SAND2013-1815P

Exceptional service in the national interest

Sandia National Laboratories

Day 1 Breakout Group Instructions
Salt R&D Workshop

S. David Sevougian

Workshop on Advancing the Science and Engineering
Supporting Deep Geologic Disposal of Nuclear Waste in Salt

Albuquerque, NM, USA
March 6, 2013

U.S. DEPARTMENT OF ENERGY
NNSA National Nuclear Security Administration

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Major Tasks of the Breakout Groups

1) Review strawman RD&D issue list and the associated importance ratings—provide comments/revisions as necessary
2) For high importance (H) items that are not currently being addressed by UFD RD&D tasks, define specific activities/ tests/modeling needed to advance the state of the art
3) Answer questionnaire for each newly proposed activity/test/model
4) If time is available, define specific activities/tests/modeling for medium importance (M) items
5) Breakout group division:
   - Group 1: Concentrate on issue resolution and test design from a postclosure perspective (EBS postclosure processes within the excavation and NBS postclosure processes in the host salt formation)
   - Group 2: Concentrate on issue resolution and test design from a preclosure perspective (design, demonstration, and preclosure)

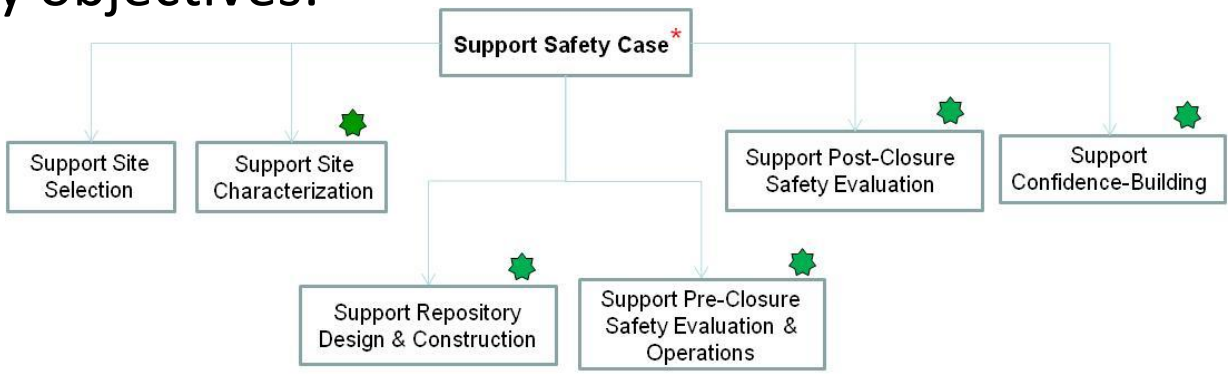
Basis for Formulation of R&D Issue List

Sandia National Laboratories

- Sources for Salt R&D Issues:
  - UFD R&D Roadmap and FEPs list
  - Hansen and Leigh 2011
  - Hansen memo (handout) and Hansen 2013 IHLRWMC paper
  - SDDI proposal
  - SDI proposal
  - Gorleben FEPs list
  - Expert judgment
- In a safety or licensing case, *all* R&D issues and FEPs must ultimately be addressed with technical arguments and evidence:
  - But at this earlier stage of the safety case (still generic) and with the currently limited resources, prioritization of issues for R&D is important
  - Existing broad technical basis for salt (WIPP, Germany) implies a reduced set of high importance issues, with most of those related to the effects of heat generation

General Basis for Importance Ratings of Issues

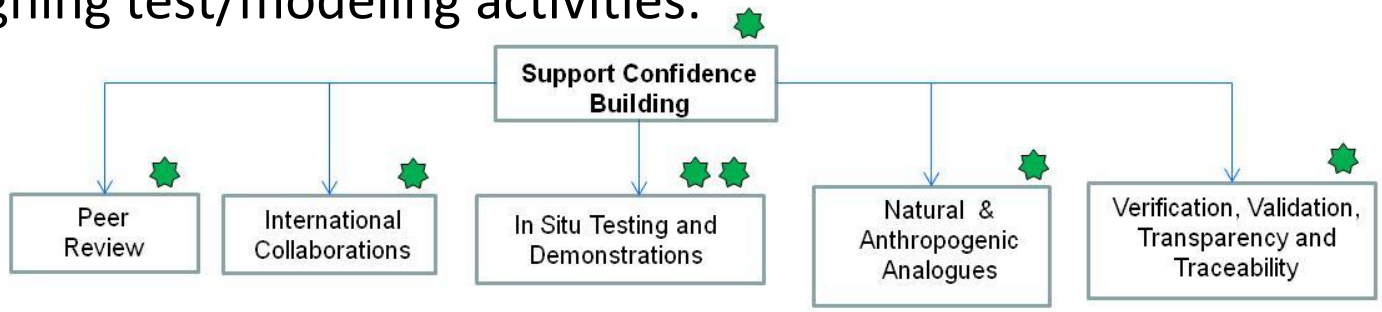
- What determines "importance"? This refers to importance to achieving a *successful safety case*, which has the following primary objectives:



- Strawman salt R&D issue list is primarily based on importance to *postclosure safety* ("…arguably the most important part of the safety case..." NWTRB 2011):
  - Postclosure safety and repository design are strongly linked in that the repository design should facilitate safety—but they are rated as two separate objectives here and in the R&D Roadmap
  - Design is also important in the preclosure stage

General Basis for Importance Ratings (cont.)

