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Regulatory Perspective on Performance Assessment

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What is Performance Assessment (PA)?

- Performance assessment is a tool that can be used for understanding how the natural and engineered features of a site retain radioactive materials.
- Thoroughly examines:
 - what can happen,
 - how likely it is, and
 - what can result.



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What Performance Assessment is Not

- PA is not a subjective process to produce a result supporting a predetermined decision (e.g., a site is safe).
- PA is not a substitute for a lack of key data.



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How is a PA conducted?

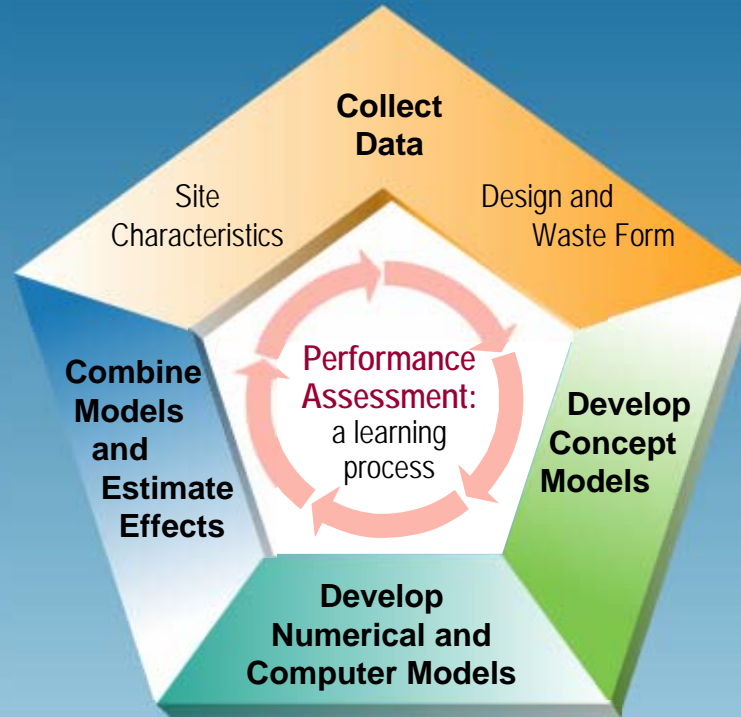
- Collect data
- Develop conceptual models
- Develop and test computer codes
- Analyze results

A team of experts typically repeats these steps many times, refining and improving the models if needed.

Overview of Performance Assessment

What is Performance Assessment?

- Systematic analysis of what could happen at a site



What is assessed?

- What can happen?
- How likely is it?
- What can result?

Why use it?

- Complex system
- Systematic way to evaluate data
- Internationally accepted approach

How is it conducted?

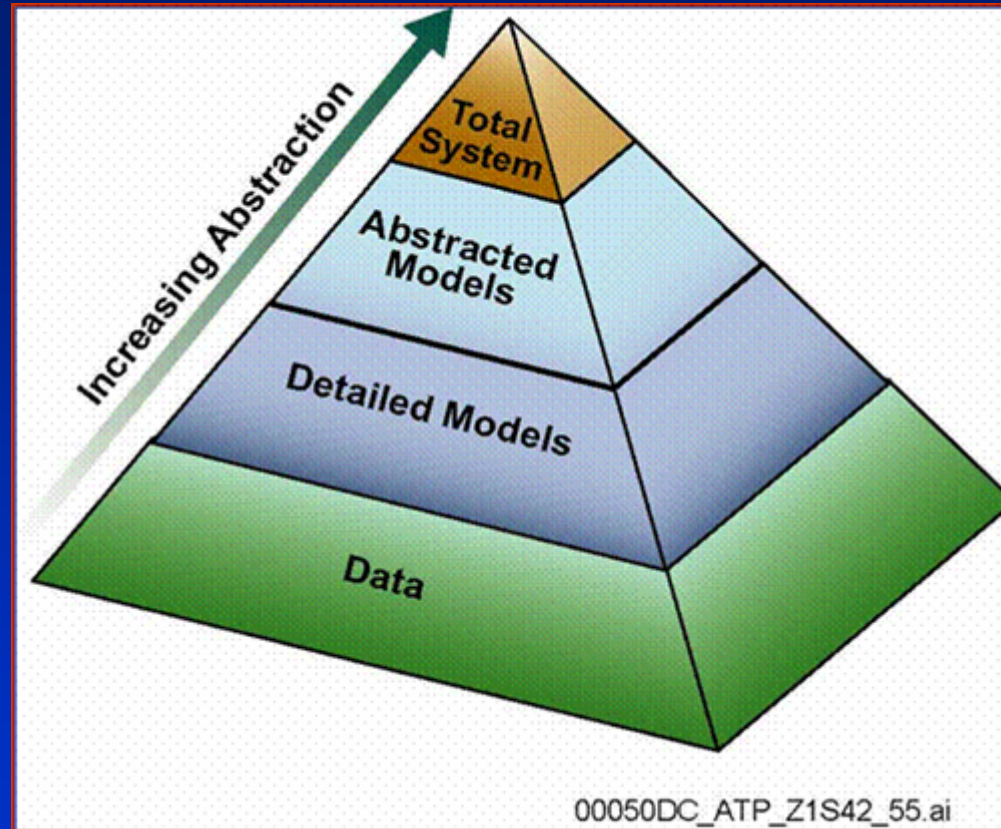
- Collect data
- Develop scientific models
- Develop computer code
- Analyze results

