MMS OCEAN SCIENCE

VOLUME 1 ISSUE 6
NOVEMBER/DECEMBER 2004

THE SCIENCE & TECHNOLOGY JOURNAL OF THE MINERALS MANAGEMENT SERVICE

NOVEMBER/DECEMBER 2004
Volume 1 Issue 6

MMS OCEAN SCIENCE is published bi-monthly by the Minerals Management Service to communicate recent ocean science and technological information and issues of interest related to offshore mineral recovery, ocean stewardship, and mineral revenues.

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ABOUT THE COVER

Top:
Oil spill response vessel.

Bottom:
Oil spill boom surrounding broken ice.

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Publication services provided by
Schatz Publishing Group

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HOW RESEARCH COMES TOGETHER

PREVENTION & PREPAREDNESS

There are over 4,000 offshore oil and gas platforms operating in the Gulf of Mexico. To the west, 23 platforms operate in Federal waters off the coast of Southern California, and to the north, there is growing energy industry interest in Alaskan offshore waters. Yet over the past 20 years, less than 0.001 percent of the oil produced from offshore oil production facilities on the continental shelf has been spilled. With the Nation's energy needs increasingly dependent on offshore oil and gas production, there is great importance placed on research that will improve the Minerals Management Service's (MMS) ability to protect the ecosystems surrounding offshore facilities.

Every study funded by MMS takes the agency one step closer to a better understanding of how the ocean works. This understanding provides the ability to predict the potential path of released oils and chemicals in the ocean. Through the use of testing facilities, scientists are able to take full advantage of advanced technology aimed at effective oil-spill prevention and response.

New studies of deepwater currents on the Gulf of Mexico continental slope are being undertaken to provide information for oil-spill risk analysis and model validation. The MMS's Oil-Spill Research projects continue to provide important information and data used in forming accurate modeling of potential oil-spill risk and in the prevention of oil-spill damage to the ocean environment.

Oil-spill research and response preparation are the perfect examples of how the many parts of MMS combine to form a solid base for decisionmaking and problem mitigation. From research on waves and currents and how oil moves in the ocean to the way the oil impacts marine life, MMS works closely with industry and other government agencies, using prevention and preparedness to ensure that America benefits from environmentally responsible energy production.

Top left: Airplane demonstrating the spraying of dispersants. *Top center:* Recovery of a disk skimmer for oil removal in ice covered waters. *Top right:* Testing of the Foxtail brush skimmer off the Alaskan coast. *Above:* An MMS inspector at an offshore facility. *Above left:* An oil-spill response vessel practicing the deployment of a boom for collecting oil on the surface.

ULTRA-DEEPWATER PRODUCTION

PART OF OUR ECONOMIC FUTURE

The Gulf of Mexico is now in its ninth year of sustained expansion of the deepwater (>1,000 feet of water depth) frontier. A total of 65 deepwater projects were under production by the end of 2002, 11 more in 2003, and an additional 14 in 2004. The Minerals Management Service (MMS) announced in June that there have been eight new deepwater oil and gas discoveries since January. The MMS estimates a total of 96 fields in production by the end of 2007. Yet the increasing demand for energy continues to outstrip domestic production. To counteract the potential of an economically disastrous reliance on oil imports, exploration of new hydrocarbon reserves in waters deeper than 6,000 feet in the ultra-deepwater of the Gulf of Mexico has become crucial.

In 1990, about 4 percent of the oil and less than 1 percent of the natural gas produced on the Gulf's Outer Continental Shelf (OCS) were from those deeper regions. By the end of 2003, more than 60 percent of the Gulf's oil production and 23 percent of its natural gas came from that area. Production potential from deepwater resources is estimated at 49.5 billion barrels of oil equivalent (BOE).

Energy exploration in deepwater is perhaps the most significant area of innovation. Deepwater oil and gas development in the Gulf of Mexico is a workhorse for U.S. domestic oil and gas production. Ocean oil production rose 535 percent between 1995 and 2002; deepwater gas production rose 620 percent over those same years. If current trends continue, by 2006 as much as 77 percent of daily oil production in the Gulf and 26 percent of daily gas production could come from the deepwater regions.

