

CRS Report for Congress

EPA's Final Health and Safety Standard for Yucca Mountain

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Summary

On September 30, 2008, the Environmental Protection Agency (EPA) issued the long-awaited revision to its 2001 Public Health and Safety Standard for the proposed Yucca Mountain deep geologic repository for high-level radioactive waste and spent nuclear fuel. While the issuance of the standard allows the Nuclear Regulatory Commission (NRC) to issue its final conforming standards and move forward toward a final license decision for the facility, EPA's standard raises several unprecedented regulatory issues and is likely to be further challenged in court. EPA's final regulation represents the first time the federal government has attempted to regulate public health far into the future, for a period of up to 1 million years. The continued prospect of legal challenges creates an uncertain atmosphere around the licensing process. It has been argued that the government's difficulty promulgating a legally defensible public health and safety standard for the Yucca Mountain repository has far-reaching impacts on the nuclear industry and the viability of nuclear power as a long-term component of the United States' energy strategy.

Permanent disposition of spent nuclear fuel and high-level radioactive waste has been the subject of substantial controversy for several decades. The creation of a deep geologic repository for this type of waste has been an element of U.S. nuclear policy since the early 1980s. The technical, legal, and policy challenges have delayed development of a repository and created an uncertain environment for high-level nuclear waste management in the United States.

Congress has held several hearings in the past few years focusing on the administration's progress toward finalizing the health and safety standard, the technical soundness of the Department of Energy's (DOE's) design for the facility, the relationship of the project to broader energy policy, and transportation safety issues for waste packages eventually sent to the facility, among other issues. Funding for the program has also been controversial.

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Background

The Nuclear Waste Policy Act of 1982 (NWPA, P.L. 97-425) defined the basic roles of the three federal agencies with responsibility over the selection, licensing, and health and safety of the first U.S. high-level radioactive waste disposal site. The Environmental Protection Agency's (EPA's) role is to establish the public health and safety standards for high-level waste disposal; the Nuclear Regulatory Commission (NRC) licenses and regulates the repository, using EPA's standards as the compliance measure; the Department of Energy (DOE) constructs and operates the repository. The Energy Policy Act (EPAct) of 1992 (P.L. 102-486) maintained these roles, but established new requirements specific to the Yucca Mountain, Nevada site. EPA was directed to issue new environmental standards specifically for the Yucca Mountain repository site. General EPA repository standards previously issued and subsequently revised no longer could be applied to Yucca Mountain. DOE and NRC had raised concerns that some of EPA's general standards might have been impossible or impractical to meet at Yucca Mountain.¹

EPAct also required EPA to contract with the National Academy of Sciences (NAS) for a technical study of "reasonable" standards that might apply to the Yucca Mountain site, and required that any standard set by EPA be "based upon and consistent with" the National Academy's findings and recommendations. The resulting study was issued August 1, 1995.² The NAS study recommended that the Yucca Mountain environmental standards establish a limit on risk to individuals near the repository, rather than setting specific limits for the releases of radioactive material or on radioactive doses, as under previous EPA standards. The NAS study also examined the potential for human intrusion into the repository and found no scientific basis for predicting human behavior thousands of years into the future.

On June 13, 2001, EPA issued a final Health and Safety Standard for the Yucca Mountain High-Level Radioactive Waste Repository.³ The regulation established a

¹ For more information see CRS Report RL33461, *Civilian Nuclear Waste Disposal*, by Mark Holt.

² The final standard is currently only available on EPA's website, pending publication in the Federal Register. [<http://www.epa.gov/yucca>].

³ 40 CFR 197 Public Health and Environmental Radiation Protection Standards for Yucca Mountain Nevada, June 13, 2001.

15 millirem/year (mrem/yr)⁴ exposure standard for the facility that applied for 10,000 years based on projected doses to a Reasonably Maximally Exposed Individual (RMEI) from the undisturbed repository as well as circumstances of human intrusion. The rule established a separate groundwater protection standard equivalent to today's drinking water standards also applicable for 10,000 years. EPA's rule also required DOE to continue RMEI projections beyond 10,000 years to the time of peak dose, but declined to set numerical standards beyond the 10,000-year time frame.

EPA calculated that its standard would result in an annual risk of fatal cancer for the RMEI of seven chances in a million. The nuclear industry criticized the EPA proposal as being unnecessarily stringent, particularly the groundwater standard. On the other hand, environmental groups contended that the 10,000-year standard proposed by EPA was too short, because DOE had projected that radioactive releases from the repository would peak after about 400,000 years. Despite DOE's opposition to the EPA standards, the Department's site suitability evaluation determined that the Yucca Mountain site would be able to meet them. NRC revised its repository regulations on September 7, 2001, to conform to the EPA standards.

