-use risk¹ by aquifer susceptibility² and multiplying the result by the ratio of a population dependent upon groundwater as a source of drinking water to a total population.³

The risk-ranking scheme used to create the GER grid is analogous to a modified HRI formula (Carney 1991). The HRI is equal to the product of Hazard and Exposure.

$$\text{HRI} = \text{Hazard} \times \text{Exposure}$$

$$\begin{aligned} \text{Hazard} &= (\text{DI} \times \text{DV}) \\ \text{Exposure} &= ((\text{PE} / \text{PC}) \times \text{Ef}) \end{aligned}$$

$$\text{DI} = \text{Degree of Impact}$$

DV = Degree of Vulnerability
PE = Population Exposed
PC = Population in Community
Ef = Exposure Factor

The Hazard component of the HRI formula is a product of Degree of Impact and Degree of Vulnerability.

The Degree of Impact is a chemical-specific component in the HRI that assesses the degrees of cancer and noncancer potency, mutagenicity, environmental fate, and pharmacokinetics. The GER analysis uses a land-use-risk data layer⁴ to assign a Degree of Impact. The U. S. Geological Survey (USGS) Multi-Resolution Land Characteristic data layer was analyzed to produce a relative-environmental-risk comparison of the 15 different land-use classifications. This analysis assessed the risk of introducing contaminants near the surface of the state.

The Degree of Vulnerability component in the HRI is a measure of the

vulnerability of the population to adverse reaction due to exposure. Factors such as age, lifestyle, and pre-existing disease are quantified when selecting a Degree of Vulnerability. In the GER analysis, the Degree of Vulnerability was assigned according to the hydrogeologic vulnerability of the aquifer system to receiving contaminants.

The GER analysis uses an inverse of the aquifer-susceptibility grid as a Degree of Vulnerability component. USGS and NYS Geological Survey hydrogeologic and geologic data layers were analyzed to produce an aquifer-susceptibility grid for NYS.

Aquifer susceptibility is a value that is derived by aerially comparing relative vadose-zone residence times under maximum load. Vadose-zone residence time can be a predictor of aquifer susceptibility—a short residence time indicates that contaminants may be introduced to the

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Wanderlust

by Patricia Ellis

A roving column by reporter Patricia Ellis, a Hydrologist with the Delaware Department of Natural Resources and Environmental Control, Tank Management Branch. Pat served as a member of U.S. EPA's Blue Ribbon Panel on MtBE. She welcomes your comments and suggestions and can be reached at Patricia.Ellis@state.de.us.



County Websites to the Rescue

There are days when you want to throw your computer out the window—the network is slow, it locks up right when you’re almost finished with a time-consuming task and haven’t saved your work yet, e-mails come flying in every few minutes, interrupting, creating more stuff to do. But there are also days when you want to hug it for making life easier.

I’ve had several projects involving a large number of properties in addition to the property where tanks have leaked. One of the difficulties in dealing with projects like this is that a large number of property owners may need to be notified for one reason or another—to sample wells in their area and send out sample results afterward, to notify people about community information meetings, or to get permission and signatures on permits to install monitoring wells at off-site locations. In the past, we’ve had to sketch out an area in the hope that the county tax office would help with names and addresses. This process could take weeks. It was even harder for many of the consultants working on these projects who were from out of state.

With the Web, this information is now available with just a few keystrokes. Each of Delaware’s three counties now has this information available online. The design of each of the sites varies, as does the amount of detail available, but the basics are there. I can get great maps showing tax parcels, and then zoom in to get the maps to be just about any scale I might need. Once I’ve located the

parcel numbers, it’s quick to get property owners’ names and addresses.

For one of my projects, located in the Rehoboth Beach resort area, about half of the property owners are full-time residents and the other half are weekend or summer residents. The website gives me the addresses where the tax bills are mailed, so I can reach homeowners in Virginia, New Jersey, or Pennsylvania—wherever they call home when they’re not at the beach. Also, I’d much rather address a letter to a real person than to “Resident,” or something equally impersonal.

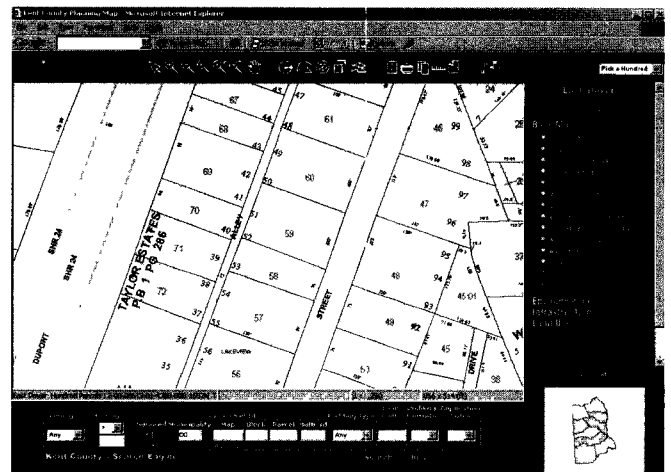
Once I’ve gotten the names and addresses that I need, it does take longer to track down phone numbers. I use a combination of the Internet white pages, local phone books, and directory assistance.

For some areas, we have the criss-cross index available, where I can look up street addresses and get phone numbers for many of the residents. Using a variety of sources, I can usually manage to track down most of the phone numbers for the residents in a neighborhood. The neighbors are sometimes willing to help out with phone numbers as well.

