Importance of the waste form from a safety assessment perspective: The SR-Site experience

Lena Z Evins,

SKB

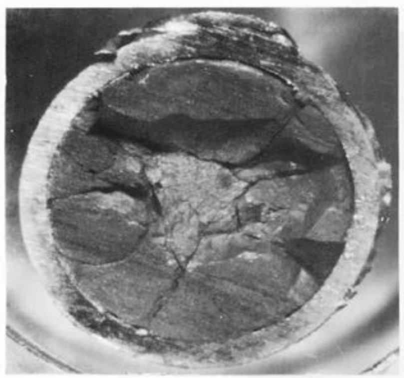
Waste form considered in SR-Site

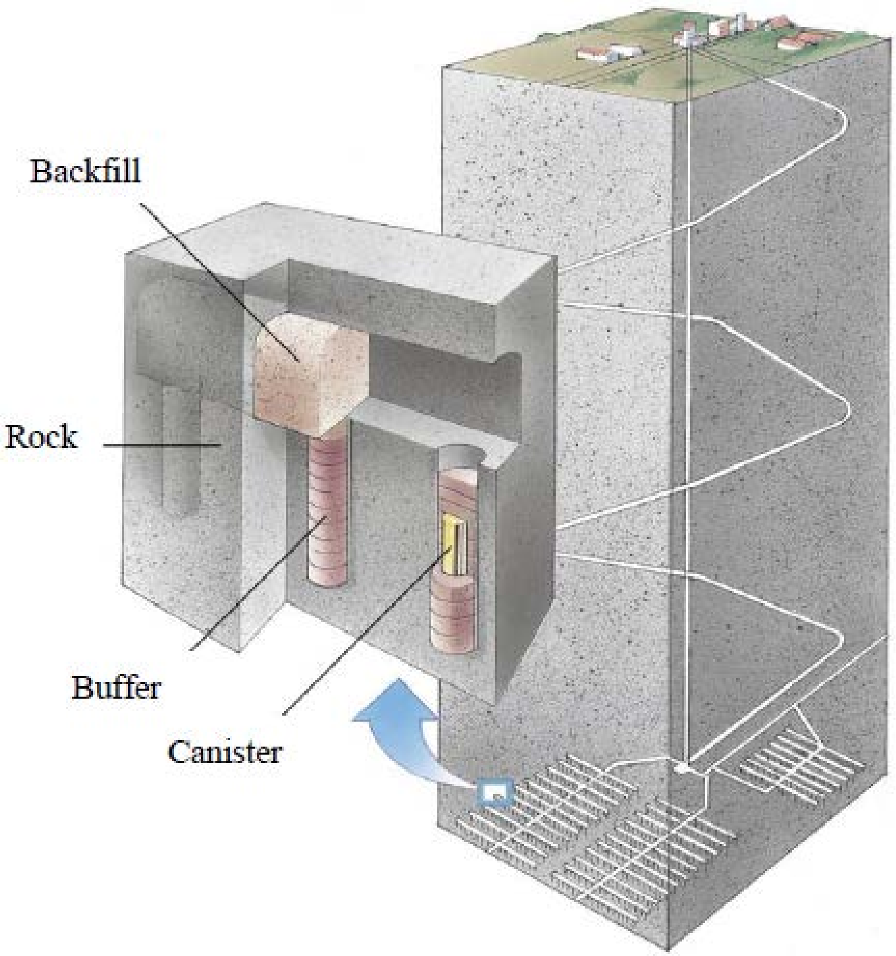
Spent nuclear fuel

UO2: BWR and PWR reactors, some MOX

Direct disposal

Canisters in bentonite at ca 500 depth in crystalline bedrock.





SR-Site safety assessment: input data (I)

The whole repository system

Data from site investigations & analyses of material properties

Waste form plays a central role:

Instant Release Fraction (IRF), Corrosion Release Fraction (CRF), Dissolution rate, and Solubilities.

