BLENDING MINING AND NUCLEAR INDUSTRIES AT THE WASTE ISOLATION PILOT PLANT*

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ABSTRACT

At the Waste Isolation Pilot Plant (WIPP), traditional procedures for underground mining activities have been significantly altered in order to assure underground safety and project adherence to numerous regulatory requirements. Innovative techniques have been developed for the WIPP underground procedures, mining equipment, and operating environments. The mining emphasis at the WIPP is upon the quality of the excavation, not (as in conventional mines) on the production of ore.

The WIPP is a United States Department of Energy (DOE) project that is located 30 miles southeast of Carlsbad, New Mexico, where the nation's first underground engineered nuclear repository is being constructed. The WIPP site, Fig. 1, was selected because of its location amidst a 607 meter thick salt bed, which provides a remarkably stable rock formation for the permanent storage of nuclear waste. The underground facility is located 655 meters below the earth's surface, in the Salado formation, which comprises two-hundred million year old halites with minor amounts of clay and anhydrites. When completed, the WIPP underground facility will consist of two components: approximately 81 square kilometers of experimental areas, and approximately 405 square kilometers of repository.

The repository area consists of eight storage panels with seven rooms each. Each room will have a nominal size of 3.9 meters high, 10 meters wide and 91 meters long (Fig. 2).

In the early 1940s, the United States began generating radioactive waste through the nation's defense programs, as a by-product of the production of nuclear weapons and the operation of military nuclear reactors. The nuclear industry has grown since that time with the expansion of United States' defense programs and the introduction of nuclear power into the commercial world. Yet, for well over 40 years, the United States has generated nuclear waste without any solution for its permanent and safe disposal. The solution for the defense program is being engineered at the WIPP through a unique blending of conventional and innovative mining technologies.

A BLENDING OF CULTURES

Mining at the WIPP engineered repository is quite different from mining in conventional potash mines like those found in the Carlsbad area. The personnel and the basic equipment are virtually the same as those in potash mines, but at the WIPP, traditional methods of mining are applied to a degree of precision mining and mining finish unlike any other underground facility today. For example, at an engineered repository like the WIPP, mining activities have extremely rigid and deliberate requirements. In a conventional mine, production and cost factors are paramount--with a primary concern of minimizing the dilution of ore. At the WIPP the "rock in the box" theory has been replaced by an emphasis on safety and a commitment to quality operations.

The WIPP has taken an industry that is steeped in the tradition of mining hard rock with brute force to yield the highest quantity and has married it to a concept that demands superior safety and an ultraconservative approach to produce the highest quality excavations. Because it is nuclear, the WIPP is scrutinized by dozens of outside agencies, and by the public, on a regular basis. In 1988 alone, WIPP underwent nine major audits to assure its compliance with safety and operational regulations. Safety is the first word a new employee hears coming through the front gate, and it is emphasized in every possible way on a daily basis. Safety observer programs, extensive training, and safety awareness programs become part of life for miners at the WIPP.

The result of our emphasis in safety is that the WIPP has twice achieved one million man-hours without a lost-time accident. In addition, the Managing and Operating Contractor (MOC) for the WIPP has won the "Operator of the Year" award from the state of New Mexico for large underground mines for the last three consecutive years. The WIPP safety record is attributed to its people and to a training program that aims to develop a culture of safety in the minds of the miners who work at the facility.