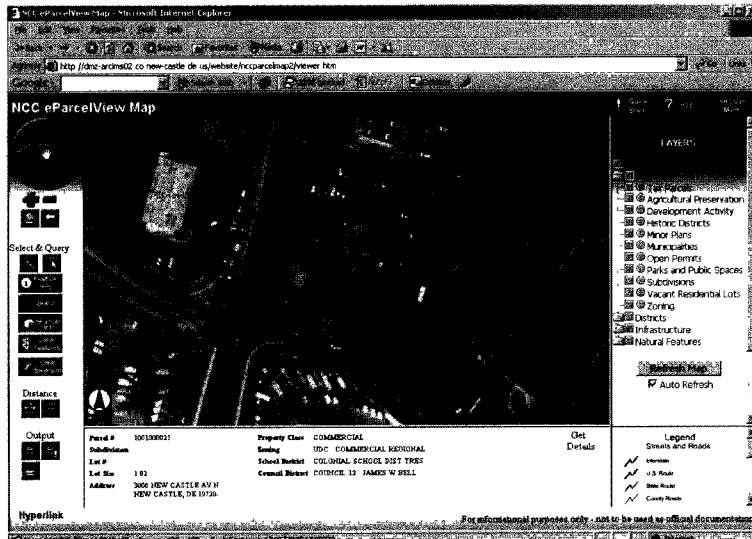
Bird’s-Eye Views

All three of our county websites have been updated so that aerial photographs are also available online. I’ve now got a bird’s-eye view of any of my sites. I can see a large area, or I can zoom in and locate the tank field, the dispensers, and even where some of the utilities are that might dictate where monitoring wells can’t be located. Sometimes I can spot other potential sources without even leaving the office! One of the county websites even tells me whether there is a basement in the building (potential pathway for vapor intrusion), and whether the property is served by public water.

The three county websites vary in their searchability. I can search by street address, property owner, or



Screenshot of Kent County “Smart Map” Web page showing a tax-parcel map. Once the tax-parcel number is obtained, a different section of the county website will give owner information. Different data layers can be toggled on and off



Screenshot of New Castle County Web page showing the layer with recent (color) aerial photograph. The parcel in the center of the photograph shows a gas station, where the canopy; concrete pad over the tank field; patches in the paving from removal of a diesel tank, dispensers and product lines; and patches from installation of the Stage II vapor-recovery lines are clearly visible.

parcel number, or I can just keep zooming in until I find my site. There are lots of other layers that can be toggled on and off to provide additional information. Two of the three county sites tell me the year when each building on a property was built. I know that if most of the homes in an area with no public water were built in the 1950s, I'm probably not going to be able to get much information about well-construction details because most of the wells pre-date the permitting requirements.

The DataMIL

The Delaware DataMIL (Delaware Mapping and Data Integration Laboratory) is a joint project of the United States Geologic Survey, Delaware Geologic Survey, University of Delaware, and Delaware Geographic Data Committee. It's an online GIS-based pilot project for the National Map (<http://datamil.delaware.gov/home.asp>). From this website, I can pull up the most recent topographic maps for an area. The DataMIL allows me to save maps that I have created and to extract various layers for use in other GIS projects. The ability to import information into other applications makes the DataMIL a more flexible tool than the county websites.

I've got parcel maps that I've downloaded for most of the projects where I deal regularly with a large number of residents. It's a good

graphic display of who's who in an area, so when I get calls from residents, it's easy to visualize where they are with respect to the source and the plume.

Zoom Zoom Zoom

We recently got a call from our public health people reporting a well with MtBE contamination. We were able to quickly pull up a tax-parcel map showing the property and surrounding area. The aerial photograph showed which properties had homes and farm outbuildings, so we could determine how many properties would need to have wells sampled. We made arrangements with the lab to have a fairly firm number of samples analyzed. Addresses for all nearby property owners were quickly obtained so residents could be notified in advance that our department wanted to collect well samples and why. Having the ability to pull this information off the Web in advance eliminated the need to make a preliminary reconnaissance trip.

So, kudos to each of our three counties! Their websites may have different designs for providing tax-parcel information, and the amount of detail may differ from site to site. But each of the three counties has created a tool that helps make at least one part of managing my projects a little easier. ■

UST-SWP: Programs Work Together to Protect Drinking Water

The New England Interstate Water Pollution Control Commission (NEIWPCC) initiated meetings in Illinois and Minnesota (Region 5) to facilitate discussion between UST and source-water protection (SWP) programs on ways to reduce potential drinking-water contamination from USTs. Since these programs have limited resources, it makes sense to partner together to protect water supplies. The goal of the meetings was to develop a written agreement, perhaps in the form of a memorandum of understanding (MOU). Both states were at different levels of integration, but their programs were split between different agencies.

The Illinois Source Water Protection program offered to train state UST program personnel on how to use the GEOcode system—the electronic database on source-protection areas and threats—in order to prioritize inspections in those areas. The UST program agreed to share inspection results with the drinking-water program. Participants also identified other partners that play key roles in implementing this effort on the local level, including boards of health and the Rural Water Association.

The Minnesota Source Water Protection program already has an MOU with its LUST program. An important goal established at the meeting was to find out whether the state's source-water inventory matches UST location data, since both maintain separate data systems. SWP personnel agreed to identify areas they felt were most threatened by USTs, using the data from source-water protection reports.

EPA Region 5 agreed to perform a percentage of its federal inspections in source-water protection areas and to follow up with both states as they move forward with their collaborative efforts. ■

Tank -nically Speaking

by Marcel Moreau

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

I've Looked at Tanks from Both Sides Now

Some years ago, I was speaking about UST inspections at an UST conference to a roomful of several hundred tank owners and operators (O/Os). To try to warm up the audience, I was foolhardy enough to ask for a show of hands of those who thought that regulatory inspections were a useful thing. I was soon gazing at a roomful of the stoniest faces I have ever seen from a podium. The chill in the air was palpable.

Sensing I had perhaps succeeded in creating an instant iceberg where I had hoped to break some ice, I said with somewhat of a gulp, "Nobody, huh?" Fortunately, I was rescued by one brave soul who finally raised his hand and said, "I think inspections are great. They let me know what I'm doing right or wrong, and I know that they help keep my competition honest too." I thanked the man and, with not much enthusiasm, launched into my talk.

That day, I became painfully aware of the depth of my misunderstanding of my O/O audience. Since then, I've recognized the importance of trying to see things from both sides of the table.

So when John Cochran (New Mexico Environment Department UST Program) called to see if I wanted to talk about inspections at this year's UST/LUST National Conference in Seattle, we began to brainstorm about creating an opportunity for inspectors and O/Os to share their views about inspections, and for each side to try their hand at guessing what the other side would say. We figured this would be a good way to get a reality check on how well each side understands the other.

We invited some regulators and O/O representatives to join our panel. These people were not randomly selected and we made no



effort to determine how representative they were of the inspector or O/O general populations. This was not intended to be a statistical study, but rather a vehicle for fostering discussion.

We gave the panel some basic questions to think about ahead of time, but we didn't really know what they were going to say. During the session, we asked three questions:

- What is the purpose of an UST compliance inspection?
- What are the benefits of an UST compliance inspection?
- What are the problems with UST compliance inspections?

