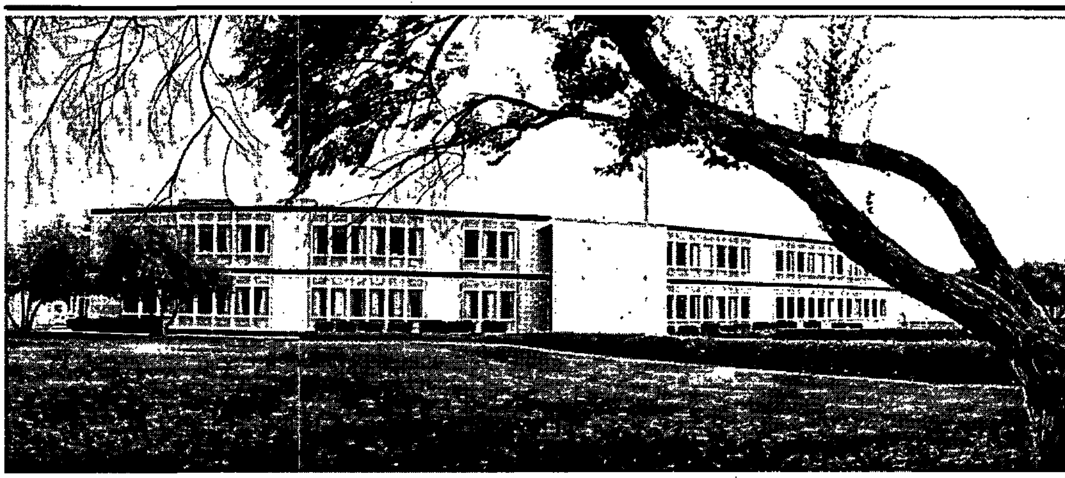
United States
Environmental Protection
Agency

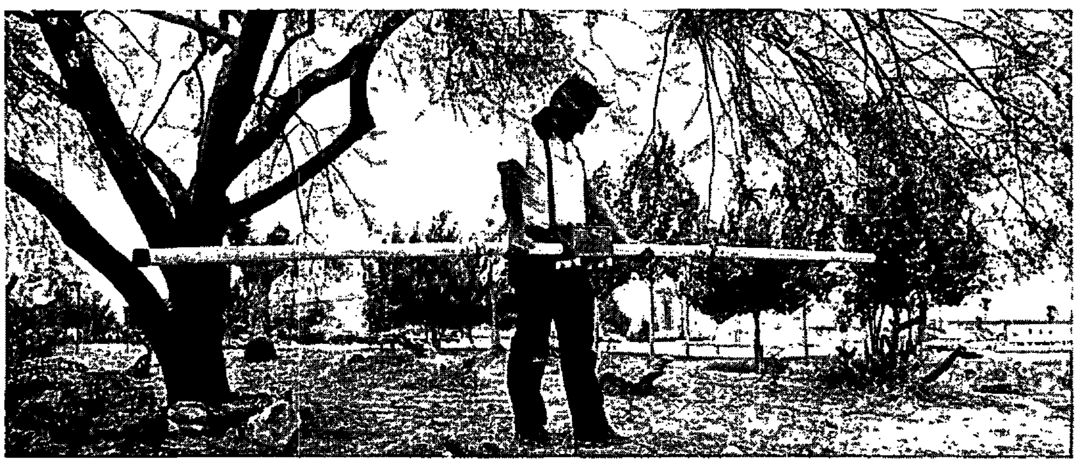
Environmental Monitoring
Systems Laboratory
P.O. Box 15027
Las Vegas NV 89114-5027

Research and Development

EPA

The Environmental Monitoring Systems Laboratory Las Vegas





Mass Spectrometry. Advanced analytical techniques provide a wide range of opportunities for the chemist involved in environmental monitoring. Mass spectrometry is the cornerstone for many of the Agency's analytical methods.

One of EPA's 14 national research laboratories

Cover:

Top- The EMSL-LV Executive Center. The hub of a multi-building complex located on the University of Nevada-Las Vegas campus.

