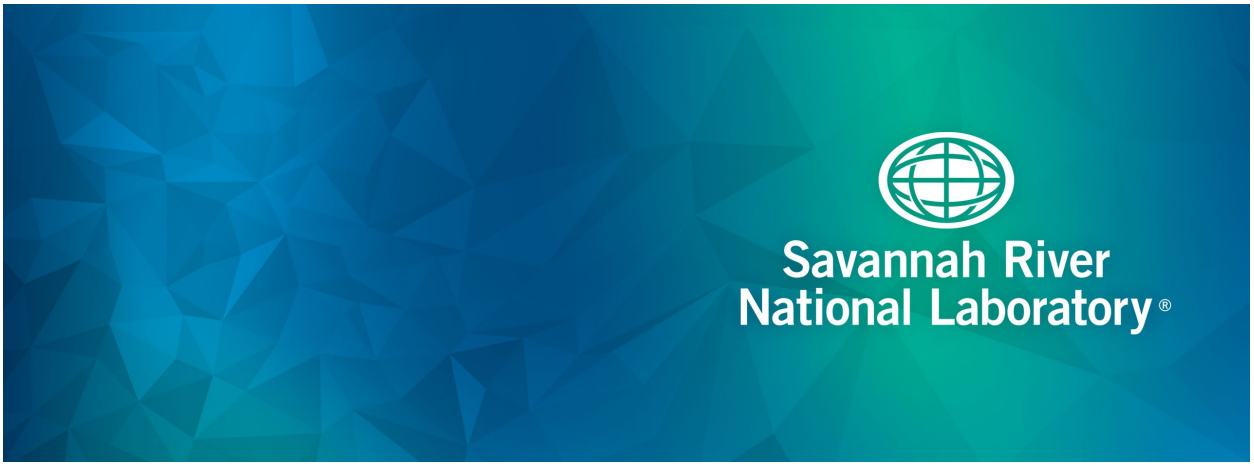

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Oak Ridge Deactivation and Decommissioning Roadmap Interview Summary Report

Evan Koelker

May 2025

SRNL-RP-2025-00067, Revision 0

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Executive Summary

In October 2023, the Department of Energy (DOE) Office of Environmental Management (EM) tasked the Savannah River National Laboratory (SRNL) with leading a team of subject matter experts (SMEs) established through the Network of National Laboratories for Environmental Management and Stewardship (NNLEMS) involving multiple national laboratories, industry, academia, and internal DOE personnel to conduct an evaluation of deactivation and decommissioning (D&D) missions within the DOE Complex. The team of SMEs, i.e., the "Roadmap Team", assessed the technical achievements and needs of each individual site as related to ongoing D&D project work. This work builds upon the DOE EM D&D Technology Development Workshop held in April 2022, that culminated in a report published in June 2022, SRNL-RP-2022-00426.

Each D&D SME were solicited for their experience and knowledge of the matter to be on the Roadmap Team and participate in internal meetings and interviews with D&D project missions. Team members belonged to multiple national laboratories including Savannah River National Laboratory, Argonne National Laboratory, Oak Ridge National Laboratory, Idaho National Laboratory, and Pacific Northwest National Laboratory; Primary contractors for the DOE including Longenecker, and Central Plateau Cleanup Company; DOE Environmental Management personnel; and academic researchers from Florida International University and Mississippi State University.

DOE-EM sites with ongoing D&D project work were chosen for assessment by the Roadmap Team. These project sites include Portsmouth, Paducah, Oak Ridge, Savannah River, the West Valley Demonstration Project, the Idaho Cleanup Project, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Nevada National Security Site, and the Hanford Site. Each project site was solicited for information in a two-step process. First, D&D project teams were provided a questionnaire composed of twelve questions pertaining to technology use, development, and needs specific to D&D project work. The questionnaire was intended to be completed by multiple personnel ranging from lead engineers, contractor representatives, project managers, and senior project advisors within each site's D&D team. Responses were then assessed by the Roadmap Team for topics related to the use of, and need for, technology improvements. Finally, an interview between the D&D team respondents to the questionnaire and the Roadmap Team was held to further examine the highlighted topics and identify technology categories of each issue.

This summary report details the Roadmap questionnaire, its responses, and the interview process for Oak Ridge. The specific D&D projects referenced during the Roadmap assessment at Oak Ridge are the those being planned and executed at the Y-12 National Security Complex and Oak Ridge National Laboratory.

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List of Abbreviations

DARA	Disposal Area Remedial Action
D&D	Deactivation and Decommissioning
DOE	Department of Energy
EPA	Environmental Protection Agency
EM	Environmental Management
FIU	Florida International University
ISD	In-situ Decommissioning
LITR	Low-Intensity Test Reactor
NNLEMS	Network of National Laboratories for Environmental Management and Stewardship
OREM	Oak Ridge Office of Environmental Management
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSTI	Office of Scientific and Technical Information
PNNL	Pacific Northwest National Laboratory
R&D	Research and Development
S&M	Security and Maintenance
SME	Subject Matter Expert
SRNL	Savannah River National Laboratory
TD	Technology Development
TDF	Technology Development Facility
WAC	Waste Acceptance Criteria

1.0 Introduction

The D&D Roadmap initiative was developed to identify high-priority technical needs, and the research areas required to meet those needs in support of the ongoing deactivation and decommissioning of Department of Energy infrastructure across the United States. Responses to inquiries for information via a standardized questionnaire and data collected during interviews with D&D project teams were analyzed by the Roadmap Team and categorized into technical areas to achieve the aforementioned goal. Each D&D technology related response and topic identified during the Roadmap initiative, from all D&D projects interviewed, were collected, categorized, and compiled to determine a more wholistic view of critical science and technology areas of interest.

Technical D&D related responses, as identified from the questionnaire and interviews, varied widely. This variation extended beyond classification of responses into distinct categories for technology use such as non-destructive assay or waste size reduction. Responses also pertained to the stage of D&D work (such as deactivation, long term security and maintenance, or full building decommissioning and demolition), utilization and availability of technology, and the level of project impact that the identified technology had on the D&D project overall. Therefore, to meet the objective of finding high priority technical needs to support ongoing deactivation and decommissioning projects multiple filters were applied to the pool of responses from each D&D project team.

Once a specific gap in technological capability for ongoing D&D work was identified, specific questions were asked of the D&D team to better understand the issue during the site interview. In addition, efforts were made to find and contact SMEs or researchers with related experience or research project work to provide context and potential solutions to each gap. Commercially available products and mature research project solutions were made a priority during this stage of the Roadmap assessment.

Beyond the identification of needed technology and research areas, the procurement and communication of D&D related information by D&D project teams were assessed. Though not specific to the stated intent of the Roadmap initiative, the propagation of information regarding the successful employment of technological solutions to D&D challenges was seen to be germane to the Roadmap's purpose. An inquiry to the methods of finding technology and/or expertise taken by each D&D project team was made to understand what methods this communication utilized.

The potential to utilize ongoing D&D projects for test bed opportunities was the final assessment point for the Roadmap initiative. Any new technology must undergo significant testing and evaluation prior to wider employment. The final stages of testing typically employ a real-world, albeit controlled, setting or utilize data collected from ongoing field projects. In direct competition with this need is the inherent risk and cost of accessing a D&D project, especially one that involved hazardous chemicals or radionuclide contamination. It is a hazardous, expensive, and challenging undertaking for workers to physically enter the premises of many of the evaluated D&D sites. Sufficient incentive is necessary to justify this cost. Often monetary compensation to the D&D project team is not available for facilitation of testing research products unless funded by the

research itself. Moreover, the driving forces for D&D project teams is to typically limit worker exposure to only that is necessary to complete a task and utilize technology or methods known and previously demonstrated to be capable of success. A notable alternative to this eventuality is research projects targeted for specific needs at each site that are identified during various stages of D&D. These opportunities can take years to develop, and are sometimes used only once, successfully, or otherwise.

This summary report details the findings gathered during the questionnaire and interview assessment solely related to the Y-12 National Security Complex and Oak Ridge National Laboratory.

2.0 Oak Ridge Background and Planned D&D Strategy

2.1 Y-12 Security Complex

The Y-12 National Security Complex, hereafter referred to as Y-12, is a large footprint facility comprising of approximately 105 acres of land and 90 total structures with combined footprints of millions of square feet (Figure 1). Y-12 is one of three primary installations on the Oak Ridge Reservation (ORR) in Oak Ridge, Tennessee. The current, large scale, D&D projects within its borders include former Manhattan Project-era facilities, Alpha-2, Alpha-4, Alpha-5, and Beta-2. These legacy facilities are now designated high-risk structures and are currently in various states of D&D progress. Primary contaminants within these facilities include an estimated 1.3 million pounds of mercury are unaccounted for at Y-12. Mercury contamination is found in liquid and vapor forms throughout these buildings, producing significant risk via exposure to D&D work teams and the environment. The U.S. Environmental Protection Agency (EPA) has identified this mercury contamination as the greatest environmental risk at Oak Ridge (GAO-24-107096). The remaining mercury cleanup at Y-12 includes the D&D of the four mercury contaminated buildings followed by large scale soil, surface water, and groundwater remediation. To supplement this effort, the nearby construction of a new, 2.2 million cubic yard capacity, waste disposal facility by the Oak Ridge Office of Environmental Management (OREM) is expected to be completed by 2030 (Barton et, al. 2025). In addition, a mercury treatment facility designed to capture and treat surface water runoff during building demolition is already in progress. Co-contaminants such as uranium and beryllium are also of note for D&D planning at Y-12 facilities as each have been important parts of the DOE missions conducted since the 1950s. Consequently, building structures and equipment are process contaminated and their disposal will generate hazardous and mixed waste streams slated to be disposed of both at the ORR and at off-site waste disposal facilities such as the Nevada National Security Site.

Currently, the Alpha 4, Alpha-5, and Beta-2 facilities reside in preparation stages for full decommissioning, the Alpha-2 building having begun demolition in June 2024. D&D work for these facilities is expected to continue into late 2036. Technology development opportunities to facilitate the D&D of these facilities are focused on the measurement and detection of mercury or beryllium, the mitigation of mercury vaporization within structures, the prevention of mercury leachate in landfills, and the immobilization of mercury in waste packaging (GAO-24-107096).

Technology development opportunities related to these challenges were identified during the D&D Roadmap assessment conducted at Oak Ridge.

2.2 Figures – Y-12 Security Complex

Figure 1. Y-12 Security Complex – Oak Ridge Reservation.

2.3 Oak Ridge National Laboratory

Oak Ridge National Laboratory (ORNL) is the DOE's largest science and energy laboratory with a wide range of mission capabilities and a decades long history of research involving a multitude of chemical elements, compounds, and radioactive materials (Figure 2). Ongoing D&D project work on the ORNL campus includes the demolition planning and completion of multiple contaminated facilities including the East Cell Bank at the former Radioisotope Development Lab and the Isotope Row Facilities (i.e. Building 3026), the ORNL Fission Production Development Lab Building 3517, Building 3118 Radioisotope Laboratory H, and Building 3005 Low-Intensity Test Reactor (LITR).

Many facilities located in the central campus area of ORNL are highly contaminated and contain large source terms of radiological materials with a varied isotope inventory. Multiple buildings slated for D&D at ORNL began operation in 1943 as part of the Manhattan Project and operated

for decades until their eventual placement in a surveillance and maintenance (S&M) program (Conley et. al., 2010). Large scale, open air, demolition will be required for these aging facility structures and will be performed within close proximity of operational research laboratories and other occupied facilities. The release of toxic or hazardous material during these operations and the exposure of D&D workers, other ORNL personnel, or the public to these substances during D&D operations is a primary driver for the selected methods to complete this work. Multiple technology needs were identified during Roadmap interview proceedings regarding the ORNL Campus to mitigate the hazards of open air demolition.