Panelists were asked to answer each question, first wearing their own "hats" and then making a switch to what they thought the other side would say. The audience was also invited to provide their input. Comments were summarized "live"

and presented to the group via a computer projector. The answers we received are summarized in the tables that accompany this article. My thoughts upon reviewing the answers are as follows.

What Is the Purpose of an UST Compliance Inspection?

Speaking from their respective points of view, inspectors and O/Os agreed on many of the purposes of an inspection. Noticeably lacking from the O/O perspective was protection of human health and the environment (although this thought did show up as a compliance inspection benefit when O/Os were speaking as inspectors). A key concern of O/Os that came out in these answers, even though it doesn't directly address the question, was fairness in the inspection process.

When guessing what they thought the other side would say in

response to the question, the O/Os seemed to have a pretty good understanding of the inspector's point of view. Inspectors' answers didn't correlate quite so well, but my suspicion is that the inspectors may have been voicing some typical "mom and pop" O/O concerns (e.g., Why pick me? What's going to happen to me? Looking for free consulting) and mom-and-pop O/Os were not represented among the O/O panelists.

What Are the Benefits of an UST Compliance Inspection?

I find it interesting that when speaking from their respective points of view, the O/Os' and inspectors' responses were quite consistent in so far as they went, but the inspectors' list of benefits was substantially longer than the O/Os'. I was encouraged to see that both sides recognized that inspections are an opportunity to establish rapport between inspectors and O/Os.

Both sides were reasonably accurate in predicting what the other side would say. Again, the inspectors speaking as O/Os included some thoughts that are more likely to come from mom-and-pop operations than from the O/O representatives on our panel.

What Are the Problems with UST Compliance Inspections?

This question raised the most contrasting viewpoints and provided some food for thought on both sides. While inspectors felt that the O/Os' reluctance to ask for help and ignorance about UST systems were signif-

icant problems, O/Os emphasized inconsistencies in the interpretation of the rules and in inspections over time.

What inspectors saw as a failure of O/Os to ask for help, O/Os saw as a failure of inspectors to clearly explain expectations. Inspectors saw a lack of knowledge (i.e., training) regarding storage systems on the part of O/Os, while O/Os pointed to a lack of training of state inspectors (O/Os also acknowledged that O/Os are in need of training). Overall, it seems to me that communication, consistency, and training are areas that both inspectors and O/Os could improve on.

When O/Os put their inspector hats on, they came up with a list of problems that was quite consistent with that of the inspectors. Inspectors wearing O/O hats, however, focused on a perception on the part of the O/Os that inspections are inconvenient, and completely missed the O/Os' concerns for consistency and clear communication. Again, this may be due to the inspectors' focus on the mom-and-pop response to inspections rather than the larger companies represented on the panel.

Parting Thoughts

This session reaffirmed for me that frank dialogue is critical to "seeing ourselves as others see us." Assessing issues from different points of view is a very valuable tool in determining the kinds of changes that might promote improved performance. Creating opportunities for dialogue might be an important first step in making life easier for both inspectors and O/Os.

Some years ago, I visited a German tank-fabrication plant on the same day that the regulatory inspector was due for a visit. I was struck at the time by the plant manager's apparent eager anticipation of the inspector's visit. The plant manager explained that the inspection would consist of the inspector picking a few tanks off the production line at random and running some tests. The plant manager was not at all concerned that the tanks might fail. The tank-construction standards were clear and his production techniques were careful.

The plant manager was, however, planning to take the inspector to lunch. He had some tricky steel fabricating to do on a project and he was hoping the inspector would give him some tips on how to do it. In Germany, being an inspector is not an introductory position; it is a position you achieve after much study and many years of experience in your field.

While I do not expect that the German model of inspections will be adopted in this country, the idea of inspectors and O/Os sitting down to lunch together does hold some appeal...even if it's just a brown-bag affair. Imagine how different life might be if on a monthly basis a brown-bag luncheon were held at some VFW hall or other neutral, low-key venue with the stated purpose of allowing inspectors and O/Os to sit down, get to know each other, and discuss issues of common concern.

These are my thoughts. What are yours? ■

What Is the Purpose of an UST Compliance Inspection?

Inspector Speaking as Inspector	O/O Speaking as O/O
<ul style="list-style-type: none"> • Ensure compliance • Provide compliance assistance • Look for leaks • Allow level playing field • Keep O/Os on their toes • Protect health and environment • See if O/Os are operating responsibly 	<ul style="list-style-type: none"> • Determine compliance • Provide education for O/O • Respond to threats • Allow level playing field • Ensure recordkeeping • Fairness expected
O/O Speaking as Inspector	Inspector Speaking as O/O
<ul style="list-style-type: none"> • Ensure compliance • Help O/O with compliance • Identify faulty components • Determine that equipment is operating properly 	<ul style="list-style-type: none"> • How do I measure up to regs? • What do I need to do? • Why pick me? • What's going to happen to me? • Looking for free consulting

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What Are the Benefits of an UST Compliance

Inspector Speaking as Inspector	O/O Speaking as O/O
<ul style="list-style-type: none"> • Allow face-to-face contact (personalize bureaucracy) • Provide two-way education • Get to know O/O (educate me) • Correct problems • Deter violations • Discover problems, releases • Encourage compliance through credibility of inspector (we are doing our job) • Reduce risk to environment • Provide outreach to small O/O • Can save O/O cost of unnecessary testing • Protect investment in property • Can allow discussion on issues concerning contractors (misinformation, poor workmanship) 	<ul style="list-style-type: none"> • Establish rapport • Audit processes to be sure they're working • Point out deficiencies • Offer quality assurance (another set of eyes to look at operation)
O/O Speaking as Inspector	Inspector Speaking as O/O
<ul style="list-style-type: none"> • Provide face-to-face meeting • Establish a presence • Even the playing field • Ensure things are working • Make sure leak detection is in effect • Allow inspector to see who is a good O/O and who is not • Protect environment • Verify maintenance and operation of equipment • Let O/O know about the penalties (especially red tag) 	<ul style="list-style-type: none"> • Establish rapport • Personalize bureaucracy • Maintain a level playing field (I know you are out here) • I'm glad you told me what to do • Unbiased opinion about leak detection and work that needs to be done (misinformation from contractors) • Hear directly from regulator what needs to be done • Get management's attention

What Are the Problems with UST Compliance Inspections?

