

The Proposed EPA Yucca Mountain Radiation Standard—Nevada's views

Victor Gilinsky
Nevada consultant
NWTRB Fall Meeting, Las Vegas,
November 8, 2005

New rule almost same as one Court tossed

<i>Individual dose</i>	Up to 10,000 years	After 10,000 years
2001 rule rejected by Court	15 mrem limit applied to <i>mean</i> TSPA dose results	<u>Infinite</u> individual dose allowed
2005 rule proposed by EPA	(Same as 2001 rule in all respects)	<u>Very high</u> individual dose allowed

1. EPA's post-10,000 year standard is even more permissive than it looks.
2. The practical effect of it—and this is less obvious—is to eliminate defense-in-depth protection *for the pre-10,000 year tier*.
3. It also fails some basic safety comparisons, including with EPA's own stated goals.

An EPA pattern of recalcitrance

- 1992 Congress had told EPA to write a rule “*based upon and consistent with*” NAS recommendations
- 1995 NAS committee said they
 - “*see no valid justification*” for a 10,000 year compliance cut-off.
 - “*recommend that compliance with the standard be measured at the time of the peak risk, whenever that occurs*”
- 2001 EPA ignored this in its rule and adopted a 10,000 year compliance cut-off
- 2004 Court of Appeals bluntly told EPA it was violating the law:

“Only in a world where ‘based upon’ means ‘in disregard of’ and ‘consistent with’ means ‘inconsistent with’ could EPA’s adoption of a 10,000-year compliance period be considered a permissible construction”

“the agency consciously and outrightly rejected the Academy’s findings and recommendations”
- 2005 EPA rule is still unresponsive—EPA seems to think the judges will accept any number, no matter how high (a mistake—the Appeals judges understood very well the importance of the peak dose in the site safety evaluation)

Peak dose measures the site's adequacy

- Defense-in-depth— the *sine qua non* of nuclear safety—requires redundancy between package and site. See, for example, IAEA Safety Requirements for Radioactive Waste, April 2005*:

The overall performance of the geological disposal system shall not be unduly dependent on a single barrier or function.

- The peak dose comes after the packages fail and waste leaks out—it measures the site's capacity to contain radioactivity. A good site has a low peak.
- EPA has a YM dose standard it defends on health and safety grounds—15 mrem/year. The obvious response to the Court is to apply it to the peak
- But EPA shrank from this because after 10,000 years DOE's calculations show a much higher dose peak than 15 mrem. (The meaning of which is simple—*the site is no good.*)
- Instead, EPA drew a two-tiered standard comfortably above DOE's calculated peak doses—with a post-10,000 year tier of "350 mrem/year" (and told DOE it didn't have to do anything more to satisfy it)