Upon the receipt of Roadmap questionnaire responses and information during the subsequent interview, technical challenges and gaps related to the Y-12 complex and general ORNL Campus D&D projects were assessed.

2.4 Figures – Oak Ridge National Laboratory

Figure 2. Oak Ridge National Laboratory

3.0 Questionnaire and Responses

The Roadmap initiative developed a 12-part questionnaire to assess the technological utilization and needs of each D&D project targeted. The questionnaire was provided to each site and routed to each D&D project team through the associated site's DOE Liaison for completion. It was intended for the questionnaire to be completed by multiple D&D project personnel including, but not limited to, lead engineers, project managers, associated SMEs related to the project, and

project contracting leads (where available). Questionnaires as completed by Oak Ridge personnel are presented in Appendix A.

The responses received from completed questionnaires were sorted by the Roadmap Team to determine their usefulness in fulfilling the overall goals of the Roadmap Initiative, to find technology gaps and critical research areas for strategic DOE planning purposes or current and near future D&D projects. To categorize technology needs, six categories were applied: the D&D stage, the technology needs' timeline, the technology needs' driver, the project impact level, the challenge type, and the needed technology type.

Each response pertaining to a technology need was assessed by the Roadmap Team using the 6 categories and their corresponding criteria to determine their relevance to the stated Roadmap goal. These criteria are summarized below:

1. Stage of D&D Work Category – Each step to prepare a facility for an end state involve the need for specific technologies. For example, responses for a project in the deactivation phase highlighted concerns with contaminant assay and sampling. This was due to the nature of that phase, as deactivation typically contains the act of inventorying the contaminant hold-up necessary. That inventory is then needed to decide upon a strategy for decommissioning. Therefore, as a project moves to the decommissioning phase, it is less concerned with technology needed for contaminant assay or sampling simply because it has already been completed (in some cases, years prior). For the purposes of the Roadmap assessment, three stages were recognized.
    1. Deactivation
    2. Long Term Storage (LTS)
    3. Decommissioning
2. Needs' Timeline Category – The responses received contained information useful to the Roadmap Team's assessment of D&D work but varied temporally. For clarity, responses contained information regarding technology that would have been useful or produced a more desirable outcome if employed in the past, is needed for work currently being conducted, or is needed for work that is planned to be executed in the near future. To properly recommend critical research areas to the DOE, the understanding of when the products of this research will be needed most is necessary. For the purposes of the Roadmap assessment, three timeline categories were recognized.
    1. Near past
    2. Current
    3. Near future
3. Needs' Driver Category – Each technology need identified by the Roadmap questionnaire was assessed for a "needs driver" and categorized by four criteria. A needs driver is defined by the overall benefit a project may receive by implementing a new technology. Four criteria have been created for this category.
    1. Project Cost
    2. Project Schedule
    3. Project efficiency
    4. Safety risk

4. Project Impact Level Category – Questionnaire responses were assessed by the Roadmap Team for the level of impact the technology had, is having, or would have upon the D&D project itself. This category was created to weigh each identified technology category using the Roadmap Team's experience and knowledge gained during the interview process. By placing weight on a technology identified in the questionnaire responses, a more accurate picture of what technology is critical to the overall D&D mission for the DOE can be seen. This was achieved by filtering out the technology that may be less beneficial and focusing on those most critical to a D&D project's success. Three criteria were created for this purpose by the Roadmap Team.
    1. High
    2. Medium
    3. Low
5. Challenge Type Category – The utilization of technology, or the need for new technology arise from specific challenges found during each stage of D&D work. The identified challenge can correlate to the overarching reason a technological solution is needed. Thus, incorporation of a set of criteria to categorize the need provided a detail analysis of the multitude of questionnaire responses. The Roadmap assessment of responses recognized eight primary 'challenge types'.
    1. Contaminant Type
    2. Contaminant Control
    3. Security and Maintenance
    4. Worker Safety
    5. Waste Processing
    6. Characterization
    7. Accessibility
    8. Project Management
6. Technology Type Category – To fully assess a potential research area that encompasses technology needed by a D&D project team, categories of technology were created. The Roadmap Team created these categories specific enough to allow for a detailed review of the assessed responses, but broad enough to group them in a useful way for strategic planning by DOE leadership. A total of 17 technology criteria were created for this assessment.
    1. Modelling
    2. Non-destructive Assay
    3. Sample Collection and Analysis
    4. Robotic/Remote Applications
    5. Fixatives and Coatings
    6. Decay and Byproduct Control
    7. Grout and Entombment
    8. Contaminant Collection and Removal
    9. Personal Protective Equipment
    10. Exposure Monitoring
    11. Waste Preparation
    12. Waste Treatment

13. Waste Shipment and Disposal
14. Interim Waste Storage
15. Artificial Intelligence

3.1 Y-12 and ORNL Roadmap Response Assessment

The Roadmap Team initiated the questionnaire process with the D&D project team members and SMEs overseeing D&D operations at the Oak Ridge Reservation prior to a full interview process. Responses to the questionnaire were received on June 18, 2024. In total, nine respondents provided completed questionnaires for assessment by the Roadmap Team. Respondents included Operations and Logistics Managers, Area Project Managers, Health and Safety Operations Managers, and Cleanup Enterprise Regulatory Documentation and Planning SMEs. Of the 108 total questions (12 questions per questionnaire as completed by 9 respondents) 70 detailed responses were received. These detailed responses covered multiple related topics including several direct mentions of technology utilized or potentially needed during work pursuing D&D at the Y-12 complex and ORNL. Repeat mentions of each identified topic of technology were discounted from an overall questionnaire analysis for technology categories conducted at all sites interviewed by the Roadmap Team. This was done to eliminate possible data bias produced by many respondents from a single site with responses pertaining to one topic or technology. The assessment criteria pertaining to the chosen questionnaire response by the Roadmap Team is presented in Appendix B.1.

The technology needs assessed by the Roadmap Team, based on the responses and requests from the Oak Ridge SMEs interviewed, were related to two separate areas of D&D projects on the Oak Ridge Reservation. The first area is the Y-12 complex. Y-12 D&D progress is linked to hazardous contaminants that permeate large structures including Alpha-2, Alpha-4, and Beta-1. Mercury and beryllium are primary contaminants that must be characterized efficiently and disposed of properly for success at the Y-12 National Security Complex, and the responses to the Roadmap questionnaire and interview process by SMEs at Y-12 reflect this. The second area is the ORNL Campus, and the ongoing D&D projects within this area. D&D projects within the ORNL Campus are located very close to operational research facilities and high occupancy buildings. The contaminants of concern within these buildings include highly radioactive isotopes in addition to other non-radioactive substances. The handling of radioactive waste and the release of contaminants by debris or dust created during building demolition were found to drive responses to the D&D Roadmap assessment process by SMEs working on D&D projects at the ORNL Campus.

Questionnaire responses chosen for assessment by the Roadmap Team were given identifying labels that designate the origin of the site, referenced D&D project, and number as they are presented in Appendix B-2 (ex.: OR – Y12 – 1). Where more general topics are covered, a designation of “Misc.” is used instead of a specific project building (ex.: OR – Misc. – 2).

The topics related to technical needs identified by the Oak Ridge project teams, and their assessment by the D&D Roadmap Team include:

- Contaminant Control and Characterization – During the questionnaire and interview process with the Oak Ridge D&D teams, technology needs related to contaminant control were assessed. Many buildings at the Y-12 security complex cannot be accessed by D&D work teams without restrictive PPE and work control practices that, while necessary, slow the progress of the project. In addition, hazardous substances such as the mercury and beryllium that contaminates some Y-12 complex buildings necessitates costly and time-consuming sampling procedures to characterize waste for segregation. Once waste is packaged and placed into the correct waste stream, some contaminants (such as mercury) remain a risk to overall D&D project performance. Characterizing and controlling contaminants both within the work zone that creates D&D waste and within the packaging it is eventually contained are critical processes for the Y-12 National Security Complex D&D project work.

  Technology criteria found to apply to contaminant control are:

  1. OR – Y12 – 1: Mercury Treatment and Control – Elemental mercury is a toxic substance present in the structure, contents, and air within the Alpha-2, Alpha-4, and Beta-1 facilities. Treatment methods for building materials, both in-situ during D&D work and within waste packaging, will be an ongoing and critical process at the Y-12 complex. For example, elemental, free liquid, mercury within waste packaging can (and has) precipitate within a standard B-25 waste container in the interim period between waste packaging at Y-12 and delivery to a disposal facility. Consequently, such a container is in violation of waste acceptance criteria (WAC), not accepted for burial, and is rejected by the disposal facility which creates work stoppages and project performance impacts. Options for the fixation, absorption, and/or chemical transformation of mercury that permeates large buildings, and their contents have the potential to greatly impact worker safety, project performance, and WAC risk factors during D&D at the Y-12 Complex. The D&D Roadmap Team has assessed this technology need as:
     i. D&D Stage/s: ‘Decommissioning’
     ii. Needs Timeline: ‘Near Future’
     iii. Needs Driver: ‘Project Schedule’
     iv. Project Level Impact: ‘High’
     v. Challenge Type: ‘Contaminant control’ and ‘Waste Processing’
     vi. Technology Type: ‘Contaminant Collection/Removal’, ‘Waste preparation’, and ‘Waste Shipment and Disposal’

  2. OR – Y12 – 2: Mercury Vapor Management – Due to the amount of mercury contamination within Y-12 buildings scheduled for D&D airborne, vapor, mercury is a continued hazard for D&D work teams. Though mercury vapor release from building components could be, at least to some extent, controlled by coatings of fixatives, specific technology related to vapor filtration or other engineering controls to reduce airborne mercury concentrations were requested by the Oak Ridge Roadmap respondents. The D&D Roadmap Team has assessed this technology need as:

i. D&D Stage/s: ‘Decommissioning’
ii. Needs Timeline: ‘Near Past’, ‘Current’, and ‘Near Future’
iii. Needs Driver: ‘Project Schedule’ and ‘Safety Risk’
iv. Project Level Impact: ‘High’
v. Challenge Type: ‘Contaminant Control’ and ‘Worker Safety’
vi. Technology Type: ‘Contaminant Collection/Removal’ and ‘Personal Protective Equipment’

3. OR – Y12 – 3: Remote or Non-Laboratory Contaminant Characterization – The waste characterization process typically involves the use of contract laboratories to determine contaminant presence and concentration. As waste is generated, by any means, samples are collected and analyzed by a licensed laboratory. The collection of samples and their analysis often requires one to several days or longer for this process to be completed. Any waste undergoing characterization must be segregated to await its inclusion in the correct waste stream. Samples collected by D&D teams may be done in the form of surface smears, waste matrix cores (i.e. concrete sampling), liquid rinsate sampling, or other methods. A waste sampling plan must ensure that the quantity and locations of these samples accurately identifies the presence of contaminants or hazardous substances. Thousands of samples may be collected for this purpose over the lifespan of a D&D project. If waste is characterized incorrectly, acceptance criteria for a chosen waste disposal facility may be violated resulting in significant cost and time loss as well as potentially exposing workers or the public to hazardous substances. Overall, waste characterization is a time-consuming and costly process with potentially severe consequences for errors. A reliable form of characterization, that can be performed by D&D teams in the field that reduces the number of analytical samples needed, would reduce the need for laboratory based analytical testing. Specific to the Y-12 Complex, beryllium contamination and its subsequent characterization is an ongoing process for work progression. Handheld spectroscopy, X-ray florescence, colorimetric testing, and mobile laboratory solutions are all being considered to expedite beryllium contaminated waste segregation by Oak Ridge D&D teams. The D&D Roadmap Team has assessed this technology need as:
   i. D&D Stage/s: ‘Decommissioning’
   ii. Needs Timeline: ‘Current’ and ‘Near Future’
   iii. Needs Driver: ‘Project Schedule’
   iv. Project Level Impact: ‘Medium’
   v. Challenge Type: ‘Contaminant Characterization’
   vi. Technology Type: ‘Non-destructive Assay’ and ‘Sample Collection and Analysis’

- Open Air Demolition Improvements – Legacy facilities on the central ORNL Campus scheduled for or currently undergoing D&D are highly contaminated with large source terms of various radiological materials. The release of dust to the surrounding areas would result in exposure of operating research facilities and personnel to contaminated materials. The removal and processing of radioactive material for disposal and the

decommissioning of existing hot cells or reactors in various states of disrepair will be conducted within high traffic areas, making contaminant release by airborne dust highly possible without costly and time-consuming control processing and equipment. Dust control measures, robotics, and improved hot cells for materials processing are all requests made by Oak Ridge D&D SMEs during the Roadmap assessment.