Inspector Speaking as Inspector	O/O Speaking as O/O
<ul style="list-style-type: none"> • Find compliance—not violations • O/O don't ask for help • Failure of O/O to communicate needs to agency BEFORE inspector gets on-site • Insufficient records or information • Lack of knowledge about UST system • Language barriers • Apathetic attitude on part of O/O 	<ul style="list-style-type: none"> • Attitude of inspector (help? or enforce?) • Inconsistent interpretation of the rules • Inconsistent inspections over time • On-site personnel often do not communicate problems discovered to upper management so that they can be addressed • Need for clarity in explaining the violation and basis in rules • No clear expectations (what do you want?) • High fines for innocent paperwork violations • Multiple inspections by multiple agencies (e.g., UST, food, air, weights, and measures) • Surprise inspections • Lack of training of O/Os and inspectors
O/O Speaking as Inspector	Inspector Speaking as O/O
<ul style="list-style-type: none"> • Frustration with repeat offenses • Scheduling • Cultural and language barriers • Availability of paperwork • Lack of knowledge of rules on part of O/O • Lack of training on part of O/O • Not having right people on-site (unannounced inspections) • Not having right equipment (e.g., dispenser keys, tools to remove sump lids) • O/O attitude may be a problem 	<ul style="list-style-type: none"> • I have to count twinkies (O/O has more important things to do) • You're interfering with my day • This is costing me money • Why do you inspect me so often? (Note: Because many O/Os do not distinguish between state-agency and EPA personnel, they feel unfairly targeted when both agencies happen to inspect the same facility.)

Making Sense of UL 971

The Revised Nonmetallic Piping Standard

by Laura Chaddock

On January 2, 2004, Underwriters Laboratories Inc. (UL) revised its standard for *Non-metallic Underground Piping for Flammable Liquids* (UL 971). The revised standard became fully effective on July 1, 2005. In order for manufacturers to continue to apply the UL mark to piping manufactured on or after July 1, 2005, their piping must undergo a review and be tested for compliance with the revised standard. Only piping that UL finds to be in compliance with the revised standard will be authorized to continue to bear the UL mark. The following questions and answers are intended to provide a brief overview of the new UL 971.

Why was UL 971 revised?

Nationwide reports of nonmetallic underground storage tank pipe failures and reports indicating that not all nonmetallic pipe is performing as intended prompted UL to take a critical look at UL 971. UL reports that these nonmetallic pipe failures are a result of improper pipe system installation, inadequate pipe system maintenance, failure to properly respond to leak-detection alarms, and other unspecified causes.

What are some of the differences between pre- and post-July 1, 2005, UL 971-listed pipe?

The most critical difference between pre- and post-July 1, 2005, UL 971-listed pipe is the physical testing to which the pipe is subjected. The revised UL 971 standard requires more stringent physical testing, which is intended to better simulate long-term use and real field conditions and thereby improve the ability of post-July 1, 2005, pipe to withstand the conditions found at operating UST facilities.

For example, prior to undergoing compatibility and permeability testing, pipe samples will be preconditioned by being subjected to bend, drop, and impact tests. Conducting

compatibility and permeability tests on pipe that has been preconditioned with the usual abuse pipe experiences during transport, assembly, and installation better approximates true installation and field conditions. As another example, to address pipe degradation resulting from long-term exposure to fuel, pipe samples will now be subject to more stringent compatibility and permeability testing that incorporates new criteria for dimensional stability and increased minimum-retention values.

Other major revisions to UL 971 include evaluating piping as a system (rather than evaluating individual components) and a requirement for installation of pipe by qualified persons.

In summary, the standard was revised to incorporate more stringent testing and installation requirements so that pipe systems manufactured to meet this revised standard have less chance of experiencing the failures we have seen in the past. (See *LUST-Line* Bulletins 47, 45, 43, and 42 for more information on nonmetallic piping failures.)

Does pre-July 1, 2005, UL 971 pipe maintain its listing?

July 1, 2005, is when newly manufactured pipe must meet the revised UL 971 standard. It does *not* affect the listing of existing pipe manufactured prior to July 1, 2005. Therefore, UL 971-listed pipe manufactured prior to July 1, 2005, can remain in the ground. It should be noted that after July 1, 2005, some states might not allow piping to be installed that does not meet the revised UL 971 standard. Owners/operators and installers should check with their state UST programs before installing nonmetallic pipe after July 1, 2005.

Note: Inspectors and owners/operators should know that purchasing UL-listed pipe after July 1, 2005, does not guarantee that the pipe was manufactured after July 1, 2005, and meets the revised UL 971 standard. In fact, it may

take months or even years before the pre-July 1, 2005, pipe stock is depleted.

How do I identify pipe manufactured on or after July 1, 2005?

Pipe manufacturers are required by UL to mark the date of manufacture on the pipe at ten-foot intervals, and on fittings or fitting bulk packaging. Most pipe manufacturers use what is called a modified "Julian Date Code." This code typically consists of a two-digit code for the year in which the pipe was made (for example, 2005 reads as 05), and a three-digit code for the day of the year (from 001 to 365) or a four-digit calendar month and day notation (for example, 0101 for January 1).

Depending on the pipe manufacturer, a modified Julian Date Code for piping manufactured on May 12, 2005 could read 05132 (two-digit year identified first, followed by the three-digit code for the day of the year), or 13205 (three-digit day of year identified first, followed by the two-digit year code), or 050512 (two-digit year identified first, followed by two-digit calendar month, ending with the calendar day).

Because manufacturers use different Julian Date Codes, it will take time and research to determine the date on which a given pipe was manufactured. If you are unable to locate or decipher the date, you can contact the supplier or manufacturer of the pipe for assistance. Also note that there are some differences in labeling (e.g., changes to product types and fuel types), which might also serve as a way to determine the difference between pre- and post-July 1, 2005, pipe.

Can pipe manufacturers use listings from an independent testing organization other than UL?

There are several nationally recognized independent testing organizations under which pipe may be listed, and several pipe manufacturers hold

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listings under more than one independent testing organization. Therefore, it could be possible that pipe manufacturers that fail to meet the revised UL 971 standard will continue to manufacture and sell their pipe using one of their other independent testing organization listings.

