



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



Long-Term Science and Monitoring for Postclosure Safety Case

Presented to:

Nuclear Waste Technical Review Board, Full Board Meeting

Presented by:

Frank Hansen

Sandia National Laboratories

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Presentation Topics

- **Regulatory requirements for performance confirmation and long-term science and monitoring**
- **Performance confirmation ongoing and planned activities**
- **Long-term science and monitoring ongoing and planned activities**



Outline of Presentation

- **Requirements and expectations for a long-term testing and monitoring program related to the postclosure safety case**
- **Components of a long-term testing and monitoring program related to the postclosure safety case**
 - **Compliance**
 - **Evolution of technical basis (proposed)**
 - **The world**



Requirements for a Long-Term Testing and Monitoring Program Related to the Postclosure Safety Case

- **NRC reporting requirements in 10 CFR 63**
 - **Performance confirmation - 10 CFR 63.131-134**
 - **Research and development to resolve safety questions (included in SAR) – 10 CFR 63.21(c)(16)**
 - ◆ **No planned activities, NRC may specify work during licensing**
 - **Updating of application – 10 CFR 63.24**
 - ◆ **“Results of research programs carried out to confirm the adequacy of designs, conceptual models, parameter values, and estimates of performance of the geologic repository”**
 - ◆ **Other information affecting the license that was not available at the time construction authorization was issued**



Performance Confirmation

- **Based on 10 CFR 63 requirements and *Yucca Mountain Review Plan* expectations**
- **Provides a comprehensive and thorough look at critical aspects of the overall system and the barriers at the time of program development or update**
- **Uses a risk-informed performance-based approach to determine complexity, extent, and number of activities needed to test the functionality of barriers important to waste isolation**
- **Receive and possess amendment**
- **Supports an eventual License Amendment for repository closure**



Performance Confirmation Plan Rev. 5

- Implemented a multi-attribute decision analysis
- Criteria included sensitivity, confidence and accuracy
 - Barrier capability and system performance **sensitivity** to the parameter
 - **Confidence** in the current representation of the parameter
 - **Accuracy** with which the proposed activity measures or estimates the parameter
- Criteria were chosen so activities reflect key aspects of the postclosure safety case



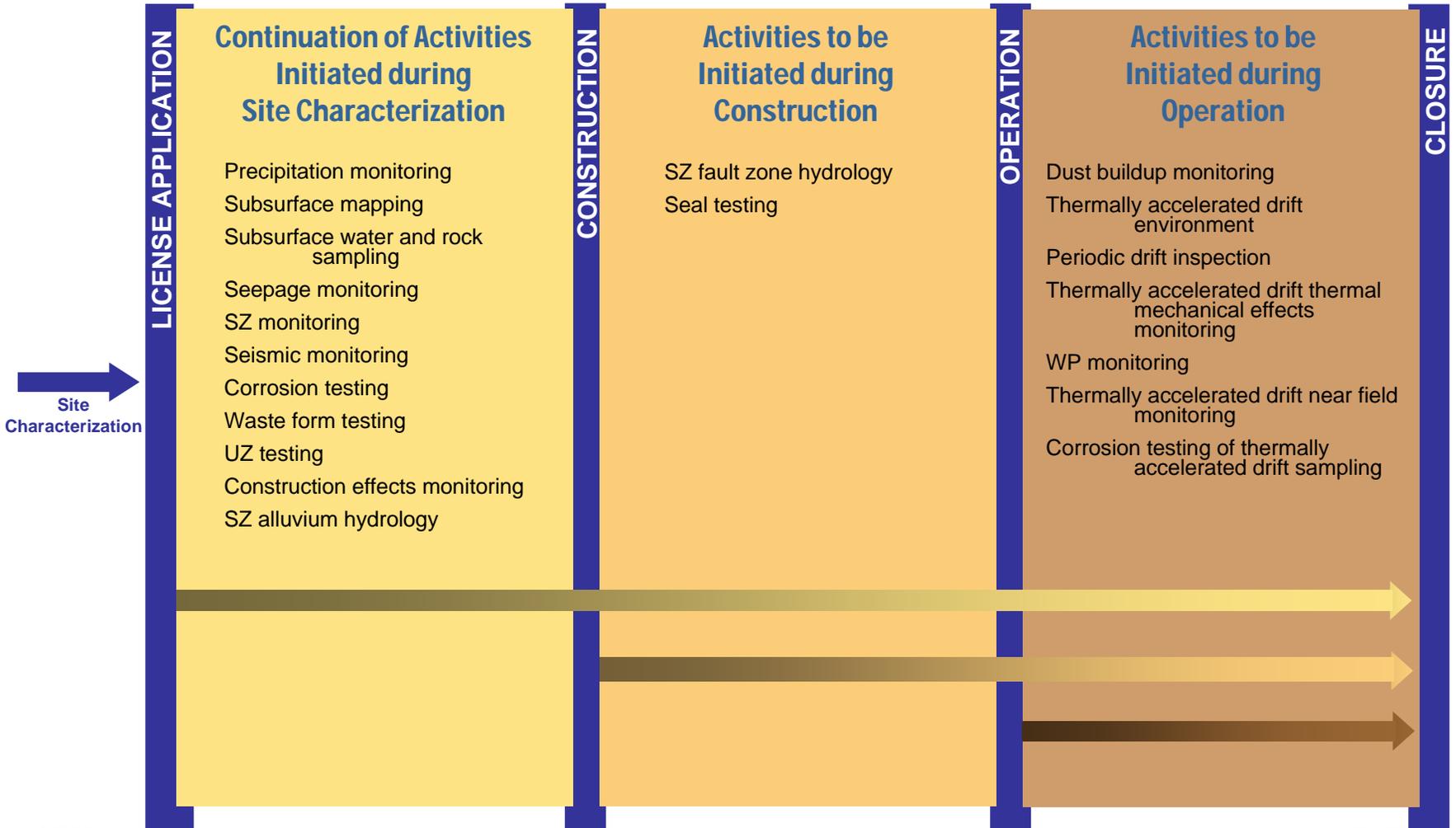
Summary of Currently Planned Performance Confirmation Activities