NRC would require a Performance Assessment to:

- Provide site and design data
- Describe barriers that isolate waste
- Evaluate features, events, and processes that affect safety
- Provide technical basis for models and inputs
- Account for variability and uncertainty
- Evaluate results from alternative models, as needed



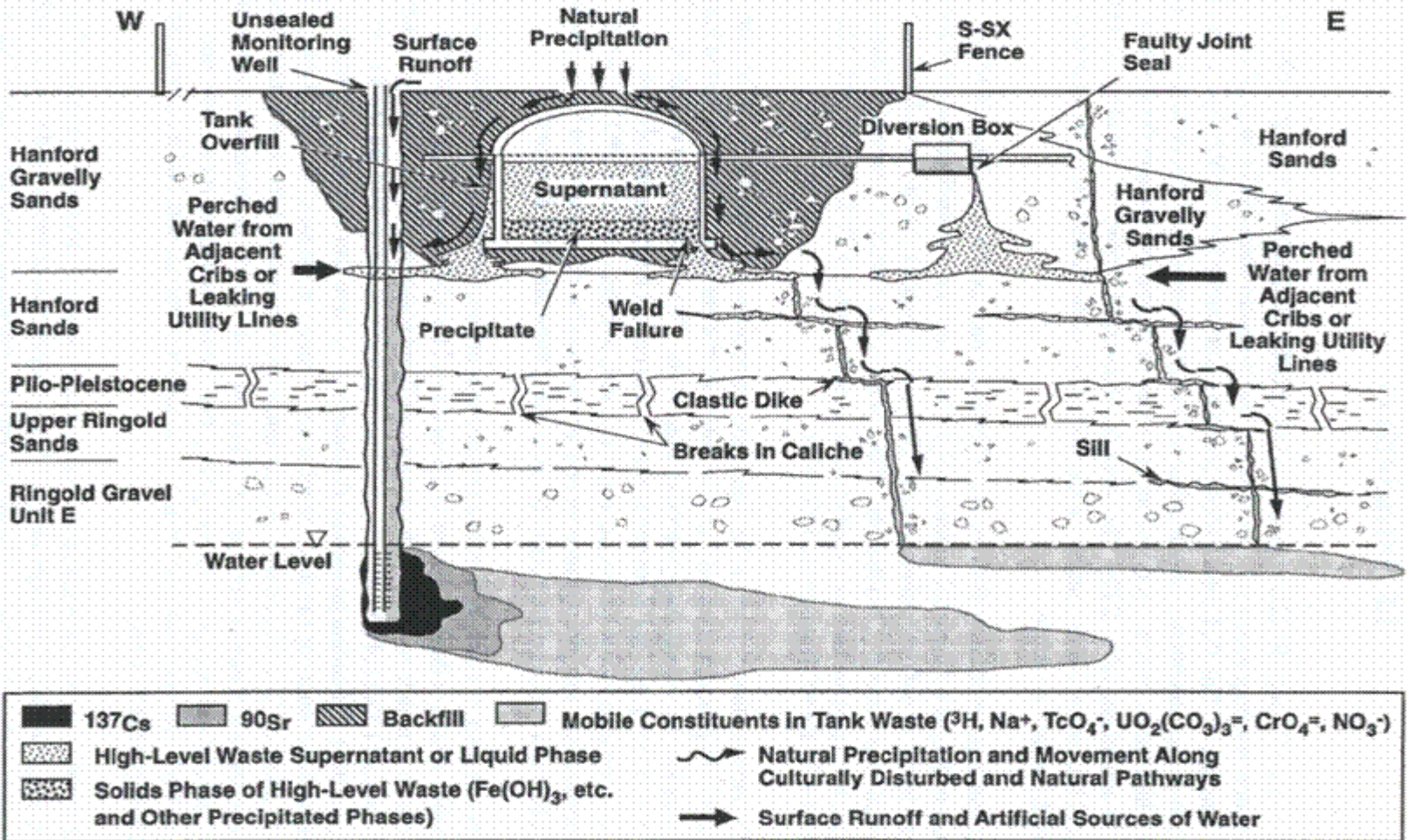
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Example of a complex site

