Criteria for Selection of

Environmental Decision Support Software

Technology Demonstration Participants

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ENVIRONMENTAL TECHNOLOGY
VERIFICATION PROGRAM

Criteria for Selection of Decision Support Software
Technology Demonstration Participants

The Environmental Technology Verification program has a major objective to test new and innovative techniques. As part of this program, the U. S. Environmental Protection Agency (EPA) in collaboration with the U. S. Department of Energy (DOE) is working to test and verify the performance of environmental decision support software (DSS) packages.

The term environmental decision support software covers a wide range of software packages with differing capabilities and objectives. For example, the environmental decision could pertain to site characterization, monitoring, supporting no further action decisions, or selecting between alternative remedial actions. Structuring a DSS tool to meet one of these end points will lead to a different emphasis in the DSS. Therefore, for the purposes of the technology verification program, criteria are needed to evaluate the different software packages for inclusion in the program.

The following criteria represent a beginning for defining the selection criteria. At this stage of the project, the criteria are broad-based with the intent of capturing a wide range of interests for the initial developer's conference. The following criteria represent the qualifications which are believed to be important. However, it is not necessary for any particular software package to satisfy all of the criteria. The decision for inclusion will be based on the overall strength of the DSS in all of the criteria. After the conference, the criteria will be refined to assist in the selection of participants for the technology verification demonstration. Based on the level of interest expressed in this program by the developers, the program may be modified and repeated to examine other decision support software and thereby permit a broader range of software to be tested.

Class of Problems

Environmental cleanup decisions require a multi-disciplinary analysis with many factors involved in the decision process. The software should integrate the necessary disciplines and analyses into a form for making a decision. Under any environmental decision analysis approach, there exists a series of sub-models which address one component of the decision making process, e.g., groundwater flow and transport models, geostatistical models, ecological and human health risk models, or cost/benefit models. The accuracy of these sub-models and their ability to support a decision will depend upon various influencing factors associated with a particular site. The purpose of this program is to emphasize the ability of the DSS tool to produce results in a robust, defensible manner which will allow the user to make better qualified decisions. It is not the purpose of this program to emphasize sub-model accuracy. Sub-model accuracy is important only to the extent that it is needed to support the decision.

The environmental decision could pertain to site characterization, monitoring, supporting no further action decisions, or selecting between alternative remedial actions. Testing all these functions at this time is not possible. To limit the problem, it has been decided to test software designed to address contaminant monitoring and sampling strategies. To limit the problem, it has been decided to test software designed to address contaminant monitoring and sampling strategies. These problems will require the software to:

- Evaluate the Nature and Extent of Contamination
- Define the Remedial Boundaries or Area of Concern
- Recommend Secondary Sampling Locations or a Long Term Monitoring Plan
- Perform Cost Benefit/Risk Analysis Regarding Sampling Strategies, Alternative Actions or Action levels

Software is not required to address all of these aspects in the decision problem, for example, it may not perform a risk analysis. However, software that includes all these features and more will be given higher priority in the selection for the demonstration. Software that focuses on other types of decisions and can handle the above issues in an ad-hoc manner will receive lower priority.

To eliminate difficulties with detailed characterization of water flow, water flow will be specified or the problem will be developed such that it does not affect the decision (e.g., soil contamination problems or problems involving the definition of the current nature and extent of contamination). Calculation of water flow is a critical issue in many subsurface contamination problems and should not be dismissed. However, it is also a difficult time-consuming task often requiring man-months of effort to calibrate a flow field correctly. It is felt that this type of effort is not possible under this evaluation.

Other aspects of decision support software, such as remedy selection and optimization of remedial design exist and should be tested. However, they are beyond the scope of this program.

Software Outputs

In making decisions concerning monitoring or sampling, there will always be some uncertainty. In general, the output of the model should be in a form that helps support environmental decisions. In this case, it should either compare alternatives or provide estimates of the level of uncertainty in the model projections.

Graphical visualization tools which assists in the analysis are commonly used in DSS. Graphical output generated by the code should be supplied as part of the support for the decision.

An important part in providing decision support is thorough documentation of parameter selections and model assumptions. Software that provides this as output will be more useful in supporting the decision process.