Technology criteria found to apply to this area of interest are:

1. OR – ORNL – 4: Robotic/Remote Applications – Access to contaminated areas via robotics, for a multitude of purposes, to reduce exposure of workers to contamination is an increasingly viable solution for D&D teams. Access and objectives can be achieved in areas physically not accessible to humans without more destructive methods. The application of a robotic solution for the purposes of radioactive material removal and handling for legacy building D&D at ORNL will allow D&D teams to reduce exposure to workers and surrounding facilities and personnel. This technology request was assessed by the Roadmap Team as:
    i. D&D Stage/s: ‘Deactivation’ and ‘Decommissioning’
    ii. Needs Timeline: ‘Near Past’ and ‘Current’
    iii. Needs Driver: ‘Project Schedule’ and ‘Safety Risk’
    iv. Project Level Impact: ‘Medium’
    v. Challenge Type: ‘Worker Safety’ and ‘Accessibility’
    vi. Technology Type: ‘Robotic/remote applications’ and ‘Waste Preparation’

2. OR – ORNL – 5: Decontamination and Dust Control – Dust fixation is a priority for open air demolition projects. ORNL D&D responses have specifically requested options for fixative alternatives for ongoing and planned D&D projects both for initial source term removal and demolition phases. This technology request was assessed by the Roadmap Team as:
    i. D&D Stage/s: ‘Decommissioning’
    ii. Needs Timeline: ‘Near Future’
    iii. Needs Driver: ‘Project Schedule’ and ‘Safety Risk’
    iv. Project Level Impact: ‘Medium’
    v. Challenge Type: ‘Contaminant Control’ and ‘Worker Safety’
    vi. Technology Type: ‘Fixatives and Coatings’ and ‘Waste Preparation’

3. OR – ORNL – 6: Portable Hot Cell – Multiple buildings at the ORNL Campus contain radioactive material within original hot cells. These facilities may have been placed into S&M for up to several decades, necessitating the removal of contaminated materials from these cells prior to their demolition. These materials in turn, must be packaged in shielded containers for transportation to other locations. The capabilities of these legacy hot cells (in existing robotic handling devices or even functional viewports to see within the cells themselves) do not allow for the repackaging or manipulation of radioactive materials where they are found. Successful removal of

these materials necessitates a secondary, and temporary, hot cell for this purpose. This technology request was assessed by the Roadmap Team as:

i. D&D Stage/s: 'Decommissioning'
ii. Needs Timeline: 'Near Future' and 'Current'
iii. Needs Driver: 'Project Schedule' and 'Safety Risk'
iv. Project Level Impact: 'Medium'
v. Challenge Type: 'Contaminant Control', 'Worker Safety', and 'Waste Processing'
vi. Technology Type: 'Robotics/Remote Applications', 'Contaminant Collection/Removal', and 'Waste Preparation'

4.0 D&D Team Interview Process

Prior to the teleconference, Roadmap Team members devised inquiries specific to each targeted questionnaire response. Where possible, researchers in areas of specific interest were contacted to provide context and information related their work and were welcomed to participate on the interview call. Each area of interest during the questionnaire response assessment was discussed further during the interview process. Each interview teleconference was recorded.

On July 29, 2024, the Roadmap Team conducted a virtual interview with the multiple senior D&D team members from Oak Ridge. All participation by Roadmap Team members was voluntary for this interview. All respondents to the D&D questionnaire, the D&D team management, and associated SMEs were invited to participate in the interview as well. Topics identified during the Roadmap Team assessment of the questionnaire were specifically targeted for further discussion during the interview.

In addition to discussions regarding each area of technology interest identified during the questionnaire response assessment and associated interview, two separate topics were discussed. Firstly, the methods of procuring and communicating D&D related information or technology by the Oak Ridge project team, and secondly, the suitability of the Oak Ridge facilities for further testbed opportunities.

4.1 D&D Technology Procurement and Communication

The development and testing of new technology are also critical processes for the improvement of work procedures, project performance, and worker safety in the inherently hazardous and technically challenging projects to D&D contaminated legacy facilities around the DOE complex. This process depends upon communication between the D&D team who needs a solution and the manufacturer or researchers that can provide or develop that solution. Currently, the United Cleanup Oak Ridge (UCOR) company is the primary contractor managing cleanup and D&D work on the Oak Ridge Reservation. UCOR works closely with several national laboratories, most predominantly ORNL, to develop new technologies for deployment at multiple D&D job sites both within the Y-12 Security Complex, ORNL campus, and elsewhere within the boundaries of the ORR.

Currently there are multiple instances of technology development and testing being completed at the ORR with close cooperation with UCOR and its Technology Development personnel. These include robotics development and future deployments by ORNL to assist in highly contaminated waste removal and repackaging for hot cells at the central campus area, mercury sensor and analysis projects within the Alpha-4 building at Y-12 by SRNL (Danielson et. al., 2024), planned robotics development for mercury sensing by Florida International University (FIU) for Y-12 facilities, and testing of fixatives developed by Pacific Northwest National Laboratory (Kugler et. al., 2024). The progress of research projects deployed by multiple National Laboratories, the willingness to test new technology developed by university research institutions like FIU through organizations such as the Minority Serving Institution Partnership Program (MSIPP), and the Technology Development division at UCOR demonstrate that D&D team management at the ORR is active in the search and utilization of new technology via avenues designed to provide them by the DOE; i.e. national laboratories and DOE funded university programs.

The communication of technology utilization at the ORR, as assessed by the Roadmap Team, includes standard reporting, presentations, and promotion. ORNL, UCOR, and associated project teams that develop technology for deployment at D&D projects at Oak Ridge routinely present research results at conferences such as the Waste Management Symposia, research workshops held around the country, and internal DOE information releases. In addition, technical reporting that details project results may be accessed through information databases such as the Office of Scientific and Technical Information (OSTI) and the D&D Knowledge Management Information Tool (D&D KM-IT).

4.2 Testbed Opportunities

D&D projects are ongoing in multiple areas at Oak Ridge. Though the entirety of the Oak Ridge Reservation is a secured facility, there are varied levels of security protocols that govern access and applied differently for separate areas.

- The Y-12 Security Complex has higher restrictions applied to personnel and equipment (including electronics) than what is typically applied in most places of the ORNL campus. Though D&D related research can be, and is currently, conducted at the Alpha-4 building within Y-12, significant procedures must be fulfilled to gain entry. Specific, task oriented, needs for new technology to D&D can be utilized to justify the cost for both funds and time to deploy a research project within the boundaries of the Y-12 complex, however the security measures in place do not make this area conducive to general testbed opportunities.
- Currently, SRNL deploys multiple mercury vapor sensors within the Alpha-4 building of the Y-12 complex, with associated robotics deployments possible in the near future by the MSIPP institution FIU. In addition, UCOR utilizes new technology developed by DOE National Laboratories such as the spray fixative AF-1000 developed by Pacific Northwest National Laboratory (PNNL) (Kugler et. al., 2024).
- Similarly, the ORNL Campus has multiple ongoing, and technically challenging, D&D projects that will provide the opportunity for new technology deployment. Due to the less restrictive security protocol at ORNL, closer access to an advanced national laboratory

provides a wider opportunity for technology deployment and local research collaboration at the deployment site.

During subsequent discussions with ORR and UCOR D&D SMEs, another opportunity for a technology testbed was presented to the Roadmap Team. The DOE Office of Environmental Management (DOE-EM) and UCOR have implemented the initial development of the Technology Development Facility (TDF), a testbed facility at the former Disposal Area Remedial Action (DARA) site on the ORR. The facility is intended to provide testing capabilities related to mercury cleanup at Oak Ridge in which the possibility of wider applications may exist. A centralized location for testing and promotion of new technology specific to D&D applications would allow for greater visibility to project teams around the DOE. The TDF has the potential to fulfil this role for the larger D&D community.

5.0 Roadmap Findings Summary

Assessment of the ORR D&D projects was conducted by the Roadmap Team in two phases. A questionnaire was applied to the D&D project team, and contained 12 questions related to technology needs and project specific details related to D&D. The questionnaire was completed by the D&D project team management, lead engineers, DOE project directorate staff, and facility SMEs with specific in-depth knowledge of the project sites.

Responses to the questionnaire were assessed by the Roadmap Team to determine specific interests related to technology application by the D&D project team. This analysis resulted in two primary topics of interest for further discussion during the subsequent virtual interview. These topics include contaminant control and characterization specific to mercury and beryllium impacts at the Y-12 Security Complex and the open-air demolition of radioactive contaminated structures at the ORNL Central Campus. Each questionnaire response related to each topic of interest was assessed by the Roadmap Team to determine the stage of D&D, the timeline a technology may be needed, the level of impact to the project a technology would have, the overall role a technology may fulfill, and the specific technology category associated with the response. This was done to accomplish one of the stated goals of the D&D Roadmap, to identify current and near-future priority areas of technology needs related to D&D projects around the DOE complex. Multiple areas of technology R&D areas were identified to apply to the ORR D&D project needs of varying degrees of priority by the Roadmap Team.

A virtual interview was held between participating members of the Roadmap Team and Oak Ridge project teams to further discuss specific interest areas. During the interview, additional subjects were related to the opportunities presented by ORR SMEs for further testbed utilization, the procurement of new information and D&D related technology by the D&D project team, and the effects of R&D product deployment in the past. Findings resulting from the interview included valuable input from the D&D project teams regarding all topics discussed, and most notably on the viability for testbed potential of D&D technology developments in different.

Technology types identified during the Roadmap assessment of the ORR projects will be utilized for a wholistic view of needed research areas at the conclusion of the Roadmap initiative in Spring of 2025. A more detailed conclusion that includes the data gathered during the questionnaire and

interview of the ORR D&D project teams will be provided in a final report at that time. Continued efforts by the Roadmap Team have been made in the interim to find suitable technology solutions to specific needs of the ORR D&D teams leading up to that final report.

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Appendix A.

A.1 Oak Ridge D&D Team Questionnaire Responses

Responses to the D&D Roadmap questionnaire are presented as received by the D&D Roadmap Team. No edits or alterations have been made.

D&D Roadmap: Facility Questionnaire for Technical Needs

Respondent Information
Name: Russell Lum
Job Title: Project Manager
Contact Information: REDACTED

1. Project Driver

Please describe the primary objective and/or driver of the D&D work taking place that you are currently involved in. This may be timeframe, environmental risk, budgetary concerns, regulatory framework, worker safety, or otherwise.
Current scope at MSRE is the performance of a Feasibility Study. D&D is not yet underway. The study is in its early phases with D0 submission of the Remedial Investigation Report pending. However, the Objective of the demolition will be to the Removal of the MSRE Complex facilities for decontamination of the area footprint since long-term occupation of this area by this reactor facility will result in environmental insult.

