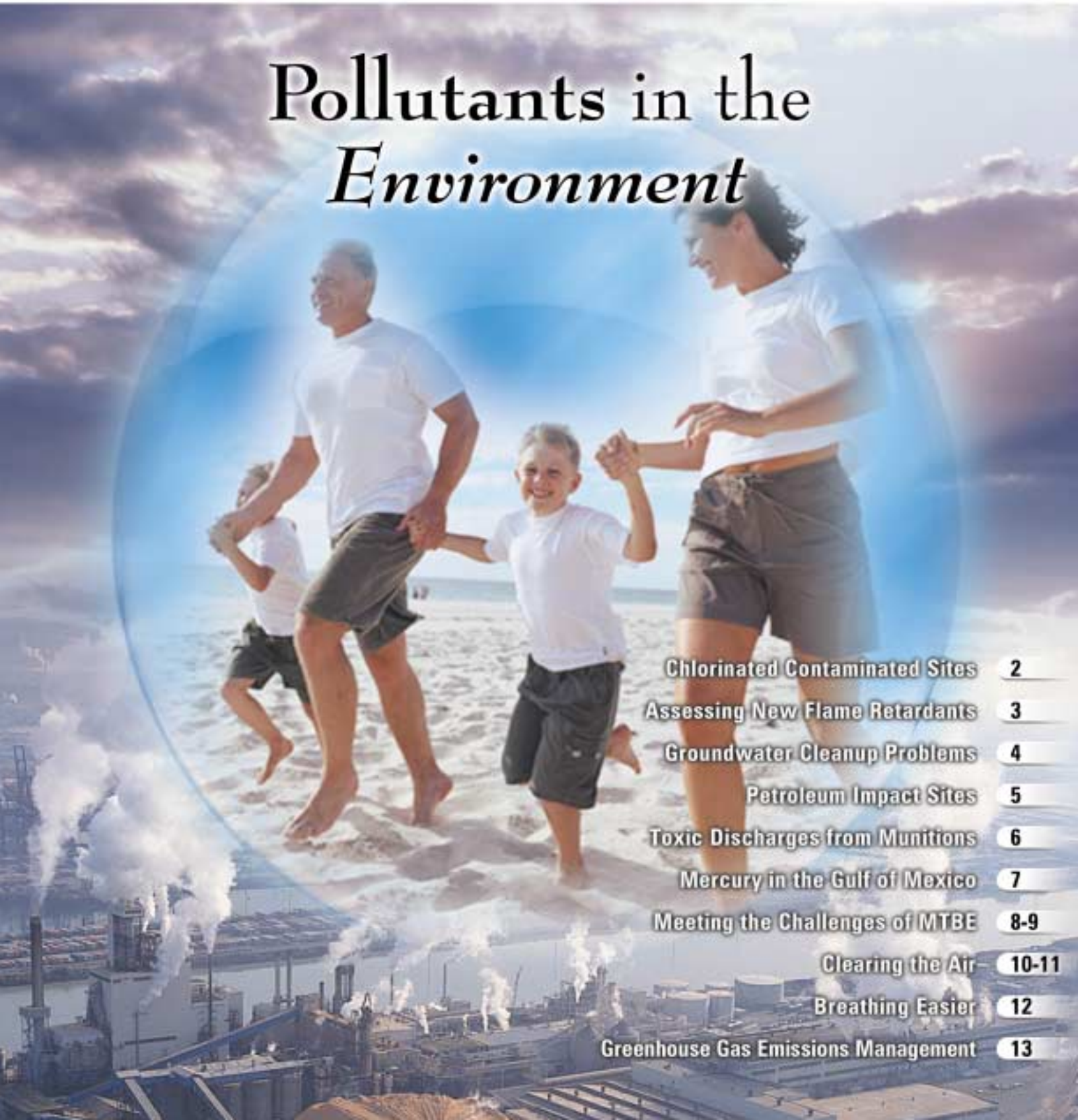
BATTELLE
Environmental Updates
Highlights of Battelle's International Environmental Leadership
Summer 2002



Pollutants in the *Environment*

Alternative Characterization Approaches in Europe for *Chlorinated Contaminated Sites*

The Regulation Outlining Criteria, Procedures and Modes for Remediation, Environmental Recovery, and Security Measures in Contaminated Sites, (D.M. 471/99), promulgated by the Italian Ministry of Environment in 1999, outlines the importance of an extensive and adequate initial characterization of pollution at contaminated sites. Battelle is performing cost-effective characterization campaigns that avoid excessive costs and provide reliable screening of the contamination, while reducing the number of samples to be analyzed. The Italian Decree compels the "Potential Polluters" to declare themselves to the Authority, perform characterization activities, and, if needed, implement a remediation program.

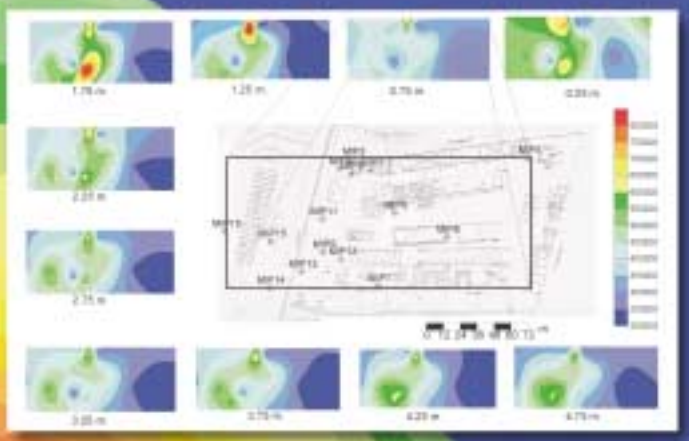
One such company contracted Battelle to perform a characterization and remediation program at a number of their Italian sites. The company commercializes chemical products for industrial uses such as TCE, PCE, and BTEX, all of which are considered serious concerns for human health related issues. Battelle developed a complete program including:

- Screening of contaminants in the subsoil;
- Installation of monitoring wells;
- Sampling of soil and groundwater;
- Laboratory analysis;
- Human health risk assessment and contaminants fate modeling; and
- Remediation.

The screening of contaminants in the subsoil has been performed using the diagraphy tool Geoprobe® Membrane Interface Probe (MIP) which generates information for the localization of volatile contaminants, evaluation of relative concentrations, and characterization of stratigraphy and lithology of the underground environment. MIP is capable of detecting both chlorinated and non-chlorinated volatile contaminants in saturated or unsaturated soils and gaseous, sorbed, dissolved, or free phase. This approach assisted with contamination source area identification and contributed to the production of a high quality analytical report for submission to the Italian authorities.

