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NUCLEAR REGULATORY COMMISSION  
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JAN 5 1993

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

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

SUBJECT: TRIP REPORT - DOE EXPERT JUDGMENT WORKSHOP

Enclosed is a report of my November 18-20 trip to Albuquerque to attend a DOE workshop on expert judgment. Also enclosed is a summary, prepared by Bill Reamer, of the presentations at the workshop.

A handwritten signature in cursive script that reads "Daniel Fehringer".

Daniel Fehringer, Acting Section Leader  
Repository Performance Assessment Section  
Hydrology and Systems Performance Branch

Enclosures:  
1. Trip report  
2. Reamer's summaries

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## TRIP REPORT

### DOE EXPERT JUDGMENT WORKSHOP

1. Date and destination of trip  
November 18-20, 1992, Albuquerque, New Mexico.
2. Purpose of trip  
Attend DOE workshop on expert judgment.
3. List of persons contacted, with titles and organizations

Jean Younker, title unknown, CRWMS/M&O  
Steve Brocoum, title unknown, DOE/OCRWM  
Leon Reiter, title unknown, NWTRB  
Steve Frischman, title unknown, Nevada

4. Detailed summary of work activities

I attended the workshop, gave a presentation on use of expert judgment in the NRC's licensing process, and participated in a panel discussion following one set of presentations.

Presentations at the workshop were generally of three types: (1) statements advocating increased and/or more formalized use of expert judgment (EJ), (2) reports of DOE's past experiences in using EJ, and (3) reports of EJ use outside of DOE, notably in NRC licensing, EPA rulemaking, and EPRI repository performance assessments. Panel discussions and comments from workshop participants tended to focus more on DOE's internal use of EJ than on use in licensing.

In general, presentations reiterated familiar material, recognizing that judgment (either formal or informal) is always part of decision-making, and describing various facets of the more formal ways of obtaining and using EJ.

DOE's experiences with decision analysis and formal uses of EJ have apparently been mixed. DOE has found formal methods to be expensive and time-consuming, and the results have not always been completely satisfactory. A discussion about some differences in views related to DOE's use of decision analysis in repository site selection were apparent in discussions between a DOE manager and a (contractor) decision analyst. As another example, some of DOE's EJ elicitation have been criticized for not including a sufficiently broad range of expert views. Several times DOE managers characterized formal techniques as "decision-aiding rather than decision-making." The DOE managers wanted to reserve for themselves the authority and responsibility for the decisions that DOE ultimately makes. An unidentified participant noted that technical experts, rather than DOE managers, will be called upon to defend DOE's decisions before an NRC licensing board.

DOE has experimented with formal methods for obtaining and using expert judgment in several areas, including HLW repository site selection, test prioritization, and WIPP performance assessments. At the workshop, it was unclear how DOE intends to use EJ to support a license application. Not surprisingly, the decision analysts who participated in the workshop seemed to be strong advocates for using formal methods. However, DOE staff and some contractors seemed to have doubts about whether the costs of formal methods would always be justified by the benefits. In a hallway conversation, one DOE staff member expressed serious reservations about the possibility of NRC guidance on use of EJ. He argued that DOE needs to have flexibility to use either formal or informal methods as appropriate for a particular decision. A DOE contractor was especially concerned that any NRC guidance not conflict with the Lawrence Livermore seismic work done for nuclear power plants. Steve Frischman of Nevada argued that DOE's treatment of its Early Site Suitability Evaluation (ESSE) report is an example of misuse of EJ. In his view, DOE cites the ESSE as a reference when it is convenient to do so, but disowns the report as "just a contractor document" when that is convenient.

Descriptions of experiences with formal uses of EJ outside DOE's programs were relatively optimistic, especially NWTRB staff member Leon Reiter's discussion of experiences in NRC reactor licensing. It is not clear, however, that these precedents received the type of scrutiny and opposition that can be expected in repository licensing. Therefore, questions remain about how well formally elicited EJ will be accepted by a repository licensing board.

