Radioactive Waste Shipments to Hanford Retrievable Storage from Babcock and Wilcox, Leechburg, Pennsylvania

Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

Westinghouse
Hanford Company Richland, Washington

Hanford Operations and Engineering Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

Approved for Public Release

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

RECEIVED
APR 18 1994
OSTI

LEGAL DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

This report has been reproduced from the best available copy. Available in paper copy and microfiche.

Available to the U.S. Department of Energy
and its contractors from
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831
(615) 576-8401

Available to the public from the U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
(703) 487-4650

Printed in the United States of America

DISCLM-1.CHP (1-91)

Radioactive Waste Shipments to Hanford Retrievable Storage from Babcock and Wilcox, Leechburg, Pennsylvania

D. R. Duncan

Date Published
February 1994

Prepared for the U.S. Department of Energy
Office of Environmental Restoration and Waste Management

**Westinghouse
Hanford Company**

P.O. Box 1970
Richland, Washington 99352

Hanford Operations and Engineering Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

Approved for Public Release

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

87B

RELEASE AUTHORIZATION

Document Number: WHC-EP-0719

Document Title: Radioactive Waste Shipments to the Hanford Site
Retrievable Storage from Babcock and Wilcox,
Leechburgh, Pennsylvania

Release Date: February 14, 1994

**This document was reviewed following the
procedures described in WHC-CM-3-4 and is:**

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist: MN Boston

M. Boston

(Signature)

February 14, 1994

(Date)

ACKNOWLEDGEMENTS

The following people generously shared their time and knowledge of Babcock and Wilcox's solid waste generation:

W. J. Ross, Babcock and Wilcox Nuclear Environmental Services, Inc.
M. Straub, Babcock and Wilcox Nuclear Environmental Services, Inc.
G. W. Vigna, B&W Nuclear Environmental Services, Inc.
F. F. Walters, Westinghouse Hanford Company
J. D. Anderson, Westinghouse Hanford Company
M. N. Serier, Westinghouse Hanford Company
M. L. Sheriff, Westinghouse Hanford Company

Also, thanks are due to S. L. Galstad and S. L. Claybrook for their assistance with the Solid Waste Information and Tracking System database and Solid Waste Burial Records.

This page intentionally left blank.

**RADIOACTIVE WASTE SHIPMENTS TO THE HANFORD SITE
RETRIEVABLE STORAGE FROM BABCOCK AND WILCOX,
LEECHBURG, PENNSYLVANIA**

D. R. Duncan

ABSTRACT

This report characterizes, as far as possible, the solid radioactive wastes generated by Babcock and Wilcox's Park Township Plutonium Facility near Leechburg, Pennsylvania that were sent to retrievable storage at the Hanford Site. Solid waste as defined in this document is any containerized or self-contained material that has been declared waste. The objective is a description of characteristics of solid wastes that are or will be managed by the Restoration and Upgrades Program; gaseous or liquid effluents are discussed only at a summary level. This characterization is of particular interest in the planning of transuranic (TRU) waste retrieval operations, including the Waste Receiving and Processing (WRAP) Facility, because Babcock and Wilcox generated greater than 2.5 percent of the total volume of TRU waste currently stored at the Hanford Site.

This page intentionally left blank.

EXECUTIVE SUMMARY

During the next two decades the transuranic (TRU) wastes now stored in the burial trenches and storage facilities at the Hanford Site are to be retrieved, processed at the Waste Receiving and Processing (WRAP) Facility, and shipped to the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico for final disposal. Approximately 2.5 percent of the TRU waste to be retrieved for shipment to WIPP was generated at the Babcock and Wilcox Plutonium Facility near Leechburg, Pennsylvania, and shipped to the Hanford Site for storage. The purpose of this report is to characterize these radioactive solid wastes using process knowledge, existing records, and oral history interviews.

The Plutonium Facility in Parks Township, PA began operations in 1960 under the ownership of the Nuclear Materials and Equipment Corporation (NUMEC). Atlantic Richfield Company bought NUMEC in 1967, then sold NUMEC in 1971 to Babcock and Wilcox. In December 1974, NUMEC was dissolved into Babcock and Wilcox. Section 2.0 provides further details of the physical plant, facility operations, facility history, and current status of the Babcock and Wilcox Plutonium Facility.

The solid radioactive wastes that were sent by Babcock and Wilcox to the Hanford Site were associated with the fabrication of $\text{PuO}_2\text{-UO}_2$ fuel rods and pellet stacks for the Fast Flux Test Facility (FFTF) cores 1, 2, 3, and 4 and the subsequent decontamination and cleanout activities. The types and estimated quantities of TRU waste resulting from these activities are discussed in detail in Section 3.0.

A detailed discussion of the packaging and handling procedures used for the Babcock and Wilcox transuranic wastes shipped to the Hanford Site are provided in Section 4.0.

Information on the radioactive wastes generated at Babcock and Wilcox can be found in a number of existing documents and databases. The most important of these are the Solid Waste Information and Tracking System (SWITS) database and Solid Waste Burial Records (SWBR). Facility personnel also provide excellent information about past waste generation and the procedures used to handle that waste. Section 5.0 was compiled using these sources to characterize the TRU waste generated at Babcock and Wilcox and sent to retrievable storage at the Hanford Site.

Between 1977 and 1983, 1,477 containers of radioactive solid waste generated at NUMEC and Babcock and Wilcox were shipped to the Hanford Site to be stored. These containers represent over 176,593 kilograms of waste occupying 443.6 m³ of space.

Section 5.0 provides an indepth look at this waste, including the following:

- Weight and volume of the waste
- Container types and numbers
- Physical description of the waste
- Radiological components
- Isotopes present in waste
- Hazardous constituents
- Current storage/disposal locations.

There are indications that shipments of transuranic wastes from NUMEC/Babcock and Wilcox to the Hanford Site occurred before 1977. Those wastes most likely were sent from Pennsylvania to Hanford Site facilities such as 234-5Z for assay. It is possible that these wastes are designated as coming from various facilities at the Hanford Site, because no waste burial records before 1977 list Babcock and Wilcox or NUMEC as a waste originator. It also is possible that waste before 1977 may have been shipped to the commercial nuclear waste disposal facility at the Hanford Site rather than the U.S. Department of Energy facility.

This page intentionally left blank.

CONTENTS

1.0 INTRODUCTION	1-1
1.1 PURPOSE	1-1
1.2 BACKGROUND	1-1
1.3 SOURCES	1-2
1.3.1 Documents That Describe Pertinent NUMEC and Babcock and Wilcox Processes	1-2
1.3.2 Documents That Describe Babcock and Wilcox Waste Packaging and Handling Procedures	1-2
1.3.3 Interviews	1-3
1.3.4 Characterization Data	1-3
1.3.5 Hazardous Waste Components	1-3
1.4 SCOPE	1-3
2.0 DESCRIPTION OF THE BABCOCK AND WILCOX'S PARK TOWNSHIP SITE PLUTONIUM FACILITY	2-1
2.1 LOCATION	2-1
2.2 PHYSICAL PLANT	2-2
2.3 OPERATIONS AT BABCOCK AND WILCOX	2-2
2.4 BABCOCK AND WILCOX PROCESS DESCRIPTIONS	2-2
2.4.1 Fabrication of Fuel Pellets	2-2
2.4.2 Recycle of Materials	2-4
2.4.3 Scrap Recovery	2-4
2.4.4 Analytical Chemistry	2-5
2.5 FACILITY HISTORY	2-6
2.6 CURRENT STATUS	2-7
3.0 WASTE GENERATION	3-1
3.1 TRANSURANIC WASTE GENERATED BY THE FABRICATION OF MIXED-OXIDE FUEL PINS	3-1
3.1.1 Drummed Dry Waste	3-2
3.1.2 Crated Dry Waste	3-3
3.1.3 Drummed Liquid Waste	3-4
3.2 TRANSURANIC WASTE GENERATED DURING DECONTAMINATION AND CLEANOUT	3-5
3.3 LOW-SPECIFIC-ACTIVITY WASTE GENERATED AT BABCOCK AND WILCOX	3-5
4.0 SOLID WASTE HANDLING PRACTICES AND PROCEDURES	4-1
4.1 HANDLING AND PACKAGING OF FUEL PIN FABRICATION WASTE	4-1
4.1.1 Handling and Packaging of Drummed Dry Waste	4-1
4.1.2 Crated Dry Waste	4-2
4.1.3 Drummed Liquid Wastes	4-2
4.2 HANDLING AND PACKAGING OF TRANSURANIC DECONTAMINATION AND DECOMMISSIONING WASTE	4-2
4.2.1 Repackaging of Waste	4-2
4.2.2 Gloveboxes and Special Equipment	4-3

CONTENTS (cont)

