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Examining Recent Expert Elicitation Judgment Guidelines: Value Assumptions and the Prospects for Rationality*

Patricia Fleming**

Introduction

Any examination of the role of values in decisions on risk must take into consideration the increasing reliance on the expert judgment method. Today, reliance on expert judgment is conspicuously present in the documents and work associated with site characterization of Yucca Mountain as a host for the United States' first high level nuclear waste repository. The U.S. Nuclear Regulatory Commission (NRC) encourages the use of probabilistic risk assessment's state of the art technology as a complement to deterministic approaches to nuclear regulatory activities.¹ It considers expert judgment as one of those technologies. At the 1998 International Conference on High Level Nuclear Waste Development, several presentations reported on the use of expert elicitation sessions held during 1997 at Yucca Mountain.²

Over a decade ago, few guidelines existed for U.S. Department of Energy (DOE) work in expert judgment. In an analysis of these guidelines, I described the author-advocates view of the role of values in

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¹ See U.S. Nuclear Regulatory Commission, *Branch Technical Position on the Use of Expert Elicitation in the High-Level Radioactive Waste Program* (NUREG-1563, 1996) [hereinafter BTP].

² See K. Coopersmith et al., *Use of Expert Elicitation to Quantify Uncertainties in Process Models for Total System Performance Assessment*, American Nuclear Society, The Proceedings of the Eighth International Conference High Level Radioactive Waste Management (May 1998); J. H. Lee et al., *Use of Expert Elicitations for Modeling Waste Package Degradation at the Potential Yucca Mountain Repository*, American Nuclear Society, The Proceedings of the Eighth International Conference on High Level Radioactive Waste Management, Las Vegas, NV (May 1998).

this method of risk assessment.³ I suggested that the guidelines assume naïve positivism.⁴ I noted that the creators of these guidelines also tended toward scientific realism in their apologetic tone that expert judgment falls short of representing the way nature is (as, presumably a deterministic approach would).⁵ I also pointed to a tendency toward what I call a heightened or super-realism. Normal science (field studies, empirical tests) represents the way the world is and for expert judgment this is only likely so. Expert judgment method, however, is capable of truly capturing expertise in a representative sense.

The purpose of this paper is to examine new guidelines from the DOE and the NRC, with a view to eliciting the epistemological assumptions about the role of values and the status of objectivity claimed for this method. Do these new guidelines also adopt naïve positivism? Does the inability to encounter raw, pure, value-neutral expert judgment reveal itself in these guidelines? Or, do these guidelines adopt the belief that values are not (and should not be) mixed directly into judgments, accounting for their sweet or bitter taste? And, is there a shift from away from the apologetic scientific realism of the earlier guidelines to that of anti-realism? An analysis of expert judgment method's commitment to value neutrality raises questions, too, for the prospects of rationality. The purpose of examining these guidelines is not to simply assert that values hide out in the expert judgment method's determination of risk, but also to examine the possibilities for adjudication of values and interests under an epistemologically sophisticated understanding of rationality.

³ See Patricia A. Fleming, *Expert Judgment and High Level Nuclear Waste Management*, 10 Policy Studies Rev. 114 (1992).

⁴ Among the naïve positivist's epistemic commitments is the belief in a sharp distinction between fact and value. Values, if they have any role to play in risk assessment via expert judgment, do so in the "context of discovery." Hans Reichenbach, *Experience and Prediction* 6-7 (1938). This context remains external to the actual method of expert elicitation, its normative analyses and its reliance on decision-theoretic procedures. Naïve positivists believe that the value-neutrality of the context of justification (method) insures that objectivity in risk assessment is maintained. For the last four decades, this epistemological stance has been challenged. Critics, within and without positivism, have asserted the epistemic impossibility of maintaining such a simplistic fact/value distinction.

⁵ They assert that, while there is a chance that conclusions based on expert judgment may be true about the world, it is not a good idea to say so because there is no justification in the method that allows this.

