RECOMMENDATIONS FOR PHASE 1 EXHUMATION STUDIES

WEST VALLEY DEMONSTRATION PROJECT AND
WESTERN NEW YORK NUCLEAR SERVICE CENTER

Prepared for:
United States Department of Energy and
New York State Energy Research and Development Authority

Prepared By:
WVDP EXHUMATION WORKING GROUP

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Contract Number DE-EM0002446

November, 2013

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November 2013

EXECUTIVE SUMMARY

This document presents the recommendations of the Exhumation Working Group (EXWG) for initial studies under the Phase 1 Study process to address a number of technical issues related to full and partial exhumation or treatment scenarios for the State Licensed Disposal Area (SDA), the NRC Licensed Disposal Area (NDA), and the high-level waste tank farm (WTF) at the West Valley Demonstration Project (WVDP) and the Western New York Nuclear Service Center (WNYNSC). The studies described herein constitute the EXWG's consensus recommendations to the United States Department of Energy (DOE) and New York State Energy Research and Development Authority (NYSERDA) to promote interagency agreement on technical areas regarding assumptions and analyses presented in the 2010 Final Environmental Impact Statement (FEIS).

In support of this effort, DOE and NYSERDA prepared seven topical questions to help the EXWG understand the areas for which further analysis may facilitate interagency consensus on Phase 2 Decommissioning decisions at the WVDP/WNYNSC. To begin addressing these questions, the EXWG makes the following initial recommendations, which are expected to inform additional follow-on studies associated with waste exhumation for the SDA, NDA, and WTF:

- *Study 1 - Waste Inventory Analysis:* Inventories of the waste types, locations, volumes, and radioactive content will be updated as appropriate and used to support future studies of full and partial exhumation scenarios by the EXWG.
- *Study 2 – Evaluation of Methods to Address Inventory Uncertainty:* Three different approaches that could potentially be implemented to better understand and potentially reduce the level of uncertainty associated with the radionuclide inventories for the NDA, SDA, and WTF will be comparatively evaluated. The three approaches include: (1) assessment of the efficacy of applying statistical techniques to the inventory data; (2) evaluation of the results of previous radiation and geophysical studies of the SDA and NDA; and (3) review and evaluation of intrusive and non-intrusive investigation techniques that could potentially reduce uncertainty by providing improved direct measurements of waste activity in the field.
- *Study 3 - Review of Precedent Projects:* A number of exhumation and in-situ treatment projects to reduce waste volume or activity have been developed and/or completed at DOE and other facilities in the United States and at international sites. These precedent projects will be evaluated to determine the state of practice and art in waste removal and treatment technologies, as well as any lessons learned that will support the development of meaningful exhumation or treatment scenarios for the NDA, SDA, and WTF.

The three studies being recommended herein are intended as a first step in meeting the ultimate objective of the Phase 1 Study process for the EXWG; that is, to reduce uncertainty and to facilitate interagency consensus regarding waste exhumation methods, costs, and risks. The information produced in the three recommended studies will form the basis for follow-on study recommendations that can be better targeted to specific potential exhumation or treatment scenarios.

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ACRONYMS AND ABBREVIATIONS

CFR	Code of Federal Regulations
DOE	United States Department of Energy
ECS	Enviro Compliance Solutions, Inc.
EXWG	Exhumation Working Group
FEIS	Final Environmental Impact Statement
GTCC	Greater Than Class C
HDPE	High Density Polyethylene
HLW	High Level Waste
NDA	NRC Licensed Disposal Area
NRC	United States Nuclear Regulatory Commission
NYSERDA	New York State Energy Research and Development Authority
PAS	Potential Area of Study
ROD	Record of Decision
SDA	State Licensed Disposal Area
SME	Subject Matter Expert
T&VDS	Tank and Vault Drying System
TRU	Transuranic Waste
WMA	Waste Management Area
WNYNSC	Western New York Nuclear Service Center
WTF	Waste Tank Farm
WVDP	West Valley Demonstration Project
WVNS	West Valley Nuclear Services, Inc.