How is California transitioning to the revised UL 971?

In California, both the UL 971 standard and California's design and construction requirements must be considered when determining the appropriate use of pipe manufactured pre- or post-July 1, 2005. California Health and Safety Code Chapter 6.7 not only requires an independent testing organization listing, but also requires that primary containment be compatible with the hazardous substance stored and that secondary containment be constructed to prevent structural weak-

ening as a result of contact with any hazardous substance released from the primary containment.

The Future of UL 971

The January 2, 2004, revision of UL 971 is just a stepping-stone toward addressing the nonmetallic pipe failures we've seen in the field. In fact, UL 971 is currently under revision to include even more stringent testing and to set higher performance criteria so that nonmetallic piping manufactured in the future will not experience the problems that we have seen in the past. So, be vigilant and continue to report those piping failures to UL at www.ul.com. ■

Laura Chaddock is Chief of the UST Leak Prevention Technical Unit at the California Water Resources Control Board. For more information on California's transition to the revised non-metallic piping standard, contact Laura at (916) 341-5870 or lchaddock@waterboards.ca.gov.

The Energy Policy Act of 2005?

On August 8, President Bush signed the Energy Policy Act of 2005 into law. The act contains a number of provisions that will impact state and federal UST/LUST programs. Over the next few months we will all be studying the act to find out just what it requires. In the next issue of LUSTLine, we'll provide an update on the act as well as some state perspectives.

Meanwhile, A PDF file of the Energy Bill can be found at following Senate website: <http://energy.senate.gov/public/>. Once at this Senate Energy and Commerce Committee home page, look to the right margin and under "Featured Items" click on "Text of Conference Report of Energy Policy Act of 2005." The text of the UST Compliance Subtitle B, Title XV, begins at page 1564 through 1607. It runs from Sections 1521 through 1541. ■

Field Notes 

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

Results of PEI's UL 971 Piping Survey Available

UL 971, *Nonmetallic Underground Piping for Flammable Liquids*, contains requirements that cover primary carrier, secondary containment, integral primary/secondary containment, normal vent and vapor recovery, nonmetallic pipe, fittings, and products intended for use underground in the distribution of petroleum-based flammable and combustible liquids, alcohols, and alcohol-blended fuels.

From October 1995 through June 30, 2005, non-metallic underground piping was produced in accordance with the UL 971 standard dated October 30, 1995. Revisions were made to the 1995 standard in response to improper piping-system installation, inadequate piping-system maintenance practices, and failure to properly respond to leak-detection alarms. The performance requirements of the "new" UL 971 became effective on July 1, 2005. That means products manufactured on or after July 1, 2005, must comply with the new requirements to be considered UL-listed.

As far as UL is concerned, the UL mark on a product serves as the manufacturer's declaration that the product complied with the UL requirements that were in effect *at the time the product was produced*. In other words, as long as the UL mark is on the pipe, UL considers the product listed. Piping produced to the 1995

standard is still UL-listed, even though it can no longer be produced.

There is some confusion in the industry about how the states will handle the "old" UL-listed pipe (manufactured from October 1995 through June 30, 2005) and "new" UL-listed pipe. More specifically, will states allow piping listed to the 1995 standard to be installed now that the new UL 971 requirements are effective?

To help tank owners, piping manufacturers, and tank-system installers understand what the states will allow to be installed after July 1, 2005, PEI recently surveyed the each state. While printing deadlines do not permit us to summarize the results of the survey in this article, the results (state by state) of the survey are available at www.pei.org. You will note that the vast majority of states have permitted piping manufactured to the old standard to be used after July 1, 2005.

A complete listing of all UL certifications is available through UL's website at www.ul.com. Select the "certifications" menu item from the UL home page. Click on "standard number," on the next page, type in 971, and then select the piping option. The website will provide information on all currently certified products. Only those products that are certified to the new requirements are identified. ■

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aquifer more readily than if there were a long residence time. Attenuation of contaminants is minimized with high linear velocity and short travel distance because the solute will have a short period of vadose-zone residence time and therefore will not have substantial time to react with the geologic matrix and existing air components of porosity.

Groundwater risk was calculated by dividing the land-use-risk grid by the aquifer-susceptibility grid. A groundwater-risk calculation is analogous to the HRI hazard component. Groundwater risk demonstrates the risks associated with introducing contaminants both at the surface and to an unconfined aquifer at the water table. Existing CERCLA NPL groundwater-contamination sites display a strong correlation to areas of significant risk on the groundwater-risk grid. This grid does not take into consideration population exposure.⁵

The HRI exposure component is equal to the ratio of the population exposed to the total population multiplied by the Exposure factor. The Exposure factor (Ef) assesses the percentage of population exposure over time. In the GER study, this value was defaulted to one. The GER analysis constructed a ratio of population using groundwater as a source of drinking water grid from census tract and public water supply wellhead protection area data layers.³

The value for population using groundwater as a source of drinking water was assumed to conform to the Source Water Assessment Areas (SWAPs) around public water supply wells. SWAP areas were provided by state and local agencies. The ratio of population using groundwater as a source of drinking water to total population is analogous to the HRI exposure factor.

The GER, which assesses the risk of introducing contaminants at the surface in NYS and the risk of those contaminants percolating through the vadose zone and being introduced to an aquifer at the water table in areas where humans use groundwater as a source of drinking water, is analogous to the HRI value as outlined below:

$$\text{HRI} = ((\text{DI} \times \text{DV}) \times (\text{PE} / \text{PC})) \times \text{Ef}$$

Assuming Ef = 1, then

$$\text{HRI} = (\text{DI} \times \text{DV} \times (\text{PE}/\text{PC}))$$

The GER formula follows, with LUR analogous to DI, the inverse of AS analogous to DV, and PGW equal to (PE/PC):

$$\text{GER} = (\text{LUR} / \text{AS}) \times \text{PGW}$$

GER = Groundwater-endangerment risk

LUR = Land-use risk

AS = Aquifer susceptibility

PGW = Ratio of population using groundwater as a source of drinking water to total population

The GER grid can be used by the GIS to statistically compare the mean UIC GER values of counties, zip codes, wellhead protection areas, or any other areas defined with boundaries. Mean GER values of zip codes, as an example, can be used to prioritize UST and UIC inspection target areas. Higher numbers indicate higher risk. In order to relate the grid to practical inspector deployment, counties and zip codes were processed to display mean GER per county and zip code. By targeting a high-risk county, then a high-risk zipcode, specific areas possessing substantial GER may be identified. These areas may be sited for UST or UIC inspections. Facilities located in these areas may be targeted for UST or UIC inspections. ■

Charles Hillenbrand is with the U.S. EPA Region 2's Water Compliance Branch. He can be reached at Hillenbrand.charles@epa.gov.

