

Continued oversight of the Waste Isolation Pilot Plant

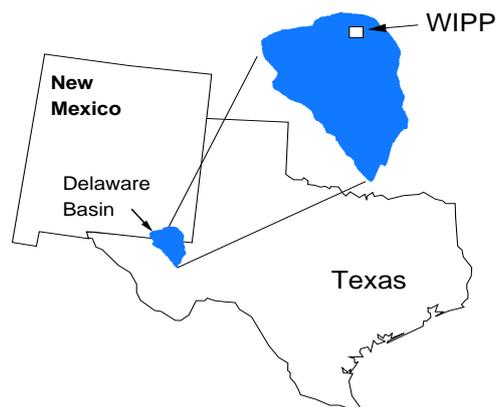
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Introduction

The United States Environmental Protection Agency (EPA) developed environmental standards applicable to the disposal of defence-related transuranic wastes at the US Department of Energy's (DOE) Waste Isolation Pilot Plant (WIPP). By statute, EPA also serves as the regulator and implements these standards at WIPP, which has been in operation since 1999. The general environmental standards are set forth in the Agency's 40 Code of Federal Regulations (CFR), Part 191 *Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes* (US NARA, 1985). These standards are implemented by site-specific compliance criteria at 40 CFR 194 (US NARA, 1996).

The repository waste area is ~650 meters below ground surface in a thick bedded salt formation that dips from west to east at ~1°. WIPP is located in the Chihuahuan Desert of south-eastern New Mexico, where the annual precipitation averages between 25 and 40 centimetres and there is high evapotranspiration (Figure 1). Much of the area around WIPP is federal land, managed by the Bureau of Land Management, and the area is sparsely populated.

Figure 1: Location of WIPP in the south-western United States



The transuranic waste disposed of at WIPP consists of materials such as radioactive sludges, soils and laboratory materials (e.g. chemical mixtures, contaminated glove boxes, paper and glass). Wastes are typically not treated unless necessary for shipping purposes (e.g. to limit hydrogen build-up). The waste is contaminated with plutonium, americium and other radionuclides, including some caesium and strontium. Transuranic waste is

defined as waste with radionuclides heavier than uranium containing more than 3 700 Bq (100 nanocuries) of alpha-emitting transuranic isotopes per gram of waste; isotopes must have half-lives greater than 20 years.

The WIPP Land Withdrawal Act limits the total disposal volume to ~177 000 cubic meters (6.2 million cubic feet) and creates two categories of waste based on operational safety considerations. Contact-handled (CH) waste is defined by a container surface dose rate of less than 2 mSv/hr (200 mrem/hr) while remote-handled waste has a surface dose rate of greater than 2 mSv/hr. The contact-handled waste is disposed of in containers placed on the floor of the repository. Figure 2 shows some emplaced contact-handled waste. The statute limits the total activity of remote-handled (RH) waste to $\sim 1.9 \times 10^{17}$ Bq (5 100 000 Ci). RH waste is currently placed in holes bored into the waste room walls, but EPA has approved DOE plans to allow the RH waste to be placed in shielded containers (drums) that will reduce the dose rate to less than 2 mSv/hr, allowing the waste to be managed as CH waste. Although shielded containers are significantly heavier than the standard containers, this strategy allows DOE the option of placing some of the RH waste on the floor, supplementing the more limited volume that can be emplaced in the walls.

Figure 2: Contact-handled transuranic waste in the Waste Isolation Pilot Plant



Initial certification

After receiving DOE's initial certification application in 1997, EPA approved the WIPP for operation in 1998 and DOE began shipping waste to WIPP in 1999. In the initial certification, EPA staff had the benefit of learning about the site and the technical issues for several years before entering into the formal certification decision-making process. During this period, EPA developed the site-specific compliance (implementing) criteria, and the agency was also able to incorporate into those criteria requirements that addressed topics that appeared to be weak in the DOE process, especially in the area of required documentation.

EPA applies a regulatory standard of "reasonable expectation", which is a concept similar to the safety case approach. Reasonable expectation recognises the uncertainties and complexities in judging the performance of a disposal system over long time periods and encourages consideration of the full record in the regulatory agency's decision process, including both quantitative and non-quantitative aspects (see e.g. 40 CFR 191.13). In its reviews, EPA looks to: i) understand the information provided by DOE, and determine whether there is appropriate and complete documentation (EPA's Completeness Determination); ii) identify points of agreement and disagreement with the conclusions drawn by DOE; iii) determine whether the information provided by DOE is sound and

provides a basis for a regulatory decision that can be defended technically and conforms to the regulatory requirements. In the review process EPA regularly communicates with DOE for clarification of existing information and may request new information as warranted.

For the initial certification, EPA relied upon DOE's modelling and reviews of the modelling to demonstrate the adequacy and quality of the modelling. The agency did not and does not conduct separate full performance assessments using separate codes, but has conducted and, as warranted, will conduct sub-system modelling as necessary (e.g. ground water or waste area specific modelling).

Re-certification and changes requested by DOE

The WIPP Land Withdrawal Act requires DOE to submit a re-certification application every five years after the initial receipt of waste. In the re-certification process DOE must identify changes that have occurred over the previous five years and analyse their impact on the potential long-term performance of the repository. Such changes could be related to the physical or chemical characteristics of the repository itself, or could arise from external factors, such as updates to the waste inventory. Once EPA determines that the re-certification application is complete, the agency has six months to review the application and make a final decision. During this review, EPA solicits and incorporates public comment. Since the agency went through an extensive review of and approval process for the modelling in the initial certification using external and contractor experts, verification modelling for re-certifications is primarily through modifying inputs to DOE's computer codes.

