

June 8, 2012

MEMORANDUM TO: Chairman Jaczko  
Commissioner Svinicki  
Commissioner Apostolakis  
Commissioner Magwood  
Commissioner Ostendorff

FROM: Brian W. Sheron, Director *(/RA/ Jennifer L. Uhle for)*  
Office of Nuclear Regulatory Research

SUBJECT: RESPONSE TO SRM-SECY-11-0172: RESPONSE TO SRM  
COMGEA-11-0001, "UTILIZATION OF EXPERT JUDGMENT IN  
REGULATORY DECISION MAKING"

The purpose of this memorandum is to inform the Commission of the staff's revised plan for the development of a guidance document to promote the consistent use of expert judgment in regulatory decision making.

Staff Requirements Memo (SRM) COMGEA 11-001, "Utilization of Expert Judgment in Regulatory Decision Making," requested staff to develop a guidance document that would promote the consistent use of expert judgment in regulatory decision making in the agency. SRM-SECY-11-0172 directed staff to (1) develop draft guidance, (2) pilot the draft guidance in the Level-3 probabilistic risk assessment (PRA) project in such areas as human reliability analysis (HRA) and severe accident analysis, and (3) refine the draft into a final report. The Commission further directed staff to inform the Commission on how piloting the guidance has been integrated into a revised plan, schedule, and resource estimate. The Commission expects the staff to complete final guidance within 18 months after the pilot.

In responding to the SRMs, the Office of Nuclear Regulatory Research (RES) initiated the project "Guidance for Expert Judgment," and assigned responsibility to the Division of Risk Analysis, Human Factors and Reliability Branch. RES staff has conducted a preliminary assessment of the U.S. Nuclear Regulatory Commission's (NRC's) applications of expert judgment, the current literature, and other agencies' guidance in expert judgment (a brief bibliography of the key documents is attached). The staff also worked with the Level 3 PRA project team to identify areas that may require the use of expert judgment (e.g., multi-unit risk, spent fuel pool PRA, low power and shutdown PRA/HRA, and Level 2 PRA containment analysis) and developed a plan for piloting the draft expert judgment guidance in the Level 3 PRA project. In addition, the staff coordinated with the new HRA method development team (per SRM-M061020) to ensure that the utilization of expert judgment in the new method would conform to the draft expert judgment guidance. This memo briefly describes staff's analysis of the project and the revised plan, as it has been integrated with the Level 3 PRA project.

CONTACT: Jing Xing, RES/DRA  
301-251-7580

***Project goal and requirements***

The goal of the project is to develop a guidance document to ensure that the agency performs formal expert elicitation, when appropriate, in support of NRC's regulatory decision making. The staff identified the following basic requirements to achieve that goal:

1. The guidance should address different types of expert judgment utilization in the NRC (e.g., eliciting experts' judgment of a topic vs. eliciting probabilities of a given event).
2. The guidance should improve the consistency of expert judgment utilization by providing a general process with basic principles along with detailed guidelines for selecting different methods treating specific technical aspects of the process.
3. To strengthen the NRC's existing practice, the new guidance should incorporate useful information from the NRC's existing guidance documents, new information from the literature, and state-of-art practices from other organizations.
4. The guidance should be piloted in selected areas of the Level 3 PRA project and refined by incorporating the lessons learned through piloting.

***Existing practice and needs summary***

1. NRC's use of expert judgment

Expert judgment utilization in the NRC can be classified into two major types: qualitative (e.g., identifying requirements, Phenomena Identification Ranking Table (PIRT)) and quantitative (e.g., estimating probabilities). The major process steps and basic principles are similar for all the applications; however, the detailed methods of implementing the process vary due to various constraint factors such as available time and resources, available experts, and the ways in which the results are used in decision making. Thus, the staff needs to assess the technical areas where expert judgment is used, identify important, prototypical situations (e.g., PIRT, probability estimation), understand the constraint factors, and identify consistencies and inconsistencies in the current practices. Such information will allow the staff to determine the scope of the guidance and specific issues that need to be addressed.

2. Existing guidance and literature for expert judgment

The staff has reviewed existing guidance and literature and summarizes the main findings as follows:

- a. The NRC has produced several expert judgment guidance documents since the 1980s. Most of these have either come from applications (e.g., Senior Seismic Hazard Analysis Committee (SSHAC)) or have been used in various applications. Many U.S. Federal organizations and international nuclear organizations also have developed expert judgment guidance. These guidance documents contain many similarities in the elicitation process; the guidance varies in the details of implementing the process for different types of judgment and constraint factors.

- b. The literature provides information on lessons learned in expert judgment and research results addressing elicitation issues, facilitating experts' common understanding of the issues, mitigating biases, and developing questionnaires with respect to human cognitive limits.

The staff will incorporate, as appropriate, this existing library of relevant information and guidance.

### 3. Expert Judgment in the Level 3 PRA Project

The staff and the Level 3 PRA project team identified potential areas where expert judgment may be needed and developed an interactive strategy for developing and piloting the guidance:

- a. Some candidate areas in the Level 3 PRA project that might necessitate formal expert elicitation in the "qualitative" realm include multi-unit risk, spent fuel pool PRA, dry cask storage PRA, and low power and shutdown PRA. Some candidates in the "quantification" realm include HRA (particularly for operator actions outside of the Level 1 internal events at full power model) and Level 2 PRA containment event tree split fractions (e.g., likelihood of vessel breach under a given set of conditions). Thus, piloting the draft guidance needs to include both qualitative and quantitative realms in Level 3 PRA.
- b. The NRC's new HRA method (referred to as IDHEAS) being developed is expected to support the HRA in the Level 3 PRA project, to the extent possible. IDHEAS implementation includes eliciting experts' judgment of human error probabilities (HEPs) for major human failure modes. This activity should conform to the draft guidance for consistent utilization of expert judgment in the Level 3 PRA project.

