



U.S. Department of Energy
Office of Civilian Radioactive Waste Management



Biosphere Peer Review

Presented to:

Nuclear Waste Technical Review Board

Presented by:

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U.S. Department of Energy

Yucca Mountain Site Characterization Office

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Outline

- **Review objective**
- **International peer review team**
- **Terms of review**
- **Implementation of review**
- **Summary of results**
- **Selected recommendations**
- **Summary**

Review Objective

- **To provide, on the basis of available international standards and guidance, an independent evaluation of the biosphere assessment methodology developed by the DOE Yucca Mountain Site Characterization Office (YMSCO)**

The International Peer Review Team

- **Assembled by the International Atomic Energy Agency (IAEA)**
- **Consisted of six members from national advisory committees, waste management organizations and regulatory bodies**
- **Included a scientific secretary from IAEA and a panel secretary to document the review**

The International Peer Review Team

(Continued)

● Panelists

- **Professor Roger H. Clarke, Panel Chair**
Director, National Radiological Protection Board
UK
- **Pedro Carboneras**
Head, Safety & Licensing Department, ENRESA
Spain
- **Ian Crossland**
Strategic Technical Liaison Manager
United Kingdom Nirex Limited
UK
- **Carl-Magnus Larsson**
Head, Dept. of Waste Management and Environment
Swedish Radiation Protection Institute (SSI)
Sweden



The International Peer Review Team

(Continued)

● Panelists:

- **Gerhard Pröhl**
Sr. Scientist at GSF, National Research Centre for Environment and Health, Institute for Radiation Protection Germany
- **Hiroyuki Umeki**
General Manager, Nuclear Cycle Backend Division Japan Nuclear Cycle Institute Japan
- **Carlos Torres-Vidal**
Scientific Secretary, IAEA BIOMASS Project International Atomic Energy Agency Austria
- **Trevor Sumerling — Panel Secretary**
Safety Assessment Management Limited UK



Terms of Review

- **Review documents describing the biosphere modeling methodology**
- **Include consideration of the**
 - **Identification and justification of the conditions and characteristics of assumed biosphere system**
 - **Development of the biosphere conceptual model, including features, events, and processes (FEPs)**
 - **Appropriateness of the GENII-S code for assessing impact**
 - **Methodology used to identify the receptor of interest and behavior and characteristics of the receptor**
 - **Selection and application of biosphere-related parameter values**

Implementation of Review

- **Examined the Biosphere Process Model Report, its sixteen supporting Analysis and Model Reports (AMRs) and calculations, Environmental Protection Agency and Nuclear Regulatory Commission proposed regulations, and other background documents (August - November 2000)**
- **Question and answer exchanges (August - November 2000)**
- **1 week site visit to YMSCO (November 2000)**
 - **Acquired additional information during interactive presentations from DOE and contractor staff**
 - **Conducted a site visit to the Yucca Mountain and Amargosa Valley region**
 - **Held closed discussion meetings**

Implementation of Review

(Continued)

- Summarized preliminary observations orally to DOE and local stakeholder groups
- Submitted draft report (January 2000)
- Submitted final report (April 2000)

Summary of Results

- **Favorable review focused primarily on efficiencies and enhancements**
- **Twenty-three recommendations**
 - **Two broad classifications**
 - ◆ **Within the regulatory framework (14)**
 - ◆ **Outside the regulatory framework to increase stakeholders' confidence in modeling (9)**
 - **Three Main Categories**
 - ◆ **DOE's Biosphere Assessment Approach (5)**
 - ◆ **Definition of Biosphere System (7)**
 - ◆ **Model Development, Data, and Results (11)**

Recommendations of the Panel

- **DOE's biosphere assessment approach**
 - **Assessment context**
 - **Regulatory requirements**
 - **Integration of biosphere into TSPA**

Recommendations of the Panel

(Continued)

- **DOE's biosphere assessment approach**

- **Assessment context**

- ◆ **Recognition of the regulatory basis for the program and historical process leading to development of integrated TSPA and its biosphere component**
- ◆ **Biosphere capability less mature than the major part of TSPA and perceived as a semi-independent “accessory” to the TSPA**
- ◆ **Separation of the biosphere from TSPA enhanced by the prescriptive nature of regulations removing an incentive to explore other potential exposure and release scenarios**

Recommendations of the Panel DOE's Biosphere Assessment Approach

- **Specific recommendations — Regulatory requirements (outside regulatory framework)**
 - A sufficiently broad examination of possible release pathways and related exposure situations should be examined to identify and justify the more closely-defined case adopted for compliance demonstration
 - Logical extensions of compliance case and alternative or supplementary situations should be considered to place the case in perspective and to assess the level of bias against broader spectrum of possible cases
- **Response**
 - Evaluation of additional pathways is currently in progress. Other analyses may be pursued later

