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Annual Status Update for OWL

Spent Fuel and Waste Disposition

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APPENDIX E
NFCSC DOCUMENT COVER SHEET[1]

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Teklu Hadgu (SNL) *Teklu Hadgu*

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SUMMARY

This report represents completion of milestone deliverable M2SF-24SN010309082 *Annual Status Update for OWL* due on November 30, 2023. It contains the status of fiscal year 2023 (FY2023) updates for the Online Waste Library (OWL).

High-Level Purpose of This Work—OWL, a database with extensive search capability, has two primary purposes:

- **Provide Consolidated Source for DOE-Managed Waste Information**—The first purpose is to deliver a user-friendly, consolidated source of information on the many different United States Department of Energy (DOE)-managed (as) high-level waste (DHLW), DOE-managed spent nuclear fuel (DSNF), and other wastes that are likely candidates for deep geologic disposal. Users access OWL through an internet connection to Sandia National Laboratories' External Collaboration Network (ECN). Content is traceable to supporting documents, and internal calculations are also documented. Provided there are no copyright or other restrictions, all documents supporting content or calculation methods are available to the user. The database is subject to regular maintenance and updates. A configuration management system safeguards the integrity of OWL content and structure. Steps taken to ensure database traceability and integrity are intended to build confidence in the use of OWL content in a variety of scientific pursuits including those in a regulatory environment.
- **Provide Geologic Disposal Safety Assessment (GDSA) Interface To Generate PFLOTRAN Input Files**—The second purpose of OWL is to provide users the ability to generate input parameter files for PFLOTRAN, a multiphase flow and reactive transport code. Potential input includes information on waste types, inventory, waste form characteristics, vessels, etc. for performance assessment (PA) analyses in the context of the GDSA framework.

FY2023 Accomplishments—FY2023 updates to OWL include general enhancements as well as advances on several ongoing, multiyear, capability expansion projects as follows:

- **Routine Release of New OWL Version**—OWL version 5.0 (SAND2023-09589W) was released on September 25, 2023 with the most significant change being associated with the new screening review process described below.
- **Development of Screening Process To Help Identify OWL Supporting Documents That Have Been Revised or Replaced by External Entity**—The technical review of OWL version 4.0 pointed out the need for a process to help identify whether an existing supporting document not originated by the OWL team has been revised or replaced and, if so, whether the newer document supplements or supersedes the older document. The process was developed and implemented resulting in several recommended changes that were included in OWL version 5.0.
- **Development of a GDSA Interface**—One of the expansion projects consists of developing a GDSA interface for OWL. The goal is to build the capability within OWL to generate input parameter files using OWL content for use in PFLOTRAN. The information required in radionuclide inventory input files for PFLOTRAN depends on whether the input file is for waste packages containing SNF or for waste packages containing HLW glass. The focus for the first area of integration was on developing an input file for HLW glass because OWL currently contains more information about HLW glass than SNF. Regular discussions between the OWL

and PFLOTRAN teams during FY2022 resulted in the selection of specific inventory and waste information for glass waste; during FY2023, data were collected, calculations were performed, and the process of updating supporting documents necessary to support the input parameter files was initiated.

- **Expansion of OWL for Vessel Information**—A second capability expansion project involves adding vessel information to OWL. For this effort, the OWL team is creating additional database structures supporting information on vessels (e.g., containers, canisters, casks, waste packages) that can be used for storage, transportation, and/or disposal of DOE-managed nuclear waste. The types of information being compiled include dimensional characteristics, weights, regulatory certification for usage, waste types and waste forms that could potentially utilize these vessels, material properties of the vessels, etc. Progress has been made on the testing and refinement of the vessel information model and tables. Sample data have been entered into the tables, and database views have been created to help evaluate the table functionality within the structured query language (SQL) server environment. In addition, preliminary vessel SSRS reports have been developed to examine how well the tables support the display of information to the user.
- **Leveraging Selected Information from the Spent Fuel Database (SFD)**—Another multiyear, expansion project involves leveraging selected information from INL's SFD for use in OWL. The SFD is a Nuclear Quality Assurance-1 (NQA-1) database with over 700 entries of DSNF. It is neither efficient nor desirable to independently duplicate information in OWL on the many different types of DSNF already residing in the SFD. In FY2022, the OWL team requested and received from INL a subset of SFD information in spreadsheet format. The spreadsheet was designated as official use only (OUO), though the controlled unclassified information (CUI) system has since replaced the OUO system. In late FY2023, the OWL team received an updated spreadsheet generated from a new SFD release. Planning is currently underway regarding how best to incorporate the SFD content into OWL. This cooperative effort allows the two databases to complement each other. Access to the SFD is limited by necessity because it is a classified database. Even with OUO/CUI restrictions, the information, once included in OWL, will be more accessible to a wider group of users. Also, as part of OWL, this information can be analyzed within the context of DOE-managed wastes beyond just DSNF.

Next Stages of This Work—Future work on OWL is expected to focus on the following:

- Update OWL as needed to ensure information integrity
- Continue GDSA interface development by expanding the database and database reports to include additional PFLOTRAN-specific information such as DSNF information similar to the HLW glass waste information already added
- Continue vessel expansion effort with primary focus on completing changes to structural database elements and secondary focus on data mining, data entry, data checking, and supporting document development
- Continue efforts to leverage SFD information already received, including determination of structural and process changes needed to incorporate SFD information into OWL
- Explore leveraging selected information from other DOE databases such as the UNF-ST&DARDS database, which contains information on vessels that may be of interest
- Prepare for the migration of OWL to the SNL's cloud computing platform

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CONTENTS

SUMMARY v

CONTENTS ix

LIST OF FIGURES xi

LIST OF TABLES xii

ACRONYMS xiii

1. INTRODUCTION 17

2. GENERAL OVERVIEW OF OWL 19
   2.1 Key Definitions 19
   2.2 Database Purpose, Scope, and Work Package History 19
   2.3 Architecture and Components 24
   2.4 Waste Type and Waste Form Information Modeling 26
   2.5 User Interface 27
   2.6 Configuration Management 36

3. STATUS OF OWL UPDATES 41
   3.1 GDSA Interface Development 41
   3.2 Vessel Expansion of OWL 43
   3.3 Leveraging Selected SFD Information 50

4. CONCLUSIONS 53

5. REFERENCES 57

APPENDIX A. EXAMPLES OF VESSELS IDENTIFIED THROUGH DATA MINING 61

A-1. TAD Canister 64

A-2. TAD Waste Package (21-PWR/44-BWR TAD) 64

A-3. M-290 Transportation Cask 65

A-4. NUHOMS 12-T Dry Shielded Canister 66

A-5. Modified NAC-1 Cask 66

A-6. Summary Observations about Vessel Information 68

APPENDIX B. OWL USER'S GUIDE 69

Navigation 70

Printing and Saving 70

How Do I….? 71

- See which wastes are included in OWL? 71
- See which wastes are at a particular site? 71
- See the DOE-managed wastes by classification (high-level waste, spent nuclear fuel, or transuranic waste)? 73
- See what the DOE has planned or proposed with respect to the disposal waste forms for the wastes? 74
- See the radionuclide inventory of a particular waste? 75
- See the radionuclide inventory of a particular waste or wastes as of a specific date (year)? 79
- See a graph showing the total radioactivity and thermal output of a waste (or all wastes) over the next 200 years? 81
- See a list of radionuclides included in OWL? 82
- See a list of documents used to support the information in OWL? 84

DOE-Managed Wastes 85

Waste Forms 86

Inventory Calculator 86

200-Year Inventory and Thermal Output 86

Baseline Radionuclide Inventory in Each Waste 87

Radionuclides 87

Supporting Documents 87

Waste-Specific Spreadsheets 87

Access, Questions or Comments 87

Attachment B-1– Change History 88

LIST OF FIGURES

Figure 2-1. High-level Architecture of OWL showing the Three Versions Existing within the Development, Release Candidate, and Production Environments....25

Figure 2-2. Home Page Screenshot for OWL Production SharePoint Site....28

Figure 2-3. Partial View of DOE-Managed Wastes Report Showing Wastes, Waste Classification, Description, Storage Facility, Total Volume, and Total Radioactivity....30

Figure 2-4. Waste Detail for Savannah River Glass Waste with Additional Selection of Options 1 and 3 for Waste Characteristics and Disposal Waste Forms Respectively....31

Figure 2-5. Partial View of Waste Forms Report Showing Waste Forms, Description, Related Waste Types, Various Properties, and Supporting Documents....32

Figure 2-6. Disposal Waste Form Characteristics for Savannah River Glass Waste....32

Figure 2-7. Partial View of Report from Radionuclide Inventory Calculator showing Projected Inventory from the Baseline Inventory of Savannah River Glass Waste to the Target Year of 2,200....33

Figure 2-8. Visual Display of Calculated Projected Activity and Thermal Output for a Waste by Year for the Next 200 Years....34

Figure 2-9. Partial View of Report for Baseline Radionuclide Inventory in Each Waste with Filtering Options Panel....34

Figure 2-10. Partial View of Radionuclides Report....35

Figure 2-11. Database Report Sample of Supporting Documents....36

Figure 3-1. Schematic of Vessel Information Model Used To Create Tables in Vessel Subsite....47

Figure 3-2. Example of a Preliminary SSRS Report for a General Vessel List....48

Figure 3-3. Example of a Preliminary SSRS Report for Vessel Detail....49

LIST OF TABLES

Table A-1. Descriptive Information for the Five Example Vessels 62
Table A-2. Physical Properties of TAD Canister 64
Table A-3. Physical Properties of TAD Waste Package (21-PWR/44-BWR TAD) 65
Table A-4. Physical Properties of M-290 Transportation Cask 65
Table A-5. Physical Properties of NUHOMS 12-T Dry Shielded Canister 66
Table A-6. Physical Properties of Modified NAC-1 Cask 67

ACRONYMS

ASTM	American Society for Testing and Materials
BWR	boiling water reactor
C.E.	common era
CoC	Certificate of Compliance
CUI	controlled unclassified information
dev schema	development schema
DHLW	DOE-managed (as) high-level radioactive waste
DOE	U.S. Department of Energy
DOE-EM	DOE Office of Environmental Management
DOE-NE	DOE Office of Nuclear Energy
DOT	U.S. Department of Transportation
DSNF	DOE-managed spent nuclear fuel
ECN	External Collaboration Network
FRG	Federal Republic of Germany
FYxxxx	fiscal year xxxx (four-digit year)
GDSA	geologic disposal safety assessment
HIP	hot isostatic press (ed/ing)
HLW	high-level radioactive waste
INL	Idaho National Laboratory
IR	Information Release
ISO	International Standards Organization
LWR	light water reactor
MS	Microsoft
NA	not applicable
NAC	Nuclear Assurance Corporation
n.d.	no date; used for references for which no date is available
NWTRB	Nuclear Waste Technical Review Board
NQA-1	Nuclear Quality Assurance-1
NRC	U.S. Nuclear Regulatory Commission

OUO	official use only
OWL	Online Waste Library
PA	performance assessment
PWR	pressurized water reactor
QA	quality assurance
RAMPAC	RAdioactive Materials PACkages
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
SAND	Sandia National Laboratories report
SFWST	Spent Fuel & Waste Science and Technology
SFD	Spent Fuel Database
SNF	spent nuclear fuel
SNL	Sandia National Laboratories
SQL	Structured Query Language
SRN	Sandia Restricted Network
SRS	Savannah River Site
SSRS	SQL Server Reporting Services
TAD	transportation, aging, and disposal
TMI	Three Mile Island
TRISO	tristructural-isotropic
TRU	transuranic
UNF-ST&DARDS	Used Nuclear Fuel-Storage, Transportation & Disposal Analysis Resource and Data Systems
U.S.	United States
UUR	unclassified, unlimited release
WFDOE	Waste Form Disposal Options Evaluation
WIPP	Waste Isolation Pilot Plant

Selected Units

Bq	becquerel
ft	foot
GWd	gigawatt·days
in.	inch
lb	pound
MTU	metric ton of uranium

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SPENT FUEL AND WASTE DISPOSITION ANNUAL STATUS UPDATE FOR OWL

1. INTRODUCTION

This report represents completion of milestone deliverable M2SF-24SN010309082 *Annual Status Update for OWL* due on November 30, 2023. It provides the status of fiscal year 2023 (FY2023) Online Waste Library (OWL) updates for the work package "OWL - Inventory - SNL" (SNL refers to Sandia National Laboratories). The OWL has two primary purposes: (1) to provide a user-friendly, consolidated single source of information on United States (U.S.) Department of Energy (DOE)-managed (as) high-level waste (DHLW), DOE-managed spent nuclear fuel (DSNF), and other wastes that are likely candidates for deep geologic disposal, and (2) to provide input parameter files with relevant information on waste types, inventory, waste form characteristics, vessels, etc. for performance assessment (PA) analyses in the context of the geologic disposal safety assessment (GDSA) framework. Much progress has already been made on fulfilling the first purpose, given that OWL was publicly released in FY2019 and afterwards entered the cycle of having improvements made for new releases. The second purpose of being able to support GDSA with input parameter files is a work in progress.

A general overview of OWL providing background information and context for the rest of the report appears in Section 2. Topics discussed include key definitions; database purpose, scope, and work package history; OWL architecture and components; waste type and waste form information modeling; user interface; and configuration management.

The status of OWL updates conducted during FY2023 is described in Section 3. The current version of OWL (version 5.0, SAND2023-09589W) was released on September 25, 2023. In addition, the OWL team made advances on several ongoing, multiyear, expansion projects including the following:

- **Development of a GDSA Interface**—The goal of developing a GDSA interface (Section 3.1) is to build the capability within OWL to generate input parameter files for use in the context of the GDSA computational framework, primarily the massively parallel subsurface flow and reactive transport code, PFLOTRAN (Hammond et al. 2014; Lichtner et al. 2020a, 2020b; Nole et al. 2021). To further the integration between OWL and GDSA, data were collected, calculations were completed, and the process of updating supporting documents regarding the PFLOTRAN input files for glass waste was started.
- **Expansion of OWL for Vessel Information**—The vessel expansion of OWL (Section 3.2) involves creating a new subsite with information on vessels (e.g., containers, canisters, casks, waste packages) designed for storage, transportation, and/or disposal of nuclear waste. The types of information being compiled include dimensional characteristics (inner and outer), weights, regulatory certification for usage, waste types and waste forms that could potentially utilize these vessels, material properties of the vessels as appropriate, etc. Progress has been made on the testing and refinement of the vessel information model and tables. Sample data have been entered into the tables, and database views have been created to help evaluate the table functionality within the structured query language (SQL) server environment. In addition,

preliminary vessel SQL Server Reporting Services (SSRS) reports have been developed to examine how well the tables support the display of information to the end user.

- **Leveraging Selected Information from the Spent Fuel Database (SFD)[1]**—Another multiyear, expansion project involves leveraging selected information from Idaho National Laboratory's (INL's) SFD for use in OWL (Section 3.3). The SFD is a Nuclear Quality Assurance-1 (NQA-1) database with over 700 entries of DSNF (DOE 2007). In FY2022, the OWL team requested and received from INL a subset of SFD information in spreadsheet format. The spreadsheet was designated as official use only (OUO), though the controlled unclassified information (CUI) system has since replaced the OUO system. In late FY2023, the OWL team received an updated spreadsheet generated from a new SFD release. Planning is currently underway regarding how best to accomplish the following: (1) change the OWL structure to accommodate SFD information (applies to existing structure for waste types/waste forms and vessel structure still in development), (2) ensure SFD information has adequate safeguards especially with respect to end-user access and export markings, (3) develop a script to transfer information automatically from the SFD spreadsheet to OWL, and (4) use the SFD spreadsheet as the source for a supporting document to link to the new content.

A summary of the status of OWL updates appears in Section 4. Appendix A provides further information on the vessel expansion, specifically some examples of candidate vessels identified through data mining. Appendix B reproduces the *OWL User's Guide* (SNL 2023), which includes a change history of the database.

[1] Note that, while the report refers to this database as the Spent Fuel Database, or SFD, the database is also sometimes referred to as the DOE SNF Database.

2. GENERAL OVERVIEW OF OWL

This general overview of OWL introduces the database by providing background information and context useful to the discussion in Section 3 on the progress made on OWL updates.

For convenience, a list of key definitions is provided in Section 2.1 followed by a description of the database purpose, scope, and work package history in Section 2.2. Section 2.3 briefly introduces the OWL architecture and components, including the three OWL environments hosting three different versions of OWL. Each version of OWL has multiple components including a database and SharePoint site. Section 2.4 addresses the waste type and waste form information modeling, and Section 2.5 uses multiple screenshots to enhance the description of the user interface. Finally, Section 2.6 discusses the configuration management of OWL, including the change control process and the release process.

2.1 Key Definitions

The following key definitions clarify the meaning of certain terms that are used in a specific manner within OWL and this status report. These terms may or may not be defined in the same manner in other reports cited herein.

Waste Type—The currently existing materials (in whatever form, abundance, and location they occupy) that either are or will be processed into some waste form to be disposed of in a deep geologic repository. Some waste types may have more than one possible waste form depending on the processing needed prior to disposal, whereas waste types that require no processing other than packaging may equate to a single waste form. In this report and in the OWL database, the waste type is sometimes referred to more simply as the "waste," a usage that is still distinguishable from the "waste form" or "disposal form."

Waste Form—The end-state material, as packaged, that is to be disposed of in a deep geologic repository. Examples include commercial spent nuclear fuel (SNF) and high-level radioactive waste (HLW) glass. For this report, a vessel that cannot be separated easily from the waste form is considered to be part of the waste form. For instance, a glass pour canister is essential for making the glass waste form. After the HLW glass is poured into the canister, the canister is not removed easily and it is not intended to contain additional waste forms or waste types. Therefore, once a glass pour canister is used for HLW glass, the canister is considered part of the waste form.

Vessel—A canister, container, cask, overpack, etc. that can serve as a single layer in a nested system designed to surround and contain[2] the waste form for the purposes of storage, transportation, and/or disposal.

2.2 Database Purpose, Scope, and Work Package History

In 2014, SNL led an analysis of the disposal of both commercial SNF and DHLW and DSNF in the variety of disposal concepts being evaluated within the previous Used Fuel Disposition Campaign and generated a report titled *Evaluation of Options for Permanent Geologic Disposal of Used Nuclear Fuel and High-Level Radioactive Waste Inventory in Support of a Comprehensive National Nuclear Fuel*

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[2] Unless stated otherwise in this report, "to contain" something means "to hold" it. The term does not imply containment in the regulatory sense, e.g., the definition provided by transportation regulations in 10 CFR 71: "*Containment system* means the assembly of components of the packaging intended to retain radioactive material during transport."

Cycle Strategy (SNL 2014). For convenience, that report is referred to herein as the WFDOE, an acronym for Waste Form Disposal Options Evaluation. That Used Fuel Disposition Campaign work covered a comprehensive inventory and a wide range of disposal concepts and provided the impetus for developing the OWL database and for evaluating waste form characteristics. These two activities—developing the OWL database and evaluating of waste form characteristics—were part of the same work package until FY2021. The two activities were considered complementary because evaluation of waste characteristics includes assessing the inventory data and ensuring information exists for disposal-relevant radionuclides. However, as work on the two activities evolved, the decision was made to separate them.

January of 2021 marked publication of the last combined report, *Annual Status Update for OWL and Waste Form Characteristics* (Weck et al. 2021a), which addressed FY2020 activities. The annual status report documenting FY2021 activities under the work package "OWL - Inventory – SNL" (Weck et al. 2021b) focuses solely on the OWL database. The FY2021 activities related to the evaluation of waste forms were conducted under the work package SF-21SN01030902 "Waste Form Testing, Modeling, and Performance – SNL". The first progress report (milestone deliverable M4SF-21SN010309021 *Modeling Activities Related to Waste Form Degradation: Progress Report*) was released on June 30, 2021 (Jove-Colon et al. 2021).

The remainder of this subsection presents the purpose and scope of the OWL database as well as a summary of the work package history starting from its inception in FY2016.

Purpose of the OWL Database—The purpose of OWL is two-fold. The first purpose is to provide a consolidated single source of information on the many different DOE-managed radioactive wastes that are likely to require deep geologic disposal, such that one can easily query the data. The second purpose is to provide input parameter files with relevant information on waste types, inventory, waste form characteristics, vessels, etc. for PA analyses in the context of the GDSA framework. Much progress has already been made on fulfilling the first purpose, given that OWL was publicly released in FY2019 and afterwards entered the cycle of having improvements made for new releases. The second purpose of being able to support GDSA with input parameter files is a work-in-progress.

Scope of the OWL Database—The OWL database itself provides the documentation and delivery of the full array of information/data for the waste types and potential waste forms for use in GDSA evaluations for generic repository analyses. The scope of the inventory information included in OWL covers DSNF and DHLW, both of which are currently planned for disposal in a deep geologic repository. Note that the DHLW includes wastes that may be dispositioned in the future with a waste classification different than HLW, a possibility that would perhaps entail a different disposal pathway. In the future, the scope of database content will also include vessel information.

OWL Work Package History—As stated above, the OWL work package previously included development of the OWL database plus the evaluation of waste form characteristics. Some highlights of the activities completed under the OWL work package starting from FY2016 appear below.

The initial effort on the work package was documented in *The On-line Waste Library (OWL): Usage and Inventory Status Report* (Sassani et al. 2016). This report provided the initial development status including (1) development of the preliminary inventory for engineering/design/safety analyses, (2) assessment of the major differences of this included inventory relative to that in other analyzed repository systems and the potential impacts to disposal concepts, and (3) the initial design and development of the prototype version of OWL to manage the information of all those wastes and their waste forms. In addition, Sassani et al. (2016) reported on the identification of potential candidate waste types and waste forms that might be added to OWL in the future to the full list from the WFDOE (SNL 2014, Table C-1).

Sassani et al. (2016) also discussed the Wilson (2016) preliminary inventory for initial GDSA analyses. That inventory includes both DHLW and DSNF waste canister counts and thermal information (Wilson 2016, Tables 2-1 and 2-3 to 2-6). The Wilson (2016) report describes each waste form in terms of both average radionuclide content and average thermal output evolution. The tabulation includes canister counts and ranges of thermal characteristics for each DHLW and DSNF waste form considered (Wilson 2016). The various types of DSNF are listed in Appendix A of Sassani et al. (2016, 2017) for the ~2,485 DSNF canisters (Wilson 2016, Table 2-1). The DHLW canister counts are given in Wilson (2016) in Tables 2-3 through 2-6, respectively, for Savannah River Site (SRS) glass (7,824 canisters), Hanford glass (11,800 canisters), INL hot isostatic pressed (HIP) calcine (4,391 canisters), and additional Hanford glass from vitrifying the contents of the Cs and Sr capsules (340 canisters; also in SNL 2014).

Sassani et al. (2017) provided an update to Sassani et al. (2016) and included the following:

- An updated set of inputs (Sassani et al. 2017, Section 2.3) on various additional waste forms covering both DSNF and DHLW for use in the inventory represented in the GDSA analyses
- Summaries of evaluations initiated to refine specific characteristics of a particular waste form for future use (Sassani et al. 2017, Section 2.4)
- Updated development status of the OWL database (Sassani et al. 2017, Section 3.1.2) and an updated user guide to OWL (Sassani et al. 2017, Section 3.1.3)
- Status updates (Sassani et al. 2017, Section 3.2) for the OWL inventory content, data-entry checking process, and external OWL beta testing initiated in FY2017

Sassani et al. (2017) updated the preliminary FY2016 inventory by adding the additional possible waste forms (DOE 2014) not previously included in GDSA representations, for which GDSA evaluation of thermal or radionuclide inventory aspects may be somewhat expanded compared to the previous analyses. Specifically, this expansion included the following:

- The 340 canisters of glass from vitrifying the contents of the Cs and Sr capsules at Hanford (Wilson 2016, Table 2-6)
- The 34 canisters of Hanford Federal Republic of Germany (FRG) glass, which has been designated as remote-handled transuranic (TRU) waste (Bounini and Anderson 2000), though it may be disposed in a deep geologic repository with other heat-producing waste
- The planned waste form for calcine waste, which is a HIP waste form (glass ceramic), with ~10 HIP cans loaded/stacked into naval canisters for a total of ~320 canisters (~5.5 ft diameter × ~15 ft height naval canisters/waste packages containing ~10 HIP cans each; SNL 2014)

Although most of these updates are relatively small from the standpoint of inventory mass, they may have implications for analyses of thermal effects. The reason is that some of these added wastes tend to have higher average thermal loads per canister than the inventory previously evaluated in GDSA. Additionally, some of these waste forms represent larger waste packages, which may expand handling and emplacement considerations (e.g., planned calcine HIP waste form waste packages).

In Sassani et al. (2017), a number of questions regarding the characteristics of various waste forms led to three studies on waste form characteristics details. The first study assessed the potential sinks for ^{129}I in the various processes at the SRS that form the HLW glass and estimated the ^{129}I content of the SRS glass. The second study assessed the quantity of ^{135}Cs contained in the Cs capsules and in the FRG glass at Hanford. Estimates of the quantities of ^{135}Cs and ^{129}I are documented in Price (2018) and Savannah River Remediation (2018), respectively. The third study validated characteristic isotopic ratios for various waste forms included in postclosure performance studies. This aspect arose because of questions regarding the relative contributions of radionuclides from disparate waste forms in GDSA results, particularly radionuclide contributions of DSNF versus DHLW glass.

Sassani et al. (2017) reported on the OWL database updates in three areas. First, additional data for waste types (and their potential waste forms) and source documentation were added to OWL to flesh out its content covering DHLW and SNF. Second, in conjunction with further data entry, a process of checking the data entered into OWL against the source documentation was launched to search for and rectify any errors in data entry. This checking was performed by technical individuals independent of the data-entry process. These individuals documented any issues noted and resolved the issues with the data-entry staff. Third, because OWL was modified throughout the year in terms of its interface and features, another process to assess the usability of OWL was completed. This process consisted of an external OWL beta test involving technical staff from within the DOE Office of Nuclear Energy (DOE-NE) and DOE Office of Environmental Management (DOE-EM), as well as at other national laboratories, using OWL. Feedback on the utility and content of OWL was provided.

In FY2018, the OWL team pursued three studies to evaluate/redefine waste form characteristics and/or performance models (Sassani et al. 2018). The first study evaluated characteristic isotopic ratios for various waste forms included in postclosure performance studies to delineate isotope ratio tags that may quantitatively identify each waste form. In the second study, the team evaluated the basis for using the glass waste degradation rate models to simulate degradation of the HIP calcine waste form. The third study is an investigation of the performance behavior of tristructural-isotropic (TRISO) particle fuels. The effort includes development of a stochastic model for the degradation of those fuels that accounts for simultaneous corrosion of the silicon carbide (SiC) layer and the radionuclide diffusion through it.

In FY2019 activities included evaluations of waste form characteristics and waste form performance models, updates to the OWL development, and overview descriptions of the management processes for OWL (Sassani et al. 2019). Those updates to OWL included an updated user’s guide, additions to the OWL database content for waste types and waste forms, changes implemented as a result of the beta testing. The first public release of OWL (version 1.0) occurred in FY2019. In addition, work began on developing methods for interfacing with the SFD (DOE 2007) at INL on the numerous entries for DSNF. This effort involved defining preliminary data exchanges to facilitate future testing of integration protocols.

FY2019 also marked the start of work on change control and release management processes for OWL development, version control, and archiving to ensure configuration management of the database after the initial release. This work became one of two focus areas for FY2020 OWL database activities. The other focus area was the preparation OWL version 2.0, which was publicly released in November of 2020. As mentioned above, the lessons learned on version 2.0 were used to finalize and document those processes in two reports (Weck et al. 2021c, 2021d). These two reports were reproduced in appendices of the FY2020 annual status milestone 2 report (Weck et al. 2021a), which was originally planned for November 2020 but was released in January 2021. These processes are also discussed in Section 2.6.

Besides the FY2020 activities to update the OWL database, Weck et al. (2021a) also documented the FY2020 activities with respect to the evaluation of waste form characteristics. Section 3.3.2.6 of Weck et al. (2021a) summarized work performed to understand better the Stage-III (higher) glass degradation rates due to transitions from steady state degradation rates (i.e., from the lower Stage-II rates). This effort included evaluating the glass degradation data sets in terms of fluid compositional evolution and changes to secondary phase formation. As mentioned previously, FY2020 marked the last year that the OWL database and the evaluation of waste form characteristics were combined in a single work package, the result being that Weck et al. (2021a) is the last combined report.

In FY2021, the primary tasks consisted of (1) using the lessons learned from the release of OWL version 2.0 to finalize the change control and release processes, (2) collecting and adding information regarding sodium-bonded spent fuel waste types and wastes forms to OWL, and (3) advancing the effort to add new information on the types of vessels capable of disposing of DOE-managed waste to OWL. The results of the first task are documented in *OWL Change Control Process* (Weck et al. 2021d) and *OWL Release Process* (Weck et al. 2021c). The results of the second task were included in OWL version 3.0, released in early FY2022. To support the third task, a new document library was created on the Development SharePoint Site to help manage workflow and promote better coordination amongst OWL team members. As discussed in Section 2.3, the Development SharePoint site is an OWL component residing in the Development Environment, the electronic workspace for OWL development activities. Initially, the library was loaded with a little over 400 documents (mostly for data mining), each of which was assigned one of four content types: “data mining,” “supporting doc development,” “vessel spreadsheet,” and “data modeling.” Each content type has its own set of metadata designed to suit the needs of that particular content type. The effort to populate the metadata began in FY2021.

Some progress was also made in FY2021 on the goal of giving OWL the ability to generate turn-key inventory-related output files according to end-user specifications such that the resulting files are ready for use as input for postclosure performance simulations. In particular, preliminary discussions with the GDSA/PFLOTRAN team were conducted, setting the stage for more substantial cooperation in FY2022 and beyond.

FY2022 started with the release of OWL version 3.0 (SAND2021-14487W) and ended with the release of version 4.0 (SAND2022-12754W), which included 17 new radionuclides added to make more complete decay chain information available for future PFLOTRAN analyses (Weck et al. 2022). FY2022 activities also included work on three multiyear expansion projects. For the first project involving development of a GDSA interface, the focus was on developing a PFLOTRAN input file for HLW glass because OWL contained more information about HLW glass than SNF. Regular discussions between the OWL and PFLOTRAN teams resulted in the selection of specific inventory and waste information for glass waste along with efforts to implement the selection. Progress on the second project—the expansion for vessel information—was two-fold: (1) continued population of the metadata for the new SharePoint Vessel Library created previously to facilitate and manage workflow, and (2) advances in the vessel information modeling resulting in the initial creation of the associated database tables. The third project involved leveraging selected information from the SFD. The OWL team selected a subset of information and sent a data request. INL responded with the requested information in spreadsheet format from SFD version (version 8.1.8) and marked the information as OUO. Planning was begun regarding how best to incorporate the content into OWL.

