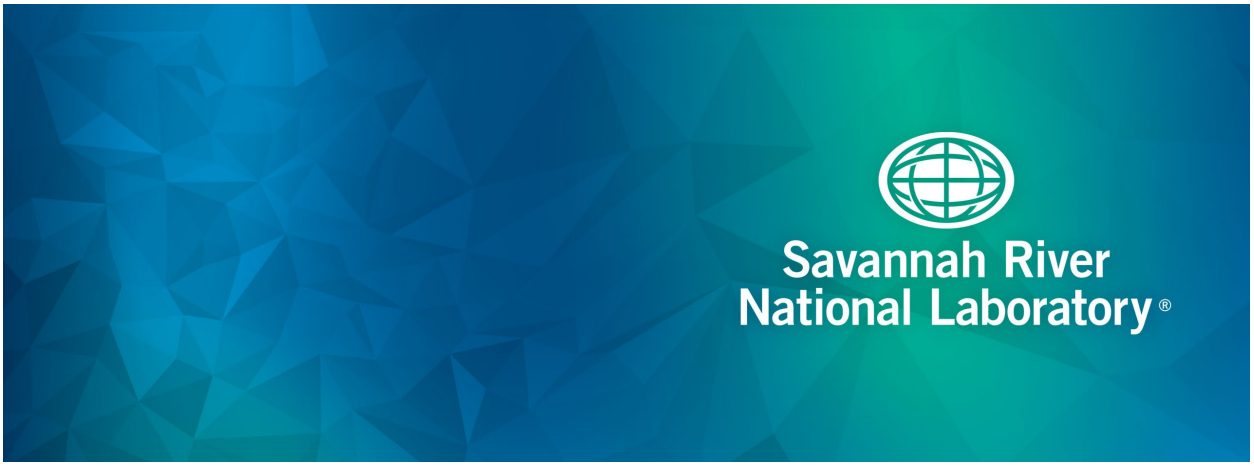

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Savannah River Deactivation and Decommissioning Roadmap Interview Summary Report

Evan Koelker

May 2025

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In addition, the authors wish to extend gratitude to the D&D teams that were interviewed for sharing their knowledge, the DOE Site Liaisons for their logistical assistance in contacting these D&D teams, and members of Network of National Laboratories for Environmental Management and Stewardship (NNLEMS) for facilitation of communications.

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 Savannah River Site (SRS). The specific D&D project referenced during the Roadmap assessment at the SRS is the D&D work conducted at the 235-F facility.

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List of Abbreviations

ABL	Actinide Billet Line
ACP	Area Completion Projects
ARF	Airborne Release Fraction
D&D	Deactivation and Decommissioning
DOE	Department of Energy
DNSFB	Defense Nuclear Facilities Safety Board
EM	Environmental Management
EPA	Environmental Protection Agency
FAMS	F-Area Material Storage
FIU	Florida International University
ISD	In-situ Decommissioning
LTS	Long Term Storage
LTSS	Long Term Safe Storage
NASA	National Aeronautics and Space Administration
NNLEMS	Network of National Laboratories for Environmental Management and Stewardship
NTC	Non-Time Critical
PuFF	Plutonium Fuel Form
RF	Respirable Fraction
R&D	Research and Development
SCDES	South Carolina Department of Environmental Services
SME	Subject Matter Expert
SRNL	Savannah River National Laboratory
SRS	Savannah River Site
TD	Technology Development
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 from through 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 SRS 235-F facility D&D project.

2.0 SRS 235-F Background and Planned D&D Strategy

F-Area Material Storage (FAMS) building (235-F), hereafter referred to as Building 235-F, is a windowless, two-story, reinforced-concrete structure located in F-Area near the center of SRS (Figure 1). Building 235-F is designated a Hazard Category 2 nonreactor nuclear facility according to DOE STD-1027-92 (SRNS-RP-2020-00444). Building 235-F exists within an array of ancillary support buildings, other nuclear facilities, and standard industrial buildings. Building 235-F is approximately 68 m (222 ft) long, 33 m (109ft) wide, and 8.5 m (28ft) high and has a footprint of approximately 2230 square meters (m^2) (24,000 square ft [ft^2]). Its basic construction consists of slab on grade, reinforced, concrete with 20 cm (14 in) thick reinforced exterior concrete walls and a flat concrete roof supported by concrete beam and girder systems.

Building 235-F was constructed in the 1950s and has since been used for a variety of missions. In the mid- to late 1960s, Building 235-F began to house the Special Products Fabrication Facility (SPFF) that supported processing of uranium-238, neptunium-237, and plutonium-239 oxide to produce actinide-bearing materials for irradiation target components. In the mid-1970s, the SPFF was decontaminated and decommissioned and the building was reconfigured to support the Actinide Billet Line (ABL) and Plutonium Fuel Form (PuFF) Facility. These facilities produced heat sources from Pu-238 powder for the National Aeronautics and Space Administration (NASA) program. All metallurgical processes within Building 235-F were shut down by 1991. All other missions regarding Building 235-F, excluding D&D, were ended by 2006. All special nuclear materials, except radiological holdup, were removed and Building 235-F began to be prepared for Long Term Safe Storage (LTSS). Deactivation continued with removal of as much nuclear material as possible until June 2019. In July 2019, the DOE instructed removal proceedings to cease, and that facility operations were to proceed with the establishment of a deactivation end state for a “Cold and Dark Transition Surveillance and Maintenance Facility”. In October 2019, the US EPA and South Carolina Department of Environmental Services (SCDES) agreed that the potential for contaminate release within 10,000 years could be mitigated by in-situ decommissioning (ISD) of Building 235-F. Currently, nearly all gloveboxes, radiohoods, radiobenches, and contaminated labs have been fully deactivated.

Four Non-Time Critical (NTC) Removal Action Alternatives were proposed for Building 235-F. The four NTC options included, no action, two ISD alternatives, and a complete building removal alternative. ISD alternatives were determined to meet contaminant migration removal action objectives to prevent the migration of radionuclide contamination from Building 235-F to

groundwater that exceed Maximum Contaminant Levels (MCLs) at varying points of assessment over a time scale of 10,000 years.

ISD options include the permanent grout entombment of varying combinations of process equipment, gloveboxes and radiohoods, and potentially entire floors of Building 235-F. Additionally, a new engineered roof over the facility would be designed and installed to shield the building from the elements. The full design process for ISD of Building 235-F was scheduled to begin in 2025 and decommissioning scheduled for 2027. Currently the D&D work driver is not regulatory and is based upon the Defense Nuclear Facilities Safety Board's (DNSFB) interest in risk reduction at legacy nuclear facilities.

2.1 Figures

Figure 1. Building 235-F – Savannah River Site (SRNS-RP-2020-00444).

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 SRS, Building 235-F, personnel are presented in Appendix A.

The responses received from a completed questionnaire 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

3.1 235-F Roadmap Response Assessment

The Roadmap Team initiated the questionnaire process with the D&D project team overseeing Building 235-F prior to a full interview process. Responses to the questionnaire were received on June 7, 2024. In total, six respondents provided completed questionnaires for assessment by the Roadmap Team. Respondents included two D&D Project Engineers, the related Chief Engineer, Building 235-F D&D Project Manager, one D&D SME associated with the Building 235-F project, and the overseeing Federal Project Director. Of the 72 total questions (12 questions per questionnaire as completed by 6 respondents) 56 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 of Building 235-F. 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.

At the time of this Roadmap initiative Building 235-F D&D was found to be in transition. Deactivation of interior components was complete and planning for building in-situ decommissioning was slated to begin in 2025. As a result, responses to the questionnaire covered topics pertaining to technological needs related to both deactivation and decommissioning. Four primary areas of interest were identified during assessment of questionnaire responses.

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.: SRS – 235F – 1). Where more general topics are covered, a designation of “Misc.” is used instead of a specific project building (ex.: SRS – Misc. – 2).

The topics related to technical needs identified by the SRS 235-F team, and their assessment by the D&D Roadmap Team include:

- Real time waste characterization and segregation – During the questionnaire and interview process with the Building 235-F D&D team, the technology need related to improved waste characterization was discussed. Waste characterization is performed to determine the proper segregation of waste streams. This is a critical process for any project generated waste that must be disposed of in a designated area, facility, burial ground, or recycling facility both on and off the premises of a project site. Characterization of waste is performed primarily by chemical analysis by a certified laboratory, which produces analytical data that is used to determine the presence and concentration of specific contaminants or hazardous materials. In turn, this analytical data is used to determine what waste acceptance criteria (WAC) can be used for the disposal of a waste stream.