Center- Electromagnetic Induction Instrumentation. This equipment measures the apparent electrical conductivity of the subsurface. These measurements have been used to locate buried metal drums, transformers, and subsurface conductive contaminant plumes.

Bottom- Measuring for Possible Exposure to Radioactivity. In a subterranean vault (designed to shield out natural background radiation) the EMSL can measure total internal radiation contamination in people.

THE ENVIRONMENTAL MONITORING SYSTEMS LABORATORY - LAS VEGAS

The Environmental Monitoring Systems Laboratory is one of the 14 national research laboratories of EPA's Office of Research and Development. Over 200 employees and 300 on-site contractor employees work at the Laboratory, which has an annual operating budget of about $30 million. Its mission is to develop, evaluate, and apply methods and strategies for monitoring the environment. Major program areas include:

- Advanced Analytical Methods
- Advanced Monitoring Methods
- Monitoring Network Design
- Quality Assurance
- Exposure Assessment
- Radiation Monitoring
- Special Projects
  (Technical Support and Emergency Response)

The Las Vegas Laboratory was established in 1955 as a U.S. Public Health Service Laboratory with responsibilty for radioactivity monitoring in public areas around the Nevada Test Site and other nuclear test sites. Environmental radiation monitoring, quality assurance, and research activities to monitor the U.S. Atomic Energy Commission's nuclear testing program were conducted by the Public Health Service throughout the 1960's. This activity included a large biological radiation research program.

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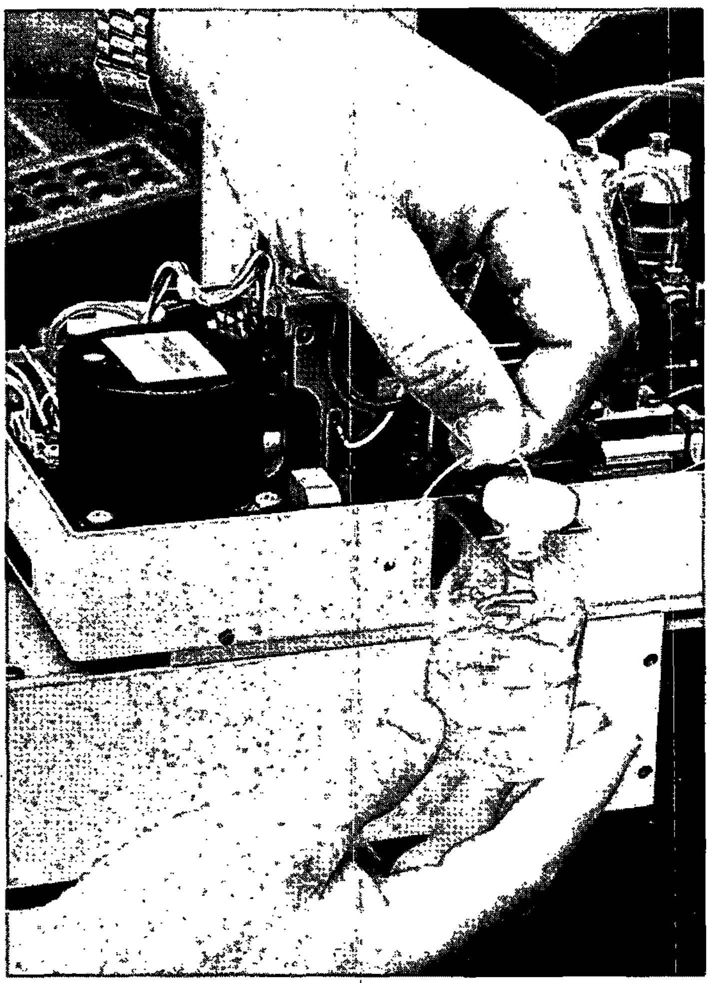
Integrated exposure of man to pollutants

When the Environmental Protection Agency was created in December 1970, the Laboratory became a part of the new Agency with an expanded mission for developing monitoring techniques for a variety of environmental pollutants. A continuing theme for the Laboratory has been the integrated exposure of man to chemical and radiological pollutants through multiple environmental pathways. In the 1970's, the application of airborne remote sensing technologies for environmental assessments became an important program. The Laboratory's aerial photography interpretation facilities in Las Vegas and its field station in Warrenton, Virginia, became the EPA's centers for environmental monitoring using overhead imagery from aircraft and satellites. In the 1980's the Laboratory assumed national leadership for the monitoring and quality assurance aspects of the Agency's hazardous waste and pesticides programs. Most recently, the monitoring and characterization of groundwater pollution has become a major focus of the Laboratory program.