D&D Project Referenced: MSRE Feasibility Study
Respondent's Position in Relation to D&D Project: Study PM, not involved with future D&D

2. Project Progress

Are there any specific instances of D&D work being hindered or enhanced by technological improvements or methodology? A specific objective of this project is to propagate useful technology or D&D techniques to other projects in the DOE complex.
D&D of this facility is just now being evaluated. The potential to use robotics for removal activities to reduce exposure to workers is a potential technological improvement that could be considered. It is understood that remote handling will be needed for a majority of removal efforts.

D&D Project Referenced: MSRE Feasibility Study
Respondent's Position in Relation to D&D Project: Study PM, not involved with future D&D

3. Technological Application

Are any technological needs that may improve the results of your D&D project absent or not functioning? This may refer to currently existing, but unobtainable, technology, theoretical application of existing technology, or fully theoretical specialized equipment.
See #2 above

D&D Project Referenced: MSRE Feasibility Study
Respondent's Position in Relation to D&D Project: Study PM, not involved with future D&D

4. Worker Safety

Are there any barriers or significant risks to D&D worker safety that apply to the current D&D project that have or could impact the performance of this work? This could involve critical safety devices, D&D techniques in hazardous environments, or specific hazard controls related to each project.
Once D&D begins very high rad dose will be a concern for workers, and will have an impact on the duration of the work due to limited stay times and remote handling.

D&D Project Referenced: MSRE Feasibility Study
Respondent's Position in Relation to D&D Project: Study PM, not involved with future D&D

5. Regulatory Framework

What regulatory controls most affect this D&D project? Are there any significant instances of inter-agency priorities that affect this project? This may range from regulatory engagement, regulation clarity, conflicting regulation, or otherwise specified by the project team.
Anticipated contention obtaining a tri-party agreement on the alternatives analyzed in the Feasibility Study which denotes the endstate of below-grade structures. Further, there is a Interim ROD which states the salts must be removed from the Drain Tanks – due to worker safety – this effort cannot be completed for decades to come which might result in some conflict.

D&D Project Referenced: MSRE Feasibility Study
Respondent's Position in Relation to D&D Project: Study PM, not involved with future D&D

6. Waste Disposition and Disposal

What issues exist that may affect project outcome that relate to waste processing on this project? This may refer to waste collection, storage, shipment, disposal facility requirements, or otherwise identified by the project team.
Large quantities of TRU constituent waste.

D&D Project Referenced: MSRE Feasibility Study
Respondent's Position in Relation to D&D Project: Study PM, not involved with future D&D

7. Public Engagement

Does the D&D project require specific public engagement or hazard protection required for the successful conduct of this work?
Unknown until a tri-party agreement is established, via a Removal Action Work Plan, on a proposed D&D plan.

D&D Project Referenced: MSRE Feasibility Study
Respondent's Position in Relation to D&D Project: Study PM, not involved with future D&D

8. Cost Efficacy

Are there any technological or methodology improvements that could conceptually improve the performance of this D&D project?
Currently available remote handling technology will be evaluated, and the benefit of any future advancements in that technology would be evaluated prior to the commencement of D&D in the future.

D&D Project Referenced: MSRE Feasibility Study
Respondent's Position in Relation to D&D Project: Study PM, not involved with future D&D

9. Project Lifespan

What is the intended project lifespan and outcome of this D&D work? This may involve eventual public use of the property (with or without environmental restrictions), long term environmental monitoring, reuse of the land by the DOE, or otherwise as identified by the D&D project team.
The site footprint will remain as a CAT II footprint until the drain tanks are cleared (~80 years from now). Afterward, it is anticipated to remain under DOE control, and will undergo long term environmental monitoring.

D&D Project Referenced: MSRE Feasibility Study
Respondent's Position in Relation to D&D Project: Study PM, not involved with future D&D

10. Research Possibilities

What areas or possibilities are available in this D&D project to deploy emerging technology? Are there any opportunities to test new research and technology related to D&D that may become available in the near future?
See #8 above.

D&D Project Referenced: MSRE Feasibility Study
Respondent's Position in Relation to D&D Project: Study PM, not involved with future D&D

11. Site Specific

What other issues have arisen during the current or previous phases of this D&D project that it is possible to improve? What lessons learned have the project team identified that may be useful to future D&D work on this or other projects?
N/A

D&D Project Referenced: MSRE Feasibility Study
Respondent's Position in Relation to D&D Project: Study PM, not involved with future D&D

12. Open Ended

Please describe any other issues that may relate to D&D project work pertaining to technological or methodological improvements that are, or may be, possible and applicable. This initiative relies upon the expertise and insight of individuals who drive D&D work for the DOE and the expertise of the interview team to recommend or initiate research to aid them.

A closure methodology using In situ Decommissioning of Below Grade Structures would benefit this D&D effort. Alternatives for TRU processing, beyond using TWPC, which will allow it to be shipped without micro-segmentation of the waste stream.

D&D Project Referenced: MSRE Feasibility Study
Respondent's Position in Relation to D&D Project: Study PM, not involved with future D&D

Technical Need: *Mercury-waste packaging/storage with future disposition non-compliance issues*

Respondent Information
Name: *Clint Mori*
Job Title: *Deputy Operations and Logistics Manager*
Contact Information: REDACTED

1. Project Driver

Please describe the primary objective and/or driver of the D&D work taking place that you are currently involved in. This may be timeframe, environmental risk, budgetary concerns, regulatory framework, worker safety, or otherwise.

D&D of facilities located at Y-12 have the potential risk of containing trace amounts of mercury contamination embedded in the debris that could be released (condensate) during temperature fluctuations once packaged in metal waste boxes or bulk containers for off-site disposition at NNSS. If enough mercury accumulates within a waste container, it could be detected by real-time radiography (RTR) upon acceptance at the NNSS disposal facility and result in a non-complaint package. This could lead to suspension of UCOR's NNSS certification program, causing delays in project schedule and productivity.

D&D Project Referenced: Primary focus on Y-12 facilities (i.e. Alpha 4)
Respondent's Position in Relation to D&D Project: Waste Management, packaging and transportation

2. Project Progress

Are there any specific instances of D&D work being hindered or enhanced by technological improvements or methodology? A specific objective of this project is to propagate useful technology or D&D techniques to other projects in the DOE complex.

The proposed technology requested is a risk mitigation for future D&D of buildings at Y-12 that are known to contain Hg contamination.

D&D Project Referenced: Primary focus on Y-12 facilities (i.e. Alpha 4)
Respondent's Position in Relation to D&D Project: Waste Management, packaging and transportation

3. Technological Application

Are any technological needs that may improve the results of your D&D project absent or not functioning? This may refer to currently existing, but unobtainable, technology, theoretical application of existing technology, or fully theoretical specialized equipment.

The technology desired is a product that can be used to fill void space within a waste container that is also capable of absorbing Hg vapors to prevent condensation. The product must be light-weight, compatible with the waste and other absorbents, and not toxic. The absorbent material must be able to chemically bond with the Hg vapor and not break down over time, releasing the contaminants. Mats

impregnated with absorbents placed inside the waste containers (on the top and bottom) that can catch mercury vapor and/or liquid mercury are also needed to prevent pooling of Hg and mitigate the risk of waste packages being rejected upon arrival at the offsite facility.

D&D Project Referenced: Primary focus on Y-12 facilities (i.e. Alpha 4)
Respondent's Position in Relation to D&D Project: *Support*

4. Worker Safety

Are there any barriers or significant risks to D&D worker safety that apply to the current D&D project that have or could impact the performance of this work? This could involve critical safety devices, D&D techniques in hazardous environments, or specific hazard controls related to each project.
The absorbent material must not be toxic to the workers or create a respiratory hazard (i.e. silica)

D&D Project Referenced: Primary focus on Y-12 facilities (i.e. Alpha 4)
Respondent's Position in Relation to D&D Project: *Support*

5. Regulatory Framework

What regulatory controls most affect this D&D project? Are there any significant instances of inter-agency priorities that affect this project? This may range from regulatory engagement, regulation clarity, conflicting regulation, or otherwise specified by the project team.
ROD's, ARAR's, Waste Acceptance Criteria for disposal facilities, Waste Handling Plans must be approvable by regulatory agencies

D&D Project Referenced: *All*
Respondent's Position in Relation to D&D Project: *Support*

6. Waste Disposition and Disposal

What issues exist that may affect project outcome that relate to waste processing on this project? This may refer to waste collection, storage, shipment, disposal facility requirements, or otherwise identified by the project team.
On-site disposal facilities are either limited on the acceptance of Land Disposal Restrictions (LDR) compliant waste that contained Hg contamination, or they do not accept Hg LDR compliant waste at all. This restriction may force UCOR to consider packaging and shipping all waste that has the potential for Hg contamination off-site. The Hg absorbent would be a risk mitigation to prevent the accumulation of Hg within waste containers caused by changes in environmental conditions.

D&D Project Referenced: Primary focus on Y-12 facilities (i.e. Alpha 4)
Respondent's Position in Relation to D&D Project: *Support*

7. Public Engagement

Does the D&D project require specific public engagement or hazard protection required for the successful conduct of this work?

None

D&D Project Referenced: *All*

Respondent's Position in Relation to D&D Project: *Support*

8. Cost Efficacy

Are there any technological or methodology improvements that could conceptually improve the performance of this D&D project?

The Hg absorbent needs to be cost effective and easily implementable.

D&D Project Referenced: Primary focus on Y-12 facilities (i.e. Alpha 4)

Respondent's Position in Relation to D&D Project: *Support*

9. Project Lifespan

What is the intended project lifespan and outcome of this D&D work? This may involve eventual public use of the property (with or without environmental restrictions), long term environmental monitoring, reuse of the land by the DOE, or otherwise as identified by the D&D project team.

Greater than 10 years.

D&D Project Referenced: *All*

Respondent's Position in Relation to D&D Project: *Support*

10. Research Possibilities

What areas or possibilities are available in this D&D project to deploy emerging technology? Are there any opportunities to test new research and technology related to D&D that may become available in the near future?

A current Hg absorbent product does not exist. Development of this project is requested.

D&D Project Referenced: Primary focus on Y-12 facilities (i.e. Alpha 4)

Respondent's Position in Relation to D&D Project: *Support*

11. Site Specific

What other issues have arisen during the current or previous phases of this D&D project that it is possible to improve? What lessons learned have the project team identified that may be useful to future D&D work on this or other projects?

Based on experience with decommissioning of facilities, porous debris has been known to leach Hg during temperature changes. Additionally, Hg has been detected within pipe scaling and presents a risk of accumulating during staging and transportation.

D&D Project Referenced: Primary focus on Y-12 facilities (i.e. Alpha 4)
Respondent's Position in Relation to D&D Project: *Support*

12. Open Ended

Please describe any other issues that may relate to D&D project work pertaining to technological or methodological improvements that are, or may be, possible and applicable. This initiative relies upon the expertise and insight of individuals who drive D&D work for the DOE and the expertise of the interview team to recommend or initiate research to aid them.

Respondent's Position in Relation to D&D Project: *Support*

Technical Need: *Mobile hot cell that can handle high-rad/air borne*

Respondent Information
Name: *Greg McGinnis*
Job Title: *Area Project Manager, ORNL D&D/Cleanup*
Contact Information: REDACTED

1. Project Driver

Please describe the primary objective and/or driver of the D&D work taking place that you are currently involved in. This may be timeframe, environmental risk, budgetary concerns, regulatory framework, worker safety, or otherwise.

To safely and cost effectively demolish obsolete legacy facilities to reduce environmental risk and reclaim the land for productive use in the continuing missions at ORNL and Y-12 at the Oak Ridge Reservation.

