



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

Multiple Lines of Evidence – Documentation and Planning

Presented to:
Nuclear Waste Technical Review Board

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**YUCCA
MOUNTAIN
PROJECT**

What the Board Has Said

- **“The Board has recommended that the DOE focus significant attention on four priority areas dealing with managing uncertainty and coupled processes, which, in the Board’s view, are essential elements of any DOE site recommendation.”**
- **“... (4) Development of multiple lines of evidence to support the safety case of the proposed repository. These lines of evidence should be derived independently of performance assessment, and thus, not subject to the limitations of performance assessment.”**

Transcript of NWTRB Meeting, Amargosa Valley, Nevada
January 30, 2001

Multiple Lines of Evidence

- **Fundamental scientific and engineering principles**
- **Natural and anthropogenic analogs**
- **Prediction and Estimation Testing**
- **Direct observation and measurement**
- **Simple models and calculations**
- **Process Models**
- **Independent expert review**
- **Confirmatory Testing**

Multiple Lines of Evidence – Documentation

- **The Yucca Mountain Site Description provides a synthesis of information on the natural system at Yucca Mountain, such as direct observations and measurements and natural analog studies**
- **The Test and Evaluation Plan documents preliminary plans for confirmatory testing**
- **The Supplemental Science and Performance Analysis (SSPA) Report, Volume 1 will (June 2001):**
 - **Include a transparent discussion of multiple lines of evidence supporting the performance analysis**
 - **Our Panelists have discussed a number of examples of multiple lines of evidence that will be summarized in the SSPA Report**

Multiple Lines of Evidence – Documentation

(Continued)

- **Example discussion of multiple lines of evidence from the SSPA:**
 - **Seepage – the conceptual understanding of drifts acting as capillary barriers is supported by direct and indirect observations in underground openings**
 - ◆ **Caves**
 - ◆ **Excavated openings**
 - ◆ **Mineral deposition in lithophysal cavities**
 - ◆ **Rainer Mesa**
 - ◆ **Observations in the sealed Exploratory Studies Facility and the Enhanced Characterization drift segments**

Multiple Lines of Evidence – Documentation

(Continued)

- **Example discussion of multiple lines of evidence from the SSPA, continued**
 - **Volcanic Hazard included studies of late Tertiary and Quaternary igneous activity – direct observations and analog sites:**
 - ♦ **Geologic mapping of basalt centers**
 - ♦ **Geochronology analyses**
 - ♦ **Geochemistry and petrology studies**
 - ♦ **Evaluation of eruptive histories in the region**
 - ♦ **Geophysical studies**
 - ♦ **Analysis of structural controls**
 - ♦ **Studies of analogous eruptive centers around the world**

Multiple Lines of Evidence – Ongoing Work

- **Examples of ongoing natural analog studies**
 - **Radionuclide Transport: Drilling and analysis at Peña Blanca to complement lab and site data on transport characteristics**
 - **Thermal-Chemical-Hydrologic Effects: Paiute Ridge, Nevada Test Site – evaluate effects of heat on the contact zone in a sequence of tuffs intruded by basalt magma**
 - **Waste Package Performance: Akrotiri site, Greece – stability of metals in underground conditions**
- **The results of ongoing analog studies will be documented in a synthesis report on analogs (planned for November 2001)**

Multiple Lines of Evidence – Ongoing Work

(Continued)

- **Independent Expert Review**
 - ◆ Peer Review of the technical basis for waste package performance
 - ◆ International Peer Review of Total System Performance Assessment for Site Recommendation
- **Interim/summary reports will be available in the fall of 2001**

Multiple Lines of Evidence – Summary

- **The DOE agrees that multiple lines of evidence should be used in addition to the numerical output from performance assessment to demonstrate repository safety**
- **The DOE believes that multiple lines of evidence are inherent in standard scientific practice**
- **We are planning to provide a more transparent discussion of multiple lines of evidence in project documents, such as the SSPA, taking into consideration today's discussion.**