SR-Site safety assessment: input data (II)

IRF, CRF

Dissolution rate

Solubilities

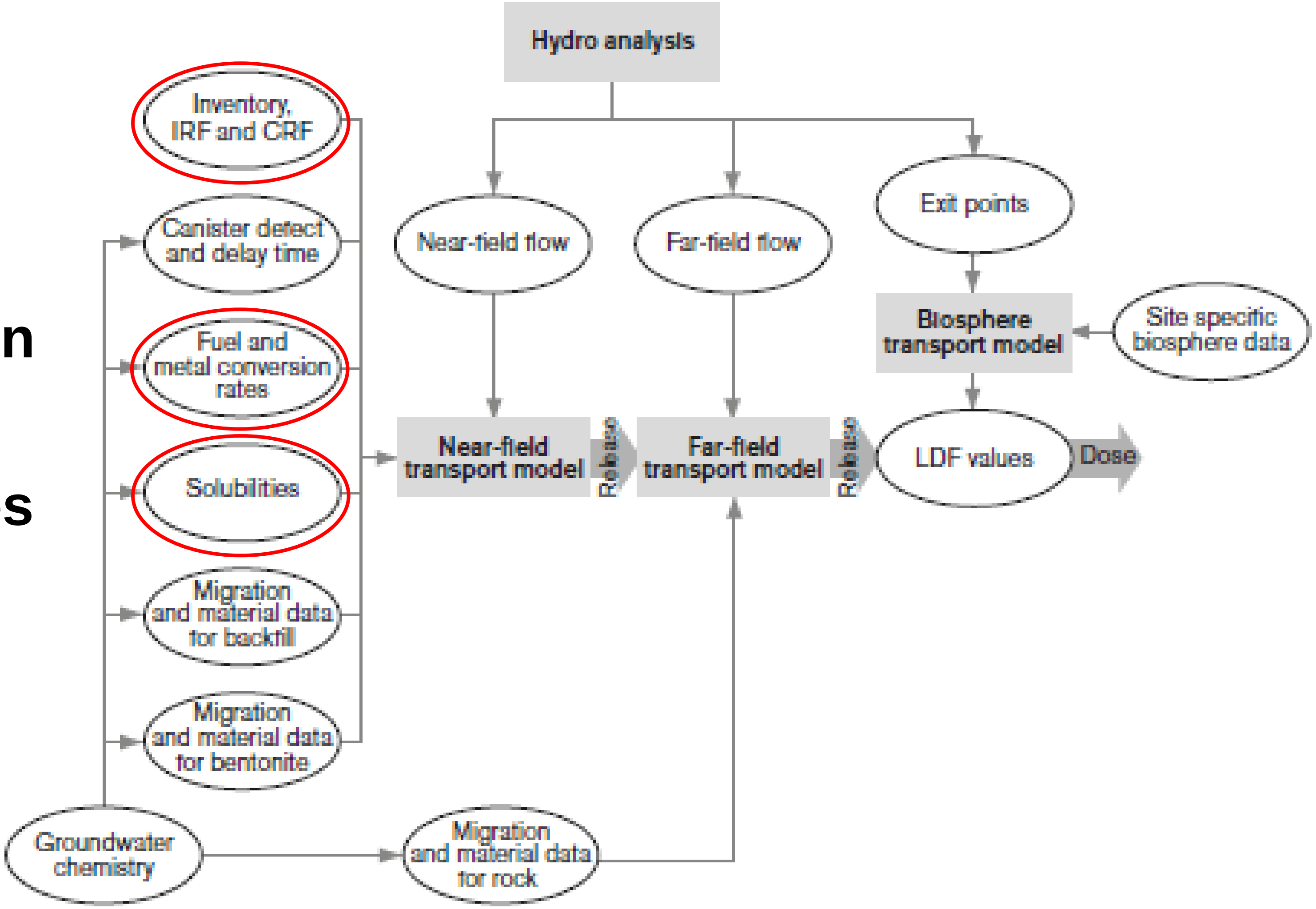


Figure 13-12. Models and data for the consequence calculations.

