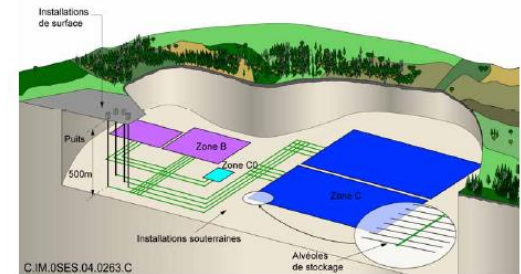


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What Does Safe Mean?

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Outline

- Four questions to address in the context of the U.S. radioactive waste management program
 - Who defines “safe”
 - Safety in the present (both occupational and public)?
 - Safety in the far future?
 - How is safety defined?
 - Who makes the determination that safety expectations are or are not met?
 - What is the basis for making the determination of safety?

Who Defines Safe?

Mission statement of the U.S. Environmental Protection Agency

The mission of EPA is to protect human health and the environment. (<http://www2.epa.gov/aboutepa/our-mission-and-what-we-do>)

Mission statement of the U.S. Nuclear Regulatory Commission

The NRC licenses and regulates the Nation's civilian use of radioactive materials to protect public health and safety, promote the common defense and security, and protect the environment. (<http://www.nrc.gov/about-nrc.html>)

How is Safety Defined?

Annual dose limits for operating facilities (NRC's 10 CFR part 20)

20.1201 Occupational dose limits for adults.

(a) The licensee shall control the occupational dose to individual adults, except for planned special exposures under 20.1206, to the following dose limits.

(1) An annual limit, which is the more limiting of--

The total effective dose equivalent being equal to 5 rems
(0.05 Sv) ... [additional requirements follow]

20.1301 Dose limits for individual members of the public.

(a) Each licensee shall conduct operations so that -

The total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem (1 mSv) in a year, exclusive of the dose contributions from background radiation

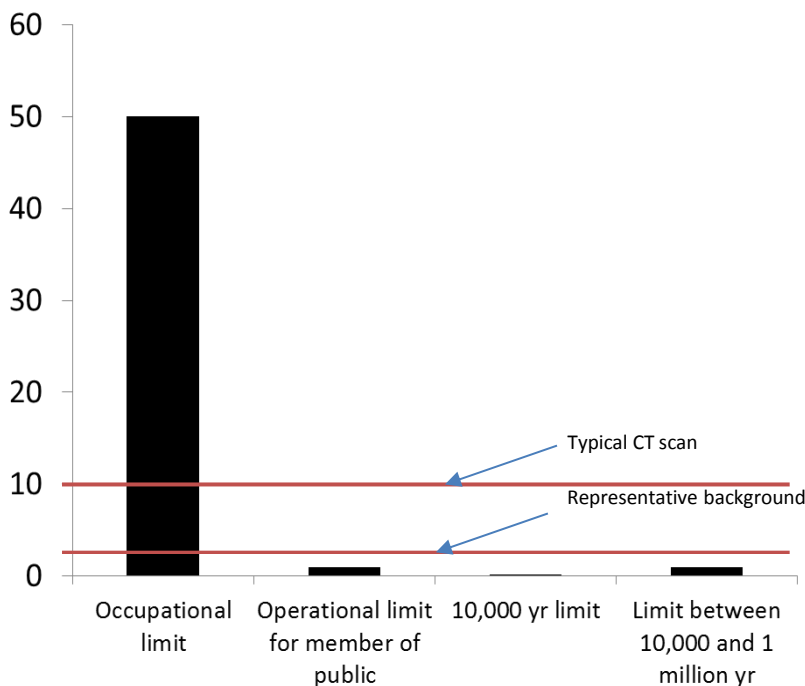
Annual dose limits for long-term repository performance (NRC's 10 CFR part 63, derived from EPA's 40 CFR part 197; specific to Yucca Mountain)

63.311 Individual protection standard after permanent closure.

(a) DOE must demonstrate, using performance assessment, that there is a reasonable expectation that the reasonably maximally exposed individual receives no more than the following annual dose from releases from the undisturbed Yucca Mountain disposal system:

- (1) 0.15 mSv (15 mrem) for 10,000 years following disposal; and
- (2) 1.0 mSv (100 mrem) after 10,000 years, but within the period of geologic stability.

NRC's Radiation Dose Limits for Yucca Mountain (mSv/yr)



Who Makes the Determination of Safety?

