

TOTAL SYSTEM PERFORMANCE ASSESSMENT AND INTEGRATION— SCENARIO ANALYSIS REVIEW

**DOE/NRC Technical Exchange on Total System Performance
Assessment (TSPA) for Yucca Mountain**

June 6–7, 2000

Sitakanta Mohanty

(210) 522-5185

smohanty@swri.org

Center for Nuclear Waste Regulatory Analyses

**Contributors: R. Benke, D. Esh, J. Firth, B. Leslie, S. Mayer,
O.Pensado, and D. Pickett**

OUTLINE

- **Scenario Analysis Sub-issue**
- **Review Scope**
- **Subissues — Areas of Review**
- **Subissues — Review Results**
- **General Review Results**
- **Summary**

TSPAI SUBISSUES

- **System Description and Demonstration of Multiple Barriers [OPEN]**
- ***Total System Performance Assessment Methodology: Scenario Analysis [OPEN]***
- **Total System Performance Assessment Methodology: Model Abstraction [OPEN]**
- **Demonstration of Overall Performance Objective [OPEN]**

SCENARIO ANALYSIS SUB-ISSUE

- **Identification of FEPs Affecting the Overall Performance Objective**
 - **Identification of an Initial List of FEPs**
 - **Categorization of FEPs**
 - **Screening of the Initial List of FEPs**
 - **Formation of Scenario Classes Using the Reduced Set of FEPs**
 - **Screening of Scenario Classes**

REVIEW SCOPE

- **Documents Reviewed**
 - **FEPs Database (Revision .00b) (Available as of September 1999)**
 - **RSS Planning Report**
 - **TSPA Methods and Assumption Report**
 - **AMRs (Available as of March 2000)**
 - **PMRs (Available as of April 2000)**
 - **Appendix 7 Meeting Handouts (Available as of March 2000)**
- **NRC FEPs Review Prioritization**
 - **Evaluate Excluded FEPs (Priority 1)**
 - **Evaluate Included FEPs (Priority 2)**

IDENTIFICATION OF INITIAL LIST OF FEPs —AREAS OF REVIEW

- **Is the List of FEPs Comprehensive Based on YM Site/Regional Characterization Data and Modes of Degradation/Deterioration/Alteration?**
- **Is There a Defensible Explanation for the FEPs Excluded As Irrelevant to the YM Setting?**
- **Is There a Systematic Approach to Developing a Comprehensive List? (Document why the initial list is believed to be comprehensive)**

IDENTIFICATION OF INITIAL LIST OF FEPs — REVIEW RESULTS

- **Database Available to Date Is Not Comprehensive: Process to Develop Site-specific FEPs Not Adequate**
 - **Need a Systematic Approach to Develop a Comprehensive FEP Database**
 - **Missing FEPs Relevant to the Proposed YM Repository**
 - **Additional Documentation on Database Construction Will Increase Credibility That the List Is As Comprehensive As Possible**
 - **Database Does Not Include All FEPs Identified in IRSRs (i.e., FEPs NRC Considers Important)**

CATEGORIZATION OF FEPs — AREAS OF REVIEW

- **Do the Categories Include Each FEP Identified in the Comprehensive FEP List?**
 - **Adequate Documentation on Categorization**
 - **Categorization Is Compatible With Screening**
- **Does the Technical Description of FEP Categories Appropriately Synthesize and Encompass Individual FEPs Comprising the Categories?**
- **Are the Categories of FEPs Utilized During Screening Representative of the Individual FEPs in a Particular Category?**

CATEGORIZATION OF FEPs — REVIEW RESULTS

- **Categorization of Secondary Entries Into Individual Primary Entries**
 - **Inadequate Documentation**
 - **Secondary FEPs Not Documented in Several PMRs**
 - **Degree of Documentation Varies From PMR to PMR**
 - **Is the ISM PMR Related to FEPs?**
 - **Poor Correspondence Between Primary and Secondary Entries**

CATEGORIZATION OF FEPs — REVIEW RESULTS (cont'd)

- **Current Categorization Scheme Not Sufficient to Ensure Compatibility Between FEPs Categorization and the Use of Categories During the FEPs Screening**
- **Categorization Not Consistent With the Guidance in Swift et al. (1999) – Only Document Available to NRC to Date**
- **NRC to Reassess Categorization After the Release of FEP AMRs and FEP Database**

SCREENING OF THE INITIAL LIST OF FEPs — AREAS OF REVIEW

- **Are the Bases Provided for Non-applicable FEPs Adequate?**
 - How Is Reference Design Used to Screen FEPs (e.g., criticality)?
- **Is There Adequate Justification Provided for Screening Events That Fall Below the Regulatory Probability Criterion?**
 - Can the Probability of Occurrence Be Technically Supported?
 - Are the Events Inappropriately Excluded By Defining Probability For Events Narrowly?
- **Are Appropriate Criteria Used to Screen FEPs?**
 - Are Appropriate Representative or Bounding Estimates Used For Consequence Analysis?
 - Are Coupling of FEPs Considered Adequately in the Analyses to Screen FEPs?

