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Evaluation of Demonstrated and Emerging Technologies for the Treatment of Contaminated Land and Groundwater (Phase III)

2000
SPECIAL SESSION

Decision Support Tools

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NORTH ATLANTIC TREATY ORGANIZATION

NATO/CCMS Pilot Study

Evaluation of Demonstrated and Emerging Technologies for the Treatment and Clean Up of Contaminated Land and Groundwater (Phase III)

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NOTICE

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OPENING COMMENTS TO THE SPECIAL SESSION ON DECISION SUPPORT TOOLS

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BACKGROUND

The Council of North Atlantic Treaty Organisation (NATO) established the Committee on the Challenges of Modern Society (CCMS) in 1969. The CCMS was charged with developing meaningful environmental and social programmes that complement other international initiatives in solving specific problems of the human environment. A major activity of the CCMS is the transfer of technological and scientific solutions and experiences among nations with similar environmental challenges. Further information about the work of the CCMS is available on *www.nato.int/ccms/info.htm*.

In 1997 the NATO CCMS adopted a proposal from the USA for a Pilot Study on treatment technologies. It will run from 1998 to 2002, with a final report in 2003 and is under the direction of the USA, the Netherlands and Germany.

The NATO/CCMS Pilot Study on the "Evaluation of Demonstrated and Emerging Technologies for the Treatment of Contaminated Land and Groundwater (Phase 3) is the third in a series of Pilot Studies considering remedial technologies. These Pilot Studies followed a Pilot Study on the problems of contaminated land directed by the UK and Germany.

The three NATO/CCMS Pilot Studies on remediation technologies has been perhaps the foremost international forum for the exchange of practical and research experience of remedial technologies. The series includes:

- Phase 1, 1986 to 1991 (Martin *et al.*, 1997; NATO, 1993; Smith *et al* 1998, US EPA, 1995 & 1998)
- Phase 2, 1992 to 1997 (Franzius *et al.*, 1996, US EPA, 1998a)
- Phase 3, 1998 to 2003 (U.S. EPA, 1998b ,1998c, 1999a, 1999b, 2000).

The Phase 3 Pilot Study has attracted participation from the following countries across the world. Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, France, Germany, Greece, Hong Kong, Hungary, Italy, Japan, the Netherlands, New Zealand, Norway, Poland, Portugal, Romania, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States have all been represented at one or more meetings by a project, government representative, CCMS Fellow, or an individual expert.

The current Pilot Study continues the theme of emerging research and technology demonstration. At each meeting a special one-day session on a topic of particular interest for the remediation of land contamination

is held. In 1998 the special session was on treatment walls (US EPA1998c), and in 1999 it was on monitored natural attenuation (US EPA 1999b).

In 2000 the topic for the special session was decision support issues. This report presents the papers of that special session, and a summary paper of the session discussions and conclusions. It has been published by NATO and the U.S. Environmental Protection Agency as part of an ongoing series of Pilot Study publications. Other publications in this series are listed in the reference section.

GOALS

The aims of the report on the special session on decision support are to:

1. Provide a general understanding of Decision Support (DS) approaches used in contaminated land remediation / risk management, their use, their features and their strengths and weaknesses, for all the NATO delegates whatever their level of knowledge about DS (a wide range of knowledge has been assumed from poor to expert)

2. Involve the Pilot Study in discussion and to document from this debate:

- perceived needs for and uses of DS from the perspective of end-users
- factors seen are most important in decision making
- evaluation of the strengths and weaknesses of existing DS and their use
- needs for DS development, in particular to take advantages of the opportunities for international collaboration offered by the Pilot Study

3. Inform both the users and potential users of DS, and also DS developers of the state of the art.

APPROACH

The emphasis of the session was on the use of decision support tools for actual remediation decisions. It considered two perspectives:

- site-specific decision making for example choosing a particular remediation system;
- remediation in terms of a risk management / risk reduction process as part of a wider process of site management.

These were addressed both as general topics and as case studies. Case studies were included to provide information on decision support techniques for specific contamination problems such as remedy selection. In the case studies, the authors present the general process to provide decision support and then discuss the application to a specific problem. The intent of this approach is to provide the interested reader with enough knowledge to determine if the process could be used on their specific set of problems. The general topics included broader issues that are not directly tied to a specific problem. The general topics included papers on the role of stakeholders in the decision process and decision support approaches for sustainable development.

Decision factors were explored from an end-user perspective, rather than what a DS developer would like them to be. Ultimately, it is the end-user that drives the decision process. There are a range of possible end-users, including regulators, property developers, local authorities, and specialist users. Furthermore, national perspectives on the use of DS appear to vary. Eliciting the differences in national perspectives was obtained through discussion and a set of questions provided to all meeting participants. The session sought to display the state-of-the-art in decision support for contaminated land management and define future directions in this area. Important issues pertaining to DS include:

- Are DS tools perceived as being useful?
- How are DS being used?
- What are the advantages and disadvantages to using Decision Support Tools (DST)?
- Are information needs for evaluating contaminated land management options understood?

It is salient to note that DS are a topic for the next call for bids for the EU Framework 5 Programme. The US EPA "owns" a number of detailed data-sets for testing and validation of DS that may offer an opportunity for collaboration. There could well be other R&D synergies too.