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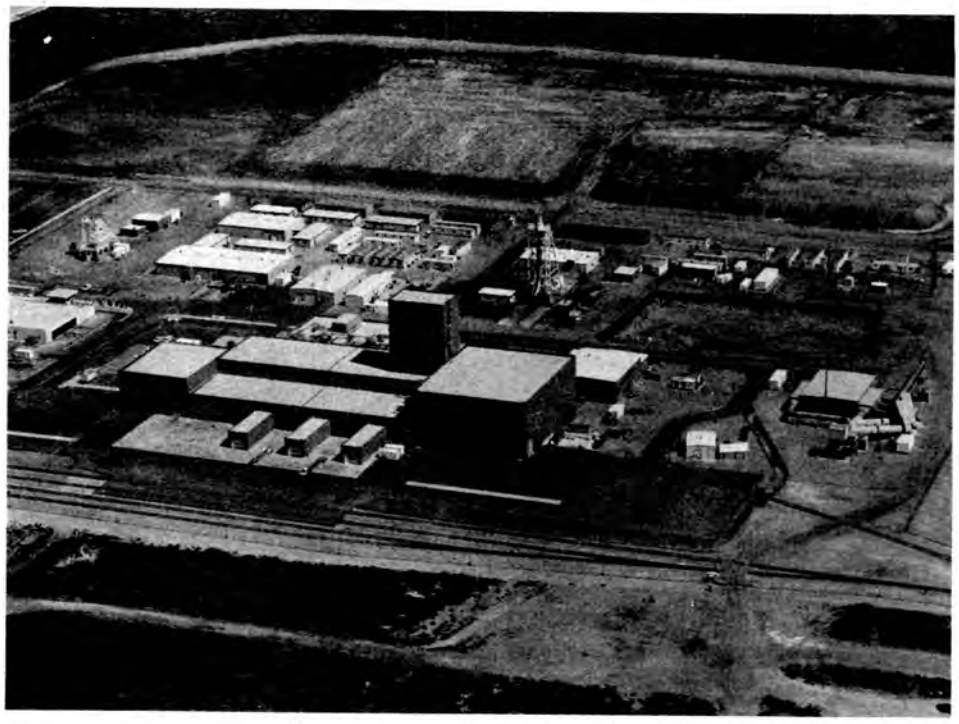

Fig. 1. Aerial View of WIPP Site.

Fig. 2. Underground Storage Room at WIPP.

The number of extensive mining procedures employed at the WIPP is vastly different from those in conventional mining. Procedures in conventional mining industries are generally written in the form of letters or memos from the mine superintendent. They are very easy to follow and much is left for interpretation. In a nuclear facility, procedures emerge as very formal controlled documents, with several levels of administrative and field verification reviews before implementation. Nothing is assumed in such procedures, nor are any points left open for interpretation. Similarly, training is extensive. Before operators can touch any mining machine or haulage truck, they must take formal training classes and pass written and practical exams, regardless of how many years' experience they might have had in previous mines.

WIPP's maintenance program focuses primarily on preventive maintenance. This program extends the life of the equipment and causes less down-time due to failures. There is a tracking system for each piece of equipment which calculates the number of operating hours and determines the prescribed maintenance on a scheduled basis. Each work package consists of extensive step-by-step procedures for repairs or changes to equipment in order to assure consistency in the program and data used to evaluate its integrity.

Decisions on any item--be it maintenance, safety or operations--are not left to chance. If there is a shadow of a doubt concerning safety, such as the suitability of a piece of equipment or how to proceed with an assignment, no decisions can be made until all responsible parties meet and concur on the appropriate plan of action. This planning can include several hours of discussion with as many as four different departments. A decision-making process such as this could shut down a production mine, but at the WIPP the product is the quality of the opening, not the production of ore.

Because the "product" at the WIPP is an excavated opening, a conventional drum miner is outfitted with a laser tracking system to mine to a tolerance of plus or minus three-eighths of an inch at the predetermined percent grade. A storage or experimental room must be mined within these tolerances to support the accurate data-gathering activities which are necessary to demonstrate the scientific theories involved with the project. The resulting productivity of this system is a finished floor of approximately 32.9 linear meters of storage panel per shift.

Haulage roads at the WIPP underground facility also require extremely tight tolerances to ensure the safe transportation of the waste along these roads. The haul road milling machine is equipped with a cutting drum mounted at the rear of the machine as shown in Fig. 3. This drum is controlled by a rotating laser beam through two receivers mounted on masts connected to the milling assembly. This recently-acquired piece of equipment is the only one of its kind in the world designed for use in the underground. The cutter mills the road surface to a very smooth, even grade; this enhances the safety of personnel, increases equipment efficiency, and reduces maintenance. It can mill 9 meters per minute, 1,219 millimeters wide, with a maximum milling depth of 152 millimeters. The smoothness of the haul roads is equivalent to that of major highways.

