NUCLEAR WASTE TECHNICAL REVIEW BOARD
FULL BOARD MEETING

SUBJECT: NUMERICAL MODELING OF PROPOSED YUCCA MOUNTAIN REPOSITORY UNDER VARIOUS THERMAL LOADS

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Thermal Modeling Assumptions

Heat source representations

- Explicit modeling of each waste package
- Areally extensive smeared modeling of heat sources

Material property representations

- Homogeneous
- Homogeneous - layered
- Spatially heterogeneous
Single Plate Model--95 C Isotherm
80 kW/acre--500 years
Conclusions: Heat Source

- The geometric distribution of heat-generating waste can impact the spatial and temporal extent of predicted thermal profiles

- No single model can capture the complexities of repository layout and phenomenological coupling

- Conclusions regarding repository thermal response should be based on results from a suite of models
Discrete Source Model

- Analytical heat-conduction in a semi-infinite medium
- Waste packages explicitly modeled as heat-generating right-circular cylinders (31,283 Spent Fuel, 13,500 DHLW)
- Depth of burial = 350 m
- Equivalent initial design-basis APD = 80 kW/acre
- Average waste characteristics: 28.5 years old and 35.4 GWd/MTU
Discrete Source Model--95 C Isotherm
80 kW/acre--500 years
Single Plate Model

- Analytical heat-conduction in a semi-infinite medium
- Heat-generating waste modeled as single plate
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- Equivalent initial design-basis APD = 80 kW/acre
- Average waste characteristics: 28.5 years old and 35.4 GWd/MTU
### Material Properties

<table>
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<th>Material</th>
<th>Homogeneous</th>
<th>Homogeneous Layered</th>
<th>Spatially Heterogeneous</th>
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<tbody>
<tr>
<td></td>
<td>TCw</td>
<td>k (W/mK)</td>
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<td>PTn</td>
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</table>
Comparison of Homogeneous and Layered Material Property Representations
Porosity Simulation

Seed 1711

83 62

60% 0%
Upscaled Porosity Simulation

The image shows a 3D representation of upscaled porosity with a color gradient indicating porosity percentages. The gradient ranges from 0% to 60%. The diagram includes coordinates S N54 and N N55, with a scale of 0 to 62 meters on the x-axis and 0 to 83 meters on the y-axis. The seed is marked as 1711.
Conclusions: Material Properties

• How the stratigraphy of the mountain is represented influences temperature predictions

• The impact of spatial heterogeneity on predicted thermal profiles must be assessed as a next step in the repository thermal modeling effort
Conclusions

• Predictions of host rock thermal response are sensitive to assumptions regarding heat source distribution and material property representations.

• The lack of extensive site-specific test data is the primary cause of uncertainty in repository thermal modeling.