The Department of Energy Guidelines

On May 22, 1995, the DOE circulated its "Principles and Guidelines for Formal Use of Expert Judgment by the Yucca Mountain Site Characterization Project."⁶ This document was created in response to the recommendations made by the Nuclear Waste Technical Review Board, a Congressionally constituted oversight body, in its "10th Report to the U.S. Congress and the Secretary of Energy."⁷ Earlier the NRC recommended that the DOE "state criteria for the formal use of expert judgment to assure that objective, quantitative analyses based on empirical data are used in preference to expert elicitation wherever possible."⁸ The NRC's concern over DOE use of expert judgment is articulated in a steady stream of documents. The major theme of such concern focuses on over-reliance of the method when "objective" data could be gathered, and on failure to address the potential for bias and conflict of interest by relying almost entirely on internal expertise.

Hence, *Principles and Guidelines* is intended to be read as representing the Office of Civilian Radioactive Waste Management's position on when the formal application of expert judgment is appropriately used in the Yucca Mountain Project. In fact, it tends to read as a philosophical view of expertise and its role in the decision-making process of determining suitability. Relatively little mention is made of the actual methodology of expert elicitation. Although it was not intended to serve as a management plan or a procedure for application of the methodology, it has functioned significantly and recently as a guide for expert elicitation. Several things are noteworthy about this document that help in the analysis of the DOE's views on the role of values in risk assessment.

⁶ See Office of Civilian Radioactive Waste Management — Yucca Mountain Site Characterization Office, *U.S. DOE Principles and Guidelines for Formal Use of Expert Judgment by the Yucca Mountain Site Characterization Project* (1995) [hereinafter *Principles & Guidelines*].

⁷ See U.S. Nuclear Waste Technical Review Board, *Report to the U.S. Congress and the Secretary of Energy* (1994).

⁸ U.S. Nuclear Regulatory Commission, *NRC Staff Site Characterization Analysis of the Department of Energy's Site Characterization Plan, Yucca Mountain Site, Nevada*, at 4-10 (NUREG-1347, 1989).

- *Expert judgment is implicit and explicit*

“The choice is not whether to use expert judgment, but rather how to use it: is the use implicit or explicit; is the application informal or formal ...”⁹ This question-statement conveys the DOE’s recognition of the pervasive and often implicit and informal role of judgment (presumably expert, if used in reference to technical matters) throughout the site characterization process. So, the question of “how to use” expert judgment is really a decision of whether to use a formal, well-documented, explicit form of expert judgment, such as expert elicitation or peer review. Moreover, expert judgment broadly denotes a method for the interpretation of data. The DOE document states that data must always be interpreted in light of judgment-based models. Interpretation of data in a consistent framework, with adequate treatment of assumptions and uncertainties, creates the technical basis required to aid management decision-making.

- *Expert judgment is incomplete*

“Perceptions regarding the relationship between the results of a decision-aiding process (*sic* expert judgment) and the decision itself can be viewed by decision-makers as inappropriately limiting their discretion to consider *other information or values* in reaching a decision.”¹⁰ This statement is meant to clarify the DOE belief that management must not be confined to a deduction from the results of expert judgment. The risk assessments provided in expert judgment elicitations are technical in nature and do not exhaust all the elements taken up in decisions related to regulatory compliance or programmatic issues. This is consistent with the DOE’s earlier finding that it has not “been able to determine the framework for a predetermined method that would be sufficiently complete to eliminate the exercise of judgment on the part of Federal officials who will make these decisions.”¹¹

⁹ *Principles & Guidelines*, *supra* note 6, at 1.

¹⁰ *Id.* at 5 (emphasis added).

¹¹ Nuclear Waste Policy Act of 1982, 10 C.F.R. Part 960; General Guidelines for the Recommendation of Sites for the Nuclear Waste Repositories, 49 Fed. Reg. 47,727 (1984).

- *Expert judgment does not extend to value judgments*

"The Project has no plans to make use of formal methods for dealing with the value judgments made by the DOE's managers in the decision-making process."¹² This method, it is claimed, cannot be expected to address the non-technical aspects of management decision.

- *No absolute standard of no prior involvement in DOE-sponsored work*

"It is not practical for ... selection as an external expert for an elicitation to be predicated on an absolute standard of no prior involvement in, or review of, DOE-sponsored work."¹³ The emphasis, instead, should be placed on the diversity of technical disciplines and views that can be acquired of well-qualified experts. To get that diversity, DOE personnel may be required to participate in expert elicitation sessions.