For the report, several maps were created from over 600 pieces of information in field data. The maps, created in 3D, helped locate monitoring wells and soil samples, which contributed to the identification of areas that were in need of remediation.

The qualitative results of the MIP have been confirmed by laboratory analysis with a high degree of correlation.



For more information contact Augusto Porta at +41 22 827 2650, portaa@battelle.org, or Marco Pellei at +41 22 827 2110, pelleim@battelle.org.

Environmental Impacts: *Assessing New* Flame Retardants

Brominated flame retardants are chemical additives in plastics, electronics, and consumer products that have been added to reduce potential risk of fire. These chemicals have come under scrutiny over the past years as research indicates that they are finding their way into the environment and human systems. Specifically of concern are polybrominated biphenyls. These chemicals are chemically similar to products that have been found to bioaccumulate in the environment and have the potential for serious health impacts.

In 1976 the Environmental Protection Agency (EPA) enacted the Toxic Substance Control Act (TSCA), which enables EPA to track and screen chemicals that may pose an environmental or human health hazard. The Act gives EPA the power to ban the manufacture and import of environmentally hazardous chemicals. As part of TSCA, EPA can require chemical manufacturers to perform certain analytical tests on compounds that the Agency believes pose a risk to human health or the environment.

Battelle recently developed an analytical method for a flame retardant compound, that included sampling procedures and analytical protocols. A second phase of that program focuses on generating the appropriate emission data for completion of the Pre-manufacture Notice (PMN), a requirement by EPA for new chemical submissions as part of TSCA requirements. EPA will use the data to assess the environmental and human health impacts of the chemicals.

Battelle's unique capabilities in chemical analysis of both chlorinated and brominated dioxins and furans provide importers and domestic producers of these subject chemicals with valuable TSCA compliance services. Battelle has performed both chemical characterizations and incineration simulation studies for a variety of clients.

Study objectives include testing the environmental effects of new chemicals that commercial manufacturers would like to produce as flame retardants or other useful purposes. The chemicals are often subject to the dioxin test rule 40 CFR 766 and PMN requirements under TSCA that require testing of the chemical's ability to generate brominated dioxins and furans upon disposal in waste incinerators.

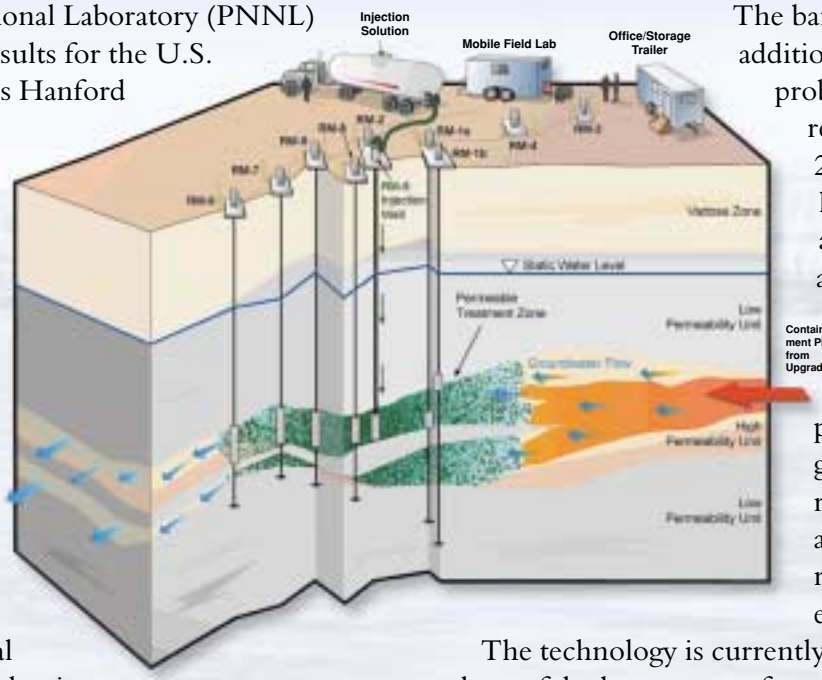
Market forces have generated increased interest in brominated flame retardant alternatives. Battelle is playing a crucial role in helping important chemical manufacturers and importers satisfy EPA requirements and consumer demand for improved, safer, and healthier products.

For more information please contact Jeffery Ferg at (614) 424-5970, fergj@battelle.org.

New Technology Tackles Groundwater Cleanup Problems

An innovative groundwater cleanup technology developed in the early 1990s at the Battelle-operated Pacific Northwest National Laboratory (PNNL) is delivering positive results for the U.S. Department of Energy's Hanford Site and soon may be dispatched to another location in Washington State.

In Situ Redox Manipulation (ISRM) treats contaminated groundwater in place by creating, within an aquifer, a permeable chemical barrier that immobilizes or destroys contaminants. Military bases, petroleum and chemical plants, and weapon production facilities are potential sites where the technology may be useful.



At Hanford, a former plutonium production complex, ISRM field tests began in 1995. Approximately four years later, a 150-foot-long ISRM barrier was installed on site to intercept and immobilize chromate—a corrosion inhibitor—as it migrates through the groundwater toward the Columbia River, about 500 feet away. The technology works, and the site's environmental restoration contractor, Bechtel Hanford Inc., is in the process of expanding the barrier to 2,300 feet. ISRM has also shown significant promise for treating groundwater contaminated with other heavy metals and volatile organic compounds, such as trichloroethylene.

To create a successful barrier treatment zone, iron must be present in the subsurface. Wells are drilled, and sodium dithionite and pH buffers are injected through the wells into the groundwater, where the chemicals react with the iron and other sediments to create a permeable chemical "curtain" or barrier. As groundwater passes through the barrier zone, subsequent chemical interactions destroy, immobilize, or convert contaminants into benign products.

The barriers do not create additional environmental problems and typically will remain effective for 15 to 25 years, reducing the long-term operations and maintenance costs associated with other cleanup methods, such as "pump and treat" (pumping polluted water out of the ground, cleaning it, and returning it to the aquifer). ISRM also reduces worker exposure to contaminants.

The technology is currently in the remedial design phase of deployment at a former chrome-plating business in Vancouver, Washington, near the Columbia River. Chromate is present in groundwater at the site, and the Environmental Protection Agency has called on PNNL scientists to participate in a field test. The ISRM technology will be used in conjunction with a separate source term remediation technology that essentially mixes chemical reductants with contaminated sediments. The Vancouver project, which involves only a few acres, is significantly smaller in scope than ISRM's application at Hanford. The field test, initiated in June, will continue through September, when the effectiveness of ISRM at this site will be evaluated.