D&D Project Referenced: *All ORNL and Y-12 D&D projects*

Respondent's Position in Relation to D&D Project: *Project Management*

2. Project Progress

Are there any specific instances of D&D work being hindered or enhanced by technological improvements or methodology? A specific objective of this project is to propagate useful technology or D&D techniques to other projects in the DOE complex.

ORNL facilities are highly contaminated and possess large source terms of radiological materials. Isotope inventory is varied and the mix of isotopes can present challenges to D&D. A particular issue is open-air dismantling and package of highly contaminated wastes. Hot cell wastes will be generated during the facility deactivation and demolition phases. Current practice is to construct a ventilated plastic structure adjacent to work areas for contamination control and entomb high contamination/dose items in concrete prior to disposal.

D&D Project Referenced: *All ORNL D&D projects*
Respondent's Position in Relation to D&D Project: *Project Management*

3. Technological Application

Are any technological needs that may improve the results of your D&D project absent or not functioning? This may refer to currently existing, but unobtainable, technology, theoretical application of existing technology, or fully theoretical specialized equipment.

A single use portable hot cell that can be used for dismantlement and become the final disposal package for these waste is envisioned as a useful technology that can be applied. Robotic or remote application options for the hot cell is also desirable.

D&D Project Referenced: *All ORNL D&D projects*
Respondent's Position in Relation to D&D Project: *Project Management*

4. Worker Safety

Are there any barriers or significant risks to D&D worker safety that apply to the current D&D project that have or could impact the performance of this work? This could involve critical safety devices, D&D techniques in hazardous environments, or specific hazard controls related to each project.
Barriers/risks: Possible exposure limit exceedances, heavy reliance on respiratory protection, lack of accurate/complete process knowledge, lack of accurate/complete as-built documentation, unknown structural condition of facilities, lack of adequate space for material staging and support facilities near work area. Overcoming the challenges of finding acceptable COTS (commercial off the shelf) technologies ready for use at a DOE site.

D&D Project Referenced: *All ORNL D&D projects*
Respondent's Position in Relation to D&D Project: *Project Management*

5. Regulatory Framework

What regulatory controls most affect this D&D project? Are there any significant instances of inter-agency priorities that affect this project? This may range from regulatory engagement, regulation clarity, conflicting regulation, or otherwise specified by the project team.
Multiple ROD's, Consent Orders, Agreements and other enforceable documents that govern multiple aspects of the work, that are not always in agreement, or may be ambiguous, or may be overly restrictive, and may be interpreted differently by different parties and/or at different times and that may have long-lasting and possibly costly impacts.

D&D Project Referenced: *All ORNL and Y-12 D&D projects*
Respondent's Position in Relation to D&D Project: *Project Management*

6. Waste Disposition and Disposal

What issues exist that may affect project outcome that relate to waste processing on this project? This may refer to waste collection, storage, shipment, disposal facility requirements, or otherwise identified by the project team.
Materials of construction proposed for application to a single use hot cell will need to meet radiological, RCRA, and universal waste disposal requirement. An on-site CERCLA landfill is provided for the disposal of most demolition materials. Proposed materials would require evaluation against any acceptance/disposal requirements at the on-site facility. Other disposal options are available but not as desirable.

D&D Project Referenced: *All ORNL D&D projects*
Respondent's Position in Relation to D&D Project: *Project Management*

Public Engagement

Does the D&D project require specific public engagement or hazard protection required for the successful conduct of this work?
Follow established UCOR procedures and comply with ORNL or Y-12 site-specific requirements regarding public notifications, and EH&S requirements for surrounding public spaces and operating facilities.

D&D Project Referenced: *All ORNL and Y-12 D&D projects*
Respondent's Position in Relation to D&D Project: *Project Management*

7. Cost Efficacy

Are there any technological or methodology improvements that could conceptually improve the performance of this D&D project?
ORNL facilities are highly contaminated and possess large source terms of radiological materials. Isotope inventory is varied and the mix of isotopes can present challenges to D&D. Decontamination and demolition solutions that employ robotic or remote handling and/or operation will allow longer stay times in facilities and improve overall completion performance.

D&D Project Referenced: *All ORNL D&D projects*
Respondent's Position in Relation to D&D Project: *Project Management*

8. Project Lifespan

What is the intended project lifespan and outcome of this D&D work? This may involve eventual public use of the property (with or without environmental restrictions), long term environmental monitoring, reuse of the land by the DOE, or otherwise as identified by the D&D project team.
Greater than 10 years

D&D Project Referenced: *All ORNL and Y-12 D&D projects*
Respondent's Position in Relation to D&D Project: *Project Management*

9. Research Possibilities

What areas or possibilities are available in this D&D project to deploy emerging technology? Are there any opportunities to test new research and technology related to D&D that may become available in the near future?

If a disposable hot cell is not possible, a mobile hot cell to use for the various demolition projects at the ORNL site would be beneficial. Since many future projects are unknown, this could possibly be used at Y-12, too.

D&D Project Referenced: *All ORNL and Y-12 D&D projects*
Respondent's Position in Relation to D&D Project: *Project Management*

10. Site Specific

What other issues have arisen during the current or previous phases of this D&D project that it is possible to improve? What lessons learned have the project team identified that may be useful to future D&D work on this or other projects?

See question 12.

D&D Project Referenced: *All ORNL and Y-12 D&D projects*
Respondent's Position in Relation to D&D Project: *Project Management*

11. Open Ended

Please describe any other issues that may relate to D&D project work pertaining to technological or methodological improvements that are, or may be, possible and applicable. This initiative relies upon the expertise and insight of individuals who drive D&D work for the DOE and the expertise of the interview team to recommend or initiate research to aid them.

When developing possible technology solutions it is important to assemble a well-represented cross-functional team to better understand all aspects of the project need and the con-ops requirements that need to be incorporated into the design and deployment of the technology including, but not limited to: health and safety, nuclear and critical safety, what happens if/when the technology should fail in the field, specialized worker training/certification requirements, the time it takes to get the technology approved for use in the field, NRTL requirements for the technology, cyber security and IT considerations, spare parts availability, technology reliability, RAD hardening requirements, ability to decontaminate and reuse the technology for other projects, etc.

Respondent's Position in Relation to D&D Project: *Project Management*

Technical Need: *Better building/waste characterization (i.e., NDA) that doesn't require human exposure*

Respondent Information

Name: *Clint Mori*

Job Title: *Deputy Waste Operations and Logistics Manager*

Contact Information: REDACTED

1. Project Driver

Please describe the primary objective and/or driver of the D&D work taking place that you are currently involved in. This may be timeframe, environmental risk, budgetary concerns, regulatory framework, worker safety, or otherwise.

To safely and cost effectively demolish obsolete legacy facilities to reduce environmental risk and reclaim the land for productive use in the continuing missions at ORNL and Y-12 at the Oak Ridge Reservation.

D&D Project Referenced: *All D&D projects*

Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

2. Project Progress

Are there any specific instances of D&D work being hindered or enhanced by technological improvements or methodology? A specific objective of this project is to propagate useful technology or D&D techniques to other projects in the DOE complex.

ORNL facilities are highly contaminated and possess large source terms of radiological materials. Isotope inventory is varied and the mix of isotopes can present challenges to sampling and characterization. Similarly, Y-12 facilities have high levels of beryllium and mercury contamination. One of the main issues is personnel protection with regards to exposure during sampling and characterization. Currently, sampling can only be achieved by physical access to the facility and the environment being characterized. In facilities with high radiological dose or hazardous environments, this can put workers at risk.

D&D Project Referenced: *All D&D projects*

Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

3. Technological Application

Are any technological needs that may improve the results of your D&D project absent or not functioning? This may refer to currently existing, but unobtainable, technology, theoretical application of existing technology, or fully theoretical specialized equipment.

UCOR is seeking technology that can collect samplings from within facilities remotely to prevent human exposure to hazardous environments. An alternative technology would be remote devices that are capable of collecting data including, but not limited to, non-destructive assay on contaminants within a facility that can be used for characterization of that facility without putting personnel in hazardous atmospheres.

D&D Project Referenced: *All D&D projects*
Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

4. Worker Safety

Are there any barriers or significant risks to D&D worker safety that apply to the current D&D project that have or could impact the performance of this work? This could involve critical safety devices, D&D techniques in hazardous environments, or specific hazard controls related to each project.
Barriers/risks: Possible exposure limit exceedances, possible heat stress, heavy reliance on respiratory protection, lack of accurate/complete process knowledge, lack of accurate/complete as-built documentation, unknown structural condition of facilities, lack of adequate space for material staging and support facilities near work area. Overcoming the challenges of finding acceptable COTS technologies ready for use at a DOE site.

D&D Project Referenced: *All D&D projects*
Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

5. Regulatory Framework

What regulatory controls most affect this D&D project? Are there any significant instances of inter-agency priorities that affect this project? This may range from regulatory engagement, regulation clarity, conflicting regulation, or otherwise specified by the project team.
Sampling and characterization is driven by EPA guidance and Waste Acceptance Criteria requirements. Extensive sampling is required prior to deactivation and demolition of buildings. EPA and the Tennessee Department of Environment and Conservation (TDEC) must approve of sampling approach and results as well as the disposition of material determined by sampling and characterization efforts for onsite landfills.

D&D Project Referenced: *All D&D projects*
Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

6. Waste Disposition and Disposal

What issues exist that may affect project outcome that relate to waste processing on this project? This may refer to waste collection, storage, shipment, disposal facility requirements, or otherwise identified by the project team.
If remote characterization technology is pursued, it must be defensible and meet the regulatory requirements for sampling and analysis.

D&D Project Referenced: *All D&D projects*
Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

Public Engagement

Does the D&D project require specific public engagement or hazard protection required for the successful conduct of this work?
Follow established UCOR procedures and comply with ORNL or Y-12 site-specific requirements regarding public notifications, security, and EH&S requirements for surrounding public spaces and operating facilities.

D&D Project Referenced: *All D&D projects*
Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

7. Cost Efficacy

Are there any technological or methodology improvements that could conceptually improve the performance of this D&D project?
ORNL facilities are highly contaminated and possess large source terms of radiological materials and Y-12 facilities contain high levels of mercury and beryllium contamination. Isotope inventory is varied and the mix of isotopes can present challenges to sampling and characterization. Current methods require significant sampling that must be managed, packaged, and shipped off-site for analysis. The current method is costly, time-consuming, and limited by worker safety controls.

D&D Project Referenced: *All D&D projects*
Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

8. Project Lifespan

What is the intended project lifespan and outcome of this D&D work? This may involve eventual public use of the property (with or without environmental restrictions), long term environmental monitoring, reuse of the land by the DOE, or otherwise as identified by the D&D project team.
Greater than 10 years

D&D Project Referenced: *All D&D projects*
Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

9. Research Possibilities

What areas or possibilities are available in this D&D project to deploy emerging technology? Are there any opportunities to test new research and technology related to D&D that may become available in the near future?
UCOR is seeking technology that can collect samplings from within facilities remotely to prevent human exposure to hazardous environments. An alternative technology would be remote devices that are capable of collecting data including, but not limited to, non-destructive assay on contaminants within a facility that can be used for characterization of that facility without putting personnel in hazardous

atmospheres. Various types of samples are collected such as non-destructive assay, wipe, water, concrete cores, etc. during deactivation activities within a contaminated facility.

D&D Project Referenced: *All D&D projects*
Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

10. Site Specific

What other issues have arisen during the current or previous phases of this D&D project that it is possible to improve? What lessons learned have the project team identified that may be useful to future D&D work on this or other projects?

