

WM2012 Conference Panel Report

PANEL SESSION 34: Geologic Repository Warning Messages to the Future – Ensuring Continuity of Memory and Messages to Future Generations

Co-Chairs: Russ Patterson, *US DOE*
Tom Peake, *US EPA*

Panel Reporter: Tom Klein, *URS-Regulatory and Environmental Compliance*

Panelists:

1. Abe Van Luik, *US DOE*
2. Jantine Schröder, *SCKCEN*
3. Steve Wagner, *John Hart and Associates*
4. Peter Galison, *Harvard University*
5. Simon Wisbey, *UK NDA*
6. John Day, *Sellafield*

An average of forty people attended this session to discuss the warning messages to future generations and the variety of approaches various countries are contemplating. After the initial introductions, **Tom Peake** gave a brief overview of the importance of post-closure warning systems at geologic repositories for nuclear waste.

Steve Wagner gave a presentation pertaining to the specific passive institutional controls (PICs) program at the Waste Isolation Pilot Plant (WIPP) in the United States. His review discussed the initial PEER review process that resulted in recommendations to the Department of Energy (DOE) on what the PICs program should look like and what messages should be given to future generations. This review covered the federal regulations for post-closure PICs programs in the US, the assurance requirements that preceded the regulations and how the DOE proposed to comply with the regulations. The WIPP PICs program identifies five levels for what and how the message in its PICs program is to be entailed.

- Level 1 – This is a man-made site
- Level 2 – Danger
- Level 3 – What happened and when
- Level 4 – The languages to be used to transmit the message
- Level 5 – Archival of the repository information

Wagner Q&A: It was asked whether monuments trigger curiosity and wouldn't it be better to do nothing at all? Wagner answered this was reviewed but it was determined that providing information was a better avenue. It was also asked if current underground hazardous waste sites provided any guidance in this matter. Many current hazardous waste sites such as the Gnome site and the Trinity site are being evaluated as to their monuments and their impact. It was asked what the cost of human intrusion at a geologic repository would be financially and what the equivalent cost would be via health affects avoided by use of a PICs program. The cost of the PICs program is estimated at \$200 million in 1996 dollars and the equivalent cost of health affects avoided is currently unknown.

WM2012 Conference Panel Report

Abe Van Luik discussed the WIPP Markers Program Development. His discussion involved the regulatory requirements, advertent vs. inadvertent intrusion, the use of written and symbolic messages, the need for layers of information and warnings and the content of the messages. Dr. Van Luik discussed how the Yucca Mountain PICs program was based on WIPP's program but adapted for a mountainous terrain and how the message of the tsunami stones in Japan were understood but that the current generation believed current technology would protect them. Dr. Van Luik identified that there is an ethical obligation to inform future generations of the existence and potential hazards of the geologic repository and that the obligation ends with providing the information. The control of the decisions of future generations is not part of what the message should be.

Van Luik Q&A: It was asked why no religious or nuclear priest, discussions to protect the repository as religion has protected historical information for centuries? Dr. Van Luik identified that the US Federal Government is prohibited from creating a religion, but perhaps the DOE Office of Legacy Management would be interested in getting involved with this task. A question of the challenge of language and its constant changing over time would impact the message and how it is interpreted. This was answered by the used of the top six United Nations languages and the local native language in the PICs program for the message. It is understood that the use of many languages would not solve the problem that the messages need to be deciphered. The question was posed that in the Delaware Basin there are thousands of boreholes but that there are no boreholes in the area of WIPP. Could the lack of boreholes be the marker system? Dr. Van Luik answered that a "negative" marker system could be possible and would need to be looked into. Finally, it was asked if the International Atomic Energy Agency (IAEA) was the most long-term group for this task. The answer was that it is unknown, but that a combination of both local and international groups needs to be considered.