- *Confidence-building* is the other key objective to be considered in designing test/modeling activities:



  - Can be used to refine/revise the strawman R&D list, e.g., to move a current "M" issue to an "H" level, based on current *"state-of-the-art" knowledge:*
    - Confidence-building activities (or any R&D activities) are more justified for an "M" issue with high parameter/model uncertainty than for an "H" issue with low uncertainty—"state-of-the art" evaluation is included in the questionnaire
  - Confidence-building activities are critical to a subset of key stakeholders
- Decision-makers will decide what weight or importance to give to the confidence-building objective versus the postclosure safety objective:
  - Given a more mature technical basis, confidence-building activities may receive a higher rating than FEPs-specific R&D activities (e.g., constituitive model development)

SE-like Process for Importance Ratings of Issues

Define *Objectives*
(e.g., support postclosure safety, design)

Define System *Functions*
(e.g., containment, limited releases)

Define evaluation *criteria and metrics*
(e.g., "impact")

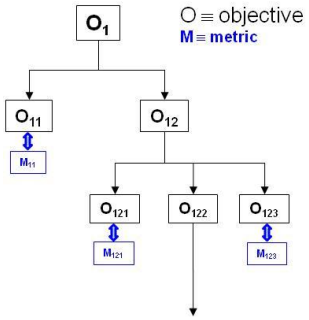
Pose the *Issues* and/or Issue Resolutions (e.g., test activities)

Assess issues (and/or activities) based on metric(s)

Define the best set of *R&D activities*

- **Stakeholder Input:**

- **Decision Framework:**



System Functions and Impact Metric

- **Postclosure Safety and Design Functions**:

Function	Type	Importance	Definition	Examples of Key Associated Parameter(s) or Characteristic(s)
Isolation/stability	Safety	Primary (P)	Aspects of the repository that isolate the waste and the EBS from external events or changes, and therefore help maintain the integrity and longevity of the barriers.	(high) seal integrity; (thick) host rock zone horizon; non-communication between salt beds and interbeds
Containment	Safety	Primary (P)	Aspects of the repository that prevent fluid contact with the waste.	(very low) permeability
Limited or delayed releases	Safety	Secondary (S)	Aspects of the repository that reduce the transfer of radionuclides to the accessible environment after the containment function is compromised.	(high) sorption, (low) solubility, (low) dissolution rates
Retrievability	Design	Primary (P)	Aspects of the repository that allow for retrievability of the emplaced waste without any releases, for a specified period of time after closure.	(sufficient) WP thickness

- **Impact of an R&D Issue on Performance of a Safety/Design Function (for process/parameter issues), or on Confidence in the Demonstration of that Performance (for models or *in situ* tests):**

Impact of an R&D Issue on the Performance of a Postclosure Safety or Design Function	
D	Direct and potentially significant impact on the success of a safety or design function
I	Indirect but potentially significant impact on the success of a safety or design function
W	Weak impact (whether direct or indirect) on the success of a safety or design function

Importance Value Ratings and Issue Categories

- **Importance Value Ratings (H, M, or L) for R&D Issues (based on function type and impact category)**:

Impact of Issue \ Function Type	Primary (P) safety function	Secondary (S) safety function
Direct (D) impact	High	Low
Indirect (I) impact	Medium	Low
Weak (W) impact	Low	Low

(Note: An R&D Issue receives a rating according to its highest function-impact combination, i.e., it may receive an L rating for one function but if it gets an H for another function, it inherits that highest rating.)

- R&D Issue categories:
  - Feature/process issues (this is the focus of the breakout groups)
  - Modeling issues
  - *In-Situ* Testing/Design/Operations Issues
  - Confidence-Building Issues

Salt R&D Feature/Process Issues

Sandia National Laboratories

(Please concentrate on your assigned issues but look at all issues)

R&D Technical Issue	Issue Importance Rating (H = High, M = Medium, L = Low) Based on (impact, function type) High Heat Load ratings	Explanation of Issue Importance Rating	Safety Objective: D = Design & Construction PrSO = Preclosure Safety & Operations, PoS = Postclosure Safety	Breakout Group: 1 = Postclosure 2 = Preclosure & Design 3 = Field Testing	Current UFD Salt R&D Activity
Wastes and Engineered Features (EBS) Feature/Process Issues					
1. Inventory and WP Loading	M (= I,P)	Indirectly related to limited and delayed releases through elemental composition of inventory (L = I,S), but also indirectly related to containment (permeability) through heat loading density and associated affects (M = I,P)	D, PrSO, PoS	2	
2. Physical-chemical properties of crushed salt backfill at emplacement	M (= I,P)	Indirectly related to the final state of the backfill permeability (containment function of the backfill)	D, PrSO, PoS	1, 2	
3. Changes in physical-chemical properties of crushed salt backfill after waste emplacement	H (= D,P)	Directly related to maintaining the containment function of the backfill by directly changing its permeability	D, PrSO, PoS	1, 2	3.1 3.2 4.4
4. Changes in chemical characteristics of brine in the backfill and EBS	M (= I,P)	Indirectly related to backfill permeability through WP corrosion and subsequent gas generation (M) Indirectly related to limited and delayed releases (L)	D, PoS	1	3.6 4.4
5. Mechanical response of backfill	H (= D,P)	Directly related to host rock permeability in the EDZ and to backfill permeability (i.e., to containment)	D, PrSO, PoS	2	3.1 3.2 4.4
6. Impact of mechanical loading on performance of the WP	H (= D,P)	Directly related to retrievability	D, PoS	2	

Salt R&D Feature/Process Issues (cont.)