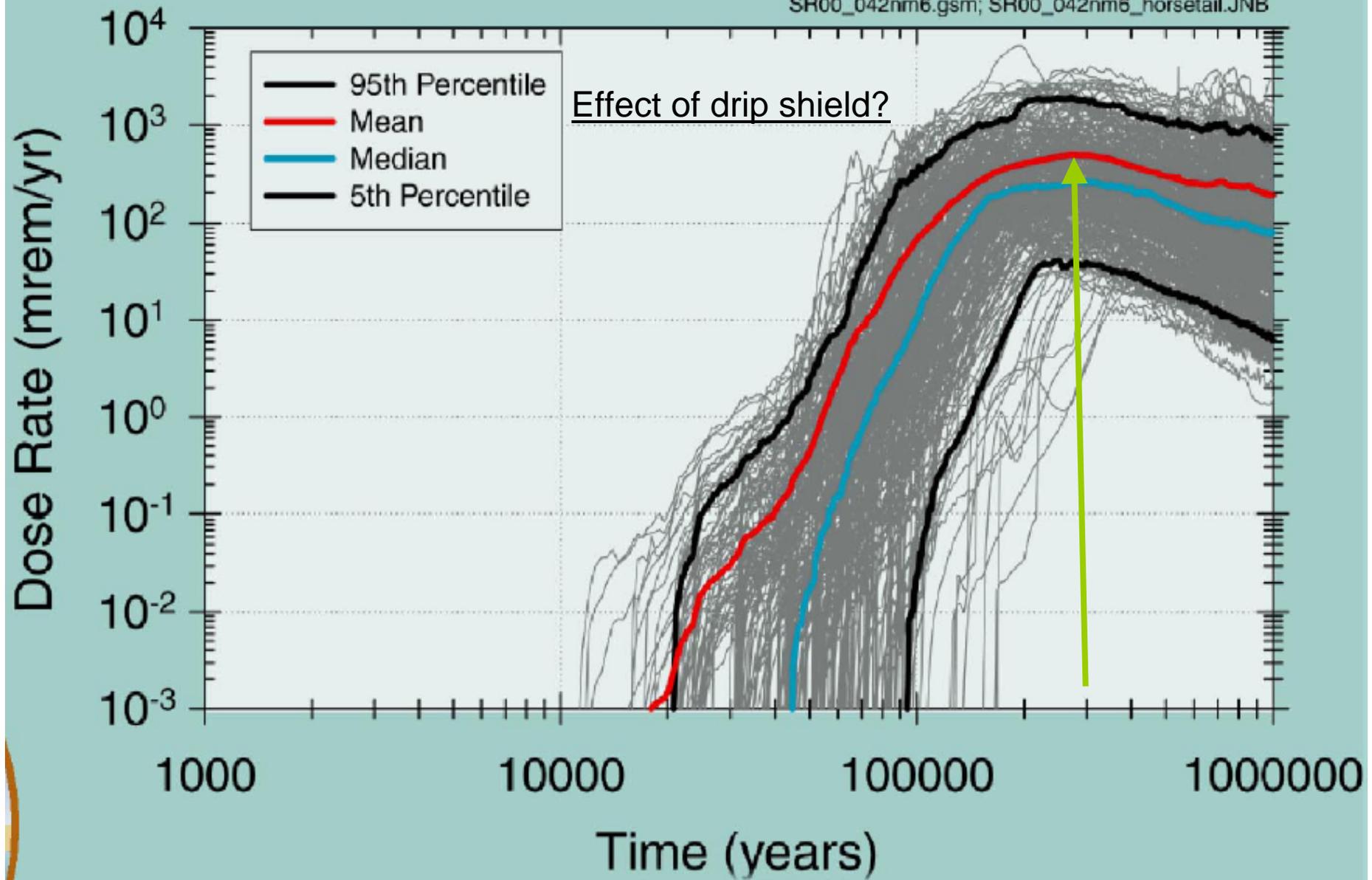
EPA's "350 mr" is really about 1,000 mr

- EPA's rationale for "350 mrem/year" is:
 - Amargosa Valley residents get 350 mrem/yr, and Colorado residents get 700 mrem, so AV residents shouldn't fuss about 350 mrem more
 - Hard to square with a limit of 15 mrem for the first 10,000 years
- It gets worse: the "350 mrem/year" is the standard for the *median* of the TSPA runs.
- In calling for the median, EPA ignores (again) NAS's *explicit* recommendation:

"We recommend that the *mean* values of calculations be the basis for comparison with our recommended standards."

(1995 NAS Report p. 123)

- "350 mrem/year" is approximately 1,000 mrem/year in terms of the *mean* TSPA results (see next slide—difference between blue and red line)



