Arthur D Little

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November 16, 1990

Mr. Brian D. Ross
U.S. Environmental Protection Agency
Region 10 - Alaska Operations Office
222 West 7th Avenue, Box 19
Anchorage, Alaska
99513-7588

Subject: Marine Sciences Consulting and Technical Services

Dear Mr. Ross:

The past year and a half has been an exciting period for the Marine Sciences Unit and for the entire Environmental, Health and Safety Practice of Arthur D. Little, Inc. The Marine Sciences Unit has grown in size, in our range of expertise and capabilities, and in our geographical locations. We presently have 45 people in the unit with diverse talents and experience.

The Marine Sciences consulting and technical services are offered worldwide from bases in Cambridge, Massachusetts, Los Angeles, Houston, Anchorage, and Cambridge, U.K. We have undertaken complex, multidisciplinary, and sensitive assignments in Prince William Sound, San Francisco Bay, Boston Harbor, New York Harbor, the Gulf of Mexico, and other regions. These consulting assignments have included applied research efforts as well as litigation support activities performed for over twenty commercial and government clients.

Our senior staff now includes Dr. Jerry Neff and Dr. Erich Gundlach. Dr. Neff's wealth of expertise in marine biology, toxicology, and the effects of pollutants augments our well-established marine chemistry, hydrocarbon geochemistry and pollutant fates capabilities. Dr. Gundlach brings years of experience in coastal processes, marine geology, oil spill response, and mapping to our existing capabilities in spill response and natural resource damage assessment.

Our staff also consists of individuals with broad experience in spill contingency planning, biological resource assessment, and environmental health. We have over 20 years of Alaskan and polar experience, and capabilities in physical oceanographic studies and modeling activities. One of our groups deals explicitly in field survey planning and implementation and has capabilities in performing complex large-scale monitoring and other survey efforts. These field teams can be deployed worldwide on short notice.

The information management systems that we offer to our clients include powerful PC based database systems that are linked to our field and laboratory data systems. Our geographic information system (GIS) brings together our mapping activities and our data fields to aid in the interpretation and visualization of complex data sets.

During the past two years our analytical chemistry laboratory capabilities have expanded greatly. We offer clients a wide range of specialized analyses tailored to address specific environmental problems, including powerful chemical techniques used as tracers or fingerprints to discriminate different contributions of pollutants to the environment.

Our present analytical chemistry facilities, GIS system, field equipment, and computer capabilities insure that we can offer clients a wide range of services. We have added staff at all levels to insure that we can also provide our clients depth in all disciplines.

We measure success by several methods, but our most important measure is client satisfaction and the degree of repeat business that we receive. I believe that by this and other criteria we have enjoyed excellent success in recent years. Arthur D. Little has instituted a corporation-wide program to seek feedback from our clients as part of our overall Total Quality Management initiative.

We look forward to demonstrating to you that Arthur D. Little is the consultant of choice in helping you to understand, manage, and solve your offshore marine, coastal, and aquatic environmental problems. The enclosed information highlights our activities and services. Additional details can be provided at your request. I look forward to your inquiries and to the opportunity to provide our consulting and technical services to you in the coming years.

Yours truly,

Paul D. Boehm, Ph.D.
Director
Marine Sciences

Enclosures

MARINE SCIENCES CAPABILITY INFORMATION

Please check the areas for which you would like to receive information.

____ **Coastal Erosion Assessment**

____ **Contingency Planning**

____ **Environmental Assessment of Oil Exploration and Production**

____ **Industrial and Municipal Pollution Assessment**

____ **Natural Resources Damage Assessment**

____ **Pollution Exposure and Risk Assessment**

____ **Analytical Chemistry**

____ **Biomediation**

____ **Computerized Mapping and Data Analysis (GIS)**

____ **Field Capabilities**

____ **Chemical Source Fingerprinting**

____ **Sample Tracking and Data Management**

____ **Toxicity Identification and Reduction Evaluations**

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Marine Environmental Sciences: Consulting and Technical Services