- **Precipitation monitoring**
 - **Sets context for seepage**
- **Seepage monitoring**
- **Subsurface water and rock testing**
- **Unsaturated zone testing**
- **Saturated zone monitoring**
- **Saturated zone fault hydrology testing**
- **Saturated zone alluvium testing**
- **Drift inspection**
- **Thermally accelerated drift near-field monitoring**
- **Dust buildup monitoring**
- **Thermally accelerated drift in-drift environment monitoring**
- **Subsurface mapping**
- **Seismicity monitoring**
- **Construction effects monitoring**
- **Thermally accelerated drift thermal-mechanical monitoring**
- **Seal testing**
- **Waste package monitoring**
- **Corrosion testing**
- **Corrosion testing of thermally accelerated drift samples**
- **Waste form testing**



Schedule

PC Testing/Monitoring Activities Activity Timelines

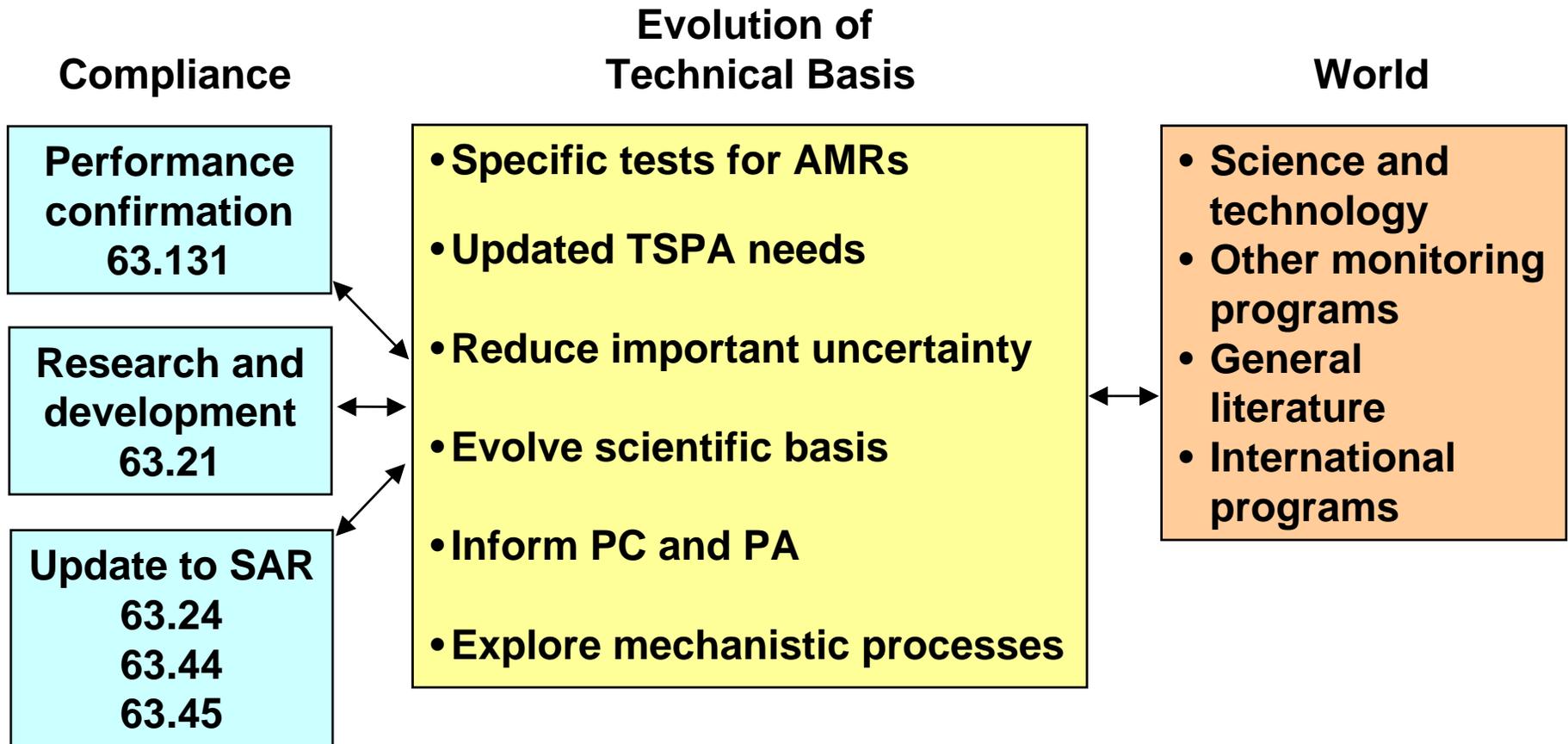


Expectations for a Long-Term Testing and Monitoring Program Related to the Postclosure Safety Case

- **Expectations**
 - **Public confidence**
 - **Continuous assessment of evolving science and technology**
 - ◆ **Science and technology**
 - ◆ **State of knowledge**
 - ◆ **Emerging technologies**
 - ◆ **International perspective**



Components of a Long-Term Testing and Monitoring Program Related to the Postclosure Safety Case



Research and Development

10 CFR 63.21(c)(16)

- **“An identification of those structures, systems, and components of the geologic repository, both surface and subsurface, that require research and development to confirm the adequacy of design. For structures, systems, and components important to safety and for the engineered and natural barriers important to waste isolation, DOE shall provide a detailed description of the programs designed to resolve safety questions, including a schedule indicating when these questions would be resolved.”**



Updates to Safety Analysis Report Related to Postclosure Safety Case

10 CFR 63.24

- **Updates to application before issuance of a license (to receive and possess and to close)**
 - **Additional natural system information obtained during construction**
 - **“Results of research programs carried out to confirm adequacy of designs, conceptual models, parameter values, and estimates of performance of the geologic repository.”**
 - **“Other information bearing on the Commission’s issuance of a license that was not available at the time the construction authorization was issued.”**



Evolution of Technical Basis

- **Examples**
 - **Specific tests for analysis model reports**
 - **Updated total system performance assessment (other than those required in 10 CFR 63)**
 - **Reduce important uncertainty**
 - **Evolve scientific understanding**
 - **Inform performance conformation and performance assessment**
 - **Explore mechanistic understanding**
- **This is not a regulatory program, but may provide feeds to those programs**