PNNL researchers also continue to support ISRM activities at Hanford, and are currently discussing with several organizations, including government agencies, the viability of applying ISRM technology at other contaminated sites.

For more information, contact Kathryn Lang at (509) 375-3837, kathryn.lang@pnl.gov.

Strategic Environmental Baselining Protects *Buyers* and *Sellers* of Petroleum Impacted Sites

Real estate transactions of commercial and industrial properties involve risk, especially at sites that have been impacted by petroleum products. Whether a sale involves a single gasoline station or a group of oil refineries, buyers and sellers have a vested interest in minimizing any existing or future environmental liability. Battelle scientists have now developed Strategic Environmental Baselining (SEB), a cost-effective and pro-active form of environmental due diligence that helps manage long-term liability much more effectively than conventional assessments.

SEB incorporates advanced chemical fingerprinting, a key component of environmental forensics, using modified EPA methods that are tailored for hydrocarbon fingerprinting. If contamination is newly discovered at a site, the critical question for the buyer and seller is whether it occurred before or after the sale as this most often determines who bears the liability. Thus, a critical environmental factor in most property litigation is determining the true nature of existing conditions at the time of the transaction. Legal cases have necessarily relied upon attempts to 'age-date' the newly discovered contamination. Unfortunately, age-dating petroleum contamination is difficult to perform and to defend technically.

Although conventional Phase I and II Environmental Site Assessments (ESAs) often identify the presence of hazardous substances at commercial and industrial properties, they do not collect chemical data that adequately distinguishes one form of petroleum from another or from other types of hydrocarbon contamination. Data that is not definitive is clearly not helpful in litigation surrounding post-sale versus pre-sale contamination.

The alternative – SEB – is an extension of the Phase II ESA that can benefit both buyer and seller in the event of future litigation. In some cases, the benefits to both parties are significant enough that they agree to a cost-sharing agreement for the SEB study. Sufficient sampling and advanced chemical fingerprinting performed at the time of a transaction provides the evidence that eliminates the need to age-date contamination at some future time. (Samples may also be taken and properly archived to await analysis, if and when needed.)

Strategic Environmental Baselining documents site conditions at the time of the sale; minimizes the seller's exposure to future liability claims that occur because of post-sale releases; reduces the buyer's exposure to future liability claims due to unrecognized pre-sale contamination; provides chemical data to facilitate speedy resolutions and pollution abatement; establishes a benchmark against which either natural attenuation or remediation of pre-sale contamination can be measured over time; helps recognize off-site contaminant source(s), such as an impact from a neighboring property after the transaction; and recognizes new sources of contamination from on-site operations post-sale.

While SEB studies cannot completely eliminate future liabilities, they are a significant new strategy that helps buyers and sellers reduce their exposure more effectively than conventional environmental site assessments.

For more information contact Dr. Scott Stout at (781) 952-5234, stouts@battelle.org.

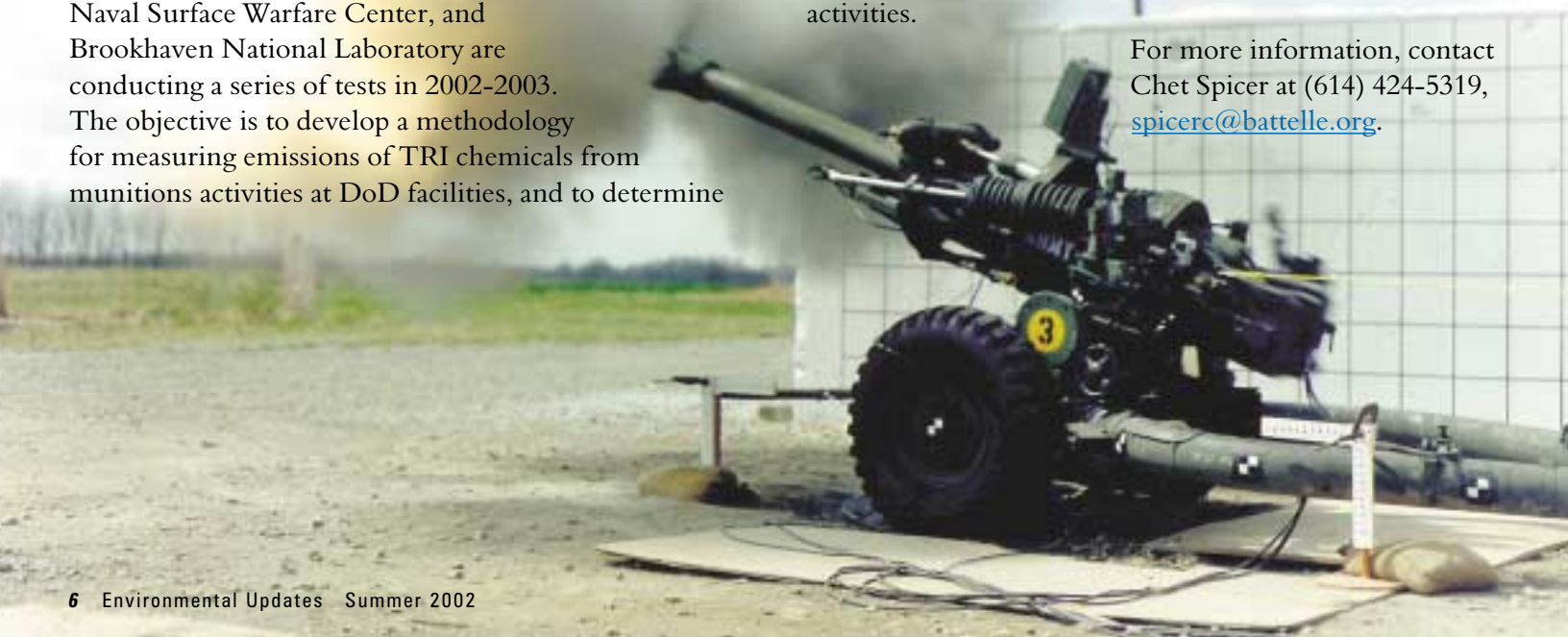
New Ways to Measure *Toxic Discharges* from **Munitions**

The Environmental Protection Agency's (EPA) *Emergency Planning and Community Right-to-Know Act* (EPCRA) requires industry and government agencies to report emissions of chemicals listed on the Toxic Release Inventory (TRI). Executive Order 12856 directed previously exempt federal facilities, including military installations, to adhere to EPCRA. This includes toxic release inventory requirements of Section 313. Department of Defense (DoD) facilities, specifically testing and training ranges, need reliable air emissions data for TRI chemicals from munitions activities to (1) meet EPCRA reporting requirements, and/or (2) demonstrate that emissions are below de minimis concentrations and therefore do not need to be reported. At present, published emission factors for munitions activities have been developed from tests conducted for open burning and open detonation (OB/OD) disposal of energetic materials. DoD needs technology that will allow emission factors for TRI chemicals to be developed for munitions usage during testing and training activities.