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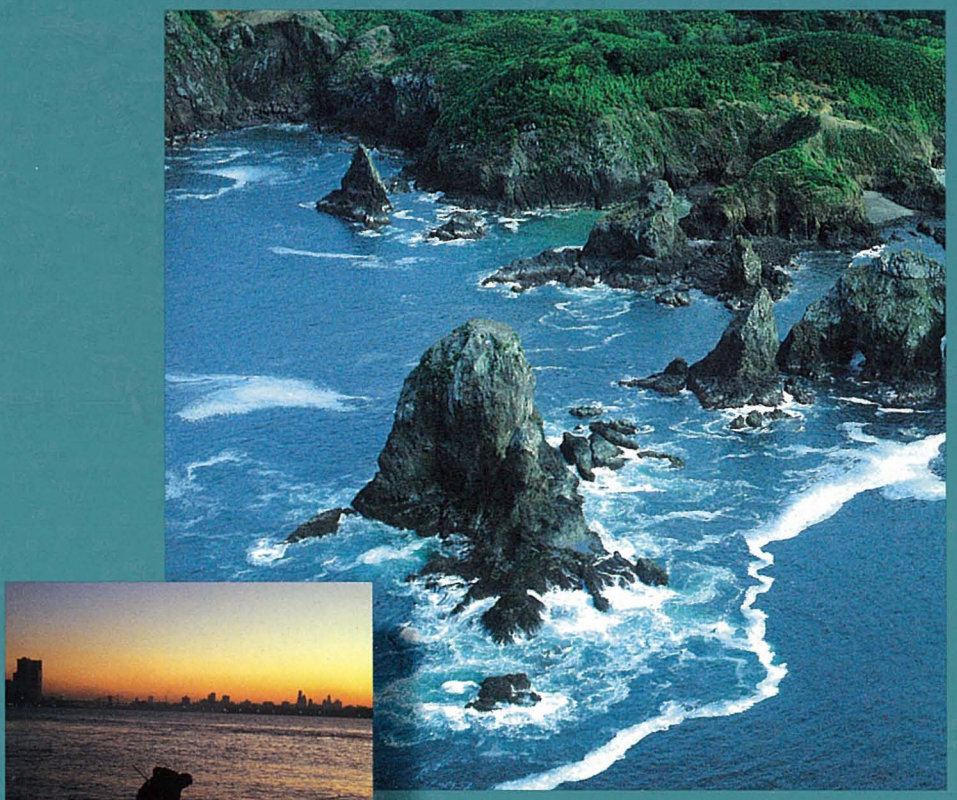


Applying unique technologies and approaches to marine and coastal environmental issues

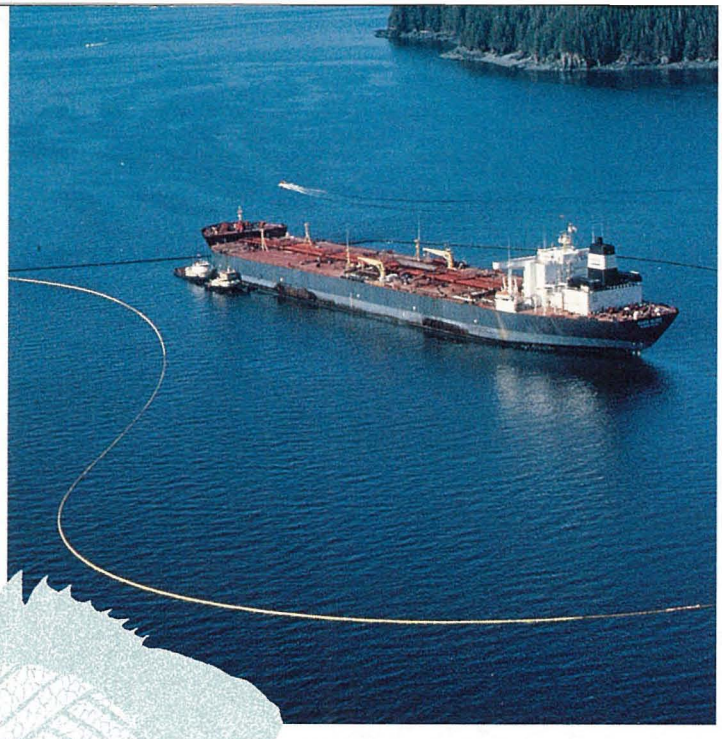
Environmental problems in the marine environment require specialized approaches and solutions.

Environmental issues and regulations concerning the coastal and offshore marine environments are receiving more attention than ever before. There is a growing awareness by governments and the public of the need to protect, manage, and in some cases restore estuaries, harbors, and coastal areas and the natural resources that they support.

