

Exceptional service in the national interest



Sandia's Role: Offering Leadership and Perspectives on International Collaboration

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Not Just a Defense Laboratory

- *Sandia's stance on international outreach in areas related to waste management is very progressive given that Sandia National Laboratories' roots lie in World War II's Manhattan Project, which built the world's first atomic bombs.*
- *The motto for the laboratory then and now is “service in the national interest.”*
- *As Sandia has grown from the laboratory established in 1950 to the laboratory that exists today, our “service in the national interest” has expanded to address issues not just related to defense*
- *but also to issues of the environment and the economy in the United States (US).*
- *An openness to international collaboration in these areas leverages collective understandings for the benefit of all countries involved.*

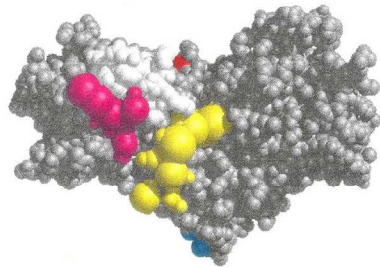


Varied Collaborative Successes

Chem-Bio Nonproliferation

Objective:

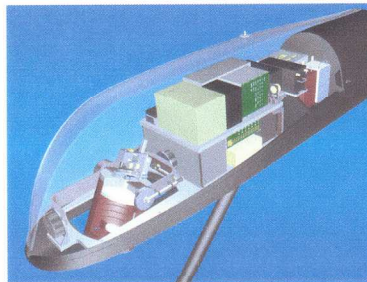
Establish leadership for DOE and SNL in the application of new and emerging technologies to the detection of and defense against chemical and biological threats



Computational Biology



μ Chemlab/CB

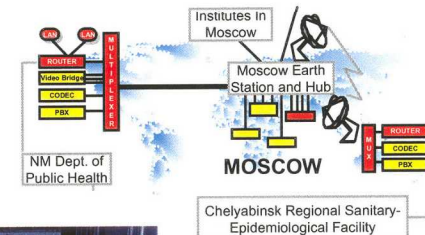


UV-LIF Biodetection



Decontamination Foams

Telecommunications System Schematic Diagram for Disease Monitoring Network



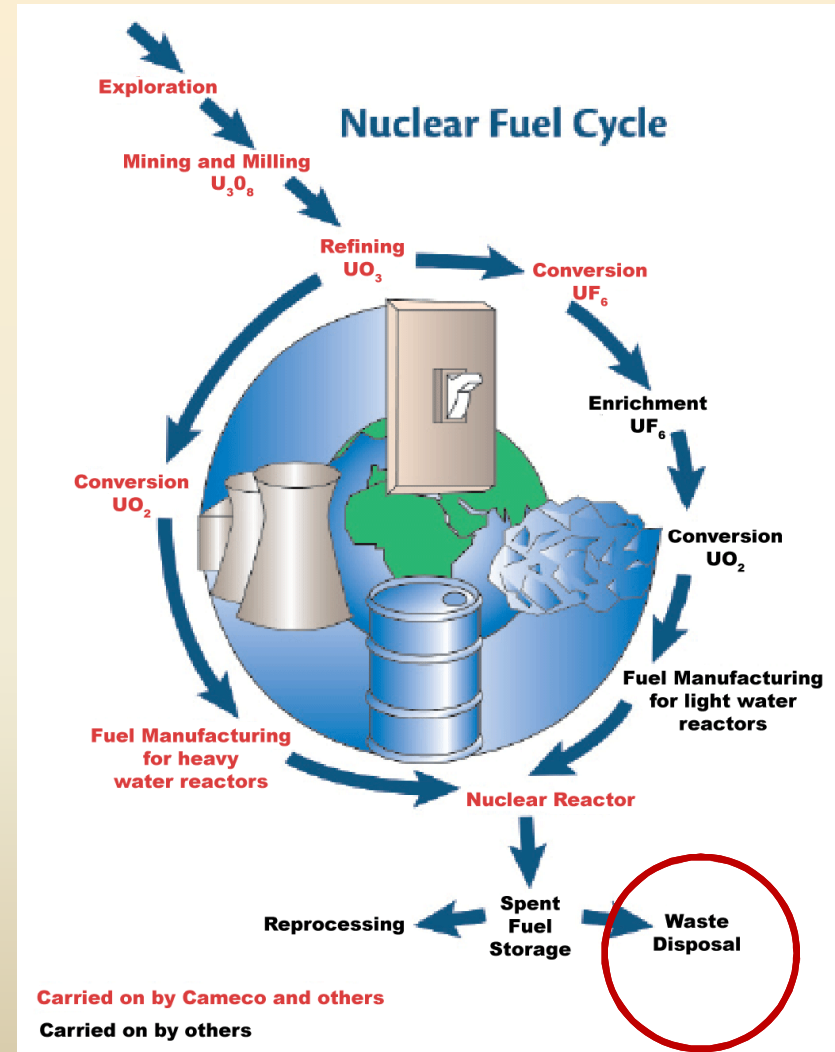
US/Russian Cooperative Disease Monitoring

Sandia has Recognized Experts Nuclear Fuel Cycle

- Economic And Environmental Concern
- Highly Motivated To Establish Forward Progress