Sandia National Laboratories

R&D Technical Issue	Issue Importance Rating (H = High, M = Medium, L = Low) Based on (impact, function type) High Heat Load ratings	Explanation of Issue Importance Rating	Safety Objective: D = Design & Construction PrSO = Preclosure Safety & Operations, PoS = Postclosure Safety	Breakout Group: 1 = Postclosure 2 = Preclosure & Design 3 = Field Testing	Current UFD Salt R&D Activity
Wastes and Engineered Features (EBS) Feature/Process Issues					
7. Brine and vapor movement in the backfill and emplacement drift, including evaporation and condensation	H (= D, P)	Brine and vapor movement in the EBS are directly related to containment by definition (fluid contact with waste), although this movement is much less likely after WP breaching (i.e., after the thermal period). Brine and vapor movement in the EBS can indirectly result in changes to backfill permeability (containment)—through gas generation from WP corrosion or through trapping of water during consolidation	D, PrSO, PoS	1, 2	4.4
8. Corrosion performance of the waste package	M = (I,P)	Only indirectly related to retrievability; Also, the waste package is not designed for long-term postclosure containment or limited and delayed releases in a salt repository	D, PoS	1	2 3.5 3.6
9. Mechanical and chemical degradation of the waste forms	L (= D,S)	Both directly (chemical) and indirectly (mechanical) related to limited and delayed releases	D, PoS	1	
10. Brine flow through waste package	L (= D,S)	Directly related to limited and delayed releases	D, PoS	1	
11. Changes in chemical characteristics of brine in the waste package	L (= I,S)	Indirectly related to limited and delayed releases		1	3.6
12. Radionuclide solubility in the waste package and EBS	L (= D,S)	Directly related to limited and delayed releases	D, PoS	1	3.7
13. Radionuclide transport in the waste package and EBS	L (= D,S)	Directly related to limited and delayed releases	D, PoS	1	

Salt R&D Feature/Process Issues (cont.)

Sandia National Laboratories

R&D Technical Issue	Issue Importance Rating (H = High, M = Medium, L = Low) Based on (impact, function type) High Heat Load ratings	Explanation of Issue Importance Rating	Safety Objective: D = Design & Construction PrSO = Preclosure Safety & Operations, PoS = Postclosure Safety	Breakout Group: 1 = Postclosure 2 = Preclosure & Design 3 = Field Testing	Current UFD Salt R&D Activity
Natural Barriers (Host Rock and EDZ) Feature/Process Issues					
14. Stratigraphy and physical-chemical properties of host rock	H (= D,P)	Directly related to isolation; characteristics of interbeds and nature of underlying and overlying beds are important to design	D, PrSO, PoS	2	Site-specific
15. Changes in physical-chemical, properties of host rock due to excavation, thermal, hydrological, and chemical effects	H (= D,P)	Directly related to host rock and EDZ permeability (containment)	D, PrSO, PoS	1, 2	2 3.3 4.3 4.4
16. Mechanical response of host rock due to excavation (e.g., roof collapse, creep, drift deformation)	H (= D,P)	Directly related to host rock and EDZ permeability (containment)	D, PrSO, PoS	2	3.3 4.3 4.4
17. The formation and evolution of the EDZ	H (= D,P)	Directly related to permeability (containment) of the EDZ host rock zone	D, PrSO, PoS	2	4.4
18. Brine and vapor movement through the host rock and EDZ, including evaporation and condensation	H (= D, P)	Brine and vapor movement through the host rock and EDZ are directly related to containment by definition (fluid contact with waste), although this movement is much less likely after WP breaching (i.e., after the thermal period). Also, can indirectly result in changes to host rock and backfill permeability (containment) due to gas generation (from WP corrosion)	D, PoS	1, 2	3.4 4.4
19. Chemical characteristics of brine in the host rock	L (= I,S)	Indirectly related to limited and delayed releases	PoS	1	
20. Changes in chemical characteristics of brine in the host rock and EDZ	M (= I, P)	Indirectly related to limited and delayed releases (L) but also indirectly related to permeability (containment) through the possible effects of gas generation (fracturing)	D, PoS	1	4.4

Salt R&D Feature/Process Issues (cont.)

Sandia National Laboratories

R&D Technical Issue	Issue Importance Rating (H = High, M = Medium, L = Low) Based on (impact, function type) High Heat Load ratings	Explanation of Issue Importance Rating	Safety Objective: D = Design & Construction PrSO = Preclosure Safety & Operations, PoS = Postclosure Safety	Breakout Group: 1 = Postclosure 2 = Preclosure & Design 3 = Field Testing	Current UFD Salt R&D Activity
Natural Barriers (Host Rock and EDZ) Feature/Process Issues					
21. Radionuclide solubility in the host rock and EDZ	L (= D,S)	Directly related to limited and delayed releases	PoS	1	3.7
22. Radionuclide transport in the host rock and EDZ	L (= D,S)	Directly related to limited and delayed releases	PoS	1	
Repository System (EBS and NBS combined) Feature/Process Issues					
23. Thermal response of EBS and Geosphere (heat transfer from waste and waste packages into the EBS and Geosphere)	H (= D,P)	Constituitive behavior of salt is a strong function of temperature. Therefore, this issue has a direct effect on mechanical evolution of the EDZ and backfill, which strongly impacts permeability (containment).	D, PrSO, PoS	2	3.2 4.4
24. Buoyancy of the waste packages	L (= W,P)	Weakly related to isolation	D, PoS	2	
25. Gas generation and potential physical impacts to backfill, EDZ, and host rock	M = (I,P)	Indirectly related to permeability changes (i.e., to containment) through possible rock fracturing	D, PrSO, PoS	1	
26. Microbial activity in the waste package, EBS, and host rock (including EDZ)	L (= I,S)	Indirectly related to limited and delayed releases	PoS	1	
27. Colloid formation and transport in the waste package, EBS, and host rock (including EDZ)	L (= D,S)	Directly related to limited and delayed releases	PoS	1	
28. Performance of seal system	H (= D,P)	Directly related to isolation of the repository	D, PoS	2	
29. Performance of ground support	L = (W,P,S)	Only weakly related to the safety and design functions	D, PrSO, PoS	2	
30. Performance and effects of ventilation	M (= I,P)	Indirectly related to containment (permeability) through the availability and movement of fluids, which may cause gas generation (and subsequent fracturing) Indirectly related to limited and delayed releases through the removal of fluid available for transport of radionuclides	D, PrSO, PoS	2	