Ultra-deepwater exploration (>5,000 feet of water depth) has uncovered exciting reservoir possibilities. One new discovery is what scientists term a "significant new play concept": ultra-deepwater fold-belts comprising large northeast-southwest trending compressional "box folds." The volume potential of this new resource is enormous. Scientists estimate dozens of box folds, each providing 1-2 billion barrels of crude oil equivalent reserve potential. However, the challenges of recovering oil and gas resources from these ultra-deepwater folds are tremendous.

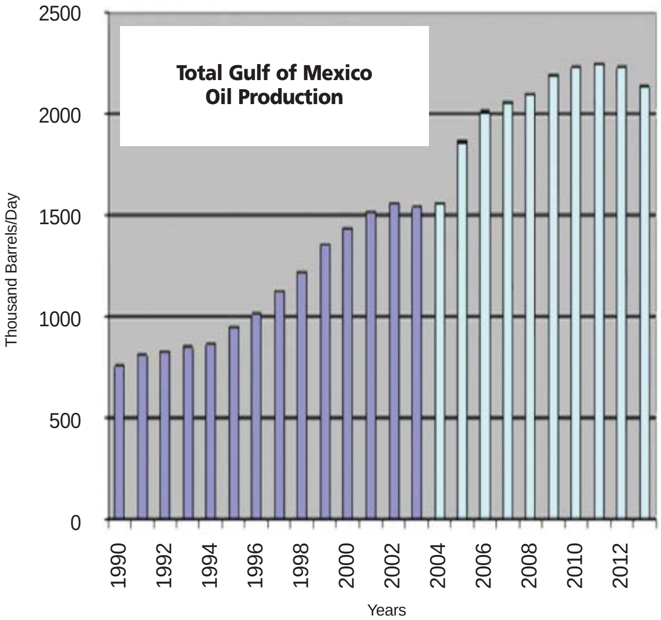
The spar structure Genesis, owned by ChevronTexaco, operates in a water depth of 2,590 feet in the Gulf of Mexico.

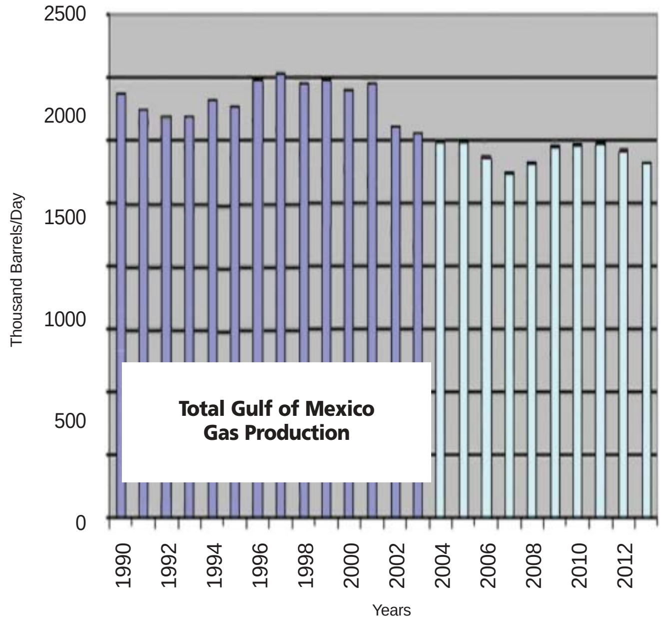
The oil and gas industry has made great technological achievements in the last few years. The growing deepwater infrastructure indicates that the Gulf of Mexico deepwaters will continue to play an integral role in the Nation's energy supply. Ongoing MMS research ensures that the implementation of technological advancements is to the benefit of everyone: environment, industry, and the American public. Polyester moorings, composite risers, cell spars, and 15,000 pounds-per-square-inch subsea trees were unheard of until recently. The effort to develop new technologies that can economically recover energy resources from ultra-deepwater is intense and ongoing.

According to MMS Director Johnnie Burton, "This effort made by the oil and gas companies, the marine service industry, fabrication yards, suppliers of all types (such as drilling mud, pipe manufacturers, computer components,

What is a BOE?