STRONGEST INTERNATIONAL PARTNERSHIPS

INTERNATIONAL OUTREACH WITH A FOCUS ON MINED GEOLOGIC DISPOSAL, THE VERY BACK END OF THE FUEL CYCLE



Collaboration is Far-Reaching



- Finland
- Sweden
- Norway
- Poland
- Germany
- France
- Spain
- Ukraine
- Czech Republic
- Austria
- Switzerland
- Slovakia
- Slovenia
- Croatia
- United Kingdom
- China
- Taiwan
- Japan
- Kazakhstan
- S. Korea

MINED GEOLOGIC DISPOSAL

- Training Programs
- Symposiums
- Workshops

- Data Sharing
- Benchmarking



Demonstration tunnel in Olkiluoto

Training Programs

- Training Program for KRMC
- Hosted 6 trainees at a time
- Total of 24 trainees
- Topics Included
 - Waste Characterization
 - Repository Science
 - Performance Assessment
 - Repository Operations



REPOSITORY MONITORING SYMPOSIUM

Project Roadmap

LITERATURE STUDY

Provides the technical basis; background information; no synthesis or judgments made

OBJECTIVES REPORT

Builds on technical basis documented in Literature Study to develop client approved objectives

QUESTIONNAIRE

Questions related to the objectives, the answers of which support development of the preferred monitoring strategy

SYMPOSIUM

Jointly with client answer questions, confirm objectives and draft monitoring strategy

SYMPOSIUM REPORT

Document approach and results from the symposium

FINAL REPORT

Document development and application of the monitoring strategy



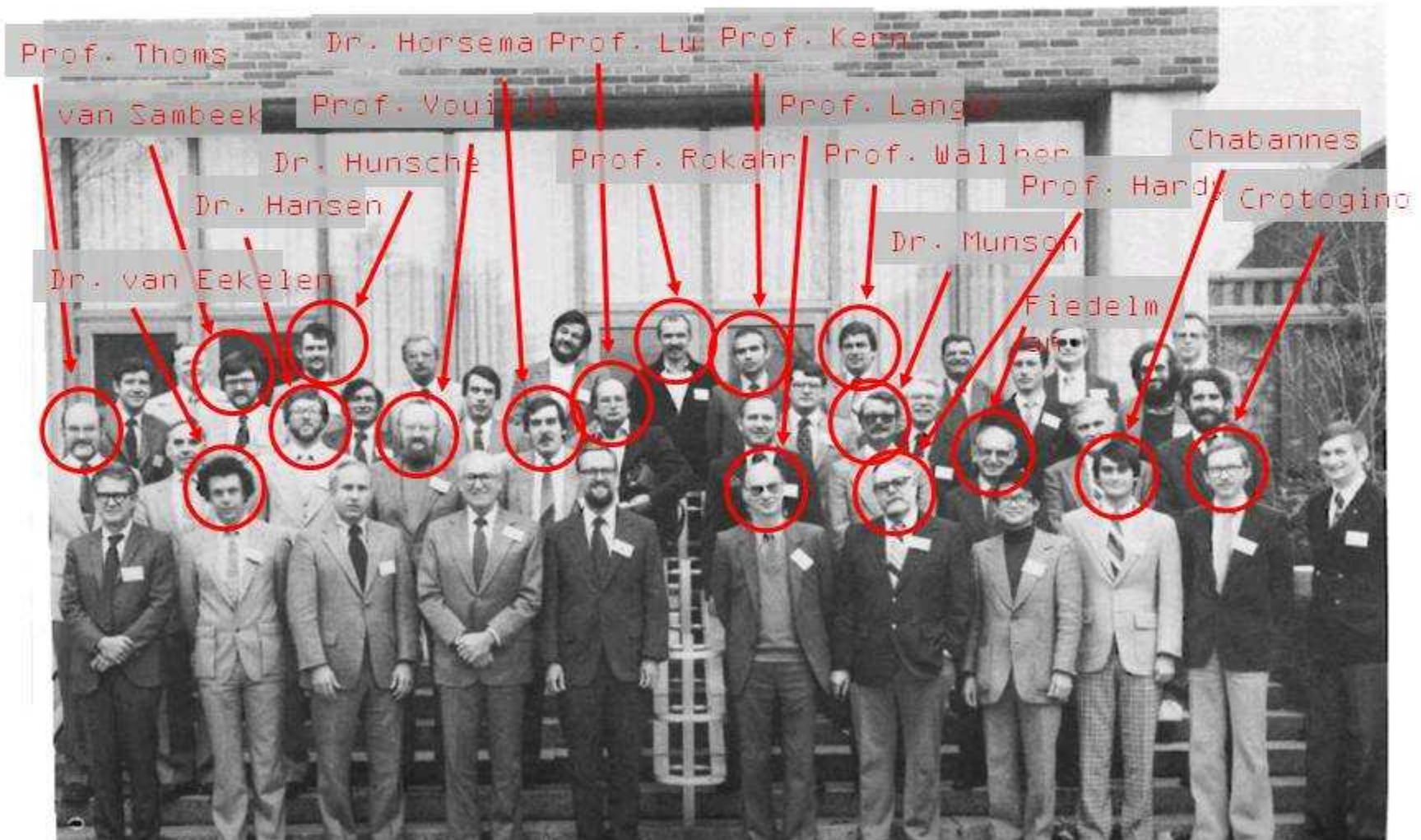
2009

***NIRAS/ONDRAF
Belgium***



Salt Mechanics Workshops

First Conference on the Mechanical Behaviour of Salt, 1981



Salt Mechanics Workshops



2013, Berlin



US/German Workshop on Salt Repository Research,
Design, and Operation
May 25-27, 2010 Jackson, Mississippi, USA