N/A

D&D Project Referenced: *All D&D projects*
Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

11. Open Ended

Please describe any other issues that may relate to D&D project work pertaining to technological or methodological improvements that are, or may be, possible and applicable. This initiative relies upon the expertise and insight of individuals who drive D&D work for the DOE and the expertise of the interview team to recommend or initiate research to aid them.

Data collected from remote technology must be dependable and defensible. Remote equipment will need configuration control and/or calibration to ensure accuracy of results.

Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

Technical Need: *Enhanced landfill liner that can absorb contaminants*

Respondent Information

Name: *Clint Mori*

Job Title: *Deputy Waste Operations and Logistics Manager*

Contact Information: REDACTED

1. Project Driver

Please describe the primary objective and/or driver of the D&D work taking place that you are currently involved in. This may be timeframe, environmental risk, budgetary concerns, regulatory framework, worker safety, or otherwise.

To ensure that LDR compliant debris from Hg contaminated facilities in the pending on-site landfill does not drive levels of mercury or other contaminants in the landfill wastewater above relevant AWQCs.

D&D Project Referenced: *On-site CERCLA Disposal Facility (EMDF)*

Respondent's Position in Relation to D&D Project: *Waste Operations*

2. Project Progress

Are there any specific instances of D&D work being hindered or enhanced by technological improvements or methodology? A specific objective of this project is to propagate useful technology or D&D techniques to other projects in the DOE complex.

The challenge to be mitigated involves ensuring that disposal of LDR compliant Hg contaminated debris in the on-site CERCLA disposal facility does not drive levels of mercury or other contaminants in the landfill wastewater above relevant AWQCs pending design and construction.

D&D Project Referenced: *On-site CERCLA Disposal Facility (EMDF)*

Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

3. Technological Application

Are any technological needs that may improve the results of your D&D project absent or not functioning? This may refer to currently existing, but unobtainable, technology, theoretical application of existing technology, or fully theoretical specialized equipment.

UCOR is seeking technology that involves geosynthetic liners that can be installed within the on-site CERCLA disposal facility, capable of absorbing Hg and other chemical contaminants and preventing them from entering the landfill leachate system.

D&D Project Referenced: *On-site CERCLA Disposal Facility (EMDF)*

Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

4. Worker Safety

Are there any barriers or significant risks to D&D worker safety that apply to the current D&D project that have or could impact the performance of this work? This could involve critical safety devices, D&D techniques in hazardous environments, or specific hazard controls related to each project.

None

D&D Project Referenced: *On-site CERCLA Disposal Facility (EMDF)*

Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

5. Regulatory Framework

What regulatory controls most affect this D&D project? Are there any significant instances of inter-agency priorities that affect this project? This may range from regulatory engagement, regulation clarity, conflicting regulation, or otherwise specified by the project team.

The on-site disposal facility must meet the design requirements of a RCRA Subtitle C landfill with a multi-liner system and leachate collection system. It must also be approved by EPA and TDEC.

D&D Project Referenced: *On-site CERCLA Disposal Facility (EMDF)*

Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

6. Waste Disposition and Disposal

What issues exist that may affect project outcome that relate to waste processing on this project? This may refer to waste collection, storage, shipment, disposal facility requirements, or otherwise identified by the project team.

The technology would be installed as part of the landfill leachate collection system.

D&D Project Referenced: *On-site CERCLA Disposal Facility (EMDF)*

Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

7. Public Engagement

Does the D&D project require specific public engagement or hazard protection required for the successful conduct of this work?

None

D&D Project Referenced: *On-site CERCLA Disposal Facility (EMDF)*

Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

8. Cost Efficacy

Are there any technological or methodology improvements that could conceptually improve the performance of this D&D project?

This type of liner technology does not currently exist within an operational CERCLA disposal facility.

D&D Project Referenced: *On-site CERCLA Disposal Facility (EMDF)*

Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

9. Project Lifespan

What is the intended project lifespan and outcome of this D&D work? This may involve eventual public use of the property (with or without environmental restrictions), long term environmental monitoring, reuse of the land by the DOE, or otherwise as identified by the D&D project team.

Greater than 10 years

D&D Project Referenced: *On-site CERCLA Disposal Facility (EMDF)*

Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

10. Research Possibilities

What areas or possibilities are available in this D&D project to deploy emerging technology? Are there any opportunities to test new research and technology related to D&D that may become available in the near future?

UCOR is seeking technology that involves geosynthetic liners that can be installed within the on-site CERCLA disposal facility, capable of absorbing Hg and other chemical contaminants and preventing them from entering the landfill leachate system.

D&D Project Referenced: *On-site CERCLA Disposal Facility (EMDF)*

Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

11. Site Specific

What other issues have arisen during the current or previous phases of this D&D project that it is possible to improve? What lessons learned have the project team identified that may be useful to future D&D work on this or other projects?
N/A

D&D Project Referenced: *On-site CERCLA Disposal Facility (EMDF)*
Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

12. Open Ended

Please describe any other issues that may relate to D&D project work pertaining to technological or methodological improvements that are, or may be, possible and applicable. This initiative relies upon the expertise and insight of individuals who drive D&D work for the DOE and the expertise of the interview team to recommend or initiate research to aid them.
The possibility of using similar technology to the makeup of the liner could be used subsurface to create a barrier or wall to prevent mercury and other contaminants from leaching to local streams during and following demolition activities.

Respondent's Position in Relation to D&D Project: *Waste sampling and characterization*

Technical Need: *Future beryllium cleanup*

Respondent Information

Name: *Robert Alred, OHST, SMS, ASP, CSP*

Job Title: *Safety and Health Operations Manager*

Contact Information: REDACTED

1. Project Driver

Please describe the primary objective and/or driver of the D&D work taking place that you are currently involved in. This may be timeframe, environmental risk, budgetary concerns, regulatory framework, worker safety, or otherwise.

Future beryllium cleanup (worker exposure, real-time detector/instrumentation to overcome the 3-day turnaround time (TAT), decontamination vs. waste disposition) is needed to free up space at Y-12 to allow for continuation of NNSA mission and mitigate environmental releases.

D&D Project Referenced: *Y-12 D&D Projects*

Respondent's Position in Relation to D&D Project: S&H Ops Manager

2. Project Progress

Are there any specific instances of D&D work being hindered or enhanced by technological improvements or methodology? A specific objective of this project is to propagate useful technology or D&D techniques to other projects in the DOE complex.

The Y-12 complex has facilities that are grossly contaminated with elemental beryllium dusts; however, the contamination associated with some facilities is more localized. It is imperative our D&D team characterize these areas accurately to prevent the spread of contamination and minimize worker exposure. Currently, our facility characterization process is to take air samples and surface smears across vast amounts of surface area to be sent to a choice of laboratories for analysis by the appropriate NIOSH and/or OSHA methodologies. Turnaround for these results ranges from three days to a week and may include thousands of smear samples at the conclusion of a campaign.

D&D Project Referenced: *Y-12 D&D Projects*

Respondent's Position in Relation to D&D Project: *S&H Ops Manager*

3. Technological Application

Are any technological needs that may improve the results of your D&D project absent or not functioning? This may refer to currently existing, but unobtainable, technology, theoretical application of existing technology, or fully theoretical specialized equipment.

The desire of the project is to obtain a handheld solution for initial characterization, i.e., spectroscopy or XRF, to help identify problem areas, minimize unnecessary decontamination efforts, reduce sample costs, and reduce delays while awaiting results.

D&D Project Referenced: *Y-12 D&D Projects*
Respondent's Position in Relation to D&D Project: S&H Ops Manager

4. Worker Safety

Are there any barriers or significant risks to D&D worker safety that apply to the current D&D project that have or could impact the performance of this work? This could involve critical safety devices, D&D techniques in hazardous environments, or specific hazard controls related to each project.

Heat stress is a major factor in our work, as workers perform duties in disposable coveralls, respirators, and other anti-contamination clothing, in temperatures that often exceed the work-rest cycles defined by ACGIH TLVs. Reducing characterization efforts drastically reduces exposure time to temperature extremes and contamination.

D&D Project Referenced: *Y-12 D&D Projects*
Respondent's Position in Relation to D&D Project: *S&H Ops Manager*

5. Regulatory Framework

What regulatory controls most affect this D&D project? Are there any significant instances of inter-agency priorities that affect this project? This may range from regulatory engagement, regulation clarity, conflicting regulation, or otherwise specified by the project team.

10 CFR Part 850, Chronic Beryllium Disease Prevention Program, is the governing regulation for our beryllium work, paired with the contractor's program containing conservative administrative action levels for air and surfaces.

D&D Project Referenced: *Y-12 D&D Projects*
Respondent's Position in Relation to D&D Project: *S&H Ops Manager*

6. Waste Disposition and Disposal

What issues exist that may affect project outcome that relate to waste processing on this project? This may refer to waste collection, storage, shipment, disposal facility requirements, or otherwise identified by the project team.

Facilities must be fully characterized to begin deactivation and demolition activities. Sampling that is approved by EPA and TDEC is necessary to meet requirements for on-site disposal. Sufficient and acceptable characterization is also needed for determination and acceptance at off-site disposal facilities.

D&D Project Referenced: *Y-12 D&D Projects*
Respondent's Position in Relation to D&D Project:

7. Public Engagement

Does the D&D project require specific public engagement or hazard protection required for the successful conduct of this work?

N/A

D&D Project Referenced:
Respondent's Position in Relation to D&D Project:

8. Cost Efficacy

Are there any technological or methodology improvements that could conceptually improve the performance of this D&D project?

The current methodology is very costly and time consuming. Shorter TAT not only provides greater protection to workers through less exposure time but also reduces cost of characterization efforts.

D&D Project Referenced: *Y-12 D&D Projects*
Respondent's Position in Relation to D&D Project: S&H Ops Manager

9. Project Lifespan

What is the intended project lifespan and outcome of this D&D work? This may involve eventual public use of the property (with or without environmental restrictions), long term environmental monitoring, reuse of the land by the DOE, or otherwise as identified by the D&D project team.

Greater than 10 years.

D&D Project Referenced: *Y-12 D&D Projects*
Respondent's Position in Relation to D&D Project: S&H Ops Manager

10. Research Possibilities

What areas or possibilities are available in this D&D project to deploy emerging technology? Are there any opportunities to test new research and technology related to D&D that may become available in the near future?

The desire of the project is to obtain a handheld solution for initial characterization, i.e., spectroscopy or XRF.

D&D Project Referenced: *Y-12 D&D Projects*

Respondent's Position in Relation to D&D Project: S&H Ops Manager

11. Site Specific

What other issues have arisen during the current or previous phases of this D&D project that it is possible to improve? What lessons learned have the project team identified that may be useful to future D&D work on this or other projects?

N/A

D&D Project Referenced:

Respondent's Position in Relation to D&D Project:

12. Open Ended

Please describe any other issues that may relate to D&D project work pertaining to technological or methodological improvements that are, or may be, possible and applicable. This initiative relies upon the expertise and insight of individuals who drive D&D work for the DOE and the expertise of the interview team to recommend or initiate research to aid them.

N/A

Respondent's Position in Relation to D&D Project:

Technical Need: *Future mercury D&D cleanup*
Respondent Information
Name: *Chad York*

Job Title: *Area Project Manager Y-12 D&D Enterprise*

Contact Information: REDACTED

1. Project Driver

Please describe the primary objective and/or driver of the D&D work taking place that you are currently involved in. This may be timeframe, environmental risk, budgetary concerns, regulatory framework, worker safety, or otherwise.
Demolish obsolete legacy facilities to reduce environmental risk and provide land for future missions at Y-12 Oak Ridge Reservation. Worker Safety in achieving this mission is paramount, these legacy facilities have systems and components that still contain liquid mercury. Over the past decades spills and releases have occurred in the facilities and mercury not only resides in piping systems, but also pits, vaults, walls, and numerous locations in the facilities. Mercury vapors continue to be an issue in these facilities, specifically during the summer months when temperatures in the buildings increase.