Development and evaluation of innovative techniques for sample extraction and analysis

ADVANCED ANALYTICAL METHODS

Measurement of an ever-increasing number of organic and inorganic contaminants in complex environmental matrices, at ever-decreasing levels of sensitivity, has required the development and evaluation of innovative techniques for sample extraction and analysis. Advanced techniques such as Liquid Chromatography, Mass Spectrometry, Fourier Transform Infra-Red Spectroscopy, Gas Chromatography, and Inductively Coupled Plasma Spectroscopy, one with the other, are developed and evaluated. Biological procedures are also being evaluated as analytical screening techniques. Among the biological test methods of interest are the Ames test, the Daphnia chronic toxicity test, phytotoxicity, and the freshwater algal assay test.

Gas Chromatrography. *The application of advanced chemistries requires highly qualified professionals. New technologies create new challenges for chemists involved in environmental analysis.*

Monitoring methods that are more reliable, more rapid or simpler to use

Overhead Remote Sensing. A train derailment in 1985 at Eastland, Texas. An oil truck (far left center) collided with a 27-car train hauling 15 to 20 different chemicals. Aerial photo interpretation showed contamination of a nearby stream.

ADVANCED MONITORING METHODS

Laboratory research is directed at providing monitoring methods that are more reliable, more rapid or simpler to use than existing techniques.

For a number of years overhead remote sensing has been used to detect waste discharges, to locate waste disposal sites, to identify erosion and other types of surface degradation, and to characterize environmental impacts of land use. In addition to aerial photography, multispectral scanning and laser fluorosensing technologies are used in assessing water quality problems.

Airborne laser systems are routinely applied to assess air particulate problems, and research is in progress to apply laser systems to measure concentrations of ozone and other gaseous pollutants in air and indicators of acid deposition in surface water.

In response to increased interest in ground-water contamination, several projects are underway to improve the Agency's ability to monitor pollutants in surface soils, in the subsurface unsaturated zone, and in ground water. Geophysical techniques to characterize site geohydrology and to locate subsurface contamination are of particular interest. Both surface and downhole geophysical approaches such as electromagnetic induction, resistivity, and magnetometry are being investigated. Current efforts include documenting the capabilities of the techniques and ensuring their appropriate use in field operations of the Agency. Also, the coupling of lasers and downhole fiber optics for direct measurement of ground-water quality is being explored. Other classical ground-water monitoring methods are also being evaluated.

Water monitoring methods development includes evaluating biological stream survey methods for determining water quality criteria at specific sites. This program involves characterizing the levels and distributuion of stream pollutants and the condition of the stream biota as a basis for determining acceptable pollution levels.

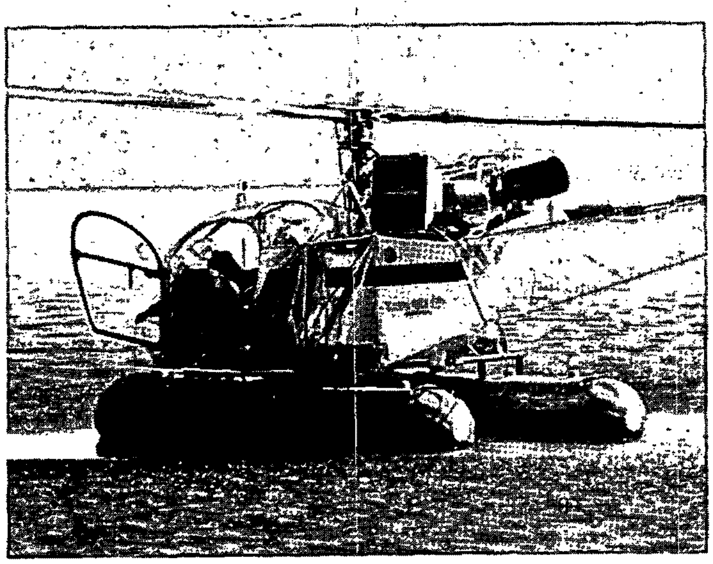
Multimedia approach to environmental monitoring

