EPA's Yucca Mountain standard: Nevada's criticism and proposal

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DRAFT slides prepared for the
NWTRB Fall Meeting, Las Vegas,
November 8, 2005

New rule almost same as one Court tossed

	Previous rule rejected by Court	**Proposed EPA rule**
pre-10,000 years	15 mrem dose applied to *mean* Water contamination limit	15 mrem dose applied to *mean* Water contamination limit
post-10,000 years	*Infinite* dose allowed No water contamination limit	*Very high* dose allowed No water contamination limit

The Court rejected an infinitely permissive standard; will it accept a highly permissive standard? Should it?

How did we get here?

- 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 limit.
  - *"recommend that compliance assessment be conducted for the time when the greatest risk occurs"*

- EPA ignored the law--it did the opposite from what the NAS recommended

- 2004 Court of Appeal bluntly told EPA it was way off base:

  *"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 … ." (*Court of Appeals, July 2004 opinion)

- In the proposed rule EPA adopts a peak dose (more or less). But just having *any* standard at the peak does not do it

Why is the peak dose so important?

- Defense-in-depth– the *sine qua non* of nuclear safety—requires redundancy between package and 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*

- The dose peak comes after the packages fail—it measures the site's capacity to contain radioactivity.
  - *The Court of Appeals judges understood this very well in insisting on a peak dose standard.*

- EPA has a waste repository dose standard--15 mrem/year

- The obvious response to the Court is to apply that standard to the peak, whenever it comes
  - But EPA recoiled from this proposal because DOE's calculations show a high peak after 10,000 years—one much higher than 15 mrem
  - The meaning of a high peak is, of course, simple—*it means the site is no good.*

- Instead, EPA proposed a two-tiered standard comfortably above DOE's calculated peak doses, with the higher tier at "350 mrem/year"

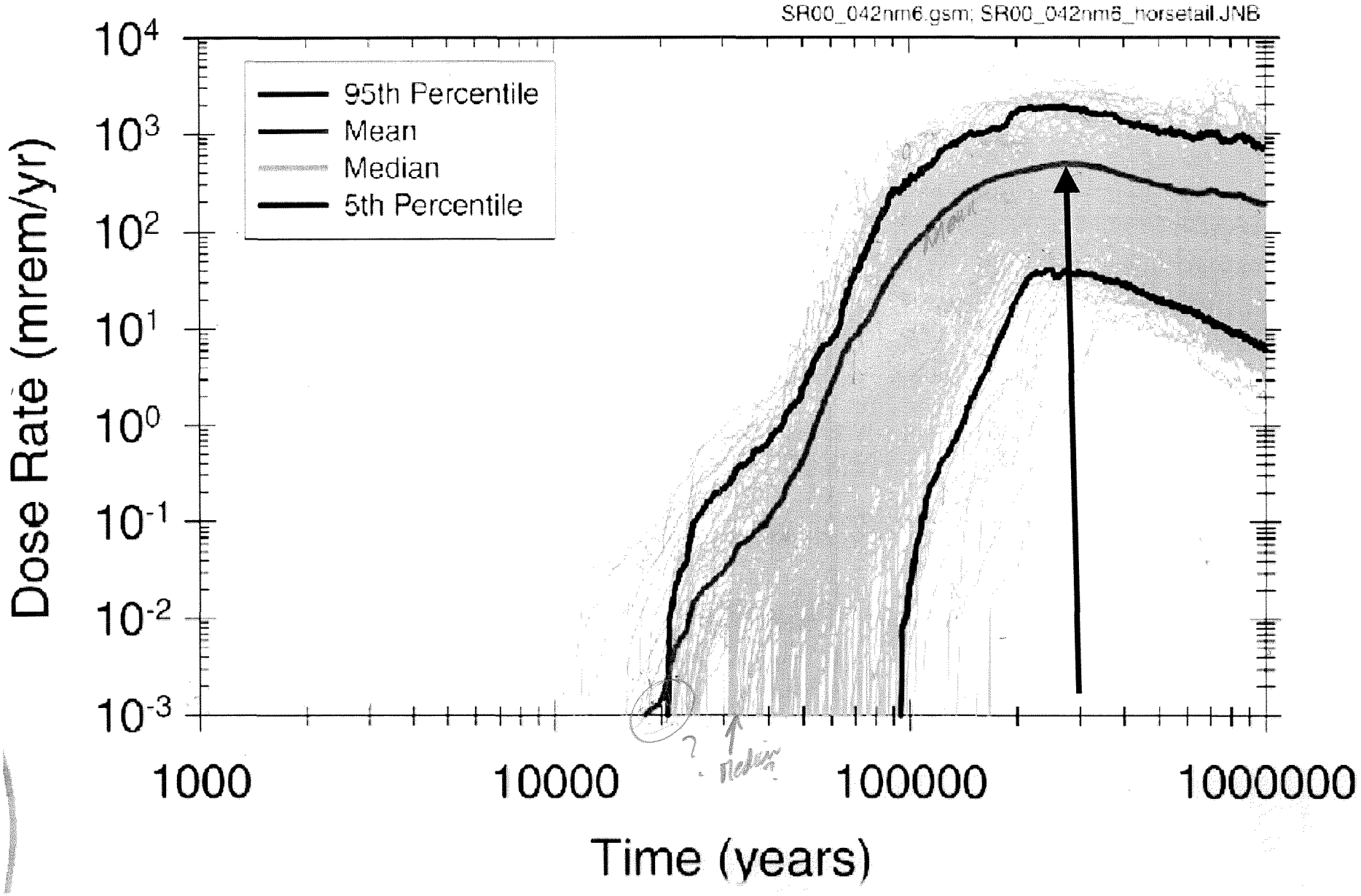
EPA calls it "350 mrem"? What's it really?

