How Does the Waste Isolation Pilot Plant (WIPP) Benefit from International Cooperation? – 14088

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ABSTRACT

The Waste Isolation Pilot Plant (WIPP) is the only deep geologic repository for disposal of radioactive waste operating in the United Sates. WIPP has operated safely for more than 15 years. It is a fair question to ask why a working repository would reach out to cooperatively engage in technical cooperation with other countries that are still working toward achieving an operating repository. The answers are quite straightforward. A primary reason for international technical cooperation is saving money by sharing in potentially useful research plans and outcomes between nations. Every participating nation thereby gains international expert review of plans and substantial knowledge for a small investment of time. Another important reason is to share our lessons learned regarding safe repository operations, thereby helping promote safety in other nations' programs. The US Department of Energy has signed technical cooperation memoranda of understanding with the German government and with the French national waste management organization. Comparisons between US (WIPP), German, French and other disposal concepts illustrate commonalities between different repository concepts and programs.

INTRODUCTION

The Waste Isolation Pilot Plant (WIPP) is the only deep geologic repository for disposal of radioactive waste in the United Sates, and with the cessation of disposal in the German geological repository for radioactive waste it is the only operating deep geologic repository for radioactive waste in the world. WIPP has operated safely for more than 15 years. It is managed by the US Department of Energy (DOE) Office of Environmental Management (EM) through its Carlsbad Field Office (CBFO).

It is a fair question to ask why the only operating repository would reach out to other countries still working toward achieving an operating repository. The answers are quite straightforward:

- Potentially saving money through sharing research plans and results.
- Enhancing the scientific credibility of WIPP safety evaluations.
- Supporting continuous improvement and optimization in repository operations and technologies.
- Helping promote repository safety in other countries through sharing scientific, technical and operational experience.

- A safely operating deep geologic repository can represent a path forward for others to adopt, in whole or in part, to address the global issue of permanent radioactive waste isolation.

At first glance it may seem that WIPP is unique when compared to other proposed repositories around the world that it would have little in common with them in terms of technical issues or safety approaches. However, comparisons between US (WIPP), German, French and other disposal concepts suggest some important commonalities, some of which are worth addressing cooperatively to forge an international consensus.

DOE, including CBFO, has recently signed technical cooperation memoranda of understanding with the German Federal Ministry of Economics and Technology, and with the French waste management organization, Andra. Both agreements include coverage of technical, scientific and safety related issues. DOE, again through CBFO as well as through other parts of its organization, is actively engaged in doing cooperative work as part of several working groups within the Nuclear Energy Agency (NEA) of the Organisation for Economic Co-operation and Development (OECD) in Paris.

COMMONALITIES BETWEEN WIPP AND SELECTED REPOSITORY CONCEPTS IN OTHER NATIONS

The WIPP repository concept is illustrated in Figure 1. The figure shows the filled disposal panels (1-5), the panel with waste emplacement in progress (6), a panel ready for waste emplacement (7), a panel yet to be excavated (8) and two proposed panels (9A and 10A).