2010, Mississippi



2012, Albuquerque

INTERNATIONAL
GERMAN WORKSHOP
Salt Repository Research,
Design, & Operation
Santa Fe, NM

2014, Santa Fe

2015, Dresden

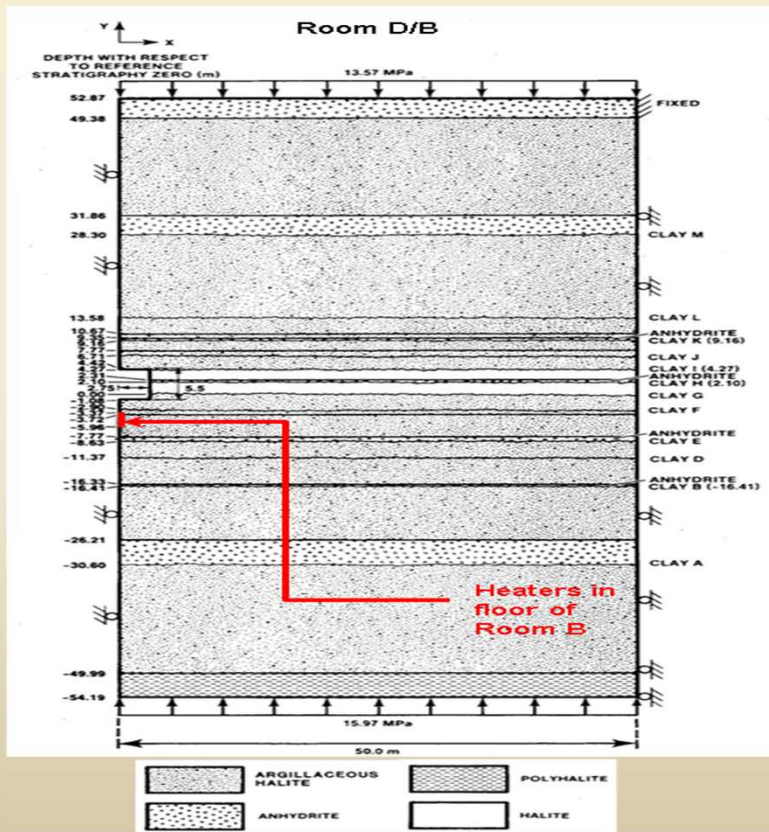
2016, Washington DC



2011, Piene Germany

Salt Mechanics Workshops

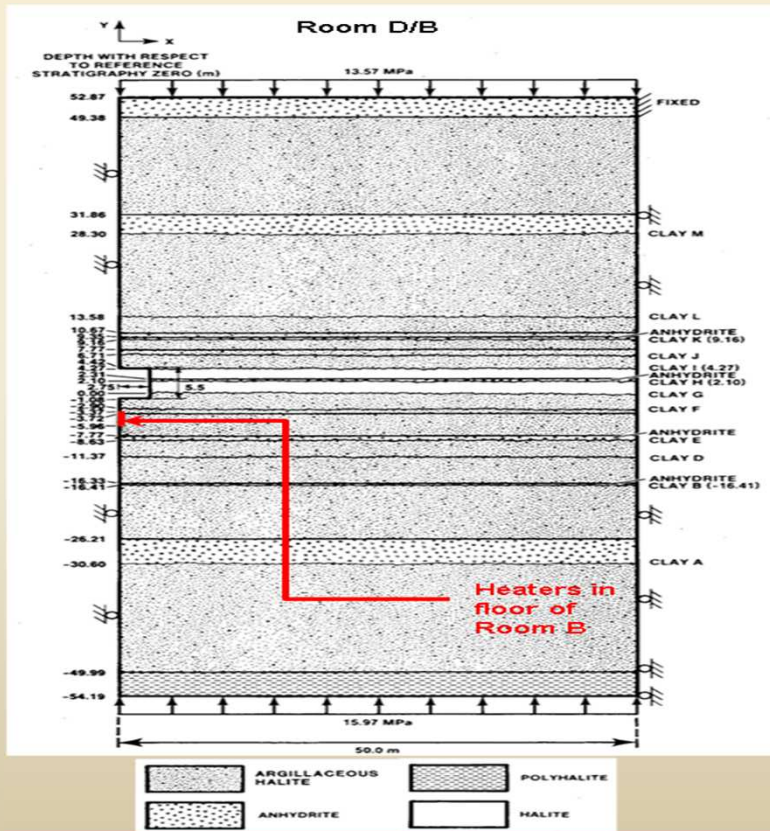
- Sandia shipped salt core to Germany for geomechanical testing
- German testing was completed rapidly