## 5. Conclusions

DOE has not yet determined the best way to use EJ during its prelicensing activities, nor has DOE determined how to use EJ to support a license application. This workshop served as a useful forum for exchanging information about past experiences and potential future ways to use EJ. However, I could not determine that anything was concluded, during the workshop, about the best way(s) for DOE to proceed. In particular, the workshop offered no useful suggestions for developing NRC guidance for use of EJ during licensing. In fact, many of the workshop participants seemed unconvinced that the formal methods advocated by decision analysts have benefits commensurate with their costs.

Rev. 2; 9/29/92

PRELIMINARY DRAFT AGENDAEXPERT JUDGMENT WORKSHOP

Las Vegas, NV

November 18-20, 1992

Wednesday, November 18, 1992

8:00	Overview	R. Dyer
8:45	NWTRB Remarks	W. North
9:15	Framework and Definition of Expert Judgment	Prof. Ronald Howard/Stanford
10:15	BREAK	

## PANEL I: THE PROCESS OF QUANTIFYING EXPERT JUDGMENT

Moderator: Dr. Bruce Judd, Decision Analysis Corp.

10:30	Systematic Process for Assessing Expert Judgment	Prof. Ralph Keeney/USC
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11:10 Discussion

11:15	Avoiding Probability Assessment Biases	Dr. Miley Merkhofer/Applied Decision Analysis, Inc
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11:50 Discussion

12:00 LUNCH

1:15	Aggregating Expert Judgments	Dr. Peter Morris/Applied Decision Analysis, Inc
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1:50 Discussion

2:00	Panel Discussion	Dr. Bruce Judd/Decision Analysis Corp.
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3:15 BREAK

## PANEL II, PART A: EXPERT JUDGMENT AS A DATA SUPPLEMENT

Moderator: Dr. Abe Van Luik, CRAMS/M&amp;O

3:30	Principles Involved	Milt Harr
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3:50 Discussion

4:00	Experience from TSPA	Dr. Paul Kaplan/SNL
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4:20 Discussion

4:30	Experience from IMARC	Dr. Robert Shaw/EPRI
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4:50 Discussion

PANEL II, PART B: EXPERT JUDGMENT IN MODEL VALIDATION

5:00 Overview Dr. Chin Fu Tsang

5:20 Discussion

5:30 Experience from WIPP Matt Kozak

5:50 Discussion

6:00 Adjourn

Thursday, November 19, 1992

PANEL II, PART B (Continued)

8:00 Approach to Expert Judgment for Modeling Dr. Abe VanLuik/  
CRWS-M&O

8:20 Discussion

8:30 Panel Discussion

PANEL III: EXPERT JUDGMENT IN PROGRAMMATIC DECISIONS

Moderator: Dr. Jean Younker, CRWS/M&O

9:30 NRC Remarks TED

9:45 BREAK

10:00 State of Nevada Experience Steve Frischman/  
State of Nevada

10:15 Discussion

10:25 AQW Experience Paul Pomeroy/NRC(?)

10:40 Discussion

10:50 DOE Experience Dr. Steve Brocum/DOE

11:05 Discussion

11:15 NWTRB Experience Dr. Leon Reiter(?)  
/NWTRB

11:30 Discussion

11:40 Panel Discussion Dr. Jean Younker

1:00 LUNCH

PANEL IV: INDUSTRY EXPERIENCE WITH EXPERT JUDGMENT

Moderator: Dr. Robert Shaw, EPRI

2:15 Eastern United States Seismic Hazards Robin McGuire/EPRI

2:25 Discussion

2:35	Legal Aspects of Licensing Hearings	Michael McCarry/ Winston & Strawn
2:45	Discussion	
2:55	New Production Reactor Seismic Design	John Savy/LLNL
3:05	Discussion	
3:15	BREAK	
3:30	Vallecitos Reactor Licensing (NRC Perspective)	Robert Jackson/Weston
3:40	Discussion	
3:50	International Programs (Esp. Swedish; European vs US [CEC-USA])	Steve Hora
4:00	Discussion	
4:10	Panel Discussion	Dr. Robert Shaw/EPRI
5:30	Adjourn	