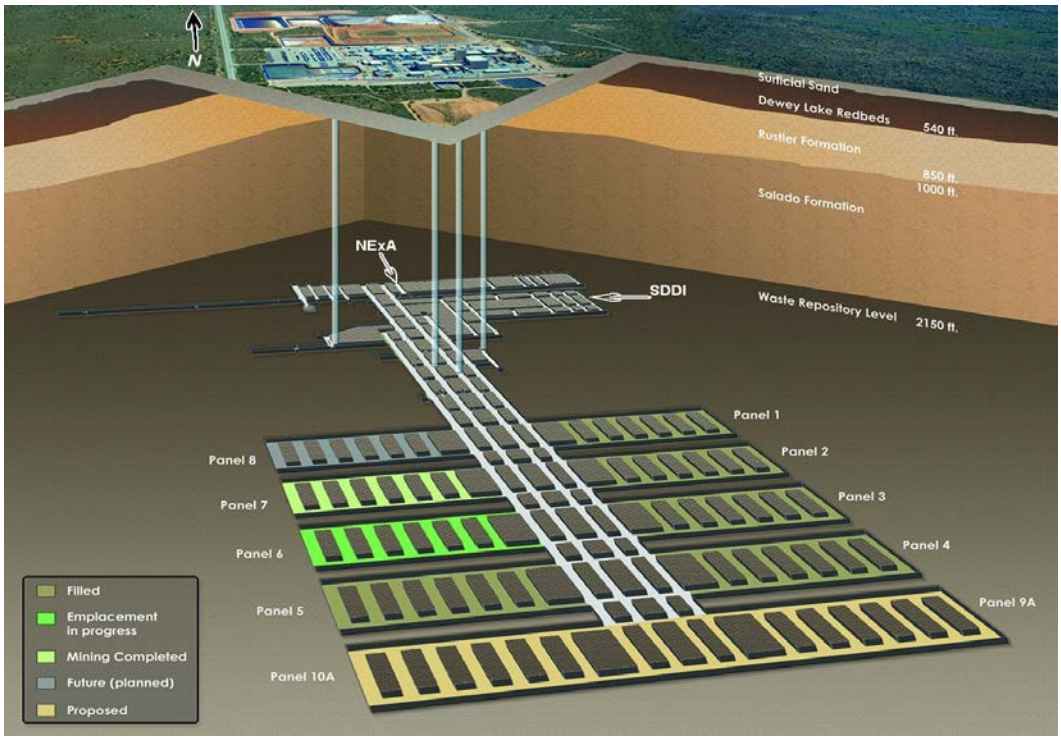


Figure 1. Underground layout of WIPP repository including its proposed expansion to the south

Figure 2 shows the French high-level waste repository concept in clay. Superficially it looks like a similar layout plan, only bigger. On a more detailed level, however, there are similarities in terms of process and operational strategy.

For example, both clay and salt, at depth and therefore under pressure, can plastically deform and seal openings, given time. Both rock types are relatively easy to mine. Because of considerable quartz content, the Callovo-Oxfordian clay proposed to be used by the French has good heat dissipation properties. Salt dissipates heat better than any other rock type.

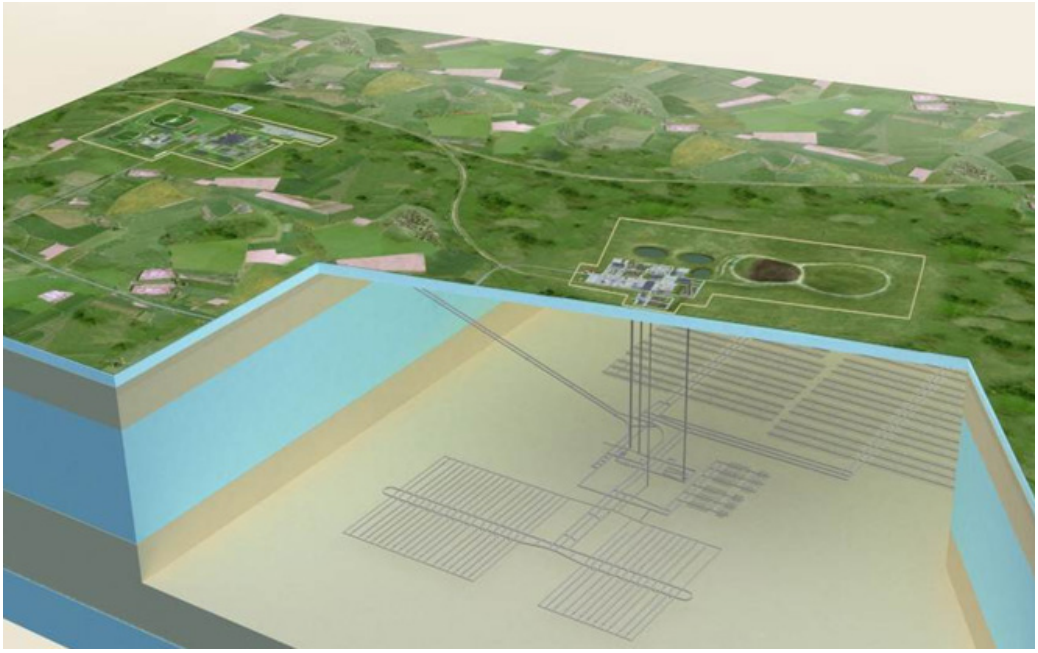
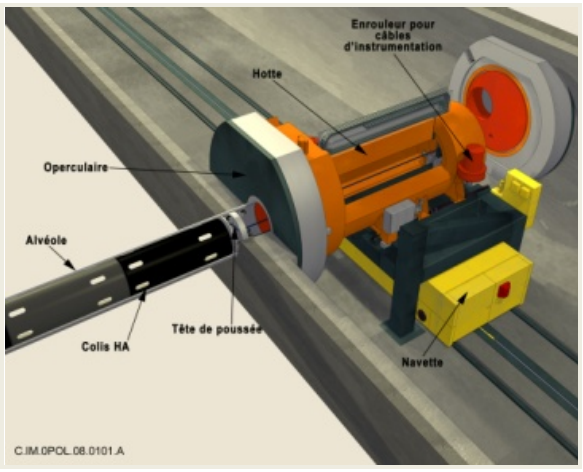