- First, where does the "350 mrem/year" come from?
  - EPA says Amargosa Valley residents get 350 mrem/yr, and Colorado residents get 700 mrem, so AV residents shouldn't fuss about 350 mrem more from YM
  - Hard to think of a flimsier rationale

- Moreover, the "350 mrem/year" is the standard for the *median* of the TSPA runs
  - Departs from past practice, and *explicit* NAS recommendation:

    "We recommend that the *mean* values of calculations be the basis for comparison with our recommended standards."
    (1995 NAS Report p. 123, *apparently missed by EPA*)

- EPA advertises the million year duration of its proposed standard, but doesn't tell the public that on basis of TSPA results (see next slide) "350 mrem/year" is approximately 1,000 mrem/year in terms of the *mean*

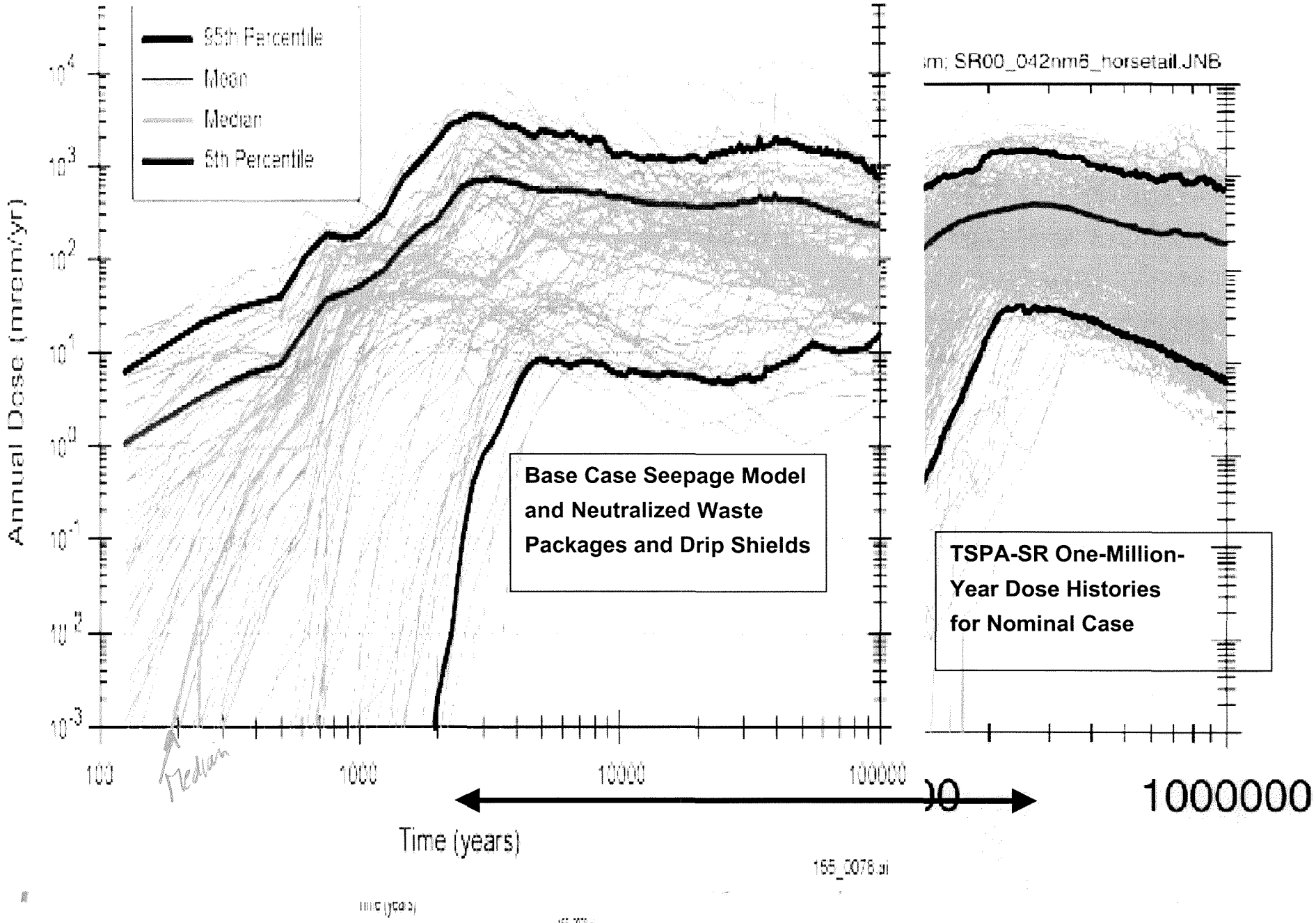

SR00_042nm6.gsm; SR00_042nm6_horsetail.JNB
95th Percentile
Mean
Median
5th Percentile
Dose Rate (mrem/yr)
10^4
10^3
10^2
10^1
10^0
10^-1
10^-2
10^-3
1000
10000
100000
1000000
Time (years)

The median ignores high dose cases

- EPA's *stated* purpose in using the median is to toss out high consequence TSPA simulation runs--is this valid?
- This is *not* like throwing out strange experimental results--say, because they are so odd something must have gone awry
- In this case, all TSPA runs reflect parameters taken randomly from distributions *assigned by DOE*--all runs should be equally valid*
- And it isn't as if DOE needs to be reined in because it is inclined to use overly conservative models

OK, 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*. We don't know when doses will really occur.
- At this point, DOE's simulation result should have no claim on our confidence—it is, so to speak, the scientific brief of an interested litigant, a brief not yet seriously tested
- It is improper for EPA (or NRC) to assume the peak is far off and then write permissive safety rules based on that assumption



Real peak somewhere in between?

But if peak is early, doesn't 15 mr apply?

- Not necessarily. We have to distinguish between simulation and reality.
- EPA is setting a design standard that applies to a computer *simulation* that projects performance far beyond our experience base
- After closure, errors will be *irretrievable*
- The 15 mrem standard applies only if NRC concludes that the peak comes before 10,000 years; otherwise the permissive post-10,000 year standard applies to the design
- Now, what if NRC accepts DOE's optimistic package corrosion estimates, but in real life the packages fail earlier?