4.3 WASTE PACKAGING AND HANDLING REQUIREMENTS AT THE HANFORD SITE	4-3
5.0 CHARACTERIZATION OF RETRIEVABLY STORED SOLID WASTE GENERATED BY BABCOCK AND WILCOX	5-1
5.1 SUMMARY OF BABCOCK AND WILCOX WASTE GENERATION	5-1
5.1.1 Waste Stored in 55-Gallon Steel Drums	5-2
5.1.2 Waste Stored in Containers Other Than 55-Gallon Steel Drums	5-3
5.1.3 Summary of Waste Generation Rates at Babcock and Wilcox	5-3
5.2 WASTE CONTAINERS	5-4
5.3 TRANSURANIC WASTE STORAGE LOCATIONS	5-4
5.4 PHYSICAL CONTENTS OF TRANSURANIC WASTE CONTAINERS	5-4
5.5 RADIOLOGICAL DESCRIPTION OF BABCOCK AND WILCOX SOLID WASTE	5-5
5.6 RADIOACTIVE ISOTOPES PRESENT IN BABCOCK AND WILCOX SOLID WASTE	5-6
5.6.1 Plutonium	5-6
5.6.2 Uranium	5-6
5.6.3 Americium	5-6
5.7 HAZARDOUS CONSTITUENTS OF SOLID WASTE GENERATED BY BABCOCK AND WILCOX	5-6
5.7.1 Solid Waste Information and Tracking System	5-6
5.7.2 Burial Records	5-7
5.7.3 Interviews with Babcock and Wilcox Facility Personnel	5-7
5.7.4 Hazardous Constituent Used in Babcock and Wilcox Facility Process	5-7
6.0 REFERENCES	6-1

CONTENTS (cont)

APPENDIXES:

A	DATA ON BABCOCK AND WILCOX WASTE GENERATION FROM THE SOLID WASTE INFORMATION TRACKING SYSTEM	A-1
A.1	CONTAINER NUMBER AND WEIGHT OF TRANSURANIC WASTE IN FIFTY-FIVE-GALLON DRUMS BY WASTE TYPE	A.1-1
A.2	BABCOCK AND WILCOX TRANSURANIC WASTE CONTAINERS SORTED BY CONTAINER DESCRIPTION, SIZE, YEAR, AND PRIMARY WASTE TYPE	A.2-1
A.3	RADIOLOGICAL DATA FOR TRANSURANIC WASTE CONTAINERS SORTED BY DATE, PRIMARY WASTE TYPE, AND STORAGE FACILITY	A.3-1
A.4	PHYSICAL CONTENTS DESCRIPTION FOR BABCOCK AND WILCOX FIFTY-FIVE-GALLON DRUMS CONTAINING TRANSURANIC WASTE SORTED BY DATE, PRIMARY WASTE TYPE, AND STORAGE FACILITY	A.4-1
A.5	PHYSICAL CONTENTS DESCRIPTION FOR BABCOCK AND WILCOX TRANSURANIC WASTE CONTAINERS OTHER THAN FIFTY-FIVE-GALLON DRUMS SORTED BY DATE, PRIMARY WASTE TYPE, AND STORAGE FACILITY	A.5-1
A.6	HAZARDOUS CONSTITUENTS OF FIFTY-FIVE-GALLON DRUMS CONTAINING TRANSURANIC WASTE	A.6-1
A.7	HAZARDOUS CONSTITUENTS OF TRANSURANIC WASTE CONTAINERS OTHER THAN FIFTY-FIVE-GALLON DRUMS	A.7-1
A.8	ISOTOPES LISTED IN FIFTY-FIVE-GALLON DRUMS CONTAINING TRANSURANIC WASTES	A.8-1
A.9	ISOTOPES LISTED IN TRANSURANIC CONTAINERS OTHER THAN FIFTY-FIVE-GALLON DRUMS	A.9-1
B	BABCOCK AND WILCOX WASTE SUMMARY TABLE	B-1

This page intentionally left blank.

LIST OF FIGURES

2-1	Layout of the Babcock and Wilcox Facility	2-8
2-2	Diagram of Fuel Fabrication Process	2-9
2-3	Plutonium Scrap Recovery Process	2-10
3-1	Volumetric Distribution of Constituents in Generated Line Wastes from the Production of Fuel Pins for Cores 1 and 2	3-6
3-2	Plutonium Distribution Among Constituents of Lines Wastes Generated	3-7
4-1	Plutonium Facility Materials Control and Accountability Burial Shipment Checklist	4-6
4-2	Plutonium Facility Materials Control Box or Drum Checklist	4-7
4-3	Burial Shipment Checklist	4-8
5-1	Number of Transuranic Fifty-Five-Gallon Drums Shipped to the Hanford Site by Babcock and Wilcox by Year	5-9
5-2	Weight of Transuranic Fifty-Five-Gallon Drums Shipped to the Hanford Site by Babcock and Wilcox by Year	5-10
5-3	Volume of Transuranic Fifty-Five-Gallon Drums Shipped to the Hanford Site by Babcock and Wilcox by Year	5-11
5-4	Number of Transuranic Other Containers Shipped to the Hanford Site by Babcock and Wilcox by Year	5-12
5-5	Weight of Transuranic Other Containers Shipped to the Hanford Site by Babcock and Wilcox by Year	5-13
5-6	Volume of Transuranic Other Containers Shipped to the Hanford Site by Babcock and Wilcox by Year	5-14
5-7	Total Number of Transuranic Waste Containers Shipped to the Hanford Site by Babcock and Wilcox by Year	5-15
5-8	Total Weight of Transuranic Waste Containers Shipped to the Hanford Site by Babcock and Wilcox by Year	5-16
5-9	Total Volume of Transuranic Waste Containers Shipped to the Hanford Site by Babcock and Wilcox by Year	5-17

LIST OF FIGURES (cont)

5-10	Metal Box Storage on Asphalt Pad Transuranic Retrievable Storage Burial Ground 4C 200 West Area	5-18
5-11	Grams of Transuranic Shipped to the Hanford Site	5-19

LIST OF TABLES

2-1	Gloveboxes and Hoods in Each Fabrication Area	2-11
3-1	Volume and Disposition of Cores 1 and 2 Generated Wastes	3-8
3-2	Plutonium Concentration in Wastes Generated by Cores 1 and 2 Work, g/m ³	3-9
3-3	Cores 1 and 2 Waste Shipped to Retrievable Storage, m ³ , and Incremental Percent (%) of Pu Loss (X.XX)	3-10
3-4	Scrap and Combined Waste Constituents for Drummed Dry Waste Generated During Cores 1 and 2 Work	3-11
3-5	Average Composition of Analytical Laboratory Liquid Wastes from Cores 1 and 2	3-12
3-6	Transuranic Waste Shipments to Richland, Washington	3-13
4-1	Transuranic Storage Requirements for the Hanford Site	4-9
5-1	Transuranic Waste Generated at Babcock and Wilcox by Container Type and Year	5-20
5-2	Babcock and Wilcox Waste Summary Data for Fifty-Five-Gallon Drums	5-22
5-3	Babcock and Wilcox Waste Summary Data for Containers Other Than 55-Gallon Drums	5-23
5-4	Babcock and Wilcox Transuranic Waste in Fifty-Five-Gallon Drums--Drum Count by Storage Location	5-24
5-5	Babcock and Wilcox Transuranic Waste in Containers Other Than Fifty-Five-Gallon Drums--Container Count by Storage Location	5-24
5-6	Distribution and Percentage of Transuranic Fifty-Five-Gallon Drum Physical Contents by Storage Location--218-W-4C	5-25
5-7	Distribution and Percentage of Transuranic Containers Other Than Fifty-Five-Gallon Drum Physical Contents by Storage Location--218-W-4C	5-26
5-8	Babcock and Wilcox Transuranic Waste in Fifty-Five-Gallon Drums--Total Grams Transuranic by Storage Location	5-27
5-9	Babcock and Wilcox Transuranic Waste in Containers Other Than Fifty-Five-Gallon Drums--Total Grams Transuranic by Storage Location	5-27

LIST OF TABLES (cont)

5-10	Fifty-Five-Gallon Drum Waste from Babcock and Wilcox Containing Greater than 175 Grams Transuranic	5-27
5-11	Other Container Waste from Babcock and Wilcox Containing Greater than 175 Grams Transuranic	5-28
5-12	Summary of Information from Solid Waste Storage Disposal Records for TRU Wastes with Hazardous Contents from Babcock and Wilcox	5-28

LIST OF TERMS

AEC	Atomic Energy Commission
ARCO	Atlantic Richfield Company
D&D	Decontamination and Decommissioning
DOE	U. S. Department of Energy
DOT	U. S. Department of Transportation
Ecology	Washington State Department of Ecology
EPA	U. S. Environmental Protection Agency
FFTF	Fast Flux Test Facility
HEDL	Hanford Engineering Development Laboratory
HEPA	High Efficiency Particulate Air Filter
IAD	Immediate Action Directive
LLW	low-level waste
LSA	low specific activity
MW	mixed waste
NRC	Nuclear Regulatory Commission
NUMEC	Nuclear Materials and Equipment Corporation
O/M	oxygen-to-metal
PVC	polyvinyl chloride
R-SWIMS	Richland Solid Waste Information Management System
R&D	research and development
RCRA	<i>Resource Conservation and Recovery Act of 1976</i>
SDAR	Storage/Disposal Approval Record
SR	scrap recovery
SWBR	Solid Waste Burial Record
SWITS	Solid Waste Information and Tracking System
SWSDR	Solid Waste Storage and Disposal Record
TRU	transuranic
VAT	valence adjustment tanks
Westinghouse Hanford	Westinghouse Hanford Company
WIPP	Waste Isolation Pilot Plant
WRAP	Waste Receiving and Processing Facility

This page intentionally left blank.