R&D Issues Crosswalked to UFD FEPs

- Handout that provides additional information about issues
- Example page:

R&D Technical Issue	Issue Importance Rating (H = High, M = Medium, L = Low) Based on (impact, function type)	UFD FEP Crosswalk	Safety Objective: D = Design & Construction PrSO = Preclosure Safety & Operations, PoS = Postclosure Safety	Breakout Group: 1 = Postclosure 2 = Preclosure & Design 3 = Field Testing	Current UFD Salt R&D Activity
Natural Barriers (Host Rock and EDZ) Feature/Process Issues					
17. The formation and evolution of the EDZ	H (= D,P)	1.1.02.02 Mechanical Effects from Preclosure Operations - In EBS - In EDZ - In Host Rock 1.1.02.03 Thermal-Hydrologic Effects from Preclosure Operations - In EBS - In EDZ - In Host Rock 2.1.07.10 Mechanical Degradation of EBS 2.2.01.01 Evolution of EDZ - Salt 2.2.07.01 Mechanical Effects on Host Rock - Salt 2.1.07.02 Drift Collapse - Drift deformation (EDZ) 2.2.08.06 Flow Through EDZ - Salt 2.2.08.07 Mineralogic Dehydration - Salt 2.2.09.01 Chemical Characteristics of Groundwater in Host Rock - Salt 2.2.09.03 Chemical Interactions and Evolution of Groundwater in Host Rock - Salt 2.2.11.04 Thermal Effects on Chemistry and Microbial Activity in Geosphere - Salt 2.2.11.06 Thermal-Mechanical Effects on Geosphere - Salt 2.2.11.07 Thermal-Chemical Alteration of Geosphere - Salt 2.2.12.02 Effects of Gas on Flow Through the Geosphere - Salt	D, PrSO, PoS	2	4.4

Test Questionnaire
(answer as many questions as you can)

Sandia National Laboratories

1) Name of Test:
2) Test Objectives, Description, and Type (lab, field, etc.):
3) R&D Issue(s) Addressed by Test:
4) Safety case objectives addressed by test (e.g., postclosure safety; preclosure safety; confidence building) and why the test is important to the safety case:
   - List objectives in order of applicability (e.g., 1. Postclosure safety, 2. Confidence-building, etc.)
5) For the proposed test describe the current "state of the art" knowledge regarding the issue(s) it addresses; in other words, why is this data necessary?
6) Define the data that will be collected/measured (e.g., name and description of process(es)/parameter(s), time duration, spatial scale, frequency, accuracy):
   - Describe how the data will be collected
7) Define the instrumentation that will be used to measure process(es)/ parameter(s) and define the instrumentation placement or layout:

Test Questionnaire (cont.)
(answer as many questions as you can)

Sandia National Laboratories

8) Define the pre-and post-test modeling/simulation needs for the activity, including:
   - Description and type of model addressed by test (constituitive; process; coupled process; N/A if testing for constructability)

9) List system features involved in test (e.g., waste package; backfill; seal system; EDZ; pristine host rock; etc.):

10) Time period of applicability for data gathered: pre-emplacement; preclosure, postclosure:
   - E.g., data gathered applies to processes occurring during first 300 years after closure; data gathered applies to processes that occur over 10,000 years after closure; etc.

11) For field tests define additional lab tests or other separate activities/data needed to support this test:

R&D Modeling Issues

Sandia National Laboratories

R&D Technical Issue	Issue Importance Rating (H = High, M = Medium, L = Low) Based on (impact, function type) High Heat Load ratings	Explanation of Issue Importance Rating	Safety Objective: D = Design & Construction PrSO = Preclosure Safety & Operations, PoS = Postclosure Safety	Breakout Group: 1 = Postclosure 2 = Preclosure & Design 3 = Field Testing	Current UFD Salt R&D Activity
Modeling Issues					
31. Appropriate constituitive models (e.g., Darcy flow; effective stress)	H (= D,P)	Direct impact on the confidence in the demonstration (modeling) of performance of primary safety functions	D, PoS		
32. Appropriate representation of coupled processes in process models	H (= D,P)	Direct impact on the confidence in the demonstration (modeling) of performance of primary safety functions	D, PoS		4.4
33. Appropriate representation of coupled processes in TSPA model	H (= D,P)	Direct impact on the confidence in the demonstration (modeling) of performance of primary safety functions	PoS	1, 2, 3	4.2 4.4
34. Appropriate inclusion and scaling/representation of spatially and temporally varying processes and features in process and TSPA models	H (= D,P)	Direct impact on the confidence in the demonstration (modeling) of performance of primary safety functions	D, PoS	1, 2, 3	4.2 4.4
35. Efficient and high performance computing of three-dimensional, spatially and temporally varying processes	M (= I,P)	Indirect impact on demonstrating the importance of primary safety functions	PoS	1, 2, 3	4.2
36. Efficient uncertainty quantification and sensitivity analysis methods	M (= I,P)	Indirect impact on demonstrating the importance of primary safety functions	PoS	1, 2, 3	
37. Verification and validation	H (= D,P)	Direct impact on the confidence in the demonstration (modeling) of performance of primary safety functions	PoS	1, 2, 3	4.3
38. Data and results management	H (= D,P)	Direct impact on confidence (QA)	D, PrSO, PoS	1, 2, 3	1