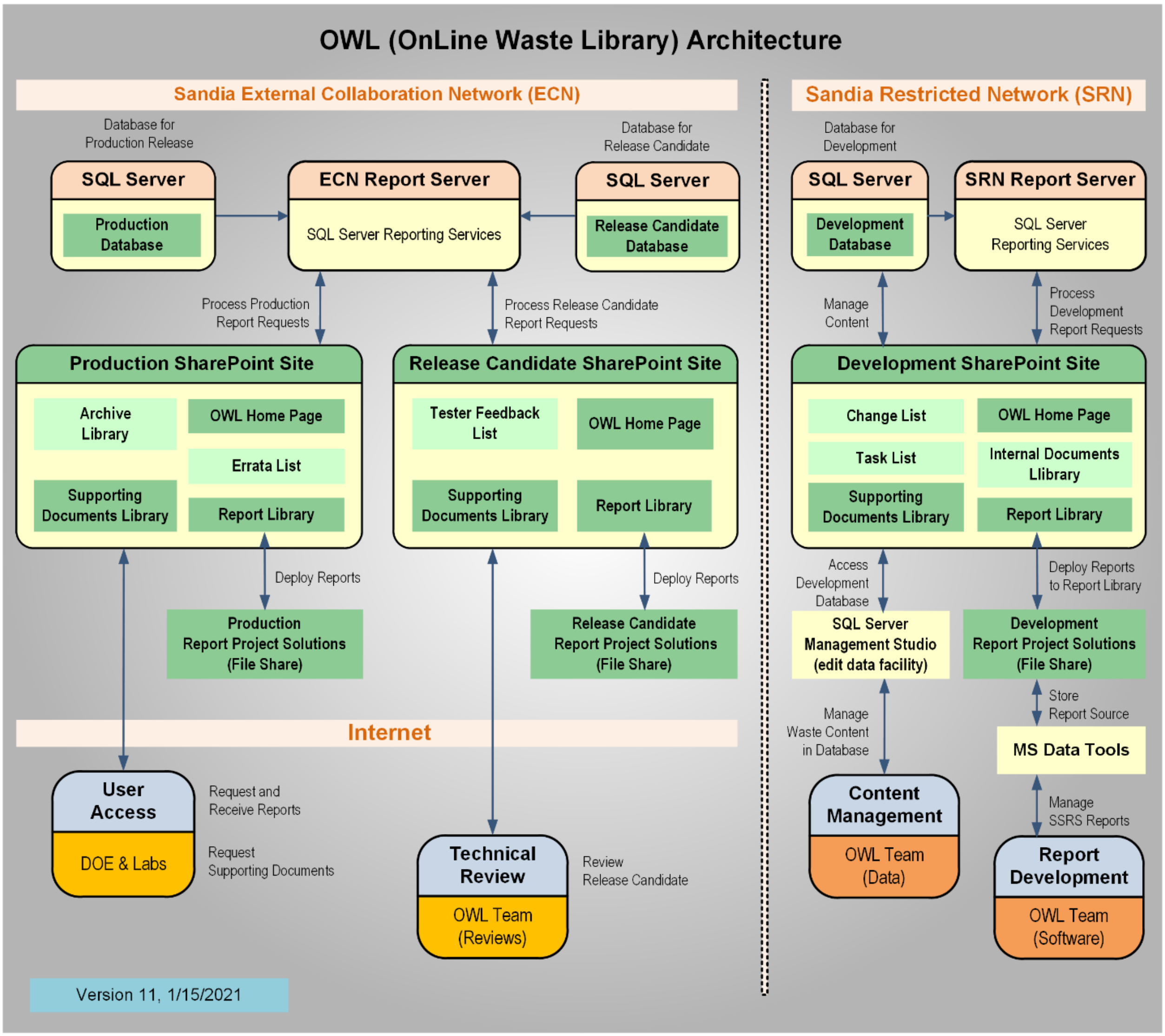
2.3 Architecture and Components

OWL development was guided by the SNL software development methodology documented on an internal SNL wiki site (Lane 2017). This methodology provides requirements for software documentation and version control, user access, and archival of system components. A key feature of this methodology is the use of multiple environments for developing software systems.

Depicted in Figure 2-1, the OWL architecture consists of three versions of OWL residing in three different environments. To the right of the figure is the development version of OWL, which resides in the Development Environment on the Sandia Restricted Network (SRN). The Development Environment is where all modifications to OWL originate except those that must be implemented directly to the Production SharePoint Site. Examples of possible modifications include database content changes, structural changes to tables, the addition or revision of supporting documents, the addition or revision of stored calculation tools, and the addition or revision of database reports. In general, changes are made first in the dev schema, which is a database schema used to identify and group database objects considered to be under development. When the changes are considered ready for use in the next OWL release candidate, the database objects are moved to the dbo schema ("dbo" refers to "database owner"). Both schemas exist within the Development Environment. The middle of Figure 2-1 shows the release candidate version of OWL, which resides in the Release Candidate Environment on the SNL's External Collaboration Network (ECN). Finally, the production release version, which resides in the Production Environment on the ECN, is seen to the left.

Figure 2-1 also illustrates how users and developers access the different versions of OWL. The development version of OWL is available only to the OWL team, which has access to the SRN. The release candidate is available to the OWL team as well as any person participating in the independent technical review. Because the release candidate is hosted on the ECN, which is available through the internet, access can be granted to technical reviewers from SNL, other national laboratories, or DOE. ECN access requires coordination with SNL for the creation of an ECN account with a username and password. In addition, because SharePoint provides the user interface, the appropriate SharePoint permission level must be granted by adding the new user to the OWL Visitors group. Once permission is granted, a link to the SharePoint site is sent to the new user. The ECN also hosts the production version of OWL, which is the version available to the end user. Users from DOE or one of the national laboratories do not need anything for access beyond an ECN account and assignment of the appropriate SharePoint permission level. As discussed in Section 3.3, one of the ongoing expansion projects for OWL involves incorporating OUO/CUI content derived from the SFD. As a result, the access process will be evaluated to determine whether any additional steps are needed to safeguard OUO/CUI content.

The OWL components existing in each environment are displayed in Figure 2-1. Each OWL environment contains a database and SharePoint site, both named according to the applicable environment, as well as other components. There are two types of system components: (1) major components (darker green shading) common to all environments such as the database and SharePoint site, and (2) local components (lighter green shading) specific to the particular environment. For example, the local components in the Development Environment on the SRN (right-hand side of Figure 2-1) are the Internal Documents Library, Change List, and Task List. Further information on the system components is provided in Weck et al. (2021c, 2021d). The configuration management of OWL is discussed in Section 2.6 as well as Weck et al. (2021c, 2021d).



NOTE: Darker green shade indicates an OWL major component; lighter green shade indicates an OWL local component.
MS = Microsoft
SQL = Structured Query Language
SSRS = SQL Server Reporting Services

Figure 2-1. High-level Architecture of OWL showing the Three Versions Existing within the Development, Release Candidate, and Production Environments

2.4 Waste Type and Waste Form Information Modeling

The core mission of the OWL database structure is to manage information on DOE-managed waste and waste forms. Much of the basic information modeling used to develop database tables and the user interface was completed in FY2017 (Sassani et al. 2017), with incremental improvements since then.

There may be up to several hundred different DOE-managed wastes that are likely to require deep geologic disposal. As discussed in Section 3.3, one of the ongoing efforts to improve OWL is to leverage information in the SFD, which contains information regarding the SNF that DOE manages. OWL is not intended to replicate this database and the information in it; the idea is to take advantage of that existing data set by incorporating selected data fields from it into OWL, thereby making those data fields available for use in postclosure PA. While the OWL information modeling will be adjusted as needed to support SFD integration, the details are still under development. Therefore, the discussion below focuses on the waste and waste form information modeling developed for OWL independent of what changes may happen due to SFD integration.

The information modeling development for OWL accommodates a number of different types of information that are currently available or could be available for each waste (and its alternative waste forms):

- Waste characteristics
    - Narrative description of waste (some waste types have variable processing characteristics because the processing or treatment of the waste is currently in progress leaving the processed or treated portion with different characteristics than the remaining unprocessed or untreated portion, e.g., SRS tank waste [processing in progress]; sodium-bonded fuel [treatment in progress]; Hanford tank waste [once treatment starts, situation will be similar])
    - Type of waste (HLW or SNF or other)
    - Origin of waste (commercial, DOE-managed, foreign, research, other?)
    - Total quantity of waste (volume and/or mass as appropriate)
    - Physical form of waste (e.g., rods, plates, powder, liquid, glass)
    - Dimensional characteristic of waste (if a solid waste)
    - Radionuclide inventory and thermal information (for reported baseline date with options to show calculated projections (1) in tabular form for any user-selected date from the current year to the year 3000 or (2) in graphical form over time for 200 years in the future)
    - Bulk chemistry of the waste (noting hazardous constituents)
    - Resource Conservation and Recovery Act (RCRA) considerations (e.g., not an issue, characteristic, listed)
- Current storage information
    - Current storage location (e.g., INL, Hanford)
    - Description of current storage method (e.g., tanks, canisters, high-integrity canisters, capsules)
    - Number of current containers
    - Dimensions of current storage method (per container, as appropriate)

  - Volume of current storage method (per container, as appropriate)
  - Mass of packaged waste as it currently exists (per container, as appropriate)
  - Radionuclide inventory and thermal information at specified times on a per-container basis (or as available)
  - Current status (e.g., awaiting treatment, awaiting packaging, ready for disposal)
- Planned or alternative processing and packaging options for final disposition
  - Description of baseline/alternative processing and/or packaging for disposal, including options for processing and/or packaging
  - Number of baseline/alternative packages
  - Dimensions of baseline/alternative package
  - Volume of baseline/alternative package
  - Mass of baseline/alternative package
  - Status of baseline/alternative planned processing (e.g., none, in progress, under development)
  - Status of baseline/alternative packaging (e.g., ready, being developed)
  - Radionuclide inventory and thermal information for treated/packaged waste at specified times on a per-package basis (or as available)
- Transportation considerations (e.g., certified transport canister exists [yes/no])
- Current base-line disposition pathway (e.g., deep geologic disposal in a repository for HLW and/or SNF, Waste Isolation Pilot Plant [WIPP], or to be determined)
- Copies of any Records of Decision (RODs) or agreements affecting the waste and its associated plans (linked to the specific data provided)
- Effects of ROD on waste (e.g., date of promised removal from state)
- Option to have the OWL team pass a user request for further information to responsible contact(s) currently in charge of the waste types and forms for storage oversight, for processing, etc. (with the intent being to keep information about the responsible contact internal to OWL)

2.5 User Interface

As mentioned in Section 2.3, the OWL user interface is provided through a SharePoint site. Figure 2-2 is a screenshot of the Production SharePoint Site home page on the ECN for the current version of OWL. The home page contains a short description of the database, a link to the *OWL User's Guide*, a link to the Errata List, Announcements, and a series of links to various database reports under the heading "For More Information About…" (referred to in this report as the "Report List").

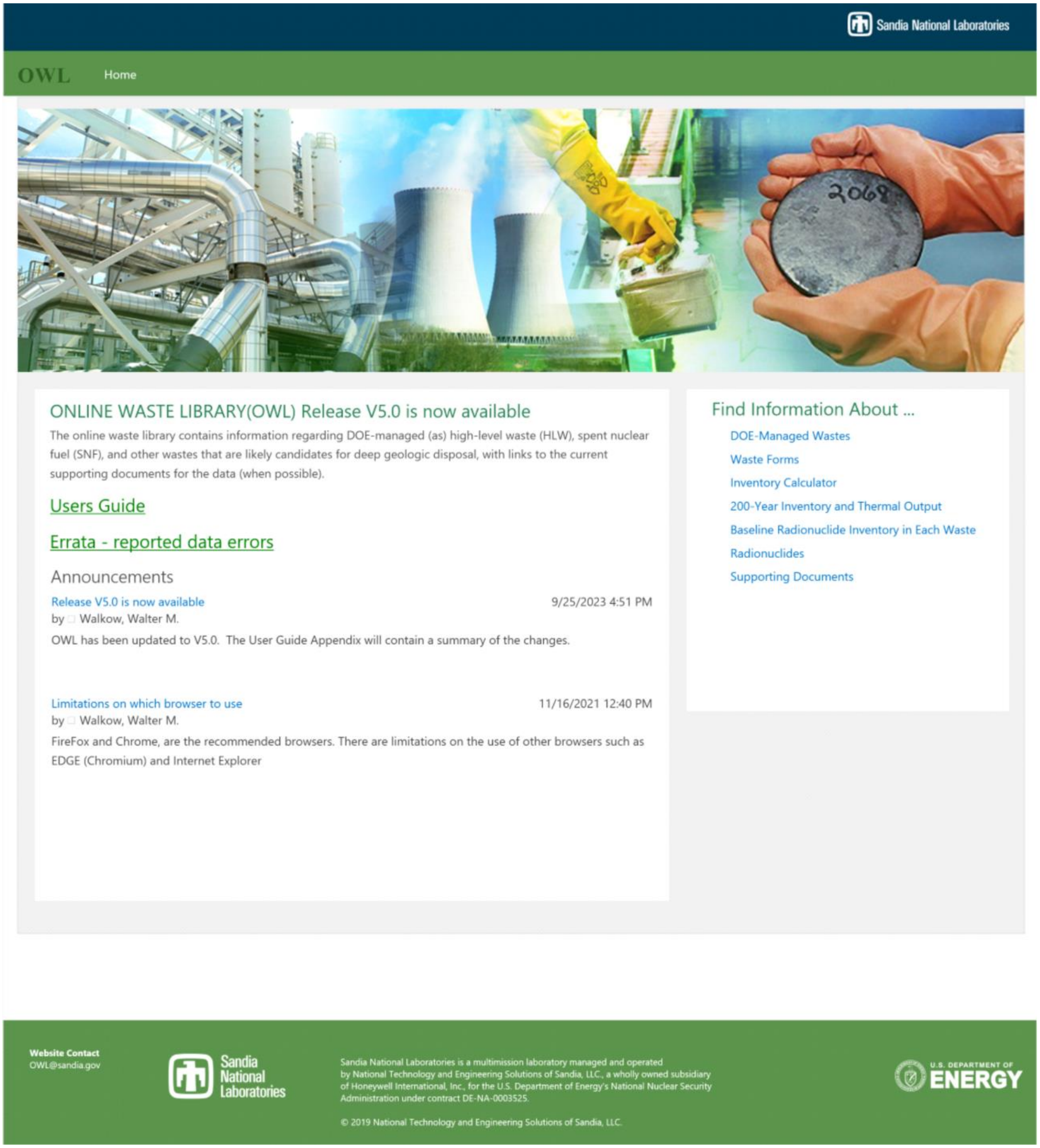


Figure 2-2. Home Page Screenshot for OWL Production SharePoint Site

The main source of information on the various options for queries and reports available in OWL is the *OWL User's Guide*. For the user's convenience, a link to the current *OWL User's Guide* is provided not only on the home page, but on all database reports generated within OWL. Version 5.0 of the *OWL User's Guide* (SNL 2023), which corresponds to OWL version 5.0, is reproduced in Appendix B.

Aside from the home page, all other database content is viewed by the end user through database reports that use SQL to search the database contents and display the results on web pages. These reports, called SSRS reports, are designed in advance by the OWL team. Infrastructure deployed in OWL allows the user to pick an SSRS report of interest and generate it on demand by clicking a link. The Report List on the home page provides access to the following primary set of SSRS reports:

- **DOE-Managed Wastes**—Search on all the wastes as well as view waste details and supporting documents
- **Waste Forms**—Search waste disposal forms, their related wastes, and supporting documents
- **Inventory Calculator**—Calculate the inventory of a selected waste in a chosen year (based on initial reported inventory)
- **200-Year Inventory and Thermal Output**—Display the projected inventory and thermal output of wastes and radionuclides by year for the next 200 years (based on initial reported inventory)
- **Baseline Radionuclide Inventory in Each Waste**—View baseline radionuclide inventory reported to be in each waste as of a specified date
- **Radionuclides**—View radionuclides, their properties, and supporting documents
- **Supporting Documents**—Display "List of Supporting Documents" with the ability to open or download the documents

Taking advantage of the web-based interface, these SSRS reports can have links allowing users to access information available in other reports. Descriptions and screenshots of this primary set of database reports are provided below. Note that the reports all have a standard OWL banner at the top with the report title, the OWL release stamp, and links for the home page, the DOE-Managed Wastes report, and *OWL User's Guide*. There is also a footer with the date/time stamp when the report was run, a contact email, and information specific to SNL and DOE. The top banner and footer have been removed from the report screenshots for simplicity.

DOE-Managed Wastes—Because of the way the database is structured, users who select the DOE-Managed Wastes option can sort waste by facility (e.g., Hanford, INL, SRS), and waste classification (e.g., HLW, SNF). This feature makes it easy to identify all the HLW types captured in OWL that are currently at Hanford, for example, which is similar to the DOE SFD capabilities.

Figure 2-3 is a screenshot of the visual display of the Waste Forms report in which users can select wastes by Facility and/or Waste Classification as well as sort by Waste, Classification, or Storage Facility (using the up/down arrows). The total volume and total radioactivity of each waste are also shown.

To filter Wastes, click on item's text below

Select a Facility Name

- ALL
- Hanford
- Idaho National Lab
- Savannah River Site

Select a Waste Classification

- ALL
- High Level Waste
- Spent Nuclear Fuel
- Transuranic (TRU) Waste

Waste (click on Name for details)	BaseLine Inventory Date	Waste Classification	Waste Description	Storage Facility	Total Volume	Total Radioactivity
Calcine Waste	Jan 01, 2016	High Level Waste	This waste is a solid granular material derived from liquid wastes produced by reprocessing SNF.	Idaho National Lab	160,000 Cubic Feet	31,300,000 Curies
Cesium and Strontium Capsules	Jan 01, 2016	High Level Waste	This waste consists of 1335 CsCl capsules and 601 SrF2 capsules, each about 21 inches tall and 3 inches in diameter. They are currently managed as high-level waste and stored in pools at the Waste Encapsulation and Storage Facility at Hanford	Hanford	128 Cubic Feet	93,600,000 Curies
Experimental Breeder Reactor-II (EBR-II) Driver Spent Nuclear Fuel	Sep 30, 2017	Spent Nuclear Fuel	Sodium-bonded driver SNF from the Experimental Breeder Reactor-II. The treatment method selected for this waste is electrorefining, which produces a uranium product, a salt waste (see Mark IV Salt Waste), and a metal waste (see Metallic Waste from Electrorefining). The same electrorefining process is used to reprocess the other EBR-II SNF and FFTF driver SNF. As a result, quantities of disposal waste forms associated with this waste represent quantities resulting from electrorefining more than just this sodium-bonded SNF.	Idaho National Lab	1295 Cubic Feet	1,090,000 Curies
Experimental Breeder Reactor-II (EBR-II) Experimental Driver Spent Nuclear Fuel	Sep 30, 2017	Spent Nuclear Fuel	Sodium-bonded experimental driver SNF from the Experimental Breeder Reactor-II. The treatment method selected for this waste is electrorefining, which produces a uranium product, a salt waste (see Mark IV Salt Waste), and a metal waste (see Metallic Waste from Electrorefining). The same electrorefining process is used to reprocess the other EBR-II SNF and FFTF driver SNF. As a result, quantities of disposal waste forms associated with this waste represent quantities resulting from electrorefining more than just this sodium-bonded SNF.	Idaho National Lab	106 Cubic Feet	100,000 Curies
Experimental Breeder Reactor-II (EBR-II) Radial Blanket Spent Nuclear fuel	Sep 30, 2017	Spent Nuclear Fuel	Sodium-bonded blanket SNF from the Experimental Breeder Reactor-II. The treatment method selected for this waste is electrorefining, which produces a uranium product, a salt waste (see Mark V Salt Waste), and a metal waste (see Metallic Waste from Electrorefining). The same electrorefining process is used to reprocess the other EBR-II SNF and FFTF driver SNF. As a result, quantities of disposal waste forms associated with this waste represent quantities resulting from electrorefining more than just this sodium-bonded SNF.	Idaho National Lab	384 Cubic Feet	81,200 Curies
Fast Flux Test Facility (FFTF) Driver Spent Nuclear Fuel	Sep 30, 2017	Spent Nuclear Fuel	Sodium-bonded driver SNF from the Fast Flux Test Facility (FFTF). The treatment method selected for this waste is electrorefining, which produces a uranium product, a salt waste (see Mark IV Salt Waste), and a metal waste (see Metallic Waste from Electrorefining). The same electrorefining process is used to reprocess EBR-II SNF. As a result, quantities of disposal waste forms associated with this waste represent quantities resulting from electrorefining more than just this sodium-bonded SNF.	Idaho National Lab	34 Cubic Feet	20,600 Curies
Fermi-1 Blanket Spent Nuclear Fuel	Sep 30, 2017	Spent Nuclear Fuel	Sodium-bonded blanket fuel from Fermi-1. This fuel has not been selected for electrorefining, as have the other sodium-bonded spent fuels.	Idaho National Lab	671 Cubic Feet	2,320 Curies
German Glass Waste	Jan 01, 1987	Transuranic (TRU) Waste	This waste consists of 34 canisters of glass prepared by Pacific Northwest Laboratory to provide heat and radiation sources for repository testing by the Federal Republic of Germany in the Asse salt mine. This waste has been classfied as RH-TRU but does not meet the requirements of the WIPP Waste Acceptance Criteria and so cannot be disposed of at the WIPP. Two of the 34 canisters are thought to contain depleted uranium and natural thorium, but no cesium or strontium. The 34 canisters are currently stored in 6 CASTOR casks and 2 GNS casks.	Hanford	936 Cubic Feet	17,200,000 Curies
Hanford Tank Waste (CH-TRU)	Jan 01, 2008	Transuranic (TRU) Waste	This waste is material that can be contact handled (CH) and is a subset of the 54.6 million gallons of liquid waste stored at Hanford. It may be transuranic (TRU) waste but has not officially been determined to be so by the DOE.	Hanford	183,000 Cubic Feet	25,100 Curies
Hanford Tank Waste (HLW)	Jan 01, 2008	High Level Waste	This waste is a subset of the 54.6 million gallons of liquid waste stored at Hanford	Hanford	6,600,000 Cubic Feet	171,000,000 Curies
Hanford Tank Waste (RH-TRU)	Jan 01, 2008	Transuranic (TRU) Waste	This waste is material that can be remotely handled (RH) and is a subset of the 54.6 million gallons of liquid waste stored at Hanford. It may be transuranic (TRU) waste, but has not officially been determined to be so by the DOE.	Hanford	464,000 Cubic Feet	2,900,000 Curies

Figure 2-3. Partial View of DOE-Managed Wastes Report Showing Wastes, Waste Classification, Description, Storage Facility, Total Volume, and Total Radioactivity

Because there is a large variety of waste information, the user can click on any waste for additional waste detail information. For example, Figure 2-4 provides a sample screenshot of the waste detail that appears when "Savannah River Glass Waste" is selected. The first two sections load first, giving the user the following options for what type of additional detail to display:

1. Waste Characteristics
2. Waste Source
3. Disposal Waste Forms
4. Disposal Waste Form Characteristics
5. Radionuclide Inventory
6. Radionuclide Characteristics
7. Waste Supporting Documents
8. Waste Contacts

The bottom part of Figure 2-4 shows the display provided when both "Waste Characteristics" and "Disposal Waste Forms" are selected.

Savannah River Glass Waste

Waste Classification	Waste Description	Storage Facility	Produced By	Is Mixed Waste?	Baseline Inventory Date & Inventory Calculator	
High Level Waste	This waste consists of 4,179 vitrified glass logs produced in the Defense Waste Processing Facility at the Savannah River Site from reprocessing Savannah River Tank Waste.	Savannah River Site	Government	No	12/31/2018	Inventory Calculator

Display Specific Waste Information by Expanding (+) the Type of Content Listed Below

⊟1. Waste Characteristics	⊟3. Disposal Waste Forms	⊞5. Radionuclide Inventory	⊞7. Waste Supporting Documents
⊞2. Waste Source	⊞4. Disposal Waste Form Characteristics	⊞6. Radionuclide Characteristics	⊞8. Waste Contacts

1. Waste Characteristics

Characteristic	Characteristic Description	Value	Supporting Document
Average thermal output of a unit of the nuclear waste	Average thermal output of a canister of glass waste as of the baseline date	40 Watts	SRS Glass Waste Information
Diameter of the nuclear waste container	Diameter of a container of glass waste	2 Feet	Evaluation of Options for Permanent Geologic Disposal of Spent Nuclear Fuel and High Level Radioactive Waste in Support of a Comprehensive National Nuclear Fuel Cycle Strategy: Volume II: Appendices
Length of the nuclear waste container	Height of a container of glass waste at Savannah River	10 Feet	Evaluation of Options for Permanent Geologic Disposal of Spent Nuclear Fuel and High Level Radioactive Waste in Support of a Comprehensive National Nuclear Fuel Cycle Strategy: Volume II: Appendices
Number of containers	Number of containers of glass waste at Savannah River as of December 2018.	4,179	Liquid Waste System Plan, Revision 21
Physical form of the waste	Physical form of the glass waste at Savannah River	Borosilicate glass	Liquid Waste System Plan, Revision 21
Total radioactivity - the total curies of all the radionuclides in the waste as of the baseline date	Total radioactivity of glass waste at Savannah River	45,600,000 Curies	SRS Glass Waste Information
Total volume of the waste as currently stored, including any packaging	Total volume of glass waste at Savannah River	129,000 Cubic Feet	SRS Glass Waste Information

3. Disposal Waste Forms

Waste Form	Description	Projected or Existing	Preferred or Alternative	Quantity	Supporting Document
Glass waste	Glass logs in canisters	Existing	Preferred	4,179 2 ft. diameter, 10 ft. tall canisters	Liquid Waste System Plan, Revision 21

Figure 2-4. Waste Detail for Savannah River Glass Waste with Additional Selection of Options 1 and 3 for Waste Characteristics and Disposal Waste Forms Respectively

Waste Forms—As seen in Figure 2-5, the Waste Forms report provides the following information for each disposal waste form: the related waste type(s), waste form description, whether the waste form is projected or existing, whether the waste form is the result of the preferred or alternative treatment, the projected or existing quantity, the projected or existing volume, and the supporting document for this information. Clicking on a specific waste form produces a report giving the waste form characteristics. For example, Figure 2-6 shows the resulting report for Savannah River Glass Waste.

Waste Types and Associated Disposal Waste Forms

Waste	Disposal Waste Form	Waste Form Description	Projected or Existing	Preferred or Alternative	Quantity	Volume	Supporting Document
Calcine Waste	Calcine Waste cemented without vitrification	Direct cementation of the calcine waste without vitrification.	Projected	Alternative	18,000 2 ft. diameter, 10 ft. tall canisters	570,000 cubic feet	On-Line Waste Library Supporting Information
	Calcine waste that has been hot isostatically pressed, with additives	Calcine waste treated by hot isostatic pressing, including silica, titanium and calcium sulfate (glass ceramic). Processing the calcine with the silica and titanium is needed to eliminate RCRA hazardous waste characteristics.	Projected	Preferred	4,045 Cans of calcine that have been hot isostatically pressed	190,000 cubic feet	On-Line Waste Library Supporting Information
	Calcine waste that has been hot isostatically pressed, without additives	Calcine waste treated by hot isostatic pressing without silica, titanium and calcium sulfate (glass ceramic).	Projected	Alternative	3,236 Cans of calcine that have been hot isostatically pressed	150,000 cubic feet	On-Line Waste Library Supporting Information
	Calcine Waste Vitrified following Separation	Calcine waste that has been vitrified following separation.	Projected	Alternative	1,190 2 ft. diameter, 10 ft. tall canisters	37,000 cubic feet	On-Line Waste Library Supporting Information
	Calcine Waste Vitrified without Separation	Calcine waste that has been vitrified without separation.	Projected	Alternative	12,000 2 ft. diameter, 10 ft. tall canisters	380,000 cubic feet	On-Line Waste Library Supporting Information
	Calcine Waste without further treatment	Calcine waste that is disposed of without further treatment.	Existing	Alternative	6,100 2 ft. diameter, 10 ft. tall canisters	190,000 cubic feet	On-Line Waste Library Supporting Information
Cesium and Strontium Capsules	Cs and Sr capsules	Cs and Sr capsules, as-is, disposed of in waste packages designed for a deep borehole, 18 capsules per package	Existing	Alternative	108 8.625 in. diameter, 16 ft. tall waste packages	686 cubic feet	Deep Borehole Disposal Safety Analysis
	Vitrified Cs and Sr from capsules	Glass logs in canisters	Projected	Preferred	340 2 ft. diameter, 15 ft. tall canisters	16,000 cubic feet	Vitrification of Cs and Sr Capsules
Experimental Breeder Reactor-II (EBR-II) Driver Spent Nuclear Fuel	Ceramic Waste Form	Glass-bonded sodalite material produced from mixing cooled, crushed salt from the electrorefiner with zeolite and borosilicate binder glass. The reported quantity and volume represent the quantity and volume of ceramic waste produced by electrorefining all sodium-bonded spent fuel (driver and blanket) from the EBR-II and the FFTF.	Projected	Preferred	96 2 ft. diameter, 10 ft. tall canister	60 cubic meters	Source Terms for HLW Glass Canisters
	Electrorefiner Salt Waste Form from Driver Sodium-Bonded Spent Fuel	A LiCl-KCl salt mix with lesser amounts of NaCl produced from electrorefining driver sodium-bonded spent fuels from both the EBR-II and the FFTF. This waste form would be disposed of without further treatment or processing (i.e., as salt). Note that Technical Feasibility of Direct Disposal of Electrorefiner Salt Waste (2017) and Roadmap for Disposal of Electrorefiner Salt as Transuranic Waste (2017) present an alternative packaging plan using existing containers.	Projected	Alternative	9 27 cm diamter, 155 cm tall stainless-steel disposal canister	0.8 cubic meters	Initial Performance Assessment to Evaluate Technical Feasibility of Direct Disposal of Electrorefiner Salt Waste in Salt Repository
	Metallic Waste Form	A Fe-Cr-Ni-Zr mixture and an iron solid solution phase that are interspersed on a microscopic scale and are produced from electrorefiner metal waste stream in the form of ingots. The quantity and volume reproted represent the quantity and volume of metallic waste produced by electrorefining all sodium-bonded spent fuel (driver and blanket) from the EBR-II and the FFTF.	Projected	Preferred	6 2 ft. diameter, 10 ft. tall canister	1.2 cubic meters	Source Terms for HLW Glass Canisters
Experimental Breeder Reactor-II (EBR-II) Experimental Driver Spent Nuclear Fuel	Ceramic Waste Form	Glass-bonded sodalite material produced from mixing cooled, crushed salt from the electrorefiner with zeolite and borosilicate binder glass. The reported quantity and volume represent the quantity and volume of ceramic waste produced by electrorefining all sodium-bonded spent fuel (driver and blanket) from the EBR-II and the FFTF.	Projected	Preferred	96 2 ft. diameter, 10 ft. tall canister	60 cubic meters	Source Terms for HLW Glass Canisters
	Electrorefiner Salt Waste Form from Driver Sodium-Bonded Spent Fuel	A LiCl-KCl salt mix with lesser amounts of NaCl produced from electrorefining driver sodium-bonded spent fuels from both the EBR-II and the FFTF. This waste form would be disposed of without further treatment or processing (i.e., as salt). Note that Technical Feasibility of Direct Disposal of Electrorefiner Salt Waste (2017) and Roadmap for Disposal of Electrorefiner Salt as Transuranic Waste (2017) present an alternative packaging plan using existing containers.	Projected	Alternative	9 27 cm diamter, 155 cm tall stainless-steel disposal canister	0.8 cubic meters	Initial Performance Assessment to Evaluate Technical Feasibility of Direct Disposal of Electrorefiner Salt Waste in Salt Repository
	Metallic Waste Form	A Fe-Cr-Ni-Zr mixture and an iron solid solution phase that are interspersed on a microscopic scale and are produced from electrorefiner metal waste stream in the form of ingots. The quantity and volume reproted represent the quantity and volume of metallic waste produced by electrorefining all sodium-bonded spent fuel (driver and blanket) from the EBR-II and the FFTF.	Projected	Preferred	6 2 ft. diameter, 10 ft. tall canister	1.2 cubic meters	Source Terms for HLW Glass Canisters
Experimental Breeder Reactor-II		Glass-bonded sodalite material produced from mixing cooled, crushed salt from the electrorefiner with zeolite and borosilicate binder glass. The					