1. BACKGROUND AND SCOPE

This document presents the recommendations of the Exhumation Working Group (EXWG) for initial studies under the Phase 1 Study process to address a number of technical issues related to full and partial exhumation or treatment scenarios for the State Licensed Disposal Area (SDA), the NRC Licensed Disposal Area (NDA), and the high-level waste tank farm (WTF) at the West Valley Demonstration Project (WVDP) and the Western New York Nuclear Service Center (WNYNSC).

1.1 EXHUMATION WORKING GROUP MISSION

The overall purpose of the Phase 1 study process is to identify and conduct additional scientific studies in order to reduce uncertainty and to facilitate interagency consensus on how to complete decommissioning of the facilities remaining at the WVDP/WNYNSC following completion of Phase 1 Decommissioning. The EXWG mission is to develop and execute studies that address key issues and related uncertainties pertaining to the following Phase 1 Potential Areas of Study (PASs) identified by DOE and NYSERDA:

- Alternate approaches for, costs of, and risks associated with complete waste and tank exhumation;
- Viability, cost, and benefit of partial exhumation of waste and removal of contamination;
- Exhumation uncertainties and benefit of pilot exhumation activities.

The SMEs combined their individual areas of expertise in radiological waste exhumation and management with information gained from a review of the 2010 Final Environmental Impact Statement (FEIS), various comments, reviews, and critiques of the FEIS prepared by others, and other relevant documents to develop the studies being recommended herein. In support of this effort, DOE and NYSERDA prepared seven topical questions to help the EXWG understand the areas for which further analysis may facilitate interagency consensus on Phase 2 Decommissioning decisions at the WVDP/WNYNSC. The seven questions are as follows:

1. Can the long-lived inventory in the SDA, NDA, and WTF be somehow selectively removed to reduce the time that these facilities will pose a hazard? If so, at what cost?
2. If the long-lived inventory cannot be selectively removed from the disposal areas, can the waste be "mined" out of the SDA and NDA while leaving a majority of the surrounding soil in place? If so, at what cost?
3. If the long-lived inventory cannot be selectively removed from the tanks, could portions of the tanks be removed while leaving surrounding tank material, or just the vaults, in place? If so, at what cost?
4. Are the robust facilities shown in the FEIS for conducting tank and disposal area removals necessary, or can removals be done using less robust, yet still protective methods, at lower cost?
5. Would answers to any of the above questions change if we waited for 30, 60, 90, or 120 years before undertaking the action? For example, could the action go from a remote action to a contact-handled action?
6. With respect to each of these questions, what are the uncertainties associated with estimations of changes in source term and cost given currently available information? Would additional studies likely better quantify and/or reduce these uncertainties? If so, what are these additional studies?
7. Are there exhumation uncertainties or data needs that can be addressed only through a pilot exhumation? Would such a pilot exhumation action be feasible and reasonable considering health and safety, worker exposure, waste generation, and cost? Given these considerations, what would be the costs/benefits of a pilot exhumation?

1.2 SUMMARY OF RECOMMENDED STUDIES

Multiple criteria for prioritizing waste removal or treatment scenarios can be identified, including (but not necessarily limited to): (1) waste comprised of certain long-lived radionuclides or groups of radionuclides that pose the greatest long-term risk to workers, the public, and the environment, the removal of which would reduce the uncertainty in the long-term threat of any waste left in place; (2) waste areas of highest activity (whether short-lived or long-lived) to achieve the greatest reduction in total activity; (3) wastes that are technically conducive to safe and effective removal with a high degree of certainty as to the waste forms and radiological makeup (e.g., 'deep holes' in the NDA); and (4) waste located in areas most prone to future erosion or landslides (as identified through analyses by and cross-collaboration with the Erosion Working Group) to reduce the uncertainty of long-term disruptive impacts from natural processes.

To address these criteria, particularly as they relate to partial waste removal or treatment scenarios, a better understanding is required of the waste inventory that would need to be removed to meet a given criterion, the associated benefits of that removal, and the costs associated with such removals. Radionuclide inventories of the three WMAs under study were previously developed from original disposal records and other available information (i.e., SDA [URS 2002], NDA [URS 2000], and WTF [WVNS 2005]), and will form the basis for the first study being recommended to support the eventual development of waste removal and treatment scenarios. In particular, existing inventories of the waste types, locations, volumes, and radiological activities will be updated and used in an evaluation of how much waste would have to be removed and in what physical forms and from which locations to best meet various remedial action criteria. The objectives, rationale, major components, and work products for Study 1 are addressed in more detail in Section 2.0.