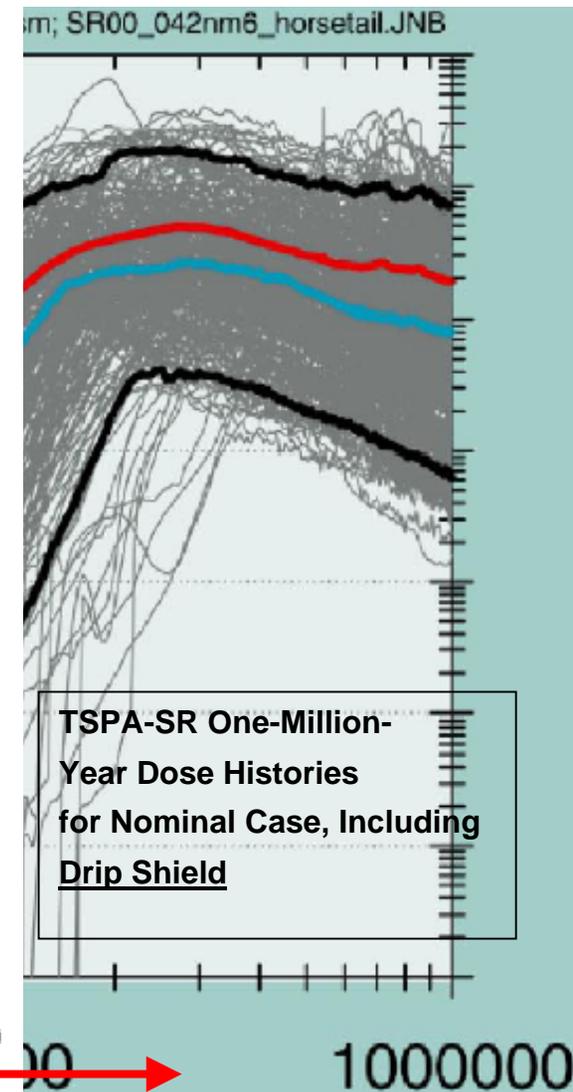
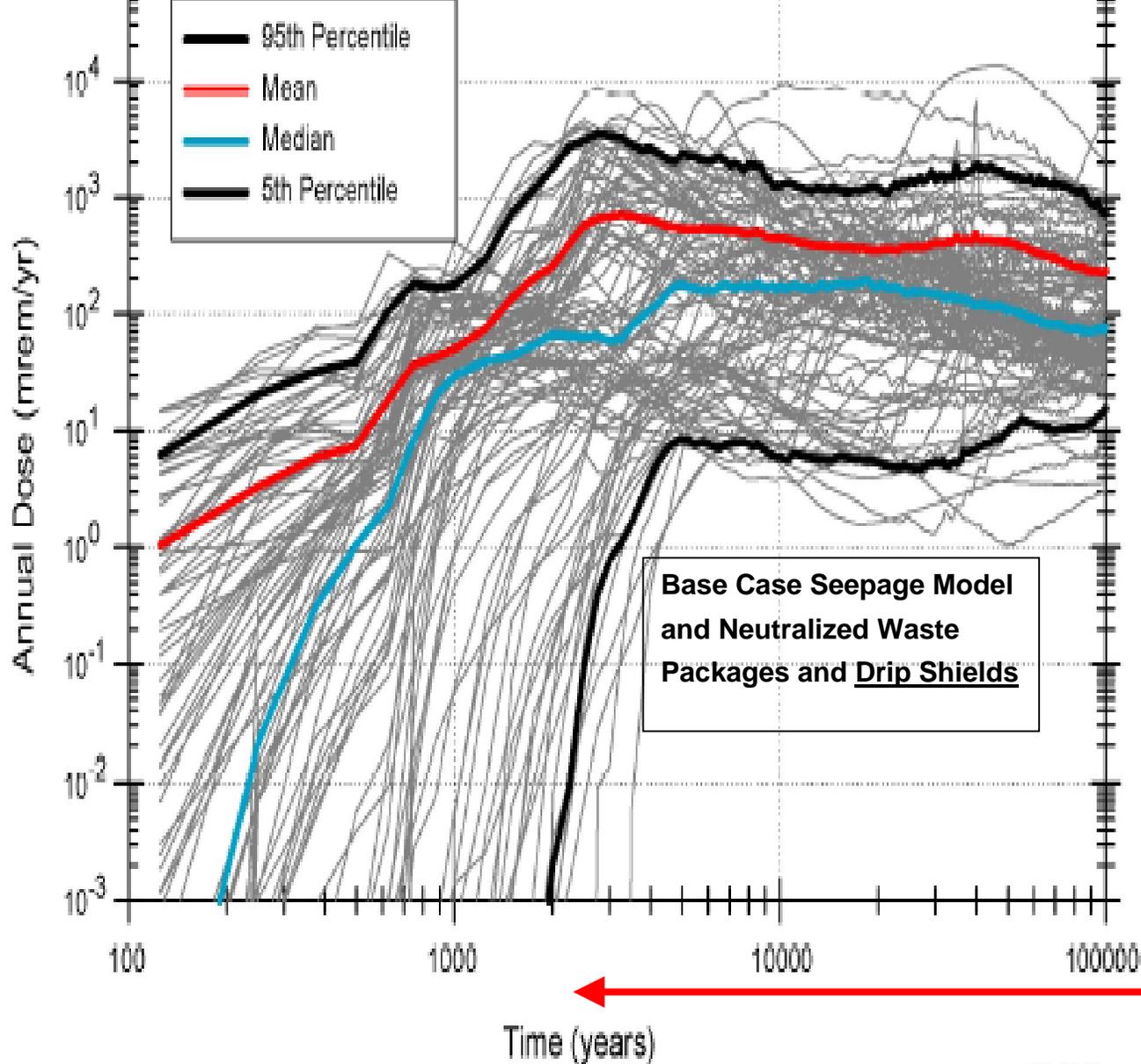
EPA uses the median to ignore high doses

“A conservative approach to constructing and evaluating performance scenarios tends to generate high-end results and a simple averaging of these results would drive the arithmetic mean to higher values that would *not be as representative* overall of the actual distribution of projected doses.” (EPA statement FR 49043)

- EPA doesn't like TSPA high dose cases. But is getting rid of cases valid?
- This is *not* like throwing out strange experimental results—say, because they are so odd something must have gone awry
- In this case—the TSPA—the individual runs reflect random parameters choices taken from distributions *assigned by DOE*—all runs should be equally valid*
- And it isn't as if EPA needs to rein in DOE's penchant for overly conservative calculations. What it comes down to is an attempt on EPA's part to quietly give DOE a leg up.