Figure 2-5. Partial View of Waste Forms Report Showing Waste Forms, Description, Related Waste Types, Various Properties, and Supporting Documents

Clear Characteristics

Disposal Waste Form Characteristics

Waste Form	Form Characteristic	Characteristic Description	Value & Unit	Supporting Document
Glass waste	Annealing range	Annealing range of HLW borosilicate glass (lower value)	450 degrees C	SRS Glass Waste Characteristics
	Annealing range	Annealing range of HLW borosilicate glass (upper value)	500 degrees C	SRS Glass Waste Characteristics
	Average thermal output	Average thermal output of a canister of glass waste at Savannah River as of the baseline date	40 watts	SRS Glass Waste Information
	Compressive strength	Compressive strength of HLW borosilicate glass	550 MPa	SRS Glass Waste Characteristics
	Density	Density of HLW borosilicate glass	2.75 g/cubic cm	SRS Glass Waste Characteristics
	Diameter of container	Nominal outer diameter of container of glass waste at Savannah River	61 cm	SRS Glass Waste Characteristics
	Heat capacity	Heat capacity of HLW borosilicate glass	0.83 J/g-K (at 25 C)	SRS Glass Waste Characteristics
	Height of container	Height of container of glass waste at Savannah River	3.00 m	SRS Glass Waste Characteristics
	Mass of loaded glass container	Maximum weight of container of glass waste at Savannah River	2,500 kg	SRS Glass Waste Characteristics
	Softening point	Softening point of HLW borosilicate glass	500 degrees C	SRS Glass Waste Characteristics
	Tensile strength	Tensile strength of HLW borosilicate glass	57 MPa	SRS Glass Waste Characteristics
	Thermal conductivity	Thermal conductivity of HLW borosilicate glass	0.95 W/m-K (at 100 C)	SRS Glass Waste Characteristics
	Total volume	Total volume of waste at Savannah River that exists as glass as of December 2018.	129,000 cubic feet	SRS Glass Waste Information

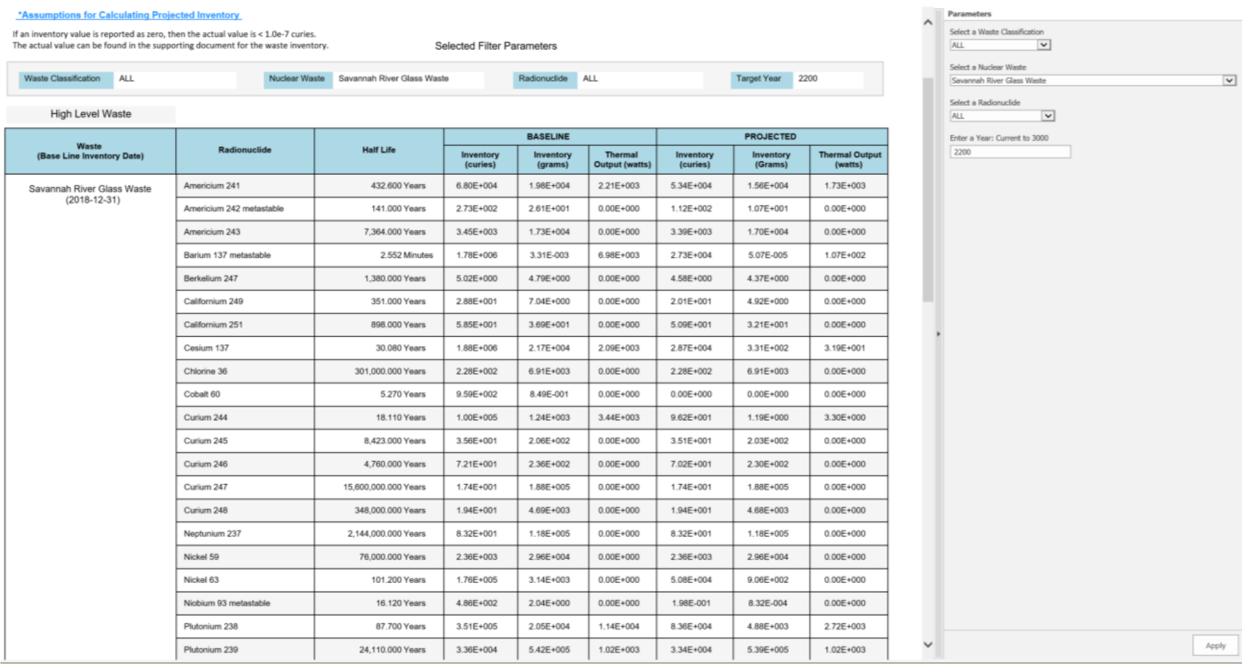
Waste Types and Associated Disposal Waste Forms

Waste	Disposal Waste Form	Waste Form Description	Projected or Existing	Preferred or Alternative	Quantity	Volume	Supporting Document
Savannah River Glass Waste	Glass waste	Glass logs in canisters	Existing	Preferred	4,179 2 ft. diameter, 10 ft. tall canisters	129,000 cubic feet	Liquid Waste System Plan, Revision 21

Figure 2-6. Disposal Waste Form Characteristics for Savannah River Glass Waste

Inventory Calculator—The OWL database features a Radionuclide Inventory Calculator, which is made possible through the use of a stored calculation tool. The user makes selections from the following options: waste classification (all, HLW, SNF, or TRU), nuclear waste (all or any of the different waste types), radionuclide (all or a specific radionuclide), and year (anything from current year to 3000 C.E.). The radionuclides included in the "all" category or available for individual selection are limited to those included in the initial reported inventory for at least one of the wastes in OWL. Based on the user selections, the Radionuclide Inventory Calculator does the necessary calculations using the initial reported inventory information and returns the results in an SSRS report. The user can access supporting documents for the basic information stored in OWL as well as documentation regarding the calculation methods used by the Radionuclide Inventory Calculator. OWL database reports can be generated to provide the inventory in various units, such as volumes, radioactivity, and/or thermal output of wastes as they currently exist.

Figure 2-7 provides an example screenshot of the projected inventory database report generated by the Radionuclide Inventory Calculator for "Savannah River Glass Waste" from the baseline inventory date to the selected target year 2200. On the right is the panel showing the filter selections used for the calculation.



*Assumptions for Calculating Projected Inventory

If an inventory value is reported as zero, then the actual value is < 1.0e-7 curies.
The actual value can be found in the supporting document for the waste inventory.

Selected Filter Parameters

Waste Classification: ALL | Nuclear Waste: Savannah River Glass Waste | Radionuclide: ALL | Target Year: 2200

High Level Waste

Waste (Base Line Inventory Date)	Radionuclide	Half Life	BASELINE			PROJECTED		
			Inventory (curies)	Inventory (grams)	Thermal Output (watts)	Inventory (curies)	Inventory (Grams)	Thermal Output (watts)
Savannah River Glass Waste (2018-12-31)	Americium 241	432.600 Years	6.80E+004	1.98E+004	2.21E+003	5.34E+004	1.56E+004	1.73E+003
	Americium 242 metastable	141.000 Years	2.73E+002	2.61E+001	0.00E+000	1.12E+002	1.07E+001	0.00E+000
	Americium 243	7,364.000 Years	3.45E+003	1.73E+004	0.00E+000	3.39E+003	1.70E+004	0.00E+000
	Barium 137 metastable	2.552 Minutes	1.78E+006	3.31E-003	6.98E+003	2.73E+004	5.07E-005	1.07E+002
	Berkelium 247	1,380.000 Years	5.02E+000	4.79E+000	0.00E+000	4.58E+000	4.37E+000	0.00E+000
	Californium 249	351.000 Years	2.88E+001	7.04E+000	0.00E+000	2.01E+001	4.92E+000	0.00E+000
	Californium 251	898.000 Years	5.85E+001	3.69E+001	0.00E+000	5.09E+001	3.21E+001	0.00E+000
	Cesium 137	30.080 Years	1.88E+006	2.17E+004	2.09E+003	2.87E+004	3.31E+002	3.19E+001
	Chlorine 36	301,000.000 Years	2.28E+002	6.91E+003	0.00E+000	2.28E+002	6.91E+003	0.00E+000
	Cobalt 60	5.270 Years	9.59E+002	8.49E-001	0.00E+000	0.00E+000	0.00E+000	0.00E+000
	Curium 244	18.110 Years	1.00E+005	1.24E+003	3.44E+003	9.62E+001	1.19E+000	3.30E+000
	Curium 245	8,423.000 Years	3.56E+001	2.06E+002	0.00E+000	3.51E+001	2.03E+002	0.00E+000
	Curium 246	4,760.000 Years	7.21E+001	2.36E+002	0.00E+000	7.02E+001	2.30E+002	0.00E+000
	Curium 247	15,600,000.000 Years	1.74E+001	1.88E+005	0.00E+000	1.74E+001	1.88E+005	0.00E+000
	Curium 248	348,000.000 Years	1.94E+001	4.69E+003	0.00E+000	1.94E+001	4.68E+003	0.00E+000
	Neptunium 237	2,144,000.000 Years	8.32E+001	1.18E+005	0.00E+000	8.32E+001	1.18E+005	0.00E+000
	Nickel 59	76,000.000 Years	2.36E+003	2.96E+004	0.00E+000	2.36E+003	2.96E+004	0.00E+000
	Nickel 63	101.200 Years	1.76E+005	3.14E+003	0.00E+000	5.08E+004	9.06E+002	0.00E+000
	Niobium 93 metastable	16.120 Years	4.86E+002	2.04E+000	0.00E+000	1.98E-001	8.32E-004	0.00E+000
	Plutonium 238	87.700 Years	3.51E+005	2.05E+004	1.14E+004	8.36E+004	4.88E+003	2.72E+003
	Plutonium 239	24,110.000 Years	3.36E+004	5.42E+005	1.02E+003	3.34E+004	5.39E+005	1.02E+003

Parameters

Select a Waste Classification: ALL

Select a Nuclear Waste: Savannah River Glass Waste

Select a Radionuclide: ALL

Enter a Year: Current to 3000: 2200

Apply

Figure 2-7. Partial View of Report from Radionuclide Inventory Calculator showing Projected Inventory from the Baseline Inventory of Savannah River Glass Waste to the Target Year of 2,200

200-Year Inventory and Thermal Output—In addition to providing the ability to calculate projected inventory for a specific target year, the database can calculate and visually display the projected inventory and thermal output by year for the next 200 years. The calculations consider only those radionuclides included in the initial inventory reported for at least one of the wastes in OWL. The calculation results are shown in charts (Figure 2-8) with user controls available to change the display according to the selected waste and radionuclide options. Figure 2-8 displays the results for all wastes in OWL. Note that the user can also display results for individual wastes and/or individual radionuclides. The option to display the inventory in either curies or becquerels is also provided. A link to the supporting document (Price 2022) with additional information on the calculations is provided.

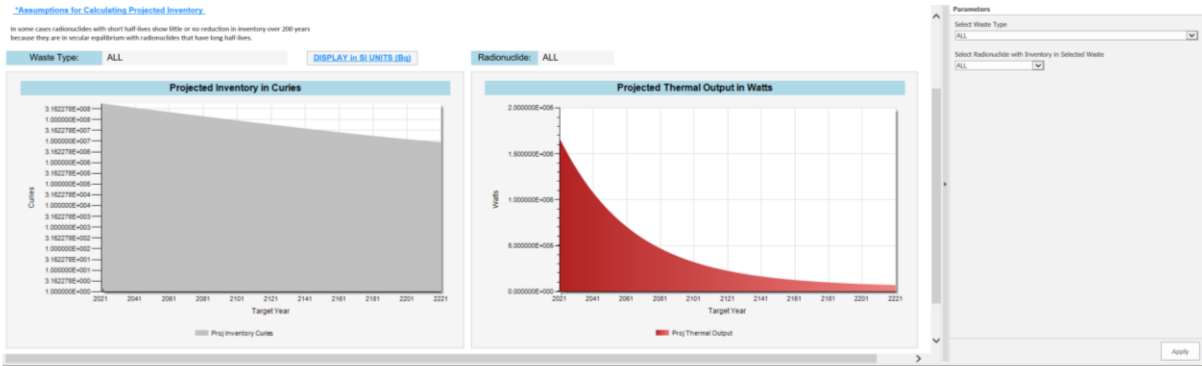
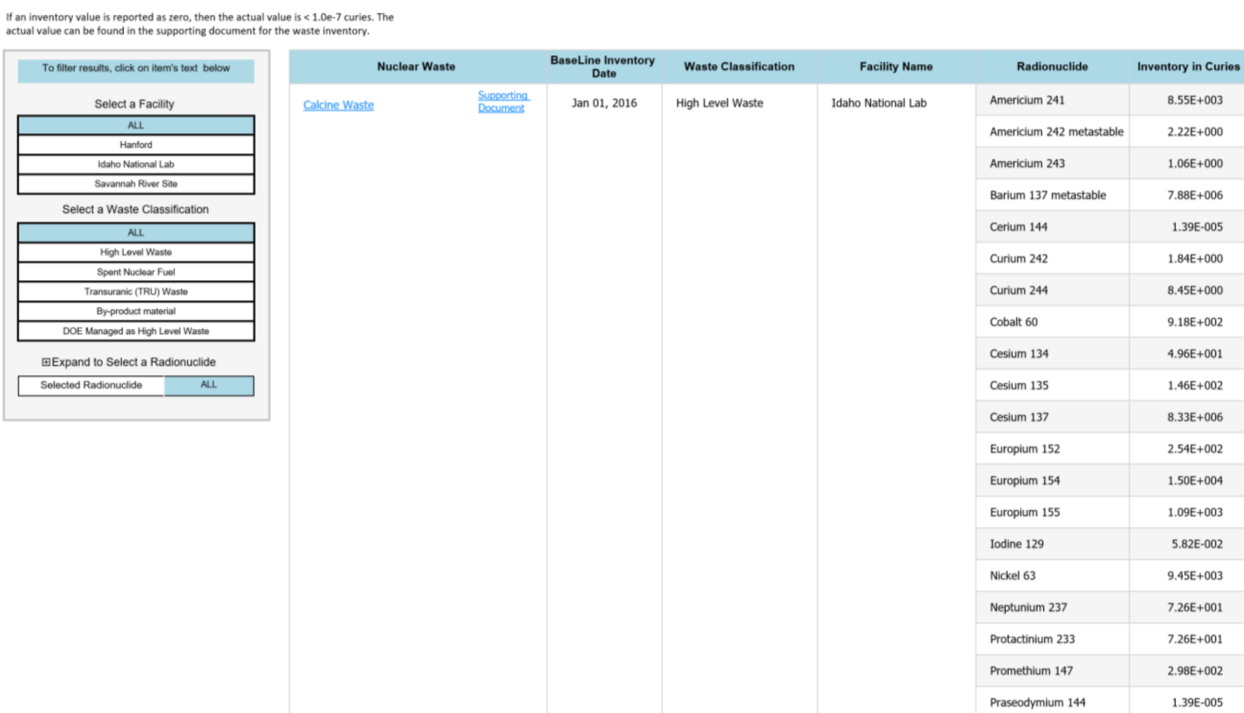


Figure 2-8. Visual Display of Calculated Projected Activity and Thermal Output for a Waste by Year for the Next 200 Years

Baseline Radionuclide Inventory in Each Waste—As seen in Figure 2-9, this report provides the baseline inventory reported to be in each waste type as of the date specified in the supporting document. Clicking on a particular waste type brings up the associated waste detail such as that in Figure 2-4. A link next to the waste type provides access to the document supporting the inventory information. The panel on the left allows the user to filter by facility, waste classification, and/or radionuclide.



Nuclear Waste		BaseLine Inventory Date	Waste Classification	Facility Name	Radionuclide	Inventory in Curies
Calcine Waste	Supporting Document	Jan 01, 2016	High Level Waste	Idaho National Lab	Americium 241	8.55E+003
					Americium 242 metastable	2.22E+000
					Americium 243	1.06E+000
					Barium 137 metastable	7.88E+006
					Cerium 144	1.39E-005
					Curium 242	1.84E+000
					Curium 244	8.45E+000
					Cobalt 60	9.18E+002
					Cesium 134	4.96E+001
					Cesium 135	1.46E+002
					Cesium 137	8.33E+006
					Europium 152	2.54E+002
					Europium 154	1.50E+004
					Europium 155	1.09E+003
					Iodine 129	5.82E-002
					Nickel 63	9.45E+003
					Neptunium 237	7.26E+001
					Protactinium 233	7.26E+001
					Promethium 147	2.98E+002
					Praseodymium 144	1.39E-005

Figure 2-9. Partial View of Report for Baseline Radionuclide Inventory in Each Waste with Filtering Options Panel

Radionuclides—Currently, the OWL database captures information on 104 radionuclides, 87 of which are included in the initial inventory reported for at least one waste listed in OWL. The additional 17 radionuclides are provided because of parent-child relationships with radionuclides that are included in the reported initial inventory. The inclusion of these additional radionuclides is part of the effort to establish the interface between GDSA and OWL. Figure 2-10 provides a screenshot from a database report showing a sample of the radionuclide information. A control panel on the right allows the user to see one of three views by choosing "Select All," "No Inventory," or "Has Inventory in Wastes." In this context, "No Inventory" means that no initial inventory for the radionuclide was reported for any of the wastes, but the radionuclide is included in OWL for establishing radioactive decay chains. "Has Inventory in Wastes" means that some initial inventory for the radionuclide was reported for at least one of the wastes in OWL. For those radionuclides included in the inventory, clicking on one of the projected inventory links brings up a screen with graphs similar to those seen in Figure 2-8 for projected inventory and thermal output. The difference is that, while graphs shown through the 200-Year Inventory and Thermal Output report can be filtered to select a waste type and radionuclide, the graphs accessed through clicking a link in the Radionuclides report (Figure 2-10) reflect the inventory of the selected radionuclide for all waste types.

Radionuclide	Description	Half Life	Inventory	Atomic Mass (u)	Thermal Output (watts/kCi)	Parent Radionuclide	Inventory Ratio	Supporting Document
Ac-227	Actinium 227	21.77 Years	Projected Inventory (200 years)	227.00				Ac-227 Nuclear Data
Ac-228	Actinium 228	6.15 Hours	No Inventory	228.00		Ra-228	1.000	Ac-228 Nuclear Data
Al-26	Aluminum 26	717,000.00 Years	Projected Inventory (200 years)	26.00				Al-26 Nuclear Data
Am-241	Americium 241	432.60 Years	Projected Inventory (200 years)	241.00	32.450	Pu-241		Am-241 Nuclear Data
Am-242	Americium 242	16.02 Hours	Projected Inventory (200 years)	242.00		Am-242m	0.995	Am-242 Nuclear Data
Am-242m	Americium 242 metastable	141.00 Years	Projected Inventory (200 years)	242.00				Am-242m Nuclear Data
Am-243	Americium 243	7,364.00 Years	Projected Inventory (200 years)	243.00				Am-243 Nuclear Data
Ba-137m	Barium 137 metastable	2.55 Minutes	Projected Inventory (200 years)	137.00	3.920	Cs-137	0.950	Ba-137m Nuclear Data
Bi-212	Bismuth 212	60.55 Minutes	No Inventory	212.00		Th-228	1.000	Bi-212 Nuclear Data
Bi-214	Bismuth 214	19.71 Minutes	No Inventory	214.00		Ra-226	1.000	Bi-214 Nuclear Data
Bk-247	Berkelium 247	1,380.00 Years	Projected Inventory (200 years)	247.00				Bk-247 Nuclear Data
C-14	Carbon 14	5,700.00 Years	Projected Inventory (200 years)	14.00				C-14 Nuclear Data
Cd-113m	Cadmium 113 metastable	14.10 Years	Projected Inventory (200 years)	113.00				Cd-113m Nuclear Data
Ce-144	Cerium 144	284.91 Days	Projected Inventory (200 years)	144.00				Ce-144 Nuclear Data
Cf-249	Californium 249	351.00 Years	Projected Inventory (200 years)	249.00				Cf-249 Nuclear Data
Cf-251	Californium 251	898.00 Years	Projected Inventory (200 years)	251.00				Cf-251 Nuclear Data
Cf-252	Californium 252	2.65 Years	Projected Inventory (200 years)	252.00				Cf-252 Nuclear Data
Cl-36	Chlorine 36	301,000.00 Years	Projected Inventory (200 years)	36.00				Cl-36 Nuclear Data
Cm-242	Curium 242	162.86 Days	Projected Inventory (200 years)	242.00		Am-242m	0.830	Cm-242 Nuclear Data
Cm-243	Curium 243	28.90 Years	Projected Inventory (200 years)	243.00				Cm-243 Nuclear Data

Figure 2-10. Partial View of Radionuclides Report

Supporting Documents—An effort from FY2017 to FY2018 consisted of loading supporting documents into OWL to provide the underpinning sources and to supplement the database content. With each OWL release, modifications are made to the Supporting Documents Library as needed to ensure the database content is adequately supported by the appropriate documents. The library typically has several hundred documents, all of which can be accessed and viewed from within OWL. Figure 2-11 provides a screenshot sample of documents available.

As part of the effort to provide supporting documents for each waste, the Excel™ spreadsheet for each waste that can be used to calculate its inventory and thermal output and (in some cases) the volume of waste was turned into a pdf. Results from the beta testing of OWL indicated that users sometimes had trouble opening or viewing the spreadsheets as Excel™ spreadsheet files, so the spreadsheets were formatted appropriately, checked, and saved as pdf files before being sent through SNL's information release (IR) process. Thus, each spreadsheet can be viewed and is referenceable. The original Excel™ spreadsheet is available upon request via an email to OWL@sandia.gov.

Title	Document Description	Comments	Author	Publisher, Date	Copyright Restrictions	Document Availability
105-K Basin Material Design Basis Feed for SNF Project Facilities	This report gives the design basis feeds for SNF project facilities	HNF-SD-SNF-TI-009, Volume 1, Rev. 3	M.J. Packer	Numatec Hanford, Inc., November 4, 1999	None	Internal Full Document
1995 Settlement Agreement between the State of Idaho, the U.S. Department of Energy, and the Department of the Navy	This is the settlement agreement reached by the State of Idaho, the U.S. Department of Energy, and the Department of the Navy regarding the management of naval SNF.	None	U.S. Courts District of Idaho	United States Courts District of Idaho, October 17, 1995	None	Internal Full Document
2008 Addendum to the 1995 Settlement Agreement	This is an addendum to the 1995 settlement agreement.	None	The State of Idaho, the Department of Energy, and the Department of the Navy	The State of Idaho, the Department of Energy, and the Departmentof the Navy, 2008	None	Internal Full Document
A Finite Difference Model Used to Predict the Consolidation of a Ceramic Waste Form Produced from the Electrometallurgical Treatment of Spent Nuclear Fuel	This report describes the development of a finite difference model to predict the consolidation of the ceramic waste as it is produced.	ANL-NT-209	K. J. Bateman and D. D. Capson	Argonne National Laboratory, October 2002	None	Internal Full Document
A Summary Description of the Fast Flux Test Facility	This report describes the Fast Flux Test Facility	HEDL-400	C. P. Cabell	Westinghouse Hanford Company, December 1980	None	Internal Full Document
Ac-227 Nuclear Data	This data sheet gives the half-life of Ac-227.	Available at http://www.nndc.bnl.gov/	National Nuclear Data Center	National Nuclear Data Center, March 2017	None	Internal Full Document
Ac-228 Nuclear Data	This data sheet gives decay radiaiton information for Ac-228.	Available at http://www.nndc.bnl.gov	National Nuclear Data Center	National Nuclear Data Center, 2014	None	Internal Full Document
Activity of Fuel Batches Processed Through Hanford Separations Plants, 1944 Through 1989	This report estimates the activity of fuel batches processed at Hanford through 1989.	RPP-13489 Rev. 0	Wootan, D. W. and S. F. Finfrock	CH2MHill, November 2002	None	Internal Full Document
Al-26 Nuclear Data	This data sheet gives the half-life of Al-26.	Available at http://www.nndc.bnl.gov/	National Nuclear Data Center	National Nuclear Data Center, March 2017	None	Internal Full Document
Am-241 Nuclear Data	This data sheet gives the half-life and decay energies of Am-241, which are used to calculate decay heat	Available at http://www.nndc.bnl.gov/	National Nuclear Data Center	National Nuclear Data Center, March 2017	None	Internal Full Document
Am-242 Nuclear Data	This data sheet gives the half-life and branching fraction of Am-242.	Available at http://www.nndc.bnl.gov	National Nuclear Data Center	National Nuclear Data Center, March 2017	None	Internal Full Document
Am-242m Nuclear Data	This data sheet gives the half-life and branching fraction for Am-242m.	Available at http://www.nndc.bnl.gov	National Nuclear Data Center	National Nuclear Data Center, March 2017	None	Internal Full Document
Am-243 Nuclear Data	This data sheet gives the half-life of Am-243	Available at http://www.nndc.bnl.gov	National Nuclear Data Center	National Nuclear Data Center, March 2017	None	Internal Full Document
Analysis of DWPF Sludge Batch 6 (Macrobatch 7) Pour Stream Glass Samples	This report provides the radionuclide inventory in a sample of sludge from macrobatch 7 at Savannah River.	SRNL-STI-2011-00555	F. C. Johnson	Savannah River Nuclear Laboratory, February 2012	None	Internal Full Document
Analysis of DWPF Sludge Batch 7a (Macrobatch 8) Pour Stream Samples	This report provides the radionuclide inventory in a sample of sludge from macrobatch 8 at Savannah River.	SRNL-STI-2012-00017	F. C. Johnson and J. M Pareizs	Savannah River National Laboratory, October 2012	None	Internal Full Document
Analysis of Sludge Batch 4 (Macrobatch 5) for Canister S02902 and Sludge Batch 5 (Macrobatch 6) for Canister S03317 DWPF Pour Stream Glass Samples	This report provides the radionuclide inventory in samples of sludge from macrobatch 5 and macrobatch 6	SRNL-STI-2010-00435	M. M. Reigel and N. E. Bibler	Savannah River National Laboratory, September 2010	None	Internal Full Document
Analysis of the Sludge Batch 7b (Macrobatch 9) DWPF Pour Stream Sample	This report provides the radionuclide inventory in a sample of sludge from macrobatch 9 at Savannah River.	SRNL-STI-2013-00462	F. C. Johnson, C. L. Crawford, and J.M. Pareizs	Savannah River National Laboratory, November 2013	None	Internal Full Document
Appendix D Na Bonded Fuel EIS	This is Appendix D of the Environmental Impact Statement to support decisions on disposal of sodium-bonded fuel.	DOE-EIS-0306_Vol 2-2000	U. S. Department of Energy	U. S. Department of Energy, 2000	None	Internal Full Document
Application of the MEDEC Process to Treat Fermi-1 Sodium-Bonded Spent Nuclear Fuel	This paper examines application of the MEDEC process to Fermi-1 sodium-bonded spent nuclear fuel.	None	Karen L. Toews, Steven D. Herrmann, David A. Sell, Richard H. Rigg, and Robert G. Pahl	Argonne National Laboratory, Unknown	None	Internal Full Document
Ba-137m Nuclear Data	This data sheet gives the half-life and decay energies of Ba-137 metastable, which are used to calculate decay heat.	Available at http://www.nndc.bnl.gov	National Nuclear Data Center	National Nuclear Data Center, March 2017	None	Internal Full Document
Bi-212 Nuclear Data	This data sheet gives decay radiation information for Bi-212	Available at http://www.nndc.bnl.gov	National Nuclear Data Center	National Nuclear Data Center, 2007	None	Internal Full Document

Figure 2-11. Database Report Sample of Supporting Documents

2.6 Configuration Management

An important part of the infrastructure supporting OWL is a coherent suite of processes working together to preserve information integrity and traceability as the database evolves over time. Planning for the change control and release processes started in FY2019 along with the first public release of OWL (version 1.0). Much of FY2020 was spent developing the details before putting the draft processes in to practice with the release of OWL version 2.0 in late FY2020. Using the lessons learned, the processes were revised and finalized in FY2021, resulting in the documents *OWL Change Control Process* (Weck et al. 2021d) and *OWL Release Process* (Weck et al. 2021c). These documents were also reproduced as appendices in the annual status milestone 2 report for FY2020 OWL activities (Weck et al. 2021a).

Overview—The change control process and the release process work together to ensure the quality of the release version of OWL. OWL is maintained and updated with the use of three environments: the Development Environment, the Release Candidate Environment, and the Production Environment. Each environment has the appropriate OWL database and SharePoint site components. The change control process governs all changes that will eventually appear in the released version of OWL in the Production Environment. In general, changes to OWL are made first in the Development Environment. When it is time for a public release, the release process controls the migration of changes to the Release Candidate Environment for technical review and IR, and then to the Production Environment for public release. Changes to the Production SharePoint Site (governed by the change control process) are implemented in conjunction with the public release (governed by the release process). The release process also controls archival of the previous version of OWL and updating the *OWL User's Guide* as appropriate to support the new OWL release.

Change Drivers and Mechanisms—The most obvious driver of change is planned updates and/or modifications to the OWL structure or content to respond to the priorities of the Spent Fuel & Waste Science and Technology (SFWST) disposal research and development program. In addition, there are multiple other mechanisms capable of triggering the need to modify OWL including (1) discovery of newer published documents that supplement or supersede the supporting technical documents for data in OWL, (2) receipt of updates from the SFD, (3) receipt of new information with supporting documentation from DOE/national laboratory staff responsible for the wastes, (4) identification of any types of issues by OWL users via the OWL email service, (5) changes to data used from the National Nuclear Data Center, and (6) discovery of errors. Currently, a user can provide feedback through the OWL email service. However, consideration is being given to developing a more refined user feedback process to enable users to ask questions, provide feedback, and report errors. This feedback information could be used to evaluate the need to plan changes in new OWL versions.

Change Control Process—Regardless of the driver for change, all changes in OWL are implemented through the change control process, which specifies that changes and associated tasks are entered into a tracking system. The key infrastructure elements for managing change are the Change List and Task List, which reside on the OWL Development SharePoint Site. When a change to OWL is approved, it is entered on the Change List. Each change has various properties (i.e., metadata fields) associated with it including a field to track status. In addition, each change has at least one associated task; complicated changes may have several associated tasks. Each task listed for a change in the Change List is entered on the Task List along with the properties for that task. The tasks are assigned to activities with defined process steps, one of which is always a review by someone independent of the work to ensure the task fulfills the intended purpose. Tasks involving data entry or development of stored calculation tools are subject to a rigorous checking process. All tasks associated with a change in the Change List must be completed before the change can be marked as complete.