Companies that transport products on the sea, industries that have installations in or adjacent to the coastal zone, and organizations that explore for and produce natural resources in and under the sea face increasing risks and narrowing environmental constraints in the conduct of business. They need to understand and manage these risks and to demonstrate environmental protection to regulatory agencies, the public, and shareholders. Companies need to prepare for and be able to respond to crises involving marine accidents and the release of pollutants.

Government agencies need to set regulatory standards, monitor the health of the marine environment, assess inputs of pollutants, and manage their marine resources.

Both industry and government need to have the best available scientific information at their disposal to understand and manage environmental risks and to make sound, balanced decisions.



Focused Solutions That Work

Our marine scientists and environmental managers are corporations' and government agencies' consultants of choice for technically sound, defensible, and efficient solutions to marine and aquatic environmental problems. This consulting area is linked to a diverse set of technical and consulting experience at Arthur D. Little. We offer clients both the credibility of one of the foremost technology and management consulting firms and focused solutions that work.

Our multidisciplinary team of specialists offers commercial and government clients a unique and internationally recognized combination of regulatory experience and scientific expertise. Our marine scientists and consultants have contributed directly to the development of important technical innovations, assessment techniques, regulations, and approaches to regulatory compliance.

This experience and credibility has been brought to bear on a diverse set of marine environmental problems during the past 20 years. Our scientific studies and development of techniques relating to the assessment of oil spills have been some of our most well-known consulting assignments. We have also assisted the oil and gas industry as they have faced ever-increasing technological challenges and environmental risks and regulations in their exploration for and production of offshore oil and gas.

We are widely credited with the development of monitoring strategies for offshore oil activities and have conducted studies for the U.S. government and for industry in this area. Coastal pollution of estuaries and harbors has been another focus of our studies, in which we developed and implemented biological and chemical monitoring strategies throughout the United States to assess the impact of man on the marine environment.

In addressing these different and complex environmental problems, Arthur D. Little uses specialized marine chemistry analytical techniques, a wide array of field sampling techniques and equipment, and an advanced set of interpretive tools, including risk assessment, toxicity identification evaluations, geographic information systems, and advanced data handling and management techniques to give our clients the most comprehensive technical and laboratory-based consulting services in the world.

We apply a multidisciplinary approach to assignments in estuarine, coastal, and open ocean marine environments.

Natural Resources Damage Assessments

Arthur D. Little is a world leader in the design and conduct of natural resources damage assessments (NRDA) for oil and hazardous chemical spills in the marine and aquatic environment. Our marine scientists have developed and applied scientifically rigorous and technically defensible approaches for assessing injury and damages to marine and aquatic resources resulting from accidental oil spills. We have documented the environmental impacts to and recovery of the marine environment from numerous oil spills, including the *Amoco Cadiz*, *Ixtoc 1*, *Argo Merchant*, *Metula*, *Tsesis*, Shell Martinez Refinery, Exxon Bayway (Arthur Kill), and *Exxon Valdez* oil spills. For these investigations, we designed field assessment and monitoring programs to map distributions of oil, determined the transport and weathering of the oil, and have documented the environmental effects of the spills on a variety of marine ecosystems.

These programs have been conducted under a variety of environmental conditions, from the arctic to the tropics, from estuaries to the open sea. Our marine sciences team possesses extensive experience with the analysis and integration of multidisciplinary databases to produce highly defensible assessments of environmental damage and recovery.

The work of the team also includes natural resource damage studies of hazardous chemicals other than oil, such as polychlorinated biphenyls.

To support our team of internationally recognized consultants, Arthur D. Little has a complete standby field sampling and response capability that can be launched from offices throughout the United States and abroad. The in-house specialized marine chemistry laboratory analysis capability ensures that our marine sciences team and its clients have dedicated access to and control of state-of-the-art capabilities. The analytical chemistry laboratory includes the latest instrumentation to analyze organic compounds (particularly petroleum hydrocarbons) and metals, and is staffed with scientists and technicians who are experts in the analysis of contaminants at trace levels in complex marine environmental matrices.

We have advised government and industry on the proper application of oil spill cleanup techniques and have helped evaluate environmental risks and benefits of these methods.