Simulation Sub-Models and Inputs

Decision support software that has the capability to accept input in many formats will be given higher priority than those that have limited input capabilities. In addition, software that uses sub-models that are based on well-understood physical, chemical, and mathematical principles will be given higher priority than those based on empirical approaches. Models based on parameters that are typically measured or reported will be given higher priority than those that have models that have unusual data requirements.

Range of Contaminants

Decision support software that can address a wide range of contaminants and environmental conditions will be given higher priority than those that cannot. This is not meant to exclude software that handles only a specific range of problems. For example, if the software had many desirable features but only handles volatile organic compounds dissolved in water, it may still be selected.

Range of Media and Phases

Decision support software that handles many media, (soil and groundwater) will be given a higher priority than those that cannot. This is not meant to exclude software that addresses only one of these media. The different transport characteristics of the contaminants in different phases make it difficult to simulate multiple phases, therefore, it is likely that many software packages will address only a single phase. In particular, because of the difficulty associated with predicting flow and transport of non-aqueous phases, this class of problem will not be emphasized in the test problems.

Support for the Decision

Decision support tools that provide a thorough scientific rationale to support the decision will be given higher priority than tools with less robust technical support. For example, tools based on a suite of analysis techniques, e.g., classical statistics, geostatistics and interpolation of the data will be given a higher priority than those based on only one of these techniques.

Stage of Development

Highest preference will be given to commercially available software packages followed by software packages that are almost ready for commercialization (e.g., nearing completion of beta-testing).

DSS which have been used by environmental managers to make decisions or communicate remedial alternatives to regulators or the public will be given higher preference for inclusion in the technology verification demonstration

Software from U.S. companies or supported by U.S. government funding will be given higher preference than non-U.S. companies.

DSS Documentation

Review of the DSS documentation and instruction manual will be performed as part of the final participant selection process. DSS with extensive and clear documentation will receive higher priority than DSS that is poorly documented.

Developers Commitment

In order to be considered for participation in this program, the DSS sponsor must be willing to commit the necessary time and resources to participate in the following activities:

- Attend the developers conference on February 18, 1998 in San Francisco, California and provide a description of the software and its capabilities.
- Assist in the design of the test problem in terms of data interface with your DSS.
- Participate in the pre-demonstration study. This study will be used to insure that data requirements of the DSS are met and that at the demonstration data handling will not be an issue.
- Participate in the demonstration to be held at Oak Ridge, Tennessee on July 13 - 24, 1998. This demonstration conference is scheduled to last a maximum of ten days. During that time, developers will be given a suite of problem descriptions with data to be solved by the DSS. The developers may attempt to solve any or all of the test problems. The developers are not required to spend the entire ten days at the demonstration. At the end of their participation, the developers must provide documentation (including a brief written description and graphical information) supporting their analysis of the test problems.
- Provide a timely review of reports and other documents.
- Participate in four conference calls to discuss problem development, details of the demonstration, and results of the demonstration.

Justification for Participation

A major factor decreasing use of innovative Decision Support Software tools on environmental problems is that they have not received adequate testing and/or acceptance. This project is focused on resolving these issues through a controlled demonstration of DSS capabilities on real world environmental problems.

The Environmental Technology Verification Program, in general, and the Decision Support Verification and Testing program, in particular, are receiving high visibility within the EPA and the DOE as a process to promote acceptance of innovative technologies for use on environmental problems.

The output of this testing program will be an Innovative Technology Verification Report for each participating DSS. The verification reports will not compare the DSS against each other but will present the evaluation of the software's capabilities in addressing the class of problems tested. Prior to publication, the vendors will be permitted to review the report and clarify any misunderstandings. This report will then receive external peer review. For DSS packages that are successful in addressing the test problems, the report will provide potential users of the DSS with assurance that the technology will work on that "class" of problems.

Based on the Verification Report, the EPA will issue a technology verification statement which will be a brief summary of the report.

Points of Contact

Interested parties should contact either Terry Sullivan (phone 516- 344-2840, email sulliva1@bnl.gov) or Anthony Armstrong (phone 423 576-1555, email aaq@ornl.gov) for further information on the technical aspects of this program. For information on this and other projects in the Environmental Technology Verification program, please contact Steve Billets (phone 702-798-2232; email: Billets-Stephen@epmail.epa.gov).