The change control process also includes steps to ensure the OWL content and results from stored calculation tools are transparent and traceable. All OWL content is tied to the original source within the database structure and that source is available to the user in the OWL Supporting Documents Library. While the user can go to the Supporting Documents Library, there are also links available to provide easy access to the document associated with a particular piece of information. Occasionally a supporting document is subject to copyright or some other restriction. In this case, permission to publicly release the document as part of OWL is sought. If the document cannot be provided, a summary identifying and describing the document is provided in the public release of OWL so that the content is still traceable to the original source. In addition, stored calculation tools are documented both in terms of the OWL content being used and the calculations being done. The documentation is stored in the Supporting Documents Library and also made available to the user through links, which means that the results from stored calculation tools are also transparent and traceable.

During the technical review for the release of OWL version 4.0, an issue arose concerning the reliance in OWL on supporting documents that have since been revised or replaced by an external entity. The change control process already addressed how to replace a supporting document with a new revision or a replacement document as well as how to handle updates to any other affected content as appropriate. However, there was no mechanism in place to help identify whether a supporting document not originated by the OWL team has been revised or replaced and, if so, whether the newer document supplements or supersedes the older document.

During FY2023, the OWL team developed a two-pronged screening process that could be implemented annually to address the identified issue. The first part is to conduct an informal waste-by-waste review. Knowledgeable people, principally other team members, are consulted to determine, for each waste, if anything significant happened in the last year. For example, the OWL team knows that the number of HLW glass logs and the volume of tank waste change every year at the SRS because waste is being actively processed. However, SRS does not necessarily issue reports every year, so a search is needed to determine if a new revision of the original supporting document has been issued. Similarly, Hanford tank waste volumes could change because wastes are being pumped from one tank to another. Again, a search is needed to check for any pertinent document revisions.

The second part of the screening process begins with a query developed to identify all supporting documents, currently included in OWL, that have revision numbers. Then a search of internet sources is conducted to identify documents that have been revised. If the document has not been revised, this observation is noted as part of the review process. An impact analysis is conducted to evaluate the identified revised documents. If the information used in OWL did not change, this observation is also noted as part of the review process. The revised document is added to OWL as a supporting document for the appropriate waste. In addition, the earlier document is retained in OWL to provide historical information for OWL users. If the information used in OWL is changed in the revised document, then a change and task are created to replace the superseded information with the information from the revised document. The document with the new information is also added to OWL as a supporting document for the appropriate waste.

The screening process was implemented for the first time in FY2023. A check on SRS documents led to the discovery that there is a new revision of the system plan, but it is not yet publicly available. The document will be added to OWL when it becomes publicly available, and an impact analysis will be completed to identify any required changes to OWL. A check of Hanford documents revealed that there is a new revision (Rev. 9) of the *River Protection Project System Plan* (Bernards et al. 2020), which was evaluated for impacts. Of the document revisions identified by OWL team members or by query, the majority of the new documents did not impact information used in OWL. That said, the impact analysis did result in recommendations for various updates to OWL, which were entered into the configuration management system. The change and associated tasks were processed, and the updates were incorporated into OWL version 5.0.

Release Process—The OWL release process ensures that all OWL releases go through independent technical review and IR in the Release Candidate Environment before being posted to the Production Environment for public access. In addition, each public release version has a release stamp indicating the version number, release date, and SAND number. The release stamp is also included on the web page displays generated by SSRS reports. As of the most recent release of OWL, only some of the output files available to export SSRS report information include the release stamp, with the goal being to ensure that it is included in all output files at some point in the future.

In any new OWL version, all system components in the Production Environment are released together as one version. Individual components are not released separately. The one caveat is the *OWL User's Guide*, which is an item within a system component (i.e., the Supporting Documents Library) that is updated in the Production Environment. The update occurs as part of postprocessing at some point—typically about a month—after an OWL release. Postprocessing and archival steps include gathering the change history from the previous release (being archived) to the new release (just posted). This change history is appended to an appendix in the *OWL User's Guide.* Appendix B of this report reproduces the latest version of the *OWL User's Guide.* The change history documenting database changes from OWL version 1.0 to the present is shown in Attachment B-1. Because the change histories are always appended, each version of the *OWL User's Guide* contains an appendix with a running history of all changes organized according to the OWL release version since version 1.0.

Summary—The change control and release processes were developed and implemented to provide confidence in the integrity of OWL information and to ensure that OWL can be used even in a more rigorous quality assurance (QA) environment. These processes are actively maintained and updated as appropriate, giving OWL the flexibility to respond to changing needs. This aspect of OWL may prove beneficial if the QA requirements for GDSA analyses change in the future.

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3. STATUS OF OWL UPDATES

Since OWL is updated at least once a year, each fiscal year involves supporting the release of a new database version. The current version of OWL (version 5.0, SAND2023-09589W) was released on September 25, 2023. The primary changes in this release involved making updates as appropriate to deal with existing supporting documents that have been revised or replaced by an external entity. This issue was recognized during the technical review of OWL version 4.0. As a result, a new screening process was developed and implemented to identify such documents as well as whether the newer document supplements or supersedes the older document. The recommended changes were entered into the configuration management system (Section 2.6) and processed for inclusion in OWL version 5.0.

The subsections below highlight the progress made on major OWL activities during FY2023. The focus has been on several ongoing, multiyear expansion projects. Section 3.1 presents the progress on GDSA interface development. The goal is to build the capability in OWL to provide input parameter files to the GDSA framework. Progress on a second expansion project—the addition of a new area of OWL to provide information on vessels—is described in Section 3.2. Section 3.3 highlights progress on a third expansion project that involves leveraging selected information from INL's SFD for use in OWL. The SFD is an NQA-1 database with over 700 entries of DSNF (DOE 2007).

3.1 GDSA Interface Development

Progress was made with respect to OWL being able to provide input parameter files to the GDSA framework. Work this fiscal year focused on continuing the effort begun in FY2022 to create an input file for PFLOTRAN that could be used to model waste packages containing HLW glass. PFLOTRAN (Hammond et al. 2014; Lichtner et al. 2020a, 2020b; Nole et al. 2021) is a massively parallel, multiphase flow and reactive transport code that is part of the GDSA suite of codes used to study postclosure performance of multiple representative disposal concepts. The primary overlap between OWL and PFLOTRAN is the radionuclide inventory of various DOE wastes, so it was logical to begin developing the interface between OWL and PFLOTRAN with radionuclide inventory. The information required in radionuclide inventory input files for PFLOTRAN depends on whether the input file is for waste packages containing SNF or whether it is for waste packages containing HLW glass; the decision was made to focus on an input file for HLW glass because OWL currently contains more information about HLW glass than it does about SNF. Future work will expand the effort to creating input files for DOE SNF.

In PFLOTRAN, the WASTE FORM GENERAL block is used to specify a waste form mechanism, details of the radionuclide species in the waste, the waste form bulk material details, and the canister that contains the waste form. Specifically, the WASTE FORM GENERAL block requires the following information:

1. Mechanism (options are GLASS, DSNF, FMDM, FMDM SURROGATE, WIPP, and CUSTOM)
2. Name of waste (e.g., Hanford glass)
3. Specific surface area – value and units (maybe only for glass waste)
4. Matrix density – value and units

5. For each isotope
    a. Identification of isotope (e.g., ^{241}Am)
    b. Atomic weight (g/mol)
    c. Decay constant (ln(2)/half-life (seconds)) in 1/seconds
    d. Quantity of radionuclide (grams of species/grams of bulk waste)
    e. Instant release fraction (a number between 0 and 1)
    f. Name of daughter if it exists

After conferring with the PFLOTRAN team, the OWL team decided that OWL would provide all the information for this block except for "Mechanism (#1)" and "Instant Release Fraction (#5e)". The waste degradation mechanism is specific to PFLOTRAN and is something that is appropriate for the PFLOTRAN analyst to select, but not something that would be appropriate to store in OWL. Similarly, the instant release fraction, which is the fraction of the isotope that is assumed to be released instantly from the waste when a waste package fails, is also something that is appropriate for the PFLOTRAN analyst to select and would not be something that would be appropriate to store in OWL. For most radionuclides, the instant release fraction is 0; therefore, the default value of the instant release fraction will be set to 0 in OWL and the file produced for PFLOTRAN will have this default value and will have a note to the PFLOTRAN user to provide a different instant release fraction, as appropriate.

Creating an input file for PFLOTRAN requires six different tasks; these are described below.

Develop Data for Input to PFLOTRAN—For some of the glass disposal waste forms, the specific surface area and the matrix density, which are properties of the glass waste form used to calculate glass degradation rates, were already available in the database. However, this was not true for all the glass disposal waste forms. Therefore, the first task was to find the data and do the necessary calculations to be able to provide the specific surface area and the matrix density for the glass disposal waste forms in OWL. After evaluating several sources of information, the OWL team decided that the best source of information for the specific surface area and matrix density of glass produced at Hanford, INL, and SRS is the *Defense HLW Glass Degradation Model* (BSC 2004). For the German glass waste, it was decided that the best source of information for the matrix density of glass is from SNL (2014). The specific surface area of the German glass waste was calculated based on canister information available in SNL (2014). These calculations and information will be available to OWL users in a future version of OWL.

Modify Database To Incorporate Data Needed for PFLOTRAN—The database had to be modified to specifically include the data developed in the previous task. Modifications included adding two columns to the Disposal Waste Form database table: "Specific Surface Area" with the unit of measure specified as m^2/kg and "Matrix Density" with the unit of measure specified as kg/m^3. In addition, a new table was created that associates radionuclide inventory with a disposal waste form; previously, radionuclide inventory was associated only with a waste, not a disposal waste form. Finally, a column was added to this new table giving the "Instant Release Fraction" with a default value of 0. Some of these modifications have been completed in the dev schema; they will be moved to the dbo schema at some point and then processed as part of an OWL release.

Populate Database with Radionuclide Daughter Names—The PFLOTRAN input file requires the name of the daughter radionuclide, if it exists (#5f). Previously, parent radionuclides and branching fractions were in the OWL database for some radionuclides, primarily for the purpose of performing radioactive decay and ingrowth calculations. Providing the daughter radionuclide for each radionuclide (if it exists) required identifying the daughter radionuclide for each radionuclide (if there is one and if the radionuclide is in the OWL database), modifying the database to add a "Daughter" column to the "Radionuclide" table to be able to add this information, and then populating the database table with that information. These changes have been completed in the dev schema, which is the first step to making the information available to OWL users in a future version of OWL.

Perform Decay Chain Assessment—As a result of the previous task, new radionuclides needed to be added to the database. Therefore, the OWL team identified all actinide radionuclide decay chains, ensured that radionuclides that are precursors to radionuclide for which inventory information is reported are in the database, added new radionuclides to the database as needed, and identified the radionuclide with which each new radionuclide is in secular equilibrium (as appropriate). Finally, supporting documents from the National Nuclear Data Center for these new radionuclides were added to the database and to the Supporting Documents folder in OWL. The information on these new radionuclides was included in OWL as of version 4.0 released in FY2022.

Update Radionuclide Supporting Documents—In performing the previous two tasks, the OWL team realized that the radionuclide supporting document for each radionuclide did not give the decay product for that radionuclide. Therefore, the radionuclide supporting document for each radionuclide was updated by replacing it with a more complete document downloaded from the National Nuclear Data Center, a document that showed the daughter product(s) for that radionuclide. If a radionuclide had more than one daughter product, the one with the highest probability was selected and was highlighted to improve transparency. Note that the highest probability daughter is included on the OWL SSRS reports, and information on all other possible daughter products is included in the supporting document. In addition, half-life data were updated, if necessary, to reflect new values. These updated supporting documents were included in OWL as of version 4.0 released in FY2022.

Modify Supporting Document with PFLOTRAN Data—The last task is to update the *On-Line Waste Library Supporting Information* report (Price 2022) to provide the basis for the specific surface area and matrix density information added to the database and to explain the decay chain information added to the database. The update of this report is in progress and will be available in a future version of OWL.

3.2 Vessel Expansion of OWL

From the beginning, the plan for OWL has been to allow the database to evolve over time in terms of both content and capability. One of OWL's primary functions is to provide access to information on DOE-managed wastes that are likely to be disposed of in a mined geologic repository. As a complement to this function, OWL is being expanded to include a subsite with information on the vessels capable of disposing of that DOE-managed waste, with the ancillary aspects of storing and transporting those wastes/waste forms.

Terminology Clarification—Within OWL, the generic term "vessel" will be used to describe a can, canister, container, cask, overpack, waste package, etc. that can serve as a single layer in a nested system designed to surround and contain[3] the waste form for potential disposal, storage, or transportation uses. Note that in some instances a "vessel" is considered a part of the waste form if that vessel cannot be separated easily from the waste form. A good example is a glass pour canister that is essential for making the glass waste form. Once the pour canister is filled with the glass, the canister is not easily removed from the glass nor is it intended to contain additional waste forms or waste types. The approach to managing information in this situation is to include the details regarding such a vessel in the expanded OWL vessel information while acknowledging in the waste form information that the vessel is regarded as part of the waste form.

Vessel Information Modeling and Development of Tables and Database Reports—Vessel expansion activities are currently focused on information modeling and development of tables and database reports. Based on the knowledge gained through initial data mining efforts, the OWL team developed a vessel information model mature enough to warrant creation of tables in the dev schema (Section 2.3).

The vessel information captured in the information modeling falls into three categories as follows:

- General information for each vessel (primarily descriptive information)
  - Vessel name
  - Vessel category (waste package, canister, container, cask, overpack, etc.)
  - Purpose (storage, transportation, or disposal)
  - Vessel description (brief text about vessel; can include content about components, configuration, basket, etc.)
  - Diagram
  - Material(s)
  - Development status (indicator of whether vessel exists, is in some stage of planning, or is conceptual in nature)
  - Waste type (as appropriate, identification of the nuclear waste type associated with the vessel)
  - Waste form (as appropriate, identification of the waste form in OWL associated with the vessel)
  - DOE facility (general facility identification only; specific locations within the site will not be given to help ensure information remains suitable for UUR designation)
  - License/certification (confidence-building documentation; may specify alternative to license or certification such as DOE safety report as appropriate)
  - Relevant regulations, codes, and standards (list reflects what is found in supporting document(s) and as such may or may not be comprehensive)

[3] As stated previously, "to contain" something in this context means "to hold" it. The term does not imply containment in the regulatory sense, e.g., the definition provided by transportation regulations in 10 CFR 71: "*Containment system* means the assembly of components of the packaging intended to retain radioactive material during transport."

  - Disposal licensing considerations (information, especially from the U.S. Nuclear Regulatory Commission [NRC], about any considerations from the standpoint of potential future repository licensing with respect to the use of the vessel for disposal purposes)
  - Supplier (entity that supplied or may supply the vessel to DOE; not necessarily the manufacturer)
  - Capacity
  - Other loading considerations (beyond properties given below)
  - Comments (any additional comments or caveats about the vessel information, including whether the vessel is associated with commercial SNF; association with a DOE-managed waste or waste form, which is the primary focus, is already addressed above)

- Properties for each vessel (characterized by numbers and units)
  - Cavity diameter
  - Cavity length
  - Cavity width
  - Cavity height
  - Available cavity volume
  - Outer diameter
  - Maximum outer diameter
  - Outer length
  - Outer width
  - Outer height
  - Minimum outer length
  - Maximum outer length
  - Wall thickness
  - Vessel bottom thickness
  - Vessel lid thickness
  - Top shield plug thickness
  - Empty weight
  - Loaded weight
  - Maximum loaded weight

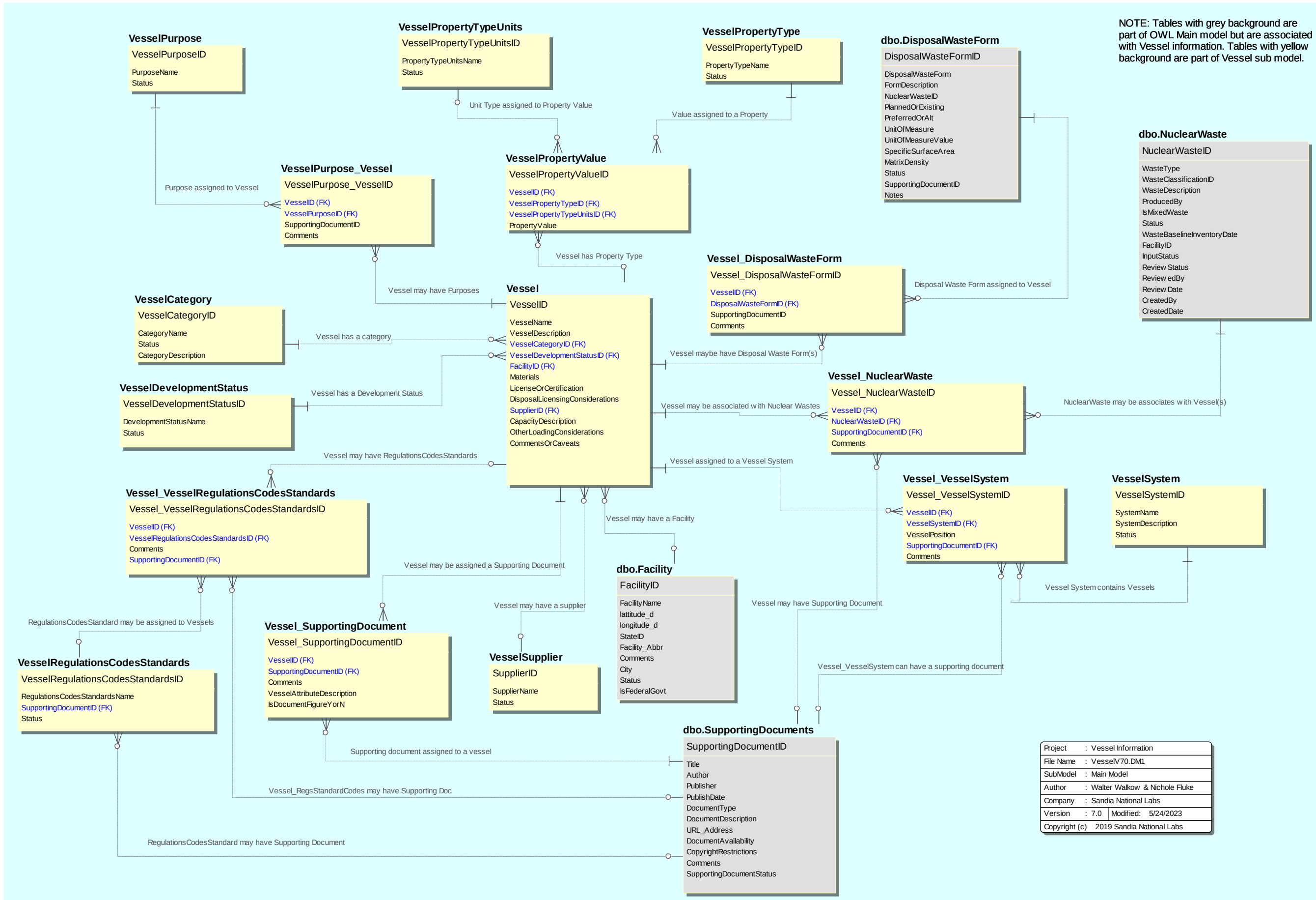
- Vessel system information (identification of nested or layered system of vessels to be used for storage, transportation, or disposal)
  - System name
  - System description
  - Identification of position of each vessel within the nested structure of the system (each layer is numbered starting with "1" for the innermost layer and working out from there)

The fact that some property-related fields above have a maximum version or both a minimum and maximum version whereas others do not is simply an outgrowth of what has been found in the data mining. Of course, not every field will be applicable to every vessel. The data mining conducted thus far has shown that the types and level of detail of information available for any given vessel vary greatly between vessels. Appendix A provides some examples of the different types of vessels identified through data mining.

Figure 3-1 is a schematic of the current vessel information modeling. Flexibility has been built into the table structure to ensure that the database is not locked into the initial set of fields already identified. This flexibility allows the OWL team to respond to new information, which is important since data mining is ongoing. If need be, new fields can be created on the fly while the tables are still being tested or even after data entry has started. There can even be changes after the vessel information has been included in an OWL release. The only requirement is that any actions taken for the vessel expansion itself or for modifications made after the expansion appears in a release must be done in accordance with the OWL change control process as described in Section 2.6 and Weck et al. (2021d).

Progress has been made on the testing and refinement of the vessel tables. Sample data have been entered into the tables, and database views have been created to help evaluate the table functionality within the SQL server environment. In addition, preliminary vessel database, or SSRS, reports have been developed to examine how well the tables support the display of information to the end user. Examples of reports for a general vessel list and vessel detail are shown in Figure 3-2 and Figure 3-3 respectively. However, change in the organization and design of the SSRS reports is expected as work progresses. The tasks to create vessel tables and SSRS reports will stay open until both are ready to be closed to ensure the tables and reports function properly with each other.

As is standard practice for OWL, the information for vessels will have clear ties to the associated supporting documents to ensure traceability. Those supporting documents will be integrated into OWL's existing Supporting Documents Library with the links to source information contained in the data tables. In addition, any supporting document that is a diagram of the vessel will be flagged as such so that the user interface can provide easy access.



NOTE: Yellow boxes signify vessel-specific tables. Grey boxes signify tables that already exist within OWL.

Figure 3-1. Schematic of Vessel Information Model Used To Create Tables in Vessel Subsite

OWL > ReportSource

Actions ▾ | 1 of 1 | Find Next | 100%

HOME PAGE DOE MANAGED WASTES USER GUIDE

Version -TBD-, Development,

On-Line Waste Library

Vessels (Draft)

Vessel Name	Description	Category	Development Status	License or Certification	Materials
18D Long DOE Standardized Canister	This vessel is the 18 in. diameter x 15 ft long DOE standardized canister. There is a canister shell and an internal basket assembly. The 6 basket types are the following: -- FFTF-Mixed Oxide Basket -- Shippingport LWBR Basket -- Shippingport PWR Basket -- Fort St. Vrain Basket -- Three Mile Island Unit 2 Basket -- Advanced Test Reactor Basket	Waste Canister	Partially Designed	Unlicensed; planned to be part of NRC-certified system. However, it has been N-stamped in compliance with 1995 ASME Boiler and Pressure Vessel Code.	Shell: SA-312 (welded or seamless pipe) Stainless Steel Type 316L (UNS S31603) Heads and lifting rings: SA-240 (plate) Stainless Steel Type 316L Optional plugs: SA-479 (bar) Stainless Steel Type 316L. The stainless steel materials are annealed and pickled.
18D Short DOE Standardized Canister	This vessel is the 18 in. diameter x 10 ft long DOE standardized canister. There is a canister shell and an internal basket assembly. The 3 basket types are the following: -- Enrico Fermi Basket -- TRIGA Basket -- Advanced Test Reactor Basket	Waste Canister	Partially Designed	Unlicensed Licensed: N-stamped in compliance with 1995 ASME Boiler and Pressure Vessel Code	Shell: SA-312 (welded or seamless pipe) Stainless Steel Type 316L (UNS S31603) Heads and lifting rings: SA-240 (plate) Stainless Steel Type 316L Optional plugs: SA-479 (bar) Stainless Steel Type 316L. The stainless steel materials are annealed and pickled.
2-MCO/2-DHLW	Vessel has two concentric cylinders. Inner vessel includes inner cylinder, bottom inner lid, and closure inner lid. Outer Corrosion barrier includes outer cylinder, outer bottom lid and top closure outer lid.	To be Determined	Partially Designed	Inner vessel: N-stamped signifying compliance with 2001 ASME Boiler and Pressure Vessel Code (ASME 2001) Outer vessel is not N-stamped because it is not a pressure vessel.	Inner vessel: Stainless Steel Type 316 (UNS S31600), modified with additional constraints on nitrogen and carbon content Inner vessel fill gas: helium Divider plates: carbon steel (SA 516) Outer corrosion barrier: Alloy 22 (UNS N06022); restrictions on alloy constituents imposed to ensure adequate performance Upper and lower sleeves: Alloy 22
21-PWR/44-BWR TAD	21-PWR/44-BWR TAD has two concentric cylinders. Inner structure includes inner cylinder, bottom inner lid, and closure inner lid. Outer corrosion barrier includes outer cylinder, outer bottom lid and top closure outer lid.	Overpack	Partially Designed	Unlicensed; planned to be part of NRC-certified system	Inner structure: Stainless Steel Type 316 (UNS S31600), modified with additional constraints on nitrogen and carbon content Inner structure fill gas: helium Outer corrosion barrier: Alloy 22 (UNS N06022); restrictions on alloy constituents imposed to ensure adequate performance Upper and lower sleeves: Alloy 22

Figure 3-2. Example of a Preliminary SSRS Report for a General Vessel List

Actions | Find Next | 100%

Version -TBD-, Development,

HOME PAGE | DOE MANAGED WASTES | USER GUIDE

OnLine Waste Library (OWL)

Vessel Detail (Draft)

Vessel Name	Vessel Description	Category	Development Status	Facility Name	Supplier Name
18D Long DOE Standardized Canister	This vessel is the 18 in. diameter x 15 ft long DOE standardized canister. There is a canister shell and an internal basket assembly. The 6 basket types are the following: -- FFTF-Mixed Oxide Basket -- Shippingport LWBR Basket -- Shippingport PWR Basket -- Fort St. Vrain Basket -- Three Mile Island Unit 2 Basket -- Advanced Test Reactor Basket	Waste Canister	Partially Designed		

Materials	Shell: SA-312 (welded or seamless pipe) Stainless Steel Type 316L (UNS S31603) Heads and lifting rings: SA-240 (plate) Stainless Steel Type 316L Optional plugs: SA-479 (bar) Stainless Steel Type 316L. The stainless steel materials are annealed and pickled.
License or Certification	Unlicensed; planned to be part of NRC-certified system. However, it has been N-stamped in compliance with 1995 ASME Boiler and Pressure Vessel Code.
Capacity Description	For FFTF-Mixed Oxide Basket: 5 FFTF standard driver fuel assemblies and 2 Ident-69 container with partially disassembled FFTF assemblies and individual fuel pins from assemblies that have undergone postirradiation examination For Shippingport LWBR Basket: 1 Shippingport LWBR seed assembly For Shippingport PWR Basket: 1 Shippingport PWR Core 2 assembly For Fort St. Vrain Basket: 5 FSV assemblies For Three Mile Island Unit 2 Basket: 1 Three Mile Island Unit 2 canister For Advanced Test Reactor Basket: 1 rectangular basket
Disposal Licensing Considerations	As part of Condition No. 6, DOE must provide additional information on certain waste packages and canisters. NRC review and approval is required before receipt for canisters andf before use for waste packages. Specifically, the NRC staff found that "these specific waste packages (i.e., 5-DHLW/DOE long codisposal, 2-MCO/2-DHLW codisposal, and Naval Short) and canisters (i.e., DHLW long, DOE long, and Naval Short) that were not analyzed by the applicant also shall not be accepted at the repository, without prior NRC review and approval, of information from DOE that either (i) confirms that the current PCSA bounds the intended performance of these waste packages and canisters at the GROA or (ii) demonstrates, through the PCSA, that these waste packages and canisters can be safely received and handled at the repository during the preclosure period in accordance with 10 CFR 63.112."

Display Specific Vessel Information by Expanding (+) the Type of Content Listed Below

⊞1. Properties	⊞3. Regulations Codes Standards	5. Disposal Waste Forms	7. Supporting Documents
⊞2. Vessel Systems	4. Purposes	6. Nuclear Wastes	

Figure 3-3. Example of a Preliminary SSRS Report for Vessel Detail

Efforts to Leverage Other DOE Databases—Information on vessels used for commercial SNF is already part of the Used Nuclear Fuel-Storage, Transportation & Disposal Analysis Resource and Data Systems (UNF-ST&DARDS) database at Oak Ridge National Laboratory. The OWL team does not intend to duplicate the information in that database. Instead, the plan is to explore ways to integrate with UNF-ST&DARDS in the future so the relevant content can be leveraged. However, if the OWL team finds information regarding a vessel being used for DOE-managed waste as well as commercial SNF, that information is captured when found rather than waiting until later when integration with UNF-ST&DARDS has been achieved.

The SFD at INL is another database with information of potential interest to OWL end users. As discussed in Section 3.3, the OWL team requested and received selected information in spreadsheet format from the SFD in FY2022. Besides information on DSNF, this spreadsheet contains information on vessels currently storing DSNF. In late FY2023, the OWL team received an updated spreadsheet generated from the latest SFD version based on the same data request. Planning for how to incorporate the SFD content into OWL is in progress. The vessel expansion project is one of the considerations in the SFD planning because some overlap is expected between vessel information gathered through data mining and that available through leveraging the SFD. The goal is to ensure a consistent and coherent treatment of vessel information within OWL. A preliminary review of the vessel information in the SFD spreadsheet recommended that work on the vessel information model and tables proceed without any immediate changes to accommodate SFD content. Such changes will wait until the scope and implementation strategy are better understood.

Another DOE database called RAMPAC (DOE n.d. [no date]; https://rampac.energy.gov/) provides information on RAdioactive Materials PACkages certified by DOE, the NRC, and the U.S. Department of Transportation (DOT). While this database does not contain tabular information that can be integrated with OWL, it can serve as a resource for vessel-related documents.

Summary—The effort to include vessel information in OWL is large and complex. Although significant progress has been made, it is expected that an OWL release with vessel information will occur at some point beyond the current fiscal year. Future work includes continued data mining, further refinement of the database structures as appropriate, data entry, and data checking. Eventually, when plans for integration with the DOE SFD and the UNF-ST&DARDS database come to fruition, there will also be the work of incorporating the vessel information from the other databases into OWL.

3.3 Leveraging Selected SFD Information

Although the DSNF inventory from some sources (e.g., N-reactor, which represents the major mass of DSNF, and sodium-bonded SNF) has been entered directly into the OWL database, it is neither efficient nor desirable to re-enter the other 700+ entries of DSNF in the INL's SFD, an NQA-1 database supported by DOE (DOE 2007). As a result, the OWL team is working with INL staff to leverage a select subset of SFD information for use in OWL.

In FY2022, the OWL team requested a subset of data, with particular attention paid to data fields that could support performance analyses of the back of the fuel cycle (primarily disposal). Fields useful to the development of the new vessels area of OWL were also identified. The OWL team took care to avoid selecting any single piece of information or combination of information with a classified designation. INL responded to the data request with a spreadsheet generated from SFD v8.1.8. The spreadsheet was designated as OUO, and INL retained ownership of the information. As a result of the OUO designation, the OWL team created a working area in the Internal Documents Library on the OWL Development SharePoint Site for SFD-related materials. Access to this library is restricted to OWL team members only.

One element of planning for leveraging the SFD is the use of periodic updates from INL, ensuring that the OWL team works with current information from the latest SFD release. In late FY2023, the OWL team received the first such update, an OUO spreadsheet generated from SFD v8.2.20 based on the same data request. Evaluation of the updated spreadsheet is in progress.