The DOE's view about the role of values in risk assessment as performed by experts emerges from the claims above. If that picture were purely positivistic in character, the DOE document would be less prone to admit both the pervasiveness of judgment throughout the characterization process and the necessity for interpretation of the data. Strict, naïve positivists tend to be blind to the underdetermination of a hypothesis by the data. This underdetermination has motivated the discussion in science on the epistemological function of interpretation in resolving model/hypothesis confirmation.

In its claim that expert judgment is incomplete, the DOE appears to understand the distinction between risk assessment and risk acceptance. True, regulatory decisions will be based on other factors as well as expert judgment, such as programmatic risk, cost, and scheduling. It is clear to the DOE that these latter factors all involve value judgments. And, insofar as risk assessment is characterized by expert judgment method, values play no intrinsic role in that method. The post-positivist (and even some less naïve positivists) would find this unacceptable. Risk assessment appeals to values in ways that risk acceptance does not. It is not devoid of values.

¹² *Principles & Guidelines*, *supra* note 6, at 1.

¹³ *Id.* at 8.

The claim that expert judgment does not extend to value judgment expresses the concomitant epistemological belief that objectivity is not possible in the making of value judgments. This is inferred from the alignment of objectivity with expert judgment. This reinforces the objective-subjective distinction sedimented in the view that values concern the less technical and indeed non-objective aspects of decision-making. This distinction sets up the problem of rationality in final decision-making in the political arena. Only the results of expert judgment are capable of objectivity. All hell breaks loose when we come to the political arena. Objectivity and its partner, rationality, will prevail only if we let science decide. And, as the DOE claims, science cannot be the final arbiter. This distinction fertilizes the notion that political consensus can only be based in political will, devoid of rationality.

The DOE recognizes that its expert elicitation might be charged with bias because so much DOE work has used internal (i.e., DOE and DOE subcontractors) expertise. A concern with bias is firmly rooted in a positivistic epistemology and is one of the mortal sins of the objective method. Post-positivists are also concerned with bias and take pains to distinguish egregious acts of self-vested risk assessments from necessarily value-laden ones. Bias is put at the extreme end of a spectrum no risk assessor can escape. So, a preoccupation with bias can function as a red herring, throwing one's attention away from epistemic valuation assumed by the methodologies of decision theory.

Interestingly, the DOE is almost post-positivist in its view of the potential for bias. The agency does not apologize for its involvement in expert elicitation *qua* subject-matter experts (an NRC term). It wants a diversity of views represented in an expert elicitation. This reads as though the representation of an agency voice in expert elicitation is threatened by over-emphasis on bias and conflict of interest. The document suggests that, because of the unique character of site characterization of a geologic repository, a DOE perspective *qua* subject-matter expertise is a *sine qua non* for a successful expert elicitation process. Curiously, wrapping this position in a concern to elicit a diversity of views opens the door for an understanding of rationality in choice consistent with post-positivist views of objectivity as a basis for that rationality. These views of objectivity stress the

representation and ultimate balancing of various scientific views in the form of intersubjective agreement.

The Nuclear Regulatory Guidelines

The body of the Branch Technical Position (BTP) provides needed treatment of expert elicitation.¹⁴ It outlines and discusses nine steps as components of an acceptable expert elicitation process. While much of the process the NRC describes is found in the earlier versions of expert election manuals and documents I reviewed in 1992, the tone of the current report is quite different. Recognition of the potential for circularity, bias, and the confusion of subjective belief with objective data, present in the earlier guidelines, are all present in the BTP but without the apologetics found in the earlier documents.

- *Circularity in expert elicitation*

The concern for overlapping roles found in the earlier literature is expressed almost as a necessity in the BTP. Defining the objective of the elicitation would ideally occur before the selection of experts. But, NRC staff say that it is not necessary that the individual steps be performed in the exact sequence they present. Subject matter experts can help to better define the objective of the elicitation as well as aid in the identification of additional information that could facilitate the elicitation.