MONITORING NETWORK DESIGN

The Las Vegas Laboratory has been in the forefront of monitoring design since the inception of the EPA. The original concept of Integrated Exposure Assessment Monitoring (IEAM) was pioneered at the Laboratory in the 1970's. This concept advocates a multimedia approach to environmental monitoring emphasizing proper selection of critical receptors, optimum siting and number of samples through proper planning, and an understanding of how pollutants are transported from the source through the environment to the receptor. Well-defined objectives dictate the actual network sampling design. For instance, if mere presence of a pollutant in the environment or compliance type monitoring is the objective, then a classical statistical network design to detect a mean value may be all that is necessary. If spatial considerations such as soil cleanup are involved, then a design using geostatistics may be necessary. Geostatistics permits one, by using data from a preliminary sampling, to design a sampling network which establishes the optimum distance between sampling points.

The output of the data from the final sampling network can be statistically analyzed to produce isopleths of concentration and standard error. If an action concentration level is given, then these isopleths represent a statistically defensible basis to define a cleanup area. This approach was used in Dallas, Texas to define two cleanup areas around two lead smelters.

Acid Rain Research. *An EMSL-LV helicopter sampling crew taking in-situ surface water measurements during the Western Lake Survey in the fall of 1985.*

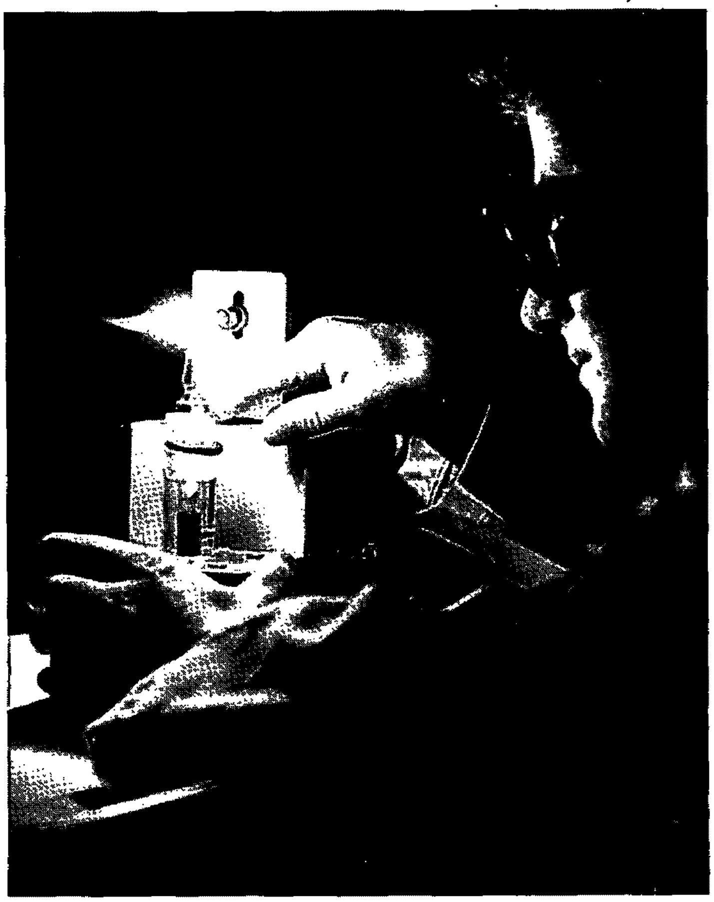


QUALITY ASSURANCE

During the past several years, EPA has directed much greater attention to quality assurance aspects of environmental sampling and analysis. Properly validated analytical test methods are developed to support regulatory monitoring requirements. Standards and reference materials are distributed to laboratories throughout the country. Studies are conducted to evaluate the performance of these laboratories and to determine the precision, accuracy, and ruggedness of analytical protocols. The Laboratory provides quality assurance support, as well as data audits for the Superfund Contractor Laboratory Program.