Planning To Incorporate SFD Spreadsheet into OWL—Incorporating the SFD information is a complex undertaking. While some of the fields needed to store SFD information already exist in OWL (i.e., the area dealing with waste types and waste forms), new fields will be needed as well, which means there may be a need for new tables and SSRS reports and/or modifications to existing tables and SSRS reports. In addition, the table structure being tested for the OWL vessel expansion (Section 3.2) may need to be adjusted. Another issue is the fact that OWL currently has a UUR designation, but the SFD spreadsheets are marked as OUO. Moreover, the OUO system has been replaced with the CUI system. Thus, one of the planning considerations is ensuring that future use of the SFD content within OWL complies with the OUO legacy and CUI requirements.

Steps to safeguard the SFD information will likely include the following: (1) designing and implementing the necessary infrastructure to electronically segregate the controlled and uncontrolled content from each other, (2) ensuring a process exists to control end-user access to controlled content, and (3) ensuring export files that contain controlled content are marked accordingly.

One of the other challenges for the OWL team is determining how best to use code to transfer the data from the SFD spreadsheet into OWL. To the extent possible, the technical software specialists on the OWL team will develop a software script to automate the transfer process. An automated method is both easier to manage and less prone to error. This script would also facilitate the processing of future periodic updates from the SFD.

To maintain the traceability of OWL content, the SFD-provided content in OWL will rely on the SFD spreadsheet (in pdf format) as the supporting document. There is no need for additional support because the SFD is an NQA-1 database. This designation signifies that the SFD content is adequately supported and maintained.

The planning required to incorporate the SFD information into OWL is a complex, ongoing effort that will extend into FY2024. When the scope and implementation strategy for changes are better understood, the OWL team will make appropriate entries in the change control system (Section 2.6) for the associated work.

Future Work—The planning discussion above effectively describes the future work needed to incorporate the initial SFD information into OWL. In summary, the effort will involve the following: (1) change the OWL structure to accommodate SFD information (applies to structures for waste types/waste forms and for vessels), (2) ensure SFD information has adequate safeguards with respect to end-user access and export markings, (3) develop a script to automatically transfer information from the SFD spreadsheet to OWL, and (4) use the SFD spreadsheet as the source for a supporting document to link to the new content. The work will be managed and documented through the relevant change and associated tasks in the change control system.

The OWL team and INL will coordinate regarding periodic updates to ensure that, when the SFD has a new release, the OWL team has access to the latest SFD information. The first step in this direction was the receipt of the updated SFD spreadsheet in FY2023. Ideally, once the SFD information is incorporated into OWL, these periodic updates from INL will occur once or twice a year as appropriate, with about two to three months lead time prior to the next OWL release to allow time to deal with any unforeseen issues with the file handling. However, in practice the timing of the periodic updates will depend primarily on the release schedule for new SFD versions.

4. CONCLUSIONS

This report represents completion of milestone deliverable M2SF-24SN010309082 *Annual Status Update* for OWL due on November 30, 2023. It provides the status of FY2023 OWL updates for the work package "OWL - Inventory - SNL." Work on the OWL database is guided by two primary purposes. The first purpose is to provide a user-friendly, consolidated single source of information on DHLW, DSNF, and other DOE-managed wastes that are likely candidates for deep geologic disposal. There may be up to several hundred different DOE-managed wastes suitable for inclusion in OWL. Because DOE programs involving nuclear waste continue to evolve, the content suitable for OWL continues to evolve as well. To fulfill the first purpose, OWL is updated periodically to capture applicable information as it is publicly released. For example, when updated information on SRS glass waste is released, OWL is updated to include the information. The second purpose is to provide input parameter files with relevant information on waste types, inventory, waste form characteristics, vessels, etc. for PA analyses in the context of the GDSA framework. There is also the potential for codes outside of the GDSA framework (e.g., process modeling codes not coupled to GDSA or storage/transportation systems assessments) to benefit from similar integration efforts.

Since OWL is updated at least once a year, each fiscal year involves supporting the release of a new database version. OWL version 5.0 (SAND2023-09589W) was released on September 25, 2022. The primary changes in this release involved making updates as appropriate to deal with existing supporting documents that have been revised or replaced by an external entity. A new screening process was developed and implemented to identify such documents and enter any recommended changes into the configuration management system (Section 2.6). The changes were processed for inclusion in OWL version 5.0.

During FY2023 the primary OWL activities involved the following: (1) GDSA interface development, (2) vessel expansion of OWL, and (3) leveraging selected SFD information. A summary of the status of these updates appears below.

GDSA Interface Development (Section 3.1)—The goal of developing a GDSA interface is to build the capability within OWL to generate input parameter files for use in the context of the GDSA computational framework, primarily the massively parallel subsurface flow and reactive transport code, PFLOTRAN. Regular discussions between the OWL and GDSA teams in FY2022 resulted in identifying the inventory and characteristics of glass waste as the first area of integration between OWL and GDSA. In FY2023 the necessary data were collected andnecessary calculations were performed; required modification of supporting documents was initiated.

Vessel Expansion of OWL (Section 3.2)—The addition of vessel information to OWL is a complex, multiyear project. The plan for OWL since its inception has been to allow the database to evolve over time in terms of both content and capability. One of OWL's primary functions is to provide access to information on DOE-managed wastes likely to be disposed of in a mined geologic repository. The OWL expansion to include information on the vessels capable of disposing of that DOE-managed waste, with the ancillary aspects of storing and transporting those wastes/waste forms, is seen as a complement to this function. Thus far, development efforts for the vessel area have emphasized mining the literature, determining which pieces of information (i.e., database fields) to capture for each vessel, building the necessary database structure into OWL, and designing the SSRS reports necessary to display the information.

The OWL team has decided to create the vessel area as a subsite to the main OWL structure containing waste type and waste form information. Once the information modeling was mature enough, the initial table structure was created in the SQL server. Testing and revision of the tables is in progress. Sample data have been entered, and database views have been created to help evaluate the table functionality within the SQL server environment. In addition, preliminary vessel SSRS reports have been developed to examine how well the tables support the display of information to the end user.

Leveraging Selected SFD Information (Section 3.3)—DOE has other databases containing information that is attractive for use in OWL. Rather than try to duplicate this information, the preference is to leverage the information of interest. The SFD is a DOE-sponsored, NQA-1 database hosted by INL with over 700 entries of DSNF (DOE 2007). Although the DSNF inventory from some sources (e.g., N-reactor, which represents the major mass of DSNF, and sodium-bonded SNF) has been entered directly into OWL, it is neither efficient nor desirable to re-enter the other 700+ entries of DSNF contained in the SFD.

In FY2022, the OWL team requested and received from INL a subset of SFD information in spreadsheet format. The spreadsheet was designated as OUO, though the CUI system has since replaced the OUO system. In any case, the use of controlled information marks a change for OWL since all previous data obtained has had a UUR designation. The initial planning calls for the OWL team and INL to coordinate regarding periodic updates to ensure that, when the SFD has a new release, the OWL team has access to the latest SFD information. In late FY2023, INL sent the first such updated file, an OUO spreadsheet generated from the latest SFD version based on the same data request. Evaluation of the updated spreadsheet is in progress.

Planning is currently underway regarding the changes to OWL necessary to not only store and display the SFD information, but also to ensure OWL has adequate safeguards, especially with respect to end-user access and export markings, to control the SFD information. In addition, the OWL team is exploring what would be involved in developing a software script to automate the transfer of data from the SFD spreadsheet into OWL. To maintain traceability, the new SFD content will be linked to the SFD spreadsheet (in PDF format) as the supporting document. No additional support is needed because the SFD is an NQA-1 database, a designation signifying that the SFD content is adequately supported and maintained.

The planning required to incorporate the information from the initial SFD spreadsheet is a complex, ongoing effort that will extend into FY2024. Afterwards, the OWL team will make appropriate entries in the change control system (Section 2.6) for the work needed to implement the planning.

Future Work on OWL—Future work on OWL is expected to emphasize the following:

- **Maintain and Update OWL**—There is an ongoing need to maintain OWL to ensure identified errata are documented and corrected and to update the database as newly released information on DOE-managed wastes becomes available.
- **Continue Effort on GDSA Interface Development**—Integration with the PFLOTRAN team will be continued, expanding the database and database reports to include more of the information needed by PFLOTRAN to model the waste in different waste packages. Specifically,

information for spent fuel would be added to the information after the process for adding glass waste information, as described above, has been completed.

- **Continue Effort on Vessel Expansion**—As discussed previously, the effort to add vessel information to OWL is a complex, multiyear endeavor. The primary focus will be on completing the testing and refining of the vessel information model and tables along with work on development and refinement of other database structures (i.e., stored calculation tools if any, and SSRS reports for display). Afterwards, attention will shift to continued data mining, data entry, data checking, and development of supporting documents. Eventually, when the SFD integration effort is more advanced, there will also be work incorporating the vessel information from the SFD into OWL. A similar situation will exist if plans to leverage selected information from the UNF-ST&DARDS database come to fruition.
- **Continue Effort on Leveraging Selected SFD Information**—As discussed above, planning is currently underway regarding how best to accomplish the following: (1) change the OWL structure to accommodate SFD information (applies to existing structure for waste types/waste forms and vessel structure still in development), (2) ensure SFD information has adequate safeguards especially with respect to end-user access and export markings, (3) develop a script to automatically transfer information from the SFD spreadsheet to OWL, and (4) use the SFD spreadsheet as the source for a supporting document to link to the new content. This planning is expected to continue into FY2024, after which the work will enter the implementation phase.
- **Explore Leveraging Selected Information from Other DOE Databases**—Another DOE database of interest is the UNF-ST&DARDS database at Oak Ridge National Laboratory. This database contains information on commercial SNF and related vessels, though it is the vessel information that is of interest since OWL focuses on DOE-managed waste. Similar to the SFD effort, the goal would be to identify and obtain a subset of information deemed suitable for use in OWL. Again, the OWL team would rather leverage information of interest from UNF-ST&DARDS than try to duplicate it.
- **Prepare for Migration of OWL to the Cloud**—The OWL Development Environment resides on the SRN and the Release Candidate Environment and Production Environment reside on the ECN. At some point in the future, all three OWL environments are expected to be migrated to SNL's cloud computing platform. The migration will likely be staged according to network, with the ECN-based environments being processed first. The effort will require planning and resources, especially given that some elements within OWL will not be available on the cloud. One example is the suite of SSRS reports currently used to display database content. These reports will likely need to be converted to paginated reports in MS Power Business Intelligence (BI) on Azure cloud computing platform.

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APPENDIX A. EXAMPLES OF VESSELS IDENTIFIED THROUGH DATA MINING

The data mining effort provides the foundation for the majority of the tasks associated with vessel expansion. Some of the vessels actually exist while others are in various stages of planning and design. The types and level of detail of information available for any given vessel vary greatly. The emphasis has been on vessels that are either planned for use or are already in use for DOE-managed wastes. These vessels may have been developed for DOE use or may have originally been developed for commercial use. Detailed information on commercial vessels is already part of the UNF-ST&DARDS database at Oak Ridge National Laboratory, and a future effort is planned for integrating with that database. In the meantime, information from other sources about commercial vessels being used to store and/or transport DOE-managed waste is being processed as part of the data mining effort.

Five different vessels are presented below as examples of the vessel information found through data mining. The example vessels are the following:

- Transportation, Aging, and Disposal (TAD) Canister
- TAD Waste Package (21-PWR/44-BWR TAD; PWR refers to pressurized water reactor and BWR refers to boiling water reactor)
- M-290 Transportation Cask
- NUHOMS 12-T Dry Shielded Canister
- Modified NAC-1 Cask (NAC refers to the manufacturer, Nuclear Assurance Corporation International)

Table A-1 provides a summary of some of the descriptive information available for the example vessels, which were selected to display some of the variety within the pool of vessels identified by the data mining thus far. Some of the vessels currently exist and some are only partially designed. Some are developed solely for DOE use and some have commercial use as well. The primary purpose may be storage, transportation, disposal, or some combination thereof. In addition, each vessel is subject to a hierarchy that dictates the layering used in a nested system of vessels. In fact, being part of a nested system of vessels is something all vessels, not just the example vessels, appear to have in common. A vessel typically needs one or more additional vessels to fulfill its intended function, be it for storage, transportation, or disposal. The additional vessel(s) may be inner or outer layers relative to the vessel of interest depending on the situation. Although the TAD canister and TAD waste package are intended for commercial SNF, they are included in the list because they serve as straightforward examples of (1) two layered vessels working together for the purpose of disposal, (2) two partially designed vessels that have standing as part of recognized DOE planning or decisions, and (3) two vessels intended solely for DOE use. They are also discussed in the Yucca Mountain license application (DOE 2008).

The subsections below provide more information about each example vessel as well as tables of physical attributes.

Table A-1. Descriptive Information for the Five Example Vessels

Descriptive Attribute	TAD Canister	TAD Waste Package (21-PWR/44-BWR TAD)	M-290 Transportation Cask	NUHOMS 12-T Dry Shielded Canister	Modified NAC-1 Cask
Primary Purpose	Transportation and Disposal	Disposal	Transportation	Storage and Transportation	Storage
Hierarchy of Vessel System (layering of vessels)[a]	Transportation/Inner Layer – None Transportation/Outer Layer – Transportation Cask Disposal/Inner Layer – None Disposal/Outer Layer – TAD waste package (21-PWR/44-BWR TAD)	Disposal/Inner Layer – TAD Canister Disposal/Outer Layer – None	Transportation/Inner Layer – The cask is licensed to transport both canistered and bare fuel Transportation/Outer Layer – None	Storage/Inner Layer – Canisters of TMI-2 Fuel Debris Storage/Outer Layer – NUHOMS 12-T horizontal storage module (storage overpack) Transportation/Inner Layer – None Transportation/Outer Layer – MP-187 (transportation and transfer cask)	Storage/Inner Layer – LWR Canister Storage/Outer Layer – ISO Shipping Container (tall or short)
Description	The TAD canister is a right circular cylinder with components including a canister shell, lid(s), and other required components (e.g., basket for holding fuel assemblies, thermal shunts, neutron absorbers) needed to perform its functions.	This waste package consists of two concentric cylinders. Inner vessel includes inner cylinder, bottom inner lid, and closure inner lid. Outer corrosion barrier includes outer cylinder, outer bottom lid and top closure outer lid. Configuration: 21-PWR/44-BWR TAD	The cask is part of a shipping container system (including specialized rail car) used by Navy to transport Naval SNF from shipyard to INL	Dry shielded canister consists of cylindrical shell with welded top and bottom cover plates forming a containment boundary. Baskets provide heat transfer paths, criticality control and structural support.	The modified NAC-1 cask is a smooth-surface, right circular cylinder with an inner and outer shell. It has been modified such that impact limiters protrude radially at both ends. Modifications also include removal or plugging of several valves connected to the confinement cavity, removal of anti-rotational lugs in the interior cavity to accommodate the LWR canister, and replacement of neutron shield tank pressure relief penetrations with threaded solid plugs.

Table A-1. Descriptive Information for the Five Example Vessels (continued)

Descriptive Attribute	TAD Canister	TAD Waste Package (21-PWR/44-BWR TAD)	M-290 Transportation Cask	NUHOMS 12-T Dry Shielded Canister	Modified NAC-1 Cask
Development Status	Partially Designed	Partially Designed	Exists	Exists	Exists
Contents	Commercial SNF assemblies	1 TAD canister containing commercial SNF assemblies	Canisters of Naval SNF	Canisters of TMI-2 fuel debris	1 LWR canister containing commercial PWR assemblies (Calvert Cliffs and Point Beach)
DOE Facility	NA	NA	Shipped to INL	INL	Hanford Site
Licensing/ Certification	Unlicensed; planned to be part of NRC-certified system	Unlicensed; planned to be part of NRC-certified system	NRC certified under 10 CFR 71 (CoC 9796 R2)	NRC certified (SNM-2508) for storage at INL	DOE safety evaluation: Carrell, R. 2002. *Annex D-200 Area Interim Storage Area Final Safety Analysis Report*. HNF-3553, Rev. 2. March.

NOTE: [a] For convenience, inner and outer layer designations are provided relative to the position of the vessel in the column header. Note that the vessel information model uses numbers to identify vessel positions within the vessel system as a whole (Section 3.2).

BWR = boiling water reactor
CoC = Certificate of Compliance
DOE = Department of Energy
INL = Idaho National Laboratory
ISO = International Standards Organization
LWR = light water reactor
NA = not applicable
NAC = Nuclear Assurance Corporation
NRC = Nuclear Regulatory Commision
PWR = pressurized water reactor
SNF = spent nuclear fuel
TAD = transportation, aging, and disposal
TMI = Three Mile Island

Source: TAD Canister: DOE 2008.
TAD Waste Package (21-PWR/24 BWR TAD): DOE 2008.
M-290: NRC 2019.
NUHOMS 12-T: Greene et al. 2013.
Modified NAC-1: Carrell 2002.

A-1. TAD Canister

The TAD canister was intended for multiple uses including transportation, aging, and disposal of commercial SNF, according to the Yucca Mountain license application (DOE 2008). Detailed design information for the TAD canister has not been developed. A performance specification was developed for selected system components in support of the license application. Table A-2 provides the physical properties of the TAD canister.

The plan presented in the license application was based on loading the majority of commercial SNF into TAD canisters at the utilities. The TAD canisters would be sealed at the utilities and transported to the repository. At the repository the TAD canisters would be loaded into TAD waste packages (21-PWR/44-BWR TAD) and emplaced into the repository. There are provisions in the plan for loading some, approximately 10%, of the TAD canisters at the repository. There are also provisions for aging, or storing, TAD canisters on the surface before loading them into TAD waste packages. Surface aging would be determined by operational considerations.

Table A-2. Physical Properties of TAD Canister

Physical Property	Value
Canister Height	186.0 – 212.0 in.
Canister Diameter	66.5 in.
Maximum Weight – TAD Canister and Waste Package Spacer	54.25 tons
Content Specification – Fuel Types	PWR & BWR assemblies
Content Specification Limit – PWR Assemblies	Less than 5% initial enrichment
Content Specification Limit – PWR Assemblies	80 GWd/MTU or less
Content Specification Limit – PWR Assemblies	No less than 5 yr cooling time
Content Specification Limit – BWR Assemblies	Less than 5% initial enrichment
Content Specification Limit – BWR Assemblies	75 GWd/MTU or less
Content Specification Limit – BWR Assemblies	No less than 5 yr cooling time

NOTE: BWR = boiling water reactor
PWR = pressurized water reactor
TAD = transportation, aging, and disposal

Source: DOE 2008, Section 1.5.1.1.1.2.1.4.

A-2. TAD Waste Package (21-PWR/44-BWR TAD)

The TAD waste package was intended for disposal of commercial SNF in a TAD canister, as described in the Yucca Mountain license application (DOE 2008, Section 1.5.2). The waste package consists of two concentric cylinders; the TAD canister fits inside the waste package inner cylinder. The inner cylinder is Stainless Steel Type 316 (UNS S31600) and the waste package outer barrier (i.e., outside of the outer cylinder) is bounded by a layer of Alloy 22 (UNS N06022). The Alloy 22 is a corrosion resistant material that is included in the design to enhance the long-term performance of the waste package. Table A-3 lists the physical properties of the TAD waste package.

Table A-3. Physical Properties of TAD Waste Package (21-PWR/44-BWR TAD)

Physical Property	Value
Waste Package Length	230.32 in.
Waste Package Outer Diameter	77.28 in.
Loaded Weight	162,055 lb
Capacity	1 TAD canister

NOTE: TAD = transportation, aging, and disposal
Source: DOE 2008, Table 1.5.2-3.

A-3. M-290 Transportation Cask

The M-290 is the rail transportation cask developed by the Navy. In 2013, the NRC licensed this cask for the transportation of both bare fuel and canistered SNF, with the last supplement being processed in 2019 (NRC Certificate of Compliance [CoC] 9796 R2 [NRC 2019]). The certificate pertains to transporting A1W and A1G SNF modules. In 2017, the Nuclear Waste Technical Review Board (NWTRB) reported that the Navy is planning to use the casks to ship the Naval SNF from the sites where the SNF is removed from naval vessels to INL for storage (NWTRB 2017). The cask can also be used for transport of the SNF to a future repository.

According to NWTRB (2017), the details of the configuration of the vessel internal contents vary depending on nature of the fuel being transported. The most significant differences relate to whether bare fuel or canistered SNF is being transported. However, characteristics derived from the fuel configuration and use can also be important. The Navy is expected to develop 16 different core dependent safety analysis reports for review by NRC. Each of the 16 will reflect a distinct configuration of Naval SNF. The physical properties of the cask are listed in Table A-4.

Table A-4. Physical Properties of M-290 Transportation Cask

Physical Property	Value
Maximum Height (Including Domes)	361.5 in.
Maximum Outer Diameter	128 in.
Maximum Weight (Including Contents)	520,000 lb
Cavity Diameter	71 in.
Cavity Height	242 in.
Body Outer Diameter – upper section	92.15 in.
Body Outer Diameter – lower section	96.15 in.
Body Steel Wall Thickness – upper section	10.6 in.
Body Steel Wall Thickness – lower section	12.6 in.

Source: NRC 2019.

A-4. NUHOMS 12-T Dry Shielded Canister

Manufactured by Transnuclear Inc., the NUHOMS storage system is a storage and transport system reported in Greene et al. (2013, pp. 139–176). This system relies on a dry shielded canister, a transfer cask, a horizontal storage module made of reinforced concrete, and a transportation cask. There are multiple dry shielded canisters designed for different uses. According to Greene et al. (2013), NRC issued SNM-2508 on March 19, 1999 for the use of NUHOMS 12-T dry shielded canister to store Three Mile Island-2 (TMI-2) fuel debris canisters at INL. The “12” indicates that the dry shielded canister can contain 12 canisters and the “T” means that it is transportable. As of March 2013 (the date of the report), 345 TMI-2 canisters had been loaded into 29 NUHOMS 12-T dry shielded canisters, which were then placed into horizontal storage modules for storage. The M-187 cask was identified as the transfer cask and the transportation cask for the NUHOMS 12-T dry shielded canister.

Table A-5 provides the physical properties for the NUHOMS 12-T dry shielded canister recorded in Greene et al. 2013. The NUHOMS 12-T dry shielded canister was also mentioned by the NWTRB in a report to Congress and the Secretary of Energy written in 2017 (NWTRB 2017, Section 5.1.1.1).

Table A-5. Physical Properties of NUHOMS 12-T Dry Shielded Canister

Physical Property	Value
Materials of Construction (canister body, basket, shield plugs)	carbon steel
Overall Length	163.5 in.
Cross Section	67.2 in.
Cavity Length	151 in.
Wall Thickness	0.625 in.
Loaded Weight	<70,000 lb
Design Heat Rejection	0.86 kW
Maximum Burnup	3.2 GWD/MTU
Cavity Atmosphere	air
Capacity (intact assemblies)	12 TMI-2 fuel debris canisters

NOTE: TMI = Three Mile Island

Source: Greene et al. 2013, unnumbered table on p. 66.

A-5. Modified NAC-1 Cask

The modified NAC-1 cask is part of a nested system used for storage at Hanford. Table A-6 lists some of the physical properties of the cask. A DOE safety evaluation documented by Carrell (2002) is the primary information source. The NWTRB later discussed the cask in a 2017 report to Congress and the Secretary of Energy (NWTRB 2017, Section 4.1.2).

The modified NAC-1 cask is a right, circular cylinder with an inner and outer shell. Each modified NAC-1 cask contains one light water reactor (LWR) canister, which serves as the innermost layer in the vessel hierarchy. The LWR canister contains commercial PWR assemblies (Calvert Cliffs and Point Beach) and provides a confinement boundary during storage. The modified NAC-1 cask provides structural protection and shielding. It is placed in an International Standards Organization (ISO) shipping container (tall or short) for storage. In this case, the shipping container is intended only to provide shelter; it is not meant for on-site or off-site transportation.

Manufactured by NAC International, the NAC-1 cask (unmodified) was licensed by the NRC to transport LWR SNF and waste material. Later at Hanford, the cask was modified for storage and on-site transportation purposes as follows: (1) impact limiters were changed to protrude radially at both ends, (2) several valves connected to the confinement cavity were removed or plugged, (3) anti-rotational lugs to the cavity interior were removed to accommodate the LWR canister, and (4) neutron shield tank pressure relief penetrations were replaced with threaded solid plugs. When the cask was modified, the NRC license for transportation was not retained. Therefore, while the modified NAC-1 casks can be transported on site, they cannot be transported off site from Hanford unless the appropriate NRC transportation license is obtained.

Table A-6. Physical Properties of Modified NAC-1 Cask

Physical Property	Value
Materials of Construction	Main Structures: stainless steel Shielding: chemical-grade lead Axial Fins at Lead/Steel Interface: copper Capscrews for Closure Lid: ASTM A-320, Grade L43, low alloy steel O-ring Seals for Closure Lid: polytetrafluoroethelene Impact Limiters: balsa, stainless steel, asbestos
Cavity Diameter	13.50 in.
Cavity Length	178.0 in.
Wall Thickness	0.3125 in.
Maximum Outer Diameter	50 in.
Outer Length (including impact limiter)	214 in.
Vessel Lid Thickness	7.5 in.
Loaded Weight	47,150 lb

NOTE: ASTM = American Society for Testing and Materials

Source: Carrell 2002.

A-6. Summary Observations about Vessel Information

As indicated by the example vessels shown above, there is a great deal of variety within the population of vessels identified through data mining the literature. Basic descriptive information includes determining whether the vessels (1) actually exist or not, (2) are used for DOE-managed waste, commercial SNF, or both, and (3) are used for storage, transportation, disposal, or some combination. Vessels must be considered in terms of a vessel system consisting of a hierarchy of vessel layers nested inside one another to accomplish the purpose of storage, transportation, or disposal. The hierarchy associated with a vessel may change if the purpose changes (e.g., the same inner vessel may use a storage overpack, a transportation cask, or a disposal waste package depending on the situation). The OWL table structure is being designed to ensure vessel systems used for different purposes can be identified and that, for each system, the relative positions of different vessels within the system are clear.

A challenging aspect of the data mining is that there is also variety in the type and level of detail of information available for different vessels. Part of that variability is a function of whether the vessel exists or not. For example, a vessel that exists and has been licensed for storage or transportation by the NRC will have far more information available than a vessel that is in the preliminary design stage. Nevertheless, a comparison of Table A-4, Table A-5, and Table A-6 reveals that, even for existing vessels, variation exists in the types of information reported. As a result, it is natural and expected that only a portion of the available fields in the vessel tables will be populated for any given vessel. Data mining of public documents really is a case of "what you see is what you get".

The variety in the nature of the vessels as well as the type and level of detail of the information available must be taken into account in the design of the vessel tables and the relationships between the tables. Care must also be taken in designing the links to the waste/waste form area of OWL. Another challenge is designing the user interface with controls to select what the user wants to see and determining how that information is going to be displayed. For the five vessel examples above, the choice was made to have a summary table (Table A-1) allowing for a comparison of certain information for all five examples. Then individual tables (Table A-2 to Table A-6) with physical properties for one example vessel at a time were presented. Similarly, the user interface is being designed to allow users to pick one or more displays that compare information for multiple vessels. The design will also allow users to pick one or more displays that provide more detailed information about a single vessel. In the end, the goal is to add useful information on vessels to OWL and to provide the user easy ways to examine the information at a high level or drill down to details to get what he or she needs.

APPENDIX B. OWL USER'S GUIDE

The links to the *OWL User's Guide* are available to the user on the OWL home page and on all of the SSRS reports. The process for updating the document is governed by the OWL release process (Weck et al. 2021c). At some point—typically about a month—after the release of a new version of OWL, the OWL team updates the *OWL User's Guide* and replaces the old version with the new version in all OWL environments. This action is the last step in the postprocessing phase of the release process.

The updated *OWL User's Guide* (version 5.0; SNL 2023) corresponding to the current OWL release (version 5.0) is reproduced below. The formatting from the *OWL User's Guide* has been retained for consistency with the original document. For example, the subheads are unnumbered, the fonts are different, and the figures do not have captions. The links in the *OWL User's Guide* to various locations in the document are shown through appropriate formatting, but they are not active in this appendix. In addition, Appendix A of the *OWL User's Guide* has been relabeled as Attachment B-1 to avoid confusion with the appendices in this annual status update report.

SAND2023-13489R

OWL User's Guide – Version 5.0
November 10, 2023

The purpose of the Online Waste Library (OWL) (https://collaborate.sandia.gov/sites/OWL/SitePages/Home.aspx) is to provide a single site that contains information on the many different U.S. Department of Energy (DOE)-managed wastes that are likely to require deep geologic disposal. Generally, these wastes are classified as either spent nuclear fuel (SNF), high-level waste (HLW), or transuranic waste (TRU). A complete list of all the DOE-managed wastes that are in OWL is available by clicking on "DOE-Managed Wastes" on the home page. TRU waste that is already destined for WIPP is not included in OWL, and commercial SNF that is not managed by the DOE is also not included in OWL.
Note that Firefox and Chrome are the recommended browsers, as there are limitations on the use of other browsers.

Navigation

Clicking on an item to open it, such as a link to a document, opens the item in a new window. To close the item, simply close the window. To go back to the previous webpage, click on the window containing that page. Many webpages allow you to navigate back to the Home Page, to the DOE-Managed Wastes webpage, or to the User Guide via links in the upper left corner of the webpage.

Printing and Saving

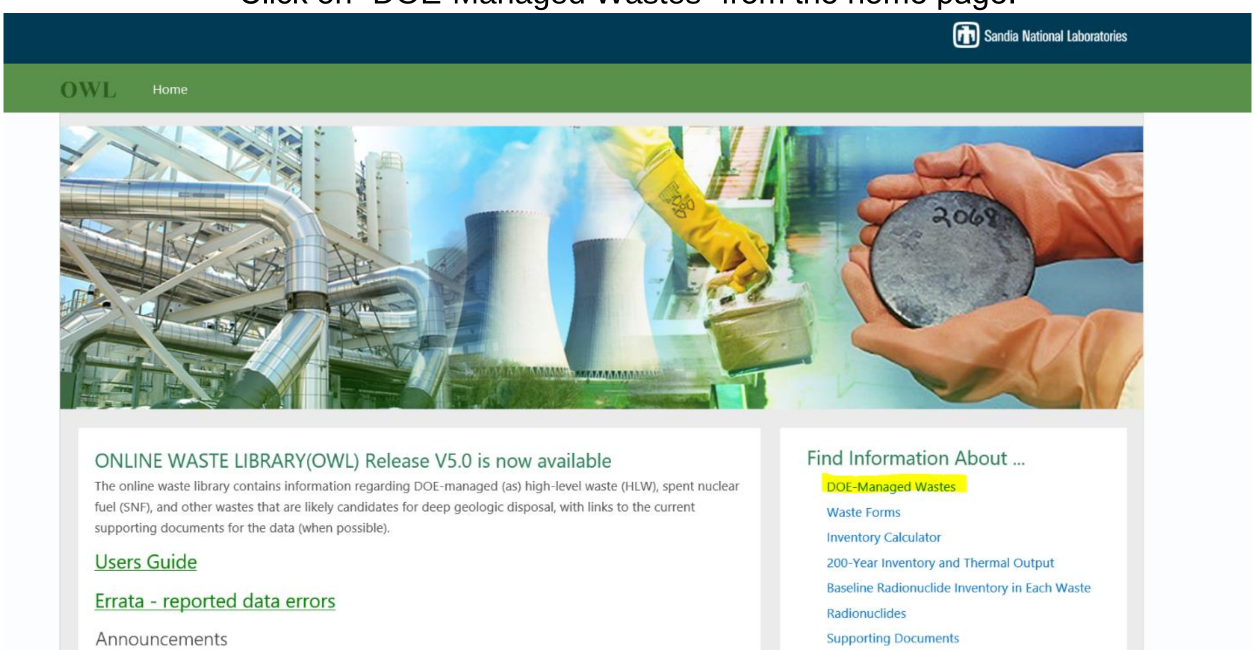
To print or save a webpage, click on "Actions" in the upper left corner of the webpage you wish to print or save. From the drop-down menu that appears, select "Print" if you want to print the webpage or "Export" if you wish to save it in a different format (e.g., pdf, Excel, Word).