We also have conducted oil spill research and field trials to determine the best use of oil spill chemical dispersants in the arctic through the Baffin Island Oil Spill Program sponsored by the U.S., Canadian, and Norwegian governments. Our team of marine scientists and consultants working on NRDA issues includes marine chemists, marine biologists, toxicologists, coastal geologists, oceanographers, modelers, and experts in database management and geographic information systems (GIS). These scientists work with economists and lawyers in developing litigation strategies and in placing value on damaged resources. We are prepared to provide litigation support to clients and their legal staffs as expert witnesses in court cases and hearings.

Arthur D. Little offers full-service consulting supported by field, laboratory, and computer professionals.

Emergency Preparedness

Arthur D. Little's team of scientists, engineers, and environmental managers includes experts on issues of crisis management, spill preparedness, and contingency planning. Using teams of marine scientists and management consultants, Arthur D. Little advises corporations on how to prepare for and respond to environmental crises such as oil and other types of spills. We have provided corporate crisis management and response plans to major oil companies with installations in and adjacent to aquatic habitats.

Our scientists prepare contingency and tactical oil spill response plans that incorporate results of facilities audits and include recommendations for enhanced spill response, resource protection, and spill cleanup. Environmental data are used to model the trajectories of oil spill transport and in specifying potential impact areas. We determine what natural resources are at risk and develop mitigation and cleanup strategies. Through extensive experience in mapping and geographic information systems we can help our clients store, analyze, present, and understand environmental data as part of their contingency plans.

Computerized Mapping and Data Analysis

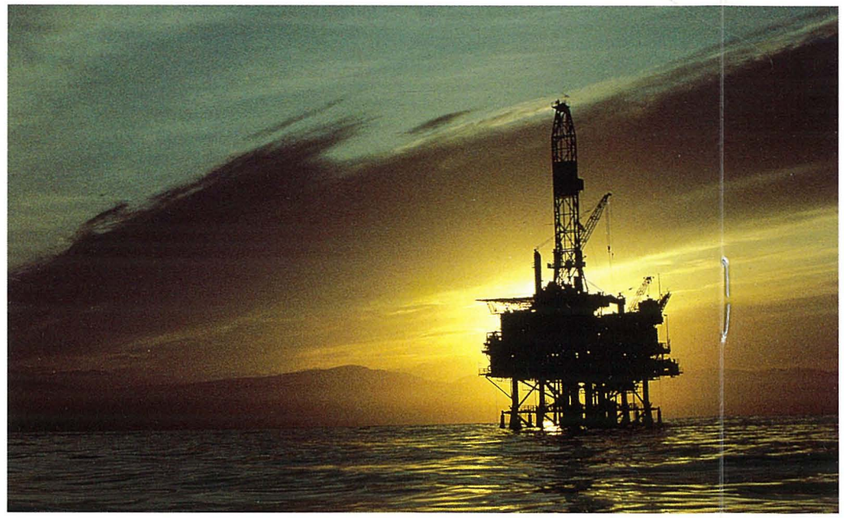
Arthur D. Little scientists use the latest in computer technology to manage large and complex data sets and to produce interactive geographic information systems (GIS) that create on-demand maps for environmental assessment and facilities management. Combined with capabilities in the design and performance of marine assessment programs, our marine sciences team provides a full capability to store, analyze, display, and present complex temporal and spatial data sets. By combining mapping of coastal areas with chemical and biological databases, we help our clients understand environmental impact and recovery. For example, data on shoreline types and biological resources are combined with emergency planning data to help provide defensible and practical contingency plans.

Our marine scientists are familiar with many GIS systems in use today including ARCINFO, GEO/SQL, and SPANS. We can readily tailor any or all of these systems to meet our client's needs.

Environmental Studies of Offshore Oil Exploration and Production

Environmental assessment of offshore oil exploration and production has placed our marine scientists in the forefront of applied marine science for two decades. Arthur D. Little's marine scientists are among the world's leaders in designing and performing research, monitoring, and compliance programs for the offshore oil and gas industry worldwide. Our scientists also have conducted landmark marine baseline and monitoring programs related to offshore development for the U.S. federal government.

The marine sciences team has performed monitoring to document the fate and effects of permitted discharges including drilling muds and produced waters. Studies have been performed in the Alaskan Beaufort Sea, the Santa Maria Basin off California, coastal and offshore waters of the western Gulf of Mexico, Georges Bank off Massachusetts, and the North Sea.



