Risk thinking and nuclear power

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Fig. 4-4
Simplified Event Trees for a Large LOCA
Performance assessment means an analysis that: (1) Identifies the processes and events that might affect the ... system; (2) examines the effects of these processes and events on the performance ...; and (3) estimates the cumulative releases ..., considering the associated uncertainties, caused by all significant processes and events.
Three Mile Island, March 28 – April 6, 1979

TMI crystallized public reaction – but it was not the origin
Safety and regulation after TMI
Chernobyl disaster
April 26, 1986
Fukushima Daiichi Nos. 4, 3, 2, 1, Wed. morning, March 16, 2011
What first prompted people to think about radioactive waste:

spent fuel and its reprocessing

- **Reprocessing**: Taking spent (used) fuel and treating it chemically and physically to recover fissionable (or other valuable) materials

- **Origins of the technology**: plutonium production for nuclear weapons, adapted for civil power

- **Byproducts**: fission products are released from the fuel elements that hold them in place, and some transuranic elements escape the reprocessing process
Sources of radioactive waste (just the “nuclear fuel cycle” for reactors)

- No reprocessing → everything in spent fuel, straight to disposal
- Reprocessing → everything in spent fuel, minus plutonium and uranium, process waste
Spent fuel storage today
Sources of radioactive waste (just the “nuclear fuel cycle” for reactors)

- Uranium mining $\rightarrow$ mill tailings
- Uranium conversion and enrichment $\rightarrow$ process waste, depleted uranium
- Fuel fabrication $\rightarrow$ process waste
- Energy extraction $\rightarrow$ fission products, transuranics, neutron-activated radioisotopes (contained in spent fuel and in reactor structures, or released to environment)
- No reprocessing $\rightarrow$ everything in spent fuel, straight to disposal
- Reprocessing $\rightarrow$ everything in spent fuel, minus plutonium and uranium, process waste
Mill tailings

Enrichment byproducts
Sources of radioactive waste (just the “nuclear fuel cycle” for reactors)

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- And every step that radioactive material is contacted $\rightarrow$ significant bulk quantities of contaminated materials
Yucca Mountain: Up until 2009, the DOE’s proposed site for final disposal of high-level radioactive waste

- A geologic repository?
- A nuclear waste dump?
Nevada Test Site
Yucca Mountain
(DOE photo)

Yucca Mountain
(Nevada state
govt. photo)
Cutaway of Yucca Mountain Geological Formation

Fig. 4-4
Simplified Event Trees for a Large LOCA
Main processes modeled in the TSPA (Total System Performance Assessment)
Yucca Mountain radionuclide inventory over time.
Simulated annual dose from Yucca Mountain (out to 10,000 years)

EPA initial standard: 15 mrem/yr, 1st 10,000 yrs
Simulated annual dose from Yucca Mountain (out to 1 million years)

- EPA initial standard: 15 mrem/yr, 1st 10,000 yrs
- EPA 2009 standard: 100 mrem/yr, past 10,000 yrs
- Rejected, U.S. Court of Appeals, 2004

Fig. 4-4
Simplified Event Trees for a Large LOCA
A historian’s commitments

- Alterity
- Particularity
- Perspective
- Pluralism

- Contingency
- Context
- Complexity
- Change
Futures proliferating out of control.
Experiential relations to risk

- Collectivity seeking shared basis
- Rational individual with agency
- Passive exposure without agency
- Captive of emotion or fear