References:

Carney, G. R. *Human Health Risk Index*, Draft document, Policy and Analysis Section, U.S. EPA Region 6, 1991.

Notes

- ¹ Hillenbrand and Simpson, in press.
- ² Hillenbrand and Friedman, in press.
- ³ Hillenbrand, Hansen, and Friedman, in press.
- ⁴ Hillenbrand and Simpson, in press
- ⁵ Hillenbrand and Ferri, in press

New Publication on Design, Construction, Modification, Maintenance and Decommissioning UST Systems from the UK

Design, Construction, Modification, Maintenance and Decommissioning of Filling Stations is the title of a publication produced jointly by the Association for Petroleum and Explosives Administration (APEA) and the Service Station Panel of the Energy Institute. The 242-page book contains information based largely on experience from the United Kingdom and makes frequent reference to legislation applicable in the UK; however, the authors anticipate that the general principles will be applicable to most regions of the world. Copies can be obtained from Portland Customer Services, Commerce Way, Whitehall Industrial Estate, Colchester CO2 8HP, United Kingdom. Phone: (44) 1206 796 351. E-mail: sales@portland-services.com.

Sierra Club Calls LUSTs a Threat to the Nation's Drinking Water

In April, the Sierra Club released a 22-page report that describes in depth the threats to public health and the environment from LUSTs. The report details the detrimental impact that leaks of gasoline and toxic substances from USTs have on the nation's groundwater, the source of drinking water for 50 percent of the population. The report also looks at current federal and state efforts to prevent and clean up leaks from USTs and concludes that they are inadequate to protect public health. The report notes the current slowdown in the number of LUST cleanups completed each year and predicts a reversal of years of progress in cleaning up the nation's backlog of LUST sites if current trends continue. The full report can be seen at http://www.sierraclub.org/toxics/Leaking_USTs/index.asp.

Maryland's New Helium Test Protocol

by Herb Meade

The Maryland Department of the Environment (MDE) determined that a cost-effective evaluation tool was needed to assist LUST investigators in pinpointing the locations of vapor releases from gasoline UST systems. The tool, which needed to be both cost effective and easy to implement, is the outcome of our ongoing struggle with increasing incidents of MtBE-impacted groundwater from fully compliant UST systems across the state. MtBE releases at a portion of these sites could be tracked to small-volume releases from catchbasin and sump failures, spills at the dispensers, and poor maintenance practices. However, we also recognized that vapor releases were a main contributing source for MtBE levels in groundwater at these sites.

MDE reviewed the many UST-testing methods currently available for system evaluation. We found that none of the commercially available tests fulfilled our immediate needs. Ultimately, we drew from our own testing knowledge to meet our requirements. We realized that folks in the UST industry, as well as other release-investigation industries, have had experience with helium as a testing compound for well over 25 years. Therefore, we decided to take a brave step and write our own protocol for UST helium testing, knowing full well this would be a first in the nation.

We began by drafting an evaluation protocol based on the experience of MDE staff who had backgrounds in testing UST systems for both tightness and vapor-recovery operation. We then conducted a forum with several active tank-testing firms in our state with helium-testing experience. With these firms we were able to fine-tune the protocol and perform field-test trials. The real-world field-test trials assisted a great deal in the development of the final protocol.

Currently, vapor evaluation is required on all gasoline UST systems that have Stage II vapor recovery and are located within the High Risk

Groundwater Use Area of our state. Most tank owners are having the evaluation performed in conjunction with the required annual Stage II vapor-recovery testing when the air-to-liquid ratio and pressure-decay tests are performed. The vapor-evaluation protocol has added \$300 to \$600 to the annual Stage II testing. As tank testers become more experienced with the protocol and previously unidentified vapor problems areas are repaired, we expect the price to decrease.

We feel that we have provided tank owners and testers with an evaluation tool that is meeting our goal of discovering small vapor releases from active gasoline UST systems. Testers in Maryland are discovering numerous tank-top fitting failures. These failures are now easily repaired and doing so prevents continuous vapor leaks into the environment. The helium test section of the new Maryland protocol appears below. For the full protocol, visit MDE's website at: www.mde.state.md.us/Programs/Land_Programs/Oil_Control/Factsheets_Publications. ■

Herb Meade is the Administrator of the Oil Control Program, Maryland Department of the Environment. He can be reached at hmeade@mde.state.md.us.

Performing the Helium-Test

1. Initially perform California Air Resources Board (CARB) Test Procedure TP-201.3 using commercial-grade nitrogen as required. Report test failure to the Oil Control Program and Air and Radiation Management Administration within two hours in accordance with Code of Maryland Regulation (COMAR 26.10.08.01A). Record any corrections made prior to and during the testing to achieve a passed test.
2. Once CARB test has been successfully completed, remove the pressure/vacuum (P/V) vent cap(s) on UST(s) to be tested and install 1-psi pressure relief valve.
3. Note: The UST systems should be in operating condition minus the vent cap. Install all fill and Stage I dust caps for the duration of the helium test.
4. Begin introducing helium into the system following the specifications as stated in CARB procedure TP-201.3. Do not exceed 1.0 inch of water column. Monitor pressure in the tank constantly.
5. Confirm helium is present in all areas to be tested. Check test connections to verify they are not leaking.
6. Lids to all sumps, tank-top components, and dispensers should remain in place until they are tested to allow for any helium release to build inside the contained area for detection.
7. Test for helium leaks at all tank-top components and areas in the dispensers at pump-island grade with the helium detector. Record the location of any positive detection of helium.
8. Repair or replace any defective components and record work performed.
9. Repeat steps #7 and #8 until no helium is detected.
10. Once helium is not detected, increase pressure to 5.0 inches of water column and repeat steps #7 and #8 until no helium is detected.
11. Testing is complete once no helium is detected at 5.0 inches of water column in all sumps and manways, at any of the tank-top components, or in the dispenser areas. Record the monometer pressure and time. Maintain the test for 10 additional minutes and record the pressure again. If pressure decay is observed, record and bring pressure back to 5.0 inches of water column and maintain for 10 minutes and record pressures. If pressure increase is observed, also record. A failure is any detection of helium or any decay of pressure after achieving 5.0 inches of water column for 10 minutes.
12. Break down test equipment and replace P/V vent caps.
13. If secondary piping exists, it must also be tested.
14. Introduce helium through one test port on the line being tested. Place a second gauge farthest from the area where the helium is being applied. Lines may have to be connected (jumped) inside dispensers to perform test. Loosen the secondary boot/hoses slightly on specific pipe being tested and check with the helium detector to verify helium is present throughout the entire pipe. Once helium is detected, seal all boots/hoses tight. Charge line to 2.0 inches of water column and watch for decay. If line is decaying, check boots/hoses with helium detector. Tighten boots/hoses as needed. If no helium is detected at the boot ends and pressure continues to decay, record decay rate if possible (inches of water column/minute or second). If pressure is not increasing or sustained, or is not confirmed at each boot end, record a failure. Point-source testing may be needed to identify area(s) of failure. If pressure maintains or increases after holding for 10 minutes, increase pressure to 5.0 inches of water column and repeat test. Pressure must be maintained for 10 minutes at 5.0 inches of water column. ■