- *The presence of bias in expert elicitation*

The BTP reflects the NRC staff's keen awareness of the potential for conflict of interest and the charge of bias resulting from both this and other factors in the inquiry process that might be identified as bias. The emphasis this report places on concern for DOE conflict of interest is remarkable and represents a departure from the earlier guidelines. Those guidelines, perhaps because they are not specific to any agency application of expert elicitation, fail to take seriously the conflicts that can result. A project's need to turn to internal experts may reflect the limited number of experts available to deal with uncertainties and the fact that those experts are already employed by or on sub-contract with the expert elicitation sponsor. The BTP points this out as an example of

¹⁴ See generally BTP, *supra* note 1.

potential conflict of interest and bias: “DOE has been criticized for relying almost entirely on its own scientific experts and contractors, with little or no external peer review.”¹⁵

It is the credibility of the expert judgments that are at stake because of the “institutional influences, financial or professional gain, or promotion of a social or political agenda.”¹⁶ To offset this potential encumbrance the NRC staff recommends a balance in choice of experts and the disclosures of possible conflicts. In this report, it does not recommend abandoning the use of DOE staff or contractor staff. It assumes that any perceived or real conflict need not influence professional judgments.

Additionally, the BTP report mentions “flexibility of thought and the ability to objectively consider evidence that challenges conventional wisdom” as a value in expert elicitation.¹⁷ Diversity of scholarly approaches, thereby avoiding “expert dependence” should also be encouraged. The reliance on cognitive psychology in distinguishing type of bias and in providing de-biasing techniques is fully integrated as central to obtaining objective expert elicitation.

- *Transparency as an antidote to subjective belief*

The NRC recognizes that the nature of inferences drawn from expert elicitation sessions are inferences from beliefs, not from traditional data collection. This Commission is motivated, in part, by concern for over-reliance on expert judgment when modes that are more traditional could be used. But among the conditions that give rise to expert elicitation is the phenomenon of underdetermination of hypothesis by evidence. “More than one conceptual model can explain, and be consistent with, the available data.”¹⁸ This difficulty, articulated throughout philosophy of science literature, has spawned treatises on a spectrum of views about the epistemological prospects for objectivity and truth in science. This literature falls under the rubric of scientific realism versus anti-realism and even the hermeneutical character of

¹⁵ *Id.* at 2.

¹⁶ *Id.* at 24.

¹⁷ *Id.*

¹⁸ *Id.* at 15.

hypothesis confirmation.

The NRC (in the BTP) does not decide on this epistemological issue. In not doing so, it makes no commitments to both a scientific realism and a super-realism found in earlier federal guidelines. Instead, it moves to offset the subjectivity of expert judgment methodology by a demand for transparency. Such a demand is met through proper documentation of reasoning, definitions, assumptions, calculations, public or restricted literature used, and the processing of expert judgments by such techniques as smoothing, interpolation, extrapolation, or aggregation of the judgments of different experts.¹⁹

Such a strong demand for transparency is motivated by the need for credibility and acceptability of DOE-sponsored work. The controversial character of site characterization and subsequent licensing of a geologic repository for the storage of high-level nuclear waste may be ameliorated by such transparency. Bias will be revealed, but a number of other benefits accrue to careful documentation. Not least among these is the capacity to engage in "technical discussions in terms of underlying principles rather than just the individual outcomes."²⁰

Three of the issues that I discussed in 1992 as perceived problems with the expert judgment method by its practitioners are not treated by the NRC in 1996 as obstacles which bar the use of the methodology. To some extent the NRC treatment of expert judgment appears rooted in a more sophisticated epistemological commitment than that of naïve positivism. Its recognition of circularity and interest in transparency suggests an understanding that risk assessment, via expert elicitation, is firmly rooted in a context of epistemic assumptions. Public policy decisions built on recognition of such assumptions is a departure from a naïve positivistic view that treats science as presuppositionless. However, how deep NRC sophistication goes is difficult to determine. The lengthy discussion of bias, while refreshing in its appearance and tone, can function not simply as a red herring but more like a beached whale in the way it may deflect attention away from the value-ladenness of

¹⁹ *Id.* at 18.

²⁰ *Id.* at 30.

expert elicitation method. On the other hand, the NRC's desire, in this report, to effect transparency suggests it is aware that values play a role in the assumptions on which expertise is built. I would prefer to think that the NRC is not hunting and beaching whales. More on this below.

The Role of Values in Expert Judgment Elicitation

The philosopher of science, Helen Longino, adopts a helpful distinction we can use in diagnosing the presence of values in the expert elicitation method.²¹ She delineates values as *contextual* and *constitutive*. She suggests that the two types of values may be related to each other.