A BOE (barrel of oil equivalent) is a unit of energy equal to the amount of energy contained in a barrel (42 liquid gallons) of crude oil. The boe is used for giving comparative overall production figures that include both oil and natural gas. It is approximately equal to 6.12x109J (joule), based on the approximate energy released by burning one barrel of crude oil. The energy content of natural gas varies because of minor variations in the amount and types of energy gases (methane, ethane, propane, butane) it contains — the more non-combustible gases in a natural gas, the lower the gigajoule value. Unless otherwise noted, a boe is assumed to refer to 6,000 cubic feet (6 Mcf) of natural gas.





underwater survey vehicles), and 30,000 personnel who work offshore every day is truly an amazing story for the country. Their hard work has paid great dividends for the Nation in providing secure sources of energy resulting in many thousands of jobs in the United States."

Offshore oil production now accounts for about 30 percent of total domestic production – more than double what it was just 12 years ago. Experts estimate it may increase to as much as 40 percent by 2010.

In addition to providing access to critical energy and other mineral resources needed for the Nation's economic well-being, MMS also collects and disburses around $8 billion a year in mineral revenues – $135 billion since 1982. The MMS is a leader in securing ocean energy and economic value for America.

The above figures include actual total oil and gas production including expected production through 2006. Values beyond 2006 include industry announced discoveries, extrapolated estimates from surveys, and estimated undiscovered resources.

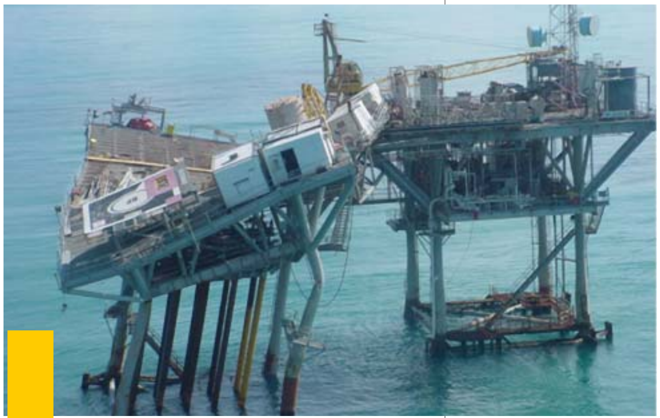
Preparing for the Future: Projecting Oil and Gas Production

The MMS, Gulf of Mexico Region, recently released new oil and gas daily production rate projections that reflect production rates into the year 2013. According to the new report, *Gulf of Mexico Oil and Gas Production Projections: 2004-2013*(MMS 2004-065), a daily oil production rate of 2.13 million barrels by the end of 2013 is estimated, along with a daily gas production rate of 13.49 billion cubic feet.

Most of the oil production and a significant portion of the gas production come from the deepwater area, defined as water depths 1,000 feet or greater. Deepwater operators were surveyed in order to forecast short-term production based on their previous production rates. Gulf oil production was an estimated 1.537 million barrels a day in 2003. Since 1997, shallow-water oil production has declined steadily, but has been offset by increased deepwater production. It is estimated that 62 percent of the 2003 oil came from the deepwater area, which surpassed shallow-water oil production in March 2000. Deepwater Operator Surveys indicate that deepwater oil production will increase significantly over the next few years.

Gas production has followed similar trends to that of oil production, with a decline in total gas production in 2002 and 2003, going from 13.83 billion cubic feet per day in 2001 to an estimated 12.19 billion cubic feet in 2003. For gas production rates to rise above current levels, significant contributions would be necessary from undiscovered deepwater projects.

IF THE WORST SHOULD HAPPEN
RESPONDING TO OIL SPILLS



Above: Boom used to contain spilled oil in water covered with a thin layer of ice.
Left: A platform in the Gulf of Mexico damaged by Hurricane Lili. No oil was spilled.

In the event of an accidental oil spill, the ideal response would be rapid and completely effective. For over 20 years, the Minerals Management Service (MMS) has funded research programs to improve oil-spill response technologies to make that ideal response possible. The Oil Spill Response Research (OSRR) program is at the forefront of research efforts to improve our capability to detect and respond to open ocean oil spills. The MMS is the principal U.S. Government agency funding OSRR. The OSRR program is a contract research program, where research is performed by academic institutions, government laboratories, and private industry. The MMS involvement varies as project initiator, funder, and participant providing scientific ideas or a provider of facilities or other resources. Current OSRR projects cover the spectrum of oil-spill response issues including remote sensing, behavior of oil, mechanical containment and recovery, chemical treating agents, *in situ* burning, and operation of Ohmsett – The National Oil Spill Response Test Facility.

