

**REMOVAL TO THE
MAXIMUM EXTENT PRACTICAL (MEP) INPUT
PACKAGE**

for the

**Section 3116 Draft Basis Document
for F-Tank Farm
at the
Savannah River Site**

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Prepared by: Savannah River Remediation, LLC
Closure & Waste Disposal Authority
Aiken, SC 29808



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ACRONYMS / ABBREVIATIONS

DOE	United States Department of Energy
FTF	F-Tank Farm
HRR	highly radioactive radionuclide
MEP	maximum extent practical
NDAA	Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005
NRC	United States Nuclear Regulatory Commission
SRS	Savannah River Site

1.0 INPUT PACKAGE DESCRIPTION

Input package FTF-WDIP-003 provides information anticipated to be used in Section 5.2.1, *Highly Radioactive Radionuclide Removal to the Maximum Extent Practical*, of the Draft F-Tank Farm (FTF) 3116 Basis Document. Development of FTF-WDIP-003 allows for early review of this information before the Draft FTF 3116 Basis Document is submitted to the Nuclear Regulatory Commission (NRC) for further consultation, and issued for public comment. This input package provides the anticipated approach for demonstrating removal of highly radioactive radionuclides (HRRs) to the “maximum extent practical” (MEP) and an annotated outline of wording representative of the information anticipated to be included in the Draft FTF 3116 Basis Document¹.

2.0 DRAFT FTF 3116 BASIS DOCUMENT APPROACH

The following describes the approach the Department of Energy (DOE) is considering for demonstrating the removal of HRRs “to the maximum extent practical” as it pertains to the closure of waste tanks and ancillary structures in FTF.

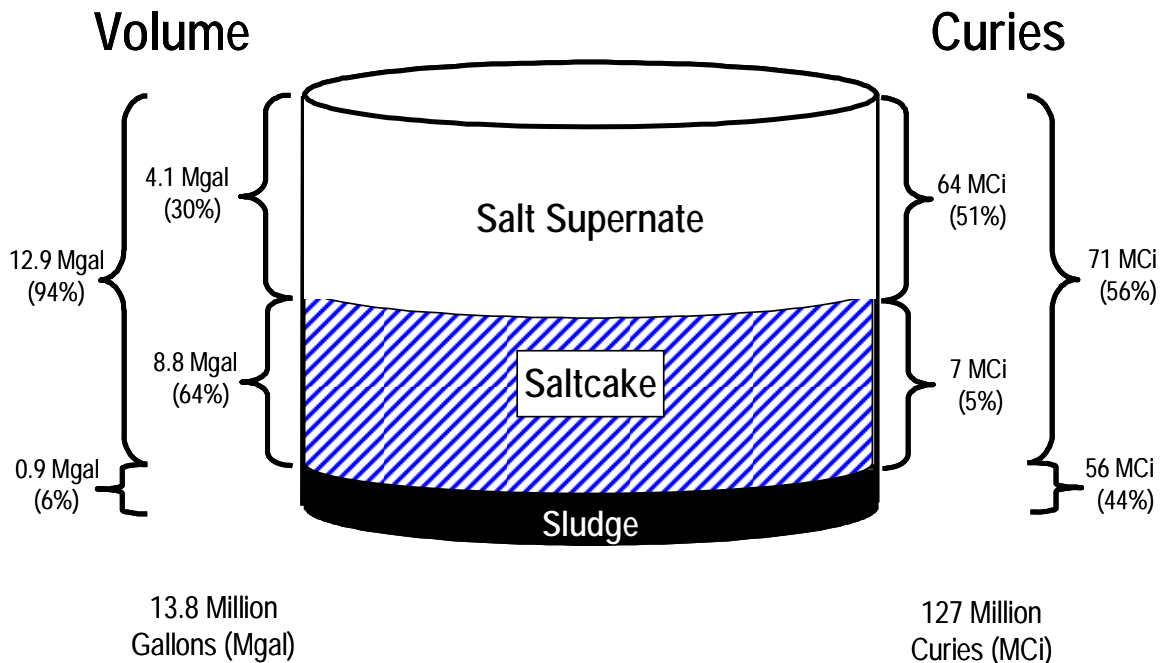
- As appropriate, the Draft FTF 3116 Basis Document will utilize the language provided in the following documents to describe “removal to the maximum extent practical.”
 - DOE-WD-2005-001, *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, and
 - DOE/NE-ID-11226, *Basis for Section 3116 Determination for the Idaho Nuclear Technology and Engineering Center Tank Farm Facility*.
- Language will be tailored to the unique features of FTF, where appropriate.
 - The waste that has historically been stored in the FTF waste tanks varies between tanks and even within individual tanks due to:
 - differing chemical separation processes within F Canyon,
 - differences in the specific tank usage in the storage or volume-reduction of the waste (e.g., Canyon Receipt Tank, Evaporator Concentrate Receipt Tank), and
 - differences in usage over time or the different waste characteristics resulting from chemical separations campaigns run within F Canyon over time.
 - Ancillary structures within FTF may also have unique features and associated residual characteristics depending on their service lives.
 - Ancillary structures are specifically discussed in Input Package FTF-WDIP-001 and will be described in the Introduction and Purpose Section of the Draft FTF 3116 Basis Document.
- Also reviewed to ensure any comments received from the NRC during prior consultations have been appropriately considered were the following documents:
 - CBU-PIT-2005-00131, *Response to Request for Additional Information on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*,