- The site won't limit doses to 15 mrem—the radioactive particles won't know about EPA's rule, they will follow Nature's rules
- The practical effect of the 10,000 year cutoff—in old and new rules—is to eliminate defense-in-depth protection *for the pre-10,000 year period, as well.*

EPA hangs its hat on "uncertainty"

- But uncertainty calls for *tighter* standards, not more permissive ones, as EPA argues
  - If we can't be sure when the peak come we should cover the contingency that it will come early and apply a tighter standard, a flat 15 mrem
  - If we are so uncertain that we don't know how the system will behave we should reject the site altogether

- Additionally, a philosophical point--comparing YM with the space program:
  - DOE's long-term YM simulations, and the scientific work underlying it, are directed to one goal—getting an NRC license
  - The consequences of post-closure errors will come too late to affect today's repository designers—unlike, say, a space program failure ("O" rings)
  - Human nature, being what it is, tells us professional self-discipline for "getting it right" will not be the same
  - In short, the long range nature of repository design demands exceptionally high *regulatory* standards
- More generally, a permissive approach to quality and safety for the post-closure period will likely infect the pre-closure operations, as well—in fact, it already has

YM rule fails comparison with WIPP

- EPA fact sheet states Yucca Mountain safety objective:

  "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—YM doesn't come close to meeting above objective
  - WIPP has no water flow and EPA says no migration of waste expected;
  - 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
  - DOE calculates substantially increase in public dose after 10,000 years
  - To match WIPP's safety EPA would have to extend 15 mrem to peak dose

Much weaker safety regime than reactors'

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

Rule at odd with IAEA safety principles

- IAEA "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.*

- Requirements for multiple safety functions [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 0051, "Geological Disposal of Radioactive Waste," IAEA Draft Safety Requirements (DS154), April 2005)

EPA should extend 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 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 it is the only standard that has a firm basis in EPA rulemaking