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MEMORANDUM FOR: Margaret V. Federline, Chief
Hydrology and Systems Performance Branch

FROM: Daniel Fehringer, Acting Section Leader
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Hydrology and Systems Performance Branch

SUBJECT: TRIP REPORT -- NEA EXPERT JUDGMENT MEETING

Enclosed is the report of my trip to Paris October 7-9, 1992, to attend an informal NEA meeting on expert judgment.

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Enclosure:
Trip report

cc: R. M. Bernero
B. J. Youngblood

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TRIP REPORT ABSTRACT
DATE OF REPORT
11/6/92

OFFICIAL TRAVELERS:
Daniel J. Fehringer

TRAVEL TO: OECD Paris

BEGINNING ON: 10/7/92

OFFICE: NMSS
Division of High-Level Waste Management
Hydrology and Systems Performance Branch

UNTIL: 10/9/92

* * * * *

MEETING TITLE AND/OR AFFILIATION:

Informal Meeting on Elicitation and Use of Expert Judgment

ORGANIZED BY: NEA

ABSTRACT AND/OR SUMMARY OF MEETING RESULTS

Following an initiative of Dr. John Bartlett, Director, Office of Civilian Radioactive Waste Management, U.S. Department of Energy, and in agreement with Dr. Ron Flowers, the Chairman of the Radioactive Waste Management Committee (RWMC) of the OECD Nuclear Energy Agency, a limited number of experts were invited to attend a meeting on the elicitation and use of expert judgments as input to performance assessments of geological radioactive waste disposal systems. Participants discussed formalized use of expert judgment for demonstrating compliance with repository safety criteria and for assessing uncertainties in predictions of performance. Methods for obtaining expert judgments, including selection of experts, elimination of potential biases, and documentation of results, were extensively discussed. Use of formal methods in HLW programs outside the U.S. and the U.K. seems to be rare. Some participants seemed skeptical about whether formal methods have sufficient benefits to justify their costs. The meeting concluded that the NEA should not initiate a working group on expert judgment, nor should NEA offer recommendations regarding formal use of expert judgment in repository performance assessments. However, the NEA should consider providing an information exchange mechanism regarding different expert judgment techniques and their applications in member countries.

Trip Report
Informal NEA Meeting
on Expert Judgment

The attached summary record of the meeting, prepared by the NEA, accurately describes the proceedings and conclusions of the meeting.

**ORGANISATION FOR ECONOMIC
CO-OPERATION AND DEVELOPMENT**

NUCLEAR ENERGY AGENCY

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STEERING COMMITTEE FOR NUCLEAR ENERGY

COMMITTEE ON RADIOACTIVE WASTE MANAGEMENT

**INFORMAL NEA MEETING ON THE ELICITATION AND USE OF EXPERT JUDGMENTS
AS INPUT TO PERFORMANCE ASSESSMENT**

Paris, 7th-9th October 1992

SUMMARY RECORD

The RWMC is invited to consider the attached summary record and discuss the results of the meeting with a view to identifying potential follow-up actions, including recommendations to the Performance Assessment Advisory Group (PAAG) and the Co-ordinating Group on Site Evaluation and Design of Experiments for Radioactive Waste Disposal (SEDE), if appropriate.

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COMMITTEE ON RADIOACTIVE WASTE MANAGEMENTINFORMAL NEA MEETING ON
THE ELICITATION AND USE OF EXPERT JUDGMENTS AS INPUT
TO PERFORMANCE ASSESSMENT

Paris, 7th-9th October 1992

SUMMARY RECORD

I. BACKGROUND FOR THE MEETING

Following an initiative of Dr. John Bartlett, Director, United States Civilian Radioactive Waste Management Program, and in agreement with Dr. Ron Flowers, the Chairman of the Radioactive Waste Management Committee (RWMC) of the OECD Nuclear Energy Agency, a limited number of experts were invited to attend a meeting on the elicitation and use of expert judgments as input to performance assessments of geological radioactive waste disposal systems (see attached list of participants). The question of formalized use of expert judgement has recently arisen in particular in discussions of demonstrating compliance with technical safety criteria and assessing uncertainties in predictions. However, the issue is wider and this first informal meeting was structured to encourage a more general discussion.