¹ The purpose of developing this input package and utilizing the scoping process parallel to development of the Draft FTF 3116 Basis Document is to expedite the identification of issues and assess the reasonability of DOE’s approach in addressing the NDAA Section 3116 criteria, thereby allowing for more informed and efficient consultation with the NRC and a more informed draft for public comment. Changes in the described approaches and information presented in this input package may occur based on discussions during the scoping process.

- associated with the approved *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site* (DOE-WD-2005-001), and
- ICP/EXT-06-01204, *Response to Request for Additional Information on the Draft Section 3116 Determination, Idaho Nuclear Technology and Engineering Center Tank Farm Facility* associated with *Basis for Section 3116 Determination for the Idaho Nuclear Technology and Engineering Center Tank Farm Facility* (DOE/NE-ID-11226)
 - The majority of the waste removal activities will take place following a determination by Secretary of Energy, should the Secretary so decide, that, based on consultation with the NRC and for the reasons set forth in the final FTF 3116 Basis Document, the stabilized residuals, tanks and ancillary structures that would remain in the FTF meet the applicable criteria in Section 3116(a) of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005, and thus are not high-level waste.
 - The NRC contemplates this situation in its staff guidance. [NUREG-1854]
 - DOE-WD-2005-001, *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, and DOE/NE-ID-11226, *Basis for Section 3116 Determination for the Idaho Nuclear Technology and Engineering Center Tank Farm Facility*, included forward-looking analyses that described future salt waste treatment activities and waste removal/grouting activities, respectively.
 - The Draft FTF 3116 Basis Document will be consistent with the approaches used in those prior 3116 Basis Documents.
 - The residual waste remaining in a waste tank or ancillary structure following successful completion of heel removal and removal of the HRRs “to the maximum extent practical” will be referred to as “residuals.”
 - The discussion of “practical” in the context of NDAA §3116 will mirror as appropriate the words used in the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site* and the *Basis for Section 3116 Determination for the Idaho Nuclear Technology and Engineering Center Tank Farm Facility*.
 - A discussion will be provided on the current status of FTF (numbers below reflect as of January 5, 2010).
 - Two closed tanks, Tanks 17 and 20
 - 20 additional waste tanks and associated ancillary structures, many of which are in varying states of cleaning operations
 - o Tanks 18 and 19 complete
 - o Tanks 3, 5, 6, 7, and 8 having undergone cleaning operations
 - 127 million curies (MCi)
 - o 71 MCi in salt waste (64 MCi in supernate; 7 MCi in saltcake)
 - o 56 MCi in sludge waste (44% of curies in FTF)
 - 13.8 million gallons (Mgal)
 - o 12.9 Mgal salt waste (4.1 Mgal in supernate; 8.8 Mgal in saltcake)
 - o 0.9 Mgal of sludge (6% of waste volume in FTF)
 - A brief discussion on bulk waste removal of both salt and sludge waste will be presented.
 - A discussion will be provided on three selected technologies for heel removal: 1) mechanical cleaning; 2) chemical cleaning; and 3) vacuum cleaning.
 - All three technologies have been successfully implemented at SRS for waste removal.

