ADVANCED MONITORING SYSTEMS INITIATIVE

R. J. Venedam, E. H. Hohman, C. F. Lohrstorfer, S. J. Weeks
Bechtel Nevada
P.O. Box 98521, Las Vegas, NV 89193

J. B. Jones
Department of Energy, Nevada Site Office
P.O. Box 98518, Las Vegas, NV 89193

W. J. Haas
Ames Laboratory, Iowa State University
128 Spedding Hall, Ames, IA 50011

ABSTRACT

The Advanced Monitoring Systems Initiative (AMSI) actively searches for promising technologies and aggressively moves them from the research bench into DOE/NNSA end-user applications.

INTRODUCTION

There is a large unfulfilled need for an active element that reaches out to identify and recruit emerging sensor technologies into the test and evaluation function. Sensor research is ubiquitous, with the seeds of many novel concepts originating in the university systems, but at present these novel concepts do not move quickly and efficiently into real test environments. The vision of AMSI is to become a widely recognized, self-sustaining "business" accelerating the selection, development, testing, evaluation, and deployment of advanced monitoring systems and components.

THE AMSI PROJECT

The AMSI project has been created in order to overcome institutional obstacles as well as promote the use of the Nevada Test Site as an appropriate venue for the field testing of emerging technology. In evaluating the nature and evolution of sensor research and development (R&D) and the development of associated delivery systems, a number of obstacles to the rapid movement of advanced sensor technology into end-user applications can be identified. Two major discontinuities are particularly noticeable. The first is the challenge of taking an innovative idea from initial conceptualization through proof-of-concept to applied research and development. The second is the challenge of moving R&D accomplishments into application. The latter gap has come to be known as the "Valley of Death" in technology development. These challenges exist in programs of all magnitudes, from major programs with funding in the billions of dollars per year to the individual institutional programs where most R&D actually takes place.

THE AMSI APPROACH

AMSI is a new approach to accelerate the development of advanced sensor and monitoring systems. AMSI is a vertically integrated Development, Testing, and Evaluation (DT&E) enterprise that searches aggressively for promising new sensors and monitoring system elements for development, integration, and application addressing Department of Energy Office of Environmental Management (DOE EM) end-user needs. The Nevada Site Office of the National Nuclear Security Administration (NNSA) and Bechtel Nevada manage AMSI, with funding provided by the DOE EM. AMSI work in support of DOE-EM can also address NNSA, Office of Civilian Radioactive Waste Management (OCRWM), Department of Defense (DoD) and Department of Homeland Security (DHS).

AMSI provides rapid prototyping, systems integration, and field-testing, including initial deployment assistance. It has easy access to unique facilities and capabilities available at the Nevada Test Site (NTS), which is also home to the Hazardous Materials (HazMat) Spill Center and the National Center for Combating Terrorism (NCCT). The Spill Center (Fig. 1) is a one-of-a-kind facility built and permitted for releases of hazardous materials for training purposes; field-test detection, plume dispersion experimentation, and equipment and materials testing under controlled conditions. The NCCT is a newly created center for training police, firefighters, hazardous material experts, public health workers, and other first responders to terrorist acts that may involve chemical, biological, nuclear, radiation, and high explosive weapons. There is no other place in the United States where the entire spectrum of activities associated with combating terrorism can be addressed in an integrated manner. The NTS has been described as a National Asset for Research and Demonstration of Environmental Management Tools and a National Test and Demonstration Center for Defense Technologies.

AMSI also has easy access to the facilities and considerable capabilities of the DOE and NNSA National Laboratories, the Special Technologies Laboratory, Remote Sensing Laboratory, Desert Research Institute, and Nevada Universities.

Fig.1 The Hazmat Spill Center on the Nevada Test Site.

AMSI OPERATING CHARACTERISTICS

- AMSI focuses its resources on high-impact solutions to end-user needs and is driven by end-user requirements.
- AMSI looks for strong end-user support (including co-funding of the proposed work) with commitment to deploy.
- AMSI emphasizes partnership to accomplish its work.
- AMSI emphasizes late stage engineering, test and evaluation in end-user/field/application conditions, and does not fund research projects.

AMSI RESULTS AND ACCOMPLISHMENTS

The AMSI project began in FY 2001 using in-house funding ($250,000) provided by NNSA/NSO.

Three initial demonstrations were performed to test the AMSI concept.

- Created and employed a fully integrated sensor-to-web-page monitoring system for monitoring the Baneberry fissure at the NTS. The system included a gamma detector, a commercially-available weather station, and a data capture system. The data were transferred by cell phone modem to an internet web page display, using the Sandia National Laboratories Material Monitoring System (MMS).
- Tested and evaluated a micro-scale chemiresistor-based sensor at the NTS HazMat Spill Center.
- Demonstrated an advanced trichloroethylene (TCE) sensor at the Sandia National Laboratories Chemical Waste Landfill.

In FY 2002, the first full year of the project, AMSI received $3 million in DOE Headquarters funding.