The previous waste inventory work was focused on providing the most reliable estimate of the waste inventory based on available records to support the comparative evaluation of the Sitewide Removal Alternative and the Sitewide Close-in-Place Alternative in the FEIS. While deterministic analysis in the FEIS deemed these estimates conservative, no rigorous quantification of uncertainty had been performed. The inclusion of partial exhumation and treatment scenarios into the EXWG's scope has elevated the importance of understanding the level of confidence that one has in the waste inventory estimates. A second study is, therefore, recommended to comparatively evaluate three different approaches that could potentially be implemented to better understand and reduce the level of uncertainty associated with the radionuclide inventories for the NDA, SDA, and WTF. The three approaches include: (1) assessment of whether statistical techniques can be effectively applied to the raw inventory data to more rigorously bound and quantify the level of confidence in the inventory values; (2) evaluation of the results of previous radiation and geophysical surveys of the SDA and NDA, with potential application of computer models to compare expected against actual observations; and (3) review and evaluation of intrusive and non-intrusive investigation techniques that could potentially reduce uncertainty by providing improved direct measurements of radiological activity of the waste in the field. More information on Study 2 is presented in Section 3.0 of this document.

The future selection of either complete or partial exhumation scenarios or waste treatment options also requires a determination of the specific approaches/technologies that will achieve successful technical performance while providing for worker, community, and environmental protection at most reasonable and justifiable cost. In response, a third recommended study will evaluate a number of exhumation and in-situ treatment projects to reduce waste volume or activity that have been developed and/or completed at DOE and other facilities in the United States and at international sites. These precedent projects will be evaluated to determine the state of practice and art in waste removal and treatment technologies, as well as any lessons learned that will support the development of meaningful exhumation or treatment scenarios for the WVDP/WNYNSC. Study 3 is developed in more detail in Section 4.0.

1.3 REDUCING UNCERTAINTY

The three studies being recommended herein are intended as a first step in meeting the ultimate objectives of the Phase 1 Study process for the EXWG; that is, to reduce uncertainty and to facilitate interagency consensus. The studies are intended to produce information that can be used directly in the evaluation and quantification of uncertainty, as well as to form the basis for follow-on study recommendations toward the goal of a continued progression in uncertainty reduction.

The initial studies are intended to address and reduce those uncertainties associated with inventory estimates in the NDA, SDA, and WTF that will be required to evaluate remedial scenarios for these WMAs by the EXWG. It is for this reason that the early emphasis is on the waste inventory (Study 1) and potential methods to reduce the uncertainty thereof (Study 2), as well as to evaluate the successes and failures of similar full or partial exhumations at other sites (Study 3).

The information generated from the three studies described herein will be used to explore the feasibility, benefits, and cost of pilot exhumation studies as a future step in the Phase 1 Study process. A final decision on the need for and scope of pilot studies will, however, await completion of any intrusive and non-intrusive investigations and a subsequent analysis of remaining data gaps and the likelihood of being able to fill those gaps.

2. STUDY 1: WASTE INVENTORY ANALYSIS

2.1 OBJECTIVE

The objectives of Study 1 are to:

- Update the radionuclide inventories for the NDA, SDA, and WTF
- Support future Phase 1 studies by the EXWG related to full and selective waste exhumation scenarios by providing information about specific locations, radionuclide activities, and volumes of materials that might be exhumed.

2.2 RATIONALE

The radionuclide inventories of the three WMAs under study were each developed from original disposal records and other available information (i.e., SDA [URS 2002], NDA [URS 2000], and WTF [WVNS 2005]). The current NDA and SDA inventory estimates used January 1, 2000 as the "reference year" and the WTF inventory used 2005. In Study 1, these inventories will be updated to a new reference year (2020) to reflect new information, field activities that have occurred in the interim, and radionuclide decay. Inventories will also be calculated at 30, 60, 90, and 120 years beyond the updated reference date to evaluate if the decay of short-lived radionuclides (e.g., Cesium-137 with a half-life of 30 years) would be sufficient within those timeframes to potentially modify the removal approach and worker protection requirements. Longer timeframes may also be considered, if necessary, to support the development and evaluation of waste removal scenarios.