Figure 2. French repository concept in Callovo-Oxfordian clay [1]

The emplacement of waste that needs to be remotely handled at WIPP uses machinery that is conceptually comparable to what is proposed for use in the French repository, as illustrated in Figures 3a and 3b.

It should come as no surprise that there are many common technical insights to be gained from working cooperatively with another repository program that is also considering a deep salt formation as a host rock. The current experiments on repository closure at Morsleben in Germany, and the past long-term experiments on the behavior of heat-emitting wastes in salt at Asse in Germany, conducted with Dutch collaboration, underscore this point. Figure 4 shows a conceptual drawing of the German concept for a repository in the Gorleben salt dome. The physical behavior of the salt in response to excavation and heat would be comparable. A difference would be the water content of a salt dome like Gorleben, roughly a tenth of the water content in the bedded salt of WIPP. Another difference in the proposed operations concept for a Gorleben repository is the use of both deep vertical boreholes and in-drift emplacement concepts for different waste forms (Figure 4). The German use of a crushed-salt slinging device to cover emplaced waste may be of interest in the US at some future time.

Several nations, Finland, Sweden, China, Canada and some others are considering the use of deep granite intrusive rock bodies, or other deep and potentially fractured rocks as in Japan, for repositories. Figure 5 shows the Chinese concept for a proposed repository near Beishan in the Gobi desert. Waste packages would be emplaced and surrounded by a buffer (a bentonite clay



(a) (b)

Figure 3. (a) WIPP shielded emplacement machinery for remote-handled transuranic waste, and (b) French concept for inserting waste packages into horizontal boreholes [2]