Radionuclide release

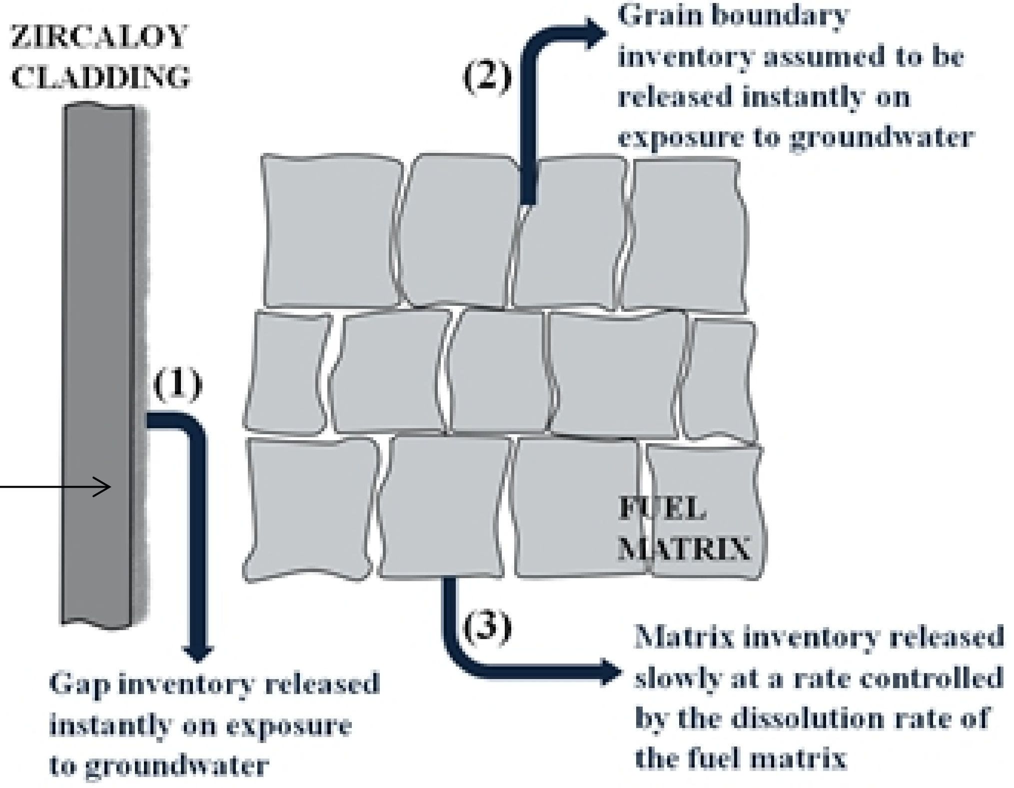
+ metal parts

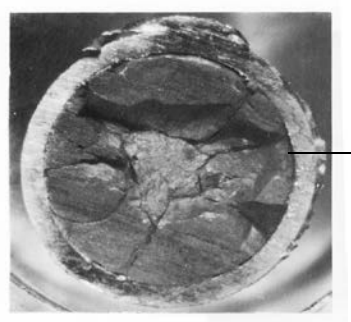
When water gets in contact with the waste!

How and when are radionuclides released?