Expert judgment has been used in various forms by many radioactive waste management programmes for their performance assessment. Expert judgment can be used notably to:

- 1) design data collection activities including setting priorities for data collection;
- 2) develop scenarios (including questions of completeness and of probability of occurrence);
- 3) formulate approaches to validate conceptual and numerical models, and reach consensus on an adequate level of validation; and
- 4) quantify numerical parameters (and their uncertainties - in terms of probability distribution functions, pdfs) in cases where definitive data are not available.

The results of the expert judgments provide inputs to performance assessment and help to provide a more complete data base for analysis of the system, especially in the early stages of a programme before data collection activities have progressed very far and they can contribute to justification of the uncertainties which are assigned to the final results of a performance assessment. The questions that arise are:

- how were these opinions and information derived and translated into performance assessment inputs?
- to which parts of the geological disposal system can expert judgment techniques be applied successfully (e.i. the engineered barriers, the geosphere, the total system)? and
- how defensible are these methods and procedures?

The meeting addressed these questions in an informal and preliminary way and tried to define how the elicitation and use of expert judgment can be used to reduce uncertainties in performance assessments in a clear and defensible manner and thus, build confidence in the results of these analyses.

II. CONDUCT OF THE MEETING

In the absence of Dr. Bartlett, who could not be present and sent his apologies, the meeting was chaired by Dr. C. McCombie (NAGRA, Switzerland). Informal presentations were made in the following sequence, including discussion:

- Introduction to the formal elicitation of expert judgement (EJ) and use in a technical and safety assessment context by Prof. D. von Winterfeldt and Dr. L. Phillips, invited by NEA as consultants;
- Cases examples and review of current experience by all participants.

The two introductory presentations on the formal elicitation aspects of EJ stressed the importance of an approach which is explicit, structured, systematic and well-documented. Such an approach requires the adoption of relatively formal operating procedures, designed to "facilitate" communication between experts and the expression of consensus views, either qualitative or quantitative, on uncertain technical issues or data distributions. The following steps are usually included:

- Identification of issues and information needs;
- Selection of an appropriate mix of experts. It is often postulated that groups' judgments are usually more reliable than individual judgments, but this is not demonstrated in all circumstances;
- Training of experts about the elicitation process;
- Elicitation in an iterative process, putting emphasis on clear definition of issues, reduction of biases and reconciliation of experts' opinions;
- Documentation of the process and communication of the results.

Varying techniques may be used for the elicitation process part, with the professional "facilitator" playing a key role in identifying the best procedures for a given context. The role of the "facilitator" is also to lead

the experts, usually through a series of joint discussions, to an interpretation of the issues and an expression of the results which are acceptable to most, if not all, of the experts involved.

The consultants' presentations and the other contributions provided basis for a valuable exchange of views between participants about the methodologies and approaches used for the formulation of EJ. It became clear during the meeting that EJ and its use cover a whole spectrum of situations: EJ can be introduced into performance assessment in a process which could be

- unstructured;
- structured without formal elicitation; and
- structured with formal elicitation.

The discussion made clear that expert judgment is continually used in all waste management programmes in a straightforward unstructured process in which individual technical experts or consultants are required to select methods and data. In most programmes structured approaches involving the use of expert groups, review panels, etc. are also employed. Only in the USA and the UK there has been extensive use of formal elicitation of expert judgment with the assistance of "specialized" consultants whose functions were to organise, "facilitate" and document the process with a view to systematizing it and improving its value.

The meeting then focused on the use of structured EJ, whether the elicitation is formal or informal. It was clearly recognised that expert judgment can be used to assist in the evaluation of specific scientific or technical uncertainties, sometimes quantitatively, or to provide inputs to multi-attribute decision-analysis. The meeting spent a great deal of time examining these various situations, and agreed to summarise its observations indicated in the next section, on the basis of contributions and suggestions made by all participants. In practice, each participant at the meeting was requested, following the discussions, to record those "messages" concerning use of elicitation of expert judgment which he considered most important and most worthy of putting before the waste management community. These notes were thereafter grouped into the following structure:

- Application of EJ;
- Methodological issues in use of EJ;
- Conclusions and recommendations to NEA.

III. OBSERVATIONS AND CONCLUSIONS OF THE MEETING

A. APPLICATION OF EJ

A.1 Role of EJ (where can it be used? where has it been used?)