Funding for research through the OSRR Program and at Ohmsett is provided from the Oil Spill Liability Trust Fund (OSLTF). The OSLTF receives funds from a five cents tax on each barrel of oil produced in or imported into the country and from interest on the fund principal, recovery of costs and damages from parties responsible for oil spills, and penalties assessed to those parties. As intended by the Oil Pollution Act (OPA), companies that produce or transport oil are supporting research to improve oil-spill response capabilities. Funding from OPA has enabled MMS to maintain a long-term OSRR program when funds for research and development from other sources are declining.

Mechanical cleanup and physical recovery of spilled oil is the most common and environmentally acceptable method currently used for dealing with oil spills. This technique utilizes booms and skimmers to contain and remove oil from the water's surface. In the Gulf of Mexico, about 19 vessels with skimmers stand ready to respond to a spill. Containment booms are usually one of the first pieces of equipment at the scene of a spill and one of the last to be removed. Containment booms localize the spill and concentrate the oil into thicker layers for removal by skimming devices. The recovery rate for mechanical cleanup at sea is generally 10-20 percent of the spill. The remainder of the oil either evaporates or eventually

Right: Oil spill response personnel training at the Ohmsett facility using an oil-spill boom to trap the oil and a skimmer to remove the oil from the surface.

is mixed and dispersed in the water. Mechanical cleanup is labor intensive, difficult in currents greater than 1 knot, and generates a mix of oil, water, and debris that must be disposed of through recycling, incineration, or placement in a landfill.

In an effort to increase the recovery rate for mechanical booms and skimmers, new designs are being refined and tested. Booms with the ability to withstand higher current and wave forces are now being investigated. Fast water skimming systems, which are effective in ocean currents up to 3 knots, will soon be commercially available. Ice booms for recovery of coldwater oil spills are also being explored.

Another method of responding to oil spills is with the use of chemical dispersants that can be applied to the spilled oil. Chemical dispersants are designed to break up the surface oil slicks permanently and disperse the oil as fine droplets into the water column so that the natural mixing action will dilute the subsurface oil concentration. This action transfers the oil from one location (the water's surface) to another (spread out within the water column), where natural biodegradation can occur. Each dispersant must pass a series of tests from the U.S. Environmental Protection Agency establishing its effectiveness and potential toxicity.

Controlled burning of an oil spill on the surface of the water is known as *in situ* burning. *In situ* burning requires a fire resistant boom, igniters, and special training, but (in some cases) is more effective than mechanical containment and recovery. Studies have shown that *in situ* burning can remove large quantities of oil from the surface in a rapid, effective, and environmentally safe manner. Because the oil is gasified during the combustion process, the need for physical collection, storage, transportation, and disposal is reduced to a small percentage of the original spill volume that remains as residue after burning.

The MMS is designated as the lead agency for *in situ* burn research in the Oil Pollution Technology and Research Plan prepared under OPA. The MMS has assembled a comprehensive compendium of scientific literature entitled *In Situ Burning of Oil Spills: Resource Collection,* MMS Project 102, that describes the role of *in situ* burning as a response option for the control, removal, and mitigation of marine oil spills. All operational aspects of burning are covered in detail. The potential impacts of this technique on the environment and on human health and safety are also addressed. The 2-CD set includes a substantial percentage of the scientific and technical literature on research, development, planning, and implementation undertaken by hundreds of individuals and dozens of organizations. It contains more than 350 documents with over 13,000 pages and nearly one hour of video. This report is available free of charge and can be obtained by sending an email to joseph.mullin@mms.gov or calling 703-736-1556.

The safety record of the oil industry operating on the Outer Continental Shelf has been exemplary over the last 20 years. The MMS is striving to ensure that the number of spills remains low and continues to decrease. Continued research and technological advances guarantee successful prevention and protection against the worst happening.

