

## How to Increase Knowledge of the Existence of a Nuclear Disposal Facility to Future Generations: Knowledge Footprint - A Perspective From an Operational Facility – 14221

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### ABSTRACT

Most geologic nuclear waste disposal programs have requirements to communicate the existence and hazards of the facility to future generations. Such programs often require a documented plan to do this prior to receiving an operational permit. This was true for the Waste Isolation Pilot Plant (WIPP), a transuranic waste disposal facility in the United States. The international community is now trying to standardize the process of preserving records, knowledge and memory (RK&M) of radioactive waste disposal facilities. The intent of RK&M is to communicate the existence and hazards of the disposal facility for as long as practical after closure. Experience from the WIPP program shows that there could be new elements placed in modern standards that may enhance communication with future generations. Because technology, social and political elements change rapidly, any RK&M protocol must include an ongoing element that actively utilizes the evolving technologies and current social and political attitudes, something that was not specifically addressed in the WIPP regulatory requirements or passive controls plan. This paper discusses how issues relating to RK&M have changed since the WIPP requirements and plans were developed, and proposes ways to help communicate the existence and hazards of a radioactive waste disposal facility to future generations.

### INTRODUCTION

The goal of RK&M has been to preserve and communicate the existence and hazards of a closed geologic radioactive waste disposal facility to future generations. The basic premise for RK&M is to address the what, the how and the how long. What information to preserve, how to preserve it and for how long? These questions have been discussed within the WIPP project in the 1980's and are currently being critically addressed by the Organization for Economic Co-operation & Development's Nuclear Energy Agency (OECD/NEA) [1].

RK&M-related experience within the WIPP project has realized that the focus of RK&M is on the post-closure period when the knowledge of the existence of the facility is critically important to ensure that the hazards of the radioactive waste are not imposed on the public or the environment. However, waste disposal programs take decades to implement, operate and decommission. The WIPP took over 25 years to site and license and has a planned 35-year operational lifetime. Closure will likely take another five to ten years and post-closure requirements include active control of the facility for an additional 100 years. RK&M objectives were planned and proposed during the WIPP's planning and licensing phases and have focused on actions that are implemented after closure, many after the active controls period. The WIPP included RK&M testing activities in its license that were to be conducted during the operational period however the operational priorities have led to rescheduling. The original post-closure RK&M plan is based on work from around 1980 to 1995 and includes some design elements that are no longer achievable today. A revised plan is required to be presented to the regulator prior to closure, expected around 2033, likely later. Waiting until that time to define the post-closure RK&M program will cause the project to miss an opportunity to ensure some of the goals of the program to occur now. Including recommendations from international RK&M investigations into the revised WIPP plan is expected. However, these investigations are mostly directed at

post-closure RK&M elements. There is one aspect of the RK&M initiative that has not been emphasized that could help in the preservation of knowledge of a disposal facility and its hazards; the “knowledge footprint.”

The knowledge footprint is the current information of the disposal system that has been introduced to currently-accessible information resources. The RK&M project recognizes the need to preserve information via world archives such as Department of Energy’s Legacy Management archive, the National Nuclear Archive and the Library of Congress. However, these archives are not as publicly accessible as other forms of information sources. The intent of the knowledge footprint is not to preserve data or technical information *per se* but to preserve the knowledge of the existence of the project. Increasing the knowledge footprint can increase the chance that triggers will exist and be publicly accessible in the future (not directly focused on only academic or industrial accessibility). If there are no information triggers left within future societies, there is less chance anyone will look for or be interested in the data in archives making their existence of little value. Secondly, an RK&M program must evolve over the life of a disposal program. Because so much will change in the information-technology world during the lifecycle of a disposal project, an RK&M program cannot propose a specific design at the time a license application is developed that uses the latest technologies and social constructs. The program should be based on an evolutionary approach that assesses the tools and technologies available and continually progresses as these tools and technologies change over time. Whereas RK&M is intended to function for as long as practical, the knowledge footprint may only enhance awareness of a disposal program for a relatively short period of time after closure, which for the WIPP case, is a period where the consequences of human intrusion is expect to be the greatest.

