

E-SMART SYSTEM FOR IN-SITU DETECTION OF ENVIRONMENTAL CONTAMINANTS

QUARTERLY TECHNICAL PROGRESS REPORT

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Contents

Abstract.....	1
1. Work Conducted in Quarter 3, CY 1995.....	2
<u>Multichannel Microsensor.....</u>	2
<u>Sawtek Integrated Modular Array Sensor (IMAS).....</u>	2
<u>Other Sensors and Actuators.....</u>	3
<u>E-SMART Network Management.....</u>	3
<u>Field Testing</u>	3
<u>Visualization</u>	3
<u>Program Management.....</u>	3
<u>Dual Use and Commercialization Planning.....</u>	4
2. Problems Encountered.....	4
3. Plans for Quarter 4, CY 1995.....	4
4. Milestones and Deliverables.....	5
5. Papers and Conferences.....	5
6. Financial Status Report	5

Abstract

On this Technology Reinvestment Project (TRP) for the Advanced Research Project Agency (ARPA), General Atomics (GA) leads a team of industrial, academic, and Government organizations to develop the Environmental Systems Management, Analysis and Reporting neTwork (E-SMART). E-SMART is a comprehensive, fully-integrated approach to in-situ, real-time detection and monitoring of environmental contaminants. GA's team members include Isco, Inc., Photonic Sensor Systems (PSS), Georgia Tech Research Institute (GTRI), Science & Engineering Analysis Corporation (SECOR), and the U.S. Air Force Armstrong Laboratory Environics Directorate at Tyndall AFB(AL).

This ARPA TRP project will further develop and advance the E-SMART standardized network protocol to include new sensors, sampling systems, and graphical user interfaces. Specifically, the E-SMART team will develop the following three system elements:

- A new class of smart, highly sensitive, chemically-specific, in-situ, multichannel microsensors utilizing integrated optical interferometry technology,
- A large, commercially viable set of E-SMART-compatible sensors, samplers, and network management components, and
- A user-friendly graphical user interface for data evaluation and visualization.

In addition, the E-SMART TRP team has signed Articles of Collaboration with another ARPA TRP awardee, Sawtek, to develop an E-SMART compatible Intelligent Modular Array System (IMAS) for monitoring volatile organic chemicals (VOC's) in the environment. This collaboration will simplify the network development required to field the IMAS sensor, and will encourage the adoption of the E-SMART standard by increasing the number of commercially available E-SMART sensors.

1. Work Conducted in Quarter 3, CY 1995

Multichannel Microsensor

A review of the chemistry requirements for the coatings to be used in the multichannel microsensor was begun, including a literature search for data relevant to coatings and interferants. Chemical analyses of candidate sensor coatings were initiated. The Sensor Requirements Document which will be used by each team members to guide their portion of the sensor development efforts was outlined and a draft was begun. To support the goal of building and testing a preliminary sensor, mock-ups of sensor components were fabricated to test design concepts under consideration.

Functional testing of the breadboarded processor-to-sensor interface (PSI) and the smart-device processor (SDP) to be used with the multichannel microsensor was conducted. These components will allow the multichannel microsensor to be compatible with the E-SMART network. A self-powered clock on the SDP was successfully programmed for internal time reference at the sensor level. The clock will be used for sampling control and for providing time and date stamps for sample measurements. The device also serves as a repository for important parameters when the SDP is powered down.

An algorithm for a four-channel microsensor was programmed in Neuron C code and downloaded into the neuron chip on the SDP. The algorithm will convert the optical response of the multichannel microsensor to scientific units of measurement.

Sawtek Integrated Modular Array Sensor (IMAS)

Sawtek signed their contract with DOE this quarter, and GA signed revised Articles of Collaboration with Sawtek which reflected the contract start date. GA and Sawtek are planning to meet next quarter to generate system level specifications for each subsystem of the IMAS, including the E-SMART interface.

Other Sensors and Actuators

Completed design and fabrication of an updated prototype of the E-SMART compatible liquid level and pressure sensors. The design of the PSI for the pressure sensor design includes a programmable analog to digital (A/D) converter that may have wide application for voltage output sensing elements.

E-SMART Network Management

Completed the development of the alpha version of the user interface to be used with the multichannel microsensor. In addition, several staff members attended advanced LonWorks® network management training at Echelon Corporation in California.

Field Testing

No field test activities were conducted during this quarter.

Visualization

A three-dimensional visualization of typical ground water monitoring data was prepared using *earthVision* software to generate the subsurface plume. The goal is to add visualization capability to the E-SMART system such that groundwater data is readily converted into similar data visualizations.

In addition, the draft visualization plan was modified to add a Geographical Information System (GIS) to the E-SMART data visualization and analysis system. *ArcView* GIS software from ESRI Corporation was procured to evaluate its applicability to E-SMART applications.

Program Management

Thus far, GA has signed a subcontract with only one team member, Photonic Sensor Systems (PSS), and PSS has subsequently completed subcontracting to Georgia Tech Research Institute (GTRI). During this quarter GA has continued subcontract negotiations

with its two remaining team members, Isco and Science and Engineering Analysis Corporation (SECOR).

Negotiations with SECOR are complete, and the subcontract has been forwarded to SECOR for signature. Subcontract award to Isco has been stalled by negotiations regarding contract schedule. Isco has elected to commence efforts on this TRP pending the successful demonstration of a related technology being sponsored by Isco under a separate contract. To support this position, Isco has requested that their subcontract from GA be extended by one year beyond the term of this TRP contract. GA plans to initiate formal discussions with DOE to resolve this issue and complete the Isco subcontract.

Dual Use and Commercialization Planning

A commercialization plan for the E-SMART system was begun. In addition, posters, brochures, and related materials were prepared for display in an E-SMART booth to be provided by GA at the ARPA Dual Use Conference in Washington DC next October.

2. Problems Encountered

The most significant problem continues to be subcontract negotiations. These negotiations have delayed issuance and completion of the subcontracts, and has likewise delayed scheduled start-dates for subcontractor efforts. In addition, Isco has requested schedule changes to allow for better allocation of their internal resources and to provide more time to assess the results of an independently funded ongoing effort with PSS and GTRI to implement a sensor utilizing the Hartman Interferometer technology underlying the proposed multichannel microsensor.

3. Plans for Quarter 3, CY 1995

During the next quarter, we expect to have completed subcontract negotiations with Isco, thereby completing the E-SMART team. A formal E-SMART project kickoff meeting has been scheduled and will be held October 18th in San Diego. Development of the coating and interferant technology for the multichannel microsensor and advances in E-SMART network management, data management, and visualization will continue.

4. Milestones and Deliverables

- *E-SMART System for In-situ Detection of Environmental Contaminants - Quarterly Technical Progress Report, Quarter 2, Calendar Year 1995* - completed and delivered per contract requirements.
- *Financial Status Report-Standard Form 269A, Reporting Period 1/1/95 - 6/30/95* - completed and delivered per contract requirements.

5. Papers and Conferences

There were no E-SMART papers published this month.

6. Financial Status Report

Per contractual direction, DOE form SF-269A, "Financial Status Report", has been completed by GA for this quarter and has been distributed to the following individuals at DOE-Idaho:

- Patrick Trudel, Program Manager
- Chief Financial Officer, Financial Management Division
- Rebecca Rich, Accounting, Financial Management Division

A copy of this Financial Status Report has been included in this quarterly progress report for reference.



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