Why worry if peak is in remote future?

- *Because it isn't necessarily in the remote future*—it could come much earlier (see next slide).
- The supposed long times for the Yucca Mountain peak—hundreds of thousands of years—are a construct of DOE's TSPA computer simulation model
- In particular, they are the result of highly optimistic assumptions about the *key uncertainty—waste package corrosion*
- DOE's "time" is just the time parameter in the *TSPA simulation model*. No one knows when peak doses would *really* occur.
- At this point, DOE's simulation result should have no claim on our confidence—it is the scientific brief of an interested litigant, a brief not yet seriously tested
- It is improper for EPA (and NRC) to assume the peak is far off and then write permissive safety rules based on that assumption



155_0078.ai

Time (years)

155_0078.ai

11/8/03

Real peak somewhere in between?

But if peak is early, isn't the dose limit 15 mr?

- Not necessarily. We must distinguish here between simulation and reality.
- EPA's rule sets a design standard, subject to a one-time prospective check by a computer *simulation* (one based on sparse geologic data and projections of package material performance far beyond our experience)
- If NRC accepts DOE's optimistic estimates that the peak comes late, the repository will be designed to the permissive post-10,000 year standard
- After repository closure, and probably before, errors will be irretrievable—the EPA dose limit is not like a speed limit that is monitored and enforced
- Now, what if DOE and NRC turn out to be wrong and years later—in real life—the packages fail earlier than projected? This is where we need defense-in-depth.
- The radioactive particles won't remember EPA's rule, they will follow Nature's rules—and nothing will limit doses to 15 mrem
- The practical effect of the 10,000 year cutoff—in old and new rules—is therefore to eliminate *defense-in-depth* protection for the pre-10,000 year period.

EPA misuses “uncertainty” arguments

- EPA’s mantra is:
 - “reasonable expectation” + “uncertainty” = justification for loose standards
- On *reasonable expectation*, EPA fails to mention *anywhere* that in oral argument the government gave it up as a looser standard than the NRC’s “reasonable assurance”, a fact noted in the Court opinion
- And *uncertainty* calls for *tighter* standards, not looser ones, as EPA argues
- The chief uncertainty is over when the waste package will fail and produce the consequent dose peak. It’s a stretch to predict this into the distant future:
 - “Prediction of the performance behavior of engineered systems beyond a few hundred years is unprecedented based on current technology.”*
- If we are uncertain about when the peak comes it is all the more vital to have a good site—to apply a flat 15 mrem across the board
- And beyond some point, uncertainty argues for *rejecting the site altogether*

EPA rule fails comparison with WIPP

Safety objective in EPA fact sheet:

“Ensure that people living near Yucca Mountain are protected to the same level as those living near the Waste Isolation Pilot Plant in Carlsbad, New Mexico . . .”

- Despite a superficial similarity—WIPP has a 15 mrem standard for 10,000 years—Yucca Mountain doesn’t come close to meeting above objective
 - WIPP has no water flow and *EPA expects no migration of waste*
 - WIPP approval does not depend on waste package performance
 - WIPP’s 10,000 year standard is, in effect, an infinite standard
- By contrast, Yucca Mountain’s waste containment is based on delayed leakage
 - Water flow through mountain
 - Waste package performance critical to licensing
 - DOE calculates substantially increase in public dose after 10,000 years—a radioactive balloon payment
- To match WIPP’s safety EPA would have to extend 15 mrem to peak dose

EPA rule fails IAEA safety principles

- Future dose limit, “Safety fundamentals, Principle 4”:

“Radioactive waste shall be managed in such a way that predicted impacts on the health of future generations will *not be greater than relevant levels of impact that are acceptable today.*”

- Defense-in-depth

“. . . safety shall be provided by means of multiple barriers whose performance is achieved by diverse physical and chemical processes. *The overall performance of the geological disposal system shall not be unduly dependent on a single barrier or function.*”

EPA background reference document 0051, “Geological Disposal of Radioactive Waste,” IAEA Draft Safety Requirements (DS154), April 2005

YM safety regime much weaker than reactors'