R&D *In-Situ* Testing/Design/Operations Issues

R&D Technical Issue	Issue Importance Rating (H = High, M = Medium, L = Low) Based on (impact, function type) High Heat Load ratings	Explanation of Issue Importance Rating	Safety Objective: D = Design & Construction PrSO = Preclosure Safety & Operations, PoS = Postclosure Safety	Breakout Group: 1 = Postclosure 2 = Preclosure & Design 3 = Field Testing	Current UFD Salt R&D Activity
***In-Situ* Testing/Design/Operations Issues**					
39. Development of accurate instrumentation and methods for *in situ* testing and characterization	H (= D,P)	Direct impact on the confidence in the demonstration (modeling) of performance of the containment safety function, through measurements of in situ stresses and rock movement (H) and brine and vapor/gas movement (M)	PrSO, PoS	3	2.1 6.1 6.2
40. *In situ* demonstration and verification of repository design, with respect to its impact on the host rock and the ability to comply with preclosure and postclosure safety requirements.	H (= D,P)	Direct impact on the confidence in the demonstration of performance of the containment safety function	D, PrSO, PoS	3	
41. Demonstrate under representative conditions the integrated design functions of the waste package, backfill, host rock, and ventilation.	H (= D,P)	May not be possible in the time frame of an *in situ* test. Direct impact on the confidence in the demonstration of performance of the containment safety function	PoS	3	
42. Provide a full-scale benchmark for understanding coupled THMC processes and comparing measured system responses with model predictions and assumptions	H (= D,P)	Similar to Issue 37, Verification and Validation. Direct impact on the confidence in the demonstration (modeling) of performance of primary safety functions	PrSO, PoS	3	4.3

R&D Confidence-Building Issues

R&D Technical Issue	Issue Importance Rating (H = High, M = Medium, L = Low) Based on (impact, function type) High Heat Load ratings	Explanation of Issue Importance Rating	Safety Objective: D = Design & Construction PrSO = Preclosure Safety & Operations, PoS = Postclosure Safety	Breakout Group: 1 = Postclosure 2 = Preclosure & Design 3 = Field Testing	Current UFD Salt R&D Activity
Confidence-Building Issues					
43. Develop generic safety case	H	This is the fundamental documentation structure for demonstrating repository safety	D, PrSO, PoS	1, 2, 3	4.1
44. Comparisons to natural and anthropogenic analogs	H	It is the best way to validate long time-scale processes	PoS	1, 2, 3	
45. International peer review and collaboration	M	Adds credibility with the scientific community	D, PrSO, PoS	1, 2, 3	5
46. In-situ testing and demonstrations	H	Adds credibility with the political and scientific communities. Was rated H in Items 39-42	D, PrSO, PoS	1, 2, 3	
47. Verification, validation, transparency, and traceability	H	Essential for all nuclear waste programs	PrSO, PoS	1, 2, 3	
48. Qualitative arguments about the intrinsic robustness of site and design	M	Helpful for understanding and transparency	PoS	1, 2, 3	

All Reference Materials (handouts)

- Primary Handouts:
  - Salt R&D Issues table with importance ratings
  - Test proposal questionnaire

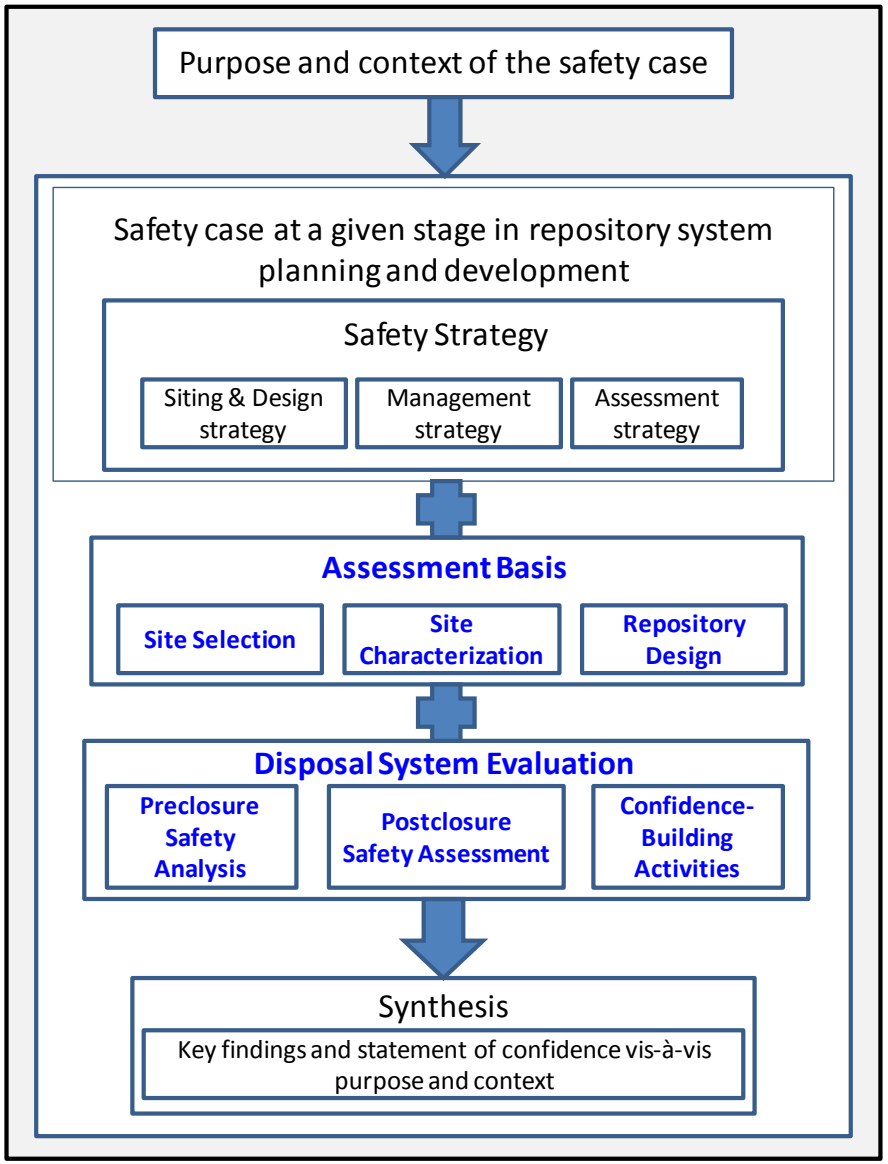
- Backup Material:
  - Table of R&D issues crosswalked to UFD FEPs
  - Table of FEPs considered in the formulation of the R&D issues for this workshop, along with "state of the art" explanations for each FEP from UFD Roadmap
  - Table of *all* UFD FEPs (208) from FCRD-UFD-2012-000320, Rev. 0
  - F. Hansen memo
  - SDDI Proposal
  - Hansen and Leigh 2011