Contextual values are defined by her as "personal, social, and cultural values, those group and individual preferences about what ought to be done."²² For example, we live in a culture that values commodification and commercialization. We believe, along with John Locke, that we can convert material with labor into a result over which proprietary interests are asserted. This is only one example of a contextual value. Experts are persons rooted, simultaneously and separately, in different contexts, ranging from the larger commercial culture, the nuclear energy practitioner world, and the ivy towers of academe, or the world of justice advocacy. They stand in some relation to the values of these contexts in their implicit or explicit adoption or rejection of the values of these contexts. As such, they are valuing beings. When it comes to risk assessment via expert judgment, the naïve positivist would have us believe that contextual values may play a harmless role in the determination of objectives of an expert elicitation.

Constitutive values are those generated from an understanding of the goals of science, such as truth, accuracy, simplicity, predictability and breadth. A naïve positivist would see no legitimate role for values in the elicitation method itself. Hence, he or she would tend to label constitutive values as principles that govern one's inquiry or assumptions associated with one's judgment. The post-positivist (and even the less naïve positivist) would argue that, whether they are labeled as such, expert judgment method and expert elicitation in particular are

²¹ See Helen Longino, *Science as Social Knowledge: Values and Objectivity in Scientific Inquiry* (1990).

²² *Id.* at 4.

governed by many of these constitutive values, and in precise ways. Of course, the interesting and important question is in what sense do social and moral values shape scientific inquiry such that we see them appear in more or less disguised form as constitutive values?

The choice to turn to expert elicitation as an acceptable methodology for risk assessment in the site-characterization of a geologic repository is itself a value statement. This choice asserts, first, that uncertainty that might bar a nation from moving forward with such a program is normatively trumped by necessity. Second, this choice asserts that such uncertainty is justifiably overridden by a pragmatism reflected in the perceived success of the method in siting nuclear plant facilities. I may be explicitly stating an obvious normative position.

The recognition of circularity in the elicitation procedures, described above as overlapping of roles, belies a belief that good public policy must be based on virtuous circularity. While circularity is itself not normally considered a value, what lies behind it is a willingness to risk a charge of bias in favor of predictability. Building in caveats when describing expert elicitations, the NRC recognizes that conflict of interest and bias may threaten such predictability. Acknowledgement of such can be interpreted as a positivistic stance, as noted above. Objectivity of the expert judgment methodology is preserved insofar as this bias and conflict of interest are controlled by measures available from cognitive psychology — measures that function much in the same way that measures to insure reliability and validity of results do in traditional empirical work. But the NRC staff hints that some of this bias may not be controllable or detectable. NRC's combined recommendation for balance in expertise and transparency of process, as well as results, evidences a more post-positivist epistemological view. That view does not shy away from the presence of values. It admits them as integral to the knowing process and recognizes that objectivity of truth is better understood as intersubjective agreement, ideally among a community of equally empowered inquirers.

It is a short step from here to a fuller awareness of the role of values internal to the expert judgment method. It is hard to say, from the BTP alone, whether NRC staff are intentionally more sophisticated

than they articulate, have just stumbled into making statements that reflect such epistemic attitudes, or are pressed by force of circumstances, i.e., political difficulties in moving nuclear waste disposal forward, to admit the large role values play in expert judgment. A multi-text analysis may tell the tale.

One final example illustrates my point. In its "Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts," the Senior Seismic Hazard Analysis Committee (SSHAC), chaired by R. J. Budnitz, seeks to provide an up-to-date Probabilistic Seismic Hazard Analysis (PSHA) methodology to guide the analyst both technically and procedurally.²³ This report reads as a set of guidelines for expert elicitation specific to seismic hazard analysis. It is not as generic as the DOE or NRC guidelines described above. One important result from their study is that differences in PSHAs (e.g., earlier analyses performed by Lawrence Livermore National Laboratory (LLNL) and Electric Power Research Institute (EPRI)) were not technical but are due to the information gathering and assembly process used in the study.²⁴ Past PSHAs met the challenge of incorporating the diversity of expert judgments into an analytical result with different procedures. Regularizing or introducing more uniformity into the analyses of disparate judgments can result in less difference.