The staff will coordinate the timeline and activities of the draft guidance development with the Level 3 PRA project schedule.

### **Revised guidance for expert judgment project plan**

RES staff revised the project plan based on the requirement and needs analysis. The detailed revised plan is attached. Staff will implement the revised plan and schedule for developing expert judgment guidance that incorporates piloting the draft guidance using the Level 3 PRA project. The staff estimates the level of effort to be 24 staff months, with expected completion in FY14-15. Staff may adjust the completion date of the final product to respond to potential changes in available resources or the Level 3 PRA project schedule.

**Selected bibliography in expert judgment**

- 1982 NUREG/CR-2255, "Expert Estimation of Human Error Probabilities in Nuclear Power Plant Operations: A Review of Probability Assessment and Scaling," W.G. Stillwell et al.
- 1983 NUREG/CR-2743, "Procedures for Using Expert Judgment to Estimate Human Error Probabilities in Nuclear Power Plant Operations," D.A. Seaver and Stillwell, W.G.
- 1984 NUREG/CR-3688, "Generating Human Reliability Estimates Using Expert Judgment," M.K. Comer et al.
- 1987 NUREG/CR-4550, "Analysis of Core Damage Frequency From Internal Events: Expert Judgment Elicitation, Part 1 Expert Panel Results."
- 1987 NUREG/CR-4982, "Severe Accidents in Spent Fuel Pools in Support of Generic Safety Issue 82," V.L. Sailer et al.
- 1987 NUREG/CR-4962, "Methods for the Elicitation and Use of Expert Opinion in Risk Assessment," A. Mosleh et al.
- 1990 NUREG/CR-5424, "Eliciting and Analyzing Expert Judgment, A Practical Guide," M.A. Meyer and Booker, J.M.
- 1990 NUREG-1150, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants"
- 1990 NUREG/CR-5411, "Elicitation and Use of Expert Judgment in Performance Assessment For High-level Radioactive Waste Repositories," E.J. Bonano et al.
- 1996 NUREG-1563, "Branch Technical Position on the Use of Expert Elicitation in the High-Level Radioactive Waste Program," J.P. Kotra et al.
- 1997 NUREG/CR-6372, "Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts," R.J. Budnitz et al.
- 2000 NUREG-1624, "Technical Basis and Implementation Guidelines for A Technique for Human Event Analysis (ATHEANA)," S. Cooper et al.
- 2008 NUREG-1829, "Estimating Loss-of-Coolant Accident (LOCA) Frequencies Through the Elicitation Process," R. Tregoning et al.
- 2012 NUREG-2117, "Practical Implementation Guidelines for SSHAC Level 3 and 4 Hazard Studies," A.M. Kammerer and Ake, J.P.
- (European Commission) K. Simola et al. (2005), "Formal Expert Judgement/An Overview," Directorate-General Joint Research Centre, Institute for Energy
- (Finland) "A Formal Process for Elicitation and Validation of Expert Judgments for Safety Case in the Context of Spent Nuclear Fuel Management"

(NASA) "Development of an Expert Judgment Elicitation and Calibration Methodology for Risk Analysis In Conceptual Vehicle Design"

(Los Almos Lab) M.A. Meyer et al., "Guidelines for Eliciting Expert Judgment as Probabilities or Fuzzy Logic"

K.A. Ericsson et al. (1993), "The role of deliberate practice in the acquisition of expert performance," *Psychological Review*, 100: 363-406

G. Klein et al., "Critical decision method for eliciting knowledge," *Systems, Man and Cybernetics, IEEE Transactions*, May/Jun 1989, Vol. 19, 3: 462-472

Enclosure:

As stated

cc: SECY  
EDO  
OGC  
OCA  
OPA  
CFO

(NASA) "Development of an Expert Judgment Elicitation and Calibration Methodology for Risk Analysis In Conceptual Vehicle Design"

(Los Almos Lab) M.A. Meyer et al., "Guidelines for Eliciting Expert Judgment as Probabilities or Fuzzy Logic"

K.A. Ericsson et al. (1993), "The role of deliberate practice in the acquisition of expert performance," *Psychological Review*, 100: 363-406

G. Klein et al., "Critical decision method for eliciting knowledge," *Systems, Man and Cybernetics, IEEE Transactions*, May/June 1989, Vol. 19, 3: 462-472

Enclosure:  
As stated

cc: SECY  
EDO  
OGC  
OCA  
OPA  
CFO

**DISTRIBUTION:**

ELeeds, NRR                      GHolahan, NRO                      JWiggins, NSIR                      MSatorius, FSME  
CHaney                              DRA r/f

**ADAMS Accession No.: ML121600282**

**WITS 201200046/EDATS:SECY-2012-0075**

|        |              |                       |              |                            |                            |
|--------|--------------|-----------------------|--------------|----------------------------|----------------------------|
| OFFICE | RES/DRA/HFRB | Tech Editor           | RES/DRA/HFRB | RES/DRA                    | RES                        |
| NAME   | J. Xing      | C. Hsu<br>(via email) | S. Peters    | R. Correia<br>(D. Coe for) | B. Sheron<br>(J. Uhle for) |
| DATE   | 5/21/12      | 5/18/12               | 5/22/12      | 6/5/12                     | 6/8/12                     |

**OFFICIAL RECORD COPY**