- The Nuclear Waste Policy Act of 1982 (Section 121) assigns licensing responsibility for repositories containing spent nuclear fuel and high-level radioactive waste to the NRC

“the Commission, pursuant to authority under other provisions of law, shall, by rule, promulgate technical requirements and criteria that it will apply, under [applicable laws] in approving or disapproving—

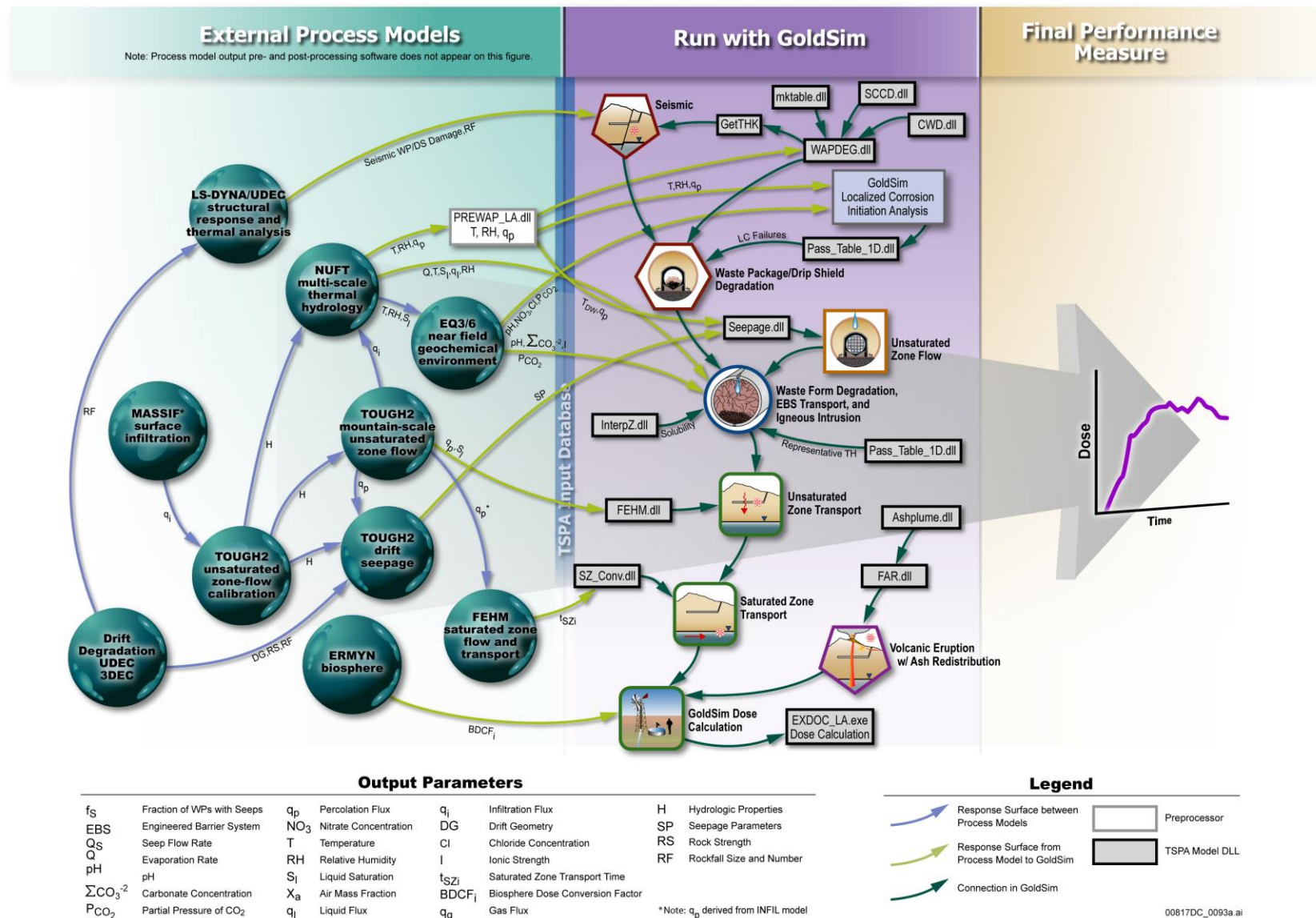
- (i) applications for authorization to construct repositories;
- (ii) applications for licenses to receive and possess spent nuclear fuel and high-level radioactive waste in such repositories; and
- (iii) applications for authorization for closure and decommissioning of such repositories.”

What is the Basis for Evaluating Safety?

- 10 CFR 63.311: “DOE must demonstrate, **using performance assessment**, that there is a reasonable expectation that [estimated doses are below the stated limits]...”
- 10 CFR 63.2: “*Performance assessment* means **an analysis that:**
 - (1) Identifies the features, events, processes (except human intrusion), and sequences of events and processes (except human intrusion) that might affect the Yucca Mountain disposal system and their probabilities of occurring;
 - (2) Examines the effects of those features, events, processes, and sequences of events and processes upon the performance of the Yucca Mountain disposal system; and
 - (3) **Estimates the dose incurred by the reasonably maximally exposed individual, including the associated uncertainties, as a result of releases caused by all significant features, events, processes, and sequences of events and processes, weighted by their probability of occurrence.**
- 10 CFR 63.303: “Compliance is based on the arithmetic mean of the projected doses...”

(emphasis added)

Yucca Mountain Total System Performance Assessment



How do Repositories Achieve Safe Isolation?

Overall performance relies on multiple components; different disposal concepts emphasize different barriers

