ENVIROTRADE: AN INTERNATIONAL ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT INFORMATION SYSTEM (SAND93-2231C)

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ABSTRACT

The U.S. Department of Energy (DOE) has collected, and will continue to collect, large amounts of information on its environmental waste sites and associated technology development efforts. This information is being gathered in a variety of formats for various purposes. Integration and delivery of this information will benefit decision makers, waste site managers, technology developers, regulators, and the private sector. No computerized system currently exists that acts as an easy-to-use computerized umbrella over all of the DOE's environmental information. The EnviroTRADE Information System, currently under development for the DOE's Environmental Restoration and Waste Management's (EM's) Office of Technology Development, provides access to a wide variety of information within a single architecture. Ongoing system development is expected to result in an extensive, networked interface to EM's diverse data benefiting a variety of users. This paper discusses the present status of the EnviroTRADE Information System as well as current and future development activities.

PURPOSE OF THE ENVIROTRADE INFORMATION SYSTEM

The U.S. Department of Energy (DOE) has committed to the remediation of waste sites throughout its complex by the year 2019. Environmental technologies must be identified and developed that will facilitate the remediation of existing problems and minimize future waste streams. Examples of remediation problems throughout the DOE complex are volatile organic compounds (VOCs) in soils and groundwater, soils contaminated with radionuclides and heavy metals, and mixed waste sites containing both hazardous and radioactive waste. Waste management problems include waste characterization and monitoring, treatment, and disposal.

DOE's Office of Technology Development (OTD) recognizes that it can accelerate its technology development efforts and leverage the expenditure of available funds through international cooperation among government entities, private industry, and educational institutions. Promising foreign technologies are being considered for application in the U.S., and the DOE hopes to involve the U.S. private sector in the application of U.S. technologies abroad.

DISCLAIMER

Consequently, OTD is sponsoring the development of EnviroTRADE (1), an international information system that facilitates the exchange of information about environmental restoration (ER) and waste management (WM) problems and technologies worldwide. During DOE's fiscal years 1992 and 1993, a prototype system was developed and demonstrated for the DOE by Sandia National Laboratories (SNL). The initial prototype system was created to demonstrate proof of concept for managing and displaying large amounts of environmental waste-site and technology information (both textual and graphical) through an easy-to-use computer interface. A Sun workstation with the initial prototype was placed in the DOE program Manager's office for demonstration, testing, and feedback for future system direction and development. A second system has been placed in the Mayak Facility at Chelyabinsk, Russia, to provide the scientists with a set of computer tools for the collection and analysis of environmental data, and eventually, the EnviroTRADE project with Russian environmental data.

ENVIROTRADE SYSTEM DESCRIPTION

The EnviroTRADE Information System contains profiles on domestic and foreign EM problems and technologies. Users are able to identify matches between worldwide problems and available or emerging technologies. For example, a user may browse the information on "Available and Applied Technologies", select a particular technology for viewing, and then request that the system locate environmental problems that might have use for the technology. Conversely, the user may browse the information on "Environmental EM Problems", select a particular problem for viewing, and request that the system provide information and contacts for applicable technologies. Where matches between problems and existing technologies are not found, the potential exists for development of new and innovative technologies to address environmental problems.

EnviroTRADE also provides general information on international energy and environmental organizations, sites, activities, and contacts. This general country information currently consists primarily of Pacific Northwest Laboratory's (PNL) Nuclear Fuel Cycle Fact Book, Version 12, provided by PNL to SNL in an electronic format for inclusion in the EnviroTRADE system.

EnviroTRADE is being developed on a Reduced Instruction Set Computing (RISC)-based UNIX workstation platform. A relational database management system (RDBMS) is being used to store, manage, and retrieve information. A graphical user interface (GUI) communicates with the RDBMS to provide the user with user-friendly "point and click" menus utilizing a standard windowing environment. The system is easy to use and provides the user with visually-oriented information such as maps and photographs or diagrams of environmental sites and technologies, as well as textual profiles of the problems and technologies. The prototype runs on a Sun workstation under the OpenLook window manager as a stand-alone system. The system design is based on a client/server model that can be maintained and delivered over a network when the information base is large enough to require that architecture.

GEOGRAPHICAL INFORMATION SYSTEM (GIS)

The EnviroTRADE prototype utilizes the capabilities of a geographical information system (GIS) viewer to manage and display any spatial data (2) that might be associated with an entry in the database. When GIS views are available, a button appears in the GUI that allows the user access to the spatial information. This information might be in the form of a map that displays and describes environmental contamination at sites, in rivers, and over large land areas. Because the DOE is funding the identification and restoration or management of sites within the DOE complex, many of the DOE national laboratories and other sites are capturing this spatial information using GIS software. These views, or appropriate subsets of views, can be embedded in the EnviroTRADE information base. Several GIS views are currently embedded in the prototype system for demonstration purposes.

UNIQUENESS OF SYSTEM FOR DOE INFORMATION MANAGEMENT

The DOE's OTD has chosen EnviroTRADE for its information management system for three primary reasons. The first reason is based on the system's unique architectural ability and backbone to manage and display large amounts of environmental information. It is designed so that as little structure as possible is imposed on the captured information since large volumes of data have already been collected in other systems with a variety of structures and depth.