- Model benchmarking has ensued

Salt Mechanics Workshops

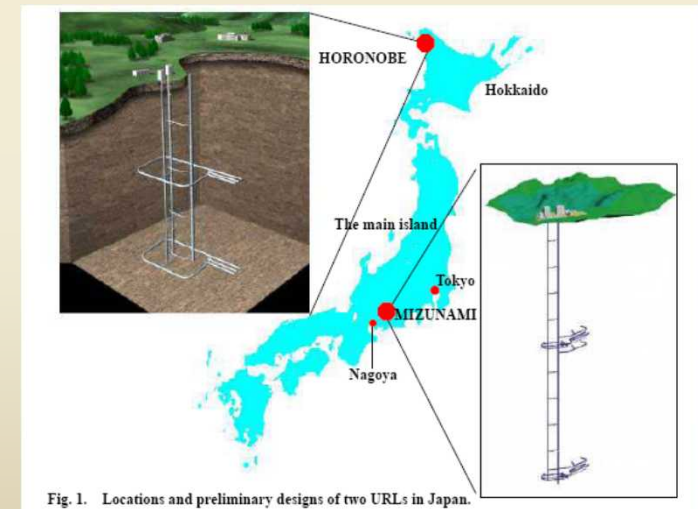
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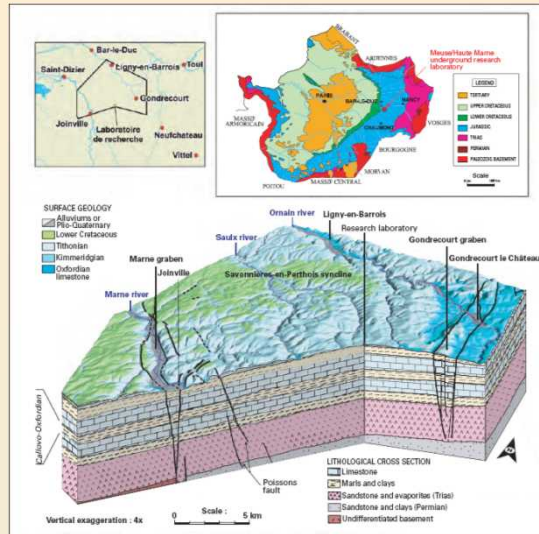
Underground Research Laboratories

- Sweden
 - Äspö
 - Stripa
- Finland
 - ONKALO
- France
 - Fanay-Augères
- Switzerland
 - Grimsel
- Japan
 - Mizunami
 - Kamaishi
- Korea
 - KAERI Underground Research Tunnel (KURT)



Underground Research Laboratories

- France
 - Meuse/Haute Marne (argillite/stiff clay)
 - Amelie (salt)
 - Tournemire (clay)
- Belgium
 - HADES (clay)
- Switzerland
 - Mont Terri (clay)
- Hungary
 - Pécs (shale)
- Germany
 - Asse, Gorleben (salt)
 - Konrad (limestone)
- Japan – Horonobe (mudstone), Tono (sandstone)

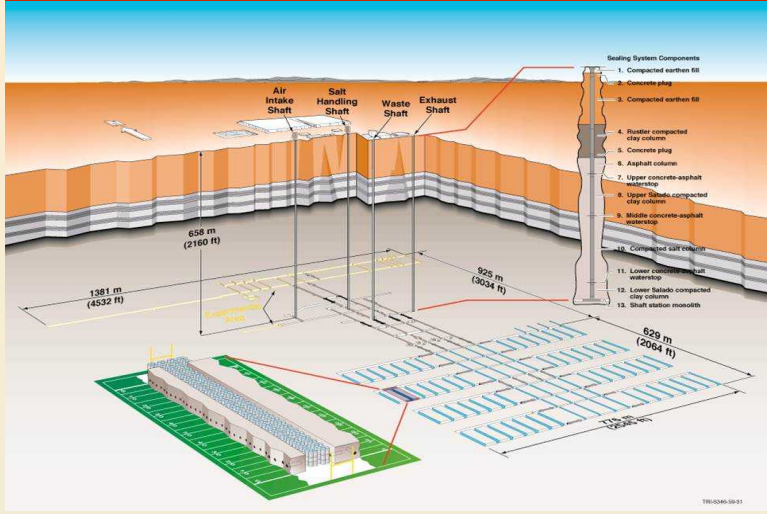


Underground Research Laboratories

- Characterization
 - Geologic, hydrogeologic, geochemical, geomechanical properties of host rock formation
- Testing
 - Characterization methods
 - Engineered materials
 - Excavation methods
 - Conceptual and numerical models
- Technology development
 - Equipment, techniques, expertise for:
 - Characterization, testing
 - Construction of repository, engineered barriers, etc...
 - Waste emplacement/retrieval
 - Repository closure
- Technology demonstration
- Benefits
 - Scientific and technological basis for waste disposal
 - Support decision making
 - Shift frame of discussion from “soft” theoretical basis to “hard” factual basis
 - Increase public confidence in waste-disposal concepts and techniques
- Costs
 - ~\$100 Million to construct
 - ~\$5-10 Million per year to operate