SCREENING OF THE INITIAL LIST OF FEPs—REVIEW RESULTS

- **Inadequate Technical Basis For Screening FEPs**
 - **NRC Anticipates A Stronger Technical Basis in the Final Version of the Database and in the FEPs AMRs**
 - **Example:**
 - **FEP Number: 2.1.03.07.00**
 - **FEP Name: Mechanical impact on waste container and drip shield**
 - **Screening: Exclude**
 - **Screening Argument: There is no possibility of forming such a tight confined space that swelling product could cause mechanical damage to the Alloy 22 outer barrier**
 - **Review comment: The argument does not explain why such possibility does not exist**

FORMATION OF SCENARIO CLASSES USING THE REDUCED SET OF FEPs— AREAS OF REVIEW

- **Are the Resulting Scenario Classes Mutually Exclusive in the Analysis Approach? Are the Rationale for the Formation of Scenario Classes Technically Acceptable?**
- **Do the Scenario Classes Include All Possible Combination of Events?**

FORMATION OF SCENARIO CLASSES USING THE REDUCED SET OF FEPs— REVIEW RESULTS

- **None of the Documents Available to Date Address This Area**

SCREENING OF SCENARIO CLASSES — AREAS OF REVIEW

- **Do the Technical Descriptions Adequately Support the Screening of Scenario Classes?**
- **Is There Adequate Justification Provided for Screening Scenario Classes That Fall Below the Regulatory Probabilities Criterion?**
 - **Can the Probability of Occurrence Be Technically Supported?**
 - **Are the Events Inappropriately Excluded by Defining Probability for Events Narrowly?**
- **Will the Omission of Scenario Classes From PA Significantly Change the Magnitude and Time of the Average Annual Dose?**

SCREENING OF SCENARIO CLASSES — REVIEW RESULTS

- **None of the Documents Available to Date Discuss Actual Screening of Class**

GENERAL REVIEW RESULTS

- **NRC Agrees With the Overall Methodology, but Additional Information Is Needed**
- **Potential Deficiencies Exist in DOE Approach That Could Hinder Sub-issue Resolution**
 - **Inconsistencies in Grouping of Secondary Entries (or Incomplete Documentation for the Classification Process?)**
 - **Roll-up of Secondary Entries Into Primary Entries (i.e., Inspection of Primary Entries Alone May Be Insufficient)**
 - **FEPs Database Attempts to Address the First Three Steps in the NRC Review Process**

GENERAL REVIEW RESULTS (cont'd)

- **Transparency and Traceability**
 - **Correspondence Between FEPs Database and Supporting Document Unevenly Established**
 - Examples: Criticality Topical Report Refers to FEPs Numbers Where As UZ Does Not**
 - **Obstacles to the Desired Level of Transparency Related to**
 - **The Structure of the Database**
 - **The Way in Which FEPs Are Incorporated Into and Distributed Among Primary and Secondary Entries (i.e., Categorization)**
 - **Lack of Correspondence Between FEPs Database and PMRs (e.g., ISM PMR)**
 - **Imprecise FEP Naming**
 - **Poor Correspondence Between Primary and Secondary Entries**
 - **Inadequate Representation of FEP Coupling**

GENERAL REVIEW RESULTS (cont'd)

- **Transparency And Traceability–Path Forward**
 - **Provide Assurance That the Database Is Comprehensive**
 - EBS FEP AMR proposes an approach for FEPs identification. A similar approach is expected in other FEP AMRs.
 - DOE should provide full documentation of the process of constructing the FEP database (e.g., explicit listing of documents that were used to generate the FEPs database)
 - **Categorization and Grouping of Secondary Entries Should Be Transparent**
 - **Indicate Plans for Updating the FEPs Database in Relation to Revisions to AMRs and How Traceability With Respect to the Revisions**
 - **In Each PMR Indicate Included FEPs and Chapter Numbers Where They Are Addressed**

SUMMARY

- **NRC Agrees With the Methodology, but Additional Information Is Needed:**
 - Describe the Process Used to Determine That the FEPs List Is Comprehensive
 - Provide Rationale Used to Partition FEPs, When Different Screening Arguments Are Used
 - Further Justification Needed to Support That An Unaffected Intermediate Performance Measure Is Sufficient for Consequence-based Screening
- **FEP Analysis AMRs May Address Questions Related to DOE's Implementation of Scenario Analysis Methodology Evaluated for Individual Abstractions**