Our marine sciences professionals have studied the effect of produced waters on coastal marine ecosystems off Louisiana and of tanker ballast water discharges on coral reefs in the Red Sea. We have undertaken field and laboratory research on the chemical composition, environmental behavior, and toxicity of drilling fluids and produced waters for the American Petroleum Institute and the Offshore Operators Committee. We have published widely in these areas and served on National Academy of Sciences marine monitoring and drilling muds panels. As expert witnesses, Arthur D. Little consultants make their knowledge and experience of the potential environmental effects of offshore oil drilling available to the oil industry and to governments in hearings and litigation support.

Coastal Erosion Assessment

Arthur D. Little's marine specialists combine their geological, oceanographic, and biological expertise to provide realistic projections of coastal loss, and to determine the best methods to control erosion. Many of the world's coastlines are actively eroding due to increased development and recreational activities. We have extensive experience studying the causes of erosion and determining the most environmentally sound method of reducing or controlling the rate of erosion. We specialize in finding "soft," nonintrusive solutions that conform to the environment, but Arthur D. Little marine scientists also can prepare design parameters for engineered solutions.

Our scientists have pioneered marine monitoring techniques and assessement strategies

Assessment of Industrial and Municipal Pollution

The assessment of industrial and municipal pollutant inputs to harbors, coastal areas, and the open ocean represents an important capability of Arthur D. Little marine scientists. Discharges of industrial and municipal sewage effluents into the coastal zone and inputs from agricultural and urban runoff and non-point sources represent threats to the health of the environment and human health. These pollutant inputs present complex monitoring and assessment challenges. Our marine scientists have designed and performed numerous monitoring programs in coastal areas and urban estuaries throughout the United States. These areas include Boston Harbor, San Francisco Bay, New York Bight, New Bedford Harbor, Narragansett Bay, and Puget Sound. Waste discharges into harbors and estuaries have been monitored for their chemical compositions, transport, and biological effects.

Coastal zone monitoring studies performed by Arthur D. Little scientists have focused on nonpoint source pollutants, sewage sludge, refinery effluents, oil-well and production discharges, and dredged materials disposal. The capability to monitor the environment is complemented by the ability to model the fate and effects of these discharges as well as secondary effects such as the lowering of dissolved oxygen in estuaries.

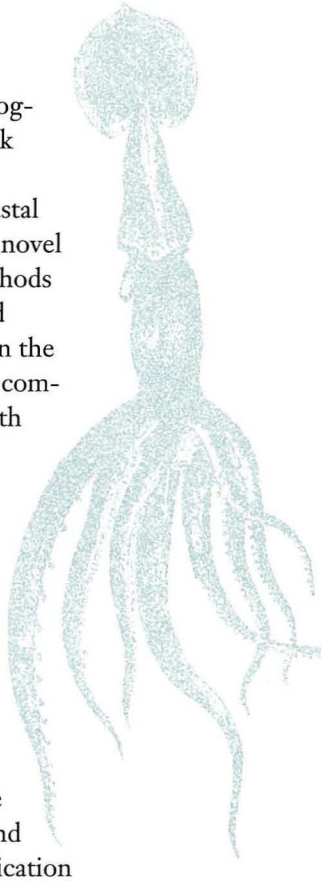
Our scientists have been involved with remedial investigation/feasibility studies and ocean discharge programs required by the Marine Pollution, Research and Sanctuaries Act, and the Clean Water Act. We have been involved in the design of the monitoring program for sewage sludge disposal at the 106-Mile Ocean Dumpsite and the development of the U.S. "Mussel Watch" monitoring program.

In addition to these research and monitoring efforts, our marine scientists have prepared numerous literature reviews, synthesis papers, and critiques of national coastal pollution issues as well as specific synthesis reports on Chesapeake Bay, Boston Harbor, Southern California Bight, and other coastal areas.

To support our consulting assignments, we help develop and use the latest laboratory, field measurement, and modeling tools.

Pollution Exposure and Risk Assessment

Marine pollution exposure and risk assessment represent important tools for Arthur D. Little's marine environmental assessment activities. Arthur D. Little marine scientists have performed exposure, ecological, and human health risk assessments for pollutant materials entering the coastal zone. We have developed novel sampling designs and methods for assessing temporal and spatial exposure regimes in the marine environment, and combined these techniques with a broad knowledge of the scientific literature and regulatory approaches to conduct risk assessments.