Sandia National Laboratories

Backup Slides

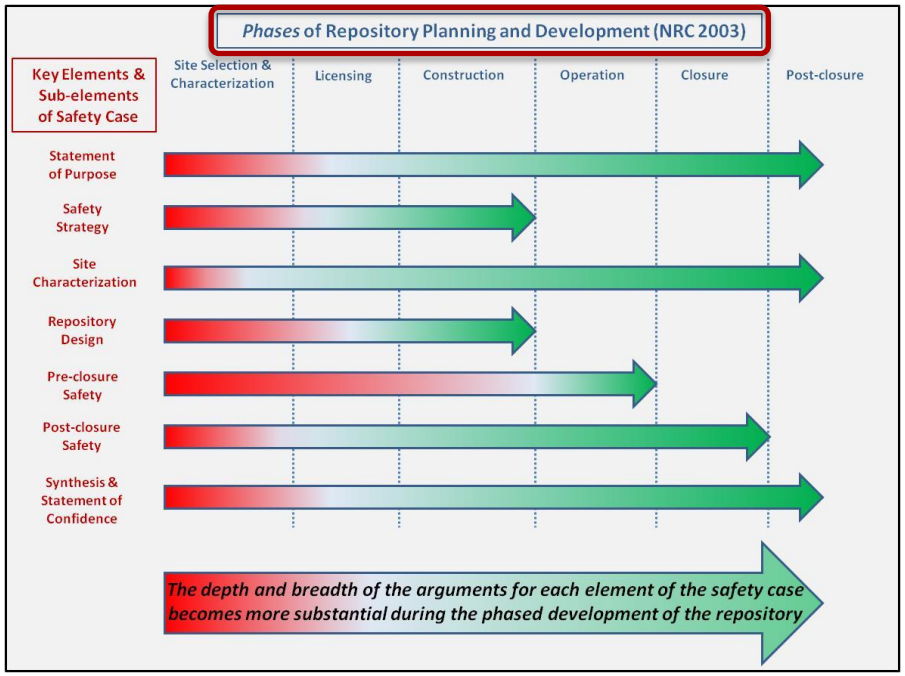
Elements of the Safety Case

- Purpose and Context
- Safety Strategy
- Assessment Basis
  - Site Selection
  - Site Characterization
    - Natural Barriers
  - Repository Design
    - Disposal Concept
    - Waste Inventory
    - Engineered Barriers
- Disposal System Evaluation
  - Preclosure Safety Analysis
  - Postclosure Safety Assessment
  - Confidence-Building Activities
- Synthesis of Findings
  - Statement of Confidence

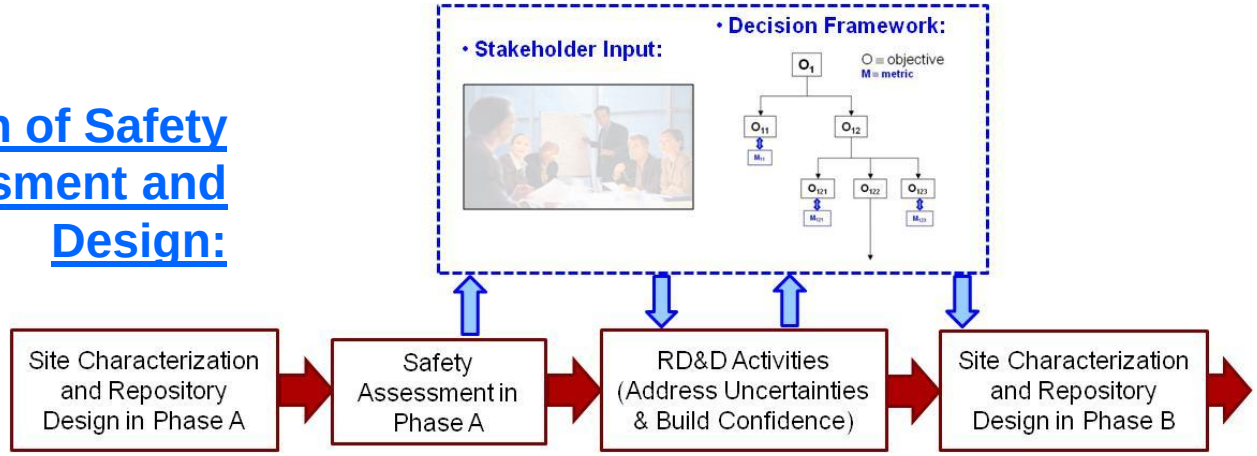


Evolution of the Safety Case

- Safety understanding and the associated technical bases evolve with phases of repository development
- Safety case provides a structured framework to assist in prioritizing the technical work in the next phase, to reduce uncertainties and enhance confidence



Iteration of Safety Assessment and Design:



Synthesis – the Case for Bedded Salt

Sandia National Laboratories

- Multiple barriers contribute to safety functions of waste isolation and containment, but the natural barrier alone is sufficient for the nominal scenario:

Natural barriers:

