

THE BIOSPHERE INTERNATIONAL PEER REVIEW

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The US Department of Energy (DOE) requested the International Atomic Energy Agency (IAEA) 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). In response, the IAEA assembled a 6-member panel of experts drawing from member nations' national advisory committees, waste management organisations and regulatory bodies. The IAEA also provided a scientific secretary from IAEA, and a panel secretary to document the review.

Panelists were:

- 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;
- 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.

The review team 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 during August through November 2000.

Question and answer exchanges occurred via email during this same time, and a 1-week site visit was made. During the site visit the review team acquired additional information during interactive presentations from DOE and contractor staff, conducted a site visit to the Yucca Mountain and the Amargosa Valley region, and held closed discussion meetings.

At the conclusion of the site visit, the review team summarised preliminary observations orally to DOE and local stakeholder groups. A draft report was submitted for checking facts only in January of 2001, and a final report was published in April of 2001.

The DOE considered the results of the review favourable, with comment focused primarily on efficiencies and enhancements. Twenty-three recommendations were made that addressed three categories: (a) DOE's Biosphere Assessment Approach (5), (b) Definition of Biosphere System (7), and (c) Model Development, Data, and Results (11).

Review of the DOE's biosphere assessment approach included a review of its assessment context. There was recognition of the regulatory basis for the program and of the impact of that basis on the historical process leading to development of integrated TSPA and its biosphere component. It was observed that the Biosphere capability was less mature than the major part of TSPA and perceived as a semi-independent "accessory" to the TSPA. This is in part due to the separation of the biosphere from TSPA by the prescriptive nature of regulations. The regulations remove an incentive to explore other potential exposure and release scenarios.

In that context, the review team recommended that 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. Documents that provide logical extensions of the compliance case and alternative or supplementary situations should be created to place the case in perspective and to assess the level of bias against a broader spectrum of possible cases. A DOE response is that evaluation of additional pathways is currently in progress, and other recommended analyses may be pursued later.

The International Review Team recommended that the consideration of the biosphere be more fully integrated into the total system model. This does not imply that a coupled modelling capability is required, rather, that the interactions be more fully considered in the system conceptualisation. DOE's response is that opportunities for better integration of the biosphere component with the TSPA are currently being investigated.

Specific recommendations were made on biosphere characterisation. For example it is stated that DOE should consider a biosphere characterisation program that includes on-site measurements, and DOE should also consider obtaining site-specific biosphere characteristics and processes related to soil and its potential development.

The DOE response is that the need for site-specific model data will be determined based on the results of the recommended and planned sensitivity analyses. Soil-related parameters will be re-evaluated; additional work will include justification of the site-specificity of the Kd values. This issue has also been raised by the US Nuclear regulatory Commission and further work was agreed to by the DOE as per a written sub-agreement included in the Total System Performance Assessment and Integration (TSPAI) Key Technical Issue (KTI) agreement.

Regarding the diet and habits that should be assigned to a RMEI or critical group for compliance assessment, the reviewers felt that DOE has placed too great 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. It was suggested that DOE consider updating the 1997 food consumption survey.

In response, several sensitivity analyses were conducted to determine how annual dose results are affected by the receptor's dietary habits. Results of these 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.

Specific recommendations were made regarding FEPs and conceptual models, such as that 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. In response, the DOE is currently comparing the conceptual bases and mathematical representation of the biosphere model with other models. This includes BIOMASS and thus enhancing FEPs identification and tracking (this issue is also identified as needing attention by the US NRC, per a written agreement for additional work by the DOE, described in the TSPA KTI document previously mentioned).

The review team felt that DOE should re-assess the treatment of uncertainties in the biosphere. In particular, DOE should consider the uncertainties that are best represented in the regulatory scenarios within the TSPA, those that are best evaluated in "stand alone" mode, and those best explored through alternative models and scenarios. DOE should also enhance discussion of uncertainties due to the scenario specification, model choice and parametric uncertainties, and explain the limitations of the approach and consequent results.

The DOE response is that model and parametric uncertainties are currently planned to be re-evaluated as a part of the upcoming LA AMR revisions, and that additional uncertainty analyses have been conducted to support SR. Results of these supplementary analyses are documented in the documentation of the Supplemental Science and Performance Analyses (SSPA) Vol. 1, Section 13.

The panel also recommended that analyses to timeframes beyond the regulatory requirement be continued, that food consumption survey(s) similar to the 1997 survey be repeated periodically, and that conditional doses be reported for the volcanic event.

Most of the recommendations received are to be acted on, and are to be included in the License Application plan for biosphere modelling. Some work suggested by the review team has been done since the review was completed, and is reported in the DOE's mid-2001 SSPA publications and subsequent documentation.