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**US DOE-EM On-Site Disposal Cell Working Group - Fostering
Communication on Performance Assessment Challenges – 14104**

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ABSTRACT

On-site disposal cells are in use and being considered at several U.S. Department of Energy (USDOE) sites as the final disposition for large amounts of waste associated with cleanup of contaminated areas and facilities. These facilities are typically developed with regulatory oversight from States and/or the US Environmental Protection Agency (USEPA) in addition to USDOE. The facilities are developed to meet design standards for disposal of hazardous waste as well as the USDOE performance based standards for disposal of radioactive waste. The involvement of multiple and different regulators for facilities across separate sites has resulted in some differences in expectations for performance assessments and risk assessments (PA/RA) that are developed for the disposal facilities. The USDOE-EM Office of Site Restoration formed a working group to foster improved communication and sharing of information for personnel associated with these Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) disposal cells and work towards more consistent assumptions, as appropriate, for technical and policy considerations related to performance and risk assessments in support of a Record of Decision and Disposal Authorization Statement.

The working group holds teleconferences, as needed, focusing on specific topics of interest. The topics addressed to date include an assessment of the assumptions used for performance assessments and risk assessments (PA/RAs) for on-site disposal cells, requirements and assumptions related to assessment of inadvertent intrusion, DOE Manual 435.1-1 requirements, and approaches for consideration of the long-term performance of liners and covers in the context of PAs. The working group has improved communication among the staff and oversight personnel responsible for on-site disposal cells and has provided a forum to identify and resolve common concerns.

INTRODUCTION

As the USDOE is planning final cleanup actions for several large sites, onsite disposition is being considered, particularly for large volumes of building debris and contaminated soils. These facilities are typically developed with regulatory oversight from States and/or the USEPA in addition to USDOE. In addition, the facilities are developed to meet design standards for disposal of hazardous waste as well as the performance based standards for radioactive waste in DOE Manual 435-1 [1]. The involvement of multiple and different regulators for facilities at different sites has

resulted in some dissimilarities in expectations for PA/RAs that are developed for the disposal facilities. In order to assist the sites in development of their regulatory documentation for their specific regulators while still maintaining compliance with the requirements, the USDOE-Office of Environmental Management formed a working group to foster improved communication and sharing of information. The intent of the working group is to work towards more consistent assumptions and approaches, as appropriate, for technical and policy considerations related to performance and risk assessments in support of a Records of Decision and Disposal Authorization Statements.

DESCRIPTION

At a business meeting of USDOE low-level waste disposal facility operators and oversight personnel for USDOE disposal facilities, it was recognized that sites considering developing new onsite disposal cells were having some difficulties in clarifying methods of working among and within the State, USEPA and USDOE regulatory regimes. These facility operators questioned the best methods for complying with different regulations overseeing onsite disposal facilities containing CERCLA hazardous materials, USDOE low-level radioactive waste (LLW), and potentially Resource Conservation and Recovery Act (RCRA) hazardous wastes. While USDOE LLW disposal facilities must comply with the requirements found in DOE Manual 435.1-1, CERCLA disposal facilities must also comply with requirements derived during negotiations with State and EPA regulators, including requirements for liners and leachate collection systems (see Fig. 1). It was difficult for the site disposal facility planners to parse out how to best comply with all of the requirements and there were different expectations at different sites. The CERCLA cell working group was formed to provide a forum to share experiences and discuss lessons learned.



Fig. 1. Environmental Restoration Disposal Facility at Hanford during construction of liner and leachate system for new cells (DOE Photo).

The mission of the working group is to foster improved communication and sharing of information for personnel associated with CERCLA and RCRA disposal cells across the DOE complex and to work towards more consistent assumptions, as appropriate, for technical and policy considerations related to performance and risk assessments in support of a Record of Decision and Disposal Authorization Statement. A number of specific goals for the working group were also identified:

- Agree on a common framework for a crosswalk/gap analysis to support consideration of CERCLA (or RCRA) documentation in the context of DOE Order 435.1.
- Identify areas where different assumptions are being made on policy related topics (e.g., time of assessment, point of assessment, performance objectives, inadvertent intrusion) and understand the basis for the current approach
- Consider the potential to develop more consistency for individual issues without compromising existing regulatory agreements
- Identify areas where different assumptions are being made on specific technical topics (e.g., liner performance, cover performance, waste forms, development of waste acceptance criteria) identify the basis for differences
- Develop fact sheets for staff use to provide the basis for consistent assumptions on specific topics and also describe the basis for why assumptions may be different in some cases.