FAQs from the NWGLDE

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

Old and New CITLDS Protocols—What's That About?

This installment of the National Work Group on Leak Detection Evaluations' (NWGLDE's) FAQs focuses on the different protocols used to certify continuous in-tank leak detection systems (CITLDS) as well as which protocol the NWGLDE believes meets the federal requirements for manufacturer's certification of equipment performance. Please Note: the views expressed in this column represent those of the work group and not necessarily those of any implementing agency

Q. Has any CITLDS equipment that was evaluated and third-party certified using the old manufacturers' protocols been accepted by the NWGLDE?

A. We can get to the answer by first looking at the history of CITLDS protocols. CITLDS had not yet been invented when U.S. EPA published protocols in 1990 for testing leak-detection methods. When CITLDS equipment came along later and the manufacturers wanted to evaluate their equipment, they had to develop their own protocols. The manufacturers developed their own protocols and had their equipment tested using these protocols. None of these protocols were alike, and most did not require very stringent tests of the operation of the equipment. Since this was before the first NWGLDE list was issued, many states reviewed and accepted CITLDS evaluations that had been performed using the manufacturers' protocols.

When NWGLDE began to review available CITLDS evaluations, it determined that most of the protocols were not sufficient. As a result, NWGLDE only listed one manufacturer's CITLDS equipment in the 3rd Edition NWGLDE list on April 18, 1997. The California State Water Resources Control Board volunteered to take the lead to try to encourage CITLDS manufacturers to come together and write an improved protocol that all manufacturers could use.

Dr. Jairus D. Flora, Jr. wrote a new protocol, and the California State Water Resources Control Board and NWGLDE, both of which provided technical reviews of the protocol, accepted the new protocol on January 7, 2000. The new protocol covered three types of continuous systems: continuous automatic tank gauging systems (ATGS), continual reconciliation, and automatic monthly inventory control. It required more stringent testing of CITLDS equipment as well as testing at both laboratories and operating fueling facilities. It also addressed the operation of the equipment in manifolded tanks, limited the oper-

ation of the equipment based on throughput, and provided for the optional inclusion of dispenser-blending data.

Most CITLDS manufacturers reevaluated their equipment using this new protocol. The CITLDS leak-detection equipment on the NWGLDE website and list were evaluated using this protocol. However, a representative of a CITLDS vendor that had its equipment recertified under the new protocol has stated that his company believes that it is not subject to the throughput limitation requirements of the January 7, 2000, protocol in states where a regulatory agency previously accepted its evaluation under the old protocol.

NWGLDE believes that the January 7, 2000, protocol provides a more thorough evaluation of CITLDS equipment and levels the playing field for CITLDS manufacturers. NWGLDE also believes that restrictions and limitations in the new protocol should apply to all equipment certified using the new protocol. However, NWGLDE does not revoke or invalidate test protocols. Therefore, the final decision as to whether or not to accept a manufacturer's certification of leak-detection equipment performance lies with the local regulatory agency.

About NWGLDE

NWGLDE is an independent work group comprising ten members, including eight state and two U.S. EPA members. This column provides answers to frequently asked questions (FAQs) the NWGLDE receives from regulators and people in the industry on leak detection. If you have questions for the group, please contact them at questions@nwglde.org.

NWGLDE's mission:

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

Take One Part Premium, One Part Diesel, and a Stroke of Lightning

by Ernest Roggelin

On June 28, 2005, an intense early evening rain and lightning storm delivered a lightning strike to the canopy and perhaps the pad of a Circle K convenience store in Pinellas Park, Florida. The station had three 10,000-gallon, single-walled fiberglass USTs containing diesel, regular unleaded gasoline, and premium unleaded gasoline. The vents for this station were located within the canopy structure. The facility did not have lightning rods.

Based on reports from observers at the station during the incident, the following initial sequence of events took place as a result of the lightning bolt strike:

- The tank pad rose three to five feet. (The pad is 36 x 40 x 1 feet of reinforced concrete, with an approximate weight of 63 U.S. tons.) The pad partially slumped into the tank excavation. A subsurface explosion would support this movement.
- There was a flash fire on the surface of the pad.
- A 36-inch circular sump traffic lid was blown 60 to 70 feet into the air and then sliced down through the canopy.
- A customer dispensing fuel into her vehicle immediately drove off, disconnecting the nozzle at the breakaway fitting.
- The concrete pad in the vicinity of the spill containment/vapor recovery ports was displaced.

Post Mortem

It has been theorized that the lightning strike delivered a spark to the vapor near the dual atmospheric vents. (The diesel and premium are together, and the regular is separate.) The spark followed a vapor trail back to at least the premium unleaded tank. At the time of the event, the premium tank contained approximately 4,055 gallons of product; the diesel contained approximately 5,220



The lightning-impacted site showing subsidence of the tank pad over the UST area.

gallons. Both the diesel and premium unleaded gasoline tanks suffered catastrophic failure. The regular unleaded tank, which did not rupture, contained 1,821 gallons.