Until now, emissions factors for DoD testing and training ranges have been developed primarily from burning and detonating munitions under enclosed conditions, and from theoretical calculations based on thermodynamic principles. Unfortunately, the accuracy of these estimates is uncertain. To determine directly the chemical emissions discharged by munitions on a range, Battelle, the Army's Aberdeen Test Center, the Navy's Naval Surface Warfare Center, and Brookhaven National Laboratory are conducting a series of tests in 2002-2003. The objective is to develop a methodology for measuring emissions of TRI chemicals from munitions activities at DoD facilities, and to determine emission factors for numerous TRI chemicals from selected munitions.

The Strategic Environmental Research and Development Program (SERDP) initiated and is sponsoring this research to help DoD respond to the EPCRA. The Battelle team is conducting two types of field campaigns. During the initial campaign, Battelle scientists will quantify TRI emissions from the discharge of weapons. The second study will focus on the measurement of emissions from the detonation of munitions upon impact. The measurement campaigns will be carried out at the Aberdeen Test Center at Aberdeen Proving Ground in Maryland. The chemical measurements will employ an array of instruments and samplers including highly sensitive and specific real-time air sampling mass spectrometers, whole air collectors, aerosol samplers, and individual monitors for specific chemical species. In order to calculate emission factors from the chemical measurements, it is necessary to account for dilution of the emissions as the emission cloud expands and moves downwind. Several special technologies will be employed to account for dilution either by measuring the volume of the emission cloud (3-D photogrammetry, aerosol lidar), or by tracking dilution via a chemical tracer (carbon mass balance, inert noble gas). Once the methodology has been established, Battelle will apply their results to determine emission factors for a broad range of DoD munitions items and activities.

For more information, contact Chet Spicer at (614) 424-5319, spicerc@battelle.org.



BATTELLE

Mercury in the Gulf of Mexico: *Do Offshore Oil & Gas Facilities Contribute?*

Some forms of mercury, particularly methylmercury, can harm virtually all types of life when they are present at high levels. Humans are exposed to methylmercury primarily through consumption of fish and shellfish, which has led to concern about mercury levels in the tissues of commercial and recreational seafood. Concerned about food safety, the American Petroleum Institute (API) commissioned Battelle to review the current literature on sources of mercury in the Gulf of Mexico and on the potential contribution of offshore oil and gas operations to levels of the metal in seafood.

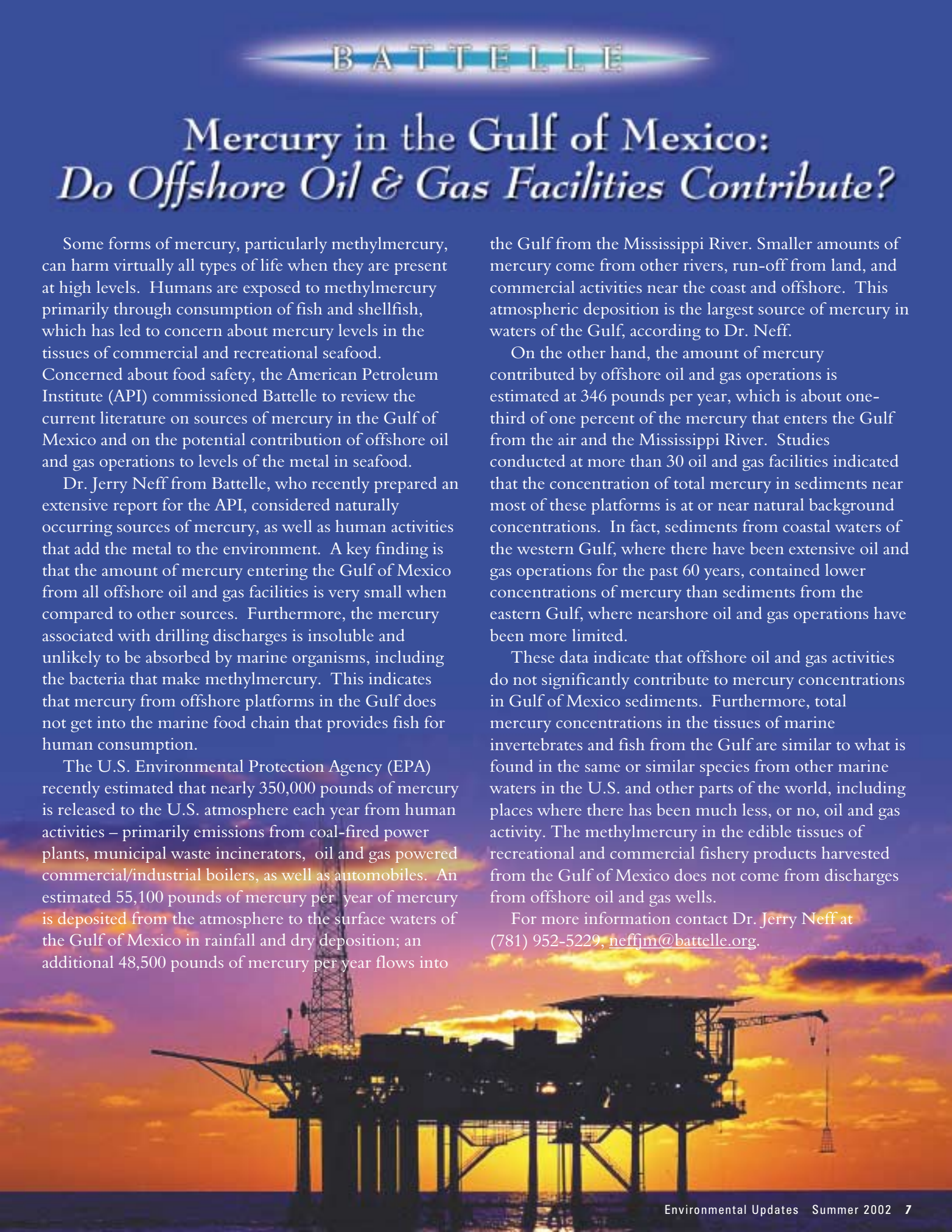
Dr. Jerry Neff from Battelle, who recently prepared an extensive report for the API, considered naturally occurring sources of mercury, as well as human activities that add the metal to the environment. A key finding is that the amount of mercury entering the Gulf of Mexico from all offshore oil and gas facilities is very small when compared to other sources. Furthermore, the mercury associated with drilling discharges is insoluble and unlikely to be absorbed by marine organisms, including the bacteria that make methylmercury. This indicates that mercury from offshore platforms in the Gulf does not get into the marine food chain that provides fish for human consumption.