Tom Peake discussed the Perspective on Passive Institutional Controls at WIPP. His discussion reviewed the two regulations for PICs at WIPP, 40 CFR parts 191 and 194. The regulatory requirements for PICs at WIPP are for inadvertent intrusion, the message must endure and be understood, no credit was given for reduction in drilling rates in the performance assessment. There are concerns over the use of granite and international archives. Mr. Peake stated that the final WIPP PICs program is required to be submitted for review by the last certification reapplication and needs to include an implementation schedule. He identified that the DOE needed to address the feasibility of the marker construction and the maintenance of long-term records. He urged the use of international development and involvement in this area.

Peake Q&A: A question was asked that since the DOE is involved, what will the EPA do under the standards. Mr. Peake answered that nothing outside of the standards (regulations) is needed. It was also asked if changing the current PICs program would be a rulemaking. Mr. Peake stated that the current regulations allows for the PICs program to change and be updated with current technologies so no rulemaking would be needed. A final question pertaining to the use of "unusual" geologic materials being used as part of the message is considered. Mr. Peake expressed an interest into

WM2012 Conference Panel Report

looking into this possibility but, he believed it may be cost prohibited and be a potential future resource.

John Day gave a presentation on Knowledge Retention Strategies. Mr. Day began his presentation by distinguishing the difference between knowledge and information. Knowledge has many dimensions that include domains, states, applications, representations and can include categories and artifacts. The need to retain knowledge is based on purpose which dictates a response. Mr. Day showed where knowledge is lost due to social and technological changes. Mr. Day discussed retaining the ability to take intelligent action by preserving information must have a knowledge plan. An example of this was his analogy of a musical score vs. an opera performance. In the nuclear industry, knowledge can be retained if it is tacit. Mr. Day showed how a knowledge map can be developed as the first step in identifying a knowledge plan. He showed knowledge retention activities involve consolidation, mothballing, reconstruction, maintenance, forgetting and innovation. Mr. Day stated that passive institutional controls alone will not work to pass along knowledge through the generations. PICs must be multidimensional.

Day Q&A: Mr. Day was asked if a knowledge map is needed would he be available to assist in its development. He stated yes, but that he does not know all the parts involved. He was asked about maintaining passive records in old formats and how much attention should be given this task. He responded that he has not been involved with maintaining records in old formats but emphasized that “tribal knowledge” is required. It was stated that Mr. Day seemed to be painting a gloomy picture of human kind’s inability to retain knowledge and it was asked if there was a way to reverse the process of loss of knowledge. Mr. Day responded that the loss of knowledge can be reversed if it is kept tacit. The question was asked that there is a responsibility to migrate records to newer technologies and how this would affect retaining knowledge. Mr. Day stated that as long as the right tool is used the knowledge can be retained.

Simon Wisbey gave a presentation on “Marking the location of Radioactive Waste Disposals – a UK Perspective”. Mr. Wisbey started his presentation by identifying that in the UK there are no regulations and no guidance on marking radioactive disposal sites. Three purposes were identified; avoiding exposure, preventing future actions, and ethical responsibilities. Mr. Wisbey described the average UK disposal facility and identified groundwater exposure pathway as the primary method of exposure due to a wet environment. He stated that the dose for human intrusion would be conditional and would remain high for long periods of time. Using the many examples of historic locations in the UK, Mr. Wisbey discussed the pros and cons of various historic sites and if they could be interpreted as to their message, beginning with Stonehenge. Locations such as Avebury and Silbury Hill were also discussed, all with the conclusion that why they are there is unknown. Mr. Wisbey stated that a “dual track” approach of both active and passive controls would be needed to reduce significant uncertainties in understandability by future generations. The use of this generational “relay chain” for information must ensure that this knowledge not be dropped by a generation. One suggestion was to input the knowledge into satellites that would send the information

WM2012 Conference Panel Report

back to earth every generation or two. Residual landscape features would help to identify the location in the future. Features such as a bund wall, altered waterways, access routes and land scars can all help in identifying a location for future generations. Mr. Wisbey identified future societal states as a prime area that needs to be considered when developing a message for future generations.