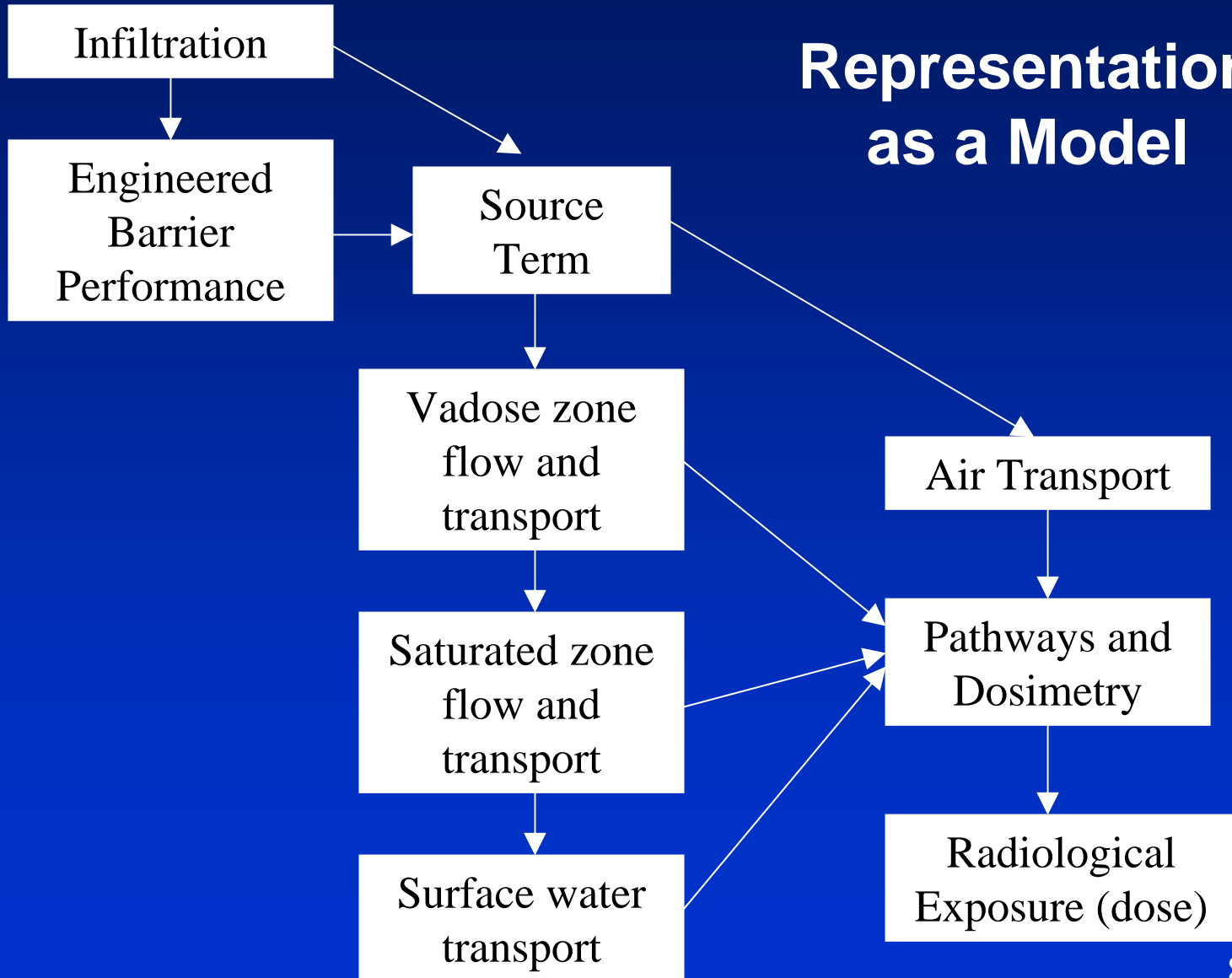


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Representation as a Model





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How is a PA used?