Recommendations of the Panel

DOE's Biosphere Assessment Approach

- **Specific recommendations — Integration of the biosphere into the TSPA (inside regulatory framework)**
 - The International Review Team recommended that the consideration of the biosphere is more fully integrated into the total system model. This does not imply that a coupled modeling capability is required, rather, that the interactions are more fully considered in the system conceptualization
- **Response**
 - Possibilities of better integration of the biosphere component with the TSPA are currently being investigated

Recommendations of the Panel

(Continued)

- **Definition of biosphere system**
 - **Biosphere characterization**
 - **Justification of biosphere scenarios**
 - **Exposed groups and individuals**
 - **Time frames**
 - **Volcanic event scenario**

Recommendations of the Panel

Definition of Biosphere System

- **Specific recommendations — Biosphere characterization (inside regulatory framework)**
 - DOE should consider a biosphere characterization program that includes on-site measurements
 - Consider obtaining site-specific biosphere characteristics and processes related to soil and its potential development in particular
- **Response**
 - The need for site-specific model data will be determined based on the results of the sensitivity analysis
 - Soil-related parameters will be reevaluated; additional work will include justification of the site-specificity of the Kd values (per Total System Performance Assessment and Integration (TSPA) Key Technical Issue (KTI) agreement)

Recommendations of the Panel

Definition of Biosphere System

- **Specific recommendations — Exposed groups and individuals (inside regulatory framework)**
 - **Regarding the diet and habits that should be assigned to a RMEI or critical group for compliance assessment, DOE has placed too great of significance on habits determined from the 1997 food consumption survey**
 - **DOE should consider all human activities that might reasonably and consistently occur but not extreme dietary intakes and exposure times**
 - **Consider updating the 1997 food consumption survey**

Recommendations of the Panel

Definition of Biosphere System

● Response

- **Sensitivity analysis has been conducted to determine how annual dose results are affected by the receptor's dietary habits**
- **Results of analysis allow the consequences of selecting a more conservative receptor to be bounded (the results are likely to be bounded by approximately a factor of three)**
- **The 1997 food consumption survey may be supplemented in the future with other available information**

Recommendations of the Panel

(Continued)

- **Model development, data, and results**

- **FEPs and conceptual models**
- **Mathematical representation of the biosphere**
- **Processes and parameters**
- **Analysis methods and results**
- **Quality assurance and model validation**

Recommendations of the Panel

Model Development, Data, and Results

- **Specific recommendations — FEPs and conceptual models (inside regulatory framework)**
 - **DOE should examine the methods of conceptual model construction described, for example, in the BIOMASS documentation and in national assessment studies to devise a method to more clearly track incorporation of individual FEPs into the biosphere model**
- **Response**
 - **The conceptual bases and mathematical representation of the current biosphere model is currently being compared to other models, including BIOMASS, to enhance FEPs identification and tracking (per TSPAI KTI agreement)**

Recommendations of the Panel

Model Development, Data, and Results

(Continued)

- **Specific recommendations — Analysis methods and results (inside regulatory framework)**
 - **DOE should re-assess the treatment of uncertainties in the biosphere and consider the uncertainties that should be**
 - ◆ **Represented in the regulatory scenarios within the TSPA and in “stand alone” mode**
 - ◆ **Explored through alternative models and scenarios**
 - **Enhance discussion of uncertainties due to the scenario specification, model choice and parametric uncertainties, and explain the limitations of the approach and consequent results**

Recommendations of the Panel Model Development, Data, and Results

(Continued)

● Response

- The model and parametric uncertainties are currently planned to be reevaluated as a part of the upcoming LA AMR revisions
- Additional uncertainty analyses have been conducted to support SR. Results documented in Supplemental Science and Performance Analyses (SSPA) Vol. 1, Section 13

Recommendations of the Panel

(Continued)

- **Recommended to continue**
 - **Analyses to timeframes beyond the regulatory requirement**
 - **Food consumption survey(s) similar to the 1997 survey**
 - **Reporting of conditional doses for the volcanic event**

Summary

- **Favorable review focused on efficiencies and enhancements**
- **Review produced 23 recommendations and suggestions presented as an aid to the future development of the biosphere program based on the international perspective**
- **Most recommendations are included in the License Application plan for biosphere modeling**
- **Some work has already been done (e.g. reported in SSPA documentation)**