Friday, November 20, 1992

8:00	Panel I Summary	Dr. Bruce Judd
8:15	Panel II Summary	Dr. Abe Van Luik
8:30	Panel III Summary	Dr. Jean Younker
8:45	Panel IV Summary	Dr. Robert Shaw
9:00	BREAK	
9:15	Roundtable Discussion	
11:00	Closing Remarks	(TBD—R. Dyer?)
11:30	Adjourn*	

\*NOTE: Moderators, panelists, and steering committee be prepared to remain in the afternoon for a working session to develop recommendations and prepare white paper.

November 23, 1992

Re: Trip Report on DOE Expert Judgment Workshop; Albuquerque, NM; November 18-20, 1992.

John Bartlett, DOE, opened the workshop. He said expert judgment has a role in achieving public and regulatory confidence in safe waste disposal. He said the workshop would discuss methods for strengthening the basis of decisions by optimizing expert judgment. He cautioned against the tendency to overinvest in expert judgment, and emphasized the need to identify instances when expert judgment should be, but is not, used. He concluded that expert judgment needs to be managed. His words were "use it, think about it, document it and manage it."

Russell Dyer, DOE, addressed DOE's use of expert judgment to assist in determining what tasks are most important for purposes of allocating funds for technical testing. He said DOE's use of it over the last 3-to-5 years ranged from less formal to more formalized means. More formal uses of expert judgment generally cost more money. DOE considers "peer review" to be a form of the use of expert judgment. DOE's exploratory shaft facility alternatives study (ESFAS) is DOE's longest, most extensive use of expert judgment.

Warner North, NWTRB, defined expert judgment as something that resides in someone's head and is relevant information but not data and measurements. He said the use of expert judgment in the repository program is at the extreme end of the scale of technical difficulty. However, its use is subject to the same principles as more simple uses of expert judgment in personal and business decisions. The main aspects of the procedure are (1) select the experts; (2) understand their story; (3) document the basis for their judgments; and (4) deal with the question: how much is enough? He described the elicitor's qualifications including training/knowledge in probabilistic models; assessing judgmental probabilities probably gained through practice; and understanding social sciences, particularly how people think about uncertainty (people do not naturally think accurately about uncertainty), risk perception and risk communication.

He said the Nuclear Waste Technical Review Board (NWTRB) tied the use of expert judgment to licensing in its first report to DOE, and argued for DOE to draw on a broader pool of experts in its second report. He also mentioned the concern that aggregation of experts' judgments heightens the need to document individual expert judgments and their bases; that the Board criticized DOE about documenting expert judgment basis; and that the credibility of DOE's process is key to acceptance outside its process. In its third report, the Board noted DOE and NRC need to agree on the potential use of expert judgment prior to beginning licensing.

He referred to a letter from Paul Pomeroy, ACNW, which identified (1) the need for consensus on an acceptable methodology (for formal elicitation and use of expert judgment in the repository licensing process) within the technical, political and public community; (2) indepth investigation of the use of expert judgment in one particular area of repository problems; (3) legal aspects regarding the admissibility and use of expert judgment in the adjudicatory process; and (4) meetings of interested parties and legal specialists to understand and plan for use of expert judgment in the legal framework of the licensing process. He noted that consensus will require us to explain expert judgment and its use "in terms your grandmother can understand."

Ron Howard, Stanford, a decision analysis expert, affirmatively answered the question "is expert judgment human knowledge?" We cannot make decisions without it, whether the decision is to settle or litigate, operate or wait, or resort to Desert Storm rather than an embargo. Thus, the question is not whether to use expert judgment but rather how to use it.