NEA Salt Club Salt FEPs Catalog

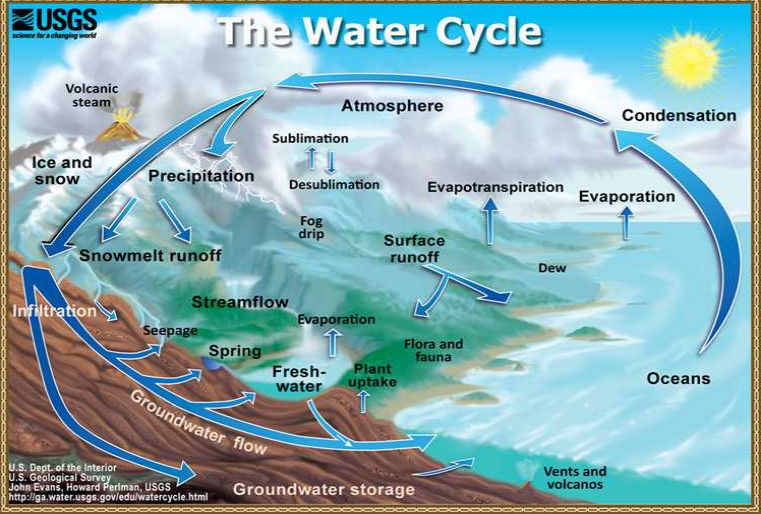
FEATURES



EVENTS



PROCESSES

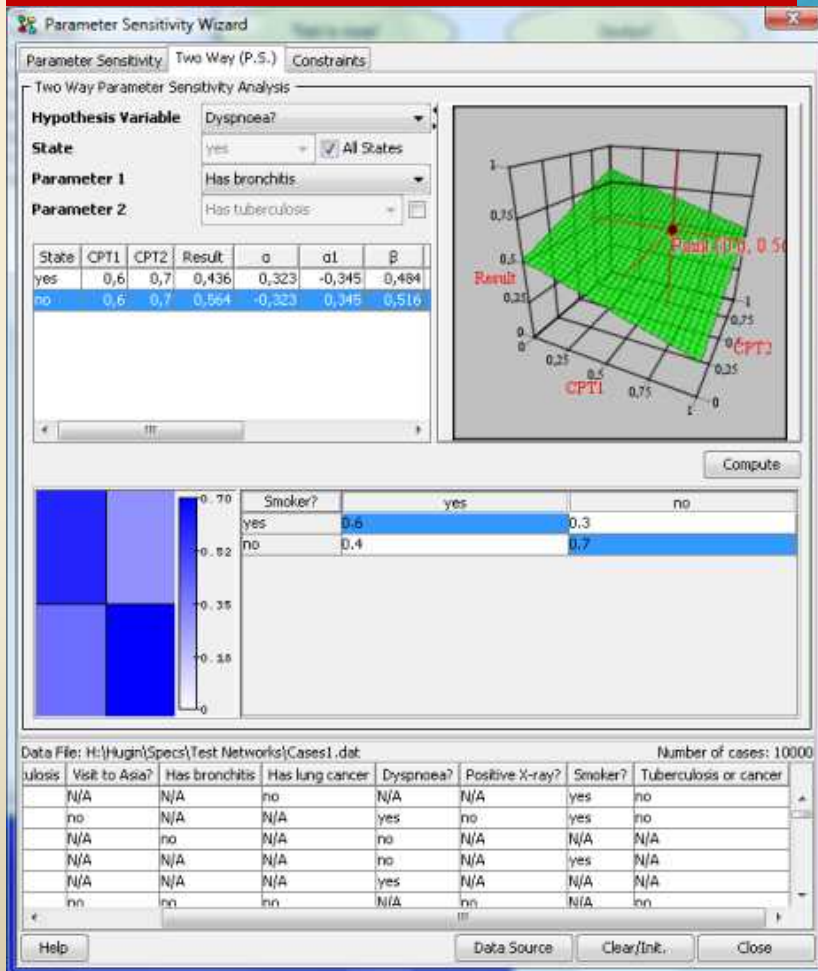


CATALOGS



