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August 26, 1994

Mr. Robert Bills
U.S. Department of Energy
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Dear Mr. Bills:

We received the DOE position paper on performance assessment methodology on August 17. Within the time available before the August 30-31 meeting we have prepared the following brief comments.

Although much of the material in the position papers seems to be drawn from the 1992 performance assessment reports, and is therefore familiar, our office does not have expertise in the discipline of probabilistic risk assessment and is not in a position to analyze the paper at the level required by the subject. We can point out the following:

1. A key issue in the WIPP PA is the treatment of uncertainty. The position paper states only that DOE will deal with uncertainty by generating only the mean CCDF (p. 10). Such an action does not adequately address the issue of uncertainty in public safety decisions. An instructive treatment is contained in Paté-Cornell, Risk Analysis and Relevance of Uncertainties in Nuclear Safety Decisions, in Public Regulation, New Perspectives on Institutions and Policies (MIT Press 1987). Briefly, Paté-Cornell argues for full disclosure of the extent and nature of analytical ("subjective") uncertainty as well as observational ("stochastic") uncertainty and a deliberate choice of a high level of certainty in public safety decisions. First, disclosure is required for the following reasons:

(a) A regulatory decision is a collective judgment among the regulator, the regulated entity, and affected parties, and various participants will have different levels of confidence in various data sources and uncertainty ranges. The range of uncertainty must be expressed to permit a public dialogue leading to a decision.

(b) To display uncertainty makes clear the possibility

of reducing the uncertainty by investment in research.

(c) In certain instances, whether the regulatory probability limit is met may depend in a nonlinear way upon a frequency (e.g., intrusion) that depends on uncertain parameters, thus calling for reduction of such uncertainty.

(d) Public confidence in a regulatory decision depends on the degree of uncertainty of risk assessments.

Further, Paté-Cornell explains, in determining regulatory compliance, there is no theoretical justification for use of the mean, median, or any other element of a distribution:

> "The probability distribution of the future frequency of the system's failure is generated by parameter and/or model uncertainties. There is no theoretical framework to justify the use of the mean, the median, or other characteristics of this distribution (fractiles, moments, etc.) to show compliance with any of the probabilistic constraints (risk and plant performance)." (at 247).

Thus, it is erroneous to select the mean or the median and to exclude other elements of the distribution from having effect on the decision.

Paté-Cornell explains that, to ensure that the regulatory limitations of probability and consequence have been met with "reasonable certainty", uncertainties must be explicitly set forth and the judgment of compliance must be made on the basis of a high probability, such as 0.95:

> "Once this analysis has been done, safety decisions must be made to ensure that with a high probability (e.g., 0.95) the plant is in compliance with the maximum acceptable individual risk constraints and with the maximum allowable frequency of failure." (at 249).

The public safety decision is different from an economic assessment made when allocating limited funds; such assessment should be governed by mean values (at 250). But when a safety constraint set forth as a maximum probability and consequence is the goal, assurance at the level of 95% is appropriate:

> "If the goal is to verify that a probabilistic threshold (e.g., individual mortality frequency) is not exceeded, it is reasonable to require that this constraint be satisfied with a probability to be specified (e.g., 0.95). One needs to consider then the probability distribution on the frequency estimates in order to

reflect analytical uncertainties." (at 250).

Thus, DOE's proposed methodology, which does not set forth the distribution of CCDF's which represents subjective uncertainty, and which selects the mean as decisive, is erroneous.

2. The paper does not present any methodology for dealing with conceptual model uncertainty. It is not sufficient to state that conceptual model uncertainty has previously been dealt with by running ceteris paribus analyses (p. 10), since the target of PA is to express risk, which such analyses do not do. Further, some conceptual model uncertainties have been dealt with in other ways (e.g., relative permeability and capillary pressure; see 1991 PA vol. 4, at 5-9).

PA requires a valid structure for displaying risk, including uncertainty as to risk -- thus including conceptual model uncertainty. It must be recognized that uncertainty in conceptual models does not imply a parameter that varies in linear fashion. Further, it may be difficult to justify the assignment of probability estimates to different conceptual models or to generate a probability distribution function. However, it remains DOE's responsibility to develop a coherent and structured approach to incorporation of conceptual model uncertainty into PA.