- Slow diffusion-dominated transport with sorption
- Long migration distance to receptor (undisturbed)
  - Host salt - very slow brine movement
  - Interbeds - absence of well-connected fractures

Transport to an aquifer in an undisturbed case will likely not occur

Engineered barriers:

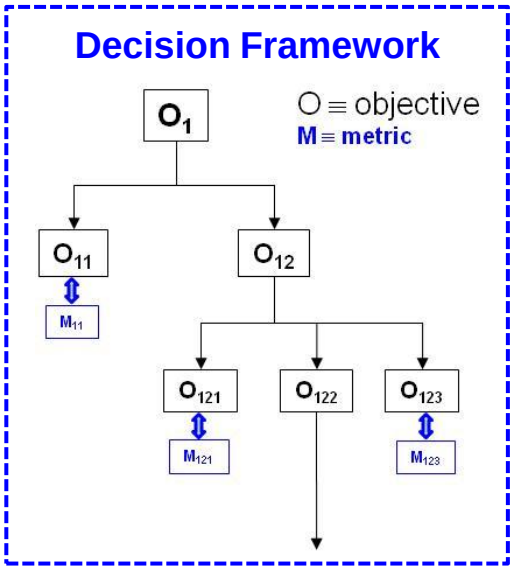
- Slow waste dissolution due to reducing chemistry
- Salt creep closure of repository and EDZ healing
  - Waste Package - performance credit not needed
  - Shaft Seals - effectiveness demonstrated at WIPP

Extensive engineered barriers are not necessary

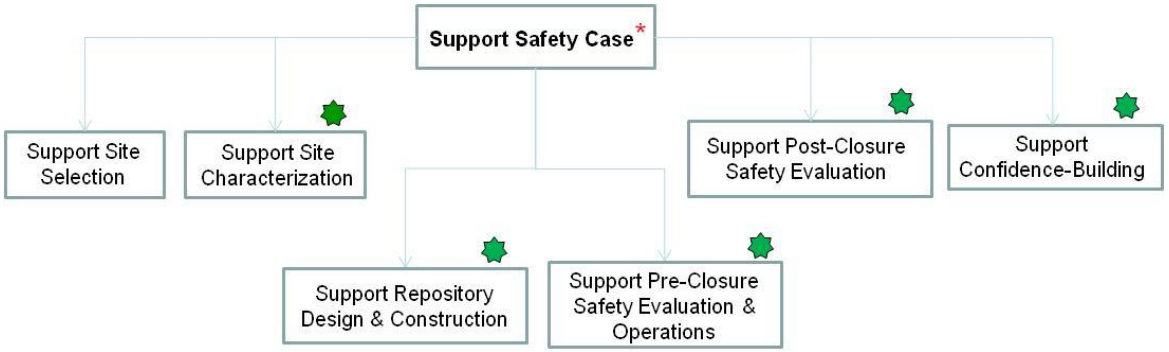
- Additional R&D to reduce uncertainties associated with thermal effects from heat-generating DOE HLW/SNF, e.g.,
  - Brine movement and vapor-phase transport; backfill reconsolidation; EDZ evolution; gas generation; radionuclide solubility; waste package buoyancy

Decision-Making Framework

- Building of Decision-Making Framework for RD&D Needs
  - Objectives Hierarchy and Criteria/Metrics
  - Use the Elements of the Safety Case as high-level objectives, i.e., *site characterization, repository design, preclosure safety, postclosure safety, and confidence-building*
  - Design metrics to measure ability to meet objectives, e.g., how important is an R&D need relative to the Safety Case: low (1), medium (2), high (3)
  - Identify alternatives, i.e., RD&D "projects" (see Roadmap) or RD&D "activities" for meeting the objectives

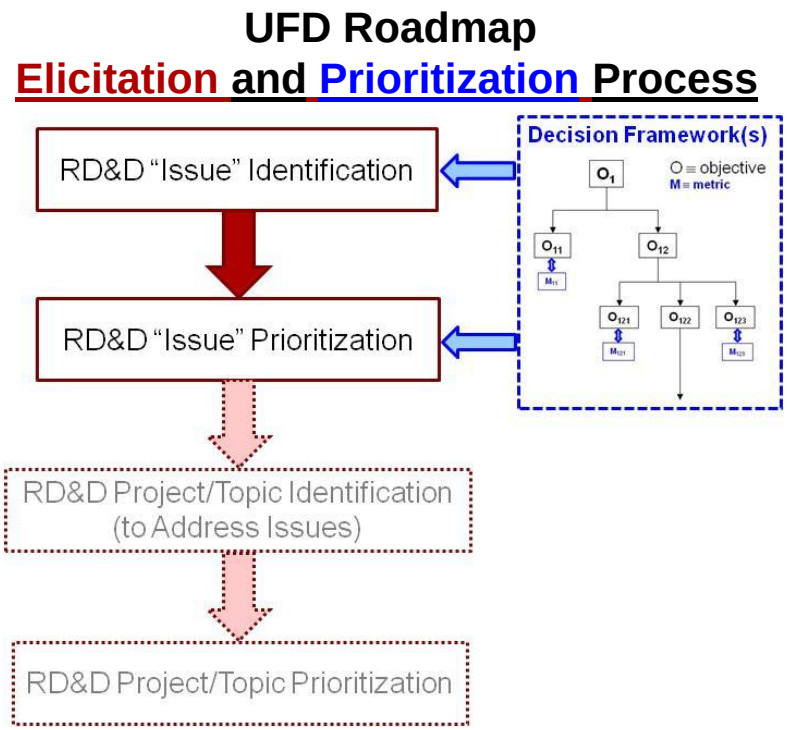


- High-Level Objectives for Salt RD&D:



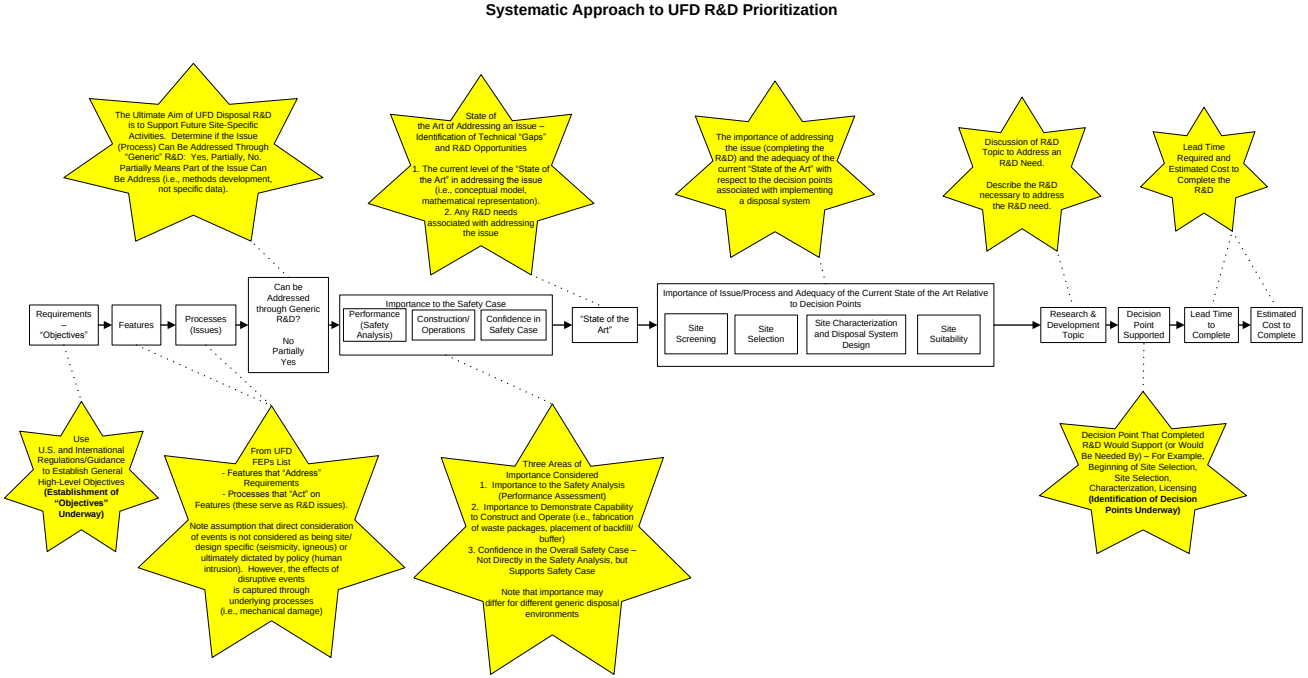
Related DOE R&D Prioritization Efforts: UFD Roadmap

- Prioritization of Salt RD&D could be conducted as a four-step process (similar to UFD Roadmap):
  - *Identification of RD&D "Issues"*
  - *Prioritization ranking of RD&D "Issues"*
  - *Identification of RD&D "projects" or "topics" to address "Issues"*
  - *Prioritization ranking of RD&D projects/topics*
- UFD Roadmap addressed the first two steps and provided an importance ranking for the identified set of RD&D issues for generic repositories in four possible host rock media
- UFD Roadmap stated that the last two steps—identifying and prioritizing RD&D projects/topics will be accomplished later



UFD Roadmap Objectives

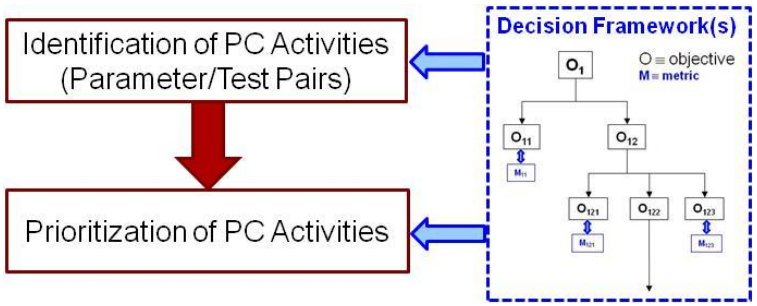
- Highest-level objectives (evaluation criteria) not explicitly stated but can inferred from the prioritization process:
  - Importance to safety assessment
  - Importance to design, construction, and operations
  - Importance to overall confidence in the safety case
  - Importance to one of four decision points (e.g., site screening, site selection, …)
  - Adequacy of current information to support a decision point



Related DOE R&D Prioritization Efforts: YMP Performance Confirmation

- Prioritization of Salt RD&D could be conducted as a two-step process (similar to YMP PC Plan):
  - *Identification of* PC parameters and associated tests (data acquisition methods) to measure them
  - Prioritization ranking of parameter/data-acquisition pairs (called "performance confirmation activities")
- Salt RD&D plan can directly use this PC two-step process by identifying "pairs" of salt RD&D needs and an associated test (data acquisition method) to address the need—called an RD&D "activity"
- Ok to identify more than one test to address an RD&D need—each need-test combination can be ranked
  - PC Plan usually had only one test per parameter but had up to six different test-parameter combinations for some parameters)

YMP Performance Confirmation Plan Elicitation and Prioritization Process



YM Performance Confirmation Objectives

- Four highest-level objectives (evaluation criteria) stated (but later implemented in a more complex fashion):
  - Sensitivity of total system performance and barrier capability to the parameter being measured
  - Confidence in the current representation of the parameter being measured
  - Accuracy of the proposed data acquisition method at measuring the parameter
  - Cost and difficulty of measuring the parameter (not used directly for total utility or score, but used later in a cost-benefit analysis)