A second unique feature of the system is its easy-to-use GUI that allows the user to navigate through the information by category or location to a specific site description or technology profile. Maps, photographs, drawings, or other graphical images may be available for viewing in addition to the textual information. If a GIS view has been attached to the data, the GIS viewer provides access to the spatial information.

A third feature is an architecture designed to implement multiple decision support tools that manipulate and analyze the information in the system. The prototype system contains a matching algorithm to bring the appropriate technologies to sites, and sites to technologies, as well as capabilities to assist the user with results - from simple lists of contacts to printed reports, facsimile and electronic mail capabilities. The modular architecture of EnviroTRADE allows for additional decision support tools to be implemented in the future such as tools that rank appropriate technologies at a site based on the user's particular criteria, that compare similar waste sites, that analyze and view flow and transport processes at waste sites, and that calculate the dosimetry and health effects of potential exposures to radioactive materials.

FUTURE DEVELOPMENT

The DOE recognizes the great need to have easy access to large volumes of accurate, current, affordable and integrated information on environmental waste problems, technology solutions and development efforts within the weapons complex. A long-term effort is needed to share and integrate environmental information and resources across

the entire complex (3). Information on waste sites must be organized and made accessible, and technologies within the DOE and private sector matched to these problems. Regulations must be considered, and management tools made available.

An integrated system of data and decision support tools will also provide knowledge beyond matching of technologies to waste sites. It will allow for successes beyond the use of the raw data itself. Patterns in data may be discovered and intelligence can be applied to the information. Redundancy of cleanup efforts can be minimized and government funding leveraged. DOE/EM decision makers require methods to analyze existing problems and ongoing technology development efforts to determine if the DOE's environmental needs are being addressed in the most efficient manner. Waste site managers with similar environmental problems must be able to identify each other and share successes and failures in applying different technology solutions. Technology developers must be able to determine where the greatest needs are located and what improvements can be made over baseline technologies. Many technologies already exist within the private sector for hazardous cleanup, but much effort must be expended in developing new technologies to deal with radioactive and mixed-waste sites within the complex. Universities need access to information about environmental research projects. In addition to these customers, the potential exists for use and expansion of the environmental information system by Department of Defense site managers and regulators such as the Environmental Protection Agency.

An effort is already underway within the DOE/EM to integrate environmental information within EM-30 (Waste Management), EM-40 (Environmental Restoration), and EM-50 (Office of Technology Development). SNL is currently expanding the prototype EnviroTRADE architecture for EM-50 with a system that will be able to deliver a wide variety of EM environmental information within a single user interface. Existing information ranges from highly structured databases to free-form textual reports that lend themselves to full-text search capabilities. Software techniques are under development to navigate and view the full range of information structures. No system within EM allows this information to be reviewed and integrated into a single user-friendly application. EM believes that this integration of all "libraries" of environmental information is the key to future success in the cleanup effort.

This over-arching system will be composed of three layers. The first layer is the network itself and the GUI-based access program that will provide extensive cross-platform flexibility. The second layer of this system will be large volumes of current, reliable, and quality information. And finally, the third layer will be the retrieval and decision support software tools, many of which are already developed or under development. Examples of capabilities that can be gained with large volumes of environmental data and software to manage it are:
  (1)   match technologies to waste sites and sites to technologies,
  (2)   identify and compare sites that have similar characteristics and requirements,
  (3)   compare technologies for effectiveness, cost, schedule, safety, and public acceptance,
  (4)   help direct DOE environmental technology development efforts,

(5) improve techniques for location of monitoring and waste characterization wells,
(6) provide data and software models to predict groundwater and contaminant transport of radioactive and hazardous contaminants from waste sites,
(7) provide dosimetry and health-effects models for analyzing the safety of existing sites and effects of disturbing sites,
(8) provide regulatory information to site managers and technology developers, and,
(9) involve and enhance the private sector interest and competitiveness in both the DOE cleanup effort and with environmental problems worldwide.

COMMERCIALIZATION OF ENVIROTRADE

Technology transfer of appropriate DOE technologies that have the potential to benefit the private sector is a priority of the DOE. EnviroTRADE is one of the technologies being considered for technology transfer. Commercialization involves identifying potential private investment partners, determining their level and nature of interest, and eliciting their guidance on commercial requirements that such a system must accommodate. If the current commercialization effort is successful, the private partner would help develop and manage a commercial version of the EnviroTRADE system. Cooperative Research and Development Agreements (CRADAs) or other mechanisms would be used to formalize the relationships among the participants.

Following a Commerce Business Daily (CBD) notice in September 1993 announcing DOE and SNL's interest in commercializing the EnviroTRADE Information System, interested private-sector companies attended a workshop held in Albuquerque, New Mexico, on November 30 and December 1, 1993. The purpose of the workshop was to provide a forum for information sharing and to explore commercialization and the potential for partnering. Possible partnership-associated negotiations are continuing at this time.

REFERENCES

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