DISCUSSION

The first task for the working group was to identify requirements and assumptions being applied at on-site disposal cells or planned disposal cells in the context of requirements in DOE Manual 435.1-1. Standard assumptions include requirements for time of compliance, inadvertent intruder analyses, performance objectives, and point of assessment. Discussions were held on the current standard approaches for demonstrating compliance with these minimum requirements and how USDOE CERCLA disposal facilities had demonstrated compliance, previously. This comparison provided insights about existing agreements and assumptions for sites contemplating new disposal facilities. Working group members developed an understanding of the need to communicate with non-USDOE regulators regarding USDOE requirements and to work to identify the appropriate path forward to satisfy the requirements of multiple regulators. These discussions were held with the same goals of all environmental actions, which is protection of people and the environment.

As a result of the initial comparison of assumptions that have been made, a few topical areas were identified for further discussion. The working group agreed that the first topic for further discussion was inadvertent intrusion. The second topic focused on considerations related to appropriate integration and segregation of the documentation and requirements from the different regulators. The third topic of interest was

approaches to address long-term performance of covers and liners in performance and risk assessments.

Inadvertent Intrusion

This is a concept that is common to radioactive waste disposal, but not so common for States and the USEPA for their regulated disposal facilities. Initial efforts on improving consistency among sites with USDOE methodologies focused on highlighting national and international standards and expectations and common assumptions regarding consideration of inadvertent intrusion for near-surface radioactive waste disposal. In addition to DOE approaches, recommendations and approaches from the IAEA [2], OECD/NEA [3], ICRP [4], and USNRC [5] were summarized to provide perspective. Activities in a recent project on Human Intrusion in the Context of Disposal of Radioactive Waste (HIDRA) for the IAEA were also discussed [6].

Some general principles for considering inadvertent intrusion were identified:

- Consideration of a limited set of stylized scenarios (e.g., centered around drilling and excavation)
- Default assumption of a loss of institutional controls at 100 years following facility closure with the potential to justify delays based on passive or engineered controls
- Assume current practices when developing scenarios and habits for potential future exposures
- Two classes of exposure scenarios: acute (people actively involved in drilling or excavation) and chronic (people that reside on the site following the intrusion)
- Assume concentrations of radionuclides to be generally assumed to be uniformly distributed within a CERCLA cell.

The activity provided a common perspective for people around the DOE Complex and provided further information for communication with the public to place the role of human intrusion scenarios in proper context. For example, consideration of such scenarios for radioactive waste is intended to provide additional evidence of the robustness of the approaches for disposal that are used. Inadvertent intrusion is an example of a case where those specific analyses may not be needed for demonstrating compliance by the non-USDOE regulators and therefore would only be analyzed by the USDOE regulator.

Documentation and Regulatory Considerations

One of the key questions identified in terms of meeting requirements of multiple regulators was how to document information that was required by one or the other of the regulators, but not both. For example, an approach involving providing additional separate documentation to the USDOE regulator to satisfy the USDOE-specific requirements was discussed. Much of the required documentation to satisfy USDOE is contained in documentation required to meet CERCLA. Thus, USDOE facilities that

intend to use mostly CERCLA-compliance generated documentation to satisfy the USDOE performance assessment and other requirements must prepare a CERCLA/DOE Manual 435.1-1 crosswalk that documents how and where the requirements have been addressed. This crosswalk requirement sets up a method for the facility personnel to explicitly document which parts of the CERCLA submittals satisfy which USDOE requirements and how these submittals provide the regulatory coverage. For those USDOE requirements that are not satisfied by the CERCLA submittals, the disposal facility personnel are expected to complete separate document(s) and submit them to USDOE.