Oil-Spill Statistics

- The U.S. uses about 700 million gallons of oil every day.
- Eleven platform spills and 16 pipeline spills greater than 1,000 barrels of oil occurred between 1964 and 1999. These spills make up the entire record (begun in 1964) for U.S. Outer Continental Shelf (OCS) spills greater than or equal to 1,000 barrels.
- Total U.S. OCS production from 1964 to 1999 is estimated at 12 billion barrels of crude oil and condensate, approximately 95% of which is transported by pipeline and 5% by tanker or barge.
- Over the past 20 years, less than 0.001 percent of the oil produced from the U.S. OCS has been spilled from offshore oil production facilities.
- Read more about Oil Spill Facts in: www.mms.gov/stats/PDFs/2002_OilSpillFacts.pdf

For more information:

MMS Oil Spill Response Research

Website: www.mms.gov/tarphome

Oil Spill Response Research Program

Website: www.mms.gov/taroilspills

***In Situ* Burn Research**

Website: www.mms.gov/tarprojectcategories/insitu.htm

Mechanical Containment and Recovery

Website: www.mms.gov/tarprojectcategories/mechanic.htm

Chemical Treating Agents

Website: www.mms.gov/tarprojectcategories/chemical.htm

IS MOTHER NATURE A POLLUTER?

NATURAL OIL SEEPS

A gas hydrate outcrop in the Gulf of Mexico with ice worms living in the depressions. Photo courtesy of the Geochemical and Environmental Research Group (GERG).

If you look at the pure numbers, Mother Nature is an unrepentant polluter. In the Santa Barbara Channel alone, she spills an estimated 100 barrels of oil a day. But that is not the whole story. While accidental spills can be very destructive to ecosystems, natural spills from oil seeps are taken in stride by the environment.

Oil and gas seeps are natural leaks of liquid and gaseous hydrocarbons that escape gradually from underground pockets. The vents that leak are commonly only about one-half centimeter wide, although they can be much larger. The release of oil has been described as "patchy." Rates of seepage can change with the seasons, tides, and earthquake activity. The rates can also change as the oil reservoir from which they draw is depleted. It is the gradual, patchy nature of the leak that enables the environment to cope with the influx of potentially damaging hydrocarbons. By contrast, offshore oil spills from production and transportation are characterized by a release of oil that blankets one place in a short period. The environment can be overwhelmed, especially if a spill contacts a shoreline, and the short-term impact can be severe.

The influx of organic matter from natural oil seeps and the resulting microbial production may stimulate growth in certain animal and plant species. Gas seeps and vents on the bottom of the Gulf of Mexico have been found to host extraordinary communities of tubeworms and mussel beds that grow by means of chemosynthesis. The process requires no light and produces no oxygen, unlike photosynthesis. In some places, leaking gas becomes gas hydrate, an ice-like substance that forms at high pressures when gas is trapped in water crystals. Tiny worms have been discovered living on hydrate outcrops.

Oil and gas seeps occur not only in the Gulf of Mexico and California, but also in Alaska. There are a reported 29 oil seep areas along the Alaskan coast. It is estimated that the seepage rates in Alaska are smaller than those in California. The lower water temperature of the Alaskan coast also produces slower oil degradation.

As part of its mission as steward of the OCS energy and marine mineral resources, MMS funds studies of oil and gas seeps and their effects on local ecosystems. One important research area is the detection of the origin of oils deposited on the ocean's surface or on the shoreline. It is important to establish whether the deposit is from natural seeps or a spill. To make the identification possible, MMS has begun a program that seeks to map the activity, location, and destination of natural oil seeps. In conjunction with the United States Geological Survey (USGS), MMS is creating a database of oil "fingerprints" that can be used by State and Federal scientists to ascertain the source of the oil residue. The MMS has also funded a study, *Studying and Verifying the Use of Chemical Biomarkers for Identifying and Quantitating Oil Residues in the Environment* (MMS 2000-086), to identify tarballs through the use of biomarkers, which are specific chemical groups unique to the original oil.

