U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

NUCLEAR WASTE TECHNICAL REVIEW BOARD
PANEL ON STRUCTURAL GEOLOGY & GEOENGINEERING

SUBJECT: PROGRESS TO DATE IN THE REPOSITORY SEALING PROGRAM

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Scope of Presentation

General Support to Project

Progress to Date

- Planning
- Performance
- Materials

General Support to Project

- Concepts report
- SCP-CDR
- SCP
- ES performance activities
- ES fault technical assessment review
- NRC position paper
- NRC action items
- NRC interface--August 1985
- ESF Alternative Study
- ESF Title I Design
- ESF Title II Design
- Unpublished work to support other activities

Planning

Sealing Concepts
(SAND83-1778)

Approach: Combine appropriate information to develop sealing concepts

- **Hydrogeology**
- **Federal and state regulations**
- **Functional requirements**
- **Numerical calculations**

Conclusions

- **Effective sealing concepts are possible to meet performance criteria**
- **Lower shaft and drift floors appear to be capable of dissipating water**

Planning
Continued...

Program Plan
(SAND84-0910)

- **Focuses on performance-related questions**

- **Six-step approach defined to answer performance-related questions**

  1. **Assess need for sealing**
  2. **Define the design requirements**
  3. **Measure material properties**
  4. **Assess the performance of sealing designs**
  5. **Perform laboratory analysis and field testing**
  6. **Reassess performance of sealing designs**

Performance

Hydrologic Calculations to Support Sealing Concepts
(SAND83-2465 and SAND84-0369)

Approach: Flow through partially saturated porous media evaluated

- **Water flow past waste packages**
- **Water flow into a shaft**

Conclusions

- **Backfilling drifts and shafts does not significantly influence flow past waste packages**
- **If backfilling is required for other reasons, a coarse-grained material is more desirable**

Performance
Continued...

Modified Permeability Zone (MPZ) Model
(SAND86-7001)

Approach: Develop a MPZ model around a shaft resulting from stress distribution and blast damage

- **Calculate stress changes around a shaft**
- **Establish relationship between stress and fracture permeability**
- **Calculate rock-mass permeability**
- **Estimate permeability changes due to blasting**

Conclusion

- **The equivalent permeability of the MPZ, averaged over an annulus one radius wide around the shaft, ranges from 15 to 80 times the undisturbed rock mass permeability**

Performance

Continued...

Technical Basis Report
(SAND84-1895)

Approach: Need for sealing evaluated

- **Performance goals proposed**
- **Design requirements computed**
- **Scenarios postulated**

Conclusion

- **For anticipated conditions, sealing is not required to meet hydrologic performance objectives**

- **Nominal sealing of shafts and ramps is required to meet airborne and human intrusion objectives**

- **More comprehensive sealing is proposed to deal with highly improbable scenarios**

Performance
Continued...

Exploratory Shaft Performance Analyses
(SAND85-0598)

Approach: Influence of ESs on repository performance evaluated

- **Water flow evaluated (3 scenarios)**
- **Air flow evaluated (2 scenarios)**
- **Chemical interaction between the liner and ground water evaluated**
- **Remediation efforts proposed**

Conclusion

- **The design and construction of the ESs are not expected to significantly influence the performance of the repository**

Materials

Interface Study

Approach: Extract concrete and grout from G-tunnel

- Measure standard mechanical and hydrologic properties of core
- Observe quality of concrete or grout pour

Conclusions

- Mechanical properties of materials exceeded design specifications
- Hydraulic conductivity low
- No apparent degradation of the concrete at interface or in concrete mass
- Poor interface bond in some cases

Picture of G-Tunnel Complex

Picture of Selected Core From G-Tunnel

Materials
Continued...

Ancient Concrete
(LA-11527-MS)

Approach: Durability of ancient cementitious materials investigated

- **Ancient mortars, plasters, and concretes collected from Rome, Ostia, and Cosa**
- **Material characterization performed**

Conclusions

- **Changes in cementitious matrix and matrix-aggregate observed but materials adjusted slowly to environment**
- **Durability of 2,000-year-old cementitious materials is significant**

Materials
Continued...

Tuff Concrete

Approach: Formulate a concrete mixture using welded tuff aggregate to determine its appropriateness

- Measure crushing and grading characteristics
- Measure physical properties of concrete

Conclusions

- Mechanical properties, expansion behavior, and processing good
- Absorption of water in tuff is high
- Potential reactivity should be evaluated
- Welded tuff can be used as a coarse aggregate in concrete

Materials
Continued...

Tuff Concrete - Geochemical Study
(LA-11532-MS)

Approach: Assess geochemical reactivity of tuff concrete

- **Crushed and intact samples**
- **Static experiments**
- **Agitated experiments**

Conclusions

- **Alteration of glassy components in tuff observed**
- **Concrete disc appears sound macroscopically**
- **An understanding of relationship between alteration of the material and its properties is necessary**

Materials
Continued...

Cementitious Materials - Mechanical Evaluation
(SAND86-0558)

Approach: Laboratory analyses performed

- **Phase I (short-term)**
- **Phase II (long-term)**

Conclusions

- **Sealing materials properties can be controlled to achieve sealing requirements**
- **Preferred cementitious materials selected**

Materials
Continued...

Cementitious Materials - Geochemical Evaluation
(LA-11222-MS)

Approach: Assess geochemical reactivity of select cementitious material

- **Formulate materials whose bulk chemical composition is similar to the Topopah Spring Member**
- **Perform static, agitated, and simulated-vapor experiments**

Conclusion

- **Cementitious materials can be developed to be compositionally similar to tuff**

Materials
Continued...

Crushed Tuff Consolidation

Approach: Conduct combined hydrologic and consolidation tests on crushed tuff

- Test various gradations of crushed tuff
- Test larger samples at various consolidation states

Conclusions

- Piping occurred through sample
- Additional development work required