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. Many thousands of samples may be collected for this purpose. Should waste be characterized incorrectly, acceptance criteria for a chosen waste disposal facility may be violated incurring 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 high consequences for errors. A reliable form of characterization, that can be performed by D&D teams in the field to reduce the number of analytical samples is needed.

Technology criteria found that applied to this area of interest are:

1. SRS – 235F – 1: Field based qualitative characterization – A reliable form of initial, even qualitative, characterization that can be performed by D&D teams in the field for the purposes of initially separating contaminated waste from uncontaminated waste has the capability to greatly reduce analytical sample collection. Direct benefits of this would be the reduced cost due to lower analytical sample number and reduced project delays awaiting the results of analytical samples. Initial field characterization techniques must often be specific to contaminant type, and many forms of field characterization methods exist for a wide variety of contaminants that include handheld spectrometers and colorimetric test kits. The D&D Roadmap Team has assessed this technology need as:
    i. D&D Stage/s: ‘Deactivation’ and ‘decommissioning’
    ii. Needs Timeline: ‘Near past’, ‘current’, and ‘near future’
    iii. Needs Driver: ‘Project cost’, ‘characterization’, and ‘project efficiency’
    iv. Project Level Impact: ‘High’
    v. Challenge Type: ‘Contaminant control’ and ‘waste processing’
    vi. Technology Type: ‘Waste preparation’

- Ventilation Ducting Inspection – The installation of an engineered roof is required to fulfil currently identified Removal Action Alternatives Beyond No Action (SRNS-RP-2021-00001) for the 235-F PuFF facility D&D project. The installation of this roof will require the removal of concrete exhaust ducting located on the current roof of Building 235-F. Full characterization of this concrete ductwork is necessary for its removal and disposal. A response from the questionnaire completed by the Building 235-F D&D team contained a direct request for technology related to a robotic application to support this process.

Specifically, the Building 235-F D&D team suggested that a robotic system capable of performing radiological survey, concrete sampling, and collecting visual (video) images of the ductwork would be required to meet the D&D needs of the concrete ductwork. This system would also need to be portable enough to be deployed from the current rooftop through small openings. Further information regarding the dimensions of openings, ductwork, and access points to the roof were not available during the questionnaire or interview processes. A request for this information has been applied to the D&D project team to better assess existing robotic systems with the desired capabilities.

Technology criteria found that applied to this area of interest are:

1. SRS – 235F – 2: 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 concrete ductwork sampling at Building 235-F is in agreement with the current assessment of this area of interest by the Roadmap Team. 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 efficiency' and 'safety risk'
    iv. Project Level Impact: 'Medium'
    v. Challenge Type: 'Contaminant type', 'characterization', and 'accessibility'
    vi. Technology Type: 'Sample collection' and 'robotic/remote applications'

- Contaminant Fixation – The predominant form of radioactive hold-up contained within contaminated areas of Building 235-F are composed of fine, sub-micron sized particulate Pu-238. The selection process for decommissioning strategy was influenced by this contaminant form and the likelihood of contaminant spread during D&D work. Questionnaire responses indicate that it may have been possible to use a fixative to influence the current decision to leave, at least in part, process equipment in place for grout entombment.

  Building 235-F has previously been the target of coating and fixative testing conducted by researchers from Savannah River National Laboratory (SRNL) and Florida International University (FIU). A commercially available fixative, Firedam™, was tested within Process Cell 7 of Building 235-F for the expressed purpose of controlling Pu-238 particulate dust. Firedam™ is a sprayable coating developed by 3M™ that dries to form an elastomeric coating to control the transmission of fire, heat, smoke, and noxious gas. The testing conducted within Process Cell 7 and Building 235-F successfully deployed Firedam™, and this product was further employed during subsequent D&D work conducted within the facility, though not within more contaminated process cells.

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

1. SRS – 235F – 3: Contaminant Fixation – The application of a fixative or coating was specifically mentioned in questionnaire responses from Building 235-F D&D project SMEs as a possible method for controlling the spread of radioactive particulates during process cell abandonment and entombment. The utilization of a fixative may still be possible during final decommissioning for Building 235-F should the D&D project team deem it a beneficial addition to their tool set. It appears possible that the application of a coating or fixative to control radioactive particulate within a process cell, utilizing a minimally sized entry point prior to a more extensive entry to apply grout or a recombiner, could reduce the risk of contaminant spread and worker exposure. A more complete assessment of possible coating and fixative application technique and the effect of its presence on hydrogen generation rates within a contaminated area would be needed to determine its possible benefits and/or downsides. This technology category was assessed by the Roadmap Team as:
    i. D&D Stage/s: 'Deactivation' and 'decommissioning'
    ii. Needs Timeline: 'Current'
    iii. Needs Driver: 'Project schedule' and 'project efficiency'
    iv. Project Level Impact: 'High'
    v. Challenge Type: 'Contaminant control'
    vi. Technology Type: 'Fixatives and coatings'

- Hydrogen generation – Radiolytic generation of hydrogen occurs when ionizing radiation (e.g. α, β, or γ) interacts with hydrogenous materials (NURED/CR-6673 – UCRL-ID-13852). The primary contaminant hold-up within Building 235-F process enclosures is sub-micron sized particulate distributed throughout the cell and associated ventilation systems (SRNS-RP-2021-00001). As process enclosure ventilation systems are shut down and sealed, hydrogen accumulation to the lower flammability limit over time is possible. Building 235-F decommissioning planning includes potential ISD measures to mitigate the hazards of hydrogen combustion such as grout emplacement within the cells or the addition of passive autocatalytic recombiners to reform hydrogen into water vapor (including a desiccant to control moisture buildup) (SRNS-RP-2021-00001). The risk of worker exposure when opening of any process cells containing hold-up must be considered, as release of residual radiological contamination in such fine powdered form is possible. Any access of process cells to emplace grout or recombiners will necessitate the opening of these enclosures. Current to the Roadmap assessment, final planning of hydrogen generation mitigation is not yet completed, and a solution has not yet been settled upon.

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

  1. SRS – 235F – 4: Hydrogen Generation During In-situ Decommissioning – The planned D&D strategy for Building 235-F will include the placement of grout throughout the 235-F Building for permanent structure ISD. Formulations of grout and the methods for its placement, if placed inside contaminated process cell, are being developed to

conduct this work safely to produce the required outcome/s as identified in the Removal Action Alternatives detailed in the 2022 Removal Site Evaluation Report / Engineering Evaluation / Cost Analysis for Building 235-F. This technology need was assessed by the Roadmap Team as:

i. D&D Stage/s: 'Decommissioning'
ii. Needs Timeline: '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: 'Decay and byproduct control' and 'grout and entombment'

2. SRS – 235F – 5: Decay and Byproduct Control – The likely generation of hydrogen by radioactive decay withing process enclosures following the cessation of ventilation must be considered with the permanent ISD of Building 235-F process cells. Building 235-F D&D project team has, and continues to, plan methods to achieve an adequate method of hydrogen control. The installation of recombiners is being considered for this purpose and are specifically mentioned in the 2022 Removal Site Evaluation Report / Engineering Evaluation/Cost Analysis for Building 235-F. Further discussion of the use and alternatives to recombiner installation was conducted during the Roadmap interview process with the Building 235-F D&D team following the questionnaire. This technology category was assessed by the Roadmap Team as:

i. D&D Stage/s: 'Decommissioning'
ii. Needs Timeline: 'Current' and 'near future'
iii. Needs Driver: 'Safety risk'
iv. Project Level Impact: 'Medium'
v. Challenge Type: 'Contaminant type' and 'contaminant control'
vi. Technology Type: 'Decay and byproduct control'

- Decommissioning Implementation – Certain technologies chosen for use during D&D projects require accompanying deployment methods. In turn these methods may require specialized features related to unique contaminants or situations as required by the task they are applied to. One questionnaire response was found to exemplify this technology need.