The Court Ruling

Various aspects of the 2001 regulation were challenged in lawsuits filed with the U.S. Court of Appeals for the District of Columbia in July 2001. The State of Nevada, the Natural Resources Defense Council (NRDC), and the Nuclear Energy Institute (NEI) each challenged different aspects of the rule. Nevada and the NRDC challenged the rule on the grounds that it was not sufficiently protective and had not been adequately justified, focusing on the 10,000-year time period. NEI challenged the groundwater protections as unnecessary, contrary to recommendations of the NAS, and outside the agency's authority under the EPAct.

On July 9, 2004, the U.S. Circuit Court of Appeals for the District of Columbia dismissed the NEI groundwater challenge, and all but one of the challenges by Nevada and NRDC. On the issue of the 10,000-year compliance standard, the Court upheld the challenge and vacated the 2001 standard, ruling that the 10,000-year compliance time frame was not "based upon and consistent with" the NAS finding that "there is no scientific basis for limiting the time period to 10,000 years or any other value ..." and their recommendation "that compliance assessment be conducted for the time when the greatest risk occurs within the limits imposed by long-term stability of the geologic environment."⁵

⁴ Radiation exposure standards typically do not specify the amount of radioactivity that can be released into the environment. Rather, these standards specify the maximum allowable exposure of an individual to radiation over a certain period of time, based on health risks that regulators determine as acceptable. In U.S. regulations, the amount of allowable exposure typically is measured in rems and millirems of radiation, accumulated over a one year period or millirems/year. (One rem is equivalent to 1,000 millirems.)

⁵ *Nuclear Energy Institute v. Environmental Protection Agency*, U.S. Court of Appeals for the District of Columbia Circuit, No. 01-1258, July 9, 2004.

2005 Proposed Final Rule

In response to the court decision, EPA proposed a new version of the Yucca Mountain standard on August 22, 2005. The proposal retained the dose limits of the 2001 standard for the first 10,000 years but proposed a higher annual dose of 350 mrem/yr for the period of 10,000 years through 1 million years. EPA based the standard on variations in natural background radiation between Colorado and Amargosa Valley, Nevada, arguing that it was reasonable to use natural background as a benchmark for exposure when the compliance point was up to 1 million years in the future. The agency also argued that it was reasonable to consider protective exposures no greater than residents of Colorado experience today from natural background radiation alone.⁶ EPA also proposed basing the post-10,000-year standard on the median dose, rather than the mean, an approach that some argued would make it easier for DOE to meet the standard. Nevada state officials called EPA's proposed standard far too lenient and charged that it was "unlawful and arbitrary."⁷ Comments submitted to the public docket both praised and attacked EPA's proposal. Those in favor of the proposal focused on the unprecedented time frames and the reasonableness of drawing comparisons with natural levels of radioactivity; opponents claimed that the proposal violated EPA's basic principles of public health protection and was designed specifically to allow the facility to be built.

2008 Final Rule

What Standard Has EPA Chosen? In its final standard,⁸ EPA has established a dual compliance standard: 15 mrem/yr with a separate groundwater protection standard for the first 10,000 years, and 100 mrem/yr for the period from 10,000 up to 1 million years. The concept of a dual standard was introduced in EPA's August 2005 proposal and has remained controversial. EPA maintains that the dual approach provides a reasonable measure of the disposal system's performance that appropriately combines protectiveness with recognition of the limitations of modeling in predicting the evolution of the system over hundreds of thousands of years. Critics argue that the dual standard explicitly condones a lesser level of protection for future generations and is designed to make it easier for the Department of Energy to ultimately meet the standard.

EPA also specified that the mean of the distribution of results should be used to demonstrate compliance with the standard at all times. This is a departure from the proposal, in which EPA specified the mean during the pre-10,000-year period, but chose the median for the post-10,000-year period. At the time, EPA stated its belief that the median better represented the central tendency of the likely distribution of results in DOE's performance assessment. In the final rule, EPA returned to the

⁶ In the proposed rule (Federal Register Vol. 70 No. 161 40 CFR Part 197 p 49037) EPA estimated the natural background exposure in Colorado to be about 700 mrem/yr.

⁷ See CRS Report RL33461, *Civilian Nuclear Waste Disposal*, by Mark Holt.