Science & Technology Program

- **Mission**
 - “Provide advanced science and technology to continually enhance our understanding of the repository system and to reduce the cost and schedule for the OCRWM mission.”
- **Vision**
 - “OCRWM and the affected public will value the contributions that scientific and technological advances have made toward safer, more expeditious, and more cost-effective waste isolation.”
- **Current science program research areas**
 - **Materials Performance**
 - **Source Term**
 - **Natural Barriers**



Other Information from the World

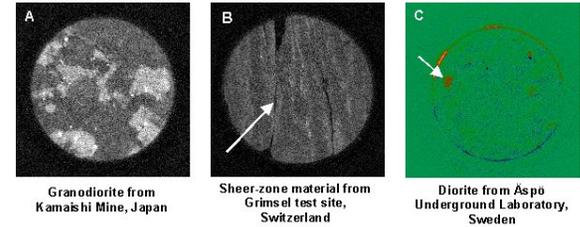
- **Other testing and monitoring**
 - Design and construction
 - Health and safety
- **General literature**
 - Expected advances in the scientific arena
 - Advances could impact the licensing case



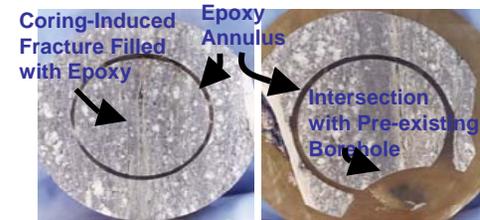
International Program

- **DECOVALEX (DEvelopment COupled models & VALidation against EXperiments)**
 - Provides statements in T-H-M-C issues for performance assessment
- **International Peer Review of TSPA (2002)**

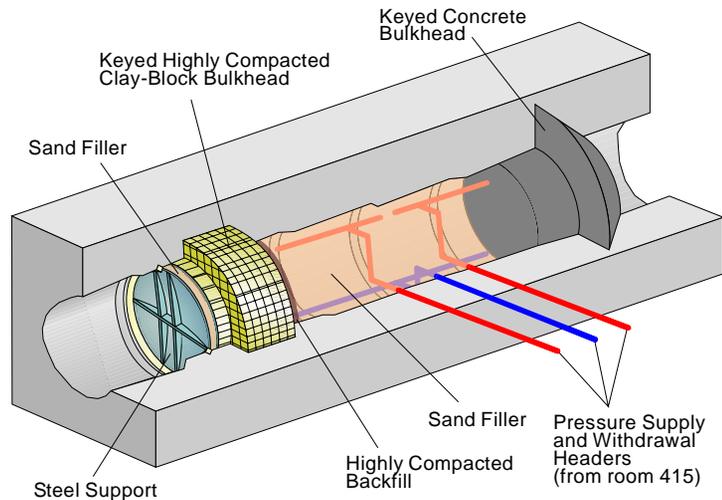
☘ Sweden Äspö Tests



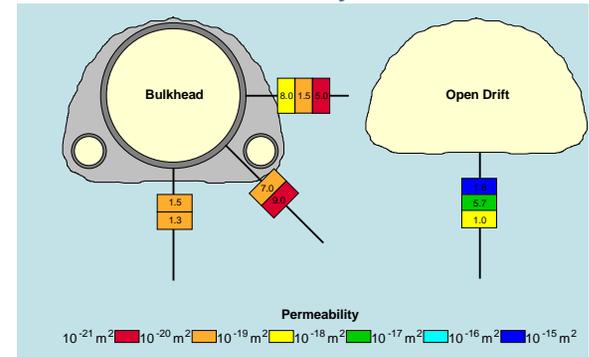
☘ Switzerland Grimsel Test



☘ Canada Tunnel Sealing Experiment



☘ Germany / EU



Ongoing and Planned Activity

- **Prepare performance confirmation test plans**
- **Continue monitoring, testing, and data collection (for ongoing tests)**
- **Iteration with the total system performance assessment and underlying process modeling**
- **Establish data ranges and condition limits for performance confirmation parameters**



Conclusion

- **Regulatory requirements for performance confirmation are well established in 10 CFR 63**
- **Long-term science and monitoring has less defined regulatory drivers**
- **Long-term science and monitoring demonstrates due diligence by the YMP**
- **The Lead Lab will work with the DOE to bring continued refinement to the testing and monitoring program**