The U.S. Environmental Protection Agency (EPA) recently estimated that nearly 350,000 pounds of mercury is released to the U.S. atmosphere each year from human activities – primarily emissions from coal-fired power plants, municipal waste incinerators, oil and gas powered commercial/industrial boilers, as well as automobiles. An estimated 55,100 pounds of mercury per year of mercury is deposited from the atmosphere to the surface waters of the Gulf of Mexico in rainfall and dry deposition; an additional 48,500 pounds of mercury per year flows into the Gulf from the Mississippi River. Smaller amounts of mercury come from other rivers, run-off from land, and commercial activities near the coast and offshore. This atmospheric deposition is the largest source of mercury in waters of the Gulf, according to Dr. Neff.

On the other hand, the amount of mercury contributed by offshore oil and gas operations is estimated at 346 pounds per year, which is about one-third of one percent of the mercury that enters the Gulf from the air and the Mississippi River. Studies conducted at more than 30 oil and gas facilities indicated that the concentration of total mercury in sediments near most of these platforms is at or near natural background concentrations. In fact, sediments from coastal waters of the western Gulf, where there have been extensive oil and gas operations for the past 60 years, contained lower concentrations of mercury than sediments from the eastern Gulf, where nearshore oil and gas operations have been more limited.

These data indicate that offshore oil and gas activities do not significantly contribute to mercury concentrations in Gulf of Mexico sediments. Furthermore, total mercury concentrations in the tissues of marine invertebrates and fish from the Gulf are similar to what is found in the same or similar species from other marine waters in the U.S. and other parts of the world, including places where there has been much less, or no, oil and gas activity. The methylmercury in the edible tissues of recreational and commercial fishery products harvested from the Gulf of Mexico does not come from discharges from offshore oil and gas wells.

For more information contact Dr. Jerry Neff at (781) 952-5229, neffjm@battelle.org.



Battelle is Meeting the Challenges of MTBE

The oxygenate methyl tertiary-butyl ether (MTBE) has been added to gasoline for over 20 years - initially to improve octane, and later to satisfy state and federal requirements for oxygenated (Oxyfuel) and reformulated gasoline (RFG). The use of MTBE in automotive gasoline has provided substantial benefits in terms of the reduction of tailpipe emissions of volatile organic compounds like benzene, carbon monoxide, and other toxics. While MTBE has provided important health benefits in terms of reduced hazardous air pollutants, MTBE-laden gasoline released from leaking underground storage tanks/systems has presented a new environmental problem. The chemical's persistence and mobility in water has led to its detection in many drinking water supplies nationwide. Even at low levels (40 mg/L) MTBE can affect water's taste and odor. Furthermore, MTBE has been designated as a possible human carcinogen, which has led to a U.S. Environmental Protection Agency (EPA) drinking water advisory of 20-40 µg/L for MTBE. The remediation and health effects of MTBE are "hot topics" for many of Battelle's clients, which has led Battelle scientists to conduct diverse investigations regarding MTBE.

Demonstrating and Enhancing Natural Biodegradation of MTBE

Natural degradation of gasoline-derived hydrocarbon contaminants (BTEX) has been increasingly relied upon as a viable remediation option. Unfortunately, under most conditions MTBE has been largely considered recalcitrant in aquifers. In an extensive laboratory study, Battelle scientists demonstrated the potential for local bacteria at two separate Navy sites in California to aerobically biodegrade MTBE, which was one of the first studies to contradict the belief that MTBE could not be naturally degraded. Using field data, Battelle engineers demonstrated the potential for MTBE in groundwater to aerobically biodegrade under the site-specific conditions. This understanding allowed Battelle to design and install a cost-effective remediation system much smaller than would have been required without this valuable information. The remediation system employed *biosparging*, which enhances the natural biodegradation of MTBE by aerating the aquifer and providing the bacteria the oxygen they needed to effectively metabolize MTBE. This approach destroys dissolved MTBE *in situ*, versus other more costly technologies that require extraction of the groundwater and some form of secondary treatment. The final biodegradation by-products of MTBE are harmless carbon dioxide and water. For more information on Battelle's capabilities in MTBE remediation, contact Jim Gibbs at (614) 424-3642, gibbsj@battelle.org.

MTBE Forensics

Because of the widespread use of MTBE and the large number of leaking underground storage tanks, the source of MTBE in groundwater is not always evident. As such, investigations tailored to address the source(s) of MTBE in aquifers require detailed chemical and hydrogeological analysis. Battelle scientists have employed detailed gasoline 'fingerprinting' in the characterization of MTBE and concurrent gasoline-derived hydrocarbons in effort to establish sources of MTBE in groundwater. By combining detailed chemical 'fingerprinting' with detailed geohydrologic assessments, sources of MTBE can be better unraveled. At Naval Base Ventura County, Port Hueneme, California, Battelle analyzed the behavior

of MTBE as it interacted with aquifer sediments in order to characterize MTBE in a groundwater plume. In the course of this investigation, Battelle was able to recognize an additional nearby source of MTBE that could be distinguished from the client's MTBE. Battelle is developing environmental forensic methods using hydrogeological properties of aquifers, fate and transport properties of contaminants, and advanced chemical 'fingerprinting' to help clients define their relative responsibility in environmental cleanup at complex sites. For more information on Battelle's capabilities in MTBE fate and transport or gasoline fingerprinting, contact Jim Gibbs at (614) 424-3642, gibbsj@battelle.org or Dr. Scott Stout at (781) 952-5234, stouts@battelle.org, respectively.

Human Health Risk Assessments – Dermal and Inhalation Exposure to MTBE

Battelle scientists, with support from the Environmental and Occupational Health Sciences Institute at Rutgers University, are working with EPA to conduct studies to determine safe levels for humans exposed to water contaminated with MTBE. These studies involve controlled, short-term, inhalation and dermal exposures to waters containing MTBE. Battelle's approach utilizes continuous, real-time breath analysis to generate exhaled-breath profiles and evaluate the kinetics of MTBE in the human body.