While questions about the short- and long-term effects of oil seeps on local ecosystems are a source of continued study, there is no doubt that the seeps have had a positive effect on the history of the local area. Native American tribes, including the Chumash, Yokuts, Achomawi, and Maidu, used tar from the seeps for ceremonial purposes – painting their faces with the sticky, black substance. It was also used for waterproofing boats and roofs. When the settlers came from the East, they used the oil to grease their wagon wheels. Perhaps even more important in the modern world, many major oil fields in the world were discovered by tracing oil seeps to their origins.

It is clear that, while Mother Nature may appear to be a polluter, the seeps that seem so unsightly have been a valuable resource. As more research is compiled, and new energy sources surrounding them are explored, they may prove even more valuable in the future.

FOR MORE INFORMATION:

Natural Seepage Along the California Coast

Website: www.mms.gov/omm/pacific/enviro/seeps1.htm

Chemosynthetic Communities

Website: www.gomr.mms.gov/homepg/regulate/environ/chemo/chemo.html

OHMSETT: NATIONAL OIL SPILL RESPONSE TEST FACILITY

Ohmsett is a large, aboveground concrete test tank used to test oil-spill containment and removal technologies. It is so large (over two football fields) that engineers are able to test full-sized booms and skimmers and other containment and cleanup equipment with a variety of crude oils and petroleum products. This enormous tank can artificially produce waves to simulate rough seas. It holds 2.6 million gallons of clear saltwater maintained by filtration systems so that video cameras can record the tests unhampered by cloudy water.

Above: Students training at the facility. The tank allows for the large-scale deployment of boom, and practice with a wide range of equipment. *Inset:* An aerial view of the Ohmsett facility. *Below left:* An oil-spill boom is being tested during a controlled, *in situ* burn at the facility.

Since reactivation in 1992, Ohmsett has been used by the public and private sector for evaluation of oil-spill response equipment and technologies such as containment booms, skimmers, temporary storage devices, oil-water separators, sorbents, and chemical dispersants. The facility is also used for research in remote sensing, formation of emulsions in warm and cold water and the evaluation of a fire resistant boom using an air-injected propane burner system. MMS has recently upgraded the testing capabilities at Ohmsett to provide a controlled environment for cold water testing and training in realistic broken ice conditions. This upgrade will allow Ohmsett to remain operational year round. Ohmsett was originally built by the U.S. Environmental Protection Agency and operated by that agency from 1974 to 1987. In 1989, responsibility for the facility was given to the U.S. Navy (USN), since the facility is located on a Naval Weapons Station in Leonardo, New Jersey. In 1990, Congress gave MMS the lead responsibility for operation and maintenance. The facility was refurbished and reopened for testing in 1992. All of Ohmsett's operating costs are covered by the Oil Spill Liability Trust Fund.

Today, Ohmsett is a premier training site for spill response personnel and new response technologies. Approximately 120 responders are trained each year on a variety of cleanup techniques. The U.S. Coast Guard and USN use the facility for training their emergency response personnel. Originally, the facility was designed to test simple mechanical technologies. These capabilities are now expanded to include dispersants, remote sensing, and *in situ* burn testing. The facility is open to all private and public sector clients on a reimbursable basis.

FOR MORE INFORMATION:

Ohmsett Facility

Website: www.ohmsett.com

Website: www.mms.gov/tarprojectcategories/ohmsett.htm

Is it adsorb or absorb?

What's the difference?

These two words are easily confused by the simple exchange of a "b" for a "d." The differences are subtle but important to scientists. A material is adsorbed when it is stuck on the surface of another material. This works for liquids sticking to the surface of a cloth. The liquid is absorbed when it is taken into the material like a sponge soaking up water.

OIL-SPILL PREVENTION – ANTICIPATING THE WORST, ACCEPTING ONLY THE BEST

Surprisingly, offshore facilities and pipelines account for less than 2 percent of the total oil spilled in our Nation's waters. (Mother Nature spills the most through natural oil seeps.) However, the Minerals Management Service (MMS) is working constantly to do even better by anticipating the worst case and planning with the best tools.

The response team during a spill drill must first assign the role of each participant and outline responsibilities based on the company's oil spill response plan.