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

  1. SRS – 235F – 6: Fixative Application – The application of a chosen fixative or specialized grout mixture during the Building 235-F D&D project will likely include the interiors of contaminated gloveboxes and radioactive cells. Breaching contaminated components could result in the release of contaminants and exposure of workers. Currently, the method for accessing these boxes and cells is still being determined.

     i. D&D Stage/s: 'Deactivation' and 'Decommissioning'
     ii. Needs Timeline: 'Near past', 'current' and 'near future'

iii. Needs Driver: ‘Project efficiency’ and ‘safety risk’
iv. Project Level Impact: ‘Medium’
v. Challenge Type: ‘Worker safety’ and ‘accessibility’
vi. Technology Type: ‘Fixatives and coatings’ and ‘grout and entombment’

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 of 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 1, 2024, the Roadmap Team conducted a virtual interview with the Building 235-F D&D team. 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. Researchers from SRNL with experience in passive autocatalytic recombiners were contacted prior to the interview for information regarding their work and invited to participate on the interview call.

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 Building 235-F D&D project team, and secondly, the suitability of Building 235-F for further testbed opportunities.

Environmental remediation and facility D&D is managed at the SRS by the Area Completion Projects (ACP) organization. Currently, SRNL works closely towards the development of a wide variety R&D solutions for ACP and the Building 235-F D&D team itself. This support takes the form of collaborative planning meetings, former employees moving between organizations, as well as technology development and testing. Specialized grout formulas are currently being developed at SRNL to meet the objectives of the 235-F decommissioning project. Fire resistant fixatives have been tested within Building 235-F process cells and contaminated rooms. A hard closed cell foam product has been modified by SRNL and FIU and undergone years of rigorous development for use in subsurface high-activity and low-activity drain line removals at the Building 235-F. Findings from the Roadmap Team assessment of the methods the 235-F D&D project utilizes to procure needed technology or solutions appear to be primarily organic, and driven by proximity to the associated National Laboratory, SRNL. Employment transfer between divisions of the SRS and SRNL is frequent, and developed connections in addition to significant institutional knowledge is transferred during that process. It is a logical assumption that this close relationship between project work and a local applied laboratory would provide the primary conduit between technology need and technology solutions.

The potential for test bed opportunities is a topic of specific inquiry in the Roadmap questionnaire and was further discussed during the interview proceeding. The 235-F D&D project has previously fulfilled the role of a testbed site during the successful deployment of the Firedam™ project in contaminated process cells. In addition, customized grout formulas are planned to be deployed during final decommissioning of Building 235-F. Further use of Building 235-F for testbed application was assessed to be unlikely based on the feedback from the D&D project team. Current D&D project work is focused on limiting unnecessary worker exposure Building 235-F in preparation for the decommissioning phase. Previous deployments of research projects have utilized D&D entry campaigns already planned by the D&D project team. The limitation of access by D&D teams necessary for continued monitoring of long-term fixatives, coatings, or other R&D products can be considered a limitation on the accessibility of researchers. The isolation of energy sources and cessation of ventilation systems, and by extension, the degradation of capabilities to support research project work efficiently and safely likewise inhibits the viability of Building 235-F for further use as a testbed. A notable exception to this assessment of testbed viability, is the requirement of concrete ductwork inspection on the roof of Building 235-F. To complete the emplacement of a new engineered roof, this ductwork will be removed, and characterization efforts of contamination by possible robotic application have been request by the D&D project team.

Notable interview findings concluded with a discussion related to the previous application of fixatives within 235-F process cell 7 and the significance of source term calculation. The calculation of source terms by D&D teams of nonreactor nuclear facilities is a process governed by DOE Handbook 3010. This document “provides a compendium and analysis of experimental data from which airborne release fractions (ARFs) and respirable fractions (RFs) may be derived” (DOE-HDBK-3010-94). The handbook provides computational formulas to calculate source terms and assess the risk of airborne pathways of human exposure to contaminants. Building 235-F contains sub-micron sized Pu-238 particulate contamination, and HDBK-3010-94 is directly applicable to the work conducted in this facility. Currently, the applications of fixatives for the purpose of contaminant control have no impact on source term calculations to determine ARFs for a project site. This means that even if a fixative is designed to control a contaminant, and is successful in doing so, there is no change in risk calculation. Effectively, the benefit of fixative application is not recognized through the DOE handbook that must be used by D&D teams, and the 235-F D&D team in this example. The last revision to DOE-HDBK-3010-94 was in the year 1994.

5.0 Roadmap Findings Summary

Assessment of the Building 235-F D&D project 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 site.

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 four

primary topics of interest for further discussion during the subsequent virtual interview. These four topics were Hydrogen Generation, Contaminant Form, Ducting Inspection, and Waste Segregation. 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 235-F 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 the 235-F D&D project team to further discuss specific interest areas. During the interview, additional subjects were related to the opportunities presented by Building 235-F 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 team regarding all topics discussed, and most notably on the viability for testbed potential of D&D project in different stages and incentives for the use of fixative technology regarding source term calculations that guide project risk assessments.

Technology types identified during the Roadmap assessment of the Building 235-F D&D project 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 235-F D&D project team will be provided in a final report at that time. Continued efforts by the Roadmap Team will be made in the interim to find suitable technology solutions to specific needs of the 235-F D&D team leading up to that final report.

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Appendix A.

A.1 SRS 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.

SRNL-L3220-2024-00005, Rev. 0

May 2, 2024

TO: Deactivation and Decommissioning Project Team

FROM: Deactivation and Decommissioning Roadmap Initiative Team

D&D Roadmap: Facility Questionnaire for Technical Needs

Purpose:
This initiative has been formed to identify high-priority technical needs and the Technology Development (TD) tasks required to meet those needs in support of the ongoing deactivation and decommissioning (D&D) of Department of Energy infrastructure across the United States. This questionnaire is intended to be completed by the personnel involved with current and near-future D&D projects in the DOE Complex. A small team of subject matter experts (SMEs) led by SRNL from the Network of National Laboratories for Environmental Management and Stewardship (NNLEMS) professionals will assess the critical needs, scientific capabilities, and practical technologies identified by this questionnaire and prioritize research and development of TD projects in the D&D focus area to assist ongoing D&D work across the DOE complex. Each D&D project will be asked to complete a questionnaire and participate in a subsequent video interview process to achieve these goals.

This questionnaire is designed to allow interviewers and interviewees to preface a video conference with topics the D&D project team finds of critical importance. By responding to the questions below the formal video conference will be a more focused process. Each interview will be summarized in a corresponding report that will be issued to the D&D project team, DOE TD division, and other participating D&D site teams that are interviewed. All projects will be assessed for opportunities to test key technologies identified by the D&D Roadmap team. A final workshop will be organized and made available for participation and presentation by each entity involved with this D&D Roadmap initiative, including private contractor companies.

Questionnaire Instructions:
The questions and topics below have been selected by the Roadmap SME team to solicit a broad range of information regarding D&D activities at the site. The questionnaire should be completed by personnel involved in the planning, implementation, and assessment of D&D projects that are currently taking place or are slated to take place in the next three to five years. Multiple answers to each question may be necessary. A complete picture of current technological needs and potential problem points is critical to the success of the D&D Roadmap initiative and its ability to provide value to the individual D&D teams. Photographs or related attachments of specific areas of interest are encouraged to be provided in addition to any questions that they may pertain to. Please have three to five employees answer each section of this questionnaire separately:

Respondent Information
Name: Karen Adams
Job Title: Federal Project Director
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.
The SRS D&D program is performed under CERCLA however, has no drivers (regulatory milestones). With no regulatory milestones, funding received to perform D&D is limited. Budget requests are substantiated with risks associated with facilities awaiting D&D. Risks include safety of co-located workers, safety of D&D workers, increased cost due to deteriorating facilities, as well as loss of D&D/operations knowledge due to attrition of D&D workers. 235-F has the closest thing to a driver; the DNFSB's interest in risk reduction at the facility.

D&D Project Referenced: D Area Closure, 235-F, SR D&D program
Respondent's Position in Relation to D&D Project: Federal Project Director

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 in-situ decommissioning 235-F is scheduled for FY27; design will begin in FY25. After design is complete, the project team will have a better understanding of technology needs. Possibilities will be designer grout mixes, hydrogen buildup after decommissioning is complete. D Area is an industrial complex technology needed is basic construction expertise.

D&D Project Referenced: 235-F, D Area Closure and D&D program
Respondent's Position in Relation to D&D Project: Federal Project Director

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.
Not currently. The in-situ decommissioning 235-F is scheduled for FY27; design will begin in FY25. After design is complete, the project team will have a better understanding of technology needs.

D&D Project Referenced: 235-F
Respondent's Position in Relation to D&D Project: Federal Project Director

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 235-F in-situ decommissioning is scheduled for FY27; design is scheduled in FY25. Based on design, worker safety aspects, grout placement techniques, grout formulation, ventilation and safety basis requirements will be better understood. The worker safety associated with the facilities in D Area (coal-fired powerhouse and water treatment facilities) will continue to degrade over time relative to the deterioration of the facilities. Cost will increase as risk to worker safety increases.