THE SESSION REPORT

While the selected set of papers is not inclusive of all work being done on decision support, it is representative of the state-of-the-art approaches to decision support and covers the spectrum of approaches. The first presentation sets the framework for decision support and defines key terms and common approaches. The topics covered include data management, site characterisation and sample optimisation, life-cycle assessment, multi-criteria analysis, evaluating financial risks to land developers, sustainable development, and stakeholder involvement in the decision process. A range of discussion activities took place to permit audience participation to define issues in decision support. The other papers in this session report are as follows.

- Framework for decision support used in contaminated land management in Europe and North America
- Geospatial decision frameworks for remedial design and secondary sampling
- Decision support tools: applications in remediation technology evaluation and selection
- Common factors in decision-making and their implications for decision support for contaminated land in a multi-objective setting
- Case Study - Cost benefit analysis/multi-criteria analyses for a remediation project
- Modelling of financial risks of remediation
- Decision support using Life Cycle Assessment in Soil Remediation Planning
- Approaches to decsion support in the context of sustainable development
- Managing environmental data
- Review of discussions about decision support issues in Europe and North America at The NATO/CCMS Special Session, and overall conclusions

REFERENCES

Franzius, V., Grimski, D., and Stietzel, H-J. (1996) International Pilot Studies on the demonstration of clean-up / remediation technologies and on the reuse of former military lands. *UTA International* 1996 Part 1 pp 70-73

Martin, I., Visser, W., and Bardos, P. (1997) Review of policy papers presented to the NATO/CCMS Pilot Study on Research, Development and Evaluation of Remedial Action Technologies for Contaminated Soil and Groundwater. *Land Contamination Reclamation* 5 (1) 11-40.

NATO Committee on the Challenges of Modern Society (1993) Demonstration of Remedial Action Technologies for Contaminated Land and Groundwater. Final Report. Published by the United States Environmental Protection Agency. Report EPA/600/R-93/012 (Parts a, b and c)

Smith, M.A., James, S.C. and Kovalick, W.W. (1998) Comparative international study of soil and groundwater remediation technologies. pp 9-18 IN Contaminated Soil '98, Proc 6th Intern FZK/TNO Conference on Contaminated Soil, 17-21 May 1998, Edinburgh, UK. ISBN 07277 26757

Thornton, S.F., Davison, R.M., Lerner, D.N. and Banwart, S.A. (1998). Electron balances in field studies of intrinsic bioremediation. GQ98 International IAHS conference on *Groundwater Quality: Remediation and Protection*, 21-25th September, 1998Tübingen, Germany.

United States Environmental Protection Agency (1995) NATO/CCMS Pilot Study Evaluation of Demonstrated and Emerging Technologies for the Treatment and Clean Up of Contaminated Land and Groundwater (Phase II). EPA Report: EPA/542/R-95/006.

United States Environmental Protection Agency (1998a) NATO Committee on Challenges to Modern Society: NATO/CCMS Pilot Study Evaluation of Demonstrated and Emerging Technologies for the Treatment and Clean Up of Contaminated Land and Groundwater. Phase II Overview Report No 219. EPA Report: 542-R-98-001a,b,c.

United States Environmental Protection Agency (1998b) NATO Committee on Challenges to Modern Society: NATO/CCMS Pilot Study Evaluation of Demonstrated and Emerging Technologies for the Treatment and Clean Up of Contaminated Land and Groundwater. Phase III. Annual Report. No 228. EPA Report: 542-R-98-002.

United States Environmental Protection Agency (1998c) NATO Committee on Challenges to Modern Society: NATO/CCMS Pilot Study Evaluation of Demonstrated and Emerging Technologies for the Treatment and Clean Up of Contaminated Land and Groundwater. Phase III 1998 Special Session Treatment Walls and Reactive Barriers. No 229. EPA Report: 542-R-98-003.

United States Environmental Protection Agency (1999a) NATO Committee on Challenges to Modern Society: NATO/CCMS Pilot Study Evaluation of Demonstrated and Emerging Technologies for the Treatment and Clean Up of Contaminated Land and Groundwater. Phase III. Annual Report. No 235. EPA Report: 542/R-99/007

United States Environmental Protection Agency (1999b) NATO Committee on Challenges to Modern Society: NATO/CCMS Pilot Study Evaluation of Demonstrated and Emerging Technologies for the Treatment and Clean Up of Contaminated Land and Groundwater. Phase III 1999 Special Session Monitored Natural Attenuation. No 236. EPA Report: 542/R-99/008.

United States Environmental Protection Agency (2000) NATO Committee on Challenges to Modern Society: NATO/CCMS Pilot Study Evaluation of Demonstrated and Emerging Technologies for the Treatment and Clean Up of Contaminated Land and Groundwater. Phase III. Annual Report. No 244. EPA Report: 542/R-00/xxx.

Note: Phase 2 and Phase 3 Pilot Study reports are available on *http://www.clu-in.com* and from *http://www.nato.int/ccms*. They are also available from the National Center for Environmental Publications and Information in the USA (fax +1 513 489 8695).