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this report is to characterize, as far as possible, the solid radioactive wastes generated by Babcock and Wilcox's Park Township Plutonium Facility near Leechburg, Pennsylvania that were sent to retrievable storage at the Hanford Site. Solid waste as defined in this document is any containerized or self-contained material that has been declared waste. The objective is a description of characteristics of solid wastes that are or will be managed by the Restoration and Upgrades Program; gaseous or liquid effluents are discussed only at a summary level. This characterization is of particular interest in the planning of transuranic (TRU) waste retrieval operations, including the Waste Receiving and Processing (WRAP) Facility, because Babcock and Wilcox generated greater than 2.5 percent of the total volume of TRU waste currently stored at the Hanford Site.

1.2 BACKGROUND

Since 1944, the production of defense-related materials at the Hanford Site and other offsite locations has generated radioactive wastes. The bulk of these wastes have been disposed of or stored in the 200 East and 200 West Areas burial grounds and waste storage facilities.

Between 1944 and 1970, both TRU and low-level wastes (LLW) were disposed of in shallow land trenches, with no attempt to segregate these materials by their chemical or radioactive natures. In 1970, the Atomic Energy Commission (AEC), now the U.S. Department of Energy (DOE), directed that AEC sites segregate "waste with known or detectable contamination of transuranium nuclides" from other waste types (*Immediate Action Directive 0511-21* (Appendix A in Duncan 1991)). Transuranic radionuclides are those with an atomic number greater than 92. The AEC further directed that these wastes be packaged and stored as contamination-free packages for at least 20 years. The 20-year interim storage period was to allow time to study permanent disposal options for TRU contaminated wastes.

The Immediate Action Directive (IAD) did not provide a detailed definition for TRU waste in 1970. AEC contractors implemented the IAD to the best of their ability with the instrumentation then available. In 1973, the *Atomic Energy Commission Manual* (AEC 1973) further defined TRU waste as material contaminated with certain alpha-emitting radionuclides with half-lives greater than 20 years, and activity greater than 10 nCi/g. The radionuclides included were ^{233}U and its daughter products as well as Pu and transplutonium nuclides, with the exception of ^{238}Pu and ^{241}Pu . In 1982, the TRU waste segregation limits were raised to 100 nCi/g, including ^{238}Pu and ^{241}Pu , as stated in DOE Order 5820.1, *Management of Transuranic Material* (DOE 1982).

In addition to radioactive materials, a wide variety of chemicals can be found in the solid wastes that are stored or disposed of at the Hanford Site. Many of these chemicals currently are classified as dangerous or hazardous by the U. S. Environmental Protection

Agency (EPA) and the Washington State Department of Ecology (Ecology). When dangerous or hazardous wastes are found in radioactive wastes, they are termed mixed wastes (MW).

When much of the MW now located at the Hanford Site was generated, there were no definitions or regulations governing the storage, disposal, or documentation of MW. In 1987, DOE issued a mixed byproduct ruling (52 FR 15937) stating that the hazardous components of mixed waste are regulated by the *Resource Conservation and Recovery Act of 1976* (RCRA). In November 1987, EPA authorized Ecology to regulate the hazardous constituents of MW at the Hanford Site (40 CFR 265).

During the next two decades the TRU waste now stored in the burial trenches and storage facilities is to be retrieved, processed at the WRAP Facility, and shipped to the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico for final disposal. Approximately 2.5 percent of the total volume of TRU waste to be retrieved for shipment to WIPP was generated by Babcock and Wilcox and transported to the Hanford Site for interim storage.

1.3 SOURCES

Data for this study were compiled from a variety of sources. Each of the major sources is listed below with a few explanatory notes. Greater detail on each of the data sources can be found in the body of this document as the information from each is discussed.

1.3.1 Documents That Describe Pertinent NUMEC and Babcock and Wilcox Processes

Documents that describe pertinent Babcock and Wilcox processes, including the *Waste Generated During Fabrication of Mixed Oxide Nuclear Fuels* (Bradley and Clark 1978) and *Technical Data Summary Report on Decontamination and Removal of Equipment in the Parks Township Site Plutonium Facility* (Babcock and Wilcox 1983) were used to determine the solid wastes that were generated at Babcock and Wilcox and sent for storage at the Hanford Site.

1.3.2 Documents That Describe Babcock and Wilcox Waste Packaging and Handling Procedures

Documents that describe Babcock and Wilcox Waste Packaging and Handling Procedures, including the *Hanford Site Radioactive Solid Waste Acceptance Criteria* (Willis and Triner 1990), were used to describe packaging and handling practices.

1.3.3 Interviews

Interviews with former Babcock and Wilcox personnel at the Parks Township, PA site were used to gather information regarding unusual waste contents and historical waste-handling and packaging procedures.

1.3.4 Characterization Data

Characterization data were primarily derived from the *Solid Waste Information and Tracking System* (SWITS) database. The SWITS database was created in 1991, primarily with the solid waste data from the Richland Solid Waste Information Management System (R-SWIMS). The SWITS database contains information about radioactive wastes, both TRU and LLW, buried or stored in the 200 Areas since 1970. Data in SWITS were originally taken from *Solid Waste Burial Records* (SWBR) and their replacements, the *Solid Waste Storage and Disposal Records* (SWSDR). Both SWBRs and SWSDRs, which will be jointly referred to as 'burial records' in this document, often contain supplementary forms such as shipment manifests, Nuclear Regulatory Commission (NRC) 741 Forms, etc.

1.3.5 Hazardous Waste Components

Hazardous waste components were determined using information from the SWITS database, SWBRs, SWSDRs, and personnel interviews. Additional information was obtained from *Unstable and Reactive Chemicals in Transuranic Retrievable Waste at the Hanford Site*, WHC-EP-0603 (Reddinger 1992) and an internal report examining hazardous components of solid waste.

1.4 SCOPE

The major sections of this document and the topics they cover are outlined briefly below. Because of the number of tables and figures included in this report, they appear at the end of each section.

Section 2.0 provides a brief description of the NUMEC and Babcock and Wilcox physical plant and the operations that occurred there. A short history of the significant Babcock and Wilcox operations that generated the solid wastes transported to the Hanford Site for storage follows this description.

Section 3.0 identifies the Solid Waste Streams that arose from pertinent Babcock and Wilcox activities. The types and amounts of solid waste that may have been generated from each waste stream are estimated.

Section 4.0 discusses the waste-handling and packaging procedures used for Babcock and Wilcox wastes shipped to the Hanford Site. Historical changes in waste handling, packaging, and recordkeeping also are reviewed in this section.

Section 5.0 contains the results of a search for actual waste container data. The search included database searches, literature review, and personnel interviews. This section describes what is known about the physical, radiological, and hazardous characteristics of the radioactive solid waste from Babcock and Wilcox.

Section 6.0 lists the references used in this report.

2.0 DESCRIPTION OF THE BABCOCK AND WILCOX'S PARK TOWNSHIP SITE PLUTONIUM FACILITY

The Parks Township Site Plutonium Facility began operations in 1960, when it was owned and operated by Nuclear Materials and Equipment Corporation (NUMEC). In April 1967, NUMEC became a wholly owned subsidiary of the Atlantic Richfield Company (ARCO) which sold the company to Babcock and Wilcox in November 1971. Babcock and Wilcox merged NUMEC into itself in late 1974. In many of the documents dating back to the mid- to late-1970's, the NUMEC name is used instead of, or in addition to, Babcock and Wilcox.

The wastes that were sent to the Hanford Site from the Plutonium Facility were generated during the fabrication of $\text{PuO}_2\text{-UO}_2$ fuel rods and pellet stacks for the Fast Flux Test Facility (FFTF) and the subsequent decontamination and cleanout activities. The FFTF, the first step in the Liquid Metal Breeder Reactor Program, is a sodium-cooled experimental breeder reactor located at the Hanford Site in Washington State. The Parks Township Plutonium Facility fabricated some of the fuel pins for cores 1 and 2 (Kerr-McGee, Crescent, Oklahoma, provided the rest) and all of the fuel pins for cores 3 and 4.

Some of the TRU wastes generated at the Parks Township site were sent to the Hanford Site for Pu scrap recovery, while the remainder of the TRU waste was placed in retrievable storage. Transuranic wastes were generated by NUMEC as early as 1972; however, the waste designated in the SWITS database does not list Babcock and Wilcox as a generator until 1981. The wastes shipped to the Hanford Site before 1981 often were redesignated as coming from the onsite facility where the waste had been received or assayed. In some cases, particularly waste generated before 1977, it may not be possible to accurately determine where waste shipped from Babcock and Wilcox can be found in the 200 Areas burial grounds. Alternately, waste may have been shipped to the commercial nuclear waste disposal facility at the Hanford Site (now operated by U.S. Ecology). There is documentation for waste shipments in 1974 to 1979 from NUMEC and Babcock and Wilcox to the commercial waste disposal facility, but records are incomplete.