In the dermal exposure study, real-time breath analysis was used to measure people's absorption of MTBE while bathing in contaminated water. In the inhalation study, subjects were continuously exposed to low levels of isotopically labeled MTBE (MTBE-d_{12}). Exhaled breath was sampled and analyzed with the real-time breath technology. Blood samples were collected from the subjects during exposure and during the 30-minute post-exposure period. The real-time technology was specially modified with a biofeedback exposure control system to allow uptake measurements during the exposure period and throughout the post-exposure period. The breath and blood data are being used within the framework of a multi-compartmental model to estimate the residence times of MTBE in the human body. The model will then be used to estimate the uptake and decay of the target chemicals in the blood.

These studies will provide important data in the development of safe exposure levels for use in human health risk assessments. For more information on Battelle's human health exposure study contact Dr. Sydney M. Gordon at (614) 424-5278, gordonsm@battelle.org.

Evaluating Technologies for Removing MTBE from Drinking Water

In response to high levels of MTBE (exceeding 1000 µg/L) found in drinking water, EPA assembled a workgroup to conduct field evaluations of technologies and processes to treat drinking water (or wellhead treatment) and groundwater contaminated with MTBE. The focus of the field demonstrations was to conduct performance evaluations on field-ready technologies and processes for treating drinking water, groundwater, and aquifer materials at the source of contamination.

Three technologies and processes were selected based on a national solicitation to determine the best available, field-ready systems. Battelle's Environmental Technology Commercialization Center (ETC^2) facilitated Cooperative Research and Development Agreements (CRADAs) between EPA and the three companies that developed the field-ready technologies. Under the CRADAs, an independent evaluation of each technology for removal or destruction of MTBE and its byproducts from contaminated aquifers will be conducted. The companies will demonstrate their technology under controlled conditions so that proper scientific evaluations can be made on the effectiveness of the process. The fieldwork for all three evaluations will be completed by this spring and the results will be available by September 2002.

ETC^2, established in 1998 through a cooperative agreement between Battelle and EPA, performs a variety of activities to help link private sector companies with EPA researchers, facilities, and expertise. To learn more about ETC^2's capabilities, visit **www.ETC2.org**, or contact Heidi Tessitore at (513) 362-2600, tessitoreh@battelle.org.

Photo (above left) courtesy of THE REYNOLDS GROUP of Tustin, California.

Clearing the Air: Battelle Addresses Regional Haze Issues

The U.S. Environmental Protection Agency (EPA) has designated 156 Federal Class I areas in the U.S. on the basis of their scenic beauty. The Class I areas consist of national parks and wilderness areas, such as Yosemite National Park and the Florida Everglades. To protect the beauty of such areas, the 1977 Clean Air Act set forth a national goal for the "prevention of any future, and the remedying of any existing, impairment of visibility in Federal Class I areas which impairment results from manmade air pollution." Although both natural and man-made factors can reduce visibility in scenic areas, a key factor is the regional haze of tiny airborne particles caused by widespread air pollution sources. In 1999, EPA implemented the Regional Haze Rule to begin the restoration of visibility in scenic areas to a natural level. Specifically, the Rule requires that by the year 2064 natural background visibility conditions be achieved in Class I areas.

Guiding States in Responding to Regional Haze

Under support of EPA's Office of Air Quality Planning and Standards, staff from Battelle's Atmospheric Science and Applied Technology department are preparing two guidance documents to aid states in developing State Implementation Plans (SIPs) for responding to the Regional Haze Rule. One document addresses the estimation of the natural background visibility conditions, which is the goal of the Rule, the other addresses how to track progress toward attainment of the visibility goals. These guidance documents highlight the key require-

ments and milestones of the Regional Haze Rule, define the methods for calculating visibility reduction, summarize procedures for handling pollution data, and offer procedures for comparing five-year periods to evaluate changes in visibility impairment.

The guidance documents are designed to provide relevant agencies with a consistent way to evaluate changes in visibility impairment in Class I areas. However, the information provided is guidance only, and users are encouraged to develop alternative procedures if they provide improved assessments of visibility. Currently, states are in the initial 2000-2004 baseline period of the Regional Haze Rule. For this phase, monitoring data is used to establish current baseline visibility conditions, in order to plan how rapid an improvement is needed to achieve natural background conditions by 2064. The improvement in visibility is to be judged by comparing the 20 percent worst visibility days, over successive five-year periods.

The guidance documents are currently undergoing final revision after successive rounds of public and scientific peer review and will be released by EPA later this year. For more information contact Thomas Kelly at (614) 424-3495, kellyt@battelle.org.

Key Topics in the Regional Haze Rule Guidance Documents:

- Methods for calculating light extinction from the data on particulate matter components measured in the IMPROVE (Interagency Monitoring for Protected Visual Environments) ambient monitoring network,
- How to take into account the effect of relative humidity on light extinction calculations,
- Steps to take when the data for a particulate matter component is missing from a sample,
- Data completeness requirements for calculating annual averages or values for the 20 percent worst visibility or 20 percent best visibility days at a monitoring site,
- Methods for selecting the 20 percent worst visibility and 20 percent best visibility days,
- Procedures for calculating baseline visibility for the 2000-2004 period,
- Procedures for calculating current visibility conditions for successive five year periods, and
- Procedures for comparing successive periods in order to evaluate progress.

Regional Haze Source Apportionment

Regional haze can partially be assessed based on reconstructed light extinction, a measure which includes the light scattering contributions of measured sulfate, nitrate, organic carbon, soil particles, coarse particles, and the light absorption by aerosol. Properly weighted for relative scattering efficiencies and including the effect of relative humidity, this calculation provides a consistent metric for tracking visibility at monitoring sites. Source apportionment represents one manner to identify pollution emission sources and to quantify their contributions to regional haze.

A recent report (May 2002) prepared by members of Battelle's Statistics and Data Analysis Systems department for the Mid-Atlantic/Northeast Visibility Union and Midwest Region Planning Organization addressed the problem of identifying emission sources and quantifying their contribution to fine particulate matter (PM2.5) and regional haze. In response to the guidelines set forth by the Regional Haze Rule, the study's goals were to identify the 20 best and 20 worst visibility days in non-urban portions of the midwestern and eastern U.S. based on receptor observations.

The study focused on 10 sites from the IMPROVE network and six sites from the Clean Air Status and Trends Network (CASTNET). Secondary goals of the study included evaluating and screening available ambient measurements for modeling air pollution with receptor models, evaluating existing emissions databases for use in identifying output from the models, and assessing output from the models.