A.1.1 EJ which can be implicit or explicit, plays a role in all waste management programmes.

A.1.2 The necessity for EJ in the wide sense is recognized by both implementers and regulators and is even, on occasion, referred to in regulations (e.g. "reasonable assurance").

A.1.3 EJ has been used in

- strategic programme planning
- site selection
- site characterisation plans
- performance assessment (P.A.)
[scenarios, models, parameter values].

The first three points are essentially in the area of decision analysis, the last can involve highly specific choices of scenarios, parameters and pdfs.

A.1.4 EJ thus plays a role at the strategic level (decision analysis) and at the technical P.A. level - but the two issues are interlinked because P.A. functions as a tool for strategic decisions

A.1.5 Formal elicitation of EJ should be considered, in particular when

- issue is important as revealed by global P.A. and sensitivity analysis;
- definitive data are lacking and difficult to get;
- there is wide diversity of opinion between experts.

A.1.6 EJ is necessary when trying to assess uncertainties, in particular when we include not only those due to measurement error, data sparsness, natural variation, etc., but also those conceptual uncertainties in our imperfect/incomplete understanding of physical and chemical systems .

A.1.7 Relatively few programmes (USA, UK) have to date made use of formal elicitation of EJ, whereas others have relied in general on less formal but, nevertheless, structured approaches involving expert panels.

A.1.8 The worth of the formal elicitation of EJ has not been demonstrated yet in the licensing/legal/institutional process related to the disposal of high-level waste, but the use of it has been found valuable by programme implementors in reaching strategic decisions or in arriving at a consensus on data values.

A.1.9 Several programmes have to date made no use of formal elicitation of EJ, but have still completed, reviewed and based decisions on P.A.

A.1.10 The regulatory review process should accept, but not require formal elicitation of EJ, as it seems that the formal aspect of the process is less important than the validity of the technical and scientific arguments put forward.

A.2 Characteristics of formal elicitation of EJ

A formal elicitation process:

- A.2.1 Encourages explicit formulation of definitions/assumptions as an integral part of the process and contributes to an improved judgment basis.
- A.2.2 Improves traceability/documentation, both about the original information available and about the elements leading to final results.
- A.2.3 Provides clear procedures to help reduce differences between experts.
- A.2.4 Can help identify and reduce biases associated with individual expert judgment.
- A.2.5 Can improve internal consistency of the final results.
- A.2.6 Can improve quality of results.
- A.2.7 Could help in compliance debate.
- A.2.8 Broadens perspectives on the issue.
- A.2.9 Requires a significant investment of time and money.
- A.2.10 May show "vulnerability" of P.A. results through more systematic display and assessment of uncertainties.
- A.2.11 May bias the results as peer pressure may influence the experts engaged in the process.
- A.2.12 Could complicate the compliance debate.
- A.2.13 Could leave an exaggerated impression of completeness and objectivity.

A.3 Promising areas for further work in formal elicitation of EJ

- A.3.1 The most straightforward/most tested role of EJ concerns elicitation of parameter values/uncertainties.
- A.3.2 The potential for treating conceptual model uncertainties through a systematic EJ approach has not yet been fully explored (may be considered at the planned PAAG/SEDE workshop on model uncertainties).
- A.3.3 The development of a scenario analysis showing the systematic and comprehensive nature of the exercise is frequently quoted as an area where EJ is most essential.

A.4 Caveats

- A.4.1 EJ should aid decision and not obviate the need or shift the responsibility for management decisions.
- A.4.2 EJ must be update-able when new data comes (e.g., by using Bayesian methods).
- A.4.3 "Process experts" organising the formal elicitation need to be directed and controlled by programme managers who have to decide about the desirability of such a process and the use of the results.
- A.4.4 Validity of EJ depends on technical rationale and not only on method of arriving at EJ (see A.1.10 above).
- A.4.5 Formal elicitation of EJ should not be used to circumvent the normal scientific investigation procedure with proper explanation for processes and events, and be limited to a statistical amalgamation of numbers. In particular, EJ should not be used as a cost-cutting method to decide upon parameter values which can be directly measured with reasonable effort, but should be used in cases where extensive measurements are not likely to significantly improve the consensus between experts.