2.1 LOCATION

Babcock and Wilcox's former Plutonium Facility is situated on a 69 acre tract located in Parks Township at the southwestern edge of Armstrong County in southwestern Pennsylvania. The site is on Pennsylvania State Highway Route 66, North, between Leechburg and North Vandergrift, near the intersection with Kiskimere Road. It is bordered on the northwest by the Kiskiminetas River. The town of North Vandergrift is 1.8 miles southeast of the site. Pittsburgh is 23 air miles to the southwest.

The Parks Township site is located in one of the narrow valleys characteristic of the Appalachian Plateau Province. The site area is a narrow, relatively flat river plain surrounded by rolling ridges. The highest land point near the site is a 122-meter- (400-foot-) high ridge approximately 1.6 km (1 mile) east.

2.2 PHYSICAL PLANT

The Babcock and Wilcox Parks Township Site Plutonium Facility is a three-story building of approximately 6,975 m² (75,000 ft²). The facility consists of nine fabrication areas, a hot cell, and administrative office areas. Additionally, the facility contains two sintering furnaces; numerous smaller conversion, presintering, drying, vacuum-outgassing and oxidation/reduction muffle-type furnaces; and analytical laboratory equipment and apparatus. Figure 2-1 provides a layout of the Babcock and Wilcox Facility.

The plant contained approximately 95 gloveboxes and hoods used to support the activities listed below in Section 2.3. Table 2-1 lists the number of gloveboxes and hoods in each fabrication area and provides a general description of their use. The gloveboxes and hoods shown include both TRU and non-TRU contaminated enclosures. This table also provides approximate sizes of each fabrication area (Babcock and Wilcox 1983).

2.3 OPERATIONS AT BABCOCK AND WILCOX

The activities performed at Babcock and Wilcox during the period when the waste sent to the Hanford Site was generated included the following:

- Manufacture of fuel for the FFTF
- Scrap recovery and conversion of $\text{Pu}(\text{NO}_3)_6$ to PuO_2
- Analytical and quality control operations
- Research and development (R&D) activities
- Handling of radioactive by-product source materials
- Fuel storage and shipping.

2.4 BABCOCK AND WILCOX PROCESS DESCRIPTIONS

The various processes involved in the fabrication of mixed-oxide fuel, which resulted in the generation of wastes that were sent to the Hanford Site, are described in this section.

2.4.1 Fabrication of Fuel Pellets

A flow diagram of the fuel fabrication process used at Babcock and Wilcox is shown in Figure 2-2. All line operations were performed in the controlled glovebox containments. The usual bag-in and bag-out operations were used to introduce working materials into the glovebox line and to remove finished products, wastes, etc. Line-generated wastes were bagged out in approximately 6-L (1.6-gal) paper cartons that were assayed individually with a lithium-drifted germanium (GeLi) counting system and packaged in 55-gal steel drums (21 cartons per drum).

PuO_2 was received from offsite suppliers in sealed cans. The PuO_2 was stored until it could be introduced to the process area where it was weighed, randomly sampled, and analyzed. The PuO_2 was calcined in a dry-air atmosphere at 825 °C for one hour,

ballmilled at 70 rpm with approximately 1.3-cm (.5-in.) tungsten carbide balls, sieved through a 170 mesh screen, and then blended in a liquid-solids V-blender. Blended 20-kg (44-lb) lots were used for subsequent processing.

The blended PuO_2 powder was mixed with UO_2 obtained from natural U ore or from depleted U stock having an isotopic composition of less than 0.3 percent ^{235}U . This mixture plus recycled mixed-oxide powder, if added, was blended in a liquid-solids model V-blender using a three-stage blending cycle. The blended batch was fed by a belt feeder into a fluid-energy jet mill for additional blending to ensure microhomogeneity. After jet milling, the mixed-oxide powder was sieved through 60-mesh screens, then was lot-blended in a V-blender.

A burnable organic binder was added to the mixed-oxide lot for controlling the density of the sintered pellets. A V-blender was used to blend the organic binder and mixed-oxide powder that were then slugged or compacted in a 20-ton, single-punch automatic press to a nominal density of 45 percent of theoretical. The slugs were broken mechanically into dense particles by treatment, in a coarse and then a fine granulator, respectively, and the granules screened into -20-mesh size fractions. The granules in these fractions were V-blended with Sterotex^{*} or Carbowax^{**} die lubricant and, using a dual-cavity compacting press, were pressed into cylindrical pellets with a density of 55 to 60 percent of theoretical.

A presintering procedure was used to reduce the oxygen-to-metal ratio of the fuel and to destroy the organic additives. This operation consisted of presintering the pellets in a batch-type electric furnace at 850 °C for 2 hours in a reducing gas mixture of Ar - 8% H_2 . Next, the pellets were sintered in a continuous production-type electric furnace at 1500 to 1700 °C for 4 to 10 hours in the reducing atmosphere of Ar - 8% H_2 . Following this process the final oxygen to metal ratio was less than 1.940.

Any mixed-oxide pellets that were oversized were centerless ground to the correct diameter, $.4940 \pm .0038$ cm (0.1945 ± 0.0015 in.). Most of the centerless grinding was done under dry conditions, superseding the earlier operation, shown in Figure 2-2, in which wet grinding was followed by washing and drying steps.

The pellets were inspected and, if necessary, vacuum degassed at 750 °C for 2 hours. The certified pellets were loaded into fuel stacks and sealed in the fuel pins. The loaded fuel pins were decontaminated by making repeated wipes with cotton swabs and methyl alcohol (Bradley and Clark 1978).

^{*}Sterotex is a trademark of Capital City Products Company.

^{**}Carbowax is a trademark of Union Carbide Corporation.

2.4.2 Recycle of Materials

The fuel fabrication line operations generated some clean, dry recyclable material that could be treated to obtain acceptable forms that were added to the mixed-oxide feed lots. Both sintered (hard) and unsintered (green) materials were processed through the recycle operation.

The recycled sintered powder and/or pellets were first screened through a 16-mesh screen. The +16 fraction was oxidized in air at 850 °C for 2 hours and then reduced in Ar - 8% H₂ (or N₂ - 8% H₂) at 850 °C for 1 hour. The material was screened again through a 16-mesh screen. The +16-mesh material was either recycled through the oxidation/reduction stages or it was crushed and then recycled. The -16-mesh material from both before and after oxidation/reduction was ballmilled for 8 hours, then was screened through a 100-mesh screen. The +100-mesh material was recycled through the ballmilling stage, while the -100-mesh material was used in the recycle powder blends prepared before jet milling (Figure 2-2).

Green recycle material was processed in the same manner as the hard material except that an additional organic removal step was required in the initial stage (Bradley and Clark 1978).

2.4.3 Scrap Recovery

The flow sheet for scrap recovery is shown in Figure 2-3. After assay, the assorted scrap materials were introduced into the scrap recovery receiving glovebox and placed in special 'charge bottles.' The scrap powder was charged into a geometrically safe dissolve and treated by refluxing with 10M HNO₃ containing 0.1% HF for approximately 4 hours. After cooling and settling, the dissolver solutions were vacuum transferred through a filter to the valence adjustment tanks (VAT) in a second glovebox. A new preweighed scrap charge and fresh acids were introduced into the dissolver and the cycle was repeated until the residue (heel) in the dissolver vessel made filtration difficult or too time-consuming. At such time, a 'boil out' run was made using the same procedure except that no scrap powders were charged to the dissolver.

The dissolver solutions in the VAT were prepared for subsequent ion exchange operations by diluting them to about 6.5M HNO₃. Ferrous sulfamate and sodium nitrite were then added for Pu valence adjustment by first reducing Pu(VI) to Pu(IV)/Pu(III), and then oxidizing Pu(III) to Pu(IV). Thus adjusted, the VAT solutions were transferred through a polishing filter to ion exchange feed storage tanks. These solutions, containing Pu, U, and other metal nitrates along with small amounts of fluorides and sulfates, next were pumped through glass columns packed with Permutit^{*} SK or Ionac^{**} 580 anion exchange resin. In the concentrated HNO₃ solution, Pu formed the anionic complex Pu(NO₃)₆⁻² which was absorbed strongly by the resin. Most of the metallic impurities in the HNO₃ solution

^{*}Permutit is a trademark of Permutit Company, Inc.

^{**}Ionac is a trademark of Sybron Chemical Holding, Inc.

did not form anionic complexes under these conditions and, consequently, were not absorbed by the resin. The Pu-loaded ion exchange column was washed with 7.2M HNO₃ to ensure complete removal of the impurities and the U. Finally, Pu was eluted from the column using 0.6M HNO₃.

Treatment of the scrap recovery solutions by ion exchange was a cyclical process consisting of four operations:

1. Resin preconditioning operation
2. Pu-loading operation
3. Pu-wash operation
4. Pu-elution operation

The Pu-containing ion exchange eluant was pumped directly into the boiler section of a steam evaporator where the solution subsequently was concentrated by evaporation. The overheads (distillate) were collected and pumped to medium-level waste tanks for storage or reprocessing. Evaporator bottoms (concentrate) of Pu(NO₃)₆ solution were mixed, sampled, and vacuum transferred to 10-L (2.6-gal) plastic bottles or to the product storage tanks. As sufficient quantities were accumulated, the Pu(NO₃)₆ solution was returned as scrap recovery product to a PuO₂ conversion facility.

