A Regulator's Perspective on Assessing Temporal Uncertainty

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Overview

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- Uncertainty Overview
- Temporal Uncertainty in the Performance Assessment Process
  - Model Development
  - Performance Assessment Results
- Confidence in the Performance Assessment Results

Overview of Uncertainty

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…as we know, there are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns – the ones we don't know we don't know.

-- Former U.S. Secretary of Defense Donald Rumsfeld.

- Various methods to categorize uncertainty:
  - **Aleatoric** - unknowns that differ each time we run the same experiment (i.e., statistical variability)
  - **Epistemic** – unknowns that differ due to a lack of knowledge (e.g., unknown unknowns)
  - **Spatial** – unknowns that differ from location to location
  - **Temporal** – unknowns that differ over time

Temporal Uncertainty

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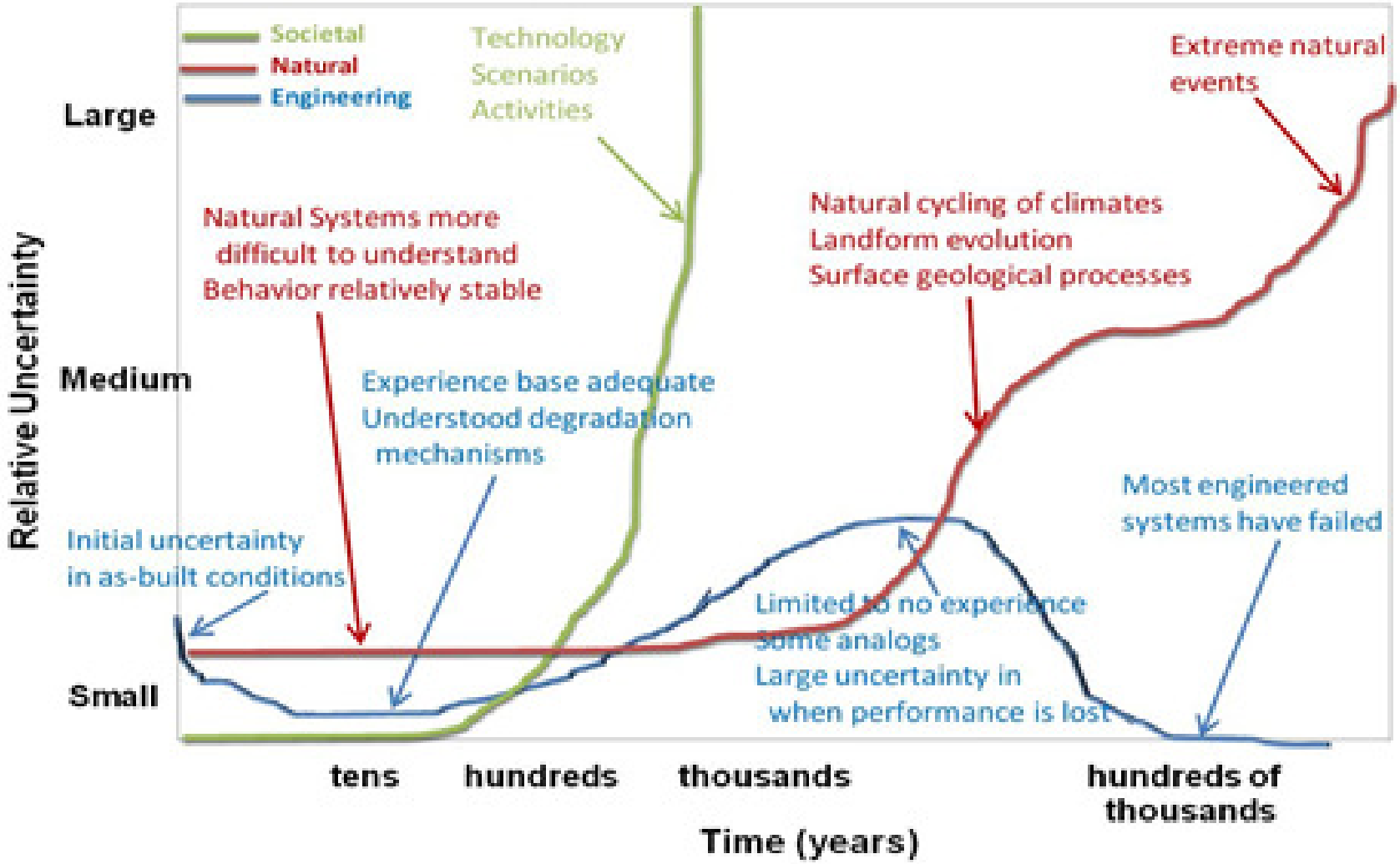