## **METHODS**

As stated earlier, the goal of RK&M has been to preserve and communicate the existence and hazards of a closed geologic radioactive waste disposal facility to future generations. The basic premise for RK&M is to address the what, the how and the how long. The use of a knowledge footprint can address the “what”, specifically relating to what information is needed to preserve knowledge of the disposal system. In its simplest form, any information that triggers the idea that the repository program existed, provides the “what.” The knowledge footprint can be used to create additional triggers outside the ones that are naturally created through the siting and operation of the disposal system. The more triggers that exist in society, the more likely the knowledge of the disposal system’s existence and hazards can be maintained. An active program that increases the knowledge footprint throughout the operational and active controls period can increase this likelihood.

How can this be done?

## **DISCUSSIONS**

Early plans for the WIPP project included assurance measures in the design even prior to promulgation of the regulations that require them [2]. These measures included passive controls intended to reduce the probability of human intrusion into the repository after closure for as long as practical. The basic question at that time was how to communicate to future societies. Expert panels were used to identify what future societies might be like and what methods of communication could be used to prevent human intrusion. Permanent markers, archived records and societal knowledge methods were some of the items investigated. These investigations occurred in the 1980’s and early 1990’s prior to many information technology and societal

technology advancements. The results of these panels were used to develop the WIPP passive institutional controls design that was documented in the WIPP Compliance Certification Application [3]. The design used various permanent markers with different levels of messages, records archival, government control and “other passive institutional controls.” The design emphasized permanent markers. There are a limited number of tasks that were to be performed prior to erecting the marker system which included testing and message research. The testing was directed at marker longevity and constructability. There were no other operational period activities outlined in the design with the exception of reevaluating the design prior to closure.

One of the design’s “other passive institutional controls” is an example of the knowledge footprint concept. The passive controls design included adding the location of WIPP on maps and information about WIPP in school textbooks and encyclopedias. Information was to be sent to national and international professional societies of cartographers and geographers. The intent was to ensure wide spread information of the WIPP site which increases the knowledge footprint concerning location. This idea can now be expanded beyond location information on paper media. The use of Geologic Information Systems (GIS) with on-line public access has greatly expanded the access and use of location information. The location of WIPP is included in many databases; examples included those of the United States Geological Society, Bureau of Land Management and the New Mexico Oil Conservation Division. Other examples include location information from satellite-derived databases. These available databases are one example of the knowledge footprint relating to location. Many geographical references to WIPP can be found on-line that were not initiated by the WIPP project. This could be argued an example of self-perpetuating information transfer which is a beneficial element of this knowledge footprint example. Where these on-line resources did not exist when the WIPP’s passive controls design was completed, the design should have had an element that continued to research and actively introduce WIPP information into new information resources. Additionally, today’s publicly accessible information sources (i.e., internet, cell phone and digital satellite access) were either not generally accessible or did not exist when the original WIPP RK&M design was developed. It is expected that other information, communication and media resources will be developed before the WIPP passive controls design is implemented. As such, an RK&M element should include ongoing information-resource elements that continuously interject information about the geologic radioactive waste disposal program using the most current resource at that time throughout the operational and active controls periods.

The WIPP regulator approved the original passive institutional controls design in 1998, with a stipulation to reevaluation of the design prior to the WIPP closure. Since the initial regulatory approval, the project has not included any new design, testing, research or design changes to the originally proposed passive institutional controls design. The project has participated in international RK&M investigations and will likely include new RK&M elements as a result of these investigations. There is justification to include RK&M-related activities during the operational and closure period that lead up to the task of finalizing the permanent markers design in approximately 2033. These activities could focus on increasing the knowledge footprint of the radioactive waste disposal program.

## **CONCLUSIONS**

The current concepts of RK&M have been studied internationally to help develop methods to inform future societies of the existence and hazards of proposed geologic radioactive waste disposal facilities. The WIPP includes RK&M in its passive institutional controls plan which was

developed during the siting phase and did not include operational period activities beyond markers material testing and message research. However, WIPP experience has shown that after waste disposal operations start, there are no incentives to continue RK&M-related activities until closure. There is an opportunity to increase the knowledge footprint during the operational and active controls periods to take advantage of advancements in RK&M-related resources. The knowledge footprint is the current information of the disposal system that has been introduced to currently-accessible information resources. The passive controls program should include in its initial plan an evolutionary approach that assesses the tools and technologies available and continually progresses as these tools and technologies change over the lifetime of the waste disposal program.

## **REFERENCES**

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## **ACKNOWLEDGEMENTS**

*Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy’s National Nuclear Security Administration under contract DE-AC04-94AL85000.*

*This research is funded by WIPP programs administered by the Office of Environmental Management (EM) of the U.S Department of Energy.*