2.4.4 Analytical Chemistry

Chemical analysis of selected samples was done routinely on each fuel lot for quality control to ensure that the fuel products met specified standards. The analytical program required continued sampling of the mixed-oxide powders and pellets and, consequently, generated additional TRU wastes.

The following procedures were used:

2.4.4.1 Carbon. The determination of the carbon in Pu oxides, U oxides, U-Pu mixed oxides, metal, and alloys was done by combustion to CO₂ followed by gas chromatographic measurements.

2.4.4.2 Chloride. Chloride was determined by photometric analysis after pyro-hydrolysis. The method was applied to the determination of residual chloride on the surface of fuel pin metal components (i.e., end caps, reflector pins, springs, plenum spacers, cladding tubes, and fuel pins).

2.4.4.3 Fluoride. The residual fluoride on the surface of the fuel pin metal components (i.e., end caps, reflector pins, springs, plenum spacers, cladding tubes, and fuel pins) was determined by extraction into a known volume of a hot solvent followed by a specific ion electrode procedure.

2.4.4.4 Gas Evolution. Gas was removed from sintered pellets by vacuum extraction at 1600 °C and was analyzed by mass spectrometry.

2.4.4.5 Moisture Analysis. Moisture content of the pellets was determined coulometrically in an electrolytic P_2O_5 cell.

2.4.4.6 Oxygen-to-Metal Ratio. The oxygen-to-metal ratio (O/M) was determined gravimetrically using a modified Lyons method involving oxidation of the sample in O_2 at 850 °C followed by reduction in Ar - 8% H_2 at 950 °C. A proven equivalent procedure, the Chikalla method, also was used for O/M ratio determinations.

2.4.4.7 Phosphorus. Phosphorus was determined by the molybdenum blue photometric method. The method was applied to Pu and mixed-oxide powders.

2.4.4.8 Sulfur. The sulfur determination involved combustion of mixed oxide powders in Leco crucibles in a stream of O_2 to form SO_2 , which then was titrated with potassium iodate.

2.4.4.9 Tungsten. The tungsten content of mixed oxide powders was determined spectrophotometrically as the dithiol complex, following separation from U and Pu by liquid-liquid extraction. Later, tungsten content was determined by a mass spectrographic procedure using a AgCl carrier.

2.4.4.10 Rare Earths. The rare earths contained in mixed-oxide samples were determined by spectrographic analysis after separation from U and Pu by solvent extraction.

2.4.4.11 Nitrogen. Two methods were available for nitrogen analysis: a carrier gas fusion extraction procedure for analysis of metals for the oxides and a Kjeldahl-spectrophotometric procedure for mixed-oxide powders.

2.4.4.12 Isotopic Analysis. The isotopic compositions of Pu and U were determined by thermal emission mass spectrometry following the separation of Pu from Am and U by anion-exchange purification.

2.4.4.13 Plutonium. Determination of the Pu content of Pu alloys, metal, nitrate, and oxides was accomplished by dissolving the sample (the oxide is dissolved in fuming H_2SO_4), oxidizing the Pu to the +6 state with Ag(II) (AgO), and titrating amperometrically with standard ferrous ammonium sulfate solution.

2.4.4.14 Uranium. Two methods were used for U analysis as follow: a phosphoric acid reduction followed by amperometric titration using standardized potassium dichromate for U fuel and process materials; and anion exchange separation and photometric method for U at concentrations between 300 and 3,000 ppm in ceramic grade PuO_2 and Pu nitrate solutions. A mass spectrographic analysis also was developed for the detection of trace amounts of U in Pu materials (Bradley and Clark 1978).

2.5 FACILITY HISTORY

The waste sent to the Hanford Site by Babcock and Wilcox was generated during five distinct operation periods. Each of these periods is described briefly below.

- Late CY 1972 to early CY 1973--Qualification testing on production of FFTF fuel pins.
- CY 1973 to CY 1975--Routine production of FFTF cores 1 and 2 and subsequent scrap recovery operations.
- CY 1975--Operations for equipment maintenance and general plant cleanout preparatory to start of FFTF cores 3 and 4 production.
- CY 1976 to CY 1979--Production of fuel pins for FFTF cores 3 and 4.
- CY 1980 to CY 1983--During March 1980, Babcock and Wilcox announced the phaseout of its Plutonium Facility operations and subsequently began the decontamination and removal of equipment in the facility. As of March 1983, 368 m³ (13,000 ft³) of TRU waste generated by this cleanout were stored in burial grounds at the DOE's Hanford Site at Richland, Washington. Also, 1,212 m³ (42,800 ft³) of low-specific-activity waste were buried at other sites (Babcock and Wilcox 1983).

2.6 CURRENT STATUS

The Park Township facility currently is occupied by Nuclear Environmental Services Inc., a subsidiary of Babcock and Wilcox. The Babcock and Wilcox Parks Township Facility is managed and operated by B&W Nuclear Environmental Services Inc., an affiliate of Babcock and Wilcox.

Figure 2-1. Layout of the Babcock and Wilcox Facility.

Figure 2-2. Diagram of Fuel Fabrication Process.

HEDL 7806 - 077.6

Figure 2-3. Plutonium Scrap Recovery Process.

Table 2-1. Gloveboxes and Hoods in Each Fabrication Area.

Fabrication area designation	General process description	Number of hoods and gloveboxes	Approximate area	
			(m ²)	(ft ²)
Fab 1	Gloveboxes to manufacture FFTF fuel and conversion of Pu(NO ₃) ₂ and Analytical Laboratory	36	781	8,400
Fab 2	Analytical Laboratory	2	186	2,000
Fab 3	Metallography, analytical gloveboxes, research and development for mixed-oxide work	10	502	5,400
Fab 4	Analytical Laboratory	4	93	1,000
Fab 5	Analytical Laboratory	14	167	1,800
Fab 6	Scrap Recovery Ion Exchange Process	15	251	2,700
Fab 7	Reloading of FFTF fuel	2	140	1,500
Fab 8	Warehouse area	0	837	9,000
Fab 9	Fuel pin cleaning, Inspection and Packaging Drum Warehouse, and Warm Equipment Storage	8	2,046	22,000
Hot Cell	Irradiated cladding and sources	4	223	2,400
Total		95	5,227	56,200

This page intentionally left blank.

3.0 WASTE GENERATION

The TRU solid waste sent to the Hanford Site by Babcock and Wilcox during the 1970's and early 1980's was generated as the result of the following three activities:

- Fabrication of FFTF fuel pins for cores 1 and 2 and subsequent scrap recovery operations
- Fabrication of FFTF fuel pins for cores 3 and 4
- Decontamination and cleanout of the Plutonium Facility Operations.

The waste created by the first activity has been described in detail in a report issued by the Hanford Engineering Development Laboratory (HEDL) (Bradley and Clark 1978). Because there is no comparable document for the fabrication of FFTF fuel pins for cores 3 and 4, it has been assumed that the waste generated by the fabrication of fuel pins for FFTF cores 3 and 4 is not substantially different from that generated during fuel pin fabrication for cores 1 and 2. The third activity, decontamination and cleanout of the Plutonium Facility, has been detailed in a technical summary report submitted by Babcock and Wilcox to Westinghouse Hanford Company (Westinghouse Hanford) (formerly HEDL) (Babcock and Wilcox 1983).

The material found in this section, "Waste Generation," and Section 4.0, "Solid Waste Handling Practices and Procedures," is based on material found in the references listed above and interviews with Babcock and Wilcox personnel.

3.1 TRANSURANIC WASTE GENERATED BY THE FABRICATION OF MIXED-OXIDE FUEL PINS

The various processes involved in the production of mixed-oxide fuel that resulted in the generation of TRU wastes are listed below:

- Fabrication of fuel pellets
- Recycle of materials
- Scrap recovery
- Analytical chemistry.

These processes have been described previously in Section 2.4. The solid wastes generated by these processes fall into three general categories: (1) drummed dry waste, (2) crated dry waste, and (3) drummed liquid waste. The total waste volume generation from the fabrication of fuel pins for FFTF cores 1 and 2 is shown in Table 3-1. This table lists the waste volume generated in each of the categories above by source. The disposition of the waste to scrap recovery, retrievable storage, or shallow land cover also is indicated. The majority of the waste sent to retrievable storage was drummed dry waste. The peak waste volume generated annually was 175.58 m³ in 1975.

Pu concentrations in wastes generated by cores 1 and 2 work are given in Table 3-2. This table presents the concentration of Pu by the following categories:

- Drummed dry wastes
- Crated dry wastes
- Drummed liquid wastes.

The greatest concentration of Pu in waste shipped to retrievable storage was found in drummed liquid wastes from the analytical laboratory. Table 3-3 provides a summary of waste shipments to retrievable storage, including the volume of waste in Kg and the percentage of total Pu loss provided in parentheses for each operating period.