- A brief discussion on the process to select those technologies will be presented.
- Past experience provides confidence that waste removal operations will meet or exceed expectations.
- The DOE is considering including in the Draft FTF 3116 Basis Document, for additional information purposes, waste treatment technology descriptions of the high-level waste system.
- Waste removal activities are anticipated to result in collective removal of all HRRs for the entire FTF by approximately 99% based on a starting point of the maximum historical radionuclide inventory in the entire FTF.
- A summary of the FTF waste will be provided in diagram form using the most current information at the time of Draft FTF 3116 Basis Document drafting.

Figure 2.0-1: FTF Waste Summary



Inventory values as of 2010-01-05

- For additional information, the Draft FTF 3116 Basis Document also will describe DOE’s activities that will occur for each waste tank or ancillary structure to clean the tanks and ancillary structures, and remove the waste containing HRRs.
- Following bulk waste removal efforts, the additional waste removal phase is typically referred to as “heel removal”. Heel removal will be documented and supported by sampling and other methods including cost benefit analyses.
- The methodology includes clear and distinct steps with metrics and supporting documentation.
 - Each step will have defined criteria that must be demonstrated.
 - A final characterization of the remaining residuals will be documented with emphasis on the curies of HRRs remaining and the location of the HRRs. This will be part of

- the overall characterization documentation that will support demonstration of closure criteria for both DOE and South Carolina Department of Health and Environmental Control regulatory requirements.
- Waste tank and ancillary structure-specific documentation will be developed. This documentation will either be integral to, or serve as primary reference(s) for, the DOE Tier 2 Closure Documentation. The Tier 2 Closure Documentation will be approved by DOE-SR authorizing the closure of the waste tank or ancillary structure. [DOE Manual 435.1-1]

Based on the above outlined approach, the following section provides an annotated outline and strategy of the material anticipated to be contained in the Draft FTF 3116 Basis Document. Although the wording will be revised as DOE further develops and refines the Draft FTF 3116 Basis Document, the information provided represents the level of information anticipated to be provided in the Draft FTF Section 3116 Basis Document.

3.0 HIGHLY RADIOACTIVE RADIONUCLIDE REMOVAL TO THE MAXIMUM EXTENT PRACTICAL

Section Purpose

The NDAA Section 3116(a) provides that certain waste resulting from reprocessing is not high-level waste if the Secretary, in consultation with the NRC, determines, among other things, that the waste has had highly radioactive radionuclides (HRRs) removed “to the maximum extent practical” (MEP). The purpose of this section is discuss the basis on which the Secretary may conclude that the FTF residual waste, tanks and ancillary structures, upon completion of waste removal activities at closure, will have had HRRs removed to the MEP and meet this criterion.

Section Contents

Section 3.1 states the applicable criterion of NDAA Section 3116(a). Section 3.2 identifies the HRRs for the purpose of this determination. Section 3.3 describes the removal processes used to remove HRRs to the maximum extent practical. Section 3.4 describes the basis for determining HRRs have been removed to the MEP.

Key Points

- The list of HRRs for FTF describes the radionuclides that could reasonably be expected to exist in the FTF waste tanks and ancillary structures and that, using a risk-informed approach, could contribute significantly to the radiological risk to workers, the public, and the environment, taking into account scientific and health physics principles, knowledge and expertise.
- Over 99% of the waste volume and radioactivity will be removed from the FTF tanks and ancillary structures prior to closure activities using mechanical, chemical or vacuum technologies that have previous been successfully demonstrated in similar waste removal activities at SRS.

3.1 Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (NDAA) Criterion

NDAA Section 3116(a) provides in pertinent part:

[T]he term “high-level radioactive waste” does not include radioactive waste resulting from the reprocessing of spent nuclear fuel that the Secretary of Energy..., in consultation with the Nuclear Regulatory Commission..., determines –

(2) has had highly radioactive radionuclides removed to the maximum extent practical.