- Developed, field-tested and evaluated a new tritium monitoring system in vadose zone and down-well applications at the NTS.
- Demonstrated a remotely controlled near-real-time measurement and data transmission system for monitoring technetium-99 (Tc-99) in water at the DOE Hanford site.
- Updated and demonstrated the Special Technologies Laboratory Identification Dosimeter (IDD) for the identification of radioisotopes at various elevations within Stack 7 of the Rocket Motor Assembly and Disassembly Facility at the NTS.
- Performed real-time sensor-to-web-page monitoring of TCE in sediment at the NTS HazMat Spill Center, using a surface acoustic wave sensor developed by Sandia National Laboratories.
- Configured and tested a Wireless Sensor Platform (Fig. 2) developed by INEEL at the NTS neutron probe calibration site.
- Packaged a SNL micro-chemical sensor in a waterproof housing for monitoring VOC's in subsurface environments and tested it in the laboratory and at the NTS HazMat Spill Center with real-time data collection and cellular telephone modem transmission to the AMSI and SNL websites.

Fig. 2. The INEEL Wireless Sensor Test Held at the Nevada Test Site.

AMSI continued its successful activities in FY 2003, with DOE Headquarters funding reduced to $2 million.

- Install and test Identification Dosimeter at NTS E-tunnel pond, targeting americium, plutonium, uranium, and cesium.
- Install and test a vadose zone tritium monitor at the NTS Greater Confinement Disposal site.
- Install and begin long term testing of a groundwater tritium monitor at the NTS GCD site.
- From NTS, remotely control and collect data from a technetium monitor test at the DOE Hanford site, Richland, WA.
- Install and demonstrate an INEEL-developed wireless moisture monitoring system in the floor of an NTS Area 5 landfill cell.
- Provide a new system to monitor hexavalent chromium (Cr (VI)) (Fig. 3) in the Columbia River salmon spawning bed at Hanford.
- Develop a new Sr-90 detection system and apply it for monitoring effectiveness of a Columbia River protection barrier at Hanford.
- Develop and test a universal sensor array at NTS and deploy for monitoring CCl_4 at Hanford.
- Complete laboratory testing of a sensor for uranium and plutonium in water.

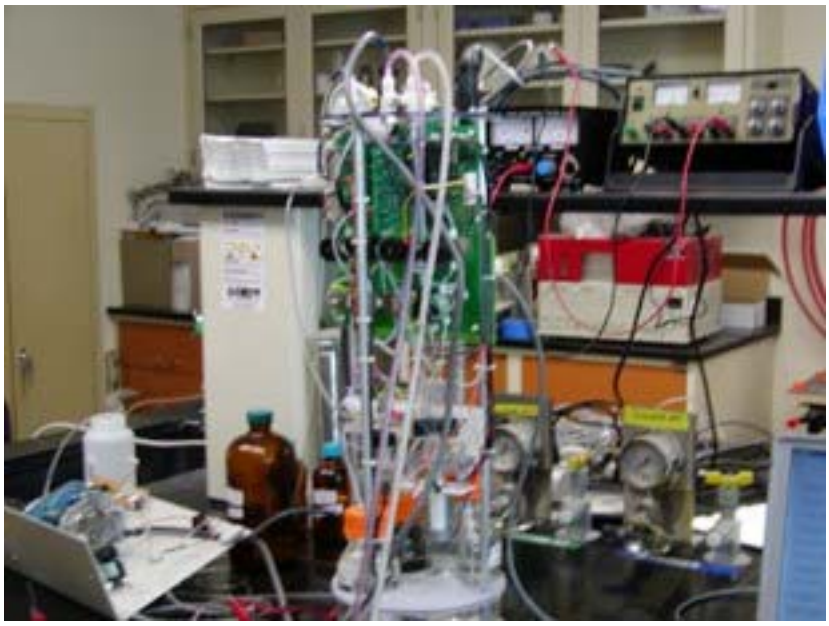

Fig. 3. The Chromium (VI) Sensor Platform Destined for the Columbia River Salmon Spawning Beds.

AMSI PROJECT ENHANCEMENTS

Enhancements to the AMSI project are underway that leverage crosscutting opportunities, while maintaining the core activities.

- AMSI support, including sensor selection, to National Security Response and Counter Terrorism programs.
- Expanding environmental-type monitoring systems to other applications of national interest.

CONCLUSION

Innovative, sophisticated monitoring systems based on advanced sensors are becoming critical enabling technologies in areas ranging from medical applications to interstellar exploration. Environmental Quality (EQ) is no exception. The benefits that AMSI has brought to this critical area are of great value to DOE and NNSA, enabling these agencies to cost effectively fulfill their long-term monitoring responsibilities.

Two major challenges are particularly important in moving advanced sensor technology from concept into end-user applications:

- The discontinuity between initial formulations through proof-of-concept to applied R&D;
- Between R&D and end-user application, the latter commonly referred to as the "Valley of Death."

In meeting these challenges the Advanced Monitoring System Initiative has enabled:

- Over two dozen sensor and monitoring systems of potentially critical National importance.
- Brokered effective collaborations within the DOE community and among other governmental agencies.

The pursuit of promising advanced sensors and monitoring system elements for further development and application, while keeping abreast of EQ end-user needs is central to the AMSI charter. Expanding the reach of AMSI from environmental-type monitoring systems to National Security Response, Combating Terrorism and other programs of National interest is the vision.