D&D Project Referenced: 235-F and D Area Closure
Respondent's Position in Relation to D&D Project: Federal Project Director

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 regulatory framework, D&D protocols and document templates are in place, function properly and are successful in the implementation of the SR D&D program. The SR D&D program is not regulatorily driven (no enforceable milestones).

D&D Project Referenced: SR D&D Program
Respondent's Position in Relation to D&D Project: Federal Project Director

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.
Definitive, real-time data that will allow for immediate, accurate field decisions in determining appropriate waste streams. This will eliminate the conservative practice of handling/disposing of clean waste as contaminated.

D&D Project Referenced: SR D&D Program

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

Public Engagement

Does the D&D project require specific public engagement or hazard protection required for the successful conduct of this work?
Public engagement is included in the regulatory process (CERCLA) and/or through SRS Citizens Advisory Board Presentations.

D&D Project Referenced: SR D&D Program
Respondent's Position in Relation to D&D Project: Federal Project Director

7. Cost Efficacy

Are there any technological or methodology improvements that could conceptually improve the performance of this D&D project?
No comments.

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

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.
The SRS will be under government control in perpetuity. Decommissioned facilities and/or the remaining slabs/grade could be reused by DOE and will be subject to long term monitoring.

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

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?
No comments.

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

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?
No comment

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

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.
No comment

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

The D&D Roadmap team appreciates all feedback and answers to this questionnaire. There are no wrong answers, and all input from experienced individuals with experience in D&D work are valuable to the success of this project and related work in the DOE complex. Results of this initiative will be shared freely with D&D project teams with the sole intention of improving the quality of work and life of these teams.

Should there be any questions or comments to this questionnaire, please contact the project leads listed below.

1. Evan Koelker
   Senior Scientist, Environmental Sciences & Dosimetry
   Savannah River National Laboratory
   Evan.Koelker@srnl.doe.gov

2. Marion Cofer
   Manager, Environmental Sciences & Dosimetry
   Savannah River National Laboratory
   Marion.Cofer@srnl.doe.gov

SRNL-L3220-2024-00005, Rev. 0

May 2, 2024

TO: Deactivation and Decommissioning Project Team

FROM: Deactivation and Decommissioning Roadmap Initiative Team

D&D Roadmap: Facility Questionnaire for Technical Needs

Purpose:
This initiative has been formed to identify high-priority technical needs and the Technology Development (TD) tasks required to meet those needs in support of the ongoing deactivation and decommissioning (D&D) of Department of Energy infrastructure across the United States. This questionnaire is intended to be completed by the personnel involved with current and near-future D&D projects in the DOE Complex. A small team of subject matter experts (SMEs) led by SRNL from the Network of National Laboratories for Environmental Management and Stewardship (NNLEMS) professionals will assess the critical needs, scientific capabilities, and practical technologies identified by this questionnaire and prioritize research and development of TD projects in the D&D focus area to assist ongoing D&D work across the DOE complex. Each D&D project will be asked to complete a questionnaire and participate in a subsequent video interview process to achieve these goals.

This questionnaire is designed to allow interviewers and interviewees to preface a video conference with topics the D&D project team finds of critical importance. By responding to the questions below the formal video conference will be a more focused process. Each interview will be summarized in a corresponding report that will be issued to the D&D project team, DOE TD division, and other participating D&D site teams that are interviewed. All projects will be assessed for opportunities to test key technologies identified by the D&D Roadmap team. A final workshop will be organized and made available for participation and presentation by each entity involved with this D&D Roadmap initiative, including private contractor companies.

Questionnaire Instructions:
The questions and topics below have been selected by the Roadmap SME team to solicit a broad range of information regarding D&D activities at the site. The questionnaire should be completed by personnel involved in the planning, implementation, and assessment of D&D projects that are currently taking place or are slated to take place in the next three to five years. Multiple answers to each question may be necessary. A complete picture of current technological needs and potential problem points is critical to the success of the D&D Roadmap initiative and its ability to provide value to the individual D&D teams. Photographs or related attachments of specific areas of interest are encouraged to be provided in addition to any questions that they may pertain to. Please have three to five employees answer each section of this questionnaire separately:

Respondent Information
Name: Grady L Friday
Job Title: Deactivation and Decommissioning Subject Matter Expert (SME)
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.

The primary objective is to prepare 235-F Facility for decommissioning as defined in the "Removal Site Evaluation Report / Engineering Evaluation/Cost Analysis for the F-Area Material Storage Building 235-F" (SRNS-RP-2021-00001). This is being accomplished by removing all the exterior interferences on and around 235-F. Examples are exterior piping, conduits and brackets located on the exterior walls and roof, also removing exterior facilities like chiller buildings, sanitary sewer lift / pumping stations, transformers and switchgear, and cooling towers.

D&D Project Referenced: 235-F Decommissioning
Respondent's Position in Relation to D&D Project: SME / Oversite

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 current task being performed at 235-F are straight forward decommissioning task, items such as removal of metals from the exterior and roof, demolition of facilities that are in close proximity of the building, etc…

D&D Project Referenced: 235-F Decommissioning
Respondent's Position in Relation to D&D Project: SME / Oversite

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 current scope of work being performed has no technological needs. Future work like characterizing the interior of the large concrete exhaust duct that is located on the roof of 235-F, this technology should be able to remotely perform Radiological survey, concrete sampling and video feedback at a minimum and be portable enough to be easily mobilized to a roof deployed through small duct opening and perform its work

D&D Project Referenced: 235-F Decommissioning
Respondent's Position in Relation to D&D Project: SME / Oversite

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.

Worker Risks are covered by OSHA and Site Safety Requirements for the current work. Future work on this project could require some unique engineering controls to perform work but that remains to be seen as the work plan is put together.

D&D Project Referenced: 235-F Decommissioning

Respondent's Position in Relation to D&D Project: SME / Oversite

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.

Non-time critical removal action under the Comprehensive Environmental Response, Compensation, and Liability Act is the regulatory mechanism to decommission Building 235-F.

D&D Project Referenced: 235-F Decommissioning

Respondent's Position in Relation to D&D Project: SME / Oversite

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.

No issues for the current work, and I know of no issue yet identified for the remainder for the work

D&D Project Referenced: 235-F Decommissioning

Respondent's Position in Relation to D&D Project: SME / Oversite

7. Public Engagement

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

Public engagement is on the approval of the removal action plan.

D&D Project Referenced: 235-F Decommissioning

Respondent's Position in Relation to D&D Project: SME / Oversite

8. Cost Efficacy

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

Done identified at this point.

D&D Project Referenced: 235-F Decommissioning

Respondent's Position in Relation to D&D Project: SME / Oversite

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.

In-situ disposal of the facility, which means it will be entombed in grout and concrete and stay in place. Project should be 5+ years if funding is available.

D&D Project Referenced: 235-F Decommissioning

Respondent's Position in Relation to D&D Project: SME / Oversite

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?

It would be hard to determine until all the engineering is complete for the decommissioning of 235-F

D&D Project Referenced: 235-F Decommissioning

Respondent's Position in Relation to D&D Project: SME / Oversite

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?

None

D&D Project Referenced: 235-F Decommissioning

Respondent's Position in Relation to D&D Project: SME / Oversite

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:

The D&D Roadmap team appreciates all feedback and answers to this questionnaire. There are no wrong answers, and all input from experienced individuals with experience in D&D work are valuable to the success of this project and related work in the DOE complex. Results of this initiative will be shared freely with D&D project teams with the sole intention of improving the quality of work and life of these teams.

Should there be any questions or comments to this questionnaire, please contact the project leads listed below.

