

January 19, 2011

MEMORANDUM TO: Chairman Jaczko  
Commissioner Svinicki  
Commissioner Magwood  
Commissioner Ostendorff

FROM: Commissioner Apostolakis /RA/

SUBJECT: UTILIZATION OF EXPERT JUDGMENT IN REGULATORY  
DECISION MAKING

## 1. Objective

To ensure that the formal utilization of expert judgment incorporates lessons learned from past major studies and is applied consistently in regulatory decision making throughout the Agency.

## 2. Background

The formal utilization of expert judgment is a process that provides either (1) quantitative estimates for the frequency and/or significance of physical phenomena, or (2) qualitative insights into the nature, scope, and/or significance of physical phenomena. Expert judgment is used when the following conditions are present: the available data or operating experience is sparse or not applicable, the subject is too complex to model accurately, and the phenomena or issues have significant safety or regulatory implications.

Expert judgment has been a principal component of the technical basis for many important regulatory decisions and its use is expected to be more prevalent in the future as issues become more complex and as technology evolves. For example,

- i. The landmark NUREG-1150<sup>1</sup> study utilized expert judgment to assess failure frequencies, failure modes, recovery actions, accident progression, and source term behavior, among other phenomena to characterize the risk associated with severe accidents in operating reactors.
- ii. Expert judgment is used for probabilistic seismic hazard assessment (PSHA) for siting and design of nuclear facilities. Due to large uncertainties in the geoscience data and in their modeling, multiple model interpretations are often possible. This has led to expert disagreement on the selection of ground motion for design at a given site. The Senior Seismic Hazard Analysis Committee (SSHAC)<sup>2</sup> concluded that the differences in PSHA results were due to procedural rather than technical differences and proposed a formal method for utilizing expert judgment in PSHA.

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<sup>1</sup> "Severe Accident Risks: An Assessment of Five Nuclear Power Plants, Final Summary Report," NUREG-1150, Vol. 1, 1990.

<sup>2</sup> "Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts," NUREG/CR-6372, 1997.

- iii. Expert judgment has been required to assess the performance of a high-level waste repository. Specifically, it is used to predict future climates, characterize waste degradation and transport if the waste package is breached, and to perform the volcanic hazard analysis.
- iv. All analyses of human reliability performance rely on expert judgment.
- v. More recently, expert judgment has been used to estimate loss-of-coolant-accident (LOCA) frequencies. These frequencies provided the basis for selecting the transition break size (TBS) proposed in the risk-informed revision of the emergency core cooling system (ECCS) acceptance criteria (10 CFR 50.46a).
- vi. Informal expert judgment is used to determine safety and security requirements for commercial and medical uses of radioactive materials.
- vii. The Phenomena Identification and Ranking Table (PIRT) process is another specific application of the formal utilization of expert judgment. Examples include:
  - a) identifying the technical issues associated with advanced reactor licensing;
  - b) understanding ECCS performance under LOCA scenarios (i.e., in GSI-191). Specifically, PIRTs were used to investigate containment coating performance, evaluate debris transport in wet and dry containments, and to identify outstanding chemical effect issues.

### 3. Motivation

There are many similarities but also significant differences in the approaches used in the above studies that can impact regulatory decision making. For example, the SSHAC approach introduces the concept of a technical facilitator/integrator (TFI) to develop the final aggregated results, but this approach may not be appropriate in all cases. For example, the LOCA frequency study did not utilize a TFI.

A unique feature of the LOCA frequency study was the adjustment of results to account for the well-known overconfidence that is typically present in individual expert judgments. The study also recommended a less-common scheme for aggregating the individual expert results into group estimates. Sensitivity studies indicated that the selection of the aggregation scheme affected the results significantly. When the recommended, but less-common, aggregation scheme is used, the TBS for a pressurized water reactor is approximately 6" while aggregating using more-common methods leads to a TBS of approximately 11"<sup>3</sup>. Selecting and documenting the appropriateness of the methods of analysis ahead of the regulatory decision should increase transparency, public confidence, and the objectivity of the results.

It is anticipated that formal use of the expert judgment process could play an important role in the resolution of difficult regulatory challenges including cyber security, digital instrumentation and control, small modular reactors, and material aging issues. The NRC would benefit from formal guidance to assist the staff in choosing the method for obtaining and utilizing expert judgment to avoid the pitfalls of the past and ensure the appropriate level of effort. The extensive elicitation used to develop the LOCA frequency estimates will not be

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<sup>3</sup> A subtle yet important point is that the choice of aggregation scheme does not, in and of itself, lead to a TBS of either 6" or 11". Rather, these sizes correspond to the frequency of  $10^{-5}$  /yr that was cited in the Commission's SRM. There are more considerations that went into the TBS, e.g., the inclusion of margin to account for uncertainties.

appropriate for all cases. In some cases, it may only require consultation with several subject matter experts.

#### 4. Recommendation

I recommend that the Commission direct the staff to provide, within 6 months, a plan for the development of guidance that will ensure that the formal utilization of expert judgment is applied consistently in regulatory decision making throughout the Agency. This plan should describe the staff's approach, schedule, and estimated resources. This plan should recognize the development of the guidance should include the following:

- i. a summary of past and ongoing significant NRC activities that utilized expert judgment to identify the lessons-learned, document the approaches<sup>4</sup>, and identify significant differences among the approaches,
- ii. a survey of recent research to identify promising new approaches (or techniques that can be applied within the broader approach) to expert judgment that may be appropriate for use in nuclear applications,
- iii. an evaluation of recent activities within other agencies that relied on expert judgment to identify the lessons-learned, document the approaches, and identify differences among the approaches and those used in NRC activities,
- iv. options that match the approach with the nature and significance of the issue and the extent to which expert judgment is relied upon in regulatory decision making,
- v. estimates of resources associated with each option for planning purposes,
- vi. guidance that is prescriptive enough to ensure consistent application of expert judgment within the Agency, yet is sufficiently flexible to account for the wide diversity of issues that the Agency faces. The user should be able to tailor the approach to be applicable to the unique issue of concern, and
- vii. the possibility of developing national standards.

#### 5. Benefits

This effort will promote a more consistent and transparent basis for regulatory decision making when expert judgment is required. It will also provide clear and consistent guidance to licensees and staff for both formally utilizing expert judgment and for reviewing licensing actions that are based, at least in part, on expert judgment. Finally, it is anticipated that this effort will improve the efficiency of Agency planning by identifying and prioritizing resources that are commensurate with the significance of the safety or security issue(s) and degree of reliance on expert judgment in the associated regulatory decision making.

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cc: SECY  
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<sup>4</sup> The expert judgment approach refers to the process used to elicit information from experts, analyze this information to develop results, and determine the implications of the results to support regulatory decision making.