OVERALL FEEDBACK ON DEPLOYMENT OF TD IN THE FIELD AND REGULATORY ACCEPTANCE

D&D Project Referenced: *Y-12 D&D Projects*
Respondent's Position in Relation to D&D Project: *Area Project Manager*

2. Project Progress

Are there any specific instances of D&D work being hindered or enhanced by technological improvements or methodology? A specific objective of this project is to propagate useful technology or D&D techniques to other projects in the DOE complex.
Engineering controls related to ventilation, air movement, and portable AC units are being applied.

D&D Project Referenced: *Y-12 D&D Projects*

Respondent's Position in Relation to D&D Project: *Area Project Manager*

3. Technological Application

Are any technological needs that may improve the results of your D&D project absent or not functioning? This may refer to currently existing, but unobtainable, technology, theoretical application of existing technology, or fully theoretical specialized equipment.

Any technology related to mitigating mercury vapors would be beneficial. Any technologies related to mercury disposal would be beneficial.

D&D Project Referenced: *Y-12 D&D Projects*

Respondent's Position in Relation to D&D Project: *Area Project Manager*

4. Worker Safety

Are there any barriers or significant risks to D&D worker safety that apply to the current D&D project that have or could impact the performance of this work? This could involve critical safety devices, D&D techniques in hazardous environments, or specific hazard controls related to each project.

The biggest issue on performance of our work scope at Y-12 is the mercury vapor mitigation. In the summer months it is difficult to perform work throughout the work shift without introducing stay times and throughout certain warmer conditions this even causes a stop work due to Hg vapor concentrations exceeding our acceptable limits established by industrial hygiene. We have introduced a variety of engineering controls to help try reducing our background concentrations along with administrative controls and PPE, however, with all those applicable controls we still continue to pause work throughout our work shift due to vapor concentrations exceeding 0.750 mg/m3 for 15 minutes for no more than 4 times spaced an hour apart per shift. With our instrumentation upper limit of detection being 0.999 mg/m3 we cap our work schedule based around those specific numbers. Once we hit 0.900 mg/m3 we are done for the day due to not being able to readily detect the Hg vapors and assuring we are below IDLH atmospheres out of extreme caution and conservatism.

D&D Project Referenced: *Y-12 D&D Projects*

Respondent's Position in Relation to D&D Project: *Area Project Manager*

5. Regulatory Framework

What regulatory controls most affect this D&D project? Are there any significant instances of inter-agency priorities that affect this project? This may range from regulatory engagement, regulation clarity, conflicting regulation, or otherwise specified by the project team.

Multiple ROD's, Consent Orders, Agreements and other enforceable documents that govern multiple aspects of the work, that are not always in agreement, or may be ambiguous, or may be overly restrictive, and may be interpreted differently by different parties and/or at different times and that may have long-lasting and possibly costly impacts.

D&D Project Referenced: *Y-12 D&D Projects*

Respondent's Position in Relation to D&D Project: *Area Project Manager*

6. Waste Disposition and Disposal

What issues exist that may affect project outcome that relate to waste processing on this project? This may refer to waste collection, storage, shipment, disposal facility requirements, or otherwise identified by the project team.

Visible elemental mercury requires treatment and disposal, which can be costly. Mercury contaminated components require extraction or separation of mercury prior to packaging which is time consuming and costly. Cleaned mercury components packaged for shipment depending on temperatures and handling may produce free visible mercury when arriving at disposal facility and can violate Waste Acceptance Criteria.

D&D Project Referenced: *Y-12 D&D Projects*

Respondent's Position in Relation to D&D Project: *Area Project Manager*

7. Public Engagement

Does the D&D project require specific public engagement or hazard protection required for the successful conduct of this work?

Mercury vapors are monitored exterior of these facilities and would not reach the public.

D&D Project Referenced: *Y-12 D&D Projects*
Respondent's Position in Relation to D&D Project:

8. Cost Efficacy

Are there any technological or methodology improvements that could conceptually improve the performance of this D&D project?
Please see responses to earlier questions.

D&D Project Referenced: *Y-12 D&D Projects*
Respondent's Position in Relation to D&D Project:

9. Project Lifespan

What is the intended project lifespan and outcome of this D&D work? This may involve eventual public use of the property (with or without environmental restrictions), long term environmental monitoring, reuse of the land by the DOE, or otherwise as identified by the D&D project team.
Greater than 10 years.

D&D Project Referenced: *Y-12 D&D Projects*
Respondent's Position in Relation to D&D Project:

10. Research Possibilities

What areas or possibilities are available in this D&D project to deploy emerging technology? Are there any opportunities to test new research and technology related to D&D that may become available in the near future?
Please see responses to earlier questions. There are several opportunities to explore emerging technologies, provided there is cost assistance.

D&D Project Referenced: *Y-12 D&D Projects*
Respondent's Position in Relation to D&D Project:

11. Site Specific

What other issues have arisen during the current or previous phases of this D&D project that it is possible to improve? What lessons learned have the project team identified that may be useful to future D&D work on this or other projects?

N/A

D&D Project Referenced:
Respondent's Position in Relation to D&D Project:

12. Open Ended

Please describe any other issues that may relate to D&D project work pertaining to technological or methodological improvements that are, or may be, possible and applicable. This initiative relies upon the expertise and insight of individuals who drive D&D work for the DOE and the expertise of the interview team to recommend or initiate research to aid them.

N/A

Respondent's Position in Relation to D&D Project:

Technical Need: *Future mercury soil/groundwater cleanup*

Respondent Information

Name: *Julie Pfeffer*

Job Title: *Cleanup Enterprise Regulatory Documentation and Planning*

Contact Information: REDACTED

1. Project Driver

Please describe the primary objective and/or driver of the D&D work taking place that you are currently involved in. This may be timeframe, environmental risk, budgetary concerns, regulatory framework, worker safety, or otherwise.

Soil remediation supports both the demolition effort (soil encountered during utility isolation, for instance) or the final site restoration. This work is being conducted under a CERCLA ROD. At Y-12, the presence of mercury in soil introduces some challenges. At ORNL and Y-12, there are numerous radionuclides also in the soil along with PCBs and solvents.

D&D Project Referenced: *Y-12 and ORNL*

Respondent's Position in Relation to D&D Project:

2. Project Progress

Are there any specific instances of D&D work being hindered or enhanced by technological improvements or methodology? A specific objective of this project is to propagate useful technology or D&D techniques to other projects in the DOE complex.

With respect to remediation of any of the contaminants found in soil at Y-12 and ORNL, there are no technological improvements currently in use. The primary planned efforts are excavation, characterization, and disposal.

D&D Project Referenced: *Y-12 and ORNL*

Respondent's Position in Relation to D&D Project:

3. Technological Application

Are any technological needs that may improve the results of your D&D project absent or not functioning? This may refer to currently existing, but unobtainable, technology, theoretical application of existing technology, or fully theoretical specialized equipment.

Need either technologies that enhance the effectiveness of mercury soil excavation (currently, mercury beads will move in front of excavator bucket) or can be used to fix mobile contamination insitu. The insitu contamination fixation can be used to immobilize contamination in place or as it moves through a barrier system. Some of the most mobile contaminants at Y-12 are solvents and at ORNL are solvents and Sr-90. There are some instances of uranium and mercury moving through the subsurface. Reducing the mobility so the contamination does not travel to adjacent surface water and/or groundwater would be helpful. However, technologies that either destroy the contaminant (in the case of solvents) or that improve the effectiveness of excavation may be preferable as then contamination is completely removed

from the environment allowing for reuse of the area without introducing disposal challenges associated with spoils generated during future construction efforts.

D&D Project Referenced: *Y-12 and ORNL*
Respondent's Position in Relation to D&D Project:

4. Worker Safety

Are there any barriers or significant risks to D&D worker safety that apply to the current D&D project that have or could impact the performance of this work? This could involve critical safety devices, D&D techniques in hazardous environments, or specific hazard controls related to each project.

Mercury vapors are the primary worker risk issue. However, in the soil environment, buildup of vapors happens to a less degree than work in a building. Some vapors can be an issue though in more confined space environments such as in trenches or pits.

D&D Project Referenced: *Y-12 and ORNL*
Respondent's Position in Relation to D&D Project:

5. Regulatory Framework

What regulatory controls most affect this D&D project? Are there any significant instances of inter-agency priorities that affect this project? This may range from regulatory engagement, regulation clarity, conflicting regulation, or otherwise specified by the project team.

The project is controlled under CERCLA through the implementation of signed RODs. The primary issue is competing priorities for work; however, there are no specific regulatory issues.

D&D Project Referenced: *Y-12 and ORNL*
Respondent's Position in Relation to D&D Project:

6. Waste Disposition and Disposal

What issues exist that may affect project outcome that relate to waste processing on this project? This may refer to waste collection, storage, shipment, disposal facility requirements, or otherwise identified by the project team.

The reformation of liquid mercury from mercury vapors in a disposal container is the most significant waste disposal issue. The various disposal locations have limitations on what liquid mercury is acceptable and unplanned liquids generally results in either the load being rejected or additional handling at the disposal location (and therefore, costs). Another area for improvements surrounds anomaly detection. Techniques to more easily identify waste that is outside the accepted profile would add value. These could include scanning techniques or field measurement techniques. Some of the existing scanning and field measurement techniques do not have sufficient accuracy to be used to

identify anomalous waste.

D&D Project Referenced: *Y-12 and ORNL*
Respondent's Position in Relation to D&D Project:

7. Public Engagement

Does the D&D project require specific public engagement or hazard protection required for the successful conduct of this work?
Minimal public engagement is required after the ROD has been signed. All work is sufficient distance from the public that no hazard protection is needed.

D&D Project Referenced: *Y-12 and ORNL*
Respondent's Position in Relation to D&D Project:

8. Cost Efficacy

Are there any technological or methodology improvements that could conceptually improve the performance of this D&D project?
Please see earlier responses. There are cost improvements associated with efficiencies.

D&D Project Referenced: *Y-12 and ORNL*
Respondent's Position in Relation to D&D Project:

9. Project Lifespan

What is the intended project lifespan and outcome of this D&D work? This may involve eventual public use of the property (with or without environmental restrictions), long term environmental monitoring, reuse of the land by the DOE, or otherwise as identified by the D&D project team.
The land will be reused by the current government contractors. There is no plan to release this land to the public. The need for mercury soil remediation will continue for many decades as portions of the Y-12 and ORNL plant become available for remediation and construction.

D&D Project Referenced: *Y-12 and ORNL*

Respondent's Position in Relation to D&D Project:

10. Research Possibilities

What areas or possibilities are available in this D&D project to deploy emerging technology? Are there any opportunities to test new research and technology related to D&D that may become available in the near future?

Please see responses to earlier questions. There are several opportunities to explore emerging technologies, provided there is cost assistance.

D&D Project Referenced: *Y-12 and ORNL*

Respondent's Position in Relation to D&D Project:

11. Site Specific

What other issues have arisen during the current or previous phases of this D&D project that it is possible to improve? What lessons learned have the project team identified that may be useful to future D&D work on this or other projects?

Nothing beyond what has already been shared.

D&D Project Referenced:

Respondent's Position in Relation to D&D Project:

12. Open Ended

Please describe any other issues that may relate to D&D project work pertaining to technological or methodological improvements that are, or may be, possible and applicable. This initiative relies upon the expertise and insight of individuals who drive D&D work for the DOE and the expertise of the interview team to recommend or initiate research to aid them.