Temporal Uncertainty in the PA

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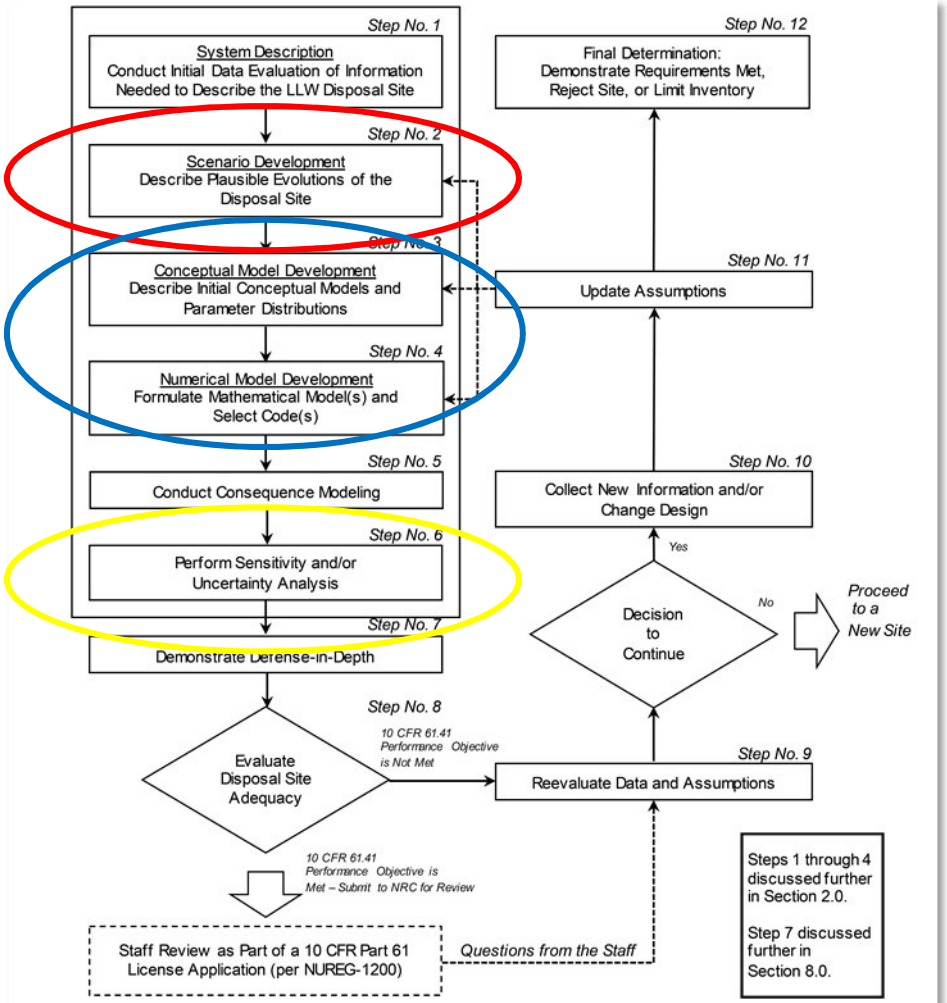

Figure 3-1 Example of a Performance Assessment Process

- Scenarios
- Modeling
- Interpretation of Results

- **Graded approach**

Modeling

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- Modeling should account for significant changes over time in site conditions.
- Uncertainty and variability can be managed through:
  - Probabilistic assessment (e.g., Monte Carlo)
  - Deterministic analyses with sensitivity analysis
  - Collection of more data
  - Alternative conceptual models
  - Use of pessimism
- Model support is important because uncertainty is always present!