	NRC REACTORS	EPA/NRC YUCCA MOUNTAIN
<i>Basic standard</i>	"Reasonable assurance"	EPA still pushing for weaker " <i>reasonable expectation</i> "*
<i>Defense in depth</i>	Multi-barrier	Overwhelming reliance on package
<i>Separate standards for individual barriers</i>	Yes	No
<i>Allowed dose</i>	~10 mrem/year to an individual <i>continually</i> at highest dose point offsite	EPA Yucca Mountain dose : ~1000 mrem/year on average at 18 km (<i>after diluting the waste stream and prescribing a limited amount of water use per individual</i>)
<i>Dealing with errors</i>	Corrected through inspection and enforcement	<i>Irretrievable</i> after closing, and probably soon after emplacement

Reasons for extending 15 mrem standard

1. To provide defense-in-depth by ensuring an adequate site:
 - *“The overall performance of the geological disposal system shall not be unduly dependent on a single barrier or function.”*
IAEA Safety Requirements for Radioactive Waste, April 2005*
2. To conform with 1995 NAS safety recommendations, as required by law:
 - *“recommend that compliance assessment be conducted for the time when the greatest risk occurs”*
 - *(Bob Fri at 9/21 ACNW meeting: “we didn’t recommend the alternative of a tiered approach”)*
3. To meet EPA’s own stated objective in relation to WIPP:
 - *“Ensure that people living near Yucca Mountain are protected to the same level as those living near [WIPP]”*
4. To meet IAEA “Principle 4” (in EPA-cited background document):
 - *“Radioactive waste shall be managed in such a way that predicted impacts on the health of future generations will not be greater than relevant levels of impact that are acceptable today.”*
5. Because 15 mrem/year is the only standard that has a firm basis in EPA rulemaking

A final point on tightening standards

- We all know you can't achieve absolute assurance that an engineered system will not fail. That in itself doesn't disqualify it.
- In typical engineering, failure is one of the ingredients of success--you learn from failures to improve designs, and the fear of failure imposes discipline on the designers (no one wants to be the one who overlooked the "O" ring on the space shuttle)
- But for this to work the feedback loop has to have a relatively short period--which is not the case here
- At Yucca Mountain the feedback loop would be measured in many, many generations—the consequences of post-closure errors will come too late to affect today's repository designers, or to correct design
 - Human nature, being what it is, tells us professional self-discipline for "getting it right" will not be as strong as, say, in the space program
 - Plus, DOE's long-term Yucca Mountain simulations, and the scientific work underlying it, are directed to one goal—getting an NRC license
- To compensate for this lack of feedback-induced professional discipline and correction, we need exceptionally high *regulatory* standards, not loose ones.

EPA's key contractor on package corrosion:

Unlike most concepts adopted by other nations, the proposed Yucca Mountain repository exposes the metallic waste packages (WPs) and drip shields (DSs) to sustained oxidizing conditions. Under those circumstances, *corrosion of the WP and DS alloys exposed to moisture is limited neither by natural immunity of the metal nor by starvation of the oxidant agent*. Instead, corrosion resistance results from the presence of an extremely thin oxide film (the “passive film”) on the alloy surface, which acts as a surface seal greatly lowering the rate of metal oxidation. . . .

Under certain conditions, passive films are susceptible to localized breakdown that exposes the underlying metal, without regeneration of the film. *Localized Corrosion then ensues that, if present, could relatively quickly penetrate through the WP wall or DS*. . . .

Engineering experience with passive metals is *extremely short* (i.e., approximately 100–150 years) compared with the timeframe of repository performance projections. *Extrapolation of present knowledge to the longer timeframe is thus highly uncertain*

S. Cohen & Associates, *Assumptions, Conservatism, and Uncertainties in Yucca Mountain Performance Assessments*, August 8, 2005 (emphasis added)

EPA hangs on to “reasonable expectation”

Court of Appeals July 2004 opinion:

“5. NRC’s “Reasonable Expectation” Standard NRC explained in its brief that there is “no consequential difference” between the reasonable assurance and reasonable expectation standards and that the two are, in fact, “[v]irtually [i]ndistinguishable.” Respondent’s Br. at 47-48. Moreover, during oral argument, counsel for NRC confirmed that the two standards are substantively identical. See Oral Argument Tr. at 106-07. Nevada deemed NRC’s representation sufficient to satisfy its claim. See Petitioners’ Reply Br. at 29 (noting NRC’s “welcome” concession that reasonable assurance and reasonable expectation are “identical” standards).”

At the same time see, Cohen & Assoc. Report, Appendix A:

“. . . . As noted above, the Court decision did not affect, and EPA is not proposing to change, the “reasonable expectation” approach in the treatment of uncertainties. A difference between the 2001 rule and the current effort is the extension of the compliance period for the individual protection standard to the time of peak dose. The principle of ‘reasonable expectation’ suffices to prevent unreasonable demands for additional data collection and exhaustive analysis.”