As part of Study 1, the ways in which the NDA, SDA, and WTF radionuclide inventories are currently compiled and segmented will be expanded to provide the supporting information for the future development of a number of exhumation scenarios.

2.3 COMPONENTS OF WORK

2.3.1 Update Radionuclide Inventories

The first component of work will be an updating of the radionuclide inventories for the SDA, NDA, and WTF for each new decay period (Year 2020 and 30, 60, 90, and 120 years thereafter, and possibly longer periods as appropriate). Radionuclide inventories will be updated and tabulated for individual disposal units consistent with the existing inventories (e.g., a 50-foot section of a trench in the SDA, an individual disposal hole in the NDA, and each tank in the WTF). The methods used previously to convert time of disposal activities to January 1, 2000 activities for the SDA and NDA (URS, 2000; URS, 2002) will be adapted to fit the specific needs of Study 1. The updating of the radionuclide inventory for the WTF will include the effects of actions that have taken place at the WTF since completion of the vitrification process.

2.3.2 Process and Apply Inventory Data

For the NDA, SDA, and WTF, the revised inventories for the new reference date and selected future dates generated under Section 2.3.1 will support the future development and evaluation of full and partial exhumation scenarios by the EXWG. The revised inventory data will be used to quantify the total inventory of a given radionuclide in an individual disposal unit and the associated volume of waste and soil that would be removed under a range of exhumation or treatment scenarios, as well as the percentage of the total inventory and waste volume represented by the amount removed from the single disposal unit. The revised inventory data, coupled with the identification of the radionuclides that are the primary long-

term contributors to off-site dose from the NDA, SDA, and WTF, may be used to evaluate potential selective removal scenarios from these WMAs.

For example, if exhumation was performed at the reference date, exhumation of 28% of the total waste/soil volume may be sufficient to remove 90% of the U-234 from the SDA, whereas only 7% of the volume would have to be exhumed to remove about 50% of the U-234. The inventory and percentage of other radionuclides in the disposal unit exhumed with the targeted radionuclide will also be incorporated into the analysis. For example, exhumation of the SDA disposal units necessary to remove 90% of the U-234 may also remove 38% of the total C-14 and 24% of the Tc-99.

Calculation of future radionuclide inventories will provide information on the need for contamination controls, remote operating practices, shielding requirements, and worker protection requirements for a range of exhumation scenarios. In addition to targeting specific radionuclides, the effects of targeting specific erosion or landslide prone areas within the SDA and NDA would also be evaluated in consultation with the Erosion Working Group. Selective removal is not necessarily limited to targeted waste exhumation, but could also involve activity reduction through chemical or physical methods. Examples would include removal and treatment of leachate from the SDA and NDA burial grounds, or additional cleaning of the WTF tanks via acid washing or high-pressure water jets with collection and treatment of the injected fluids.

2.4 WORK PRODUCT

The primary work product for this task will be a series of tables and graphs that summarize the inventory at various points in time and location and its application to multiple waste exhumation scenarios. This information will be compiled into a study report (see Section 5.0), which will include the use of the updated inventory and related analyses to support the recommendation of selective exhumation scenarios.

3. STUDY 2: EVALUATION OF METHODS TO ADDRESS INVENTORY UNCERTAINTY

3.1 OBJECTIVE

Study 2 will involve a comparative evaluation of three different approaches that could potentially be implemented to better understand and reduce the level of uncertainty associated with the radionuclide inventories and locations for the NDA, SDA, and WTF (i.e., uncertainty in inventory estimates [disposal records, volume, activity], waste burial location, NDA mapping uncertainty, etc.). The three approaches include: (1) application of statistical techniques to the raw inventory data to more rigorously bound and quantify the level of confidence in the inventory values; (2) evaluation of the results of previous radiation and geophysical studies of the SDA and NDA, with potential application of computer models to compare expected against actual observations; and (3) review and evaluation of intrusive and non-intrusive investigation techniques that could potentially reduce uncertainty by providing improved direct measurements of the radiological activity of waste in the field.