How Do I….?

See which wastes are included in OWL?
See which wastes are at a particular site?
See the DOE-managed wastes by classification (high-level waste, spent nuclear fuel, or transuranic waste)?
See what the DOE has planned or proposed with respect to the disposal waste forms for the wastes?
See the radionuclide inventory of a particular waste?
See the radionuclide inventory of a particular waste or wastes as of a specific date (year)?
See a graph showing the total radioactivity and thermal output of a waste (or all wastes) over the next 200 years?
See a list of radionuclides included in OWL?
See a list of documents used to support the information in OWL?

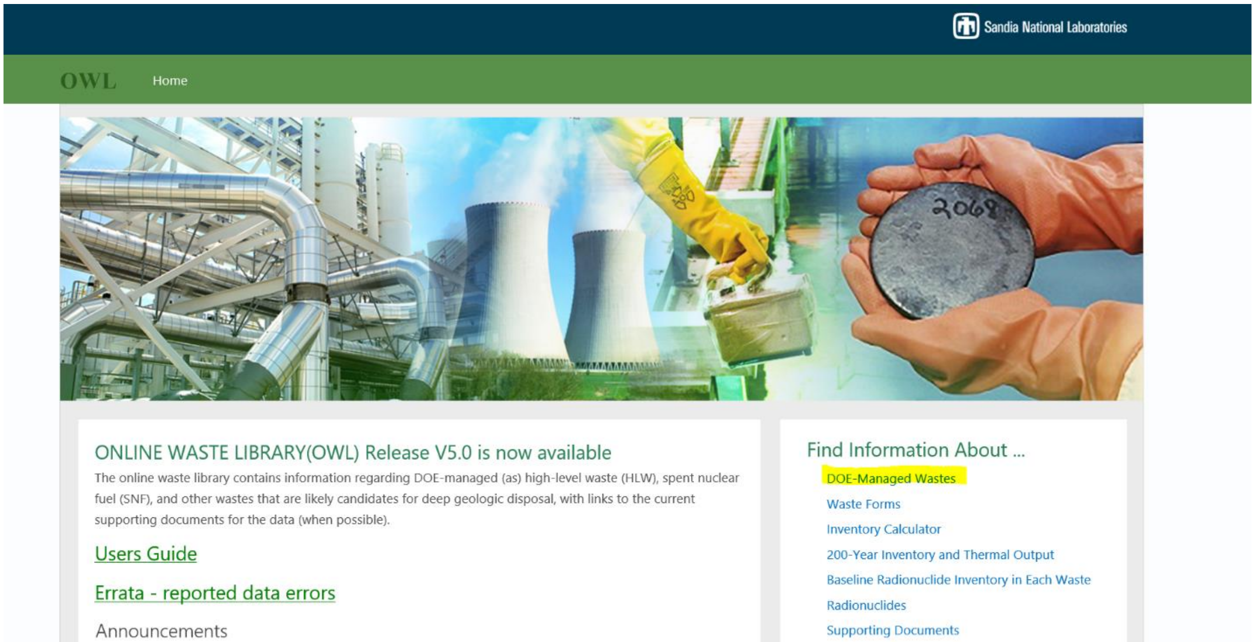
See which wastes are included in OWL?

Click on "DOE-Managed Wastes" from the home page.



See which wastes are at a particular site?

Click on "DOE-Managed Wastes" from the home page, then select the name of the desired facility from the selection pane on the left side of the page. In the example shown below, Hanford is selected.



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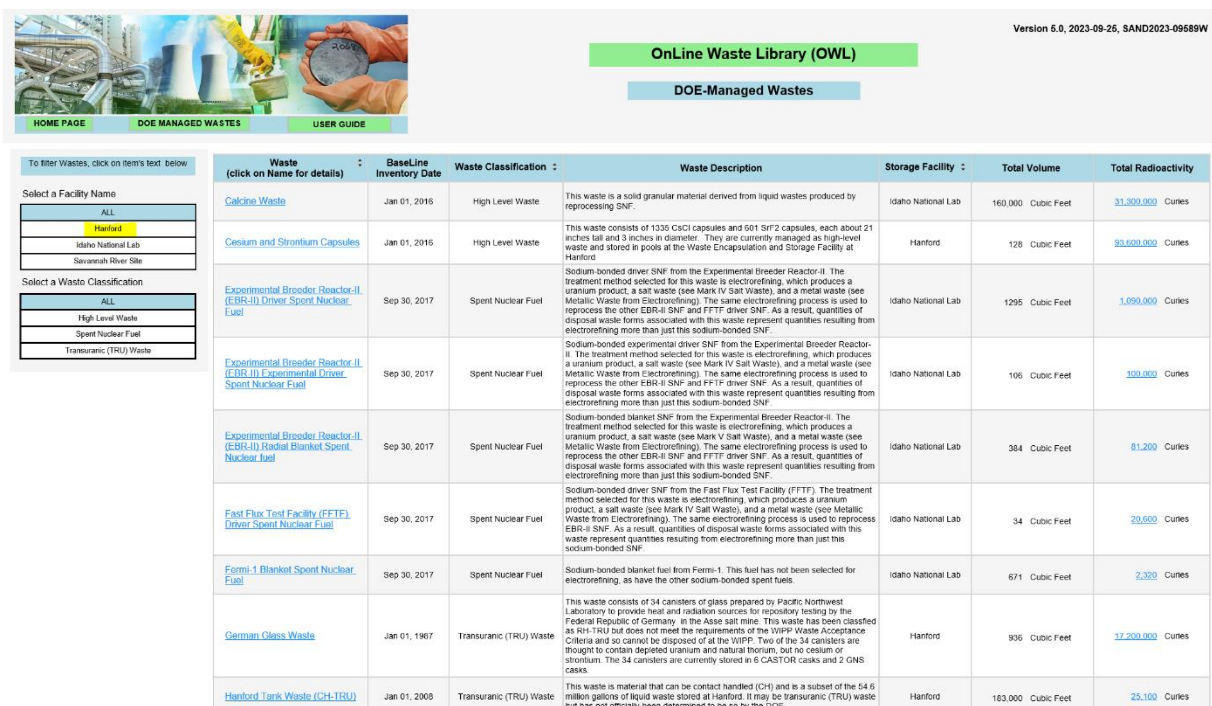
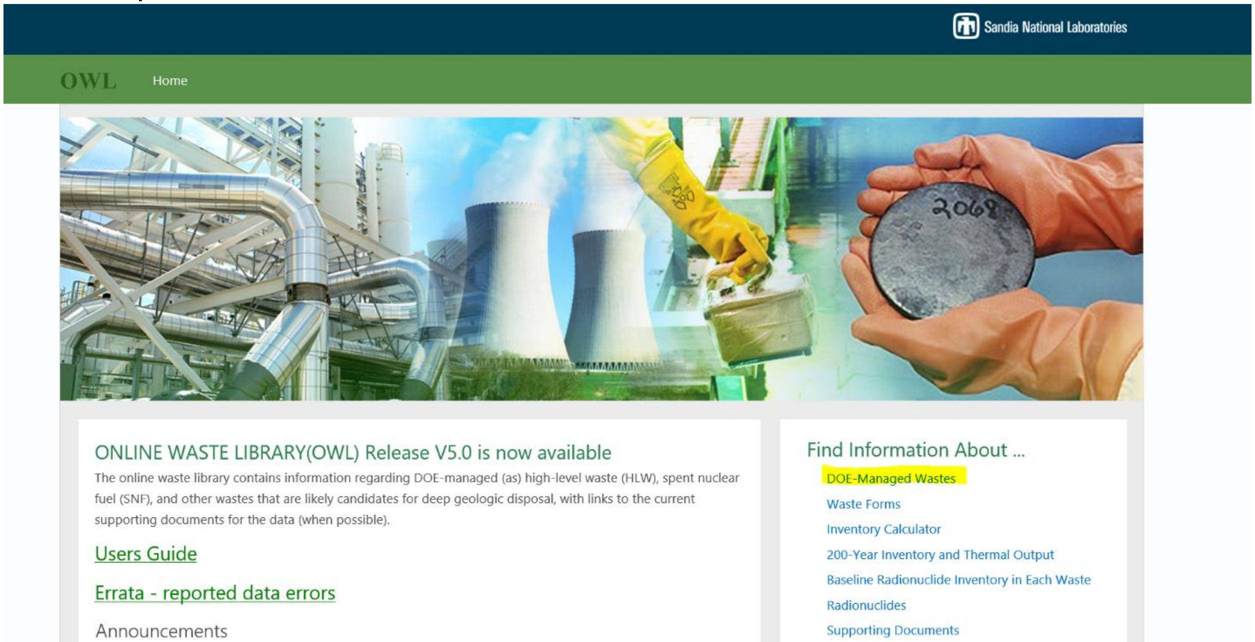


Waste (click on Name for details)	BaseLine Inventory Date	Waste Classification	Waste Description	Storage Facility	Total Volume	Total Radioactivity
Calcine Waste	Jan 01, 2016	High Level Waste	This waste is a solid granular material derived from liquid wastes produced by reprocessing SNF.	Idaho National Lab	160,000 Cubic Feet	31,300,000 Curies
Cesium and Strontium Capsules	Jan 01, 2016	High Level Waste	This waste consists of 1335 CsCl capsules and 601 SrF2 capsules, each about 21 inches tall and 3 inches in diameter. They are currently managed as high-level waste and stored in pools at the Waste Encapsulation and Storage Facility at Hanford	Hanford	128 Cubic Feet	93,600,000 Curies
Experimental Breeder Reactor-II (EBR-II) Driver Spent Nuclear Fuel	Sep 30, 2017	Spent Nuclear Fuel	Sodium-bonded driver SNF from the Experimental Breeder Reactor-II. The treatment method selected for this waste is electrorefining, which produces a uranium product, a salt waste (see Mark IV Salt Waste), and a metal waste (see Metallic Waste from Electrorefining). The same electrorefining process is used to reprocess the other EBR-II SNF and FFTF driver SNF. As a result, quantities of disposal waste forms associated with this waste represent quantities resulting from electrorefining more than just this sodium-bonded SNF.	Idaho National Lab	1295 Cubic Feet	1,090,000 Curies
Experimental Breeder Reactor-II (EBR-II) Experimental Driver Spent Nuclear Fuel	Sep 30, 2017	Spent Nuclear Fuel	Sodium-bonded experimental driver SNF from the Experimental Breeder Reactor-II. The treatment method selected for this waste is electrorefining, which produces a uranium product, a salt waste (see Mark IV Salt Waste), and a metal waste (see Metallic Waste from Electrorefining). The same electrorefining process is used to reprocess the other EBR-II SNF and FFTF driver SNF. As a result, quantities of disposal waste forms associated with this waste represent quantities resulting from electrorefining more than just this sodium-bonded SNF.	Idaho National Lab	106 Cubic Feet	100,000 Curies
Experimental Breeder Reactor-II (EBR-II) Radial Blanket Spent Nuclear fuel	Sep 30, 2017	Spent Nuclear Fuel	Sodium-bonded blanket SNF from the Experimental Breeder Reactor-II. The treatment method selected for this waste is electrorefining, which produces a uranium product, a salt waste (see Mark V Salt Waste), and a metal waste (see Metallic Waste from Electrorefining). The same electrorefining process is used to reprocess the other EBR-II SNF and FFTF driver SNF. As a result, quantities of disposal waste forms associated with this waste represent quantities resulting from electrorefining more than just this sodium-bonded SNF.	Idaho National Lab	384 Cubic Feet	81,200 Curies
Fast Flux Test Facility (FFTF) Driver Spent Nuclear Fuel	Sep 30, 2017	Spent Nuclear Fuel	Sodium-bonded driver SNF from the Fast Flux Test Facility (FFTF). The treatment method selected for this waste is electrorefining, which produces a uranium product, a salt waste (see Mark IV Salt Waste), and a metal waste (see Metallic Waste from Electrorefining). The same electrorefining process is used to reprocess EBR-II SNF. As a result, quantities of disposal waste forms associated with this waste represent quantities resulting from electrorefining more than just this sodium-bonded SNF.	Idaho National Lab	34 Cubic Feet	20,600 Curies
Fermi-1 Blanket Spent Nuclear Fuel	Sep 30, 2017	Spent Nuclear Fuel	Sodium-bonded blanket fuel from Fermi-1. This fuel has not been selected for electrorefining, as have the other sodium-bonded spent fuels.	Idaho National Lab	671 Cubic Feet	2,320 Curies
German Glass Waste	Jan 01, 1987	Transuranic (TRU) Waste	This waste consists of 34 canisters of glass prepared by Pacific Northwest Laboratory to provide heat and radiation sources for repository testing by the Federal Republic of Germany in the Asse salt mine. This waste has been classfied as RH-TRU but does not meet the requirements of the WIPP Waste Acceptance Criteria and so cannot be disposed of at the WIPP. Two of the 34 canisters are thought to contain depleted uranium and natural thorium, but no cesium or strontium. The 34 canisters are currently stored in 6 CASTOR casks and 2 GNS casks.	Hanford	936 Cubic Feet	17,200,000 Curies
Hanford Tank Waste (CH-TRU)	Jan 01, 2008	Transuranic (TRU) Waste	This waste is material that can be contact handled (CH) and is a subset of the 54.6 million gallons of liquid waste stored at Hanford. It may be transuranic (TRU) waste but has not officially been determined to be so by the DOE.	Hanford	183,000 Cubic Feet	25,100 Curies

See the DOE-managed wastes by classification (high-level waste, spent nuclear fuel, or transuranic waste)?

Click on “DOE-Managed Wastes” from the home page, then select the desired waste classification from the selection pane on the left side of the page. In the example shown below, “Spent Nuclear Fuel” is selected.



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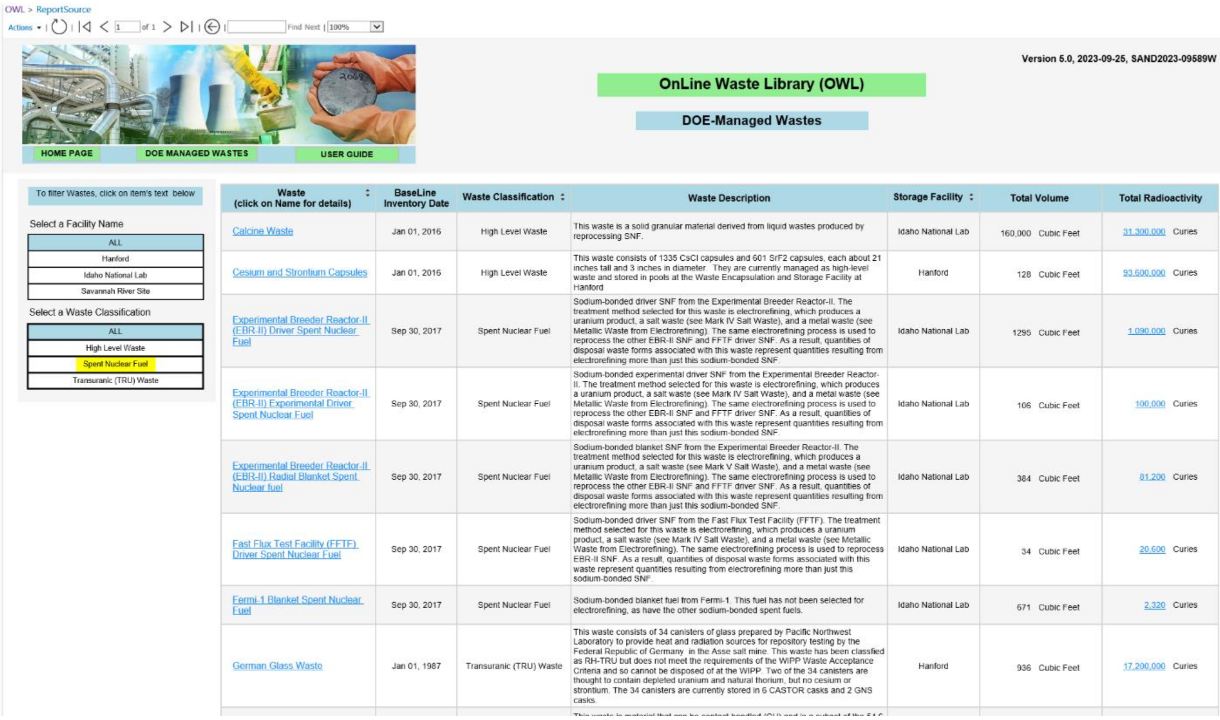
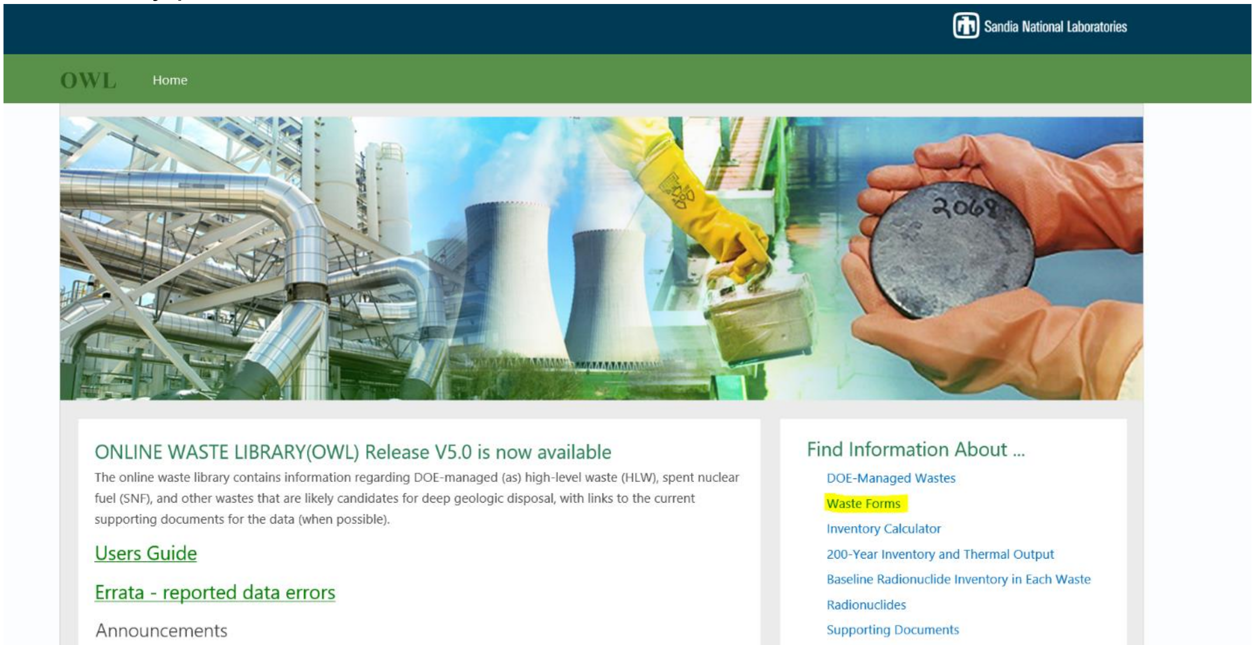


Waste (click on Name for details)	BaseLine Inventory Date	Waste Classification	Waste Description	Storage Facility	Total Volume	Total Radioactivity
Calcine Waste	Jan 01, 2016	High Level Waste	This waste is a solid granular material derived from liquid wastes produced by reprocessing SNF.	Idaho National Lab	160,000 Cubic Feet	31,300,000 Curies
Cesium and Strontium Capsules	Jan 01, 2016	High Level Waste	This waste consists of 1335 CsCl capsules and 601 SrF2 capsules, each about 21 inches tall and 3 inches in diameter. They are currently managed as high-level waste and stored in pools at the Waste Encapsulation and Storage Facility at Hanford	Hanford	128 Cubic Feet	93,600,000 Curies
Experimental Breeder Reactor-II (EBR-II) Driver Spent Nuclear Fuel	Sep 30, 2017	Spent Nuclear Fuel	Sodium-bonded driver SNF from the Experimental Breeder Reactor-II. The treatment method selected for this waste is electrorefining, which produces a uranium product, a salt waste (see Mark IV Salt Waste), and a metal waste (see Metallic Waste from Electrorefining). The same electrorefining process is used to reprocess the other EBR-II SNF and FFTF driver SNF. As a result, quantities of disposal waste forms associated with this waste represent quantities resulting from electrorefining more than just this sodium-bonded SNF.	Idaho National Lab	1295 Cubic Feet	1,090,000 Curies
Experimental Breeder Reactor-II (EBR-II) Experimental Driver Spent Nuclear Fuel	Sep 30, 2017	Spent Nuclear Fuel	Sodium-bonded experimental driver SNF from the Experimental Breeder Reactor-II. The treatment method selected for this waste is electrorefining, which produces a uranium product, a salt waste (see Mark IV Salt Waste), and a metal waste (see Metallic Waste from Electrorefining). The same electrorefining process is used to reprocess the other EBR-II SNF and FFTF driver SNF. As a result, quantities of disposal waste forms associated with this waste represent quantities resulting from electrorefining more than just this sodium-bonded SNF.	Idaho National Lab	106 Cubic Feet	100,000 Curies
Experimental Breeder Reactor-II (EBR-II) Radial Blanket Spent Nuclear fuel	Sep 30, 2017	Spent Nuclear Fuel	Sodium-bonded blanket SNF from the Experimental Breeder Reactor-II. The treatment method selected for this waste is electrorefining, which produces a uranium product, a salt waste (see Mark V Salt Waste), and a metal waste (see Metallic Waste from Electrorefining). The same electrorefining process is used to reprocess the other EBR-II SNF and FFTF driver SNF. As a result, quantities of disposal waste forms associated with this waste represent quantities resulting from electrorefining more than just this sodium-bonded SNF.	Idaho National Lab	384 Cubic Feet	81,200 Curies
Fast Flux Test Facility (FFTF) Driver Spent Nuclear Fuel	Sep 30, 2017	Spent Nuclear Fuel	Sodium-bonded driver SNF from the Fast Flux Test Facility (FFTF). The treatment method selected for this waste is electrorefining, which produces a uranium product, a salt waste (see Mark IV Salt Waste), and a metal waste (see Metallic Waste from Electrorefining). The same electrorefining process is used to reprocess EBR-II SNF. As a result, quantities of disposal waste forms associated with this waste represent quantities resulting from electrorefining more than just this sodium-bonded SNF.	Idaho National Lab	34 Cubic Feet	20,600 Curies
Fermi-1 Blanket Spent Nuclear Fuel	Sep 30, 2017	Spent Nuclear Fuel	Sodium-bonded blanket fuel from Fermi-1. This fuel has not been selected for electrorefining, as have the other sodium-bonded spent fuels.	Idaho National Lab	671 Cubic Feet	2,320 Curies
German Glass Waste	Jan 01, 1987	Transuranic (TRU) Waste	This waste consists of 34 canisters of glass prepared by Pacific Northwest Laboratory to provide heat and radiation sources for repository testing by the Federal Republic of Germany in the Asse salt mine. This waste has been classfied as RH-TRU but does not meet the requirements of the WIPP Waste Acceptance Criteria and so cannot be disposed of at the WIPP. Two of the 34 canisters are thought to contain depleted uranium and natural thorium, but no cesium or strontium. The 34 canisters are currently stored in 6 CASTOR casks and 2 GNS casks.	Hanford	936 Cubic Feet	17,200,000 Curies

See what the DOE has planned or proposed with respect to the disposal waste forms for the wastes?

Click on “Waste Forms” from the home page, then select the waste form in which you are interested. In the example shown below, “Calcine waste that has been hot isostatically pressed, with additives” was selected.



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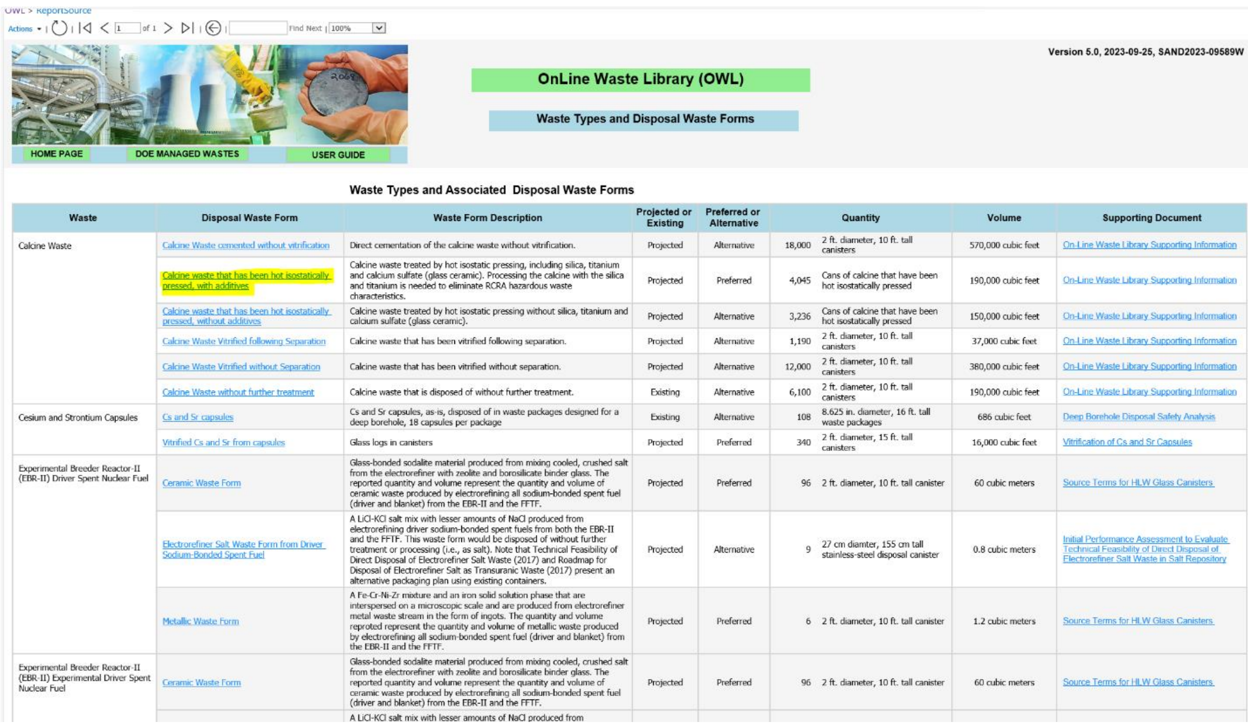
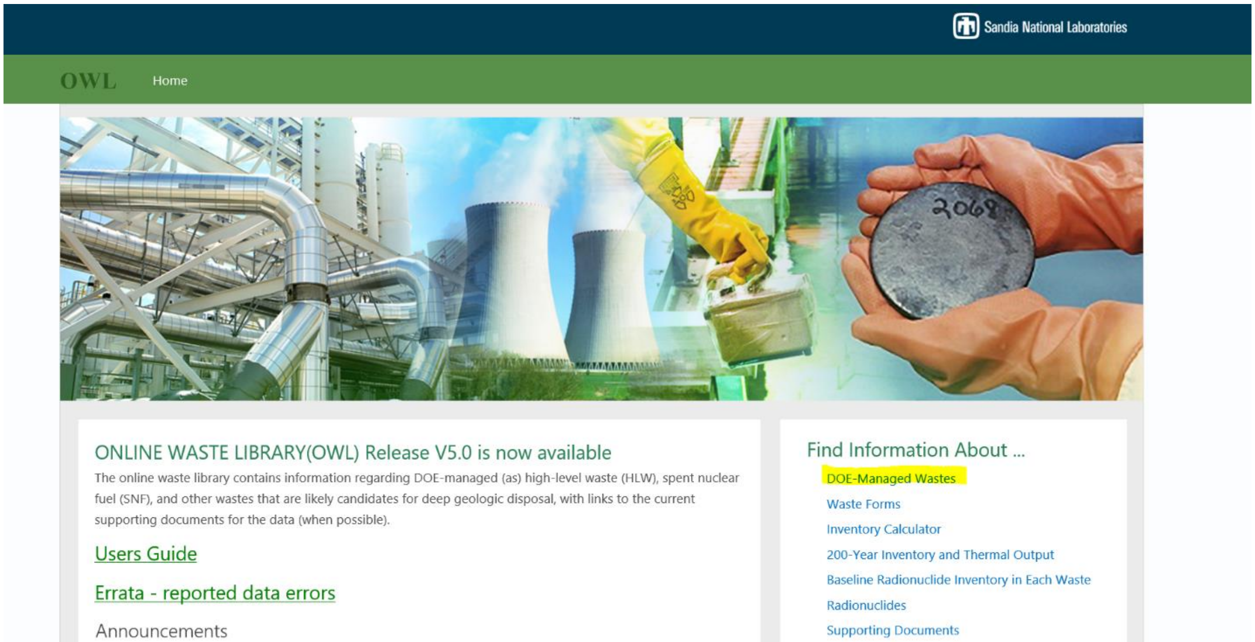


Waste Types and Associated Disposal Waste Forms

Waste	Disposal Waste Form	Waste Form Description	Projected or Existing	Preferred or Alternative	Quantity		Volume	Supporting Document
Calcine Waste	Calcine Waste cemented without vitrification	Direct cementation of the calcine waste without vitrification.	Projected	Alternative	18,000	2 ft. diameter, 10 ft. tall canisters	570,000 cubic feet	On-Line Waste Library Supporting Information
	Calcine waste that has been hot isostatically pressed, with additives	Calcine waste treated by hot isostatic pressing, including silica, titanium and calcium sulfate (glass ceramic). Processing the calcine with the silica and titanium is needed to eliminate RCRA hazardous waste characteristics.	Projected	Preferred	4,045	Cans of calcine that have been hot isostatically pressed	190,000 cubic feet	On-Line Waste Library Supporting Information
	Calcine waste that has been hot isostatically pressed, without additives	Calcine waste treated by hot isostatic pressing without silica, titanium and calcium sulfate (glass ceramic).	Projected	Alternative	3,236	Cans of calcine that have been hot isostatically pressed	150,000 cubic feet	On-Line Waste Library Supporting Information
	Calcine Waste Vitrified following Separation	Calcine waste that has been vitrified following separation.	Projected	Alternative	1,190	2 ft. diameter, 10 ft. tall canisters	37,000 cubic feet	On-Line Waste Library Supporting Information
	Calcine Waste Vitrified without Separation	Calcine waste that has been vitrified without separation.	Projected	Alternative	12,000	2 ft. diameter, 10 ft. tall canisters	380,000 cubic feet	On-Line Waste Library Supporting Information
	Calcine Waste without further treatment	Calcine waste that is disposed of without further treatment.	Existing	Alternative	6,100	2 ft. diameter, 10 ft. tall canisters	190,000 cubic feet	On-Line Waste Library Supporting Information
Cesium and Strontium Capsules	Cs and Sr capsules	Cs and Sr capsules, as-is, disposed of in waste packages designed for a deep borehole, 18 capsules per package	Existing	Alternative	108	8.625 in. diameter, 16 ft. tall waste packages	686 cubic feet	Deep Borehole Disposal Safety Analysis
	Vitrified Cs and Sr from capsules	Glass logs in canisters	Projected	Preferred	340	2 ft. diameter, 15 ft. tall canisters	16,000 cubic feet	Vitrification of Cs and Sr Capsules
Experimental Breeder Reactor-II (EBR-II) Driver Spent Nuclear Fuel	Ceramic Waste Form	Glass-bonded sodalite material produced from mixing cooled, crushed salt from the electrorefiner with zeolite and borosilicate binder glass. The reported quantity and volume represent the quantity and volume of ceramic waste produced by electrorefining all sodium-bonded spent fuel (driver and blanket) from the EBR-II and the FFTF.	Projected	Preferred	96	2 ft. diameter, 10 ft. tall canister	60 cubic meters	Source Terms for HLW Glass Canisters
	Electrorefiner Salt Waste Form from Driver Sodium-Bonded Spent Fuel	A LiCl-KCl salt mix with lesser amounts of NaCl produced from electrorefining driver sodium-bonded spent fuels from both the EBR-II and the FFTF. This waste form would be disposed of without further treatment or processing (i.e., as salt). Note that Technical Feasibility of Direct Disposal of Electrorefiner Salt Waste (2017) and Roadmap for Disposal of Electrorefiner Salt as Transuranic Waste (2017) present an alternative packaging plan using existing containers.	Projected	Alternative	9	27 cm diamter, 155 cm tall stainless-steel disposal canister	0.8 cubic meters	Initial Performance Assessment to Evaluate Technical Feasibility of Direct Disposal of Electrorefiner Salt Waste in Salt Repository
	Metallic Waste Form	A Fe-Cr-Ni-Zr mixture and an iron solid solution phase that are interspersed on a microscopic scale and are produced from electrorefiner metal waste stream in the form of ingots. The quantity and volume reproted represent the quantity and volume of metallic waste produced by electrorefining all sodium-bonded spent fuel (driver and blanket) from the EBR-II and the FFTF.	Projected	Preferred	6	2 ft. diameter, 10 ft. tall canister	1.2 cubic meters	Source Terms for HLW Glass Canisters
Experimental Breeder Reactor-II (EBR-II) Experimental Driver Spent Nuclear Fuel	Ceramic Waste Form	Glass-bonded sodalite material produced from mixing cooled, crushed salt from the electrorefiner with zeolite and borosilicate binder glass. The reported quantity and volume represent the quantity and volume of ceramic waste produced by electrorefining all sodium-bonded spent fuel (driver and blanket) from the EBR-II and the FFTF.	Projected	Preferred	96	2 ft. diameter, 10 ft. tall canister	60 cubic meters	Source Terms for HLW Glass Canisters
		A LiCl-KCl salt mix with lesser amounts of NaCl produced from						

See the radionuclide inventory of a particular waste?