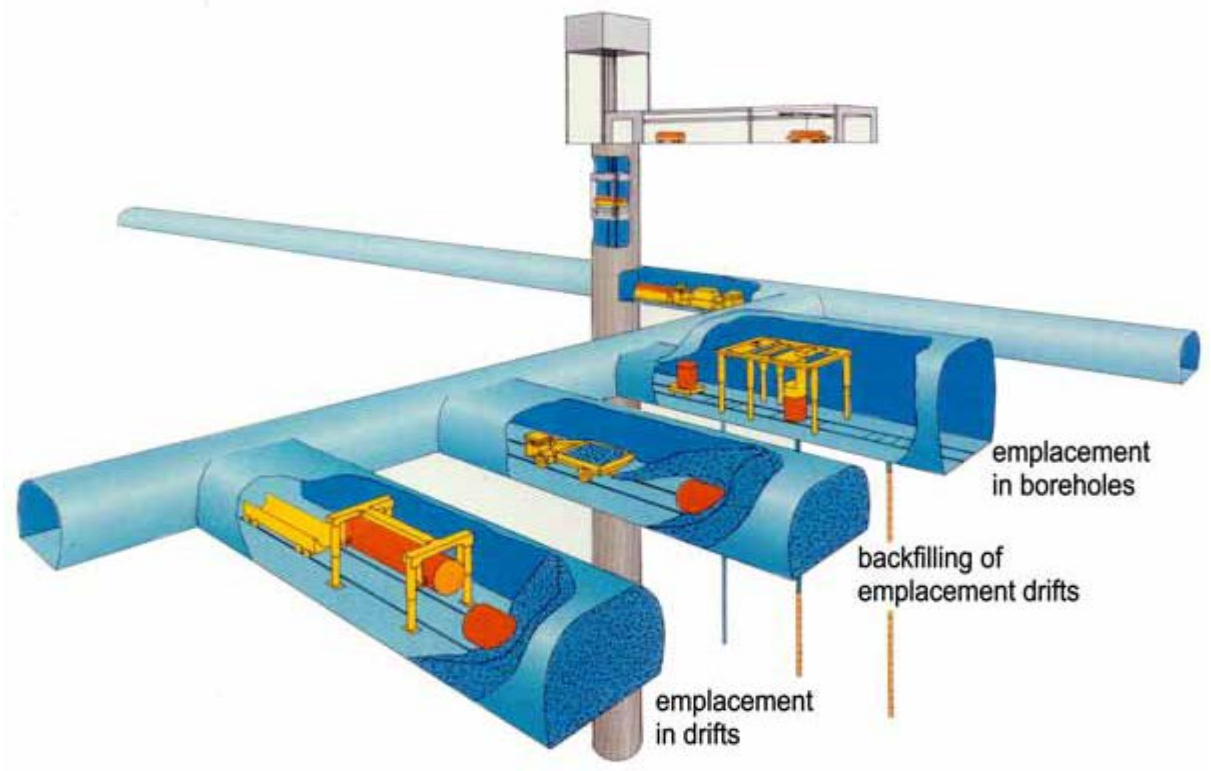


Figure 4. Conceptual layout for a proposed repository in the Gorleben salt dome in Germany, with potential drift and borehole emplacement machinery. [3]

that expands when it gets wet) in boreholes. The boreholes are sealed, and at closure, access shafts will also be sealed. The main illustrated repository will house containers with high-level waste. Other radioactive waste types may be disposed of in the bin-like structure on the right of the figure.

What does the WIPP repository experience have in common with these very different types of repositories? The same thing all repository programs have in common: the need to--

- Organize and design to prevent operational accidents or mitigate their consequences.
- Ensure that all work related to safety-systems is carried out in accordance with national and international quality-assurance standards.
- Build cases for operational and long-term safety.
- Communicate the case for operational and long-term safety to various types of decision-makers and other stakeholders.
- Plan for permanent closure monuments or markers, and their messages for a timeframe relevant to the disposal concept and location..

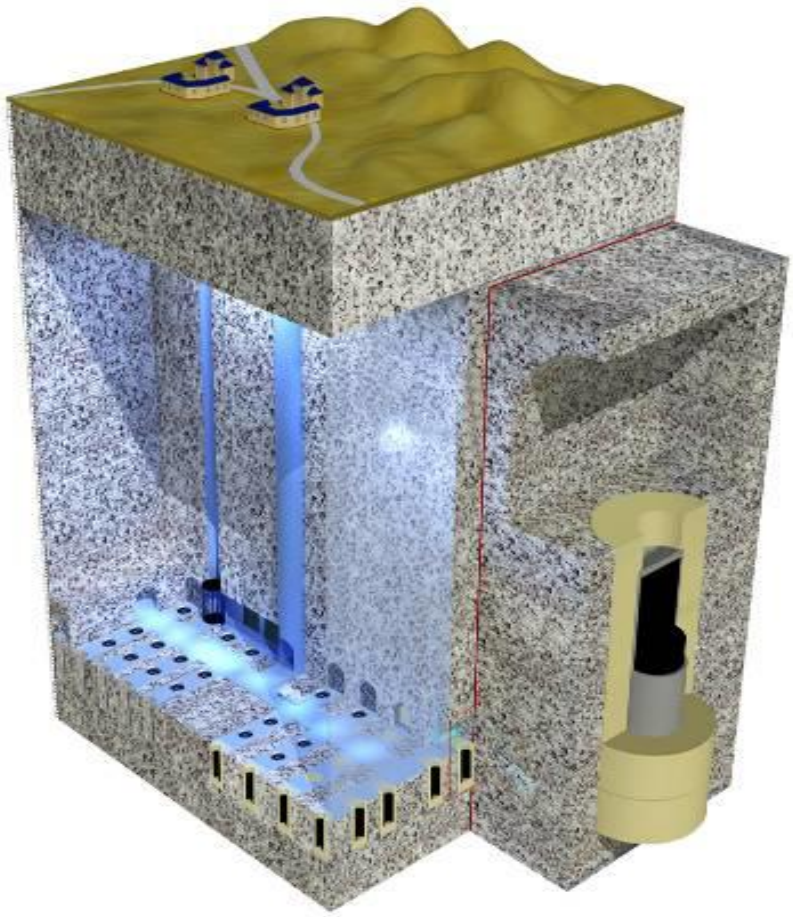


Figure 5. Conceptual drawing of repository in deep granite in the Gobi desert, China [4]