After performing necessary data quality and assurance activities, the data from each site, along with monthly relative humidity factors, were used to calculate reconstructed light extinction. Two state-of-the-art source apportionment models (Positive Matrix Factorization {PMF} and UNMIX) were then used to attempt to identify contributors to the regional haze. Preliminary identifications were assigned to most of the sources detected with PMF. At each site, a "secondary sulfate source" was determined to be the largest contributor to regional haze during the 20 percent worst days. In some cases, a "secondary organic compound" also was found to be strongly associated with the 20 percent worst days. For more information, contact David Wendt at (614) 424-7653, wendtd@battelle.org.

Breathing Easier with Reference and Learning Center for **Air Program Managers**

Coal-fired power plants, cement plants, and incinerators on U.S. Army bases can release hazardous chemicals and contaminants to the air and surrounding communities. Other military facilities, such as aircraft gunnery ranges, firefighter training centers and maintenance facilities may also add dangerous materials to the air. Each army base must meet all applicable air quality requirements without impacting its national security work. A new Web-based learning and resource center created by Pacific Northwest National Laboratory (PNNL) for the U.S. Army Forces Command (FORSCOM) helps the Army's air program managers meet these requirements and manage pollution. PNNL is operated by Battelle for the U.S. Department of Energy (DOE).

The online resource center increases the ability of air program managers "to do the right thing," according to PNNL Project Manager Marina Skumanich. "It puts information right at their fingertips." An air program manager ensures compliance with the federal Clean Air Act, as well as with state, local, Army, and Department of Defense clean air regulations. In 1998, one of FORSCOM'S top priorities was to develop a training program to help air program managers effectively and efficiently meet regulations, stay up-to-date on new information, and share strategies and information with others. Thus, the Air Program Manager's Learning and Resource Center was born.

The Center, available at http://www.seattle.battelle.org/forscom/index.htm, is organized into five major content tracks:

- *Regulations* – Provides information and context on environmental laws and regulations, and a comprehensive analysis of the Clean Air Act.
- *Hot Air* – Concentrates on topics of major concern to air programs, as identified by the FORSCOM air program managers.
- *Management* – Describes how to organize and manage an effective air program. It also outlines the air program manager's duties, and captures lessons learned and best practices.
- *Science* – Explains the underlying scientific principles and tools related to air pollution.
- *Installation* – Gives a visual perspective of possible air pollution sources and provides a tool to survey facilities.

The Learning Center has other notable features for air resource managers. The resource page provides information and tools, including printable air program activity checklists and forms, links to additional information sources, a list of regulations, and a glossary of relevant terms. Users can determine their strengths and weaknesses in various subject areas by completing tests at either beginning or advanced levels.

"The Center is very user-friendly," says Kate Baker, PNNL Co-Project Manager. "The product has been favorably evaluated and used by the customer."

For additional information, contact Marina Skumanich at (206) 528-3307, sku@battelle.org.

BATTELLE

Greenhouse Gas Emissions Management

Corporations are increasingly interested in understanding their greenhouse gas emissions and reporting these results to their stakeholders. There are two primary drivers prompting this increased interest: the desire to better manage emissions, and the need to provide increased information on environmental performance.

Due to continually evolving accounting and reporting standards, however, greenhouse gas emissions reporting presents a challenge to organizations. With few exceptions, greenhouse gas emissions are largely unregulated and reporting to government agencies is not required. Consequently, corporations must confront several questions:

- Which greenhouse gases and emissions sources should be included in our emissions inventories?
- How should the emissions be quantified?
- How can we account for sources that we may only partially be responsible for?
- How can emissions be tracked over time within our changing organization?

Members of Battelle's Environmental Management Group have successfully addressed these issues for several key clients. For ChevronTexaco, they recommended procedures for corporate emissions data collection and, together with ChevronTexaco's guidance, contributed to the development of a computerized greenhouse gas and energy inventory system that is now being used worldwide by the company. This system:

- Estimates emissions of carbon dioxide, methane, and nitrous oxide for all major petroleum industry operations, including emissions associated with purchased energy;
- Tracks energy consumption of company operations;
- Reports emissions on both an absolute and per unit output basis;
- Allows the reporting of emissions on a total, equity share, and operated basis;
- Is based on easy-to-use Excel interface;
- Uses menu-driven configuration of emissions sources;
- Allows monthly data input into spreadsheet by business units;
- Accepts wide range user-selected measurement units;
- Maintains audit trail for input data;
- Conducts internal checks for data completeness; and
- Provides for automated signoff and submission of business unit data to corporate headquarters via e-mail.

The benefits of such a system are numerous. They include the use of consistent estimation methods throughout the organization and the facility to set emission reduction targets against a reliable baseline, the ability to report emissions along a range of dimensions, and the facilitation of third party emissions verification. A direct demonstration of this capability can be arranged with ChevronTexaco.

For more information on Battelle's corporate greenhouse gas emissions inventory work, contact Mr. Christopher Loreti at (781) 895-4883, loretic@battelle.org, or Dr. Bernhard Metzger at (781) 895-4886, metzgerb@battelle.org.

Battelle Announces Formation of Environment

Battelle announces the formation of the Environmental Management Practice, which focuses Battelle's management consulting expertise on the environmental, health, and safety (EHS) challenges faced by industry.

An integral part of this new business segment is the Environmental Management Practice, which focuses Battelle's science and management expertise on the environmental, health, and safety (EHS) challenges faced by industry. We are pleased to announce the following individuals as Environmental Management Practice team members:

Richard Chidester

With over 20 years' experience in fostering international relationships with government agencies and energy and industrial organizations, Mr. Chidester helps clients solve environmental safety and planning issues. He works with international organizations and companies to develop streamlined management systems. Mr. Chidester received a J.D. from Franklin Pierce Law Center and bachelor's in history from Northern Arizona University. Mr. Chidester may be reached at (206) 528-3230, chidesterr@battelle.org.

William Dowling

Mr. Dowling has over 12 years' experience in environmental, health, and safety issues. His areas of expertise are in providing environmental due diligence and liability valuation of contaminated site support to industrial clients. Mr. Dowling is highly experienced in RCRA/CERCLA, compliance review, and remediation. Mr. Dowling received a master's and bachelor's in geology from the University of Vermont and Denison University. Mr. Dowling may be reached at (781) 895-4863, dowlingw@battelle.org.

Peter Gamble

Mr. Gamble has over 12 years of experience as an environmental scientist. He provides expertise in project scoping, development, management, data analysis, report preparation, and technical facilitation between the private sector and local, state, and federal resource agencies. Mr. Gamble received a bachelor's in environmental science from the University of Massachusetts, Amherst. Mr. Gamble may be reached at (781) 895-4894, gamblep@battelle.org.

