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Evaluation of Waste Package and Drip Shield Juvenile Failure Rates

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Outline

- Definition of Juvenile Failure
- Factors That Influence Juvenile Failure Rates
- Industrial Failure Rate Data
- Uncertainties For Waste Packages and Drip Shields
- Summary

Juvenile Failure

- DEFINITION: Penetration through the waste package or the drip shield during the preclosure period
- Defects that do not penetrate the waste package and drip shield may also exist
- In the TPA code, juvenile failures are conservatively estimated to occur at the start of the postclosure period (t = 0)
- The TPA code contains mechanistic models to evaluate waste package and drip shield performance during postclosure

Factors That Influence Juvenile Failure Rates

- Design codes and requirements
- Materials selection
- Fabrication processes
- Operating parameters and procedures
- Nondestructive examination and inspection
- Human reliability considerations

Industrial Failure Rate Data

- Failure rates from industrial experience are not directly applicable to waste packages or drip shields
  - Some similarity in materials, fabrication processes and design codes
  - Dissimilar operating conditions and inspection criteria
- Decreased industrial failure rates as a result of operating experience, improvements in nondestructive examination, and use of design codes
- Industrial data examples
  - Boiler and pressure vessels use similar fabrication processes and design codes
  - Fuel rods and storage casks selected as examples from the nuclear industry
- Dry Storage Casks for Spent Nuclear Fuel
  - No reported failures in service (licensed since 1986)
  - 4 reported cases of weld defects found during post-weld inspection of VSC-24 casks (19 in service through July 1998)

Uncertainties For Waste Packages and Drip Shields

- Weld defect densities and nondestructive examination
- Residual stress mitigation
  - Non uniform heating/cooling, process variability, and laser peening for waste packages
  - Processes, procedures, and inspection methods for the drip shield not fully defined
- Handling procedures and emplacement processes
- Task analysis and human error rates

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Summary

- Industrial failure rates not directly applicable to waste packages and drip shields, however, a correlation can be made to general industrial fabrication technologies and inspection methods/criteria that will be utilized in waste package construction
- For industrial components considered in our study, failures early in service are due to fabrication defects, deficient nondestructive evaluation/inspection, and human errors
- Decrease in industrial failure rates attributed to increased experience, improvements in nondestructive examination and use of design codes
- Uncertainties identified for waste packages and drip shields are expected to be addressed

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