1. Evan Koelker
   Senior Scientist, Environmental Sciences & Dosimetry
   Savannah River National Laboratory
   Evan.Koelker@srnl.doe.gov

2. Marion Cofer
   Manager, Environmental Sciences & Dosimetry
   Savannah River National Laboratory
   Marion.Cofer@srnl.doe.gov

SRNL-L3220-2024-00005, Rev. 0

May 2, 2024

TO: Deactivation and Decommissioning Project Team

FROM: Deactivation and Decommissioning Roadmap Initiative Team

D&D Roadmap: Facility Questionnaire for Technical Needs

Purpose:
This initiative has been formed to identify high-priority technical needs and the Technology Development (TD) tasks required to meet those needs in support of the ongoing deactivation and decommissioning (D&D) of Department of Energy infrastructure across the United States. This questionnaire is intended to be completed by the personnel involved with current and near-future D&D projects in the DOE Complex. A small team of subject matter experts (SMEs) led by SRNL from the Network of National Laboratories for Environmental Management and Stewardship (NNLEMS) professionals will assess the critical needs, scientific capabilities, and practical technologies identified by this questionnaire and prioritize research and development of TD projects in the D&D focus area to assist ongoing D&D work across the DOE complex. Each D&D project will be asked to complete a questionnaire and participate in a subsequent video interview process to achieve these goals.

This questionnaire is designed to allow interviewers and interviewees to preface a video conference with topics the D&D project team finds of critical importance. By responding to the questions below the formal video conference will be a more focused process. Each interview will be summarized in a corresponding report that will be issued to the D&D project team, DOE TD division, and other participating D&D site teams that are interviewed. All projects will be assessed for opportunities to test key technologies identified by the D&D Roadmap team. A final workshop will be organized and made available for participation and presentation by each entity involved with this D&D Roadmap initiative, including private contractor companies.

Questionnaire Instructions:
The questions and topics below have been selected by the Roadmap SME team to solicit a broad range of information regarding D&D activities at the site. The questionnaire should be completed by personnel involved in the planning, implementation, and assessment of D&D projects that are currently taking place or are slated to take place in the next three to five years. Multiple answers to each question may be necessary. A complete picture of current technological needs and potential problem points is critical to the success of the D&D Roadmap initiative and its ability to provide value to the individual D&D teams. Photographs or related attachments of specific areas of interest are encouraged to be provided in addition to any questions that they may pertain to. Please have three to five employees answer each section of this questionnaire separately:

Respondent Information
Name: Pat O'Neill

Job Title: Project Manager 235-F Decommissioning

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.

Removal Site Evaluation Report/Engineering Evaluation/Cost Analysis for the F-Area Material Storage Building (235-F) (U) SRNS-RP-2021-00001

D&D Project Referenced: 235-F Decommissioning Project
Respondent's Position in Relation to D&D Project: 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.

If adequate lock down/capture/fixative technology existed, it may have driven the alternative selection process (EECA) in a different direction i.e. removal of the building process equipment and building structure. If developed it could provide additional options for D&D of other facilities.

D&D Project Referenced: 235-F Decommissioning Project
Respondent's Position in Relation to D&D Project: 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.

Formulation of and application methods for coatings that result in the effective lock down and immobilization of P-238 within process enclosures.

D&D Project Referenced: 235-F Decommissioning Project
Respondent's Position in Relation to D&D Project: 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.

Worker exposure to radiological contaminants present and future. Long-term risk is reduced if facility and equipment is removed versus in-situ decommissioning.

D&D Project Referenced: 235-F Decommissioning Project
Respondent's Position in Relation to D&D Project: 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.

CERCLA

D&D Project Referenced: 235-F Decommissioning Project
Respondent's Position in Relation to D&D Project: 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.

Effective encapsulation or lock down of contamination reduces waste handling and disposal risks.

D&D Project Referenced: 235-F Decommissioning Project
Respondent's Position in Relation to D&D Project: 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?

Yes but at SRS a successful program is in place.

D&D Project Referenced: 235-F Decommissioning Project
Respondent's Position in Relation to D&D Project: Project Manager

8. Cost Efficacy

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

Complete removal of radiological or nuclear facilities reduces long-term monitoring and care costs as well as potential risk.

D&D Project Referenced: 235-F Decommissioning Project

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

Insitu decommissioning ensures long-term care and monitoring and does not support land reuse, while actual facility D&D supports it.

D&D Project Referenced: 235-F Decommissioning Project

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

Probably too late for 235-F but would support other site projects. F Canyon for example.

D&D Project Referenced: 235-F Decommissioning Project

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

Grout formulation for ISD. Hydrogen reduction technology.

D&D Project Referenced: 235-F Decommissioning Project

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

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: Project Manager

The D&D Roadmap team appreciates all feedback and answers to this questionnaire. There are no wrong answers, and all input from experienced individuals with experience in D&D work are valuable to the success of this project and related work in the DOE complex. Results of this initiative will be shared freely with D&D project teams with the sole intention of improving the quality of work and life of these teams.

Should there be any questions or comments to this questionnaire, please contact the project leads listed below.

1. Evan Koelker
   Senior Scientist, Environmental Sciences & Dosimetry
   Savannah River National Laboratory
   Evan.Koelker@srnl.doe.gov

2. Marion Cofer
   Manager, Environmental Sciences & Dosimetry
   Savannah River National Laboratory
   Marion.Cofer@srnl.doe.gov

SRNL-L3220-2024-00005, Rev. 0

May 2, 2024

TO: Deactivation and Decommissioning Project Team

FROM: Deactivation and Decommissioning Roadmap Initiative Team

D&D Roadmap: Facility Questionnaire for Technical Needs

Purpose:
This initiative has been formed to identify high-priority technical needs and the Technology Development (TD) tasks required to meet those needs in support of the ongoing deactivation and decommissioning (D&D) of Department of Energy infrastructure across the United States. This questionnaire is intended to be completed by the personnel involved with current and near-future D&D projects in the DOE Complex. A small team of subject matter experts (SMEs) led by SRNL from the Network of National Laboratories for Environmental Management and Stewardship (NNLEMS) professionals will assess the critical needs, scientific capabilities, and practical technologies identified by this questionnaire and prioritize research and development of TD projects in the D&D focus area to assist ongoing D&D work across the DOE complex. Each D&D project will be asked to complete a questionnaire and participate in a subsequent video interview process to achieve these goals.

This questionnaire is designed to allow interviewers and interviewees to preface a video conference with topics the D&D project team finds of critical importance. By responding to the questions below the formal video conference will be a more focused process. Each interview will be summarized in a corresponding report that will be issued to the D&D project team, DOE TD division, and other participating D&D site teams that are interviewed. All projects will be assessed for opportunities to test key technologies identified by the D&D Roadmap team. A final workshop will be organized and made available for participation and presentation by each entity involved with this D&D Roadmap initiative, including private contractor companies.

Questionnaire Instructions:
The questions and topics below have been selected by the Roadmap SME team to solicit a broad range of information regarding D&D activities at the site. The questionnaire should be completed by personnel involved in the planning, implementation, and assessment of D&D projects that are currently taking place or are slated to take place in the next three to five years. Multiple answers to each question may be necessary. A complete picture of current technological needs and potential problem points is critical to the success of the D&D Roadmap initiative and its ability to provide value to the individual D&D teams. Photographs or related attachments of specific areas of interest are encouraged to be provided in addition to any questions that they may pertain to. Please have three to five employees answer each section of this questionnaire separately:

Respondent Information
Name: Thelesia (Lisa) Oliver
Job Title: EC&ACP Engineering Chief Engineer
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.
Bldg. 236-H D&R - Primary Objective/Driver: End of Mission, Footprint Needed for Other Mission(s)
Bldg. 772-F Deactivation - Primary Objective/Driver: End of Mission, Reduction in S&M Costs, Establish Safe Storage awaiting decommissioning.
Bldg. 235-F Decommissioning Planning - Primary Objective/Driver: End of Mission, Reduction in S&M Costs, End State Achievement

D&D Project Referenced: See Above
Respondent's Position in Relation to D&D Project: D&D Engineering 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.
Bldg. 236-H D&R - Progress: Superstructure is down, and waste containerization is ongoing.
Bldg. 772-F Deactivation - Progress: Deactivation is ongoing. Funding is a challenge / constrained.
Bldg. 235-F Decommissioning Planning - Progress: Preferred alternative (end state) selected using Removal Site Evaluation Report / Engineering Evaluation and Cost Analysis. Decommissioning design is in the early stages - the E7 Modification Traveler is routing for approval.

D&D Project Referenced: See Above
Respondent's Position in Relation to D&D Project: D&D Engineering 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.
Tech Improvement Enhancement: we have and will use specialty grout mixes developed with help of researchers in SRNL are useful to the decommissioning projects that rely on InSitu Disposal end states.
Tech Needs: approach for prevention/mitigation of hydrogen deflagration (option to recombiners), method for grout placement in process enclosures without losing confinement, specialty grout for particulate Pu-238.