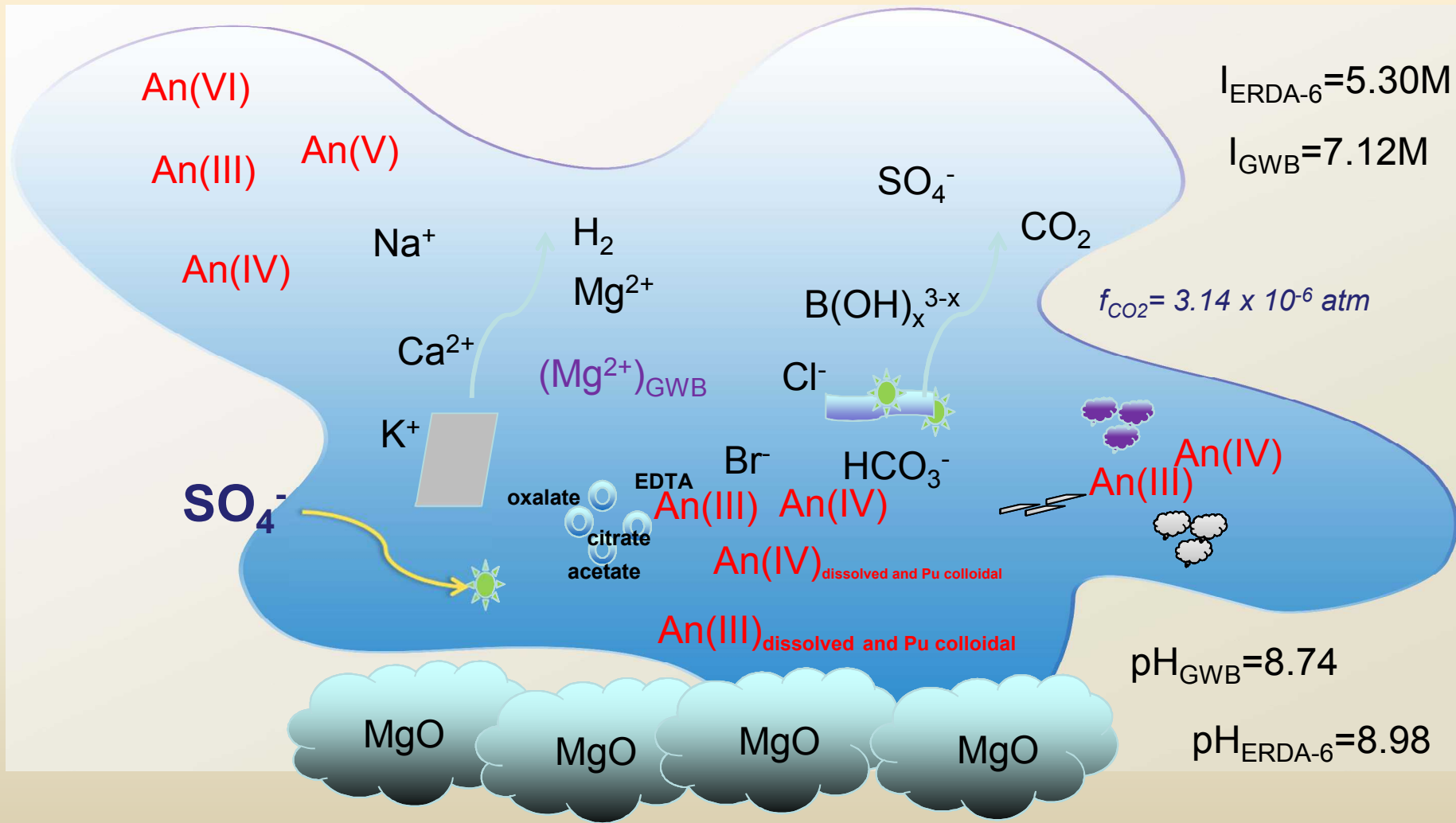
Uncertainty Analysis Workshop

Quantification of Uncertainty



Sensitivity Analysis

ABC Salt Workshops

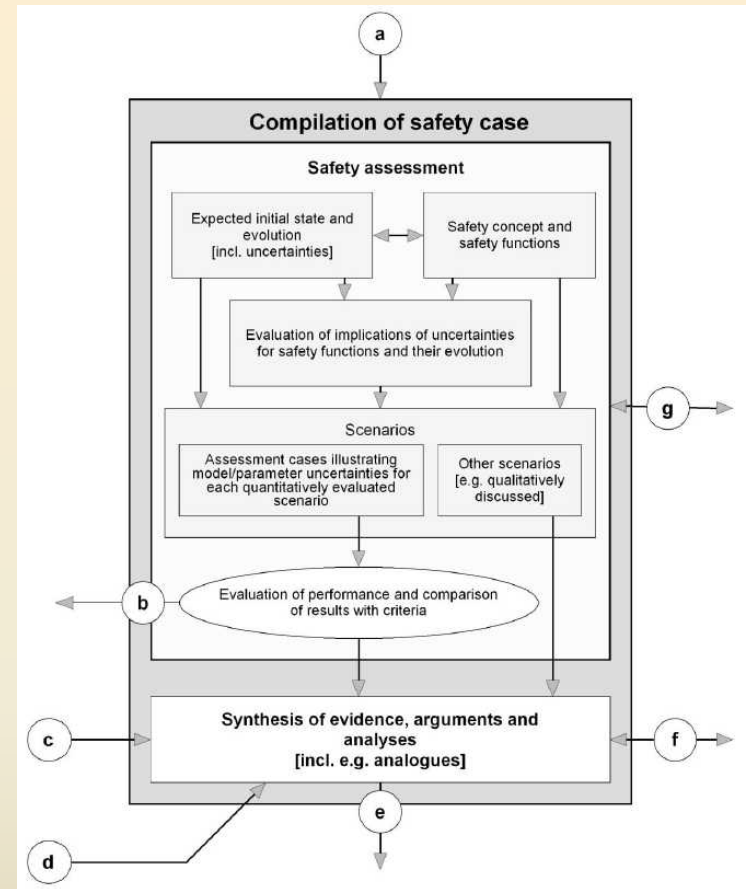


TOP-DOWN?