Currently, comprehensive Oil Spill Response Plans (OSRP's) are required of every owner or operator of a present or proposed production facility on the Outer Continental Shelf (OCS). Included in the response plan is a "worst case" discharge response plan. The plan must include the identification of any onshore areas that could be affected by an accidental oil spill. To identify these areas, the Oil Spill Risk Assessment (OSRA) model is used. The model simulates the anticipated trajectory of a surface oil slick by using temporally and spatially varying models of ocean current and wind fields.

In addition to developing the likely trajectory of the spill, the lessee is required to outline the availability of the appropriate equipment and materials, the necessary trained personnel, and the time needed to deploy those resources in the event of a "worst case" spill. The plan must also outline responses to less severe spills or emergencies. The OSRP directive was implemented to ensure that the capability exists and is available for a full response to any accidental spill.

At 1 of the 20 drills conducted each year, the response team works together at a table top exercise.

To verify the plans work, the MMS Gulf of Mexico Region initiated the Unannounced Oil Spill Drill Program. The program was initiated to test the ability of offshore oil and gas and pipeline operators to contain or mitigate and clean up an oil spill by using the procedures and resources defined in their Oil Spill Response Plans.

Rusty Wright, Oil Spill Program Administrator, said, "The fact that MMS conducts about 20 oil spill drills a year has helped industry improve their capability to respond to actual oil spills."

Regional Director Chris Oynes said, "Since the inception of the Unannounced Oil Spill Drill Program, MMS has observed that the response capabilities, response efficiencies, and response training have improved to where the oil and gas industry in the Gulf of Mexico is prepared to respond properly in the event of an actual oil spill."

The selection of an operator to participate in an unannounced drill is based on such factors as the number of oil producing facilities, the volume of oil production, and proximity to sensitive areas. With an eye to the operator's current activities, a location is chosen and a spill scenario is developed. There are three types of exercises: Table Top, Mobilization, and Mobilization and Equipment Deployment. During these exercises, an MMS monitoring team presents to the Incident Commander a scenario involving one or more of the operator's facilities and then observes the Spill Management Team's simulated or actual response.

At the conclusion of a drill, the MMS monitoring team discusses with the Spill Management Team the strong and weak areas of the response. The MMS requires that a written report be submitted within 15 days with complete documentation of the exercise. The MMS then prepares a written evaluation of the exercise. Exemplary responses are acknowledged and recommendations/requirements for improvement are given when warranted by MMS. An Incident of Noncompliance may be issued for poor performance.

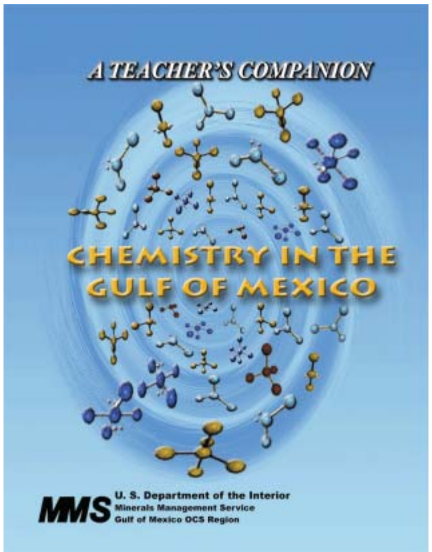
The U.S. Coast Guard observes and assists with the response team during the drill. An effective response requires that everyone works together as a team.

CHEMISTRY IN THE GULF OF MEXICO

Why is river drainage good for plants but bad for shrimp and crabs? Why are there "rain" and "chimneys" on the sea bottom? Where do eddies go to die? These are some of the questions answered by posters and teacher's companion guides available through the Minerals Management Service (MMS). The materials are part of MMS's program to educate the public in general and students in particular about the natural resources and environment that they will inherit.

"Chemistry in the Gulf of Mexico" is just one of a series of posters and guides produced by MMS that make scientific studies in the Gulf understandable and challenging. Students are given basic concepts in ways that make them easily understood, but presented projects that will challenge them to think about problems and processes.

One lesson concerns hypoxia, a condition in which the dissolved oxygen concentration of water decreases below 2 milligrams/liter (normal is 5-8 milligrams/liter). Hypoxia occurs in the Gulf because rivers, such as the Mississippi, dump nutrients and sediments from land-derived organic matter and runoff from farmland and cities into the ocean. This brings additional nourishment to plants growing in the water column



(phytoplankton). When the plants use all the nutrients, they die and sink to the bottom, where they decay, using up all the oxygen in the process. Shrimp, crab, and fish in the area are deprived of the oxygen they need and must move to survive.