The first technical topic discussed was the time of compliance. USDOE requirements establish a 0.025 mSv (25 mrem) annual dose to a member of the public at the time of compliance of 1000 years post closure with a transition to interpretation of potential peak impacts beyond that time in an increasingly risk-informed and qualitative manner for longer and longer times. While the vast majority of the radionuclides disposed in a CERCLA disposal facility will likely decay below detection prior to 1000 years following closure of the facility, some longer-lived radionuclides will likely be present due to the nature of the origin of the waste and therefore the potential impacts beyond 1000 years must be considered. The term “impacts” is used to stress that indicators other than dose can be used to discuss potential peaks beyond 1000 years. Depending upon the requirements of the non-USDOE regulators, some facilities may be requested to calculate potential doses to a member of the public for other time periods, also, however, USDOE requirements are that the dose limit identified above, must be met. The working group discussed how other USDOE sites managed that information in addition to information requested by non-USDOE regulators.

Another regulatory topic discussed was the applicability of 10 CFR Part 61 requirements for USDOE facilities and wastes. When the US Nuclear Regulatory Commission (USNRC) developed those regulations, they explicitly excluded USDOE wastes from consideration because it was unlike standard commercial wastes. Since the State regulators may also be Agreement States and familiar with USNRC regulations, they may wish to include 10 CFR Part 61 requirements as a “To Be Considered” requirement under the CERCLA process. USDOE sites are not subject to these requirements but are subject to the requirements under DOE Manual 435.1-1, which are similar, but not the same, and specifically developed for USDOE-type LLW. Options for discussing this with non-USDOE regulators were discussed by the working group.

Long-term Performance of Cover and Liner Systems

Another major topic discussed in this year was approaches for the consideration of the design choices and modeling of the longevity of covers and liners. This is an ongoing project and the discussions in the working group have brought many issues to light. A general framework for design of the disposal system and consideration of long-term performance is being developed. A few key messages have been emphasized. For example, when identifying a choice of cover or liner material, emphasis was placed on the need for the developer to consider the source term (e.g., waste form, types of waste

to be disposed, and the degree of compaction among other criteria) in conjunction with natural and engineered barriers (covers, liners) in the context of the total system. It can be easy to focus attention on individual features of a cover or a liner system, but in the end, the total disposal system needs to perform in an integrated manner to meet the performance objectives. By considering a total disposal system, the features that have a significant influence on performance, and likewise, features with minimal impact can be identified. The evolution of the water balance in different parts of the system over time was emphasized as a means to better understand long-term performance (see Fig. 2). Considering how water moves through the system helps to provide perspective on the roles and significance of different design components in terms of the overall goal of reducing releases from the base of the facility. A general understanding of the movement of water from one layer to the next can help to focus development of conceptual models and assessment efforts on the aspects of the problem that can influence the overall performance of the disposal facility.

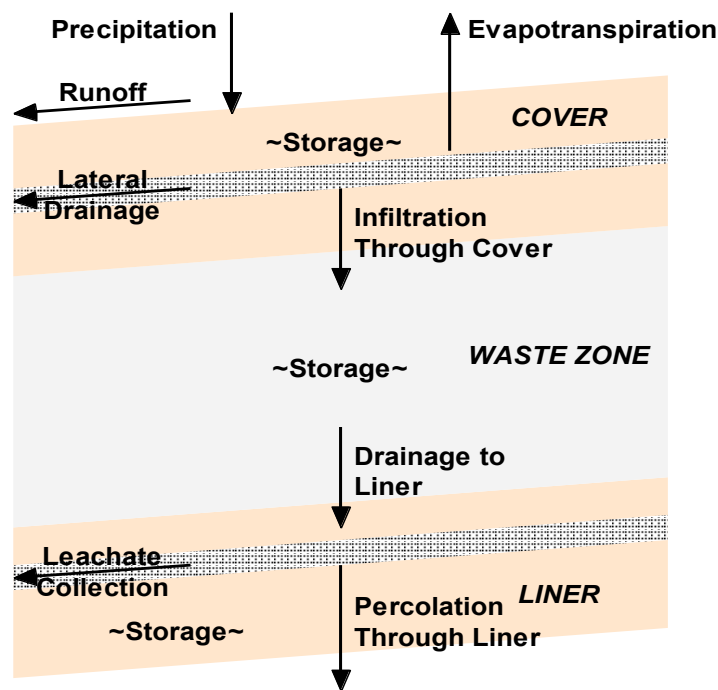


Fig. 2. High-level perspective of water balances in the context of total system behavior.