Standards and reference materials are distributed to laboratories throughout the country

Flame Sealing Radioactive Standards. *Radioactive solutions are diluted, calibrated and sealed in glass ampules for shipment to participating federal, state and private laboratories as part of EPA's quality assurance program.*



In 1982, the Laboratory, in cooperation with the University of Nevada-Las Vegas, established a Quality Assurance Laboratory to support EPA's Superfund program. This facility, equipped with the most modern analytical instrumentation, evaluates proposed analytical methods, provides samples to evaluate performance of other laboratories, and conducts referee analyses as needed. Its hazardous materials containment facility provides a capability to handle dioxin and other highly toxic materials.

In the area of sampling quality assurance, the Laboratory has developed guidance on sampling procedures and sample handling for soil and sediment sampling. Currently, the Laboratory is initiating a sampling quality assurance program for ground-water monitoring.

Risk estimates for environmental pollutants

EXPOSURE ASSESSMENT

Human exposure assessment provides critical information required to make risk estimates for environmental pollutants. A comprehensive approach is required to develop simultaneous information on sources, exposure, dose, effects, and control. An Exposure Monitoring Test Site (Chattanooga, Tennessee) has been selected for testing exposure monitoring methods and systems. The Site will be characterized by collecting available data into a comprehensive data base. Additional data will be collected through monitoring activities. Collectively, these data will be used for model validation and methods evaluation. Another program is aimed at improving techniques for validating mathematical models which predict the fate of chemicals in specific environmental systems. Initial emphasis has been on fate in soil, streams and ponds. Current research is directed towards indoor air pollution problems.

RADIATION MONITORING

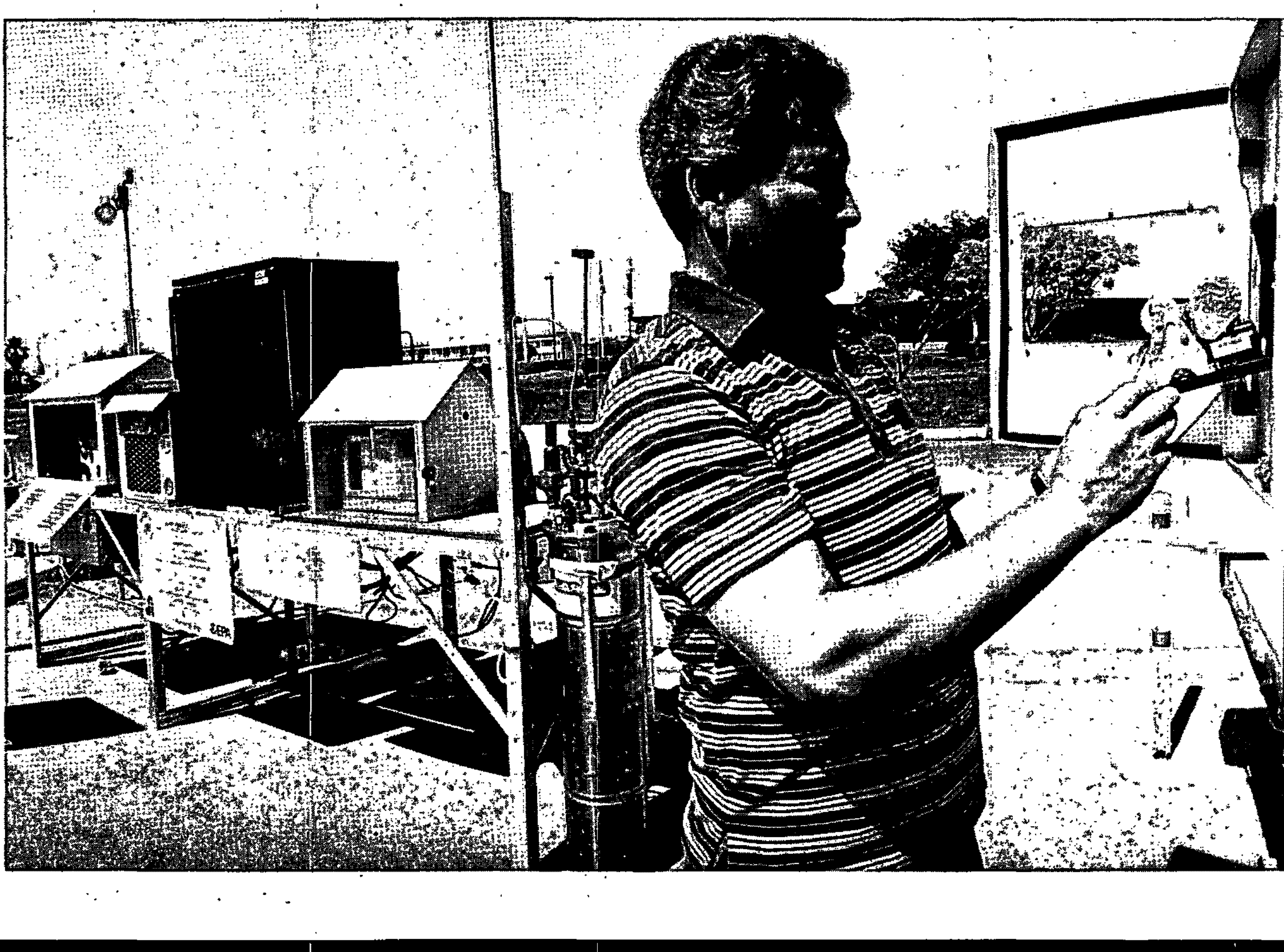
Monitoring provides the framework for documenting potential radiation exposures of populations living near the Nevada Test Site (NTS) and other nuclear test sites. Mobile monitoring teams are deployed around the NTS during nuclear tests. In the unlikely event that radioactivity is released, they are prepared to work with local officials in directing protective actions, including evacuation of residents if necessary. Throughout the year, air and ground-water monitoring systems measure off-site radiation levels, and programs for sampling milk, cattle, and wildlife are operated to detect any inadvertent contamination. Thermoluminescent dosimeters, in place at 130 fixed locations in addition to those worn every day by 50 off-site residents, measure accumulated radiation exposures. A whole-body counting facility is operated in Las Vegas to measure radioactivity in body tissues.