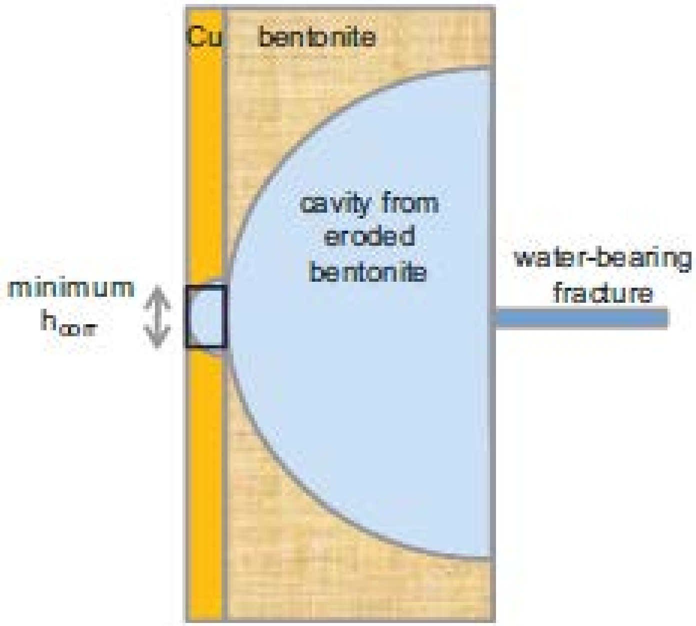
Distribution in the different parts of the fuel.

Example IRF: I-129 and Cs-137.