3.2 Identification of Highly Radioactive Radionuclides

(HRR Determination Input Package, FTF-WDIP-002)

3.3 Removal of Highly Radioactive Radionuclides to the Maximum Extent Practical

The NDAA Section 3116(a) of the NDAA provides that certain waste resulting from reprocessing is not high-level waste if the Secretary of Energy, in consultation with the NRC, determines, among other things, that the waste has had HRRs removed “to the maximum extent

practical.”² This section discusses the basis for the Secretary of Energy to conclude that the FTF residual waste, tanks and ancillary structures will have had HRRs removed to the MEP upon completion of waste removal activities at closure. Removal to the maximum extent “practical” is not removal to the extent theoretically “possible.” Rather, a “practical” approach to removal is one that is “adapted to actual conditions³”; “adapted or designed for actual use”; “useful⁴”; selected “mindful of the results, usefulness, advantages or disadvantages, etc., of [the] action or procedure⁵”; fitted to “the needs of a particular situation in a helpful way”; “effective or suitable”. Therefore, the determination as to whether a particular HRR will be removed to the MEP will vary from situation to situation, based not only on the available technologies but also on the overall costs and benefits⁶ of deploying a technology with respect to the conditions in a specific FTF waste tank or ancillary structure. The MEP standard contemplates room for exercising expert judgment in weighing several factors. Such factors may include environmental, health, timing, or other exigencies; the risks and benefits to public health, safety, and the environment arising from further HRR removal as compared with countervailing considerations that may ensue from not removing or delaying removal; the reasonable availability of proven technologies; the usefulness of such technologies; and the sensibleness of using such technologies. What may be removal to MEP in a particular situation or at one point in time may not be that which, on balance, is practical, feasible, or sensible in another situation or at a prior or later point in time.

The DOE notes that it may not be practical to undertake further removal of certain HRRs because further removal is not sensible or useful in light of the overall benefit to human health or the environment. As a general matter, such a situation may arise if certain HRRs are present in such low quantities that they make an insignificant contribution to potential doses to workers, the public, and the hypothetical future human intruder.⁷ [NUREG-1757. Vol. 2]

² The NDAA Section 3116 does not specify “remedial goals” or other numerical objectives, and does not require DOE to develop any such removal goals or objectives.

³ [A Dictionary of Modern English Usage]

⁴ [www.infoplease.com/ipd/A0598638.html]

⁵ [http://dictionary.cambridge.org/define.asp?key=practical*2+0&dict=A] “practical (EFFECTIVE): fitting the needs of a particular situation in a helpful way; helping to solve a problem or difficulty; effective or suitable”.

⁶ While prior NRC and DOE requirements for waste determinations called for removal “to the maximum extent *technically* and *economically* practical” (NRC_03-02-93; DOE M 435.1-1), Section 3116 omits these adverbs, thereby suggesting that a broad range of considerations, including but not limited to technical and economic practicalities, may appropriately be taken into account in determining the extent of removal that is practical.

⁷ The DOE normally would view radionuclides as making an insignificant contribution if the contribution to dose from those radionuclides, in both the expected case and degraded cases using sensitivity analyses, does not exceed the following: 1) 10% of the 25-mrem/yr all-pathways annual dose to the public, 2) 10% of the DOE 100-mrem annual dose limit to the intruder (under all reasonable intruder scenarios), 3) 10% of the DOE 500-mrem acute dose limit to the intruder (under all reasonable intruder scenarios), and 4) 10% of the annual worker dose to relevant provisions of 10 CFR 20. For perspective, DOE may also consider the extent to which such radionuclides contribute to an annual dose of 4 mrem to the receptor from the groundwater pathway. This methodology is based on NRC consultation and is intended to be consistent with the guidance and general approach in Volume 2 of NUREG-1757, Consolidated NMSS Decommissioning Guidance [ref.], which explains that “NRC staff considers radionuclides and exposure pathways that contribute no greater than 10% of the dose criteria to be insignificant contributors.” The above-referenced NUREG, which applies to NRC licensees, is being used only as general guidance, and DOE’s use of this NUREG as guidance should not be construed to suggest that it is a requirement under Section 3116 of the NDAA or that either the NUREG or 10 CFR 20, Subpart E is applicable in the 3116 context.