He defined decision quality as a function of having the right organization, the right frame or bounds of the decision, the right representation or basis, the right logic or analysis, the right communication, and the right commitment to action. A quality decision requires (1) the appropriate frame for the decision, (2) creative, doable alternatives, (3) meaningful, reliable information, (4) clear values and tradeoffs, (5) logically correct reasoning, and (6) a commitment to action from the necessary people.

Expert judgment or human knowledge can be represented in a decision through descriptions of distinctions and contrasts, relationships, and uncertainty. Since by definition, we seek representations of something and not the thing itself, expert judgement is not a source of "truth" but rather a source for a better understanding; experts can provide alternatives as well as information. He described the concept of quality human knowledge which is knowledge that includes all material considerations, current understanding, current information and the absence of bias.

He also noted the need for a defensible decision. The "prototype" stage of a decision is an early phase which shows problems and the corrections. The next stage of a decision is the "integrated" stage which is typically the decision stage achieved by a business in order to take action on a project. However, more is required for decisions in the repository program. Specifically, decisions must reach the "defensible" stage which requires substantially more effort on our part, to go beyond the integrated stage. He suggested we use a "process certifier" who certifies we are using the right process for a particular elicitation and a "content certifier" who certifies that we are working on the right

problem and using the right expert. He also suggested including a "devil's advocate" in the process to reach the defensible stage.

Ralph Keeney, USC, a decision analysis expert and participant in DOE projects, noted that expert judgments are always used. The important questions are how is it used (i.e., qualitative, quantitative, degree of formality) and for what purpose it is used (i.e., model building, data collection, data assessment). He also noted expert judgment is used to complement the current practice, not replace it. He said he prefers experts who will put their names on their assessments.

He defined probability as a number that is a state of mind that quantifies the current state of knowledge -- it is not reality.

The importance of documentation is not different from documenting any scientific work; however, all assessments do not need the same degree of documentation. When aggregating expert judgments of several experts, the fundamental information from the individual assessments should be kept.

Lawyers generally oppose the decision analysis process; they do not favor an explicit process.

Lee Merkhofer, ADA, a decision analysis expert and DOE project participant, defined bias in expert judgment as a systematic error in probability judgments. Research shows such bias is commonplace among lay persons and experts. It is a flaw in some aspect of the reasoning process which cannot be corrected, but can be overcome by using specific techniques to counteract the bias that otherwise occurs. The "granddaddy" of all biases is overconfidence, in the form of underestimating uncertainty, particularly at the extremes.

Motivational bias is another form of bias. As a last resort, it may require disqualification of the expert. There is some study evidence showing the opportunity for motivational bias on the part of the probability analyst.

Peter Morris, ADA, a decision analysis expert, addressed disagreement among experts. He said it is a myth that if several experts agree, then they must be right. Another myth is that if experts disagree, they must not know what they are talking about. He said, however, it is important to find the source of the disagreement. Consensus is not necessary among experts and should rarely occur in theory. It is also not consistent with two important points for obtaining expert judgment: Don't mask or suppress uncertainty; do include a wide range of expert opinion.

Dependence among experts on the same data may affect aggregation of differing expert opinions. Also, if aggregation is done at a high level (i.e., overall judgment), it may filter out

important differences among experts at lower levels (i.e., intermediate or constituent judgments) that may affect the bottom line.

Decisionmakers should have the full range of opinion in the form of what each expert said; the range may show greater uncertainty by evidencing that experts disagree. He noted the question whether one should resort to statistics to bridge gaps or disagreements between experts; does it hide the true uncertainty reflected in the disagreement? He noted professional societies have processes to address disagreements, and suggested the decision analyst should not try to supplant such processes.

"Encoding uncertainty" refers to putting an expert's uncertainty into a probability distribution. He would not exclude a "community expert" from the elicitation process. He suggested use of expert judgment raises the question of what is the alternative; use of the formalized elicitation methods raises the question of how much do you trust the alternatives to it?

He noted that making expert judgments explicit may not make them less controversial; a limitation of the process is therefore the willingness to be explicit.