⁸ [<http://www.epa.gov/rpdweb00/docs/yucca/RIN%202060-an15-final-40-cfr-197amendments.pdf>].

mean for both time periods, citing public comments that pointed to a recommendation in the NAS report that the mean be used as the basis for any standard.⁹

What Is the Basis for EPA’s 2008 Standard? In choosing 100 mrem/yr as the final standard for the 10,000 to 1 million-year time period, EPA abandoned the controversial “variations in natural background” approach it proposed in 2005. That approach would have set the standard based on comparisons of background levels between Amargosa Valley (the closest populated area to the proposed facility) and another geographical location in the United States. For the proposal, EPA chose Colorado. Their concept was that, so long as the hypothetical future residents of Amargosa Valley did not receive more radiation exposure in the far future than residents of Colorado receive from natural background radiation today, the exposure could be considered protective. EPA cited the unprecedented time period as one justification for its approach and referenced international precedent for using natural background levels as a “reasonable and logical reference point.”¹⁰

In the final standard, EPA changed its approach. EPA states that it was not possible to reliably estimate levels of background exposure in a way that was relevant to making the kinds of comparisons between locations it envisioned in the proposal. EPA concluded that “comparing background radiation estimates from specific locations does not provide a clear or sufficient basis for a regulatory standard applicable to the Yucca Mountain disposal system.”¹¹ The agency did not abandon comparisons to background completely. The final rule notes that the 100 mrem/yr level “reasonably comports” with background estimates in Amargosa Valley, but relies more heavily on arguments that 100 mrem/yr is directly protective of public health. EPA cites both national and international standards in support of its decision, and points to existing domestic regulations,¹² which each use 100 mrem/yr, as well as the National Council on Radiological Protection (NCRP) endorsement of the 100 mrem/yr level incorporated in the international system of radiation protection.¹³ EPA went on to state that it “acknowledges and concurs with the broad consensus in the protectiveness of the 100 mrem/yr level and, furthermore, considers it especially suitable for application to the extreme far future, when planning for and protecting public exposures is much less certain.”

Key Questions

Comments submitted to the public docket both praised and attacked EPA’s 2005 proposal. Those in favor of the proposal emphasized the unprecedented time frame

⁹ National Research Council. *Technical Bases for Yucca Mountain Standards*. National Academy Press. 1995. p. 123.

¹⁰ Federal Register Vol. 70 No. 161, 40 CFR Part 197, p. 49039.

¹¹ EPA final rule, p. 71 [<http://www.epa.gov/rpdweb00/docs/yucca/RIN%202060-an15-final-40-cfr-197amendments.pdf>].

¹² NRC’s 10 CFR20.1301 and DOE Order 5400.5.

¹³ National Council for Radiation Protection Report 116, Limitation of Exposure to Ionizing Radiation.

and the reasonableness of drawing comparisons with natural levels of radioactivity at such long time frames. Supporters of the repository see EPA's regulation as the last tool NRC needs to complete its technical review. Opponents raised issues with the 2005 proposal in three key areas: 1) they claimed that the proposal was not protective of public health, 2) that it was legally indefensible; and 3) it was designed specifically to allow the facility to be built. Nevada state officials called EPA's proposed standard far too lenient and charged that it was "unlawful and arbitrary."¹⁴

In the final regulation, EPA argues that it has addressed these issues; it lowered the numerical standard significantly, from the 350 mrem/yr in the proposal to 100 mrem/yr, explaining that the original assumptions it used to justify comparing background levels in geographically similar areas were called into question by new data submitted during the public comment period. Acknowledging that it was unable to arrive at defensible estimates of natural background,¹⁵ EPA opted to use a different approach for the final standard. Some may argue that even adopting the 100 mrem/yr level as EPA did in the final standard is not protective of public health and that the final standard is further flawed by promulgating a dual standard that adopts a lesser level of protection for future generations than applies for the first 10,000 years.

Protecting Public Health. There has been much debate over the years about what is protective of public health when it comes to radiation. EPA has repeatedly held that an increased risk over a lifetime of 1 in 10,000 to 1 in 1 million excess cancer deaths is protective. The original 2001 Yucca Mountain regulation adopted a 15 mrem/yr standard for 10,000 years, which, at the time, the agency calculated was equivalent to a 7 to 8.5 in 1 million annual cancer risk.¹⁶ The final 2008 regulation maintains this level for the first 10,000 years. In considering the unprecedented challenge of carrying the compliance standard beyond 10,000 years out to 1 million years, EPA argues that a different framework should apply. EPA estimates that the nominal annual risk associated with 100 mrem/yr is 5.75×10^{-5} or 5.75 in 100,000, which it describes as fully consistent with the NAS report. EPA considers the standard both protective, given the extremely long time frames involved, and reasonable because it effectively addresses the uncertainty in projecting doses for up to a million years. The agency also emphasizes what it considers a "broad consensus" regarding 100 mrem/yr as a protective public dose limit. Some disagree with this assessment, arguing that a 100 mrem/yr exposure results in a 4×10^{-3} or 4 in 1,000 risk over a 70-year lifetime,¹⁷ a level of risk that would be unacceptable in a regulation today.¹⁸

¹⁴ See CRS Report RL33461, *Civilian Nuclear Waste Disposal*, by Mark Holt.