A more detailed description of drummed dry waste, crated dry waste and drummed liquid waste types follows (Bradley and Clark 1978). It is assumed that the fabrication of fuel pins for cores 3 and 4 generated waste types identical to the waste types described below for cores 1 and 2 work.

3.1.1 Drummed Dry Waste

3.1.1.1 Line and Laboratory Wastes. Line and laboratory wastes included miscellaneous small items of equipment, electrodes, rubber gloves, plastics, primary filters, etc. Small packages of laboratory wastes, similar to the line wastes, were packaged with line wastes. Other wastes identified from the laboratory operations include the following:

- Leco^{*} crucibles, which were used for combustion of mixed-oxide powders
- Discarded glass and metal components
- Pellets in mounts.

Figure 3-1 shows the volumetric distribution of constituents in line generated wastes from cores 1 and 2 work. The Pu distribution among line waste constituents of generated line wastes is shown in Figure 3-2.

3.1.1.2 Non-Line Wastes. Non-line wastes, generally identified as 'non-glovebox waste,' included all materials destined for discard from plant operating and service areas where known or potential radioactive materials contamination existed (e.g., 'controlled zones'). These wastes were commonly

- Packaging materials
- Housekeeping trash
- Cloth and plastic sheet materials
- Used non-radioactive materials containers
- Maintenance scrap
- Decontamination wipes
- Scrap balances.

^{*}Leco is a trademark of Leco Corporation.

A large fraction of this waste (> 75 percent) was 'suspect TRU' waste assayed at nominal zero Pu content.

3.1.1.3 High-Efficiency Particulate Air (HEPA) Filters and Jet Mill Bags. High-efficiency particulate air (HEPA) filters and jet mill bags sent to disposal were specific process items used in all gas handling lines or ducts for particulate removal from gas streams before discharge. A total of 206 drums containing HEPA filters from the production of cores 1 and 2 were shipped to retrievable storage; this included 99 drums at nominal zero Pu assay. Jet mill bags from the fabrication of cores 1 and 2 contributed a minor increment to the waste volume sent to retrievable storage. Essentially the entire volume increment of jet mill bags was sent to offsite scrap recovery at the Hanford Site.

3.1.1.4 Scrap and 'Combined' Wastes. Scrap and 'combined' wastes originated in all controlled zones within the operation facility. Essentially all of this drummed waste was generated during plant maintenance and cleanout operations. Plant maintenance and cleanout operations occurred primarily in calendar year (CY) 1976 in preparation for beginning fuel pin fabrication for FFTF cores 3 and 4 and in CY 1980 through 1983 as Babcock and Wilcox phased out its Plutonium Facility Operations. Scrap items included the following:

- Spent equipment
- Broken tools
- Furnace brick
- Glovebox windows
- Other items from within the glovebox enclosures too large for paper can containment.

'Combined' wastes included items from more than one originating source. For example a non-line waste increment with added line waste packages became 'combined' waste. (The actual term used by Babcock and Wilcox personnel for this type of waste was 'mixed' waste; however, in this report, the term mixed waste refers to TRU waste that also contains hazardous constituents. To avoid confusion, the Babcock and Wilcox term 'mixed' waste has been replaced with 'combined' waste.) Approximately 42 percent of the volume was assayed at nominal zero Pu. Table 3-4 provides a breakdown of the scrap and combined waste constituents generated during cores 1 and 2 work.

3.1.2 Crated Dry Waste

3.1.2.1 Spent HEPA Filters. Spent HEPA filters, other than the primary filters described above in Section 3.1.1, were used in several locations, typically final filter bank installations. The frame dimensions of these filters measures 61 cm square by 51 cm long (24 in. square by 20 in. long). Over 40 percent of the total crated waste volume from

cores 1 and 2 work shipped to retrievable storage contained large size HEPA filters. Nearly all of these filters, 95.6 percent of the volume, were assayed at nominal zero Pu content.

3.1.2.2 Scrap and 'Combined' Wastes. Scrap and 'combined' wastes contained miscellaneous constituents, which were generally identified as 'scrap' or 'general use waste.' Crates were used for packaging these wastes, which included:

- Rejected fuel cladding
- Spent equipment
- Equipment components
- Other parts too large for drum containment.

Over 70 percent of the volume of this shipped waste category was assayed at nominal zero Pu content.

3.1.3 Drummed Liquid Waste

3.1.3.1 Scrap recovery liquids. Scrap recovery liquids refer to ion-exchange raffinates. Sludges include insolubles washed from tanks or filtered from process streams and spent resins from ion-exchange columns. Scrap recovery liquids and sludges from cores 1 and 2 work were contained in 299 drums of shipped waste. Sludges, contained in five of the drums, included about 45.5 percent of the total Pu associated with this waste category.

3.1.3.2 Analytical Laboratory Wastes. Analytical laboratory wastes were generated from analyses of solution by procedures required for chemical analysis of selected samples to ensure that fuel product specifications were met. Liquid wastes from the analytical laboratory contain a variety of solutions arising from use of these procedures. The average composition of the laboratory wastes from cores 1 and 2 is given in Table 3-5.

3.1.3.3 Non-Scrap Recovery Liquids. Non-scrap recovery liquids included all other liquids not originating from scrap recovery operations or laboratory analyses. Typical liquids were the following:

- Sump drainage
- Hydraulic oils
- Organic solvents
- Lubricants
- Spent solvents or cleaning solutions.

Seventy percent of this waste from the fabrication of cores 1 and 2 was classified as 'low specific activity' (LSA) and was acceptable for shallow ground burial disposition at sites other than the Hanford Site. All liquid wastes were immobilized before shipment to the Hanford Site.

3.2 TRANSURANIC WASTE GENERATED DURING DECONTAMINATION AND CLEANOUT

The TRU waste that was generated during the decontamination and cleanout of the Plutonium Facility came primarily from the repackaging of waste drums and bagging-out of equipment from gloveboxes, cut-up gloveboxes, and other associated equipment. Table 3-6 shows the number of waste containers from the decontamination and decommissioning (D&D) of the Babcock and Wilcox Plutonium Facility that was shipped to Rockwell Hanford Operations during 1981, 1982, and 1983. The table also provides the grams of Pu and the volume for each container.

3.3 LOW-SPECIFIC-ACTIVITY WASTE GENERATED AT BABCOCK AND WILCOX

In addition to the TRU waste sent to the Hanford Site, LSA waste was sent to the U.S. Ecology Burial Site in Beatty, Nevada (Babcock and Wilcox 1983). From February 1980 through November 1982, a total of 291 crates of LSA waste from the D&D of the Babcock and Wilcox Plutonium Facility was buried.

Figure 3-1. Volumetric Distribution of Constituents in Generated Line Wastes from the Production of Fuel Pins for Cores 1 and 2.

*Leco is a trademark of Leco Corporation

Figure 3-2. Plutonium Distribution Among Constituents of Lines Wastes Generated.

*Leco is a trademark of Leco Corporation

Table 3-1. Volume and Disposition of Cores 1 and 2 Generated Wastes.

Origin of waste increment and type of container	Generated waste volume (m ³ /yr)						Disposal to		
	1972	1973	1974	1975	1976	Total	Scrap recovery	Retrievable storage	Shallow land cover
Drummed dry waste									
Line and laboratory	11.45	30.40	30.61	34.77	4.16	111.39	2.29	109.10	-
Non-line	2.29	13.12	23.32	32.89	2.08	73.70	-	73.70	-
HEPA filters and jet mill bags	2.08	8.95	13.33	19.36	0.83	44.55	1.67	42.88	-
Scrap and mixed	1.25	7.29	3.33	4.58	4.37	20.82	0.62	20.20	-
Crated dry wastes									
Spent HEPA filters	-	1.59	-	13.37	8.50	23.46	-	23.46	-
Scrap and mixed	-	-	13.17	5.44	15.63	34.24	-	34.24	-
Drummed liquid wastes*									
SR liquids and sludge	Nonoperating period			46.64	15.61	62.25	-	62.25	-
Analytical Laboratory	0.42	1.87	3.12	1.67	0.62	7.70	-	7.70	-
Non-SR liquids	-	0.83	7.50	16.86	15.82	41.01	-	12.28	28.73
Totals	17.49	64.05	94.38	175.58	67.62	419.12	4.58	385.81	28.73

*Liquid wastes were immobilized before shipment.

SP = scrap recovery.

Table 3-2. Plutonium Concentration in Wastes Generated by Cores 1 and 2 Work (g/m³).

Origin of waste increment and type of container	Year (g/m ³)						Plutonium shipped to (g/m ³) ^a	
	1972	1973	1974	1975	1976	Average	Scrap recovery	Retrievable storage
Drummed dry wastes								
Line and laboratory	42.27	78.19	95.50	143.03	123.07	101.45	765.07	87.52
Non-line	0.00	2.06	7.41	24.75	2.40	13.83	-	13.83
HEPA filters and jet mill bags	30.77	74.53	97.15	62.65	2.41	72.75	862.87	41.98
Scrap and mixed	3.20	9.60	14.41	45.85	253.55	69.16	569.35	53.81
Crated dry wastes								
Spent HEPA filters	-	6.92	-	0.52	7.65	3.54	-	3.54
Scrap and mixed	-	-	0.00	0.00	10.30	4.70	-	4.70
Drummed liquid wastes ^b								
SR liquids and sludge	-Non-Operating Period-			5.32	21.97	9.49	-	9.49
Analytical Laboratory	188.09	241.18	198.08	202.40	187.10	208.05	-	208.05
Non-SR liquids	-	0.00	23.47	0.00	0.00	4.29	-	14.37
Totals	36.08	56.25	55.77	44.44	34.19	46.80	774.24	41.65

^aAll immobilized liquid waste shipped to shallow land cover assayed as 0 g/m³.