3.2 RATIONALE

The current inventories of the SDA and NDA are based on disposal records and other historical data from the period of active waste disposal operations at the West Valley site. The work to develop these inventories was thorough, and further mining of the raw inventory records would not be expected to improve the reliability of the inventory estimates themselves. The reliability of the waste inventories was at least partially corroborated at the time of development by information on the type of waste processed at the generating facility and the manner in which the disposal units were filled. Nevertheless, because the computed inventories are only as reliable as the records and other information upon which they were based, and the reliability of those records is not known, the degree of uncertainty in the estimated volumes and locations of waste remains a concern, particularly for the SDA.

The previous work was focused on providing the most reliable estimate of the waste inventory to support the comparative evaluation of the Sitewide Removal Alternative and the Sitewide Close-in-Place Alternative in the FEIS. These ‘all or nothing’ removal alternatives moderated the need to reliably match disposed wastes to specific locations. Now, however, consideration of partial exhumation and treatment scenarios has elevated the importance of understanding the level of confidence that one has in the waste inventory estimates within a given disposal unit. Additional studies are, therefore, necessary to test the reliability of the existing waste inventories and to reduce the uncertainty in future decisions based on those inventories.

As indicated above, three methods with the potential to better understand and reduce the level of uncertainty associated with the radionuclide inventories and locations are to be evaluated in Study 2. The first is to evaluate the efficacy of incorporating statistical methods into the process originally used to generate the waste inventories. The intent is to advance the understanding of the level of confidence that one can have in the inventory estimates to support the agencies in their decision-making process. The second approach will evaluate the results of past field surveys performed at the SDA, NDA, and WTF to assess whether these surveys, along with related computer modeling, can be useful in testing the reliability of the inventory estimates. Direct field measurements provide the best option to reduce inventory uncertainty. The third approach will, therefore, involve the review and evaluation of intrusive and non-intrusive investigation techniques that may be used to reduce uncertainty in the inventory estimates for the SDA, NDA, and WTF.

3.3 COMPONENTS OF WORK

3.3.1 Statistical Evaluation of Inventory Source Data

The process by which the waste inventory was developed for the NDA and SDA was comprised of three primary components, including: (1) determination of the radionuclides present in a given waste burial (container or group of containers) based on descriptive information from disposal records, results of analysis of waste samples and generator surveys, and ORIGEN calculations for the fuel assemblies processed; (2) allocation of activities to those radionuclides based on parameters reported in disposal records such as dose rate or mass of waste; and (3) assignment of locations to the waste burial based on information recorded in disposal records. In each step of the process, uncertainty can be introduced due to incomplete or faulty records, generalizations, or assumptions.

In Study 2, an evaluation will be made of how conducive the SDA and NDA waste inventory process is to a statistical evaluation, as well as the level of effort that would be required to complete the evaluation if deemed appropriate. Of primary importance will be whether the key input terms to the process can be meaningfully defined by a probability distribution or, at a minimum, whether reasonable error bounds can be placed on those terms. If so, then statistical methods can be used to quantify how the uncertainty in the individual input terms propagates through to the final waste inventory estimates. The statistical approach is expected to vary based on waste type and location, particularly as related to fundamental differences between the waste types and waste disposal techniques of the SDA versus the NDA. The intent in Study 2 is to apply the statistical approach as a test case to several trenches or other waste units to evaluate the efficacy of the approach. This information will then be used to estimate the level of effort that would be required for full-scale application of the approach versus the value to be gained, and to determine if the full-scale application is warranted as a follow-on Phase 1study.

A statistical treatment of the SDA and NDA inventory source data would represent an advancement in the waste inventory process to enhance the understanding of the uncertainty associated with the waste inventories. However, as with any attempt to better understand the amount and location of the radioactive materials buried in the waste management areas and the uncertainty thereof, the statistical approach may ultimately be limited by the amount and accuracy of the original records. As a result, any one of four potential outcomes is possible for this component of Study 2, including:

1. The available informational base for the SDA and NDA is found to be potentially lacking to reasonably bound or to define the necessary probability distributions for the input terms of interest. In this case, the statistical work would be terminated.
2. The test case of the statistical approach proceeds to completion, but the resultant error bar on the final waste inventory estimate is so large that no value would be provided toward the Phase 1 Study goal of facilitating interagency consensus. No further work would be recommended.
3. The test case of the statistical approach proceeds to completion with positive findings, but the level of effort required for full-scale application to the SDA and NDA would greatly exceed the value gained with respect to the Phase 1 Study goals. No further work would be recommended.
4. The test case of the statistical approach proceeds to completion with results that contribute to the understanding and quantification of uncertainty for the SDA and NDA. Assuming cost-reasonableness, a recommendation would be made for full-scale application as a follow-on study.