B. METHODOLOGICAL ISSUES

B.1 Relationship between informal/formal approaches of EJ

- B.1.1 Structured methods for formal elicitation of EJ exist and have been used in waste management and elsewhere, for both individual and group approaches. However, it is not clear under what conditions it would be preferable to use individual or group assessments.
- B.1.2 The formal elicitation character of EJ is not essential; the appropriate degree of formalism should depend on the importance of the issue being handled and on the benefit which is expected from the use of EJ in this particular context.
- B.1.3 Many characteristics of formal elicitation of EJ are found also in an informal but still structured approach at the group level and in the systematic use of expert working groups with subsequent peer review.
- B.1.4 There is no one best way to use EJ as many generic and specific conditions have to be taken into account; the context matters (cultural, social, economic, legal, political, technical) and the process has to be fit for purpose.

B.2 Open questions on methodology for formal elicitation of EJ

The following questions have been raised during the meeting, without apparently having already received satisfactory answers:

- B.2.1 What is rigorous definition of formal EJ? There does not seem to be an agreed definition and the process seems to be best described through illustrative examples.
- B.2.2 Are results reproduceable? (and are alternatives any better?)
- B.2.3 How do we best choose experts (number and type)?
- B.2.4 Is group or individual elicitation preferable?
- B.2.5 How do we aggregate individual EJs?
- B.2.6 How can the "quality" of an EJ be determined?

B.3 Recommendations (methodological)

As a logical consequence of the above questions, the following suggestions were made as matters of general interest which it would be worthwhile to look at, possibly on the occasion of specific EJ exercises:

- B.3.1 It would be useful to ask a "professional EJ facilitator" to summarize the main guidelines for the practical application of EJ elicitation techniques to waste management issues and P.A. context.
- B.3.2 The issue of reproduceability of EJ was raised and the possibility of developing reproduceability tests was suggested (vary experts and facilitator?).
- B.3.3 Similarly the development of systematic guidelines for the choice of experts was recommended.
- B.3.4 The development of "mixed" group-individual procedures for elicitation should be envisaged.
- B.3.5 It would be useful to examine how formal elicitation of EJ could be used in legal/adversarial framework.

C. CONCLUSIONS AND RECOMMENDATIONS TO NEA

The following conclusions and recommendations were made with specific reference to the role that NEA can play in this field and are addressed therefore to the RWMC.

C.1 Concerning information dissemination on EJ

- C.1.1 The meeting has shown that it would be useful to provide more information on EJ cases and examples to those persons involved in waste management and P.A. studies in Member countries.
- C.1.2 It was recommended therefore that NEA should provide an information exchange mechanism on EJ techniques and examples of relevant studies carried by Member countries in this field. This type of information does not seem to be widely circulated at present outside each country.
- C.1.3 NEA should report the results of this meeting to the RWMC and its sub-groups (PAAG, SEDE) and encourage discussion on the subject of EJ elicitation (the RWMC may then wish to formulate specific recommendations to its sub-groups as may be relevant to their agenda).

C.2 Concerning a potentially more active role(s) of NEA in the EJ area

It was generally agreed at the meeting that:

- C.2.1 NEA should not make formal recommendations on the use of EJ in a formalized manner, given in particular the wide spectrum of situations where EJ can be used and the inherent limitations in the process.
- C.2.2 NEA should not therefore initiate a working group on EJ for the time being.
- C.2.3 The usefulness of a topical workshop may however be considered by RWMC, but participants had no specific suggestions to offer on its possible scope and desirable date.
- C.2.4 Furthermore, it was suggested that NEA could establish data bases of information on geological and chemical parameters important to the safety case and provide reference data classes with associated variabilities. It was remarked on that occasion that this type of activity was already included in the NEA programme with the development of the Thermochemical Data Base (TDB).
- C.2.5 Finally, it was suggested that NEA might sponsor some of the methodology testing/development activities proposed under B.3 above.

D. OTHER MATTERS

- D.1. Participants were informed of the organisation of a workshop on expert judgment in the USA in November 1992, and it was recommended that a report on this workshop should be presented at the next RWMC meeting on 11th-12th february 1993 in Paris, as complementary information.

**INFORMAL NEA MEETING ON THE ELICITATION AND USE OF EXPERT JUDGEMENT
AS INPUT TO PERFORMANCE ASSESSMENT**

**OECD/Paris
7th-9th October 1992**

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