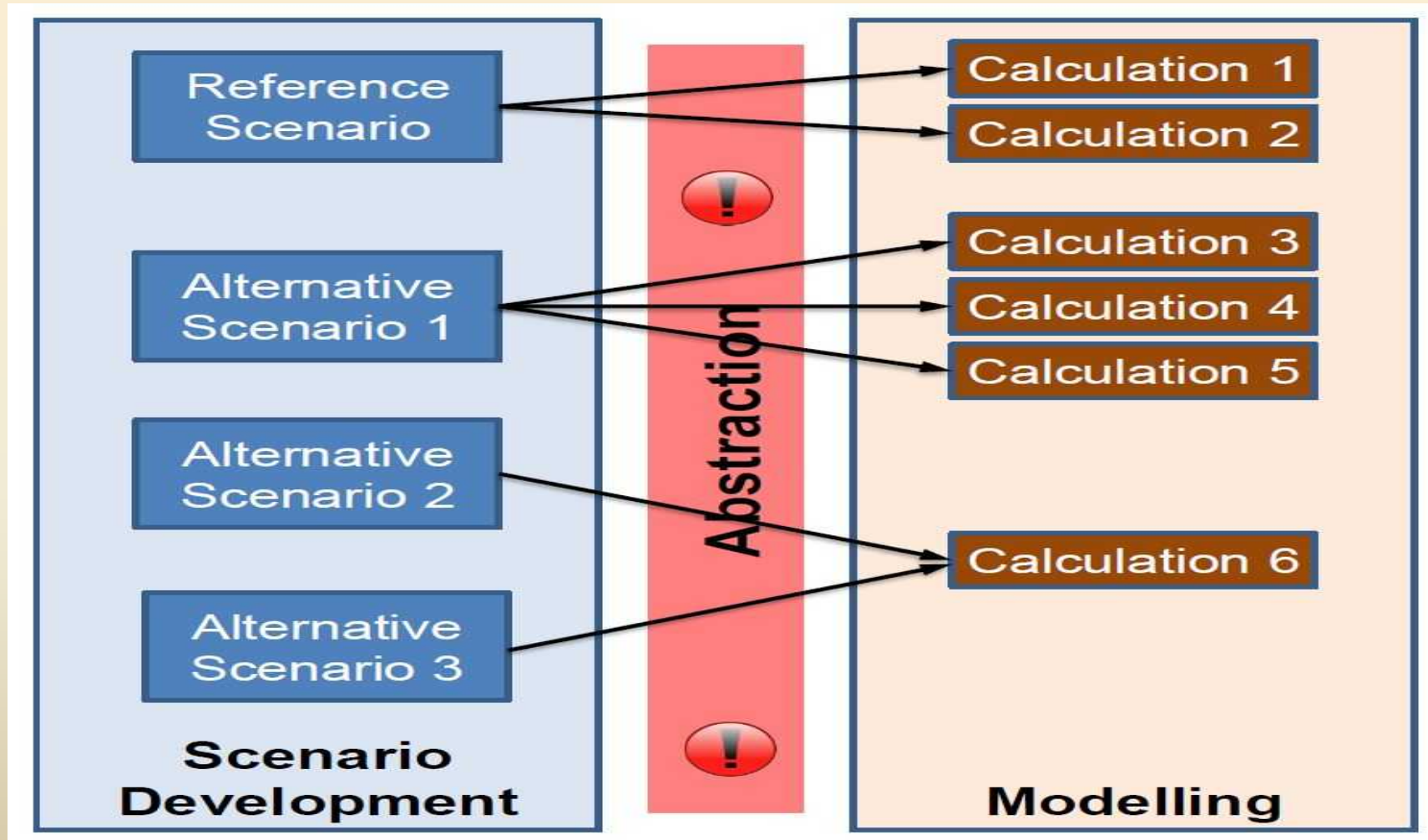
Take the safety concept and the safety functions of the disposal system as their starting point.

BOTTOM-UP?

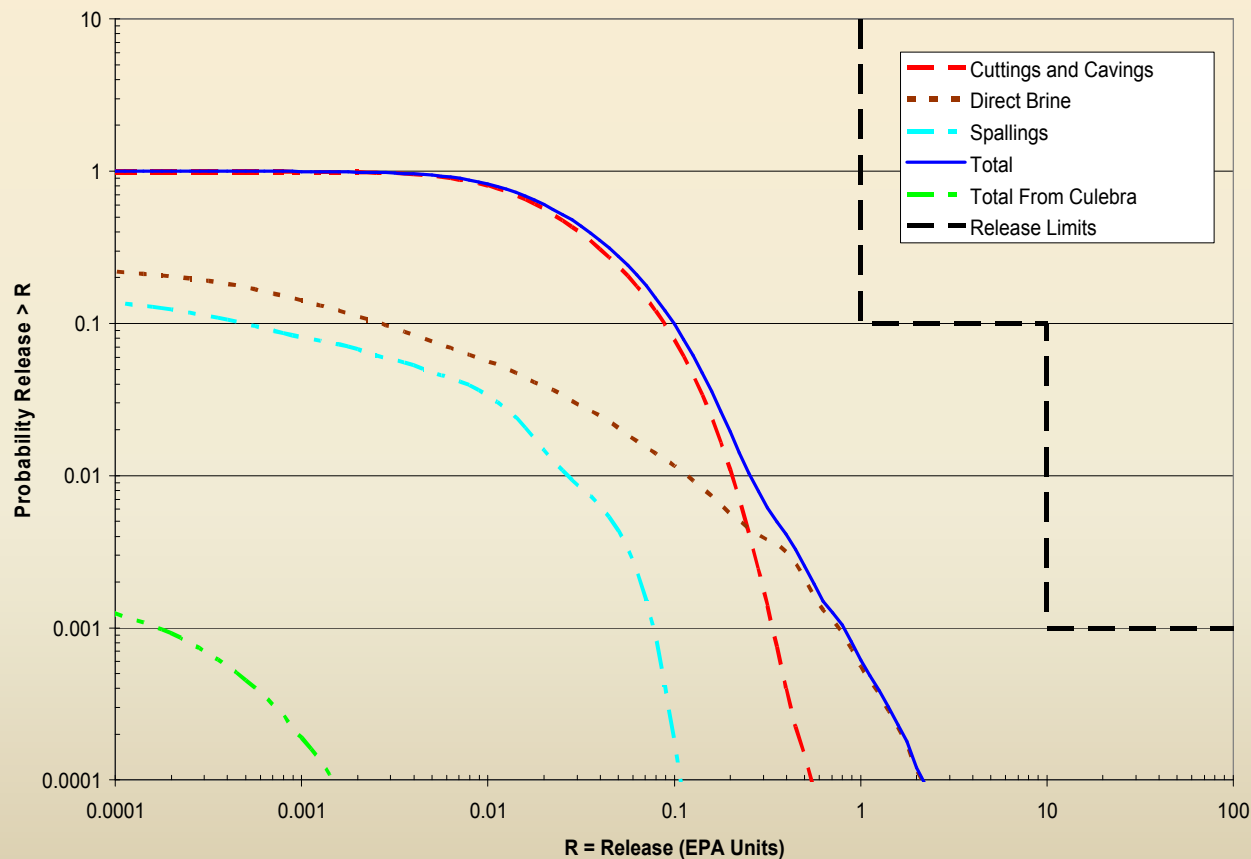
Start with a phenomenological system description based on the available scientific and technical knowledge concerning FEPs and their interaction.



