West Valley Probabilistic Performance Assessment

QPM June 2016

Neptune and Company, Inc.

www.neptuneandco.com

Phase 2 Decision Making

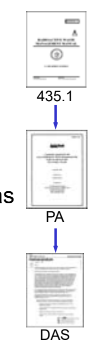
- DOE/NYSERDA will make Phase 2 decisions for:
  - High-level waste tanks
  - NRC licensed disposal area
  - State licensed disposal area
  - Non-source area of the north plateau GW plume
  - Contaminated soils
  - Contaminated stream sediments

Phase 2 Decision Process

- Supplemental Environmental Impact Statement (SEIS)
  - NEPA
  - SEQRA
  - Contract procurement in progress
- Probabilistic Performance Assessment
  - Basis for the SEIS long-term performance assessment
  - Neptune and Company, Inc. (Neptune)
- Additional Information Sources
  - Phase 1 Studies
  - LiDAR Topographic Surveys
  - Radiological characterization
  - Others

Performance Assessment

- For the DOE and its LLW sites, PAs are intended to establish “reasonable expectation” that performance objectives are not exceeded.
- PAs are traditionally deterministic and conservative, yet any such analysis has *inherent uncertainties* in assumptions, parameter values, and in the models themselves.



What is Performance Assessment?

Performance Assessment is an analysis of a the release of a radionuclides from a site, and an estimation of the exposure to future humans to radionuclides for a specific set of future site scenarios that are based on expected future land use.

PAs are intended to evaluate whether or not performance objectives are met.

The concepts in this presentation apply to all types of radioactive and hazardous wastes.

Why Do PAs Need Improvement?

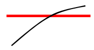
Traditionally, PAs have:

- Supported the *status quo*
- Focused on demonstrating compliance rather than on optimal decision making
  - Disposal, closure, long-term management
- Built-in conservatism leading to:
  - Poor (sub-optimal) decision making
  - Unnecessarily increased costs
  - Opaque to stakeholders (and to reviewers)
- All difficult to communicate and defend

Deterministic Modeling

Deterministic models

- produce deterministic (single-valued) output with no uncertainty,
- are easy to compare to deterministic performance objectives,
- typically strive for conservatism*, and
- may be a good choice for simple demonstration of compliance.



* What is conservative may not always be obvious, and conservatism can obscure model complexities.

Probabilistic Modeling

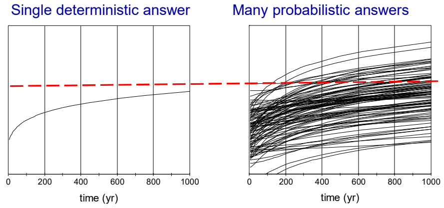
Probabilistic models

- strive to be realistic (not conservative),
- represent uncertainty using probability density functions for model parameters,
- propagate uncertainty through Monte Carlo simulation, and
- calculate model outputs as probability density functions.

Honest Answers

Single deterministic answer

Many probabilistic answers



- Does not represent uncertainty
- Increased chance of making the wrong decision

- Reflects uncertainty clearly
- Decision maker has to evaluate comfort level

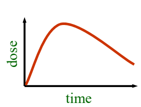
Determinisitic *vs* Probabilistic

	pro	con
deterministic analysis	• May be appropriate for simple compliance demonstration • If so, then simple for decision makers and public	• Uncertainties are unspecified • What is "conservative" may not be known • No global SA possible
probabilistic analysis	• Better represents state of knowledge • Requires development of input distributions • Facilitates global SA and uncertainty analysis	• Requires more computer time (perhaps)

