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SOURCE TERM OVERVIEW:

A CANADIAN PERSPECTIVE

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Source Term	**=**	**flux of radionuclides at the exit from the engineered barriers, i.e., at the interface between the engineered barriers and surrounding geological medium**
Engineered Barriers	**=**	**metallic containers, clay-based buffer and backfill layers**

Ti CONTAINER FAILURE MODEL

Assumption	Potential Improvement	Expected Impact of Improvement
Initial defects		
CC initiates on all containers (Ti - 2)	limited initiation (Ti - 12, Ti/Pd) (D, M)	lower dose
Sufficient O_2 present for unlimited CC propagation	include effect of O_2 exhaustion (D)	lower dose
HIC present T <30°C	detailed HIC model (D)	small effect?
Failed container provides no barrier	include mt resistance of failed container (D)	lower dose
No explicit microbial effects	include microbial effects (e.g., pH)	no effect

SCOPE OF PRESENTATION

- Source-term model for the Canadian Concept:
  - container failure model (Ti, Cu)
  - release of radionuclides from used fuel
  - mass transport (buffer, backfill)
  - assumptions/improvements/limitations
- Issues re probabilistic properties of source term for risk assessment.
- Ways to enhance the credibility of a source-term model.

Cu CONTAINER FAILURE MODEL

Assumption	Potential Improvement	Expected Impact of Improvement
General corrosion rate controlled by Cu^{2+} mass transport	rate controlled by mass transport processes of Cu^{2+} and oxidant (D, M)	lower long-t dose
No creep	include creep model (D)	?
No pitting	mechanistic pit model	no effect ?

RADIONUCLIDE RELEASE MODEL FOR SPENT FUEL

Assumption	Potential Improvement	Expected Impact of Improvement
Short t		
Instant-release for gap and grain-boundaries	kinetic model for grain boundaries (D, M)	lower dose
Zircaloy		
Zircaloy is not a barrier to release from fuel. Zircaloy sources are released congruently, controlled by ZrO_2 solubility	CC + uniform corrosion model for Zircaloy (D)	lower dose from fuel; increase dose from Zircaloy sources(?)

RADIONUCLIDE RELEASE MODEL FOR SPENT FUEL

Assumption	Potential Improvement	Expected Impact of Improvement
<u>Long t</u>		
Congruent release of radionuclides from a solubility-limited dissolving fuel matrix (UO_2/U_4O_4)	kinetic model for fuel dissolution accounting more fully for α - radiolysis (D, M)	increase long-t dose (?)
<u>Precipitation</u>		
Solubility limits of secondary phases controlled by amorphous oxides. Diffusion-precipitation coupling is included	crystalline oxides	lower long-t dose (especially Tc)

↑ precipitation coupling in glass dissolution

MASS TRANSPORT MODEL FOR SPENT FUEL

Assumption	Alternative	Expected Impact of Alternative
1-d analytical with sectors	2-d, 3-d (numerical)	small effect ?
Mass-transfer coefficient exit boundary condition	n-layer solution (numerical)	increase dose
Linear constant sorption	equilibrium or kinetic sorption model (numerical)	small effect for major radionuclides
All parameters are constant with time	t-dependent parameters (e.g., buffer degradation) (numerical) (D)	?
No gas phase transport	Two-phase model (numerical) (D, M)	lower dose by expulsion of incoming water; increase dose by expulsion of contaminated water and gas transport?
No explicit microbially mediated transport	explicit microbial effects (e.g., via gas production, colloids) (D)	no effect w.r.t. two-phase model

- experimentalists) project team, under one roof
  theoreticians)

- model developed and defended by both

ISSUES RELATED TO THE PROBABILISTIC PROPERTIES OF A SOURCE TERM FOR RISK ASSESSMENT

GENERAL

- variability ≠ uncertainty ≠ probability
- time dependence ≠ wide pdf
- consistent treatment of uncertainty is required in various component models
- simplified models may be required to get convergence of runs, given limited computer resources

SPECIFIC

- the probabilistic nature of the instant release inventories per container can be derived using fuel performance codes and the reactors power history

WAYS TO FURTHER ENHANCE CREDIBILITY OF SOURCE TERM MODELS

- benchmarking

- a wide scope program, but focused via both data and model sensitivity analysis

- better presentation methods