During the excavation process at the WIPP, several standard pieces of mining equipment were either purchased or modified to meet specific requirements. When the WIPP began the excavation of the first storage panel, Panel 1, it became evident that the roadheader being used would not excavate the amount of salt in the prescribed time to keep within schedule. A Marietta 3612 Drum Miner was purchased to improve excavation schedules. By installing a laser system on the drum miner, mining of the floor and the back could be accomplished to a tolerance of less than 50.8 millimeters in 6 meters, well beyond the capability the manufacturer believed possible.

The WIPP also possesses several other unique pieces of equipment, and exercises other unique applications of traditional equipment. The LHD truck can haul up to 4,000 kilograms of excavated salt from the continuous miner to the Salt Handling Shaft, where the salt is loaded and hauled to the surface. The LHDs are also used as support equipment for installation of electrical and compressed air utilities throughout the underground facility.

CONCLUSION

There are many more differences and technological advances being made in the mining activities at the WIPP, but the main differences between conventional mining techniques and those in the nuclear world lie in the drastic changes that are occurring in terms of the mining culture that is established at the WIPP. The WIPP is well on the road to achieving a metamorphosis: as more machines are modified, attitudes change, and tighter tolerances are set.

Modifying a machine is fairly simple. Changing age-old attitudes in the mining industry is, however, a more difficult journey. Asking the miners to change their basic philosophies and strongly-held beliefs about the way to do things is a long, on-going transition. At WIPP, they have come to learn that what you take out is much less important than what is left behind--the excavation--and that commitments to safety and quality are prerequisites for establishing one of the finest underground repositories in the world.

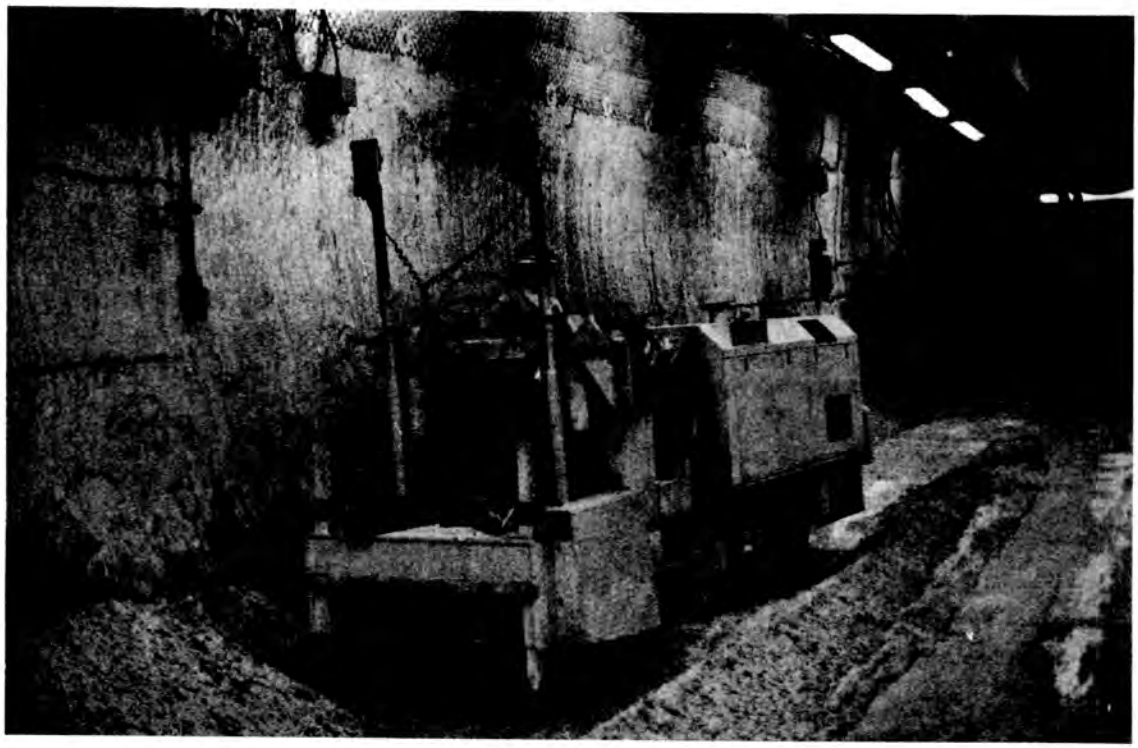

Fig. 3. Haul Road Milling Machine at WIPP.