Dan Fehringer, NRC, said there were two schools of thought within NRC about its review of expert judgment. One school would look only at the basis for the judgment. The other school believes that the process for obtaining the judgment is also important.

Milt Harr, Purdue, argued that engineers have been constructing major projects for many years by designing the facility, making changes during construction, and correcting failures that inevitably occur after completion. Analysis alone cannot change this engineering process.

Data quantifies hypotheses of experts; there is no such thing as absolute data.

Paul Kaplan, Sandia, a DOE contractor, argued that the relationship between expert judgment and scientific inquiry is subject to continuing serious question. Scientific inquiry means proof by an hypothesis. While uncertainties must be characterized, expert judgment is a questionable way to do so; the problem is the expert is simply being asked to speculate.

Robert Shaw, EPRI, described EPRI's use of expert judgment in performance assessment modeling. He said EPRI had significant problems in selecting experts for participation in the project. Some experts were uncomfortable with the elicitation process and seemed afraid to say "I don't know." He said elicitation is not the best way to get the "best value" for a parameter from a panel.

Chin Fu Tsang, LBL, a DOE contractor, discussed expert judgment in model validation. Validating a computer code used in a model is purely mathematical. However, expert input is needed for validating the model itself. No absolute validation is possible; only practical or conditional validation is possible for (1) the particular site, (2) observables/performance, (3) the range of parameters, and (4) the range of uncertainties.

His suggestions for expert input included that input be obtained on the site specific information (the "state of the information"), general scientific knowledge (the "state of the knowledge"), and sensitivity analyses, uncertainties and the range of application. "Partial experts" are the experts who know everything about the site and other experts who have the needed generic scientific knowledge. The latter should be given the site specific information and told to study it before the elicitation.

He would bring in the current state of scientific knowledge by eliciting the opinions of a broad selection of experts; the elicitation should include an indepth discussion of the bases of the opinions. He would obtain the proper interpretation of the current state of information through multiple expert groups (i.e., groups with experts having different specialties) some of which might have knowledge of other sites.

He emphasized that it is not possible in model validation to prove the validity of long-term predictions. He also reiterated the following, basic points of elicitation: education of experts; an indepth, scientific-inquiry approach; discussion among experts; discussion of the bases of the experts' opinions; and multi-discipline groups. Expert judgment will be more useful in the portions of the model dealing with interpretation of site specific information, general scientific knowledge, and uncertainties.

Matt Kozak, SNL, discussed experience from NRC's LLW program. He said the scientific method cannot be used for performance assessment; it is not possible to observe phenomena of interest (i.e., the potential future conditions that could cause a site to fail), nor to test the model under the conditions of concern. Predictions covering a 10,000 year period are a decision analysis problem, not a scientific method process; we cannot predict over 10,000 years and the public knows it. "Validation" should therefore be replaced with "confidence."

We may be able to reduce the parties' later arguing if all of them join in the performance assessment at the outset. He believes it is possible to answer whether or not an intervenor's particular concern makes any difference to the performance assessment. Only when we are unable to say that a particular concern cannot possibly matter need we go on to determine what the state of knowledge and information is on the concern, and whether the concern is real.

Kathleen Trauth, SNL, addressed DOE's experience in using formalized methods at WIPP. She said formalized methods were used for the most sensitive issues as revealed by their annual sensitivity analyses. She noted they had used expert panels in the following areas: possible models for future societies' behavior; marker development to design a marker system to deter human intrusion; source term (solubility) to estimate radiological concentrations in the repository brine; radionuclide retardation for distribution coefficients; and the geostatistics expert consultation group. She noted the use of external members would address the credibility/defensibility issue.

A commenter said that the potential for misuse of expert elicitation requires oversight and vigilance. For example, the retardation group was made up of three Sandia personnel whose work had gone into the performance assessment; the solubility panel's output was not useful and failed to conduct appropriate experiments; and the future societies' panel predicted drilling rates without looking at actual, recent drilling near the site.