POTENTIALLY SAVING MONEY THROUGH SHARING RESEARCH AND PLANS

An important reason for international technical cooperation is saving money by sharing in potentially useful research plans and outcomes with other nations. Every participating nation thereby gains substantial knowledge for a small investment, mostly of time by experts to participate in reviews, on their part. To assure this technical exchange takes place, CBFO, through its membership in a technical working group under the OECD/NEA, proposed a 'Salt Club' to formalize this technical cooperation for those countries investigating salt as a host medium. The Salt Club has a more formal name: "Safe Disposal of Long-lived and Heat Generating Radioactive Waste in a Deep Geological Repository in Rock Salt," is now in its third year, and promotes the sharing of information from various researchers in various countries on the chemistry of actinides in brines, on the physical properties of salt in a repository with various types of waste, and on microbial effects in a salt repository. [5]

ENHANCING THE SCIENTIFIC CREDIBILITY OF WIPP SAFETY EVALUATIONS

Enhancing the credibility of scientific work being done for WIPP's periodic revisions to its permitting documentation is also being addressed through international cooperation.
Membership and active participation in the Thermodynamic Data-Base Project of the OECD/NEA [6] is providing the opportunity, for example, of getting experts available to that group to review data in use in many places including WIPP, and make a recommendation for a standardized set of data. This peer review would improve the pedigree of data used in the modeling of brine chemistry and actinide solubility in brines.

HELPING PROMOTE REPOSITORY SAFETY IN OTHER COUNTRIES

Another reason for international cooperation is to share our lessons learned regarding safe repository operations. The CBFO Manager is a member of the International Association for Environmentally Safe Disposal of Radioactive Materials (EDRAM) organization [7]. This is a high-level international group made up of executives from nuclear waste management programs from around the world. It was set up to provide upper management opportunity to discuss technical or safety issues amongst peers.

The WIPP tour program is a very effective tool for introducing technical people to the type of organization, structure and processes required to effectively insist on there being a safety-conscious work environment for every person associated with the repository program. WIPP tours have hosted many international repository program staff members, and all levels of repository program management. In the 2012-2013 time-period, WIPP has hosted staff members and managers from 16 countries: 7 European countries, 3 countries from the Americas, and 6 countries from the Asia/Pacific region of the world. The primary benefit to those countries' representatives is learning what is involved in operating a safe repository.

Other cooperative work is also aimed at promoting waste management safety in other countries and typically involves participation in interactions promoted by the US Department of State, or

invitations to provide expertise for safety-related missions of the International Atomic Energy Agency.

THE WIPP REPOSITORY AS A WORLD SCIENTIFIC RESOURCE

Several non-repository related international cooperative experiments are taking advantage of the WIPP repository's essentially potassium free salt and its ability to shield the deep underground very effectively from terrestrial and cosmic radiation. An ongoing low-background radiation biology experiment is US-university run with Israeli collaboration. An Enriched Xenon Observatory studying neutrino-less double-beta decay is run by a US university consortium with participants from Switzerland, Canada, Germany, and Russia. Samples of WIPP salt, cores of various sizes, have been shared with German and Canadian collaborators. Planned heater tests are to be shared with members of the Salt Club in terms of both plans, for peer-review purposes, and results. In a very meaningful way, WIPP is a world scientific resource.

CONCLUSIONS

International cooperative work between repository programs is coordinated though international agencies and through bilateral agreements. CBFO, managing the WIPP deep geologic repository, participates in coordinated international efforts that address specific technical and scientific issues that repository programs have in common, regardless of their host rock of choice.

CBFO and its supporting technical and scientific organizations also work with other countries through bilateral agreements that call for technical exchanges of mutual benefit.

International cooperation—

- brings fiscal benefits when research plans and results and experiences are shared,
- brings quality benefits when international reviews of scientific data and models are taken advantage of,
- may help make postclosure marker and message plans more reasonable and cost-effective through an international dialogue that will result in consensus guidance on this difficult topic, and

may benefit nations' repository safety approaches through sharing the WIPP experience of 15 years of safe operation; as of 1 October 2013, WIPP had four million person-hours without a lost time accident, evidence of a working safety culture.

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