One suggestion advanced by the PSHA in its Technical Facilitator Integration (TFI) method is to downweight outlier judgments. An outlier, as defined by the NRC in their BTP, "refers to those opinions which lie apart from the views or expected (average) views of other experts."²⁵ Since consensus is one of the goals of expert judgment method, the SSHAC felt the need to define consensus and to do so in a way that permits this downweighting. Four possible meanings of "consensus" are considered, ranging from belief in *the same deterministic model* or value for a variable, belief in *the same probability distribution*, agreement that a particular composite probability distribution *represents the group of experts*, to agreement

²³ See Senior Seismic Hazard Analysis Committee, *Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts* (NUREG/CR-6372; UCRL-ID-122160, April, 1997) [hereinafter PSHA].

²⁴ See *id.* at xi.

²⁵ See BTP, *supra* note 1.

that a particular composite probability distribution *represents the overall scientific community*.²⁶ The SSHAC accepts the latter definition of consensus as the easiest one to use. Hence, consensus in the ordinary understanding of the expression is not likely to result from PSHA. This is supported by the belief that no single interpretation concerning a complex earth-sciences issue is a “correct” one (hints of anti-realism). So, while the legitimate range of technically supportable interpretations must be represented, they should also be assigned relative importance or credibility by the technical integrator.

It is the technical integrator who will downweight a persistent outlier interpretation. The sponsors of this report argue that “this is preferable to the stiff adherence to an equal weighting scheme, which can result in the final seismic hazard being driven by a single outlier input.” Downweighting the outlier in past expert elicitations has created a logical trap, diminishing the expertise of someone *a priori* judged to be an expert. Now, justification of downweighting comes from the type of consensus sought. “The perspective of developing a composite representation of the overall community of scientists affords a way out of the logical trap.... To represent the overall community, if we wish to treat the outlier’s opinion as equally credible to the other panelists, we might properly assign a weight (in a panel of 5 experts) of 1/100 to his or her position, not 1/5.”²⁷

Here we see epistemic values at work. On one hand, credibility is defined as a function of relative distance from consensus. Outlier views are not completely discredited. Rather, one’s expertise is assigned a credibility quotient in relation to its nearness to the agreement of other experts. That agreement is assumed to represent the overall community of scientists. Hence, novel or anomalous knowledge is overridden by other values at work: epistemic democracy, ease, and simplicity.

The NRC is one of the sponsors of this report. Yet, in the BTP the NRC asks for transparency in the aggregation process that “will render these judgments including disparate views or outliers” useful for subsequent analyses. The NRC requires that aggregation techniques be accompanied by rationale as well as documentation “sufficient to trace the impact of the individual expert’s judgment on the consolidated

²⁶ See PSHA, *supra* note 23, at 36.

²⁷ *Id.*

judgment and show what effect, if any, the disparate views would have on design and/or performance.”²⁸ The downweighting of the outlier’s views, at least by the Technical Integrator in an expert elicitation, seems irrelevant to the NRC. Insofar as the Commission considers an outlier’s view in its examination of reports based on expert judgment, that potentially equalizes the weight of that view. This departs from the epistemic or constitutive value of downweighting suggested by the SSHAC.

These epistemic differences must be understood as value differences. To view them merely as principles or assumptions is to rob them of their full normative impact and to disable one from connecting the adoption of certain epistemic or constitutive values with contextual values. To admit that the expert *qua* expert makes value judgments is to, at least, move away from the naïve positivism of earlier guidelines. The positivist, Richard S. Rudner, legitimized this move in 1962 with his famous essay “The Scientist Qua Scientist Makes Value Judgments.”²⁹ Post-positivism goes farther. It connects constitutive and contextual values and, in some cases, chooses anti-realism as the preferable epistemological view.

One may not want to, or need to, decide on what may appear to be arcane philosophical issues, in grappling with the role of values in risk assessments relevant to site characterization for a high-level nuclear waste repository. However, introducing the rhetoric of valorization into the expert judgment method further enables even greater transparency in the acceptance of risk assessments based on expert judgment. Transparency does not replace rationality but it is one of its conditions. Bringing to light the variety of values and the way they are used will help us to gauge whether rationality, defined as value-based decision-making resulting from intersubjective agreement among a community of equally empowered (if not weighted) inquirers, has a future in nuclear waste disposal, in its risk assessments, and in the expert elicitation which will often underlie such assessments.



²⁸ See BTP, *supra* note 1.

²⁹ See Richard Rudner, *The Scientist Qua Scientist Makes Value Judgments* 492-98, in *Introductory Readings in the Philosophy of Science* (E. D. Klemke et al. eds., 3d ed. 1998).