Students are challenged to look at the problem from many points of view: those of the government, scientists, farmers, shrimpers, oil industry, commercial fishermen, citizens, environmental groups, and the fertilizer industry. Each area is researched and dialogue is established among all the stakeholders to explore solutions to the problem.

Detrital "rain" is another process which is explored. Tiny animals called zooplankton live in the ocean along with phytoplankton. When they die, their bodies sink to the bottom. This constant downflux of zooplankton and phytoplankton is called detrital rain. The remains are eaten by bacteria and degrade into nitrates, phosphates, and other nutrients. This process consumes oxygen and brings about hypoxic conditions as well.

And the chimneys? The chimneys are made of tiny crystal rosettes of barite that link together in long chains. The barium comes from salt domes below the seafloor. These domes are dissolving and the salt that results migrates up through cracks in the sediment. When barium comes in contact with the sulfates in seawater, barium sulfate results and precipitates into chimneys.

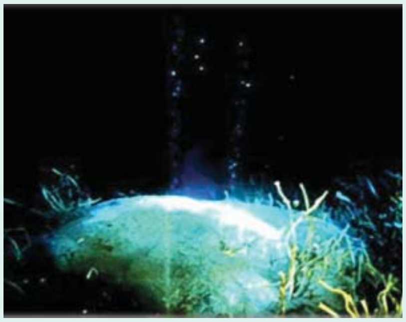
The answer to the question "Where do eddies go to die?" can be found at the MMS website at http://www.gomr.mms.gov/homepg/regulate/environ/studies/2001-066.pdf.

The "Chemistry in the Gulf of Mexico" poster and teacher's companion can be ordered from Minerals Management Service, Gulf of Mexico OCS Region, Attn: Public Information Office (MS 5034), 1201 Elmwood Park Blvd., New Orleans, LA 70123.

Sources of Oil Inputs into Marine Environments

In a 2002 study, the National Research Council of the National Academy of Sciences concluded that North America petroleum inputs into marine environments were the result of the following:

- 63% - Natural seepage
- 22% - Municipal and industrial waste and runoff
- 8% - Atmospheric fallout from consumption
- 3% - Marine transportation
- 2% - Recreational marine vessels
- 2% - Offshore oil and gas development



Right: Hydrate mound with bubbles escaping. Photo courtesy of Texas A&M University, Geochemical and Environmental Research Group (GERG)

Securing Ocean Energy and Economic Value for America

Platform Harmony in the Santa Barbara Channel.

NEW WAVES

Late-breaking News & Information

When Mother Nature Talks, MMS and Industry Listen

This hurricane season has been an especially active one. Hurricanes Charley, Frances, and Ivan have devastated the coastlines of Florida and brought severe weather to the Gulf. Because of the potential impact of hurricanes and tropical storms on oil and gas production facilities, the oil industry and Minerals Management Service (MMS) work together to make sure that workers are safe and pollution event risks are minimized.

To minimize potential damage from storms, structures are now required to be designed to withstand a 100-year storm event. Nonessential personnel are evacuated early and all others leave before the wind and seas make transport impossible. Producing wells are shut down through the use of valves on platforms and at the well heads. Industry is required to have safety valves both at the surface of the well and subsurface to reduce the potential for an oil spill or gas leak.

In the aftermath of Hurricane Ivan, few of the 4,000 platforms or the 117 rigs working in the Gulf sustained major damage. Of the 33,000 miles of pipeline, only a few leaks were initially reported, but several pipelines were later found to have significant damage. Although the amount of structural damage was relatively minor, the impacts on production were significant. Even by early October, three weeks after the storm, approximately 471,000 barrels of oil and 1.7 million cubic feet of natural gas were still shut in.

Most of the 25,000 to 30,000 workers involved in the production of offshore oil and natural gas are back at work. Despite the fury of Ivan, there were no reports of any injuries, fatalities, or significant pollution associated with offshore facilities – a significant tribute to the programs in place for safeguarding life, property, and the environment.

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