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

The D&D worker is exposed to industrial hazards as well as residual chemical and radiological hazards that remain in the excess facility. And, when the scope of deactivation work is limited due to funding constraints, the decommissioning worker will be necessarily exposed to more significant risks. Typically, the more contaminated, complex, or higher risk decommissioning projects are managed as CERCLA activities (non-time critical removal actions) so we can consider the D&D worker exposure when we develop the Engineering Evaluation / Cost Analysis document used to evaluate end state alternatives under consideration. For Building 235-F, a primary concern is the fine particulate plutonium (primarily Pu-238) contamination.

D&D Project Referenced: See Above

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

At SRS, the Inactive Facility Disposition process is integrated with the Environmental Cleanup Program via the Federal Facility Agreement. The Core Team (DOE-SR, USEPA, and SCDHEC) reviews the facility decommissioning evaluation used to select a decommissioning model and the decommissioning project final report used to document whether the D&D remnants require further evaluation during the Area Completion process. Note that the evaluation essentially documents whether CERCLA is warranted. When CERCLA is not warranted, facility disposition activities are governed by NEPA. CERCLA and NEPA have distinct stakeholder engagement activities. CERCLA removal actions are required to consider applicable or relevant and appropriate requirements (ARARs). Core Team reviews and comments on the CERCLA documentation.

D&D Project Referenced: Information above is general, not project specific.

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

To some extent, D&D projects are waste management projects. Solid facility characterization is critical to selecting the decommissioning model; planning the work execution to protect the worker and environment; segregating, packaging, and disposing of resultant waste; and securing Core Team agreement as to the administrative path for the D&D remnants. TSDFs require special approval to receive CERCLA waste (resulting from implementation of a CERCLA removal or remedial action).

ISD projects must carefully consider what is grouted in the facility given DOE 435.1 requirements for disposal facilities.

D&D Project Referenced: The information above is general, not project specific.
Respondent's Position in Relation to D&D Project: D&D Engineering Management

7. Public Engagement

Does the D&D project require specific public engagement or hazard protection required for the successful conduct of this work?
Public engagement is covered in the response to #5 above.
Hazard protection is covered in the response to #3 and #5 above.

D&D Project Referenced: Information above is general, not project specific.
Respondent's Position in Relation to D&D Project: D&D Engineering Management

8. Cost Efficacy

Are there any technological or methodology improvements that could conceptually improve the performance of this D&D project?
None identified.

D&D Project Referenced: Information above is general, not project specific.
Respondent's Position in Relation to D&D Project: D&D Engineering 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.
The majority of clean or moderately contaminated inactive facilities can be decommissioned within a single fiscal year. More complex, contaminated, or higher risk decommissioning projects that warrant use of CERCLA typically take several fiscal years to complete.
Facility disposition projects aim to achieve the stated end state, avoid creating a waste unit, and minimize surveillance and maintenance costs/effort.

D&D Project Referenced: The above information is general, not project specific.
Respondent's Position in Relation to D&D Project: D&D Engineering 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?
Unknown. Most facility disposition projects are of short duration and involve industrial as well as chemical and radiological hazards. Research and technology activities for those projects would need to be sufficiently robust and require minimal set up and testing. CERCLA decommissioning projects take longer to complete but typically involve significantly higher risk to workers. The relative value of any research and technology must be balanced against the corresponding increase in risk to the decommissioning worker risk.

D&D Project Referenced: The above information is general, not project specific.
Respondent's Position in Relation to D&D Project: D&D Engineering 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?
Lessons Learned:
Time spent on declaring the facility cold and dark (without any hazardous energy sources) at the start of the project is time well spent for the safety of the decommissioning worker.
Hazards not addressed during deactivation because of funding limitations/constraints are even more difficult to address during decommissioning because of the loss (shutdown) of operating systems.
Solid facility characterization is critical to several subsequent activities in the D&D project schedule.

D&D Project Referenced: The above information is general, not project specific.
Respondent's Position in Relation to D&D Project: D&D Engineering 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.
Are there specialty grout mixes better suited to different radionuclides or forms of rad contamination?
Are there grout placement approaches that would help with filling gloveboxes and enclosures without breaching confinement? Are there tools, techniques, approaches that would enhance the process whereby we confirm the lack of hazardous energy sources.

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

The D&D Roadmap team appreciates all feedback and answers to this questionnaire. There are no wrong answers, and all input from experienced individuals with experience in D&D work are valuable to the success of this project and related work in the DOE complex. Results of this initiative will be

shared freely with D&D project teams with the sole intention of improving the quality of work and life of these teams.

Should there be any questions or comments to this questionnaire, please contact the project leads listed below.

1. Evan Koelker
   Senior Scientist, Environmental Sciences & Dosimetry
   Savannah River National Laboratory
   Evan.Koelker@srnl.doe.gov

2. Marion Cofer
   Manager, Environmental Sciences & Dosimetry
   Savannah River National Laboratory
   Marion.Cofer@srnl.doe.gov

SRNL-L3220-2024-00005, Rev. 0

May 2, 2024

TO: Deactivation and Decommissioning Project Team

FROM: Deactivation and Decommissioning Roadmap Initiative Team

D&D Roadmap: Facility Questionnaire for Technical Needs

Purpose:
This initiative has been formed to identify high-priority technical needs and the Technology Development (TD) tasks required to meet those needs in support of the ongoing deactivation and decommissioning (D&D) of Department of Energy infrastructure across the United States. This questionnaire is intended to be completed by the personnel involved with current and near-future D&D projects in the DOE Complex. A small team of subject matter experts (SMEs) led by SRNL from the Network of National Laboratories for Environmental Management and Stewardship (NNLEMS) professionals will assess the critical needs, scientific capabilities, and practical technologies identified by this questionnaire and prioritize research and development of TD projects in the D&D focus area to assist ongoing D&D work across the DOE complex. Each D&D project will be asked to complete a questionnaire and participate in a subsequent video interview process to achieve these goals.

This questionnaire is designed to allow interviewers and interviewees to preface a video conference with topics the D&D project team finds of critical importance. By responding to the questions below the formal video conference will be a more focused process. Each interview will be summarized in a corresponding report that will be issued to the D&D project team, DOE TD division, and other participating D&D site teams that are interviewed. All projects will be assessed for opportunities to test key technologies identified by the D&D Roadmap team. A final workshop will be organized and made available for participation and presentation by each entity involved with this D&D Roadmap initiative, including private contractor companies.

Questionnaire Instructions:
The questions and topics below have been selected by the Roadmap SME team to solicit a broad range of information regarding D&D activities at the site. The questionnaire should be completed by personnel involved in the planning, implementation, and assessment of D&D projects that are currently taking place or are slated to take place in the next three to five years. Multiple answers to each question may be necessary. A complete picture of current technological needs and potential problem points is critical to the success of the D&D Roadmap initiative and its ability to provide value to the individual D&D teams. Photographs or related attachments of specific areas of interest are encouraged to be provided in addition to any questions that they may pertain to. Please have three to five employees answer each section of this questionnaire separately:

Respondent Information
Name: Alex Davis
Job Title: EC&ACP Engineer
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.

- **235-F Decommissioning: No longer in use, reduction/removal of S&M costs, eventual end state**
- **772-F Deactivation: No longer in use, reducing S&M costs, and preparing it for eventual decommissioning**
- **236-H D&R: No longer in use and the location is needed for future SRTE mission(s)**

D&D Project Referenced: **stated above**
Respondent's Position in Relation to D&D Project: **D&D Engineer**

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.

There is the potential to install PARs (Passive Autocatalytic Recombiners) in 235-F during its future decommissioning. There is Pu-238 inside the gloveboxes in the building that cannot be removed due to ALARA reasons. As it decays, it generates hydrogen over time, which presents an explosion hazard post-decommissioning. We are still working through multiple different methods for decommissioning and installing PARs is one of those potential methods. However, this is a relatively new technology used primarily in nuclear power plants and has never been used in this type of application.

D&D Project Referenced: **235-F Decommissioning**
Respondent's Position in Relation to D&D Project: **D&D Engineer**

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 way to effectively remove Pu-238 without violating ALARA would definitely change how we eventually decommission 235-F.

D&D Project Referenced: **235-F Decommissioning**
Respondent's Position in Relation to D&D Project: **D&D Engineer**

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.

Funding. Certain projects (e.g. D-Area Powerhouse evaporators) will get more dangerous to perform the longer it sits.

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

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 first thing that comes to mind is resolving very simple comments from EPA and DHEC on our documents shouldn't take several months. Of course, this doesn't apply to all comments they have, but some in the past have been ones that could've been resolved with a simple phone call with me. There must be a way to simplify this process.