Wisbey Q&A: Mr. Wisbey was asked that since there is no regulation requiring the UK to develop passive institutional controls would they stay in this process. He answered a definite yes.

Peter Galison gave a presentation on “Nuclear Consent in Space and Time”. Dr. Galison identified two problems: 1) siting of facilities being fair, and 2) markings being fair. Both problems require informed consent, transparency, and require knowledge and records to be available. Dr. Galison stated that recent events such as the Gorleben protests, Hanford, Yucca Mountain and Deaf Smith, Texas did not have all the requirements stated above. He stated that WIPP was unusual since there was widespread local acceptance but that the controversy was outside of the immediate area. Dr. Galison reviewed the Swedish siting policy where initially eight sites were chosen and all rejected by the local residents. Then two sites were chosen when the economic effects and a general understanding (knowledge) was part of the process. Dr. Galison stated that for nuclear consent in space requires transparency, economics and a multiscale approach. For nuclear consent in time, reversibility to avoid non-consensual binding decision on the future, warnings and knowledge are essential. He stated a “forced choice” such as status quo was not an option.

Galison Q&A: Dr. Galison was asked how you define cyclic yes /no consent over time. He stated that scale must be considered and that there is no single answer. The question is reversibility required for consent in time was asked and he responded no, irreversibility is no consent. Reversibility can be changed but it must be decided which burden is most important. Historically, the “Field of Thorns” fear markers are not a workable solution. Markers should be based on the future level of risk. Dr. Galison was asked as with religious signs, would an attractive monument be an option. He answered yes, but that option has not been looked into.

Jantine Schröder gave her presentation “Remembering (not) to forget”. Ms. Schröder identified she is involved with the Records, Knowledge and Memory (RK&M) project from the Nuclear Energy Agency (NEA), which is to develop a manual for countries to follow in determining the records, knowledge and memory for geologic repositories. The RK&M includes 15 organizations in 12 countries. Its mission is to develop best practices and fill gaps while incorporating lessons learned from other sciences. Ms. Schröder stated that historically the emphasis has changed over time. In the 1980’s the message was awareness of the danger and to stay far away. In the 1990’s the focus was on intrusion scenarios and community involvement. In the 2000’s, the focus has been on informing the future and a general understanding of the disposal location.

Key questions that the RK&M group is asking are:

WM2012 Conference Panel Report

- What?
 - Use of experts and their capacity to act to determine what is needed
 - Factual – location, design, and hazard
 - Data to be preserved. Always ask why to narrow this large amount of data to its basis
- Why?
 - Through legal or regulatory methods
 - Passive safety
 - Active safety and security
 - Public confidence
 - Cultural heritage
 - Ethical need
- When?
 - Start as soon as possible and last as long as possible
 - Should entail short-term, mid-term and long-term solutions
- Who?
 - Who is the implementer? Regulators, governments have formal responsibilities, life-cycle approach.
 - Cradle to grave information
 - Affected municipalities
 - Multi-disciplined approach
- How?
 - Must be flexible and adaptable over time
 - Systemic approach
 - Include language
 - Include symbols
 - Include images
 - Include markers
 - New part of society
 - Dual Track Approach
 - Direct and indirect approach

Ms. Schröder stated that traditional records won't work and that a "rolling future" concept is needed that will maintain the meaning of the information, mitigate potential loss of information, include international cooperation and overcome economic challenges.

Schröder Q&A: Ms. Schröder was asked what RK&M's timeline for conclusion is. She stated that a document produced in the 2014 time frame will identify the future of the project. A question was asked if it matters or not if the repository archives were in a populated area or not, is there just one strategy to use. She answered that variables must be addressed and stay on a generic level. Another question was if there is a performance confirmation process in the works, such as community monitoring. Ms. Schröder stated yes, this must be included as part of the whole consideration.

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