In the case of the WTF, the feasibility of performing a quantitative (e.g., Monte Carlo) uncertainty analysis of the inventory was previously addressed and deemed potentially inadequate in the WTF inventory report (WVNS 2005) due to the limited characterization data available. Alternatively, the

uncertainty in the WTF inventory was captured in the 2005 report by providing three inventory sets: Best Estimate, Conservative, and Worst Case inventories. The Best Estimate inventory was based on the most realistic values and assumptions available (e.g., using the mean of replicate samples). The Conservative inventory was based on "realistic conservatism" – "conservatism" in the sense of preserving adequate safety margins, and "realistic" in the sense of being anchored within the upper end of the measured data (e.g., using the mean value plus two times the standard error for replicate samples). Finally, the Worst Case inventory was an extreme upper bound estimate (e.g., for replicate samples, using the highest observed result plus the reported sample uncertainty). Because it is expected that the WTF characterization data will continue to remain limited, it may be determined that any future evaluation of inventory uncertainty for the WTF will be restricted to a similar Best Estimate, Conservative, and Worst Case approach. Consideration will be given, however, to the use of statistical methods to evaluate the propagation of uncertainties through the inventory estimating process.

3.3.2 Review of Previous Surveys

The results from previous radiation studies completed at the West Valley site, including those reported in the Environmental Information Document (WVNS, 1993), will initially be evaluated to determine if they provide an independent source of information to corroborate the inventory. Computer models, such as Microshield, will be used, if warranted, to compare the measured gamma radiation to what would be expected to be measured at the surface based on the soil cover and the computed waste inventory at a given location. Even if the previous survey results are insufficient to allow for inventory verification, application of the Microshield model may still provide valuable insight into what one can expect to measure using other intrusive and non-intrusive technologies prior to making recommendations for further studies.

The results of past geophysical surveys will also be evaluated as a possible supplement to the information provided in the existing inventory regarding the physical properties of the waste placed in the NDA and SDA. The resulting information may be useful in the future selection of methods of excavation and requirements for waste processing and packaging.

3.3.3 Evaluation of Potential Investigation Methods

Technologies and methods that could provide additional characterization data to meet the study objective of uncertainty reduction will be evaluated based on published information and previous applications at other sites. Among the technologies to be evaluated are an updated gamma walkover survey, a passive neutron survey, 3D tomographic imaging, a gamma spectrometer modified for use in monitoring wells, poly-shielded BF3 multiple tubes to assay fast neutrons from fission products, and soil gas monitoring for fission product gases at various depths. Employing certain technologies within vertical borings that penetrate the HDPE cover into the soil overlying the waste, or within horizontal borings installed by directional drilling into the soil horizon between or below the waste trenches, may yield important information on the spatial distribution of radionuclides in the trenches and disposal holes. The costs and potential benefits of both types of borings will be evaluated as part of Study 2, including any potential risks associated with the intrusive nature of these techniques and measures to eliminate or mitigate these risks.

3.4 WORK PRODUCT

Study 2 will provide a qualitative determination of the reliability of the current inventory and, as appropriate, recommendations for additional statistical and/or field studies to address the resultant uncertainty, both of which will be incorporated into the study report. Based on the Study 2 review and the work being performed under Study 1, subsequent surveys and investigations may be recommended to

reduce the level of uncertainty in the SDA and NDA inventories in support of the selection of partial waste exhumation or treatment scenarios.

4. STUDY 3: REVIEW OF PRECEDENT PROJECTS

4.1 OBJECTIVE

The objective of Study 3 is to apply the experiences in exhuming or treating waste disposal areas and tanks at other DOE, commercial, and international sites to help determine: (1) the state-of-practice and state-of-the-art in exhumation and treatment technologies; (2) methods for worker, public, and environmental protection; (3) lessons learned; and (4) what uncertainties were important and how they were addressed.