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

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.

No comments

D&D Project Referenced: **N/A**
Respondent's Position in Relation to D&D Project: **same**

7. Public Engagement

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

Not to my knowledge.

D&D Project Referenced: **N/A**
Respondent's Position in Relation to D&D Project: **same**

8. Cost Efficacy

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

Not to my knowledge.

D&D Project Referenced: **N/A**
Respondent's Position in Relation to D&D Project: **same**

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.

Echoing Lisa's comments in her questionnaire for the remainder. I have nothing I can add to hers.

D&D Project Referenced: **N/A**
Respondent's Position in Relation to D&D Project: **same**

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?

D&D Project Referenced:_____
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?

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.

_____
_____
_____
_____
_____
_____

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

The D&D Roadmap team appreciates all feedback and answers to this questionnaire. There are no wrong answers, and all input from experienced individuals with experience in D&D work are valuable to the success of this project and related work in the DOE complex. Results of this initiative will be shared freely with D&D project teams with the sole intention of improving the quality of work and life of these teams.

Should there be any questions or comments to this questionnaire, please contact the project leads listed below.

1. Evan Koelker
   Senior Scientist, Environmental Sciences & Dosimetry
   Savannah River National Laboratory
   Evan.Koelker@srnl.doe.gov

2. Marion Cofer
   Manager, Environmental Sciences & Dosimetry
   Savannah River National Laboratory
   Marion.Cofer@srnl.doe.gov

SRNL-L3220-2024-00005, Rev. 0

May 2, 2024

TO: Deactivation and Decommissioning Project Team

FROM: Deactivation and Decommissioning Roadmap Initiative Team

D&D Roadmap: Facility Questionnaire for Technical Needs

Purpose:
This initiative has been formed to identify high-priority technical needs and the Technology Development (TD) tasks required to meet those needs in support of the ongoing deactivation and decommissioning (D&D) of Department of Energy infrastructure across the United States. This questionnaire is intended to be completed by the personnel involved with current and near-future D&D projects in the DOE Complex. A small team of subject matter experts (SMEs) led by SRNL from the Network of National Laboratories for Environmental Management and Stewardship (NNLEMS) professionals will assess the critical needs, scientific capabilities, and practical technologies identified by this questionnaire and prioritize research and development of TD projects in the D&D focus area to assist ongoing D&D work across the DOE complex. Each D&D project will be asked to complete a questionnaire and participate in a subsequent video interview process to achieve these goals.

This questionnaire is designed to allow interviewers and interviewees to preface a video conference with topics the D&D project team finds of critical importance. By responding to the questions below the formal video conference will be a more focused process. Each interview will be summarized in a corresponding report that will be issued to the D&D project team, DOE TD division, and other participating D&D site teams that are interviewed. All projects will be assessed for opportunities to test key technologies identified by the D&D Roadmap team. A final workshop will be organized and made available for participation and presentation by each entity involved with this D&D Roadmap initiative, including private contractor companies.

Questionnaire Instructions:
The questions and topics below have been selected by the Roadmap SME team to solicit a broad range of information regarding D&D activities at the site. The questionnaire should be completed by personnel involved in the planning, implementation, and assessment of D&D projects that are currently taking place or are slated to take place in the next three to five years. Multiple answers to each question may be necessary. A complete picture of current technological needs and potential problem points is critical to the success of the D&D Roadmap initiative and its ability to provide value to the individual D&D teams. Photographs or related attachments of specific areas of interest are encouraged to be provided in addition to any questions that they may pertain to. Please have three to five employees answer each section of this questionnaire separately:

Respondent Information
Name: John C. (Jack) Musall
Job Title: D&D Project Engineer
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.

I am currently supporting two D&D projects: (1) deactivation of the F/H Laboratories per Deactivation Project Plan V-PMP-F-00278, and (2) decommissioning of Building 235-F per SRNS-RP-2021-00001(Revision 1, Engineering Evaluation & Cost Analysis) and Modification Traveller, MT-V35-2023-00001. The primary objectives/drivers of the F/H Laboratories deactivation are to prepare the laboratories for long-term Safe Storage, which is a state relatively free of non-radiological hazards, with reduced, stable radiological hazards, and with minimal continuing S&M. The primary objectives/drivers for the 235-F decommissioning are to permanently eliminate residual hazards (primarily radiological) associated with the structure, prevent exposure of the hypothetical future industrial worker to radiological contaminants present in Building 235-F that exceed 1E-06 risk thresholds (including principal threat source material); and prevent the migration of radionuclide contamination from Building 235-F to groundwater at concentrations that exceed maximum contaminant levels to the extent practicable.

D&D Project Referenced: See references in the above response.
Respondent's Position in Relation to D&D Project: Engineering support for projects via implementation of Manual 1C and E7 procedures

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 235-F decommissioning project is just getting underway. Regulatory documents have been completed and "design input" is under development. The Project Team will start on "design output" in FY25. For this project, the two biggest technical challenges are (1) how to prevent/mitigate hydrogen deflagration long-term (current approach is to install recombiners coupled with absorbent) and (2) how to place grout in process enclosures without loss of confinement (current approach is to use traditional confinements such as airlocks, huts, and glovebags and traditional short-term fixatives such as fogging). As of yet, these technical challenges have not hindered the decommissioning project. The F/H Laboratories deactivation is about halfway done with work scheduled to wrap up in early FY27. The Project Team has completed work on approximately half of the identified deactivation "zones." With respect to this project, the biggest technical challenges have been the assay of contaminated components (generally reside in HCAs/ARAs, so accessibility is a challenge) and the long-term prevention/ management of water inleakage to the underground LAD/HAD tanks and cells (a possible permanent

solution under consideration is to grout the tanks and cells). As of yet, these technical challenges have not hindered the decommissioning project. Deactivation project has made extensive use of a non-combustible fixative (FireDam) originally developed for use in 235-F. Fixative was used extensively in Shielded Area "A" of 772-F and in labs of 772-1F.

D&D Project Referenced: See description and references in response to Question 1.
Respondent's Position in Relation to D&D Project: Engineering support for projects via implementation of Manual 1C and E7 procedures

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.

Current plans are to grout Building 235-F as part of its decommissioning. In general, placed grout will act as physical barrier around the radiological holdup (primarily Pu-238), preventing worker intrusion and water infiltration/exfiltration. Plans are also to place grout within contaminated components such as cells and gloveboxes. There, the grout isolates the holdup and prevents it from being acted upon (and dispersed) by air and water currents. The physical isolation is beneficial but could be more beneficial if the holdup was chemically bound to the grout.

D&D Project Referenced: 235-F Decommissioning
Respondent's Position in Relation to D&D Project: Engineering support for project via implementation of Manuals 1C and E7 procedure

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.

Building 235-F is slated for "in-situ" decommissioning versus complete demolition, primarily so as to avoid worker exposure and the risk of uptake/contamination events [see Comparative Analysis (Table 3) in SRNS-RP-2021-00001]. That said, there is still significant worker exposure/risk associated with the "in-situ decommissioning" alternative because it does involve extensive entry into Building 235-F (an HCA/ARA) for the installation of forms/supports and placement of grout. Additionally, it is anticipated that grout will be placed inside contaminated components such as cells and gloveboxes. Breaching these contaminated components could release contaminants into 235-F and lead to worker exposure. The best method for breaching the contaminated components and introducing grout is TBD.

D&D Project Referenced: 235-F Decommissioning
Respondent's Position in Relation to D&D Project: Engineering support for project via implementation of Manuals 1C and E7 procedure

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.

With regard to the 235-F decommissioning, it is being conducted as a CERCLA "non-time critical removal action." IAW CERCLA regulations, the Project Team prepared an Engineering Evaluation/Cost Analysis (EE/CA) to understand the decommissioning alternatives and—coupled with an "action memorandum"—to select an alternative for implementation. Other than to specify "in-situ decommissioning" via grouting of the 1st and 2nd floors and installation of an engineered roof, the EE/CA and action memorandum do not contain "regulatory controls." I am not aware of any interagency priorities that are impacting the decommissioning project. (The F/H Laboratories deactivation is subject to DOE orders/guides and NEPA regulations but no other overarching regulations apply and hence there are no regulatory controls worth mentioning for that project.)

D&D Project Referenced: 235-F Decommissioning

Respondent's Position in Relation to D&D Project: Engineering support for project via implementation of Manuals 1C and E7 procedure

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.