There are three different ways to do this. One way is to click on “DOE-Managed Wastes” from the home page, then click on the name of the waste, then click on the plus sign (+) next to “5. Radionuclide Inventory.” This will display the inventory (in Curies) for the waste. In the example below, Cesium and Strontium Capsules is the waste selected.



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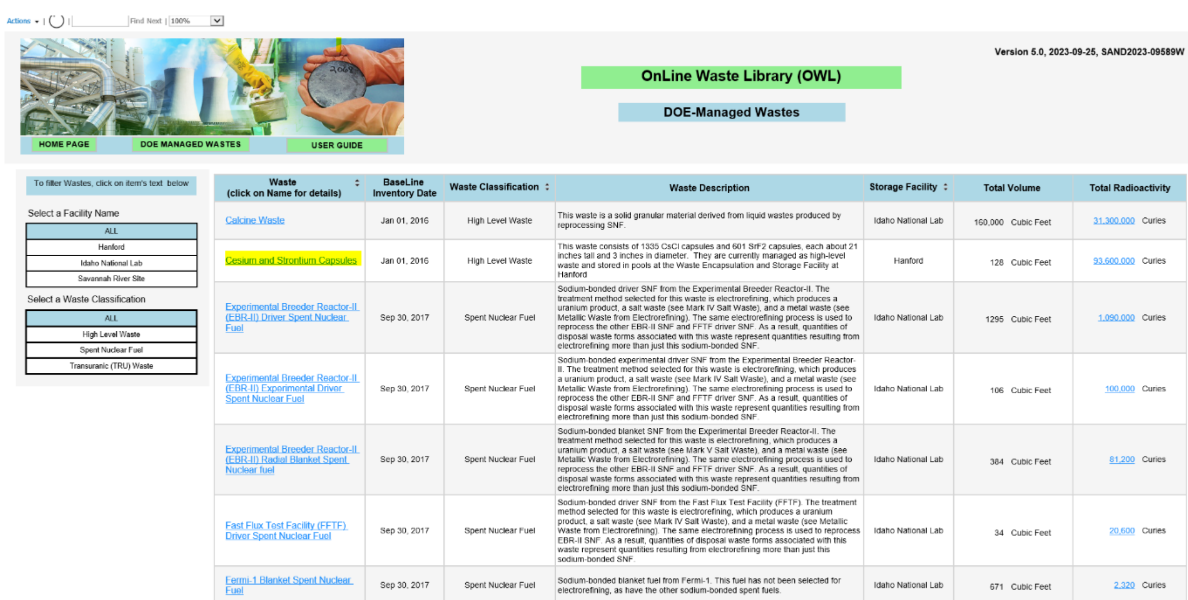


then

Actions | Find Next | 100%

HOME PAGE | DOE MANAGED WASTES | USER GUIDE

Version 5.0, 2023-09-25, SAND2023-09589W

OnLine Waste Library (OWL)

Waste Detail

Cesium and Strontium Capsules

Waste Classification	Waste Description	Storage Facility	Produced By	Is Mixed Waste?	Baseline Inventory Date & Inventory Calculator	
High Level Waste	This waste consists of 1335 CsCl capsules and 601 SrF2 capsules, each about 21 inches tall and 3 inches in diameter. They are currently managed as high-level waste and stored in pools at the Waste Encapsulation and Storage Facility at Hanford	Hanford	Government	Yes	1/1/2016	Inventory Calculator

Display Specific Waste Information by Expanding (+) the Type of Content Listed Below

⊞1. Waste Characteristics
⊞2. Waste Source
⊞3. Disposal Waste Forms
⊞4. Disposal Waste Form Characteristics
⊞5. Radionuclide Inventory
⊞6. Radionuclide Characteristics
⊞7. Waste Supporting Documents
⊞8. Waste Contacts

then

Actions | Find Next | 100%

HOME PAGE | DOE MANAGED WASTES | USER GUIDE

Version 5.0, 2023-09-25, SAND2023-09589W

OnLine Waste Library (OWL)

Waste Detail

Cesium and Strontium Capsules

Waste Classification	Waste Description	Storage Facility	Produced By	Is Mixed Waste?	Baseline Inventory Date & Inventory Calculator	
High Level Waste	This waste consists of 1335 CsCl capsules and 601 SrF2 capsules, each about 21 inches tall and 3 inches in diameter. They are currently managed as high-level waste and stored in pools at the Waste Encapsulation and Storage Facility at Hanford	Hanford	Government	Yes	1/1/2016	Inventory Calculator

Display Specific Waste Information by Expanding (+) the Type of Content Listed Below

⊞1. Waste Characteristics
⊞2. Waste Source
⊞3. Disposal Waste Forms
⊞4. Disposal Waste Form Characteristics
⊟5. Radionuclide Inventory
⊞6. Radionuclide Characteristics
⊞7. Waste Supporting Documents
⊞8. Waste Contacts

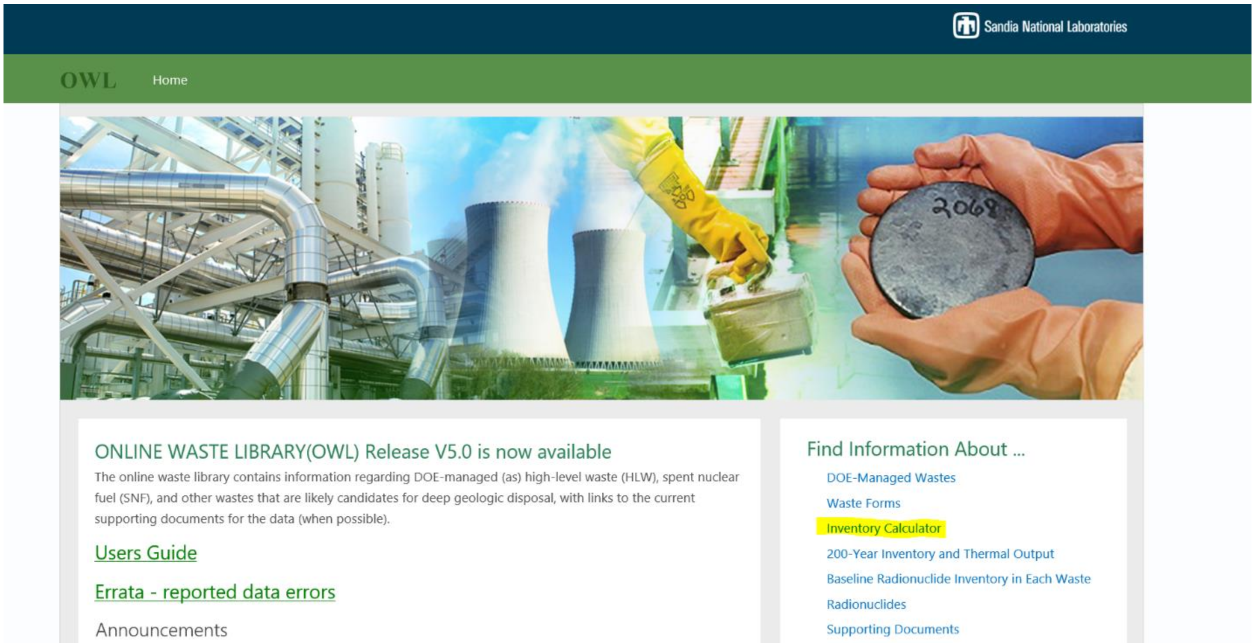
5. Radionuclide Inventory

If an inventory value is reported as zero, then the actual value is < 1.0e-7 curies.
The actual value can be found in the supporting document for the waste inventory.

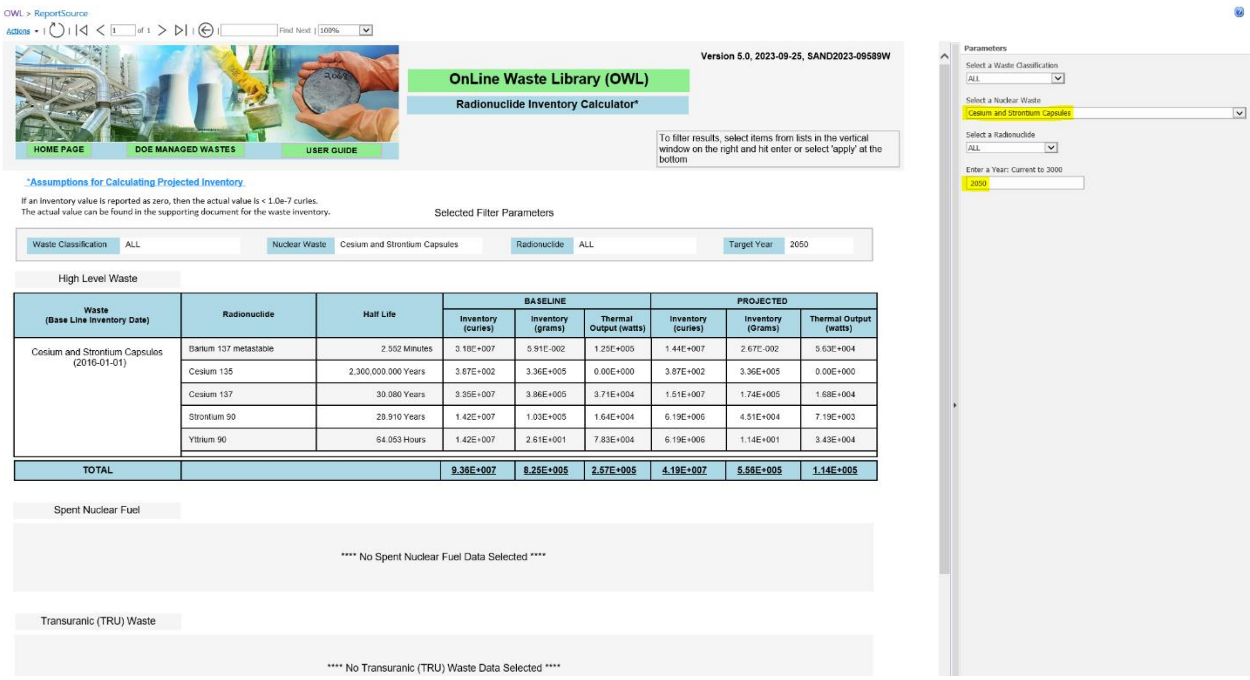
Radionuclide	Inventory Description	Inventory Calculator	Value	Supporting Document
Barium 137 metastable	The total curies of Ba137-m in the 1,335 capsules.	Inventory Calculator	3.18E+007 Curies	Capsule Calculations
Cesium 135	The total curies of Cs135 in the 1335 capsules	Inventory Calculator	3.87E+002 Curies	Capsule Calculations
Cesium 137	The total curies of Cs137 in the 1335 capsules	Inventory Calculator	3.35E+007 Curies	Capsule Calculations
Strontium 90	The total curies of Sr90 in the 601 capsules	Inventory Calculator	1.42E+007 Curies	Capsule Calculations
Yttrium 90	The total curies of Y90 in the 601 capsules	Inventory Calculator	1.42E+007 Curies	Capsule Calculations

-OR-

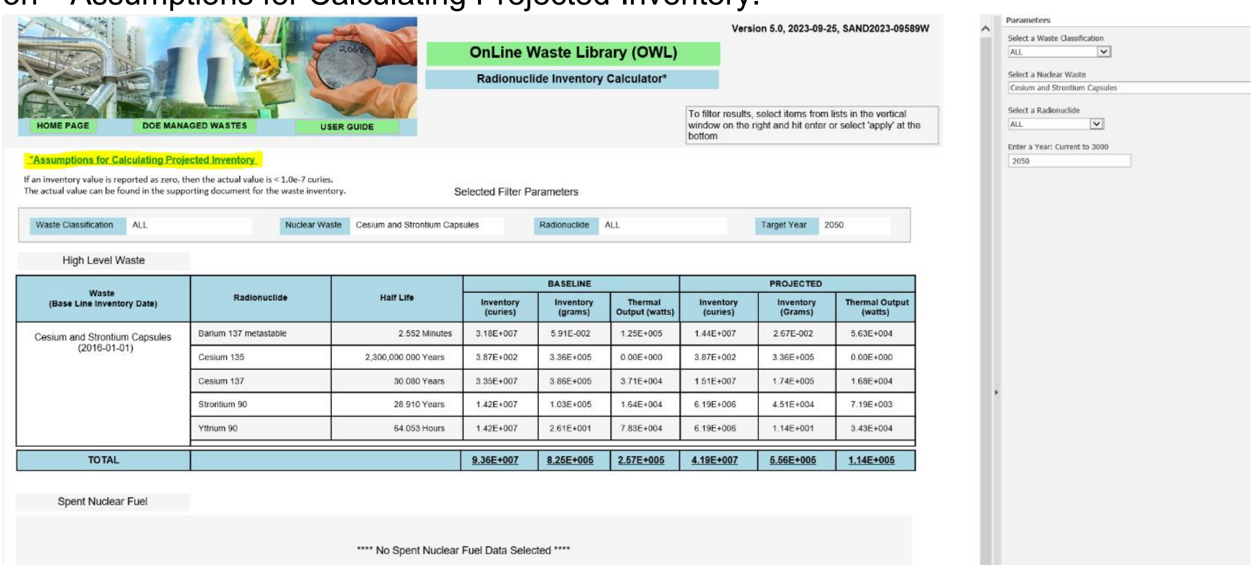
The second way is to click on “Inventory Calculator” from the home page. This will display the inventory (in Curies and grams) of every radionuclide in every waste, along with the thermal output of heat-generating radionuclides in every waste, both as of the baseline date for the waste and at some specified time (date). From the Radionuclide Inventory Calculator page, you can filter the wastes by waste classification, waste, and radionuclide, and you can select the year for which you would like the inventory calculated. After making these selections, click “Apply” on the lower right side of the webpage. In the example below, the inventory for the Cesium and Strontium Capsules is calculated for 2050.



Then

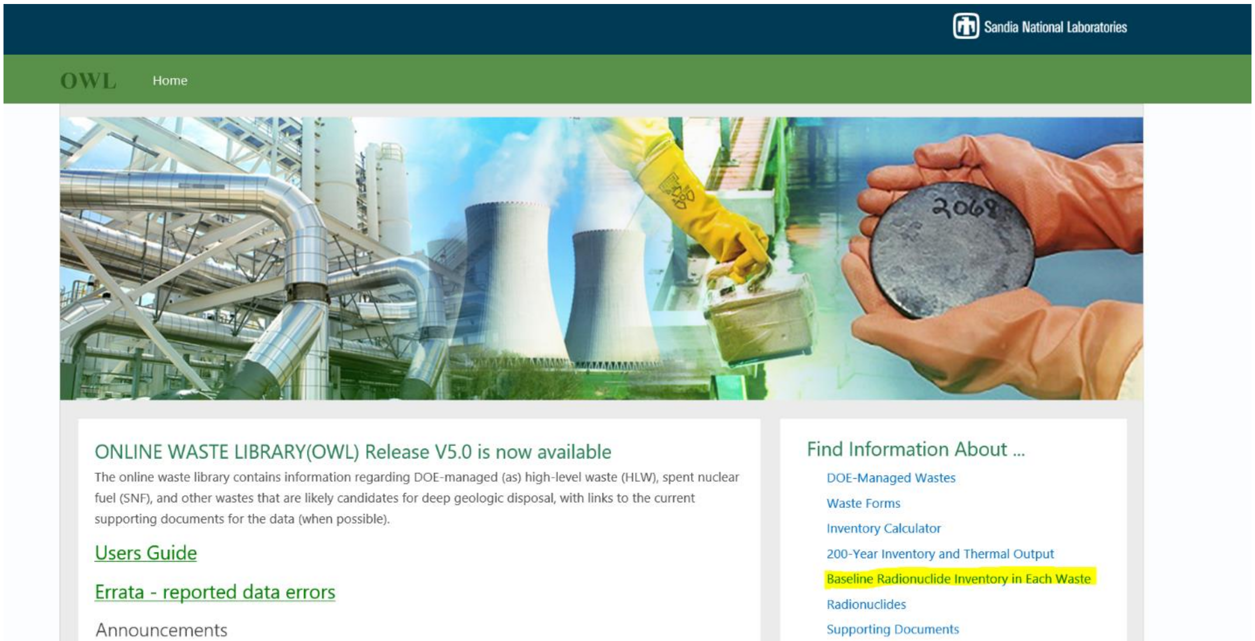


You can see the assumptions made in calculating radionuclide inventories by clicking on "*Assumptions for Calculating Projected Inventory."



-OR-

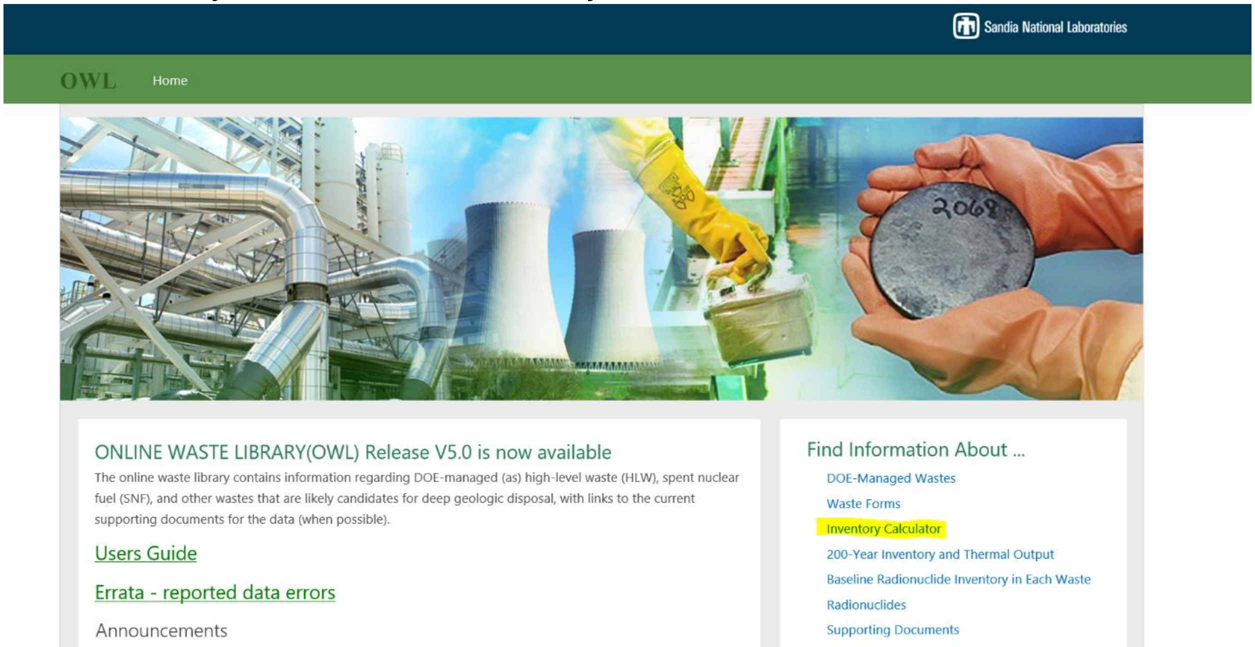
The third way is to click on "Baseline Radionuclide Inventory in Each Waste" from the home page. This will display the inventory (in Curies) of every radionuclide in every waste as of the baseline date for that waste. You can filter the number of wastes or radionuclides that appear by selecting a facility, a waste classification, and/or a radionuclide from the selection boxes on the left side of the page. In the example shown below, the facility selected is Hanford, the waste classification selected is High Level Waste, and all radionuclides are shown.



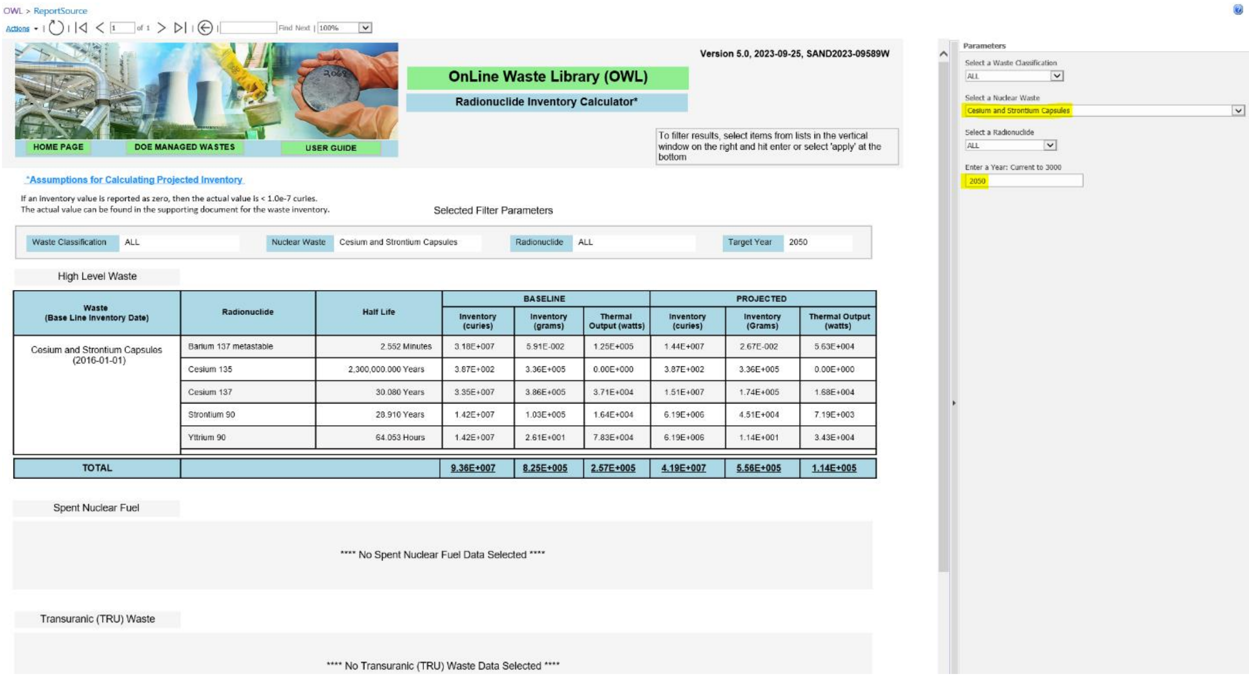
then

See the radionuclide inventory of a particular waste or wastes as of a specific date (year)?

Click on "Inventory Calculator" from the home page. This will display the inventory (in Curies and grams) of every radionuclide in every waste, along with the thermal output of heat-generating radionuclides in every waste, both as of the baseline date for the waste and at some specified time (date). Enter the desired date (year) into the selection pane on the right side of the page and click on "Apply" on the bottom of the right side of the page or hit “Enter” on your keyboard. You can filter the list of radionuclides displayed by selecting the waste classification, a particular waste, or a radionuclide from the selection pane on the right side of the page and clicking on “Apply” on the bottom of the right side of the page. In the example below, Cesium and Strontium capsules is the selected waste and the year for which the inventory is selected is 2050.



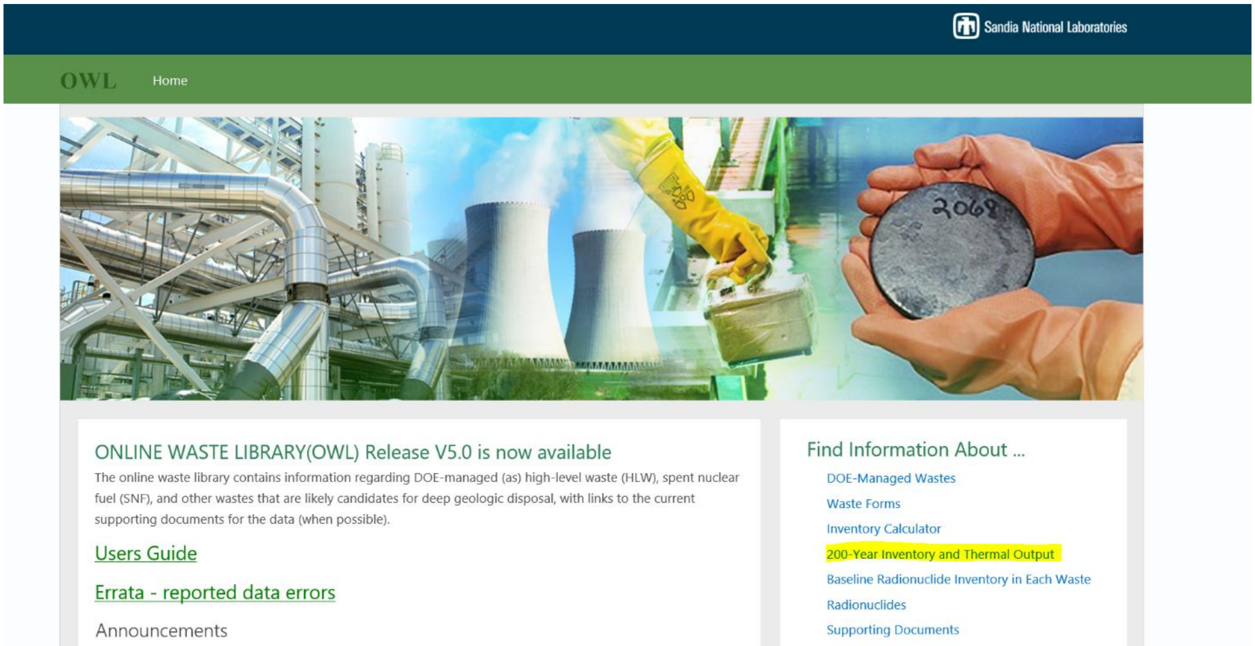
then



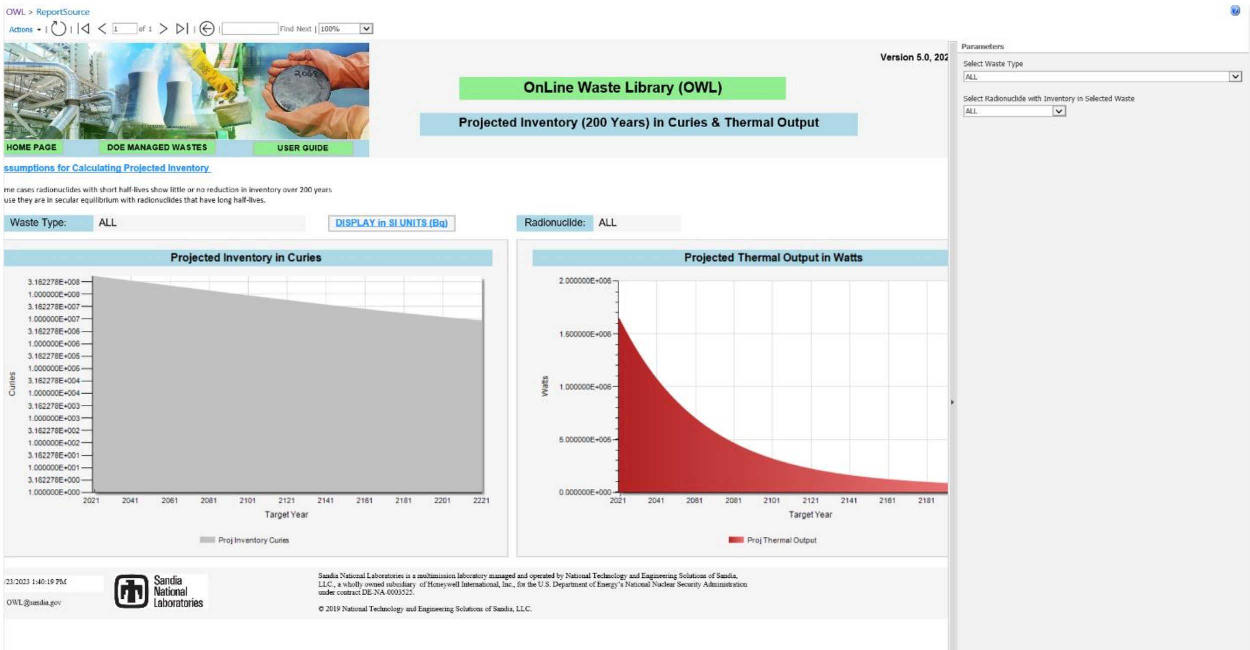
Waste (Base Line Inventory Date)	Radionuclide	Half Life	BASELINE Inventory (curies)	BASELINE Inventory (grams)	BASELINE Thermal Output (watts)	PROJECTED Inventory (curies)	PROJECTED Inventory (Grams)	PROJECTED Thermal Output (watts)
Cesium and Strontium Capsules (2016-01-01)	Barium 137 metastable	2.552 Minutes	3.18E+007	5.91E-002	1.25E+005	1.44E+007	2.67E-002	5.63E+004
	Cesium 135	2,300,000.000 Years	3.87E+002	3.36E+005	0.00E+000	3.87E+002	3.36E+005	0.00E+000
	Cesium 137	30.080 Years	3.35E+007	3.86E+005	3.71E+004	1.51E+007	1.74E+005	1.68E+004
	Strontium 90	28.910 Years	1.42E+007	1.03E+005	1.64E+004	6.19E+006	4.51E+004	7.19E+003
	Yttrium 90	64.053 Hours	1.42E+007	2.61E+001	7.83E+004	6.19E+006	1.14E+001	3.43E+004
TOTAL			9.36E+007	8.25E+005	2.57E+005	4.19E+007	5.56E+005	1.14E+005

See a graph showing the total radioactivity and thermal output of a waste (or all wastes) over the next 200 years?