4.2 RATIONALE

The ability to safely and effectively reduce the volume and/or activity of waste in the disposal areas and tanks at the WVDP/WNYNSC is a major challenge with considerable uncertainty. While recognizing that conditions at the WVDP/WNYNSC are somewhat unique, there is a considerable record of exhumation and treatment projects at other sites from which valuable information can be derived to supplement the direct experience of the SMEs on similar projects. Additionally, other exhumation techniques have been studied, but not yet implemented, at a number of other sites. These studies will likewise be reviewed.

Experiences at other sites will provide a line of direct evidence that selective waste removal or in-situ treatment may be an acceptable alternative, that lower-price removal or treatment technologies may exist, that less robust protective measures may be sufficient, and that some uncertainties can be reduced. In addition, the recommended review of precedent waste removal and treatment projects is expected to provide examples of where community acceptance has been achieved and both technical and administrative challenges have been overcome.

4.3 COMPONENTS OF WORK

The scope of Study 3 is to conduct a literature search and, if warranted, expand to interviews to determine approaches, problems encountered, and how uncertainties were addressed at other completed, ongoing, and planned waste removal and treatment projects. The review of precedent projects will also examine how radiological hazard categories, as defined in 10 CFR 830 Subpart B (2001), were addressed at other sites in comparison with the FEIS. Among the projects to be reviewed are the following:

<u>SDA and NDA</u>

- Hanford (WA) Site 618 Burial Grounds
- Idaho National Engineering and Environmental Laboratory Pit 9
- Hanford Site Burial Grounds – 200 East and 200 West Areas: Transuranic Pilot Retrieval
- Los Alamos (NM) National Laboratory TA-21 Burial Site
- Oak Ridge (TN) 22-Trench Area Remote Handled Transuranic Waste (TRU) Retrieval Project
- Maxey Flats (KY) Low-Level Radioactive Waste Disposal Facility
- Parks Township (PA) Shallow Land Disposal Areas
- Fernald (OH) Waste Pits

High-Level Waste Tanks

- Savannah River (GA) High-Level Waste Tanks
- Idaho Nuclear Technology and Engineering Center/Idaho Chemical Processing Plant (DOE, 1998)
- Hanford AX Tank Farm (DOE, 1999) and 241-C Tank Farm (DOE, 2010)
- Fernald K-65 Tanks
- International Sites: Sellafield, United Kingdom and La Hague, France

4.4 WORK PRODUCT

The findings of Study 3 that will be incorporated into the study report include: (1) various technical approaches employed at other sites and their potential applicability to the three WMAs at the West Valley site; (2) waste removal and treatment technologies with high potential applicability to the waste forms in the NDA, SDA, and WTF; (3) special relevant problems encountered at other sites and how they were addressed and resolved; and (4) recommendations for any follow-on studies that would reduce the uncertainty of whether a certain approach or technology would be successful for waste exhumation or treatment at the SDA, NDA, or WTF, including pilot studies.

5. REPORT AND SCHEDULE

5.1 STUDY REPORT

A comprehensive Exhumation Study Report will be generated by the SMEs that will serve both as a report of findings for the individual studies and as a source of recommendations for further studies for consideration by DOE and NYSERDA based on those findings. Any recommendations for additional studies made in the Study Report will be based on identified data gaps and key areas of uncertainty, with consideration of the costs and risks that would be incurred versus the benefits that would be gained in reducing the key areas of uncertainty.

5.2 SCHEDULE

As indicated throughout this document, the recommended three studies represent only the initial Phase 1 study process for the EXWG. These initial studies will, therefore, have to be completed in a timeframe that can accommodate additional studies within the overall Phase 1 scheduling objective of submitting a final set of Phase 1 findings and recommendations to DOE and NYSERDA during calendar year 2016. It is estimated that the initial studies and related work products recommended herein can be completed within six months of DOE and NYSERDA approval. A detailed study schedule will be completed as part of the next phase of project scoping once the recommended studies are accepted by the Agencies.

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