In addition, DOE must submit proposed changes to the WIPP repository to EPA for review and approval for those changes that could impact long-term performance. Since the WIPP is an operating facility, DOE periodically identifies potential changes that it would like to make for different reasons, such as disposal efficiency. For example, DOE requested, and EPA approved, a reduction in the amount of the required engineered barrier at WIPP. DOE conducted an analysis suggesting that it could save money while adequately maintaining the expected long-term conditions if they reduced the amount of magnesium oxide chemical barrier. The magnesium oxide is used to buffer the pH for control of actinide solubility and reacts with carbon dioxide if the waste panels are saturated with brine. EPA's initial review raised questions about DOE's analysis and required DOE to conduct a fuller study of the issue. EPA also conducted an independent analysis of the topic before agreeing to DOE's request. However EPA did impose a minimum limit on the amount of magnesium oxide that must be emplaced with the waste area and a requirement for DOE to track the carbon in the system to better ensure that there would be enough magnesium oxide to function as intended.

The planned change request may require the conduct of performance assessments outside of the re-certification process. The agency reviews the planned change request and re-certification information using an approach similar to that taken during the initial certification. Typically, these planned change requests are administrative (that is, not conducted through regulation) actions, though EPA has requested public comment on several of the requests.

The five-year re-certification requirement is advantageous in that it facilitates the continued communication between the agencies and makes it more likely that some key staff will overlap the review cycles, which allows issues to be resolved earlier and makes the process run more smoothly. This is illustrated by the difference between the first and second re-certification applications. EPA's review of the first application, submitted in March 2004, identified a number of areas where more information was needed, so that the application was not deemed complete for nearly two years. By contrast, with a much better idea of the needs of the regulator, DOE's 2009 application needed only limited additional information. A disadvantage of the five-year cycle is that it can seem as though

one application has just been submitted when work on the next must begin. A longer cycle might allow more “breathing room” and opportunity to address other issues, but would also make it harder to retain the institutional knowledge necessary to conduct the review efficiently.

Observations about the process from initial approval through operations

As stated previously, the initial certification presented a number of challenges to both the EPA and the DOE. Both agencies responded to this precedent-setting situation with high-quality technical and managerial staff. In addition, the National Academy of Sciences had been involved with the programme in an ongoing independent review role and the DOE WIPP programme benefitted greatly from those interactions, as did the EPA. Nevertheless, the issues that needed to be addressed technically and from a regulatory perspective were numerous. The EPA had to identify the most important issues and prioritise its resources to those issues. The agency required the DOE and itself to produce high quality documentation that addressed the technical issues and the regulatory requirements in a thorough and defensible manner.

For the re-certification process, the approach is similar, but there are fewer issues that need to be addressed from first principles. Because of the requirement to account for items that have changed, the site developer (DOE) needs to be cognisant of the scientific literature and advances in knowledge for topics that could affect performance. The regulator also needs to maintain an awareness of the issues. For example, after WIPP was certified, new information became available about microbial extremophiles that needed to be considered for their potential impact on WIPP. Actinide solubility research continues to become available in the literature, being generated by the WIPP programme itself or outside researchers.

At some point in the application process there will be a need to transition from a focus on primarily site characterisation and research to translating the research information into compliance demonstration. Different personnel may be needed because some of the researchers may not be able transition from research to compliance. Nevertheless, the developer needs to be able to maintain the requisite expertise to address technical issues that are certain to come up.

Maintaining expertise will be an issue even after the facility is operating and is a challenge for both the implementer and regulator. This is because site developers and regulators need to have mechanisms to address changes, both large and small, after the facility begins operation for reasons as varied as efficiency, cost, safety and regulatory compliance. A process or procedure needs to be developed and agreed to by all entities on how and when changes will be made. To some extent, the five-year re-certification requirement constrains the change process, as both agencies know there will be periods where the DOE is focused on preparing the application and the EPA is focused on reviewing it, so that other potential changes will have to be strategically pursued to avoid losing momentum.

Maintaining expertise over longer times is a continuing issue because regulator and developer staff will move on to other projects and retirements. Some EPA staff have retired or taken new jobs, and while fortunately the core contractor staff have remained present, they too will be unavailable at some point. The DOE scientific staff have had a great deal of turnover since the initial certification. One thing that EPA staff did to help document the process after the initial certification was to develop a document and a series of slides to capture key lessons from the experience. The information from that effort is still being used as the third re-certification approaches.

Summary

In summary, the initial certification of the WIPP required an extensive effort. The five-year re-certification process is similar but is less intense with fewer issues, and the site developer still has to develop high quality information. The site developer can focus on those areas that have changed, and there will be further changes during the operational period of the facility. One advantage of the re-certifications is that both the site developer and regulator can build upon the existing knowledge base instead of dealing with everything as a new issue; however, staff turnover brings challenges to maintaining the knowledge base.

References

- US National Archives and Records Administration (US NARA) (1985), "Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes", *Code of Federal Regulations*, Title 40, Part 191.
- US NARA (1996), "Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations", *Code of Federal Regulations*, Title 40, Part 194.
- The Waste Isolation Pilot Plant Land Withdrawal Act, Public Law 102-579, as amended by Public Law 104-201 (H.R. 3230, 104th Congress).