The timing of performance of different design features and impacts on total system performance was another key area of interest. A variety of information was collected to help with the assessment of performance of individual components of covers, liners and the waste layer itself. Timing of the failure of different components was a key consideration. For example, if the cover is sufficient to limit infiltration into the disposal facility to very low levels for several hundreds of years, the changes in performance of the liner system over time is not as critical. However, in such cases, the intact liner system can play a significant role during operations to collect leachate associated with rainfall and operational use of water for dust suppression or compaction prior to

installation of the final cover. Once the cover is in place and excess water drains from the waste layer, the liner becomes less important. At wetter sites, the type of liner material and presence of a leachate collection system can be more important after closure, especially the relative timing of the failure liner and cover materials. Other considerations include the role of waste stabilization and void space reduction to limit the potential for subsidence that can lead to localized impacts to the cover. The capability to model long-term performance of the disposal facility is dependent upon appropriate assumptions of the cover, liner, and waste forms.

The primary purpose of this activity was to gather information into a reference document that would serve as a resource for design of facilities and consideration of long-term performance of cover and liner systems in the context of overall performance of the disposal system. A draft paper has been developed which includes a general approach for consideration of long-term performance as well as specific information about the roles of different components of cover and liner systems (e.g., evapotranspiration layers, drainage layers, etc.) and mechanisms that can change (degrade or improve) the performance of different layers over time. Detailed information regarding approached to consider long-term performance of different design features is also being developed.

CONCLUSIONS

USDOE sites that are considering onsite CERCLA disposal cells must comply with the requirements in DOE Manual 435.1-1 in addition to non-DOE based requirements from States and the USEPA. A working group was developed to provide a forum to improve communication and develop common understanding on policy and technical issues. Such a forum provides a means to assist those sites in developing appropriate documentation to demonstrate compliance with the USDOE requirements as well as non-DOE regulators and to better coordinate approaches that are being used around the USDOE complex. The working group has produced a number of topical position papers and improved communication among the staff and oversight personnel responsible for on-site disposal cells across the USDOE Complex. Overall, the working group has proven to be an effective forum to identify and resolve common concerns and provide information that can be used in future efforts. Additional issues to discuss among the working group are being assembled and this working group is expected to continue while these potential new CERCLA facilities are being developed.

REFERENCES

1. USDOE, "Radioactive Waste Management Manual," DOE M 435.1-1 Change 1, US Department of Energy Office of Environmental Management, Washington, DC (2001).
2. IAEA, "Disposal of Radioactive Waste," Specific Safety Requirements, Safety Series No. SSR-5, International Atomic Energy Agency, Vienna (2011).
3. OECD/NEA, "The Environmental and Ethical Basis of Geological Disposal of Long-Lived Radioactive Wastes: A Collective Opinion of the Radioactive Waste Management

- Committee of the OECD Nuclear Energy Agency,” OECD Nuclear Energy Agency, Paris, France (1995).
4. ICRP, “Radiation Protection Recommendations as Applied to the Disposal of Long-lived Solid Radioactive Waste,” ICRP Publication 81, Annals of the ICRP 28 (4) (1998).
 5. USNRC, “Update of Part 61 Impacts Analysis Methodology,” NUREG/CR-4370, US Nuclear Regulatory Commission, Washington, DC (1986).
 6. Seitz, R.R, Y. Kumano, L. Bailey, C. Markley, E. Andersson, and T. Beuth, “Considerations Related to Human Intrusion in the Context of Disposal of Radioactive Waste – The IAEA HIDRA Project,” Proceedings from Waste Management 2014, Phoenix, AZ, March 2-6 2014 (2014).