DETERMINISTIC?



PROBABILISTIC?

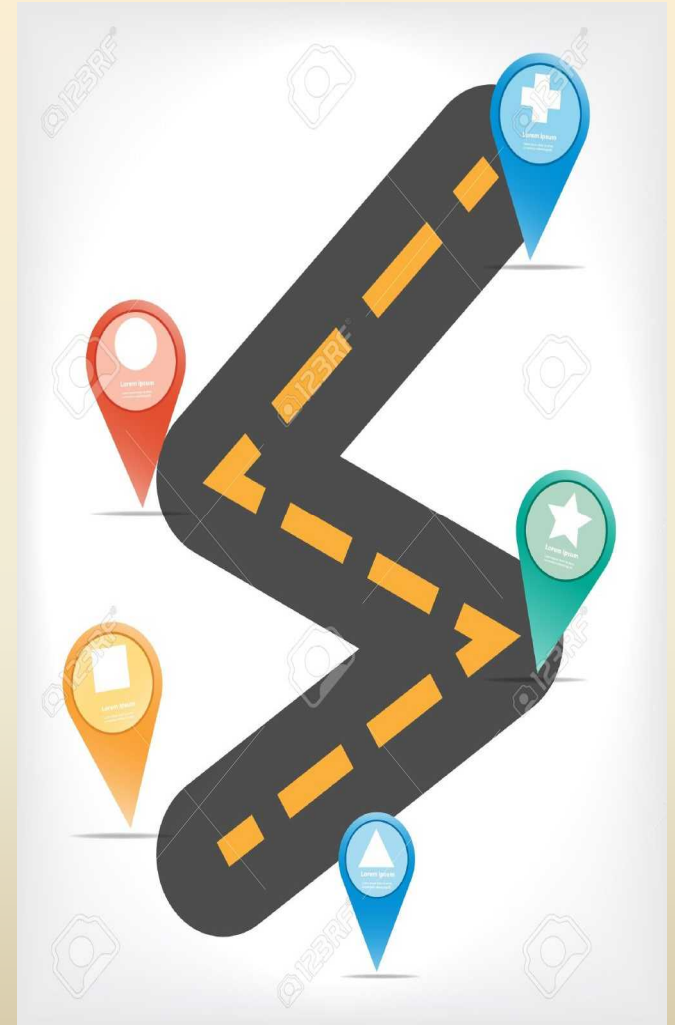


← *Less than 1 chance in 10 of exceeding 1 EPA unit*

← *Less than 1 chance in 1000 of exceeding 10 EPA units*

IAEA URF Network

- **Roadmap has 3 major uses:**
 - Reach a consensus by the URF Network on the set of activities and technologies needed for repository development
 - Provide a vehicle to forecast training and workshop needs
 - Provides a framework to help plan and coordinate URF Network activities



IAEA URF Network - Roadmap

- Describe the different phases and activities in a repository development program for the disposal of HLW/SNF
- Identify the links between research and development (R&D) conducted in URLs and the overall repository development program
- Describe the role of URLs in the development of new repository technologies and provide examples of these technologies
- Construct detailed matrix of repository development phases and activities



Mechanism for Collaboration

- Work For Others Agreements
- Memoranda of Understanding
- Participation in IAEA and NEA events

USING THESE MECHANISMS SANDIA HAS BEEN ABLE TO LEVERAGE ITS SCIENCE AND TECHNOLOGY BY INTERNATIONAL COLLABORATION VIA AN ACTIVE PARTICIPATION WITH INTERNATIONAL PROGRAMS IN DEEP GEOLOGIC DISPOSAL

Conclusion