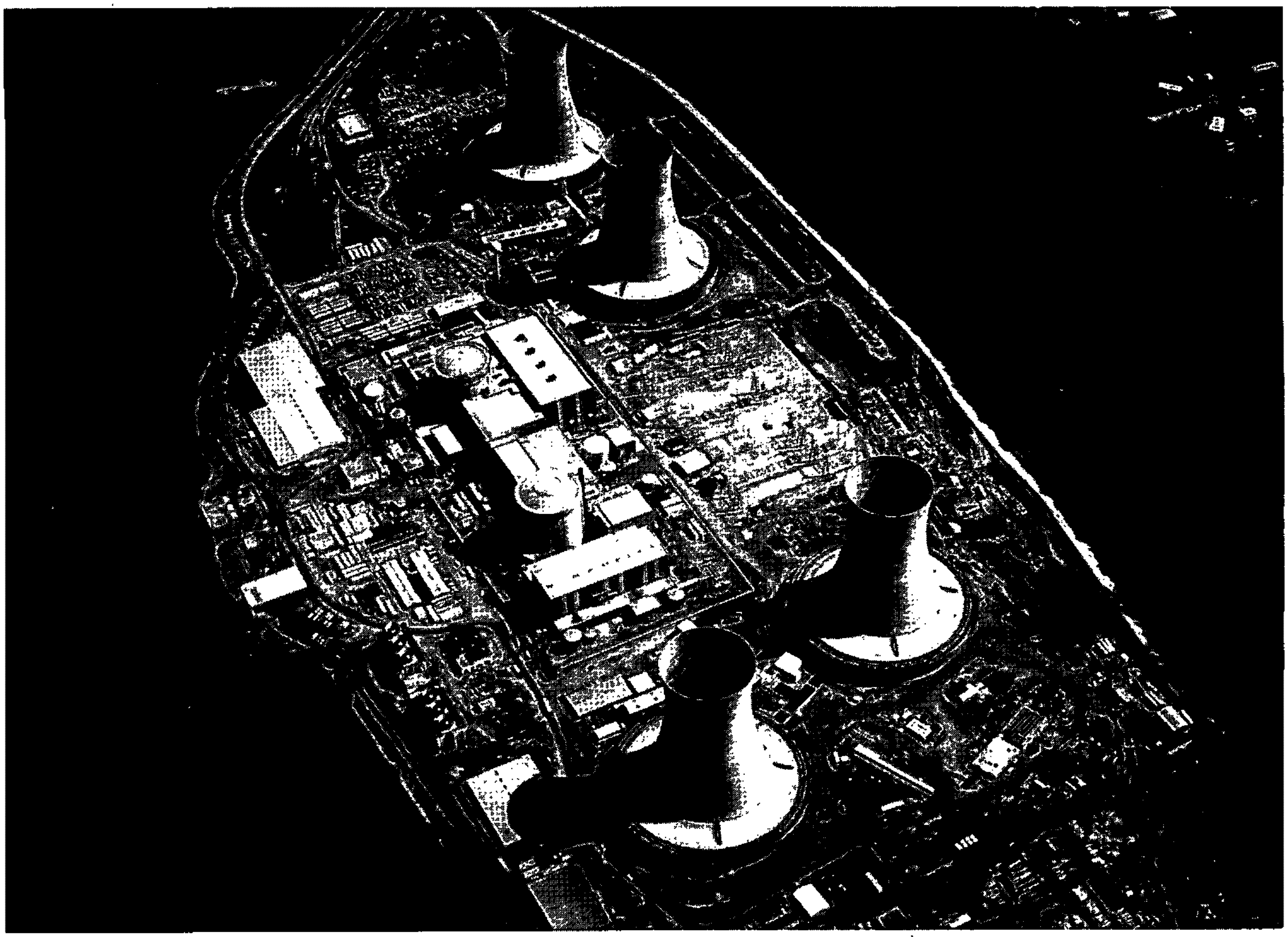
Laboratory scientists have modified commercial detection equipment for specialized field applications and have designed and built very sensitive laboratory analytical systems. The Laboratory has monitored for all types of fission products, using specially equipped vehicles, and aircraft when necessary, in different types of environments from Alaska to the Nevada desert.