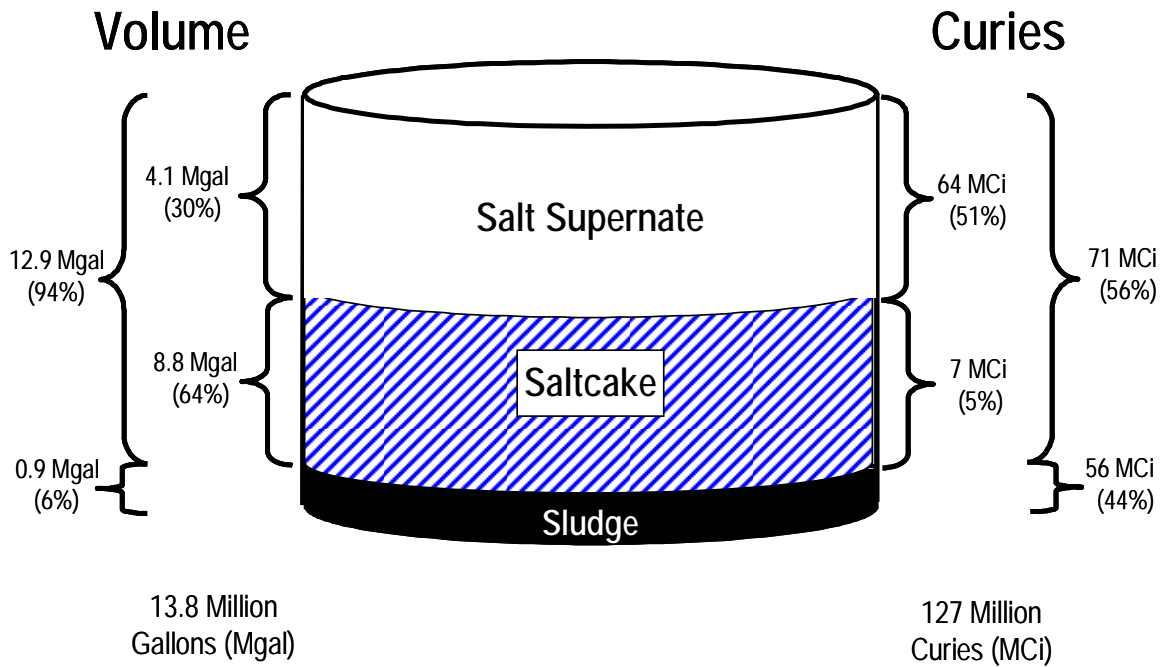
The HRRs will be removed from FTF waste tanks and ancillary structures to the MEP for the purposes of removing them from service and eventual closure. Removal of HRRs to the MEP in FTF waste tanks and ancillary structures occurs through a systematic progression of waste removal and cleaning activities using proven technologies, accompanied by documented sampling and analyses, such that further removal of HRRs is not sensible or useful in light of the overall benefit to human health, safety and the environment

3.3.1 Current Status of FTF Waste Removal Activities⁸

- A discussion will be provided on the current status of FTF (numbers below reflect as of January 5, 2010).
 - Two closed tanks, Tanks 17 and 20
 - 20 additional waste tanks and associated ancillary structures, many of which are in varying states of cleaning operations
 - o Tanks 18 and 19 complete
 - o Tanks 3, 5, 6, 7, and 8 having undergone cleaning operations
 - 127 million curies (MCi)
 - o 71 MCi in salt waste (64 MCi in supernate; 7 MCi in saltcake)
 - o 56 MCi in sludge waste (44% of curies in FTF)
 - 13.8 million gallons (Mgal)
 - o 12.9 Mgal salt waste (4.1 Mgal in supernate; 8.8 Mgal in saltcake)
 - o 0.9 Mgal of sludge (6% of waste volume in FTF)
- Will include summary figure of FTF Waste
- A brief discussion on bulk waste removal of both salt and sludge waste will be presented.
- A discussion will be provided on three selected technologies for heel removal: 1) mechanical cleaning; 2) chemical cleaning; and 3) vacuum cleaning.
 - All three technologies have been successfully implemented at SRS for waste removal.
 - Past experience provides confidence that waste removal operations will meet or exceed expectations.
 - Waste removal activities are anticipated to result in collective removal of all HRRs for the entire FTF by approximately 99% based on a starting point of the maximum historical radionuclide inventory in the entire FTF.