The subsequent panel discussion clarified that DOE intends to use expert judgment to cut off the data collection process, but the principle is consistent with the scientific method that one may stop scientific study with a given uncertainty; the scientific method does not require a matter be studied to death. It is also important that the expert panel's purpose should be determined in advance: Is it to determine data needs, or to defend something before the NRC, or to influence the public?

Steve Frishman, State of Nevada, was critical of one example of expert judgment use -- DOE's early site suitability evaluation (ESSE). It was an abuse and failure to use the scientific method because of the ESSE's "two value logic" which asked whether a particular position could be confirmed or not confirmed and failed to consider the third value of whether we do not know enough to confirm or disconfirm. He said the ESSE scientists also were out of their field in condemning the carbon-14 regulatory standard. He criticized DOE for using the ESSE as a document reference for cost and management decisions after disclaiming DOE responsibility for the report.

He also argued that the recent amendments to the Waste Policy Act destroyed existing regulation by creating a third barrier, in addition to the engineered barriers and the geologic setting, that is, the institutional barrier. He said the law required NRC to make certain assumptions even if the National Academy of Science's recommendations are to the contrary. He also questioned stacking expert judgment on expert judgment.

Tom Isaacs, DOE, discussed the use of multi-attribute utility analysis (MUA) in the environmental assessments for the site selections in 1986 for further characterization. He said MUA is

useful but very expensive. In addition, it does not prevent the politicians from acting based on political need. He recommended that DOE should approach the repository program by acknowledging what it knows and does not know, what are the uncertainties and what is the expected performance; and leave the ultimate decision whether to license to the NRC. Expert judgment should be one element of providing a robust safety case.

Steve Brocoum, DOE, noted that an NEA concern is that the worth of expert elicitation has not been demonstrated in licensing, legal and institutional processes although it has been found useful by program implementers.

He identified several levels of formality for obtaining expert judgment as follows: (1) informal, that is, two people talking; (2) formal working groups and peer review panels, that is, the ordinary way of doing business; and (3) formal elicitation.

He also identified several, potential weakness of elicitation in programmatic decisionmaking, including preoccupation with process which may hide problems; a tendency to focus on decisionmaking rather than on aiding the decisionmaker; the need for strong management oversight to get the process to meet specific needs; attention to critical panel makeup; and complexity of the process that may leave decisionmakers unable to explain it. However, others noted that too much management oversight might create problems for the decision analyst and his technique.

Brocoum said the expert judgment process would likely be used by DOE in site suitability decisions and in iteration of the ESSE. He observed two modes for DOE to include outside experts: (1) internal elicitation followed by outside peer review (ESSE, ESF); (2) internal data provision followed by elicitation of outside experts (WIPP).

Leon Reiter, NWTRB, responded to the concern that elicitation would present for the licensing process the problem of the "remote, distant body of elicited experts." He said that in the Lacrosse enforcement proceeding (13 NRC 276), the Board received elicited expert judgment into the record. The Board recognized the inadequacy of earthquake data and the need to resort to judgment. The Board seemed to accept use of a panel to develop estimates of ground motion. In Big Rock (20 NRC 655), the Board accepted expert judgment analysis in the Systematic Evaluation Program. It noted the qualifications of the elicited experts, and was aware that experts' opinions had been aggregated by the NRC staff. In Seabrook, the NRC staff put elicited expert opinion into the record but the Board did not use it. The intervenor was one of the experts involved in the study. He said the EPRI seismicity study had not, to his knowledge, been presented to the Board.

He offered, as lessons from the prior use of elicitation before the Board, that elicited expert judgment could be successfully defended in licensing proceedings, that it was not hampered by the absence of the experts themselves, and that it was not bothered by the aggregation of the opinions. He also noted the Board did not challenge the individual judgments obtained by the Staff, the Staff kept the experts anonymous from other experts, only the statements, but not the bases, of the individual judgments were documented, the staff did not use formal elicitation techniques, and the Board posed strong questions.