Christopher Loreti

Mr. Loreti has over 17 years of experience in the evaluation of the fate and transport of chemicals in the environment. His recent work focuses on the management of greenhouse gases. He has managed and supported air and water quality improvement studies, environmental impact assessments, and pollutant fate and transport evaluations. Mr. Loreti received a master's in engineering and policy from Washington University and bachelor's degrees in chemical engineering and environmental engineering from Northwestern University. Mr. Loreti may be reached at (781) 895-4883, loretic@battelle.org.

Bernhard Metzger

Dr. Metzger is a recognized leader in environmental impact assessments and management issues affecting oil and gas companies. Over his 20-year career, he has performed assignments related to liability management, greenhouse gas management, and impact assessments and directed the environmental design of exploration and production programs for clients worldwide. Dr. Metzger received a doctorate in engineering sciences as well as a master's in operations research from Harvard University, a master's in water resources and environmental sciences from the Massachusetts Institute of Technology, and a master's in civil engineering from the University of Karlsruhe, Germany. Dr. Metzger may be reached at (781) 895-4886, metzgerb@battelle.org.

Jon Olson

Dr. Olson is a specialist in organizational design and analysis. He has extensive experience in the international arena supporting safety performance, organizational safety, safety culture, and management systems. He has over 25 years' experience in strategic planning, organization assessment, leadership development, and change management. Dr. Olson received a doctorate and master's in sociology from the University of Southern California, and his bachelor's in sociology from Southern Oregon College. Dr. Olson may be reached at (206) 528-3200, olsonj@battelle.org.

tal Management Group

Donald Salmond

For over 25 years, Mr. Salmond has helped global energy clients understand and manage their environmental, health, and safety (EHS) management obligations. His experience ranges from assessing facility-level environmental liabilities to developing corporate EHS strategy and programs. Mr. Salmond received a master's in business administration from Rivier College, a master's in environmental engineering and bachelor's in civil engineering from Northeastern University. Mr. Salmond may be reached at (781) 895-1053, salmondd@battelle.org.

Dean Slocum

Mr. Slocum works with senior management of global industries to enhance business value through improved understanding and management of strategic environmental, health, and safety (EHS) issues. His focus is on strengthening EHS, social, and sustainability management systems, strategy, and organization for global energy industries, particularly related to high profile issues. Mr. Slocum received a master's in public administration from the University of Hartford and bachelor's in sociology from Bates College. Mr. Slocum may be reached at (781) 895-4887, slocumd@battelle.org.

Alan Tilstone

Mr. Tilstone has over 25 years' consulting experience in the earth sciences and geotechnical and environmental engineering. He specializes in merger and acquisition environmental due diligence, environmental risk management, site investigation and remediation. Mr. Tilstone received a master's in rock mechanics and excavation engineering from the University of Newcastle-Upon-Tyne and bachelor's in geology from the University of Bristol, England. Mr. Tilstone may be reached at (781) 895-4877, tilstonea@battelle.org.

"Green" Business Plan Competition Results

Ohio's Central State University's National Environmental Technology (NET) Incubator announced the winners of its First Annual Business Plan Competition held on April 17, 2002. Process Research & Development Technologies of Florence, Kentucky won $10,000 and an expense-paid trip to Boston to present its business plan before equity investors at the Early Stage Capital Forum in June, 2002. The company specializes in innovative chemical and biological pollution prevention and treatment processes.

Dr. Rakesh Govind of PRD Tech Inc. receiving the first place award in the Business Plan Competition from Jerry Mahone, Executive Director of the NET Incubator.

The second-prize winner, Whisper Wash, received $5,000 for its business plan for an environmentally friendly airplane de-icing system. The third-prize winner, Crystal IS, won $2,500 for its plan to commercialize innovative semiconductors.

The NET Incubator held the competition to provide an opportunity for energy and environmental technology entrepreneurs to have their business plans analyzed by a group of experts. The contestants received feedback on how to improve their business model and presentation approach. The competition was co-sponsored by Battelle Memorial Institute's Environmental Technology Commercialization Center, the Energy & Environmental Capital Network, the Office of Energy Efficiency of the Ohio Department of Development, and Central State University. This was the Incubator's first business plan competition, but the sponsors plan to make it an annual event. The NET Incubator provides affordable office and laboratory space and business support to help small businesses develop environmental and energy technologies into products and services.

Dr. Rakesh Govind (center) and Ramesh Merlarkode (President of PRD Tech Inc.) at the NET Incubator.

For more information on this program contact Rita Yusko at (630) 845-6551, yuskor@battelle.org.

Battelle Environmental Updates
Summer 2002 Information

- ⬭ Please add my name to your mailing list
- ⬭ Please note my change of address
- ⬭ No, I no longer wish to receive a FREE copy of Battelle Environmental Updates
- ⬭ I am interested in hearing more about what Battelle can do in the following areas.

- ☐ Human Exposure & Risk Assessment
- ☐ Ecological Risk Assessment
- ☐ Natural Resource Management
- ☐ Chemical Analysis
- ☐ Fate, Transport & Effects of Contaminants
- ☐ Environmental Forensics Investigations
  Pipeline Technology Center
- ☐ Statistical Design
- ☐ Atmospheric Science & Applied Technology
- ☐ Environmental Remediation
- ☐ Oil & Gas Industry Consulting
- ☐ Environmental Management Information Systems
- ☐ Environmental Safety & Health Systems
- ☐ Source Emissions Characterization & Monitoring
- ☐ Environmental Systems & Decision Analysis
- ☐ Life Cycle Assessment & Management
- ☐ Environmental Policy and Program Development

Name: _____ **Title:** _____

Company: _____

Address: _____

City: _____ **State:** _____ **Zip:** _____ **Country:** _____

Telephone: _____ **Fax:** _____

E-mail: _____

Please fax this form to (781) 934-2124 or mail it to the following address:

Joan Sundstrom
Battelle
397 Washington Street
Duxbury, MA 02332

Battelle Environmental Updates is the official newsletter of the international environmental practice of Battelle Memorial Institute, a 7000-employee, international research organization headquartered in Columbus, Ohio. We welcome your comments and suggestions. **If you would like additional information about any of the articles, our services, or the authors, please contact Joan Sundstrom at (888)-290-0571 or via e-mail at sundstrj@battelle.org.**

Battelle

397 Washington Street
Duxbury, Massachusetts 02332-0601

Address Service Requested

Non-Profit
U.S. Postage
PAID
Columbus, OH
Permit No. 909