N/A

Respondent's Position in Relation to D&D Project:

Technical Need: C*hallenges given high-rad, beryllium, etc. & disposition pathway for any TD solutions*

Respondent Information

Name: *Greg McGinnis*

Job Title: *Area Project Manager, ORNL D&D/Cleanup*

Contact Information: REDACTED

1. Project Driver

Please describe the primary objective and/or driver of the D&D work taking place that you are currently involved in. This may be timeframe, environmental risk, budgetary concerns, regulatory framework, worker safety, or otherwise.

To safely and cost effectively demolish obsolete legacy facilities to reduce environmental risk and reclaim the land for productive use in the continuing missions at ORNL and Y-12 at the Oak Ridge Reservation.

D&D Project Referenced: *All ORNL and Y-12 D&D projects*

Respondent's Position in Relation to D&D Project: *Project Management*

2. Project Progress

Are there any specific instances of D&D work being hindered or enhanced by technological improvements or methodology? A specific objective of this project is to propagate useful technology or D&D techniques to other projects in the DOE complex.

ORNL facilities are highly contaminated and possess large source terms of radiological materials. Isotope inventory is varied and the mix of isotopes can present challenges to D&D. A particular issue is open-air demolition of highly contaminated facilities, which are located at both ORNL and Y-12. Decontamination and source term removal is performed to the extent practical to prevent contamination spread during demolition. An aggressive/effective decontamination method followed by a highly adherent/dust suppressing fixing agent for contaminants such as radiological, beryllium, etc. would be a benefit for open-air demolition, confined spaces and high elevations.

D&D Project Referenced: *All ORNL and Y-12 D&D projects*

Respondent's Position in Relation to D&D Project: *Project Management*

3. Technological Application

Are any technological needs that may improve the results of your D&D project absent or not functioning? This may refer to currently existing, but unobtainable, technology, theoretical application of existing technology, or fully theoretical specialized equipment.

Effective decontamination methods/fixative materials are available for use. Agents specifically formulated or designed for the removal and dust suppression of contaminated materials are of interest. Robotic or remote application options for these materials is also desirable.

D&D Project Referenced: *All ORNL and Y-12 D&D projects*
Respondent's Position in Relation to D&D Project: *Project Management*

4. Worker Safety

Are there any barriers or significant risks to D&D worker safety that apply to the current D&D project that have or could impact the performance of this work? This could involve critical safety devices, D&D techniques in hazardous environments, or specific hazard controls related to each project.
Barriers/risks: Possible exposure limit exceedances, possible heat stress, heavy reliance on respiratory protection, lack of accurate/complete process knowledge, lack of accurate/complete as-built documentation, unknown structural condition of facilities, lack of adequate space for material staging and support facilities near work area. Overcoming the challenges of finding acceptable COTS technologies ready for use at a DOE site.

D&D Project Referenced: *All ORNL and Y-12 D&D projects*
Respondent's Position in Relation to D&D Project: *Project Management*

5. Regulatory Framework

What regulatory controls most affect this D&D project? Are there any significant instances of inter-agency priorities that affect this project? This may range from regulatory engagement, regulation clarity, conflicting regulation, or otherwise specified by the project team.
Multiple ROD's, Consent Orders, Agreements and other enforceable documents that govern multiple aspects of the work, that are not always in agreement, or may be ambiguous, or may be overly restrictive, and may be interpreted differently by different parties and/or at different times and that may have long-lasting and possibly costly impacts.

D&D Project Referenced: *All ORNL and Y-12 D&D projects*
Respondent's Position in Relation to D&D Project: *Project Management*

6. Waste Disposition and Disposal

What issues exist that may affect project outcome that relate to waste processing on this project? This may refer to waste collection, storage, shipment, disposal facility requirements, or otherwise identified by the project team.
Specific decon/fixing agents proposed for use in decontamination and open-air demolition will need to meet radiological, RCRA, and universal waste disposal requirements. An on-site CERCLA landfill is provided for the disposal of most demolition materials. Proposed materials would require evaluation against any acceptance/disposal requirements at the on-site facility. Other disposal options are available but not as desirable.

D&D Project Referenced: *All ORNL and Y-12 D&D projects*
Respondent's Position in Relation to D&D Project: *Project Management*

7. Public Engagement

Does the D&D project require specific public engagement or hazard protection required for the successful conduct of this work?

Follow established UCOR procedures and comply with ORNL or Y-12 site-specific requirements regarding public notifications, and EH&S requirements for surrounding public spaces and operating facilities.

D&D Project Referenced: *All ORNL and Y-12 D&D projects*

Respondent's Position in Relation to D&D Project: *Project Management*

8. Cost Efficacy

Are there any technological or methodology improvements that could conceptually improve the performance of this D&D project?

ORNL facilities are highly contaminated and possess large source terms of radiological materials. Similarly, Y-12 facilities have high levels of beryllium and mercury contamination. Isotope inventory is varied and the mix of isotopes can present challenges to D&D. Decontamination and demolition solutions that employ robotic or remote handling and/or operation will allow longer stay times in facilities and improve overall completion performance.

D&D Project Referenced: *All ORNL and Y-12 D&D projects*

Respondent's Position in Relation to D&D Project: *Project Management*

9. Project Lifespan

What is the intended project lifespan and outcome of this D&D work? This may involve eventual public use of the property (with or without environmental restrictions), long term environmental monitoring, reuse of the land by the DOE, or otherwise as identified by the D&D project team.

Greater than 10 years

D&D Project Referenced: *All ORNL and Y-12 D&D projects*

Respondent's Position in Relation to D&D Project: *Project Management*

10. Research Possibilities

What areas or possibilities are available in this D&D project to deploy emerging technology? Are there any opportunities to test new research and technology related to D&D that may become available in the near future?

Testing technology onsite can be made possible.

D&D Project Referenced: *All ORNL and Y-12 D&D projects*

Respondent's Position in Relation to D&D Project: *Project Management*

11. Site Specific

What other issues have arisen during the current or previous phases of this D&D project that it is possible to improve? What lessons learned have the project team identified that may be useful to future D&D work on this or other projects?

See question 12.

D&D Project Referenced: *All ORNL and Y-12 D&D projects*

Respondent's Position in Relation to D&D Project: *Project Management*

12. Open Ended

Please describe any other issues that may relate to D&D project work pertaining to technological or methodological improvements that are, or may be, possible and applicable. This initiative relies upon the expertise and insight of individuals who drive D&D work for the DOE and the expertise of the interview team to recommend or initiate research to aid them.

When developing possible technology solutions it is important to assemble a well-represented cross-functional team to better understand all aspects of the project need and the con-ops requirements that need to be incorporated into the design and deployment of the technology including, but not limited to: health and safety, nuclear and critical safety, what happens if/when the technology should fail in the field, specialized worker training/certification requirements, the time it takes to get the technology approved for use in the field, NRTL requirements for the technology, cyber security and IT considerations, spare parts availability, technology reliability, RAD hardening requirements, ability to decontaminate and reuse the technology for other projects, etc.

Respondent's Position in Relation to D&D Project: *Project Management*

Appendix B.

B.1 D&D Roadmap Assessment Categories and Criteria

D&D Roadmap Assessment Categories and Criteria

Category 1

D&D Stage

1.) Deactivation

2.) Long Term Storage

3.) Decommissioning

Category 2

Needs Timeline

1.) Near Future

2.) Current

3.) Near Past

Category 3

Needs Driver

1.) Project Cost

2.) Project Schedule

3.) Project Efficiency

4.) Safety Risk

Category 4

Project Impact Level

1.) High

2.) Medium

3.) Low

Category 5

Challenge Type

1.) Contaminant Type

2.) Contaminant Control

3.) Security and Maintenance

4.) Worker Safety

5.) Waste Processing

6.) Characterization

7.) Accessability

8.) Project Management

Category 6

Technology Type

1.) Modelling

2.) Non-Destructive Assay

3.) Sample Collection

4.) Robtoic/Remote Applications

5.) Fixatives and Coatings

6.) Decay and Byproduct Control

7.) Grout and Entombment

8.) Contaminant Collection/Removal

9.) Personal Protective Equipment

10.) Exposure Monitoring

11.) Waste Preparation

12.) Waste Treatment

13.) Waste Shipment and Disposal

14.) Interim Waste Storage

15.) Artificial Intelligence

B.2 D&D Roadmap Assessment of Oak Ridge Questionnaire Responses

D&D Roadmap Assessment of Oak Ridge Questionnaire Responses

OR - Y12 - 1: Mercury Treatment and Control		
Chosen Questionnaire Response	**Assessment Category**	**Assessment Criteria**
D&D of facilities located at Y-12 have the potential risk of containing trace amounts of mercury contamination embedded in the debris that could be released (condensate) during temperature fluctuations once packaged in metal waste boxes or bulk containers for off-site disposition at NNSS. If enough mercury accumulates within a waste container, it could be detected by real-time radiography (RTR) upon acceptance at the NNSS disposal facility and result in a non-complaint package. This could lead to suspension of UCOR's NNSS certification program, causing delays in project schedule and productivity.	Stage	3
	Timeline	1
	Driver	2
	Impact	1
	Challenge	2,5
	Technology	11,13

OR - Y12 - 2: Mercury Vapor Management		
Chosen Questionnaire Response	**Assessment Category**	**Assessment Criteria**
Any technology related to mitigating mercury vapors would be beneficial. Any technologies related to mercury disposal would be beneficial.	Stage	3
	Timeline	1,2,3
	Driver	2,4
	Impact	1
	Challenge	2,4
	Technology	8,9

OR - Y12 - 3: Remote or Non-Laboratory Characterization		
Chosen Questionnaire Response	**Assessment Category**	**Assessment Criteria**
The desire of the project is to obtain a handheld solution for initial characterization, i.e., spectroscopy or XRF, to help identify problem areas, minimize unnecessary decontamination efforts, reduce sample costs, and reduce delays while awaiting results.	Stage	3
	Timeline	1,2
	Driver	2
	Impact	2
	Challenge	6
	Technology	2,3

OR - ORNL - 4: Robotic/Remote Applications		
Chosen Questionnaire Response	**Assessment Category**	**Assessment Criteria**
ORNL facilities are highly contaminated and possess large source terms of radiological materials. Isotope inventory is varied and the mix of isotopes can present challenges to D&D. Decontamination and demolition solutions that employ robotic or remote handling and/or operation will allow longer stay times in facilities and improve overall completion performance.	**Stage**	**1,3**
	Timeline	**1,2**
	Driver	**2,4**
	Impact	**2**
	Challenge	**4,7**
	Technology	**4,11**

OR - ORNL - 5: Decontamination and Dust Control		
Chosen Questionnaire Response	**Assessment Category**	**Assessment Criteria**
ORNL facilities are highly contaminated and possess large source terms of radiological materials. Isotope inventory is varied and the mix of isotopes can present challenges to D&D. A particular issue is open-air demolition of highly contaminated facilities, which are located at both ORNL and Y-12. Decontamination and source term removal is performed to the extent practical to prevent contamination spread during demolition. An aggressive/effective decontamination method followed by a highly adherent/dust suppressing fixing agent for contaminants such as radiological, beryllium, etc. would be a benefit for open-air demolition, confined spaces and high elevations.	**Stage**	**3**
	Timeline	**1**
	Driver	**2,4**
	Impact	**2**
	Challenge	**2,4**
	Technology	**5,11**

OR - ORNL - 6: Portable Hot Cell		
Chosen Questionnaire Response	**Assessment Category**	**Assessment Criteria**
A single use portable hot cell that can be used for dismantlement and become the final disposal package for these waste is envisioned as a useful technology that can be applied. Robotic or remote application options for the hot cell is also desirable.	**Stage**	**3**
	Timeline	**1,2**
	Driver	**2,4**
	Impact	**2**
	Challenge	**2,4,5**
	Technology	**4,8,11**

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