The Laboratory has also developed special expertise in communicating with a public which has become increasingly concerned over low-level radiation exposure. These capabilities were central to success in the Laboratory's monitoring following the Three Mile Island nuclear power reactor incident. That activity included monitoring air, water, and milk; establishment of an analytical laboratory; and implementation of an extensive community relations program. Following that experience, the Laboratory, in cooperation with the Department of Energy, established a network of Community Monitoring Stations, under the supervision of local residents around the Nevada Test Site. This local participation has enhanced public confidence in the monitoring results.

Documenting potential radiation exposures

Radiation Monitoring. *An EMSL-LV monitor checks equipment at one of the community monitoring stations established at various locations surrounding the Nevada Test Site.*





Three Mile Island. *During the emergency at Three Mile Island the EMSL-LV was called upon to provide radiation monitoring support.*

Broad monitoring capability

SPECIAL PROJECTS

The Laboratory has, over the years, undertaken a number of special projects utilizing its broad monitoring capability. Perhaps most well-known was the emergency radiation monitoring program deployed and operated around Three Mile Island. Another example is a major study of visibility impairment in the southwest in an effort to define the nature of and causes for visibility degradation in that region. Recently, the Laboratory has been responsible for a major effort in the National Surface Water Survey (NSWS) and the Direct Delayed Response Project as part of the Agency's responsibilities under the Acid Precipation Act of 1980, more commonly known as Acid Rain. The Laboratory is responsible for providing logistical support, standardized methods, analytical support, and a comprehensive QA program for the Survey. For the Direct Delayed Response Project, the Laboratory is responsible for providing the analytical methods, analytical support and quality assurance for the soils portion of the effort. Another area of responsibility is the evaluation of monitoring methods to be used in the Acid Deposition Monitoring Program.