⁸ Sections 3.3.1 through 3.3.4 of this input package describe the approach that DOE is considering for use in developing the Draft FTF 3116 Basis Document. The wording is not intended to be representative of the wording DOE anticipates including in this section of the Draft FTF 3116 Basis Document.

Figure 3.3-1: FTF Waste Summary



Inventory values as of 2010-01-05

3.3.2 Mechanical Cleaning

A brief discussion will be provided describing the following:

- What is meant by “mechanical cleaning”
- How mechanical cleaning has been used successfully in waste removal activities at the SRS
- How mechanical cleaning will be employed for future cleaning activities in FTF.

3.3.3 Chemical Cleaning

A brief discussion will be provided describing the following:

- What is meant by “chemical cleaning”
- How chemical cleaning has been used successfully in waste removal activities at the SRS (e.g., Tank 16)
- How chemical cleaning will be employed for future cleaning activities in FTF.

3.3.4 Vacuum Cleaning

A brief discussion will be provided describing the following:

- What is meant by “vacuum cleaning”
- How vacuum cleaning has been used successfully in waste removal activities at the SRS
- How vacuum cleaning will be employed for future cleaning activities in FTF.

3.4. Basis for Removal to the Maximum Extent Practical⁹

3.4.1 Determination of Removal to the Maximum Extent Practical

Based on waste removal activities to date and anticipated new technologies, FTF waste removal activities are anticipated to result in collective removal of all HRRs by approximately 99% based on a starting point of the maximum historical radionuclide inventory in the overall FTF. Although the collective removal of HRRs will meet this 99% level, individual tanks or ancillary structures may not achieve this level of HRR removal on an individual basis. Demonstration that waste removal within a particular waste tank or ancillary structure has achieved 99% removal of HRRs is not, by itself, a justification for stopping waste removal activities. In addition, demonstration that residual radionuclide inventory of a given waste tank or ancillary structure is below that assumed in the FTF PA is not sole justification that HRRs have been removed to the MEP. In order to demonstrate that HRRs have been removed to the MEP, waste removal activities on a given tank or ancillary structure will not be considered complete until the following criteria is clearly demonstrated for each particular tank or ancillary structure taking into account, among other things, the conditions in the specific waste tank or ancillary structure, the status of the FTF and available technologies at the time that waste removal activities are being undertaken:

- waste removal technologies were deployed until it can be demonstrated that waste removal using the existing technology is no longer practical, and
- an evaluation of other existing or emerging technologies has been completed and it has been determined that deployment of other additional waste removal technologies is not practical.

The determination of when additional waste removal is no longer practical will be supported by evidence that the potential benefits from long-term risk reduction to the public and the hypothetical future human intruder, from continued waste removal, is not justified when considering the potential costs and risks associated with additional removal. Examples of the costs and factors associated with additional removal include, among others: increased radiation exposure to site workers or the public due to removal activities; increased risk associated with impacts to other DOE missions involving risk-reducing activities; and direct monetary expenditures. If the determination that additional removal is no longer practical is based on diminishing effectiveness of a current technology being used, the criteria used to reach that conclusion will be formally documented. The determination of diminishing effectiveness will be done utilizing such things as sampling and analysis, visual observation, expert judgment, radiation monitoring, equipment operating parameters or a number of other applicable metrics. Whatever the basis for the conclusion is, it will be clearly demonstrated with evidence supporting the diminishing effectiveness of the technology.

