



EFFECT OF WASTE PACKAGE FAILURE ON RADIONUCLIDE RELEASE RATE

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DOE/NRC TECHNICAL EXCHANGE ON
TOTAL SYSTEM PERFORMANCE ASSESSMENTS FOR YUCCA MOUNTAIN

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Premise: Radionuclide release depends strongly on mode of waste package failure

1. Mode of failure determines how water will enter and leave
2. Mode of failure will affect chemistry inside waste package
3. Corrosion products might limit flow and diffusion to outside of waste package
4. Corrosion product may serve as effective sorbers of released radionuclides both inside and outside the waste package

1. Mode of failure determines how water will enter and leave the canister

A. "Bathtub" model

- Water enters canister in one corrosion hole and leaves through the same or a different hole.
- Height of water in bathtub determined by the position of the holes
- Bathtub can involve a large fraction of the fuel by immersion
- Bathtub might be transient; exist for several thousands of years until other corrosion holes cause it to empty. "Pulling the plug" Might lead to a transient increase in release rate

B. Flow-through model

- Water enters and leaves canister by corrosion holes, But does not pool
- Smaller portion of fuel involved; only that portion wetted by dripping water or water vapor inside canister, *but*
- Dripping water could be more corrosive of fuel per unit wetted area than stagnant water

2. Mode of failure will affect chemistry inside Waste package

- Corrosion of waste-package and waste-form materials will consume oxygen and possibly other constituents entering the waste package (e.g., silica)
- Size and properties of corrosion holes might limit the easy exchange of atmospheric oxygen. Reduced partial pressure of oxygen will likely reduce release rates of many radionuclides.

3. Corrosion products might limit flow and diffusion to outside of waste package

- Area of corrosion holes and properties of filling material will affect advective and diffusive transport of radionuclides
- Low pH inside corrosion pit might limit amount of iron oxide precipitate

4. Corrosion product may serve as effective sorbers of released radionuclides both inside and outside the waste package

Conclusions

- Mode of waste package failure will affect release of radionuclides
- There can be substantial credit for waste package components even under failed conditions, but their use must be justified.