With regard to the F/H Laboratory deactivation, there is no straightforward disposal path for the LR56, a transport vehicle for high-activity liquid effluents that were disposed to H-Canyon. The LR56 is highly contaminated and heavily shielded with lead. There is no cheap and easy method to disposition the LR56 into two wastestreams: radiological waste and lead waste. So, the Project Team is planning to abandon the LR56 in place on a covered pad to the west of 772-1F. With regard to the 235-F decommissioning, a good bit of concrete rubble will be generated during roof demolition in preparation for installation of the new engineered roof. The segmentation and disposal path for this rubble is TBD until better characterization is developed for the rubble (may be clean waste suitable for disposal to the Site's C&D Landfill or could be LLW suitable for disposal to the E-Area slit trenches).

D&D Project Referenced: See description and references in response to Question 1.

Respondent's Position in Relation to D&D Project: Engineering support for projects via implementation of Manuals 1C and E7 procedure

7. Public Engagement

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

With regard to the F/H Laboratories deactivation, there was no specific requirement for public engagement. With regard to the 235-F decommissioning, public engagement is complete and no specific hazard controls came out of the public engagement. Note that both projects are located in F-

Area, far from the Site's boundary, and that the 235-F decommissioning project has acceptable future impacts on industrial workers and groundwater.

D&D Project Referenced: See description and references in response to Question 1.
Respondent's Position in Relation to D&D Project: Engineering support for projects via implementation of Manuals 1C and E7 procedure

8. Cost Efficacy

Are there any technological or methodology improvements that could conceptually improve the performance of this D&D project?
No improvements were identified for either the F/H Laboratories deactivation or the 235-F decommissioning.

D&D Project Referenced: See description and references in response to Question 1
Respondent's Position in Relation to D&D Project: Engineering support for projects via implementation of Manuals 1C and E7 procedures.

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 F/H Laboratories deactivation project has a lifespan of approximately 6 years (FY22-FY27). The outcome of the project is a deactivated facility in Safe Storage for 10-25 years (until an overall project to "close" F-Area except for the SRPPF). Post-deactivation, annual S&M costs are projected to be approximately $5M, assuming 772-4F (Fanhouse) remains operational to provide exhaust ventilation to 772-F. The 235-F decommissioning project has a much longer timeline. Excluding the time to prepare/issue regulatory documentation (e.g., EE/CA and "action memorandum"), the project has a lifespan of approximately 10 years (~FY24-FY33). The outcome of the project is a waste site (radiological holdup entombed in a concrete structure) expected to remain intact for ~1,000 years. Post-decommissioning, annual S&M costs are projected to be <$100K. Land use restrictions and institutional controls are assumed to remain in place indefinitely for the waste site.

D&D Project Referenced: See description and references in response to Question 1
Respondent's Position in Relation to D&D Project: Engineering support for projects via implementation of Manuals 1C and E7 procedures.

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?
Although not required for success of the 235-F decommissioning project, a grout that chemically bonds to plutonium oxides could be beneficial (however, a chemical bond may not be technically feasible given the chemistry of plutonium oxides). Also, have used FireDam as a fixative in 235-F and now in

the F/H Laboratories. Within 235-F, some time has elapsed since its application and it might be useful to study/understand degradation of the fixative since time of application. The use of recombiners/ absorbents entombed in the 235-F waste site appears to be a unique use of these two proven technologies for prevention of hydrogen deflagration. Would be interesting to do a literature survey of how hydrogen deflagration is prevented in other entombments with significant void space. Finally, some SRNL development work is already planned in support of the 235-F decommissioning. Current formulations for foamed grout and zero-bleed, flowable grout will be evaluated and improved based on current technology and practices (current formulation were used approximately 15 years ago during the decommissioning of P and R-Reactors). These same improved formulations may be used in the grouting of the 772-F LAD/HAD cells and tanks to entomb contaminants and permanently address water inleakage.

D&D Project Referenced: See description and references in response to Question 1
Respondent's Position in Relation to D&D Project: Engineering support for projects via implementation of Manuals 1C and E7 procedures.

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?
No additional issues other than those discussed in Question 10.

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

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.
No other issues were identified.
Respondent's Position in Relation to D&D Project: N/A

The D&D Roadmap team appreciates all feedback and answers to this questionnaire. There are no wrong answers, and all input from experienced individuals with experience in D&D work are valuable to the success of this project and related work in the DOE complex. Results of this initiative will be shared freely with D&D project teams with the sole intention of improving the quality of work and life of these teams.

Should there be any questions or comments to this questionnaire, please contact the project leads listed below.

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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 SRS Questionnaire Responses

D&D Roadmap Assessment of SRS Questionnaire Responses

SRS - 235F -1: Field Based Qualitative Characterization		
Chosen Questionnaire Response	**Assessment Category**	**Assessment Criteria**
Definitive, real-time data that will allow for immediate, accurate field decisions in determining appropriate waste streams. This will eliminate the conservative practice of handling/disposing of clean waste as contaminated.	Stage	1,3
	Timeline	1,2,3
	Driver	1,3
	Impact	1
	Challenge	2,5,6
	Technology	11

SRS - 235F -2: Robotic/Remote Applications		
Chosen Questionnaire Response	**Assessment Category**	**Assessment Criteria**
The current scope of work being performed has no technological needs. Future work like characterizing the interior of the large concrete exhaust duct that is located on the roof of 235-F, this technology should be able to remotely perform Radiological survey, concrete sampling and video feedback at a minimum and be portable enough to be easily mobilized to a roof deployed through small duct opening and perform its work.	Stage	3
	Timeline	1
	Driver	3,4
	Impact	2
	Challenge	1,6,7
	Technology	3,4

SRS - 235F- 3: Contaminant Fixation		
Chosen Questionnaire Response	**Assessment Category**	**Assessment Criteria**
If adequate lock down/capture/fixative technology existed, it may have driven the alternative selection process (EECA) in a different direction i.e. removal of the building process equipment and building structure. If developed it could provide additional options for D&D of other facilities.	Stage	1,3
	Timeline	2
	Driver	2,3
	Impact	1
	Challenge	2
	Technology	5

SRS - 235F - 4: Hydrogen Generation During In-situ Decommissioning		
Chosen Questionnaire Response	**Assessment Category**	**Assessment Criteria**
Tech Improvement Enhancement: we have and will use specialty grout mixes developed with help of researchers in SRNL are useful to the decommissioning projects that rely on InSitu Disposal end states. Tech Needs: approach for prevention/mitigation of hydrogen deflagration (option to recombiners), method for grout placement in process enclosures without losing confinement, specialty grout for particulate Pu-238.	**Stage**	**3**
	Timeline	**1,2**
	Driver	**2,4**
	Impact	**1**
	Challenge	**2,4**
	Technology	**6,7**

SRS - 235F - 5: Decay and Byproduct Control		
Chosen Questionnaire Response	**Assessment Category**	**Assessment Criteria**
There is the potential to install PARs (Passive Autocatalytic Recombiners) in 235-F during its future decommissioning. There is Pu-238 inside the gloveboxes in the building that cannot be removed due to ALARA reasons. As it decays, it generates hydrogen over time, which presents an explosion hazard post-decommissioning. We are still working through multiple different methods for decommissioning and installing PARs is one of those potential methods. However, this is a relatively new technology used primarily in nuclear power plants and has never been used in this type of application.	**Stage**	**3**
	Timeline	**1,2**
	Driver	**4**
	Impact	**2**
	Challenge	**1,2**
	Technology	**6**

SRS - 235F - 6: Fixative Application		
Chosen Questionnaire Response	**Assessment Category**	**Assessment Criteria**
Building 235-F is slated for “in-situ” decommissioning versus complete demolition, primarily so as to avoid worker exposure and the risk of uptake/contamination events [see Comparative Analysis (Table 3) in SRNS-RP-2021-00001]. That said, there is still significant worker exposure/risk associated with the “in-situ decommissioning” alternative because it does involve extensive entry into Building 235-F (an HCA/ARA) for the installation of forms/supports and placement of grout. Additionally, it is anticipated that grout will be placed inside contaminated components such as cells and gloveboxes. Breaching these contaminated components could release contaminants into 235-F and lead to worker exposure. The best method for breaching the contaminated components and introducing grout is TBD.	**Stage**	**1,3**
	Timeline	**1,2,3**
	Driver	**3,4**
	Impact	**2**
	Challenge	**4,7**
	Technology	**5,7**

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