The majority of waste removal activities in the FTF will take place following the issuance of the FTF 3116 Basis Document. However, as provided in the following sub-section, DOE

⁹ Section 3.4 of this input package describes the approach that DOE is considering for use in developing the Draft FTF 3116 Basis Document. The wording is not intended to be representative of the wording DOE anticipates including in this section of the Draft FTF 3116 Basis Document.

will continue waste removal activities within individual FTF waste tanks or ancillary structures until the above criteria for HRR removal to the MEP has been demonstrated.

3.4.2 Demonstration of Removal to the Maximum Extent Practical

The DOE plans to include in the Draft FTF 3116 Basis Document evidence providing the basis for the Secretary of Energy's determination regarding removal of HRRs to the MEP. This information is anticipated to include, as an example, information and results from the waste removal activities that have occurred in FTF Tank 18, demonstrating the basis for achieving removal of HRRs to the MEP.

3.4.3 Documentation of Waste Removal and Tank Cleaning Activities

For additional information, DOE is considering including in the Draft FTF 3116 Basis Document a discussion on actions that will occur to support cessation of waste removal activities on individual waste tanks and ancillary structures, which will support demonstrated satisfaction of closure criteria for both DOE and South Carolina Department of Health and Environmental Control regulatory requirements.

The discussion will include the following elements:

- During cleaning operations, data will be collected and documented concerning potential additional activities with the deployed technology
- Activities that assess potential deployment of other additional waste removal technologies will be documented
- Removal effectiveness of the overall waste volume and the specific HRRs will be documented
- Using the final characterization data along with future potential dose impacts provided by the FTF Performance Assessment (PA), a cost-benefit analysis will be performed and documented. In performance of this analysis, examples of costs include financial costs, delays, increases to risks to workers and members of the public, generation of secondary waste streams, downstream Liquid Waste System impacts, etc.
- When final residual characterization and the cost-benefit analysis are complete, a Final Report will be prepared. This documentation will include final residual characterization information and the cost-benefit analysis results. This documentation will either be integral to, or serve as primary reference(s) for, the DOE Tier 2 Closure Documentation.

4.0 REFERENCES

A Dictionary of Modern English Usage, H. Fowler, 1930.

CBU-PIT-2005-00131, *Response to Request for Additional Information on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, Savannah River Site, Aiken, SC, Rev. 1, July 14, 2005.

DOE M 435.1-1, Chg. 1, *Radioactive Waste Management Manual*, U.S. Department of Energy, Washington DC, January 9, 2007.

DOE/NE-ID-11226, *Basis for Section 3116 Determination for the Idaho Nuclear Technology and Engineering Center Tank Farm Facility*, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho, Rev. 0, November 2006.

DOE-WD-2005-001, *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, Savannah River Site, Aiken, SC, January 2006.

http://dictionary.cambridge.org/define.asp?key=practical*2+0&dict=A, *Cambridge Dictionary of American English*, Cambridge University Press, visited May 2010.

<http://infoplease.com/ipd/A0598638.html>, *Infoplease referencing Random House Unabridged Dictionary*, Random House, Inc., visited May 2010.

ICP/EXT-06-01204, *Response to Request for Additional Information on the Draft Section 3116 Determination Idaho Nuclear Technology and Engineering Center Tank Farm Facility*, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho Rev. 0, March 16, 2006.

NDA 3116, *Public Law 108-375, Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005, Section 3116, Defense Site Acceleration Completion*, U.S. Department of Energy, Washington DC, October 28, 2004.

NRC_03-02-93, Bernero, R. M., *Denial of Petition for Rulemaking Submitted by the State of Washington and the State of Oregon*, Office of Nuclear Material Safety and Safeguards, Washington, DC, March 2, 1993.

NUREG-1757, Vol. 2, *Consolidated Decommissioning Guidance, Characterization, Survey, and Determination of Radiological Criteria Final Report*, U.S. Nuclear Regulatory Commission, Washington DC, September 2006.

NUREG-1854, *NRC Staff Guidance for Activities Related to U.S. Department of Energy Waste Determinations, Draft Final Report for Interim Use*, U.S. Nuclear Regulatory Commission, Washington DC, August 2007.

WSRC-IM-98-00033, Cercy, M.J., *Systems Engineering Methodology Guidance Manual*, Savannah River Site, Aiken, SC, Rev. 14, March 19, 2008.