Scenarios: effect on barriers

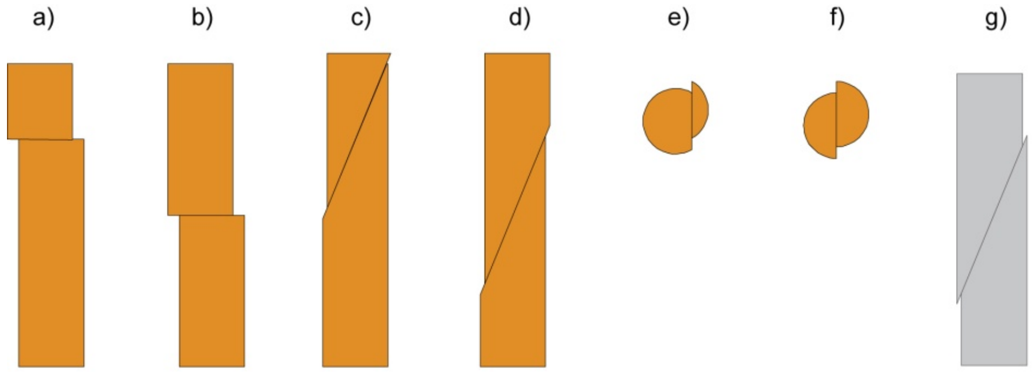


Evaluate the probabilities for containment failure

Describe the consequences, in terms of dose and risk

Primary safety function: containment
Secondary: retardation

Consequence of containment failure:
Radionuclide release and transport



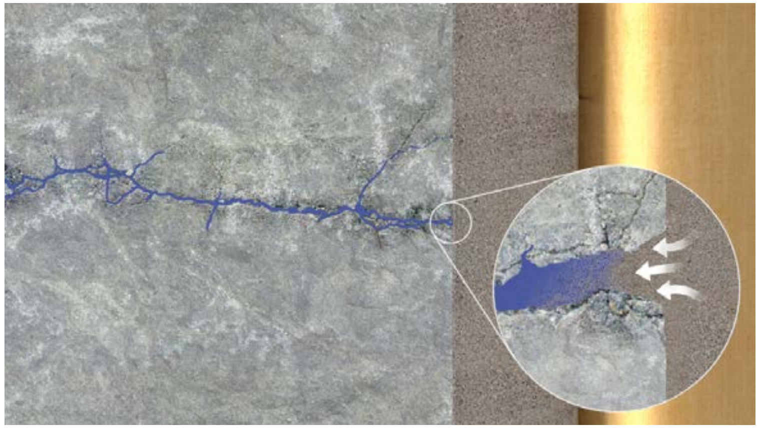
Consequences in failure scenarios

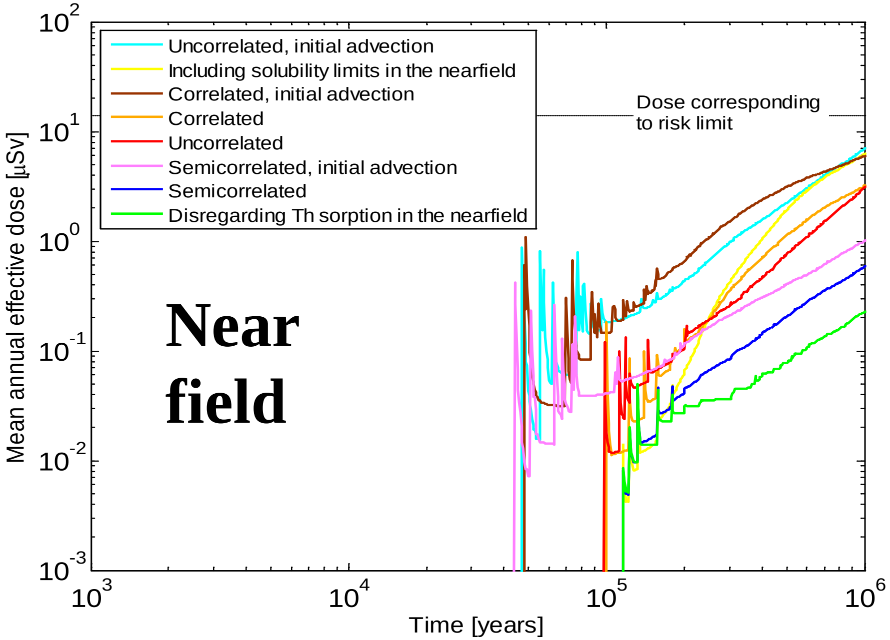
Example:
Canister corrosion
& bentonite erosion:
0.12 canister in 1 Ma.

"High" flow rate deposition holes
high erosion rate, high corrosion rate

Fuel dissolution rate significantly impacts the result

Importance of the stability,
in the repository environment,
of any other and future waste forms





Some reflections

Providing input data vs. the larger view:

How to choose data - sound scientific method!

Decades of research for fundamental process understanding

Any safety assessment concerning geological disposal of nuclear waste requires a research programme devoted to the stability of the waste form.

Journal of Nuclear Materials 420 (2012) 54–62

Contents lists available at SciVerse ScienceDirect

Journal of Nuclear Materials

journal homepage: www.elsevier.com/locate/jnucmat

ELSEVIER

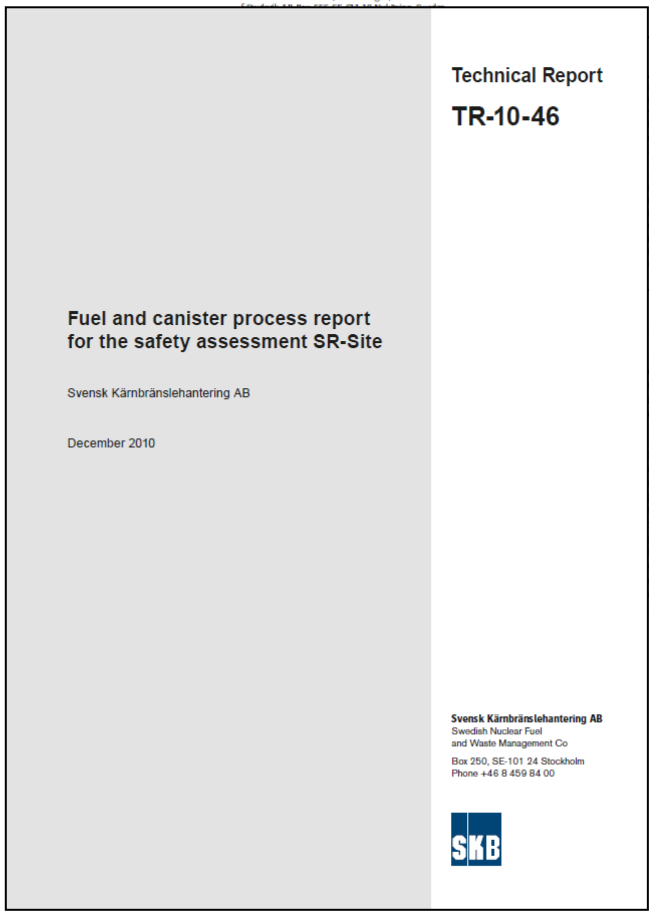
Rapid aqueous release of fission products from high burn-up LWR fuel: Experimental results and correlations with fission gas release