^bLiquid wastes are immobilized before shipment.

SR = scrap recovery.

Table 3-3. Cores 1 and 2 Waste Shipped to Retrievable Storage (m³) and Incremental Percent of Pu Loss (%) (X.XX).

Origin of waste increment		Process tests	Production operations			Total to retrievable storage
		1972 - 1973	1973	1974	1975	
Line and laboratory	m ³	14.91	27.66	31.14	35.39	109.10
	%	(4.71)	(13.70)	(14.41)	(26.61)	(59.43)
Non-line	m ³	2.98	12.78	24.12	33.82	73.70
	%	(0.01)	(0.16)	(1.09)	(5.08)	(6.34)
HEPA filters and jet mill bags	m ³	2.70	8.47	12.87	18.84	42.88
	%	(0.69)	(3.86)	(3.90)	(2.75)	(11.20)
Scrap and mixed	m ³	1.63	6.91	5.36	6.30	20.20
	%	(0.05)	(0.40)	(3.44)	(2.86)	(6.76)
Spent HEPA filters	m ³	-	4.02	9.02	10.42	23.46
	%	-	(0.09)	(0.20)	(0.23)	(0.52)
Scrap and mixed	m ³	-	-	15.89	18.35	34.24
	%	-	-	(0.47)	(0.53)	(1.00)
SR liquids and sludge	m ³	-	10.67	23.94	27.64	62.25
	%	-	(0.63)	(1.42)	(1.63)	(3.68)
Analytical Laboratory	m ³	0.54	1.23	2.75	3.18	7.70
	%	(0.68)	(1.60)	(3.57)	(4.12)	(9.97)
Non-SR liquids	m ³	-	3.54	13.58	23.89	41.01
	%	-	(0.00)	(1.10)	(0.00)	(1.10)
Volume shipped (m ³)		22.75	75.28	138.67	177.83	414.54
Pu in period, % of total loss		(6.13)	(20.42)	(29.64)	(43.81)	(100.00)

SR = scrap recovery.

Table 3-4. Scrap and Combined Waste Constituents for Drummed Dry Waste Generated During Cores 1 and 2 Work.

Number of drums		Description of drum contents	Percent of category	
Total	Nominal 0.0g Pu		Volume	Pu content
14 ^a	0	Non-line wastes with selected Pu-bearing waste packages transferred from 31 other drums	14.43	74.23
25 ^b	10	Scrap equipment, vault parts, mixed large glovebox scrap, and equipment parts ^c	25.78	10.45
10	0	Miscellaneous waste not specifically named	10.31	6.58
2	0	Empty metal and plastic containers	2.06	4.94
10	2	Scrap balances	10.31	2.76
3	0	Laboratory scrap and insulator pellets	3.09	0.49
21	19	Furnace brick and parts	21.65	0.31
1	0	Decontamination and cleanup wastes	1.03	0.21
8	7	Glovebox windows and parts and greenhouse remnants	8.25	0.03
3	3	Apollo [*] (U only) and utility room filters	3.09	0.0
97	41	Totals	100.00	100.00

^aAll of these drums contain added waste packages.

^bSeven of these drums contained large size glovebox waste packages.

^cTypical equipment and parts included the following: scrap batteries; jet mill parts; vault doors and parts; pressure cooker; V-blender; ball mill parts; Syntron^{**} glassware; glovebox floor parts; and scrap balances.

Pu = plutonium.

^{*}Apollo is a trademark of International Water Technologies.

^{**}Syntron is a trademark of FMC Corporation.

**Table 3-5. Average Composition of Analytical Laboratory
Liquid Wastes from Cores 1 and 2.**

Analysis producing the waste	Plutonium concentration (ppm)	Percentage of total waste volume
Chloride plus fluoride	< 100	22.9
Phosphorus	150	11.4
Contains butanol with methanol, acetone	< 100	2.4
Tungsten		
Contains titanium, chloride, sulfate	400	8.4
Contains pentylacetate methanol, acetone	< 100	3.1
Rare earths	< 100	6.3
Contains tri-N-octylamine-xylene mixture, acetone and methanol	400	3.6
Nitrogen	< 100	9.7
Contains Cl, F, and excess of NaOH	400	8.2
Isotopic analysis	< 100	4.8
Plutonium	< 100	5.0
Cleaning liquid H ₂ SO ₄ , Ag ₂ SO ₄ , Fe(III)	400	5.0
2M H ₂ SO ₄ , 10% NaHSO ₄ + trace of HNO ₃	1000	5.2
Uranium--Titrimetric	< 100	3.6
Uranium--Photometric	100	0.2
Contains tin, chloride, hydroxylamine	800	0.2

Table 3-6. Transuranic Waste Shipments to Richland, Washington. (2 sheets)

Shipment number	Date	Plutonium (g)	Volume		Description
			m ³	ft ³	
3536 - 1	06/19/81	982	14.0	495	66 drums
- 2	07/10/81	1,135	16.1	570	76 drums
- 3	07/24/81	1,136	16.1	570	76 drums
- 4	08/07/81	1,122	16.1	570	76 drums
- 5	08/21/81	1,019	16.1	570	76 drums
- 6	09/08/81	1,019	16.1	570	76 drums
- 7	09/18/81	943	15.9	563	75 drums
- 8	10/02/81	1,060	16.1	570	76 drums
- 9	10/21/81	1,140	16.1	570	76 drums
-10	11/06/81	1,115	16.1	570	76 drums
-11	12/29/81	1,079	16.1	570	76 drums
1981 total		11,750	175.2	6,188	825 drums
3536 -12	03/12/82	164	12.9	455	Crates MK-1-1 and 1-7, 6 drums
-13	04/15/82	364	14.1	500	Crates MK-1-9 and 1-5, 12 drums
-14	05/14/82	275	11.6	410	Crates MK-1-6 and 1-8
-15	06/04/82	20	11.6	410	Crates MK-1-4 and 1-10
-16	06/18/82	80	7.9	279	1 Crate MK-1-2 and 1 stainless steel tank
-17	07/16/82	209	10.7	378	Crates MK-1-3 and 1-70
-18	08/23/82	333	9.8	346	Crates MK-1-66 and 1-67
-19	10/18/82	279	9.8	346	Crates MK-1-68 and 1-57

Table 3-6. Transuranic Waste Shipments to Richland, Washington. (2 sheets)

Shipment number	Date	Plutonium (g)	Volume		Description
			m ³	ft ³	
4242 - 1	11/05/82	117	9.8	346	Crates MK-55 and MK-56
- 2	11/12/82	668	16.2	571	76 drums
- 3	11/19/82	10	6.1	216	2 stainless steel tanks
- 4	12/03/82	15	3.6	127	2 stainless steel tanks
- 5	12/17/82	59	7.96	281	Crate MK-64 and 1 stainless steel tank
- 6	12/17/82	72	16.1	570	76 drums
1982 total		2,665	148.2	5,235	
4242 - 7	01/12/83	0	16.1	570	76 drums
- 8	03/04/83	47	16.1	570	76 drums
- 9	03/04/83	31	11.8	416	Crates MK-65 and MK-69
1983 total		78	44.1	1,556	
Grand total		14,493	367.53	12,979	1,147 drums 20 crates 6 tanks

4.0 SOLID WASTE HANDLING PRACTICES AND PROCEDURES

This section describes the handling and packaging procedures for Babcock and Wilcox waste from the fabrication of cores 1 and 2 and the D&D of the facility. No information that describes the packaging and handling of waste produced during the period of cores 3 and 4 fabrication is available. It is assumed that the practices and procedures used by Babcock and Wilcox to handle wastes from cores 1 and 2 fuel pin fabrication is similar to that used for cores 3 and 4. Included at the end of this section are examples of the shipping and accountability checklists used by Babcock and Wilcox personnel. These checklists may provide additional handling and packaging information. Figure 4-1 is the Materials Control and Accountability Burial Shipment Checklist. Figure 4-2 is the Materials Control Box or Drum Checklist; a Burial Shipment Checklist is shown in Figure 4-3. In addition to describing waste packaging and handling at Babcock and Wilcox, Section 4.3 describes the solid waste acceptance criteria at the Hanford Site during the time period during which the waste was sent.

4.1 HANDLING AND PACKAGING OF FUEL PIN FABRICATION WASTE

4.1.1 Handling and Packaging of Drummed Dry Waste

4.1.1.1 Line and Laboratory Wastes. Line and laboratory wastes were bagged out of production line glovebox containment into about 6-L (nominal 1 1/2-gal) paper cans. After assay, these cans were loaded into 17C 55-gal steel drums before disposal. Small packages of laboratory wastes that were similar to the line wastes were included with line wastes.