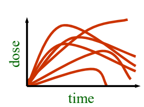
Managing Uncertainty

- We know that our knowledge is incomplete.
- How can we account for imperfect knowledge?
- Each modeling parameter and process has inherent uncertainty and variability
  - Inputs should be based on what we think we know (expectation) and how unsure we are (uncertainty)
  - And therefore the results must also be uncertain

no single answer is correct



a collection of answers reflects our knowledge



Probabilistic Modeling

- Model preparation
  - Gather pertinent information
  - Develop conceptual model
- Model structure
  - Variables (parameters) and relationships
  - Include alternative models, scenarios
- Model specification
  - Probability distributions, correlations
  - Costs, value judgments

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PPA Contract Technical Scope

- Near-term review and sensitivity analysis
  - Direction for site-specific scientific studies
- Transition PA from a deterministic model to a probabilistic model
  - GoldSim
- Phase 2 Alternatives analysis
- Materials to support the SEIS

Review of 2010 DPA

- In-depth review of existing DPA models, supporting documents and data
  - FEHM
  - STOMP
  - CHILD (erosion)
  - FORTRAN
    - Separate programs that collect process model results together in a systems model
    - Provides results for the 2010 FEIS PA

Transition to probabilistic PA

- Statistical specification of input distributions
  - Data-based – literature review and meta analysis – model abstraction – expert elicitation
- Model evaluation – including SA
- Model iteration until value of further model improvement is not warranted (value of information)

What PAs Should Be

- Decision-focused, considering
  - stakeholder concerns and values
  - costs of action
  - uncertainty (with probabilistic modeling)
- Sustainable
- Transparent
- Defensible
- Adaptive depending on results

PPA Steps

- FEPs/CSM
- White papers
- Supporting models
- GoldSim PPA
  - Dose, concentrations, ALARA
- Sensitivity Analysis
  - Iteration as necessary

FEPs and CSM

- FEPs – Features, Events, Processes (and Scenarios – FEPSs)
- CSM – Conceptual site model is directly linked to the FEPSs analysis
- Consider probability and consequence when building the FEPSs/CSM

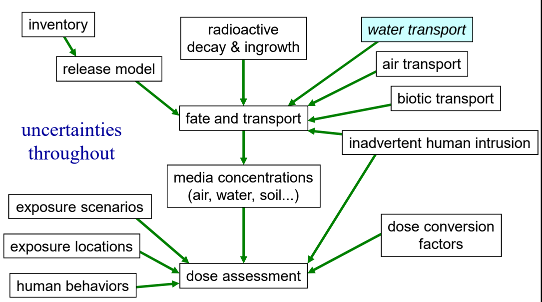
Features, Events, and Processes

Features are characteristics of the Site, e.g., soil, geology, water, air, waste
Events might occur in the future, e.g., earthquakes, volcanoes, tsunamis, meteors, ice ages
Processes are ongoing actions, e.g., subsidence, erosion, biotic mixing, hydrology, geochemistry
Scenarios describe how humans might come into contact with residual waste

Conceptual Site Model (CSM)

- Inventory
- Engineered barriers
  - Release and transport into environment
- Environment
  - Transport
- Exposure scenarios (human)
  - Dose
- Changes over time
  - Consideration of future climate

A PA Influence Diagram



Science-based modeling software

- GoldSim (systems-level modeling)
  - Probabilistic simulation engine with a built-in graphical interface for building differential equation and transfer function models
- Process-level models
  - Erosion modeling
  - Groundwater modeling
  - Sediment transport
  - External irradiation modeling
  - Engineered features
  - Inadvertent intrusion and institutional control

Long-term Probabilistic PA Summary

- Alternatives focused
- Probabilistic system allows full global SA to be performed
  - Identifies inputs that are the primary drivers for the results
  - Can perform SA over the decision options
- Technically defensible, transparent, open, traceable

Support for SEIS

- Modeling results will be available for the SEIS – the cross-over should be straightforward in principle

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Outreach and communication

- Participate in on-going communication and outreach efforts with stakeholders
- Use non-technical language to explain the PPA/GoldSim process and its use in the phased decision process
- Use a web-based platform to share steps in the GoldSim process with the public
- Provide regular PPA updates at QPMs