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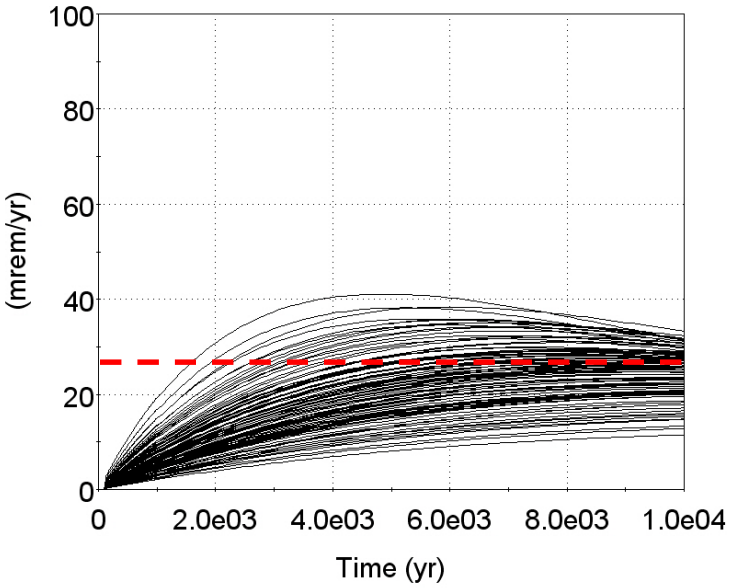
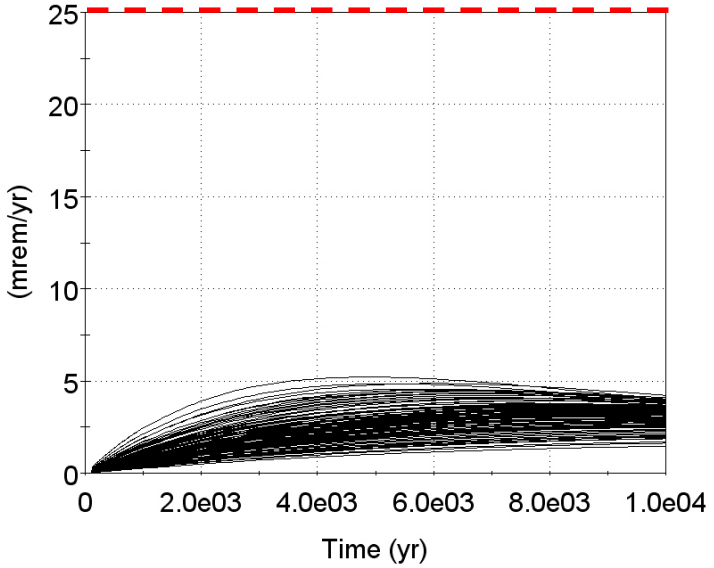
- Is model adequately supported by the *system description*?
- Is the *data sufficient* to support the model?
- Is variability in data adequately captured and lack of knowledge (i.e., *uncertainty*) of the system assessed?
- Has the impact of *model uncertainty* been evaluated?
- Is the *model output supported* by comparison to independent data?

Performance Assessment Results - Examples





- Does either result demonstrate compliance with 61.41?
  - Both may or both may not

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- What is the level of *confidence* in the results?
- Are there assumptions, events, processes that can materially affect the *magnitude or timing* of the doses?