¹⁵ [<http://www.epa.gov/rpdweb00/docs/yucca/RIN%202060-an15-final-40-cfr-197amendments.pdf>].

¹⁶ 40 CFR 197.

¹⁷ EPA Response to Comments, p. 168 [<http://www.epa.gov/rpdweb00/docs/yucca>].

¹⁸ There has been ongoing disagreement among federal regulatory agencies as to what exposure limit is adequate to protect human health, resulting in standards of varying stringency. Accordingly, federal radiation exposure standards vary depending on the source and conditions. For example, worker protection standards are the least stringent, allowing
(continued...)

In the 2008 regulation, EPA argues that the increasing uncertainty in dose projections over very long time periods reduces the ability of performance assessment modeling to meaningfully distinguish among alternative and equally likely “futures” represented by individual model simulations. EPA also explained that it was attempting to balance the principles of intergenerational equity with the need to create a compliance standard that did not demand more than can be provided by scientific analysis. EPA argues that the dual nature of the regulation achieves this balance.

Legal Uncertainty. Critics believe EPA’s standard will be legally vulnerable because they maintain that it does not fully address the District Court’s direction to be based upon and consistent with the NAS report. They have also argued that any standard that accepts a greater individual risk in the far future than what we would consent to today is both not protective and not consistent with the NAS recommendation. There are many opinions on which parts of the standard may be vulnerable to legal challenge, and many more opinions about whether the regulation would survive challenge. Some Senate leaders have predicted further litigation, arguing that the standard is weak and puts people unnecessarily at risk.¹⁹

Meeting the Standard. There are several aspects to consider related to the potential for any facility to establish compliance with a regulatory standard when likely exposures occur so far in the future. First, can DOE adequately demonstrate, using probabilistic models, that the design of the facility is sufficient to meet EPA’s and NRC’s regulatory standards? Modeling the performance of an engineering design is not unusual. What makes the Yucca Mountain repository, or any other deep geologic repository, unusual is the time span over which the model must be extended. Many assumptions must be built into the model to account for both natural and man-made variables, all of which carry their own uncertainties. These uncertainties are magnified when the projection is extended over tens of thousands, or in this case, over 1 million years. In its revised Final Supplementary Environmental Impact Statement for the Yucca Mountain repository, DOE estimates the maximum mean annual individual dose at 2 mrem/yr,²⁰ a level that appears to meet EPA’s 100 mrem/yr standard. DOE, however, has cautioned that, should the assumptions it used to develop the probabilistic model be successfully challenged during NRC’s licensing process, their estimates of maximum annual individual dose could change. A DOE spokesperson has stated that DOE believes it can meet EPA’s standard,²¹ but many critics, including the state of Nevada, are skeptical that any facility will be able to

¹⁸ (...continued)

individual exposure of up to 5 rems (5,000 millirems) per year, whereas the most stringent standard is EPA’s drinking water standard of 4 millirems per year. The substantially greater stringency of the drinking water standard is attributed to the potential for internal human exposure through consumption.

¹⁹ [<http://reid.senate.gov/newsroom>].

²⁰ [http://www.ocrwm.doe.gov/ym_repository/seis/docs/002_Summary.pdf].

²¹ Allen Bensen, DOE spokesperson, quoted in the *Las Vegas Review Journal*, October 1, 2008, [<http://www.lvrj.com/news/29991329.html>].

demonstrate through engineering design and probabilistic modeling that it can protect the public from exposure for 1 million years.

Conclusion

Now that EPA has issued the final health and safety standard, attention will shift to the licensing process and the many technical and policy issues to be addressed in that context. NRC's technical review and licensing process will take several years and may proceed regardless of additional legal challenges to EPA's standard. As Congress continues to oversee the Yucca Mountain repository program, it will face issues related to whether DOE's technical work is sufficient to demonstrate compliance with EPA's standard and other safety issues surrounding storage and transportation of spent nuclear fuel and high level radioactive waste to the facility should it be licensed. Annual appropriations will be a key venue in this debate. Some have argued that it would be a better public policy choice to continue to store nuclear waste on-site at the power plants where it is produced while continuing to search for as a safer, more cost-effective solution to permanent disposal of spent nuclear fuel and high-level nuclear waste. A larger issue is how will the continuing controversy over the Yucca Mountain Project affect the U.S. nuclear power industry and its role in broader national energy policy.