We have used biological monitoring techniques including ecological, bioaccumulation, and toxicological methods for assessing risk. Our marine scientists have designed and conducted toxicity identification evaluations (TIE) to characterize effluents entering the marine environment. Members of the marine sciences team have been active in helping government and industry develop approaches to water quality and sediment quality criteria. Our marine sciences team helps clients understand and demonstrate potential impacts of pollutants through the conduct of risk assessment programs, leading to better risk management and risk communication.

Advanced Laboratory Capabilities

Marine analytical chemistry laboratory capabilities at Arthur D. Little directly support marine environmental assessment programs. Our extensive marine chemistry laboratories provide specialized analyses tailored to meet our clients' requirements for defensible data in support of marine baseline and monitoring programs. These laboratories offer state-of-the-art facilities and instrumentation, and a sophisticated, proprietary laboratory information management system that tracks bar-coded samples from field collection through receipt in the laboratory to data submission.

Close integration of the laboratory with Arthur D. Little's field sampling operations ensures that chain-of-custody, sample labeling, and shipment issues are addressed. Close oversight of these laboratories by our marine sciences team ensures that data will meet or exceed all quality objectives and that only technically reviewed and quality assured data will be released. Our consulting and laboratory staffs work together to provide the right methodologies to answer the client's questions. This cooperation often leads to the development of new methods or the refinement of existing methods. Tailored analytical techniques have recently been applied to the assessment of the *Exxon Valdez* oil spill. Arthur D. Little chemists were national leaders in these efforts.

Our marine chemistry laboratories are staffed by professionals that have extensive experience in the analysis of pesticides, polychlorinated biphenyls, petroleum and combustion-derived polynuclear aromatic and heterocyclic hydrocarbons, molecular biomarkers, butyltins, organometallics, trace metals, and polar organic compounds. This experience also covers a wide range of sample matrices including seawater, sediment, crude and refined oils, sewage sludges, drilling fluids, oilfield produced waters, air, and marine organisms. Our laboratories engage in numerous method-development programs for government and industry and also participate in voluntary inter-laboratory calibration programs.

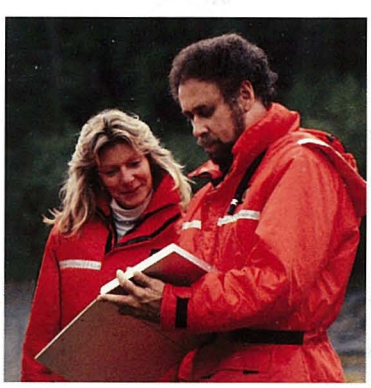
Arthur D. Little's marine scientists are respected leaders in their fields.

From left to right: Dr. Theodor C. Sauer, Dr. Jerry M. Neff, Dr. Erich Gundlach, Dr. Paul D. Boehm, director of Marine Sciences, and Dr. Michael J. Wade.

Arthur D. Little's Marine Sciences Unit offers expertise in:

- Regulatory analysis
- Assessment/monitoring program design
- Field sampling and measurement activities
- Laboratory analysis
- Information management/ presentation (GIS)
- Interpretive assessment and research reports
- Expert testimony

Arthur D. Little marine scientists have provided expert testimony and are widely published on all issues that directly affect users of the marine environment. We apply unique technologies and direct approaches to solving regulatory and technical problems. In a typical effort on behalf of our clients, our scientists travel almost anywhere in the world, working to provide innovative, defensible, and cost-effective solutions to difficult marine environmental problems.



Sandra Tate Freitas, field operations manager, and Dr. Paul D. Boehm review an oil spill field sampling project.

For more information, please contact Dr. Paul D. Boehm, director of Marine Sciences.

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The Choice of Professionals

For more than four decades Arthur D. Little has been the leader in environmental, health, and safety consulting throughout the world. Based in Cambridge, Massachusetts, with active marine environmental consulting operations in Los Angeles, Houston, Anchorage, and Cambridge, U.K., our marine scientists forge close working partnerships with clients in order to meet their needs.

About Arthur D. Little

Arthur D. Little, the international management and technology consulting firm, helps corporations, institutions, and governments meet the challenges of today's complex and rapidly evolving global marketplace. Through its international network of offices and laboratories, the company is unique in its ability to respond to clients' needs by combining management and technological expertise with extensive industry knowledge.

In addition to environmental, health, and safety management, Arthur D. Little's consulting services include strategy and organization, operations management, information and telecommunications management, and product development.

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