Saltstone Example

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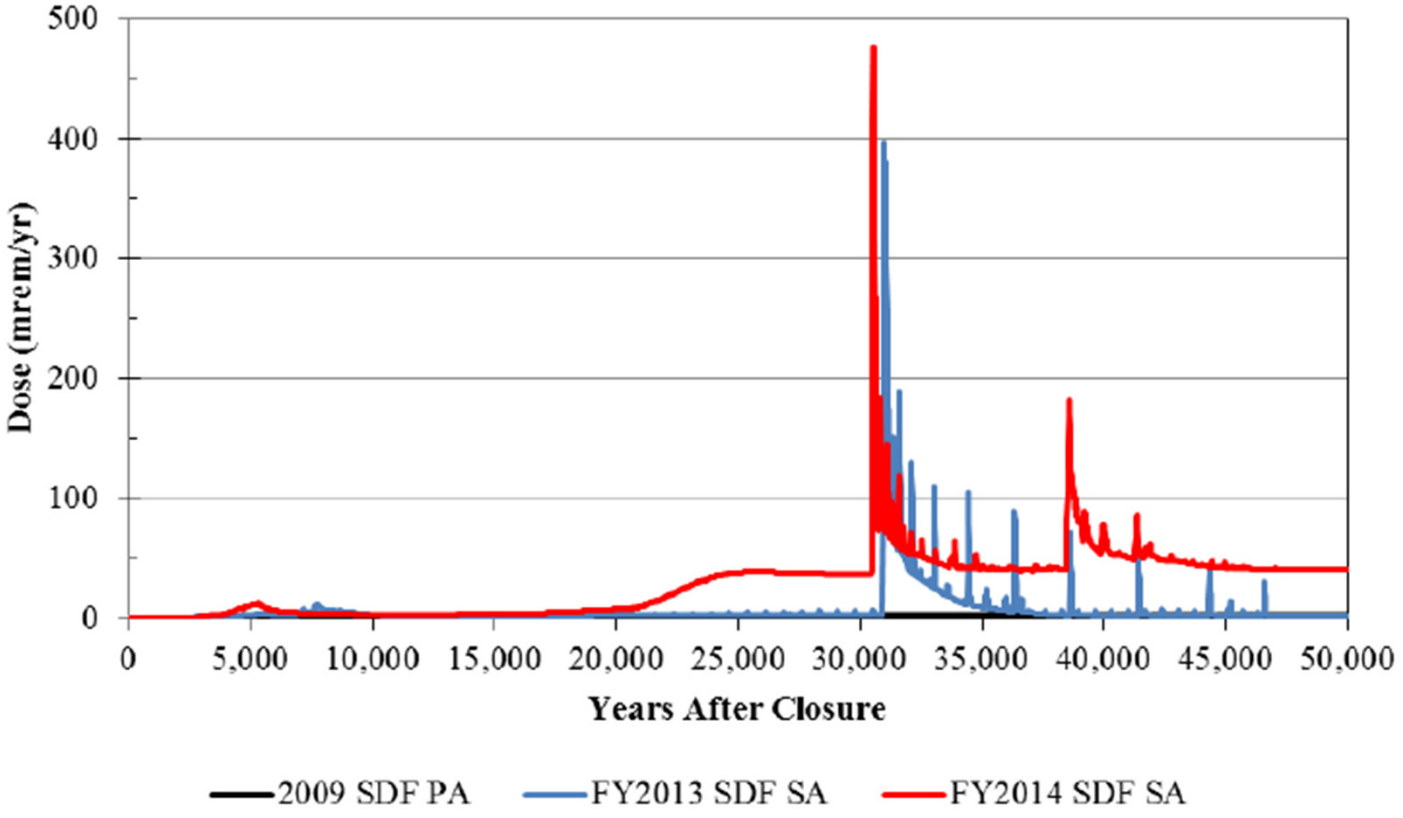
Figure 1.1-2: Comparison of the 100-Meter MOP Peak All-Pathways Dose within 50,000 Years for SDF PA, FY2013 SDF SA, and FY2014 SDF SA



Saltstone Example

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- Projected Tc-99 dose is significantly beyond the period of performance.
- However, uncertainty exists in the timing of the peak dose due to uncertainty in the performance of barriers (e.g., reduction of Tc, grout degradation).
- What is the likelihood of the peak moving within the period of performance?