L. Johnson[a,*], I. Günther-Leopold[b], J. Kobler Waldis[b], H.P. Linder[b], J. Low[c], D. Cui[c], E. Ekeroth[c], K. Spahiu[d], L.Z. Evins[d]

[a] Nagra, Hardstrasse 73, 5430 Wettingen, Switzerland

[b] Paul Scherrer Institute, 5232 Villigen, Switzerland

© 2011 Published by Elsevier B.V.



Technical Report

TR-10-46

Fuel and canister process report for the safety assessment SR-Site

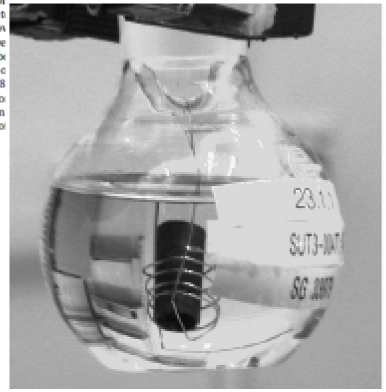
Svensk Kärnbränslehantering AB

December 2010

Svensk Kärnbränslehantering AB
Swedish Nuclear Fuel
and Waste Management Co

Box 250, SE-101 24 Stockholm
Phone +46 8 459 84 00

SKB

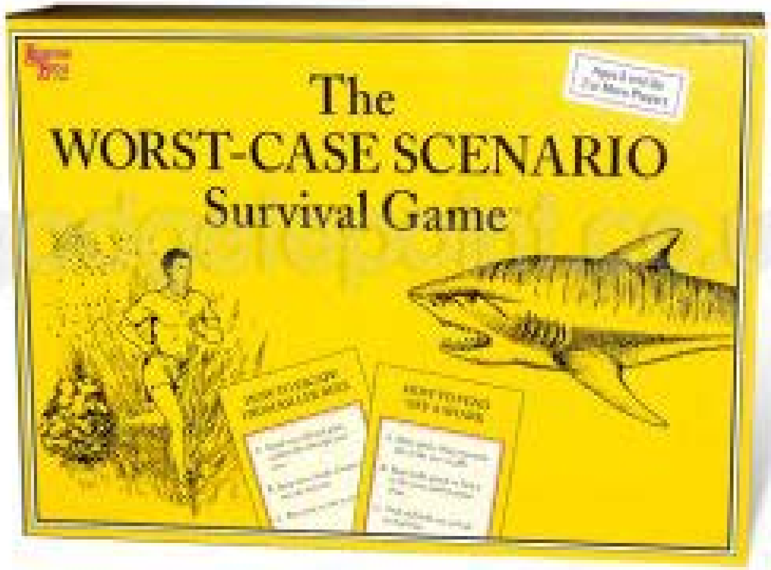


Without research programme…

As illustration:
effect of lack of data and scientific understanding

Fuel residues in epoxy: estimate contribution to risk
– no research, no relevant data, what to do?

Conservative approach:
Epoxy-samples in one (1) canister
ca 3% of U compared with one normal
PWR canister, ~ 0.0005% of all U in repository.
…BUT all this assumed rapidly released.
Contribution of ca 5% of overall risk
- epoxy-U elevates risk a factor 10,000
compared to "normal" U



⇨ Unrealistic & extremely conservative estimation

Thank you for listening!