On June 28, the Pinellas Park Fire Department, Pinellas County Hazmat, Bureau of Emergency Response, and representatives of Circle K were the initial responders. Circle K's construction manager, Daryl Gottilla, and its remediation manager, Alan Cubberley, provided direction throughout the initial and following days. Circle K was very proactive, fully meeting the Florida Department of Environmental Protection's "contain, remove, abate" criteria following a discharge event.

Circle K arranged for the contents of the regular tank and for free product on the groundwater interface (at five feet below land surface) to be transferred by vacuum truck (SWS & US Filter) to a 20,000-gallon FRAC-tank. The tanks had been installed in a crushed-rock backfill material. Circle K's consultant, Environmental Compliance Services, began installing observation wells around the perimeter of the tank field that same evening.

On June 29, additional free product was removed. The exact amount of free product recovered has not been determined—the failure of both tanks was at or below the groundwater table elevation. Sections of the slab were removed, allowing workers to observe that the center portions of the premium and diesel tanks between the turbine sumps and the opposite end-cap were "missing" above the groundwater level (about 25 feet of tank). The Pinellas Park Fire Department monitored vapor levels during the excavation process. The weather was hot and humid with little wind to disperse the strong vapor presence. Later in the day, the remainder of the concrete pad was removed.

On June 30, the regular unleaded tank was exposed and removed intact from the excavation. A well-drilling contractor was on-site to install permanent and temporary wells. The accessible portions of the damaged USTs were removed. Product piping and vent lines were not removed at this time.

On July 1, the contractor back-filled the excavation with clean fill material and placed four 6-inch prod-



◀ Firefighter examining tank remains.

The excavation showing the remains of the diesel and premium tanks along with product. ▼



uct-recovery wells. During the cleanup of the concrete and steel rebar scrap, sparks from a quick-cut saw ignited crushed-fiberglass tank parts in the construction dumpster, necessitating a visit by the fire department.

The retrofit schedule was advanced to initiate tank replacement by mid-summer. The initial site-preparation involved installing sheet-piling with well-points. The effluent from the points was air stripped and stored in a FRAC-tank. During this site-preparation process, the excavation was thoroughly cleaned of failed-tank remnants, all piping components, and concrete debris. The vent pipes were moved out from the canopy and toward the edge of the property. This closure-completion

and installation-initiation process began on July 13.

The World Weighs In

A brief synopsis of the event, gleaned from media reports, was distributed worldwide via the Internet in a moderated newsgroup, "Dangerous Goods & HazMat." This led to a series of e-mails from industry consultants opining on the cause of the tank failures. One position indicated

that the vapor-rich ullage would not support ignition, nor would it allow the movement of a spark or ignition pathway back down the tank vent pipe. Other positions suggested a possible ignition of product vapors in the crushed-rock backfill beneath the pad, or the flash boiling of groundwater to create a steam explosion. ■

Ernest Roggelm is an Environmental Manager with Florida's Pinellas County Health Department Storage Tank Program. He can be reached at ernest_roggelm@doh.state.fl.us. Photos are courtesy of Ernest Roggelm, Lisa Frazier, Jamie Barnett, and Michael Flanery of the Pinellas CHD Storage Tank Program.

18th Annual National Tanks Conference Call for Abstracts



NEIWPC is accepting abstracts for professional papers to be considered for presentation at the 18th Annual National Tanks Conference & Exposition to be held March 20-22, 2006, at the Memphis Cook Convention Center in Memphis, Tennessee. The deadline for submitting abstracts is September 9, 2005. Complete instructions and the online submittal form can be accessed through NEIWPC's website, www.neiwpc.org/tanks06. Also, check this website for information on updates and exhibiting opportunities.



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August 1985/Bulletin #1 - November 2004/Bulletin #48
The LUSTLine Index—is ONLY available online.
To download the LUSTLine Index, go to www.neiwpc.org/lustline.htm, and then click on LUSTLine Index.

EPA Denies RFG Waivers

On June 2, U.S. EPA announced that it would deny separate requests from California, New York, and Connecticut to waive the oxygenate requirement for reformulated gasoline (RFG). Reformulated gasoline contains 2 percent oxygen by weight. Since California, New York, and Connecticut ban the use of MtBE, RFG in those states contains only ethanol.

EPA's RCRA/SF/OUST/EPCRA Call Center Discontinues Support of UST Program

As of April 1, EPA's RCRA/SF/OUST/EPCRA Call Center is no longer providing information about EPA's UST/LUST program. For information about the UST/LUST program, see the EPA OUST website at www.epa.gov/oust. To order publications developed by OUST, call EPA's publications distribution center at (800) 490-9198.

New UST-LUST Virtual Classroom Unveiled

OUST introduced a new online, Internet-accessible training tool on

the UST program at the UST/LUST National Conference in Seattle. The *UST-LUST Virtual Classroom*, currently has two training modules. The first, "Introduction to the Underground Storage Tank (UST) Program," explains tank regulations, describes the differences between the UST and LUST programs, discusses financial responsibility, and orients new users to the components of a tank system. The second module, "Basic UST Inspector Training," describes how inspectors can prepare for and conduct compliance inspections at typical UST sites. A third module providing training for LUST site managers will be added this year. The *UST-LUST Virtual Classroom* is available 24 hours a day through EPA's website at <http://www.epa.gov/oust/virtual.html>.

OUST Publishes Maintenance Manual for UST Sumps and Spill Buckets

UST Systems: Inspecting and Maintaining Sumps and Spill Buckets - Practical Help and Checklist (EPA 510-R-05-001) was published in May. The manual, which was reviewed by EPA, states,

and industry, is intended to help UST owners and operators improve the operation and maintenance of their UST-system sumps and spill buckets by presenting recommended inspection guidelines and best management practices.

The manual will help owners identify and inspect the sumps and spill buckets associated with their UST systems; explain some simple steps owners can take to maintain their sumps and spill buckets and identify potential problems; and provide owners with tips for fixing common problems before they cause a release of petroleum products to the environment. The manual includes safety considerations, a general introduction to the kinds of sumps, basic maintenance procedures for sumps and spill buckets, and a sump and spill bucket inspection checklist.

The manual can be viewed and downloaded from the OUST website at <http://www.epa.gov/oust/pubs/sumpmanl.htm>, and free printed copies are available from NSCEP at (800) 490-9198.

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