Confidence in Results

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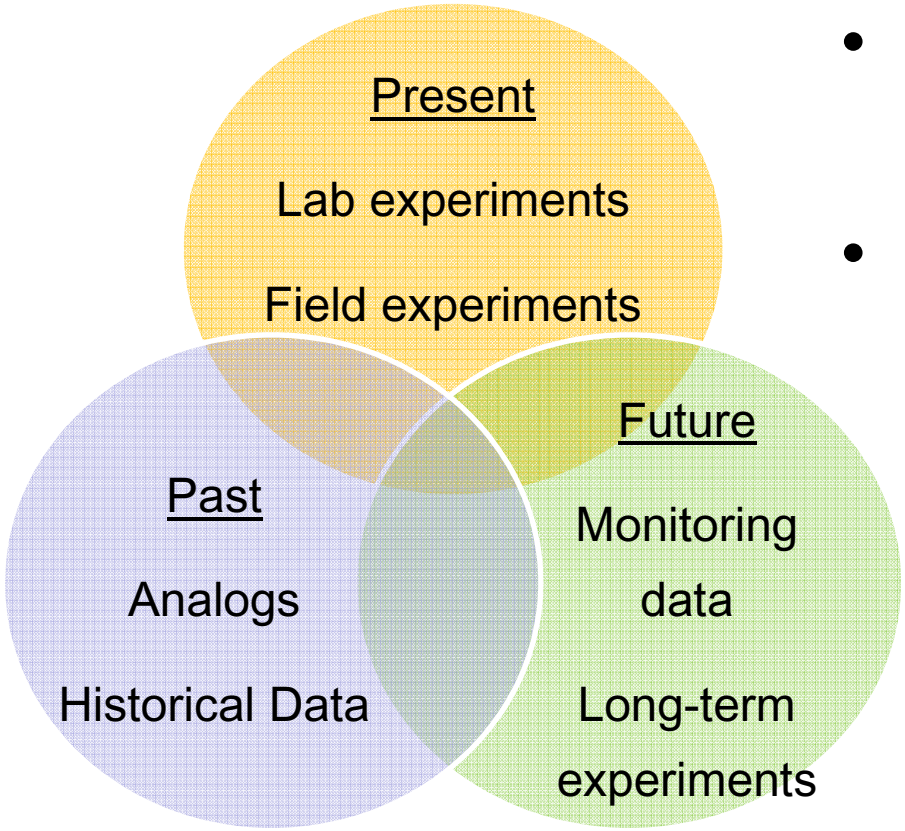
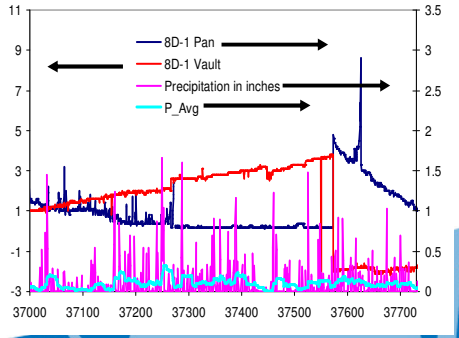
- Model Support (i.e., confidence building) is very important.
- Confidence developed via:
  - Technical checking and review
  - Quality assurance
  - Hand calculations
  - Comparison to other models
  - Comparison to site observations
  - Comparison to comparable sites (e.g., analogs)

Model Support - Past, Present, and Future Conditions



- The real world can be highly dynamic.
- Model support should be provided for the full range of expected future conditions.



Risk-Informed

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- Focus on those aspects that are most critical to meeting the performance objectives
- Defense-in-depth – multiple barriers (both natural and engineered) are present to limit exposures to the receptors and their capabilities are supported.

Final Thoughts

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- Performance assessments must assess uncertainty in our understanding of how a disposal facility might evolve over time.
- Regulators are often concerned with assumptions (and their support) that can materially affect the timing or magnitude of the results.
- Confidence in the results is highly dependent upon the level of model support.

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