During panel discussions, Tom Isaacs stated the expert judgment process exposes the decisionmaker to misuse by persons who do not want the project to succeed. Frishman said he believed Nevada experts would participate in an expert judgment process if it were a particular point of inquiry and not the overall "go/no go" decision, if the scope and purpose of the elicitation were well-defined, and if individual experts were not tied to the elicitation outcome. Other panelists agreed that some experts would not participate if they were tied to the group outcome.

A representative of the National Academy of Sciences said NAS could not write the standards or provide the numbers for inclusion in the standard because the NAS charter prohibits it. Rather, it will report on scientific approaches, analyses, and technical support for EPA to consider. She said there should be no assumptions on the outcome of the report; the panel has not even been identified, and the report will be reviewed within NAS.

Robin McGuire, an industry consultant for EPRI, described use of expert elicitation as input for the Eastern U.S. seismic study by EPRI. EPRI required consensus on interpretations of data within the participating teams but not between the teams. The results were used to identify plants for further study.

He said the elicitation process must be compliant with the fundamental earth sciences involved. He suggested the need "to go slow in order to go fast." He recommended using scientist/engineers, rather than subjective probability facilitators, in the lead elicitation role in order to have legal credibility. Otherwise, experts may be pressured to make probability statements during the elicitation that they are uncomfortable in making and might therefore later disavow. Decision analysts should act in the true role of facilitator to help experts put interpretations in terms of probabilities. Otherwise, use of the analysts could distort the scientific inquiry purposes and focus too much on subjective probabilities which are not the main point of the elicitation process. The output of the process should be the scientific representation of uncertainty for inclusion in a licensing decision.

Mike McGarry, an private attorney for TRW, gave a primer on the licensing process.

Robert Winkler, Duke, a decision analyst expert, said EPA used expert judgment in setting air quality standards. He mentioned the importance of eliciting qualitative judgments before training in and elicitation of quantitative judgments, including probability assessments of data. By qualitative judgments, he means the experts' reasons for their probabilities, the theories they believe in, and anything else which explains their views and is not quantitative.

He said EPA used the results as information in decisionmaking, but had not formally incorporated the results into decisions.

He said it was important to have an expert in the subject matter on the assessment team along with a decision analyst. Both would visit and elicit the experts.

When experts interact, it is better to elicit the individual assessments first, before the interaction, in order to address the concern for independence and influence. He also noted there were a number of different ways to conduct the elicitation process although there are some general principles that may apply.

Robert Jackson, Roy F. Weston, described expert opinion in the Vallecitos Licensing Board proceeding. He noted the licensing process creates regulatory uncertainty right up to last hour of the process. For example, the Vallecitos Board sent the parties back for more data. He also offered that it will be the individual scientist on the stand who will carry the day, not the managers.

Steven Hora, Hawaii, a decision analyst, discussed elicitation in consequence models. Because of the cost, he suggested using the process only for important issues, or issues where there is conflicting information. Only parameters having a physical interpretation should be the subject of an elicitation. He emphasized the importance of clarity in presenting issues to the experts, diversity of views, training, use of state-of-the-art techniques, equal treatment of experts, and identification of each expert with his or her probability and rational. He suggested calibrating experts to measure the goodness of their probability assessments but had no answer to what to do if an expert flunks the probability test.

During the panel discussion, the point was made that unsuccessful elicitations commonly involve poor framing of the decision or problem to be solved.

The Nye County representative asked how outsiders will be included in the elicitation process, and how will the perception be countered that DOE contractors control this process.

Another panelist made the point that analysts with an appearance of bias should not be used.

Expert judgment to be used in performance assessment should be published to undergo scientific scrutiny.

We should recall the purpose of expert judgment which is to bring into the data, model or decision current scientific knowledge comprehensively, and to bring in the proper interpretation of the current state of information.

There is not one protocol for elicitation of expert judgment. In addition, there is disagreement over whether the analyst should be more than just a facilitator, group elicitation vs. individual elicitation, team vs. individual experts, and consensus/aggregation.