- To estimate radionuclide release and transport, and potential exposure to an average member of a critical group.
- To estimate important parameters and models.
- To evaluate the effects of uncertainty and variability.
- To provide information to decision makers.



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Uncertainty and Variability

- Uncertainty and variability - example
- The impact of uncertainty and variability must be factored into decision making.
- Uncertainty and variability can be managed through:
 - Probabilistic assessment (e.g., Monte Carlo)
 - Deterministic analyses with sensitivity analysis
 - Collection of more data
 - Use of conservatism



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Uncertainty and Variability - continued

- The NRC does not prescribe whether analyses should be deterministic or probabilistic.
- Each has advantages and disadvantages.



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Example - deterministic approach

Estimate values
of parameters



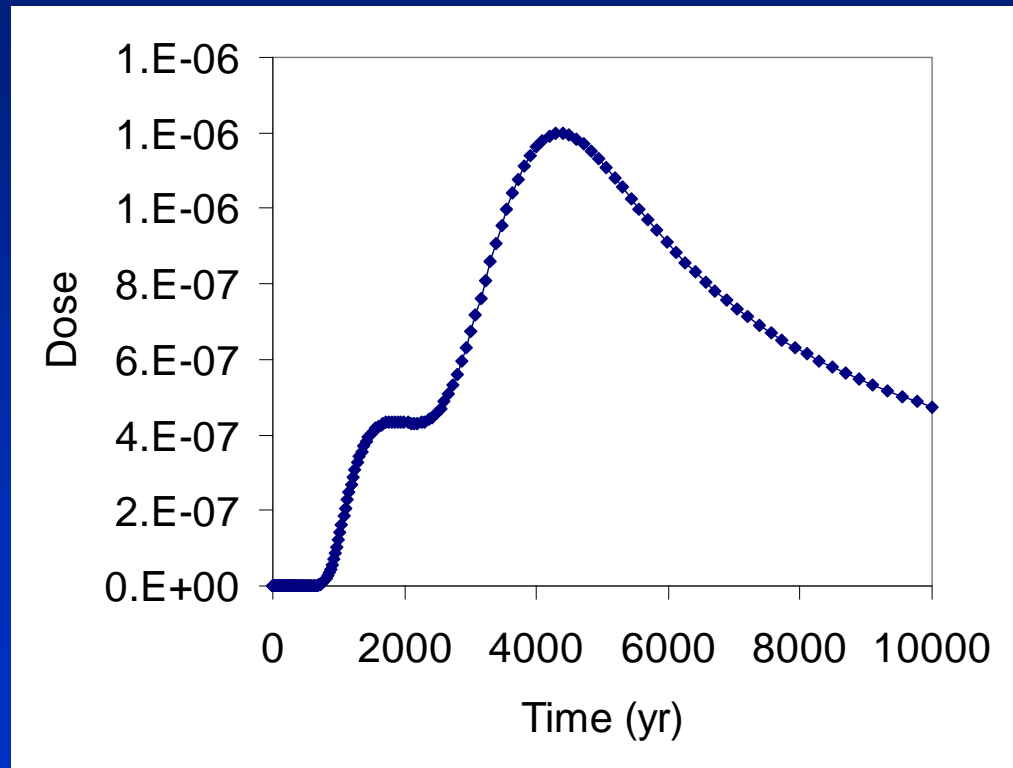
X, Y, Z



Input parameters
into a model



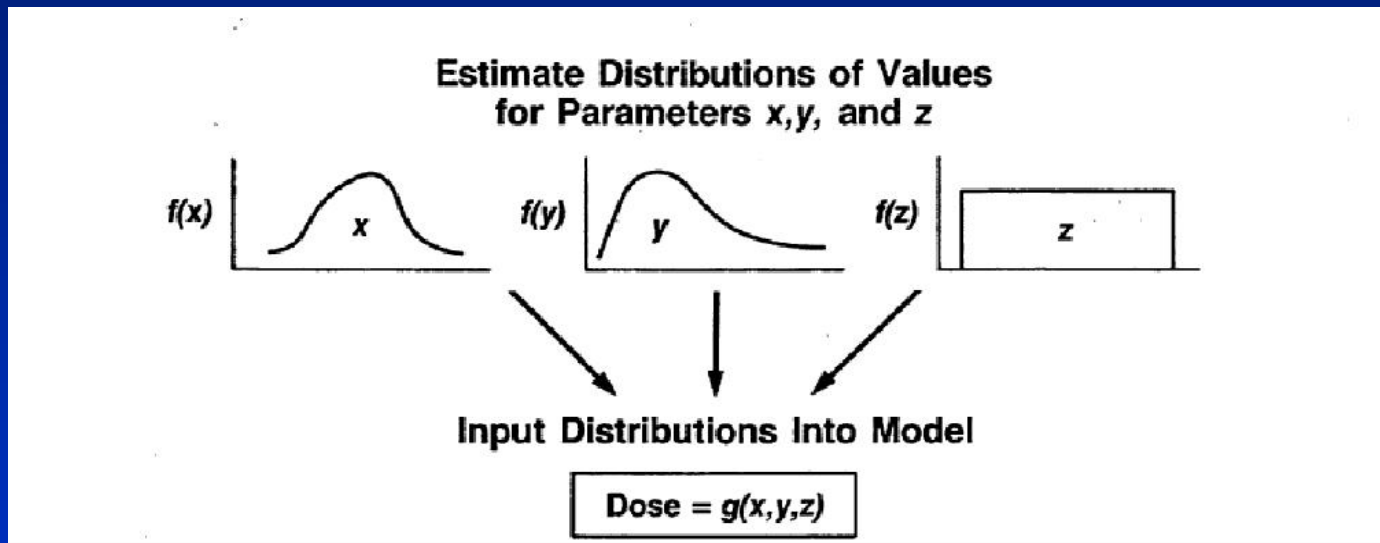
$Dose = g(X, Y, Z)$





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Example of probabilistic approach



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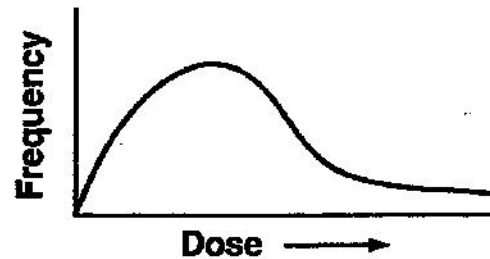


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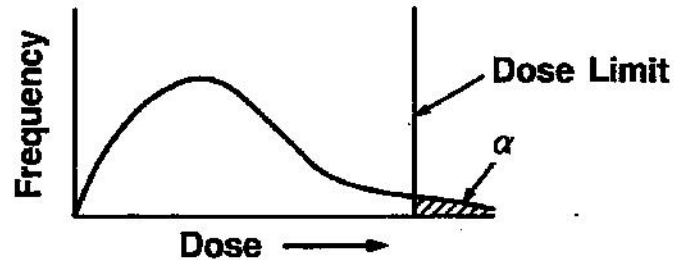
Example of probabilistic approach - continued



Produce Distribution of Model Results



Compare With Dose Limits



α = Probability of Dose Limit
Being Exceeded



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Probabilistic vs. Deterministic

- **Deterministic**
 - Easier to understand
 - Simpler to explain
 - More straightforward to implement
 - Treatment of uncertainty can be difficult

- **Probabilistic**
 - More rigorous treatment of uncertainty
 - Can be used to identify important data
 - More complicated
 - More difficult to implement



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Confidence in PA Results

- Confidence building 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)



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Potentially Affected Populations

- Potentially affected populations are site-specific.
- Pathway analysis should result in the determination of the total intake of radionuclides by the average member of the critical group.
- Receptors are individuals who can potentially be exposed to radiation.
- Critical group – *group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances.*



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Potentially Affected Populations - continued

- The average member of the critical group is that individual who is assumed to represent the most likely exposure situation, based on cautious but reasonable exposure assumptions and parameter values.
- For example, in a rural environment, a family farm adjacent to a contaminated site may be the reasonably conservative selection for the critical group.



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Conclusions

- Performance assessment is a widely accepted process.
- Performance assessment is intended to be an objective process for assessing risks and the associated impact of uncertainties in order to inform decision makers.
- Performance assessment is intended to increase understanding.



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Reference

NUREG-1573 'A Performance Assessment Methodology for Low-Level Radioactive Waste Disposal Facilities, Recommendations of NRC's Performance Assessment Working Group', US Nuclear Regulatory Commission, Washington, DC, October 2000.