3. The paper contains references (pp. 5, 16-17) to the related problems of aggregation, resolution, and computational efficiency. However, to state that these issues exist and are related does not quantify them and resolve the issues. These discussions are lacking.

4. Discussing the conceptual basis for scenario development, the paper indicates (p. 11) that certain scenarios are excluded from consideration by regulatory directive, referring to what is now Appendix C. Appendix C is expressly nonbinding, and DOE does not regard itself as bound by certain other aspects of Appendix C, such as the assumption that the likelihood of drilling should be taken to be 30 boreholes per square kilometer per 10,000 years.

DOE should incorporate the category of scenarios termed regulatory exclusions into its risk analysis. Incorporation of the previously excluded category will mean that intrusion probabilities will need to be estimated for future human actions such as resource development, mining, archeological investigation and the like, which have previously been left out of PA.

Similarly, any separate treatment of so-called low-probability high consequence scenarios must be questioned. The source of this exclusion is in Appendix C, whose status is at best uncertain. As the paper (p. 13) notes, it is possible to exclude

any category of events by narrowing scenario definitions.

5. Much of the discussion in the position paper is conclusory and qualitative. In describing the scenario development process, for example, it is said that the first step involves "compiling or adopting a 'comprehensive' list of events and processes that potentially could affect the disposal system." (p. 15). It is difficult to argue with this objective. However, to state the objective is not to describe a methodology. The paper continues, noting that the "determination of both scenarios and scenario probabilities is a complex process with significant uncertainties," and it refers the reader to Hora et al. (1991), the documentation of the expert panels on human intrusion, which has been criticized on numerous grounds. (See our comments on the 1992 PA, April 8, 1994, at 11-13). It is difficult to determine whether DOE is seeking comment on the position paper, which is a summary of PA methods, or on the cited works which report on the application of such methods. If DOE is calling for response to the application rather than the method, we refer it to our previously-cited comments.

6. Similarly, the discussion of the calculation of scenario consequences contains a general discussion of method and refers broadly to the lengthy documentation of the application of that method. It is unclear on what materials DOE is seeking comment (particularly when DOE suggests that comments may include "ideas and justifications for variations in our technical assumptions regarding modeling parameters"). In any case, we will reserve our comments on specific parameters for the meetings which concern those technical issues.

7. The description of the method of selection of variable parameters and determination of their ranges and distributions is inadequate. Indeed, the paper does not describe a method at all. The paper merely states that "information about the ranges and distributions of possible values is drawn from a variety of sources" and that the "review process that leads from the available data to the construction of the cumulative distribution functions ... is unavoidably subjective, and involves some judgment of the investigators and performance assessment analysts." (at 21). This is not a description of a scientific process; this language would describe random selection. Further, there is no discussion at all of how particular parameters were selected as variables.

8. The descriptions of the generation of samples and propagation of samples through the analysis are likewise very general and refer broadly to much more detailed discussions of the performance assessment. What would be more appropriate in a position paper, for example, is a theoretical discussion of the method which led to the decision that a sample size of 70 is

correct for a model with 49 variables and similar decisions.

9. There is no discussion of the method for identifying correlated variables and dealing with the correlations in sampling and other stages.

10. The paper contains no reference to the State-DOE agreements as they affect performance assessment and compliance demonstration. DOE should state whether it intends to comply with the State-DOE Consultation and Cooperation Agreement and the Working Agreement, as they have been amended over time. Specifically, DOE should make reference to the Working Agreement provision which requires DOE to consult with the State in selecting radionuclide retardation factors and to select "a range of values to be conservative, but reasonable, based on the lowest reasonable values experimentally obtained." (1988 Modif. to Working Agreement, at 9).

11. It is not clear why the paper contains a discussion (albeit brief) of uncertainty analysis, sensitivity analysis, and systems prioritization (pp. 23-27). There is as yet no method to connect these exercises to a demonstration of compliance.

We appreciate your consideration of these comments.

Very truly yours,

Lindsay A. Lovejoy, Jr.

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