Click “200-Year Inventory and Thermal Output” from the home page. This will display a graph of the total radioactivity of all the wastes and the thermal output of all the wastes over the next 200 years. You can switch between Curies and GBq for the projected inventory by clicking on “Display in SI Units (Bq)” or “Display in Curies,” as appropriate. You can filter the wastes included in the graphs by selecting the waste type or radionuclide from the selection pane on the right side of the page and clicking on “Apply” on the bottom of the right side of the page. In the example shown below, “All” waste types is selected and “All” radionuclides is selected.

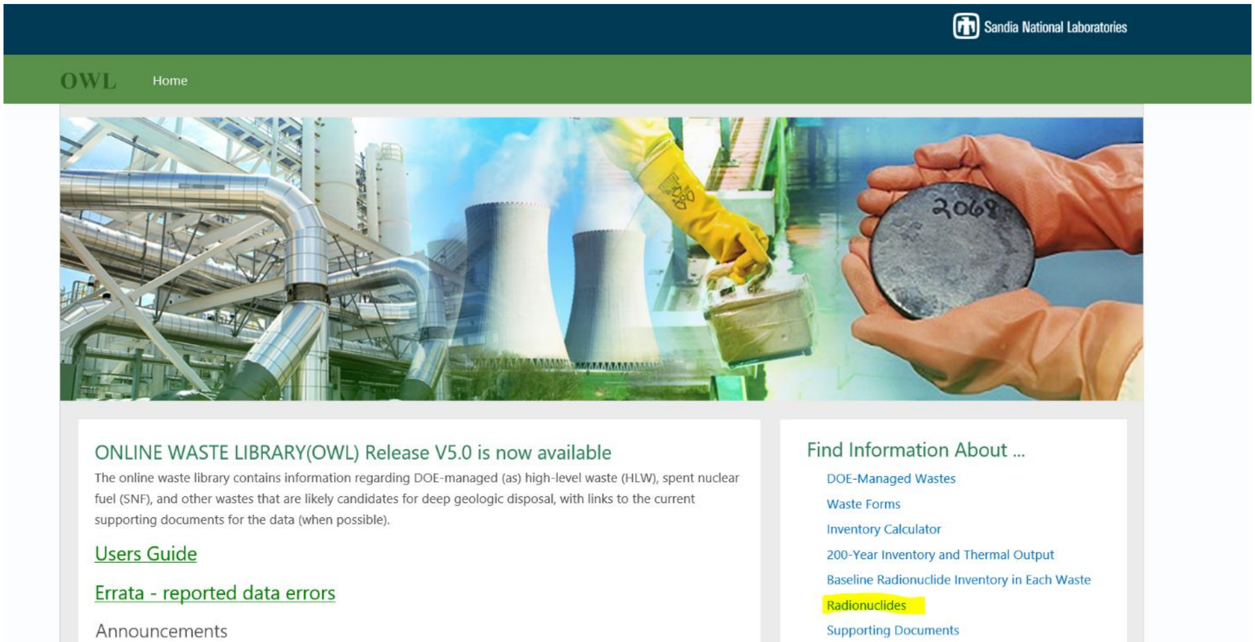


then

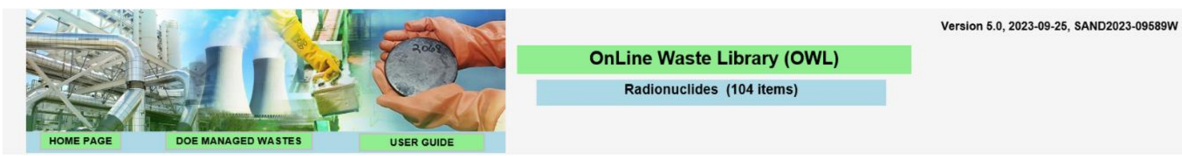


See a list of radionuclides included in OWL?

Click on "Radionuclides" from the home page. This will display a list of all radionuclides in OWL, along with the half-life of each radionuclide, a link to a graph of the inventory of that radionuclide over the next 200 years, its atomic mass, its heat generation rate (if applicable), its parent radionuclide (if needed for radioactive decay calculations), and its decay ratio (if needed for radioactive decay calculations). Radionuclides can be sorted alphabetically, by half-life, by atomic mass, and by thermal output by clicking on the up and down triangles in the header row of the table. In the example shown below, radionuclides are sorted by decreasing half-life. You can filter the inventory displayed by selecting "Select All," "No Inventory," or "Has Inventory in Wastes" from the selection pane on the right side of the screen. In this context, "No Inventory" means that no initial inventory for the radionuclide was reported for any of the wastes but it is included in OWL for establishing radioactive decay chains. "Has Inventory in Wastes" means that some initial inventory for the radionuclide was reported for at least one of the wastes in OWL.



Then

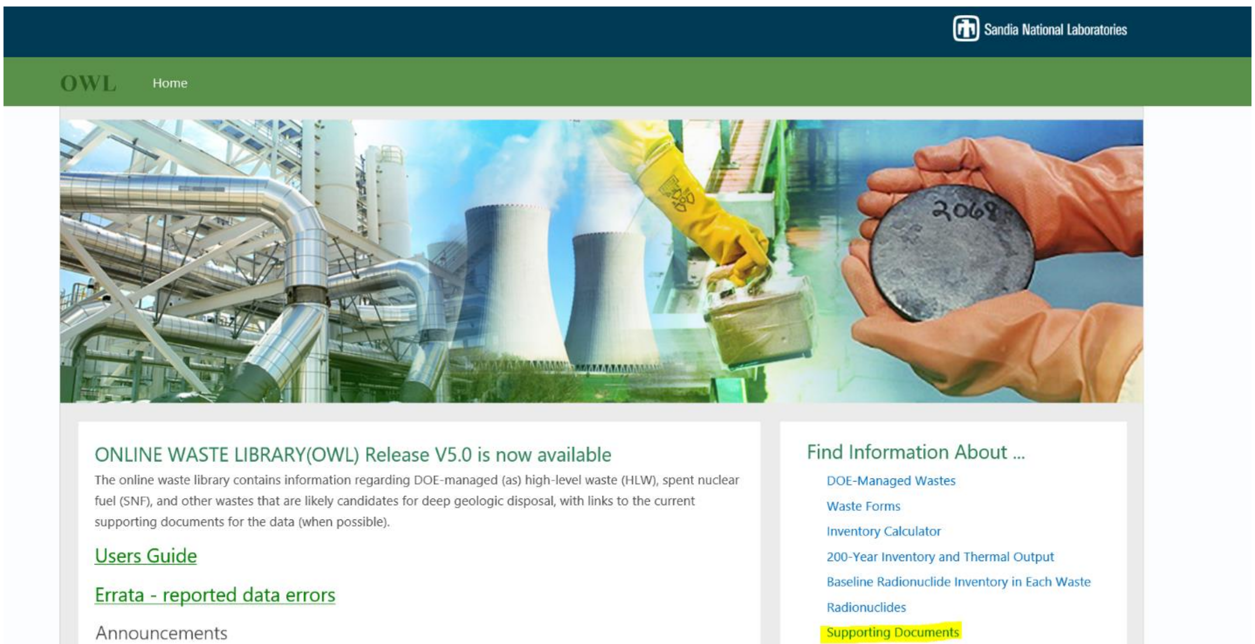


Radionuclide	Description	Half Life	Inventory	Atomic Mass (u)	Thermal Output (watts/kCi)	Parent Radionuclide	Inventory Ratio	Supporting Document
Ac-227	Actinium 227	21.77 Years	Projected Inventory (200 years)	227.00				Ac-227 Nuclear Data
Ac-228	Actinium 228	6.15 Hours	No Inventory	228.00		Ra-228	1.000	Ac-228 Nuclear Data
Al-26	Aluminum 26	717,000.00 Years	Projected Inventory (200 years)	26.00				Al-26 Nuclear Data
Am-241	Americium 241	432.60 Years	Projected Inventory (200 years)	241.00	32.450	Pu-241		Am-241 Nuclear Data
Am-242	Americium 242	16.02 Hours	Projected Inventory (200 years)	242.00		Am-242m	0.995	Am-242 Nuclear Data
Am-242m	Americium 242 metastable	141.00 Years	Projected Inventory (200 years)	242.00				Am-242m Nuclear Data
Am-243	Americium 243	7,364.00 Years	Projected Inventory (200 years)	243.00				Am-243 Nuclear Data
Ba-137m	Barium 137 metastable	2.55 Minutes	Projected Inventory (200 years)	137.00	3.920	Cs-137	0.950	Ba-137m Nuclear Data
Bi-212	Bismuth 212	60.55 Minutes	No Inventory	212.00		Th-228	1.000	Bi-212 Nuclear Data
Bi-214	Bismuth 214	19.71 Minutes	No Inventory	214.00		Ra-226	1.000	Bi-214 Nuclear Data
Bk-247	Berkelium 247	1,380.00 Years	Projected Inventory (200 years)	247.00				Bk-247 Nuclear Data
C-14	Carbon 14	5,700.00 Years	Projected Inventory (200 years)	14.00				C-14 Nuclear Data
Cd-113m	Cadmium 113 metastable	14.10 Years	Projected Inventory (200 years)	113.00				Cd-113m Nuclear Data
Ce-144	Cerium 144	284.91 Days	Projected Inventory (200 years)	144.00				Ce-144 Nuclear Data
Cf-249	Californium 249	351.00 Years	Projected Inventory (200 years)	249.00				Cf-249 Nuclear Data
Cf-251	Californium 251	898.00 Years	Projected Inventory (200 years)	251.00				Cf-251 Nuclear Data
Cf-252	Californium 252	2.65 Years	Projected Inventory (200 years)	252.00				Cf-252 Nuclear Data

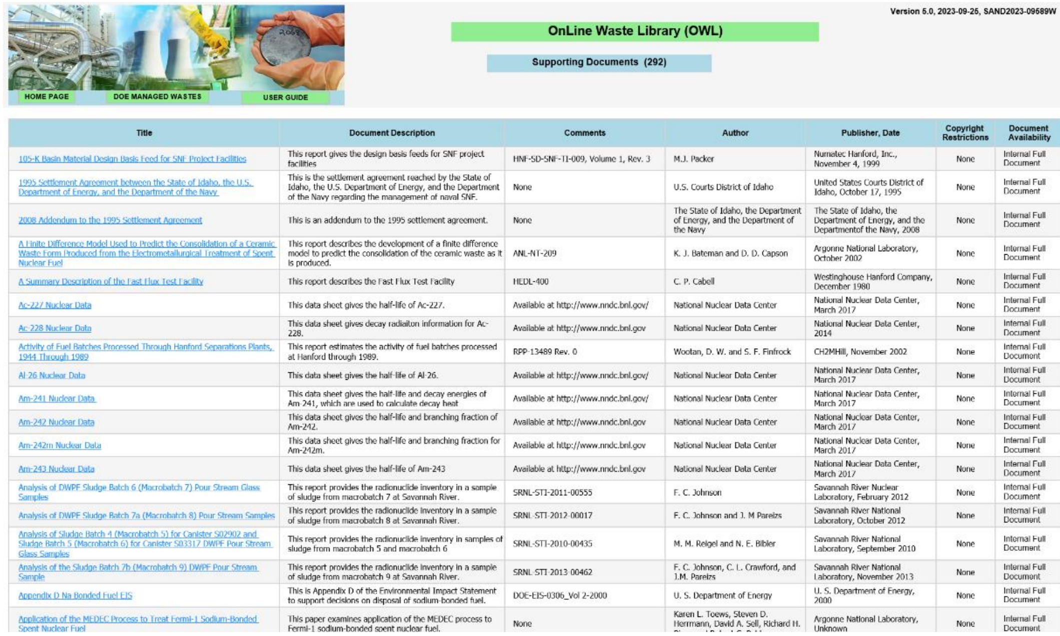
See a list of documents used to support the information in OWL?

Click on “Supporting Documents” from the home page. This will display a list of all the supporting documents found in OWL, along with a description of the document, any comments (such as report number), author(s), publisher, and date of publication. Clicking on the document title will open the document in a new browser window.

The supporting documents include technical reports; radionuclide data from the National Nuclear Data Center; government reports such as Records of Decision, Environmental Impact Statements, and planning documents; and documents that provide additional information that may be of interest to OWL users. Multiple versions of regularly updated reports are sometimes included to provide historical information and promote traceability. Documents that are not approved for public release are avoided to the extent possible.



then



HOME PAGE | DOE MANAGED WASTES | USER GUIDE

Version 5.0, 2023-09-25, SAND2023-09589W

OnLine Waste Library (OWL)

Supporting Documents (292)

Title	Document Description	Comments	Author	Publisher, Date	Copyright Restrictions	Document Availability
105-K Basin Material Design Basis Feed for SNF Project Facilities	This report gives the design basis feeds for SNF project facilities	HNF-SD-SNF-TI-009, Volume 1, Rev. 3	M.J. Packer	Numatec Hanford, Inc., November 4, 1999	None	Internal Full Document
1995 Settlement Agreement between the State of Idaho, the U.S. Department of Energy, and the Department of the Navy	This is the settlement agreement reached by the State of Idaho, the U.S. Department of Energy, and the Department of the Navy regarding the management of naval SNF.	None	U.S. Courts District of Idaho	United States Courts District of Idaho, October 17, 1995	None	Internal Full Document
2008 Addendum to the 1995 Settlement Agreement	This is an addendum to the 1995 settlement agreement.	None	The State of Idaho, the Department of Energy, and the Department of the Navy	The State of Idaho, the Department of Energy, and the Departmentof the Navy, 2008	None	Internal Full Document
A Finite Difference Model Used to Predict the Consolidation of a Ceramic Waste Form Produced from the Electrometallurgical Treatment of Spent Nuclear Fuel	This report describes the development of a finite difference model to predict the consolidation of the ceramic waste as it is produced.	ANL-NT-209	K. J. Bateman and D. D. Capson	Argonne National Laboratory, October 2002	None	Internal Full Document
A Summary Description of the Fast Flux Test Facility	This report describes the Fast Flux Test Facility	HEDL-400	C. P. Cabell	Westinghouse Hanford Company, December 1980	None	Internal Full Document
Ac-227 Nuclear Data	This data sheet gives the half-life of Ac-227.	Available at http://www.nndc.bnl.gov/	National Nuclear Data Center	National Nuclear Data Center, March 2017	None	Internal Full Document
Ac-228 Nuclear Data	This data sheet gives decay radiaiton information for Ac-228.	Available at http://www.nndc.bnl.gov	National Nuclear Data Center	National Nuclear Data Center, 2014	None	Internal Full Document
Activity of Fuel Batches Processed Through Hanford Separations Plants, 1944 Through 1989	This report estimates the activity of fuel batches processed at Hanford through 1989.	RPP-13489 Rev. 0	Wootan, D. W. and S. F. Finfrock	CH2MHill, November 2002	None	Internal Full Document
Al-26 Nuclear Data	This data sheet gives the half-life of Al-26.	Available at http://www.nndc.bnl.gov/	National Nuclear Data Center	National Nuclear Data Center, March 2017	None	Internal Full Document
Am-241 Nuclear Data	This data sheet gives the half-life and decay energies of Am-241, which are used to calculate decay heat	Available at http://www.nndc.bnl.gov/	National Nuclear Data Center	National Nuclear Data Center, March 2017	None	Internal Full Document
Am-242 Nuclear Data	This data sheet gives the half-life and branching fraction of Am-242.	Available at http://www.nndc.bnl.gov	National Nuclear Data Center	National Nuclear Data Center, March 2017	None	Internal Full Document
Am-242m Nuclear Data	This data sheet gives the half-life and branching fraction for Am-242m.	Available at http://www.nndc.bnl.gov	National Nuclear Data Center	National Nuclear Data Center, March 2017	None	Internal Full Document
Am-243 Nuclear Data	This data sheet gives the half-life of Am-243	Available at http://www.nndc.bnl.gov	National Nuclear Data Center	National Nuclear Data Center, March 2017	None	Internal Full Document
Analysis of DWPF Sludge Batch 6 (Macrobatch 7) Pour Stream Glass Samples	This report provides the radionuclide inventory in a sample of sludge from macrobatch 7 at Savannah River.	SRNL-STI-2011-00555	F. C. Johnson	Savannah River Nuclear Laboratory, February 2012	None	Internal Full Document
Analysis of DWPF Sludge Batch 7a (Macrobatch 8) Pour Stream Samples	This report provides the radionuclide inventory in a sample of sludge from macrobatch 8 at Savannah River.	SRNL-STI-2012-00017	F. C. Johnson and J. M Pareizs	Savannah River National Laboratory, October 2012	None	Internal Full Document
Analysis of Sludge Batch 4 (Macrobatch 5) for Canister S02902 and Sludge Batch 5 (Macrobatch 6) for Canister S03317 DWPF Pour Stream Glass Samples	This report provides the radionuclide inventory in samples of sludge from macrobatch 5 and macrobatch 6	SRNL-STI-2010-00435	M. M. Reigel and N. E. Bibler	Savannah River National Laboratory, September 2010	None	Internal Full Document
Analysis of the Sludge Batch 7b (Macrobatch 9) DWPF Pour Stream Sample	This report provides the radionuclide inventory in a sample of sludge from macrobatch 9 at Savannah River.	SRNL-STI-2013-00462	F. C. Johnson, C. L. Crawford, and J.M. Pareizs	Savannah River National Laboratory, November 2013	None	Internal Full Document
Appendix D Na Bonded Fuel EIS	This is Appendix D of the Environmental Impact Statement to support decisions on disposal of sodium-bonded fuel.	DOE-EIS-0306_Vol 2-2000	U. S. Department of Energy	U. S. Department of Energy, 2000	None	Internal Full Document
Application of the MEDEC Process to Treat Fermi-1 Sodium-Bonded Spent Nuclear Fuel	This paper examines application of the MEDEC process to Fermi-1 sodium-bonded spent nuclear fuel.	None	Karen L. Toews, Steven D. Herrmann, David A. Sell, Richard H.	Argonne National Laboratory, Unknown	None	Internal Full Document

The information available by clicking on each of the links under "Find Information About…" on the OWL home page is discussed below.

<u>DOE-Managed Wastes</u>

The information for each waste on this webpage includes its baseline inventory date, its classification (SNF, HLW, or TRU), a description of the waste, where it is stored, its current total volume, and its total radioactivity as of the baseline date. Clicking on the name of the waste opens a Waste Detail Report for that waste. This webpage reports whether the waste was produced by the government, whether it is a mixed waste, and its baseline inventory date, and contains links that present:

- A graphical representation of the projected inventory and thermal output of the waste over the next 200 years (Projected Inventory link)
- Waste Characteristics - thermal output, chemical constituents present, dimensions of the nuclear waste container, the number of containers of the waste, and the physical form of the waste
- Waste Source
- Disposal Waste Forms
- Disposal Waste Form Characteristics – thermal output, dimensions of the waste form, mass of the waste form
- Radionuclide Inventory – Activity (Curies) of each radionuclide reported or calculated to be present in the waste
- Radionuclide Characteristics – half-life and decay ratio (where applicable) for each radionuclide in the inventory for that waste

- Waste Supporting Documents – a list of all documents used as sources of information for that waste. Clicking on the title of a supporting document will open that document in a new window
- Waste Contacts – the name and contact information for a person who is knowledgeable about that waste.

Waste Forms

Each waste also has at least one “disposal waste form.” For some wastes, such as N-reactor spent fuel or Savanah River glass waste, the waste is intended to be disposed of without further treatment. Hence, the current waste is also the disposal waste form. For other wastes, such as the Hanford tank wastes, the current plan is to treat the waste prior to disposal. For these wastes, the current waste is not the disposal waste form, and possible waste forms are presented. For each disposal waste form, OWL indicates whether the waste form already exists or is planned, and whether the waste form has been declared by the DOE to be the preferred waste form or if it is an alternative to that preferred waste form. All wastes and their associated waste forms are available by clicking on “Waste Forms” on the home page.

Inventory Calculator

Clicking on “Inventory Calculator” from the home page opens a page that gives the radionuclide inventory and thermal output of each waste as of its baseline date and allows the user to calculate the inventory and thermal output at a user-specified year. The selection pane for the parameters for the calculation is on the right side of the page. You can select the waste classification (HLW, SNF, or TRU), a specific nuclear waste, a radionuclide, and a year. Click on the “Apply” button on the bottom of the right side of the page after selecting the desired parameters to generate the report. The selection pane on the right side of the page can be made to disappear by clicking on the triangle in the gray bar to the left of the selection pane. Assumptions that were made in calculating the inventory can be seen by clicking on “Assumptions for Calculating Projected Inventory” at the top of the Radionuclide Inventory Calculation page.

200-Year Inventory and Thermal Output

Clicking on “200-Year Inventory and Thermal Output” from the home page opens a page that gives a graphical representation of the inventory and thermal output of the user-selected waste and radionuclide over the next 200 years. The selection pane for the waste type and radionuclide is on the right side of the page. You can select a particular waste (or all of the wastes) and a particular radionuclide that is reported as having an initial inventory in a waste (or all of the radionuclides). Click on the “Apply” button on the bottom of the right side of the page after selecting the desired parameters to generate the report. The selection pane on the right side of the page can be made to disappear by clicking on the triangle in the gray bar to the left of the selection pane.

Baseline Radionuclide Inventory in Each Waste

Clicking on “Baseline Radionuclide Inventory in Each Waste” from the home page opens a page that gives the inventory of each radionuclide reported to be in each waste as of the baseline date for each waste. On the left side of the page the user can select wastes by facility or by classification and can select “all” radionuclides or a specific radionuclide.

Radionuclides

Clicking on “Radionuclides” from the home page opens a page that gives the following information for each radionuclide in the OWL database: name, half-life, atomic mass, thermal output (if applicable), its parent (if applicable), the inventory ratio with the parent (if applicable), and a link to the supporting document for some of the information for that radionuclide. You can filter the inventory displayed by selecting “Select All,” “No Inventory,” or “Has Inventory in Wastes” from the selection pane on the right side of the screen. In this context, “No Inventory” means that no initial inventory for the radionuclide was reported for any of the wastes but it is included in OWL for establishing radioactive decay chains. “Has Inventory in Wastes” means that some initial inventory for the radionuclide was reported for at least one of the wastes in OWL.

Supporting Documents

Clicking on “Supporting Documents” from the home page opens a page that lists the following information for the supporting documents in the OWL: title of the document, a description of the document, document number (if applicable), URL address (if applicable), the author, the publisher, the date and whether there are copyright restrictions. Clicking on the title of the document will open a new webpage displaying the document or will open a dialog box that allows the user to open the document, save the document, or save the document with another name.

Waste-Specific Spreadsheets

Each waste has a spreadsheet that gives the inventory and thermal output as of the baseline date and allows the user to calculate the inventory and thermal output as of a user-specified target date. Depending on the waste, spreadsheets may also have other information, such as the volume of the waste as currently stored. These spreadsheets are displayed in pdf format to allow users to view the spreadsheet without needing access to Excel™. If you would like the Excel™ version of the spreadsheet, please send an email to OWL@sandia.gov specifying which spreadsheet(s) you would like.

Access, Questions or Comments

If you would like access to OWL, or if you have any questions or comments, please send an email to OWL@sandia.gov.

Attachment B-1– Change History

On-Line Waste Library - Production Date: 9/25/2023, SAND2023-09589W

Changes for Version 5.0 - Major Update

Category	Change Title	Change Description
Errata	Correct errors identified in review of OWL Release Candidate 5.0	Several errors were identified in the review by OWL personnel of OWL Release Candidate 5.0 This Change Item tracks the tasks associated with making corrections.
Planned Work - New	Enhance OWL by developing a systematic approach to incorporating updates to existing information	Supporting documents provide traceability for data that have been entered into OWL. Some of the data, and the documentation for the data, will be periodically updated. This change will evaluate options for incorporation of these updates into OWL. The change will include both the evaluation and the implementation of the best option.

On-Line Waste Library - Production Date: 9/26/2022, SAND2022-12754W

Changes for Version 4.0 - Major Update

Category	Change Title	Change Description
Errata	Implement Enhancements from Tester Feedback Comments	Tester Feedback has identified typographical errors and enhancements to the description of the ER salt waste forms.
	Correct errors identified in reviews of the Release Candidate for OWL v4.0	This change will implement corrections to OWL required as a result of Tester Feedback provided from the independent review of Release Candidate V4.0 and errors discovered by OWL team reviews. The following Tasks have been completed to implement this change: Correct half-life of Po-212 in database; Add title page to Appendix_D_Na_Bonded_Waste_EIS.pdf; Correct File not found in Link by replacing the file in the RC with the correct file from development; Add message 'No Records Found' when search for Nuclear Wastes results in no records; Correct the field used to display the 'tool tip' of the Supporting Documents link in the Radionuclide report.
Planned Work - New	Add Notes To Explain Setting Very Small Amounts to Zero	When the amount (curies or gm) of a radionuclide falls below a threshold, the OWL value is set to zero. It is confusing when a radionuclide is included in the inventory for a particular waste form but has 0 curies or gm. Notes will be added in the affected SSRS reports to explain the situation and direct the user to the supporting document with the correct number.
	Add radionuclides to OWL to support Pflotran decay chains	Add radionuclides to OWL to support decay chains used in Pflotran analyses. The following radionuclides have been added - Bi212, Pb212, Po216, Ra224, Rn220, Pu243, Np240, U240, Ac228, Bi214, Pb214, Po214, Po218, Rn222, Pa234, Th234, Po212.
Planned Work - Revisions	Improve display of projected inventory of Pa-233	The half-life for Pa-233 is 26.975 Days, but the inventory remains constant throughout the 200 year projection that is displayed. The reason for this is that Pa-233 is in secular equilibrium with Np-237 and the half-life of Np-237 is 2,144,000 years. It would help the user to have this information displayed along with the graph. This change should also be implemented in other cases where secular equilibrium is involved. The priority for this change is low becuase this is not an error. This is an opportunity for improvement to assist the users.

On-Line Waste Library - Production Date: 11/18/2021, SAND2021-14487W
Changes for Version 3.0 - Major Update

Category	Change Title	Change Description
Errata	Correct Erratum Identified in the Inventory Calculator	The Inventory Calculator report has a default projected date of 2021. When you open the report the values for Cm-242 in Calcine waste are Baseline = 1.84E+000 curies & Projected = 2.57E+004 curies. Hanford HLW Baseline = 1.20E+002 curies & Projected = 2.88E+004 curies. Hanford RH-TRU Baseline = 1.11E+000 curies & Projected = 7.00E+003 curies. Hanford CH-TRU Baseline = 3.96E-002 curies & Projected = 7.43E+001 curies. The baseline inventory values are correct but the projected values cannot be correct. The source of the error is unclear, but it is noted that in each of these cases the parent Rn - Am-242m is absent from the waste inventory. The problem may be with the stored calculation tool for this SSRS report.
Planned Work - New	Add Sodium-Bonded Spent Fuel Waste Type and Waste Forms to OWL	Add information regarding sodium-bonded spent fuel, its quantities, planned treatments, and current status to the OWL database.
Planned Work - Revisions	Modify 200-Year Inventory and Thermal Graphs	Implement improvements to the 200-year inventory and thermal graphs, per the discussion during the OWL teleconference on October 20, 2020.

On-Line Waste Library - Production Date: 11/13/2020, SAND2020-12464W

Changes for Version 2.0 - Major Update

Category	Change Title	Change Description
Errata	Fix Typo on Production SharePoint Site Home Page	On the Production SharePoint Site home page in the announcement identifying recommended browsers, "Flrefox" should be "Firefox". Note also that in the first announcement "initial" is spelled "intial". However, that error does not need fixing since the first opportunity to fix it (i.e., during release of OWL version 2.0) is also when the announcement will be deleted because it will be out of date. Note that the task to fix this typo cannot be done until the Production SharePoint Site is updated during the release process.
	Correct Error on Thermal Graph for Cs-137 and Pu-238 in Hanford Tank Waste (CH-TRU)	In the 200 Year Inventory and Thermal Output report, when Cs-137 or Pu-238 and Hanford Tank Waste (CH-TRU) are selected, the thermal graph comes up with an error – “Axis Object – auto Interval doesn’t have proper value.”
	Identify secular equilibrium between Pa-233 and Np-237 as well as between Th-231 and U-235.	The decay calculations for Pa-233 and Th-231 should reflect that Pa-233 is in secular equilibrium with Np-237 and that Th-231 is in secular equilibrium with U-235. This can be fixed in the database. Pa-233 and Th-231 are not important radionuclides, so the impact of this error is insignificant.
	Update the total radioactivity for the Hanford Cesium and Strontium Capsules	Modify the total radioactivity for the Hanford Cesium and Strontium Capsules to reflect appropriate significant figures. The current value of 93,575,237.7 Curies will be changed to 93,600,000 Curies.
	Change INEEL identification to INL	"Idaho National Engineering and Environmental Laboratory (INEEL)" became "Idaho National Laboratory (INL)" in 2005 after consolidation, so all instances of INEEL should be changed to INL.
	Correct Barium-137 metastable designation	The designation for Barium-137 metastable should be changed from Ba 137-m to Ba-137m in dbo.RadioNuclide in the database.
	Fix 200-Year Inventory and Thermal Output Report	In the 200 Year Inventory and Thermal Output report, the thermal output for Cm-244 is not shown. According to the Radionuclide Inventory Calculator, though, this radionuclide does produce heat. The fix may involve simply re-running a stored calculation.

Planned Work - Revisions	Move Sand Number next to Release	Sand Number is related to the Release, move it next to Release on Home Page and on SSRS reports
	Link Liquid Waste Plans Revs. 17, 19, and 21 to Savannah River Tank Waste	Three SRS Liquid Waste System Plans (Revs. 17, 29, and 21) are in the list of Supporting Documents but are not linked to Savannah River Tank Waste, so that when a user looks at the Supporting Documents for the SR Tank Waste, these three documents do not appear. They do not support any data directly, but provide background information.
	Delete "Idaho National Lab - Navy" from the Baseline Radionuclide Inventory in Waste SSRS report	Change how the drop-down list is generated so that "Idaho National Lab - Navy" does not appear.

On-Line Waste Library - Production Date: 9/30/2019, SAND2019-11783W

Changes for Version 1.0 - Initial Release

No Changes - Initial Release

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