The common practice was to sweep all powder from glovebox waste (i.e., gloves, plastic, glass, paper, etc.) before packaging. The fingers were cut off the gloves to eliminate air pockets during compaction. Glassware was placed in metal containers, crushed, and double-bagged. Metal cans were cleaned with a wire brush, the interior and exterior were painted with a latex paint, allowed to dry, and then compacted. Glovebox/hood equipment had all sharp edges removed with a file. If unable to be filed, the edges were covered with tape. The entire piece of equipment was painted, allowed to dry, and double-bagged.

4.1.1.2 Non-Line Waste. Non-line waste was generally identified as 'non-glovebox' waste. Some of the non-line waste drum contents were compacted to approximately half of their initial bulk volume.

4.1.1.3 Primary HEPA Filters. Primary HEPA filters were packaged one per 17C 55-gal drum. They were of 30-cm-square by 45-cm-long (12-in.-square by 18-in.-long) frame configuration with end piping adaptors for inline installation.

4.1.1.4 Jet Mill Bags. Jet mill bags were contained in 6-L (1 1/2-gal) paper cans.

4.1.1.5 Scrap and 'Combined' Drummed Waste. Scrap and 'combined' drummed waste, transferred to scrap recovery, were identified as 'dry bagged waste' rather than by particular materials or named items in contained packages (Bradley and Clark 1978).

4.1.2 Crated Dry Waste

4.1.2.1 Spent HEPA Filters. Spent HEPA filters, other than the primary filters described above, of 60-cm-square by 50.8-cm-long (24-in.-square by 20-in.-long) frame dimensions were used in several locations, typically final filter bank installations. Spent HEPA filters too large for 55-gal drum containment were enclosed within rectangular boxes. In most cases single filters were contained in .31 m³ (11 ft³) boxes. Up to four filters were packaged in some of the larger boxes.

4.1.2.2 Scrap and 'Combined' Wastes. Scrap and 'combined' wastes (reject fuel cladding, general use waste, and equipment components) were packaged in crates ranging in size from 0.25 m³ to 3.4 m³. Spent equipment and parts too large for drum containment were contained in other crates (Bradley and Clark 1978).

4.1.3 Drummed Liquid Wastes

4.1.3.1 Liquid Wastes. Liquid wastes from the fabrication of cores 1 and 2 were immobilized within 17-C steel drum containment by absorption on Speedi-Dri (vermiculite), before shipment offsite. Drums were not provided with vent clips; however, they were outgassed before being sealed. After about 1980, no liquid waste in Floor-Dry was permitted to be sent to burial. All liquid waste had to be solidified in cement.

4.1.3.2 Hot Cell Liquid Wastes. Hot cell liquid wastes were solidified in concrete mix or Portland cement (Babcock and Wilcox 1983).

4.1.3.3 Contaminated Hydraulic and Vacuum Pump Oil. Contaminated hydraulic and vacuum pump oil was mixed with sand and Portland cement. Water was added to the mixture to produce a slurry. The oil did not separate after addition of the water or after solidification (Babcock and Wilcox 1983).

4.2 HANDLING AND PACKAGING OF TRANSURANIC DECONTAMINATION AND DECOMMISSIONING WASTE

4.2.1 Repackaging of Waste

At the completion of FFTF contract manufacturing, a 300-drum inventory of waste ranging from 10 to 100 g of Pu per drum and 58 primary and secondary filters each containing 1 to 30 g of Pu resulted in a waste inventory with a total of 8.8 kg (19.4 lb) of Pu. This waste could not be shipped as packaged in the Super Tiger since only a nondispersable form of Pu could be shipped in that container. Because of these shipping restrictions, an N-55 shipping container, which allowed transportation of 76 55-gal drums

per trailer, was selected. However, the N-55 overpack container was limited to 15 g of Pu per drum. The previously packaged inventory of waste did not meet this limit and had to be repackaged and recounted so that the total quantity of Pu per drum was equal to or less than 15 g.

Repackaging resulted in the generation of additional waste because the previously packaged waste had to be bagged into the glovebox system and work within the glovebox generated more waste, chiefly plastic and gloves. Additionally, a single 15-g waste carton package (15-cm diameter by 30 cm long [6-in. diameter by 12 in. long]) would not effectively use the available volume in a 55-gal drum. In some cases, the remaining volume was filled with zero value waste or LSA waste. Also, since 60-cm by 60-cm by 50-cm (24-in. by 24-in. by 20-in.) filters would not fit inside a 55-gal drum, these filters and 30-cm by 30-cm by 60-cm (12-in. by 12-in. by 24-in.) filters were cut up and repackaged.

Repackaging of the 349 drums of waste remaining after completion of FFTF contract manufacturing resulted in 744 drums of waste for burial (Babcock and Wilcox 1983).

4.2.2 Gloveboxes and Special Equipment

The regulations and restrictions relative to transporting TRU waste to Rockwell Hanford required that gloveboxes and equipment be decontaminated to a specific level of removable contamination and a polyvinyl alcohol fixative applied. During the D&D of the Babcock and Wilcox Plutonium Facility, 56 gloveboxes were decontaminated, disassembled, cut into pieces, placed in plastic polyvinyl chloride (PVC) bags, and smeared before packaging in steel burial crates. The edge of each package was wrapped with foam to prevent the cut surfaces and sharp corners from puncturing the PVC bags. The foam was taped in place with duct tape and then a plastic PVC sheet was unrolled and taped in place under the glovebox floor. A five-sided PVC envelope was then placed over the package and taped in place.

The jet mill, hydraulic press, and slug press were decontaminated, disassembled, and packaged with techniques similar to those previously described for gloveboxes and equipment. The Fab 1 and Fab 3 sintering furnaces were disassembled by removing all of the brickwork and double-bagging the brick for storage as TRU waste (Babcock and Wilcox 1983).

4.3 WASTE PACKAGING AND HANDLING REQUIREMENTS AT THE HANFORD SITE

Eleven historical waste packaging manuals were reviewed for information regarding packaging and labeling requirements for TRU waste in retrievable storage at the Hanford Site. These manuals covered requirements from 1974 through 1988. Babcock and Wilcox shipped waste to the Hanford Site beginning in the mid-1970's and ending in 1983.

Packaging requirements have changed over time and have become more stringent. Table 4-1 summarizes TRU storage requirements for the Hanford Site from 1974 through 1988. The columns in Table 4-1 are not symmetrical; when a definition or requirement is consistent between manuals, text is shared under several document number columns. A blank spot indicates that no requirements or definitions are found in that manual. Definitions (i.e., hazardous and toxic materials, etc.) change from manual to manual and so require reference to each particular manual.

Some of the more significant changes that have occurred in the past 20 years with regard to the packaging, handling, and record keeping for radioactive wastes that were sent from Babcock and Wilcox for retrievable storage at the Hanford Site are as follow:

- The definition of TRU waste has changed since 1970, and the designation of waste packages as TRU also has changed. During the period from 1970 to 1973, TRU segregation was based on generator practice. From 1974 until 1982, TRU waste was segregated if the concentration of TRU was greater than 10 nCi/g. In 1982, the current 100 nCi/g definition for TRU waste was implemented by the DOE.
- Because of the varied contents of the waste containers, chemical reactions can occur. Gases may accumulate, including hydrogen that can contribute to fire and/or explosion. Since 1982, waste materials that generate H₂, O₂, or NO_x are prohibited unless drums have been permanently fitted with vent clips to allow continual release of gases or include catalyst packs to recombine any hydrogen that may be produced.
- Criticality specifications limited the amount of TRU to less than 250 g per 55-gal drum from 1975 to 1978 and to 200 g per drum after that time. Before 1975 the criticality limit on drums and cartons was 400 g.
- Individual container weights were not required before 1977; however, estimated weights for pre-1977 containers were added to the records in the R-SWIMS database during the data reentry program in the mid-1980's. Standard weights were given for each container type. All 55-gal drums, for example, were given a value of 68 kg (150 lb).
- Originally, waste burial records for TRU were not done for individual containers, but for entire shipments. In 1982, TRU burial and storage records began to be based on an individual container basis. The entry of unique data for each waste container into the R-SWIMS database was not fully implemented until 1984. During the R-SWIMS reentry program, historical TRU records were converted to an individual basis so that today there is one SWITS record for each TRU container stored at the Hanford Site.

The conversion from group data to individual container data required some assumptions about the containers in the group to be made. Chief among these assumptions was that an even distribution of radiological and hazardous constituents existed among the members of the group.

LLW records are still kept for multiple containers rather than for individual containers.

- Information on the hazardous constituents of waste containers was not required before 1986. During the R-SWIMS reentry program any available information from the SWBRs was added. However, this information is limited.
- Physical descriptions of the waste contents were not required on the SWBR before 1978. SWITS records for waste buried before 1978 list the contents as 'miscellaneous' in most cases. In more recent years, the physical contents description has become more detailed. Many of the records now include the weight and volume percentages of a given component in the waste container.
- Between 1972 and 1978, combustible and noncombustible waste components were segregated. Although the SWITS database did not retain a data field for this information, it was added to the physical contents description field.
- The most common TRU waste container used at the Hanford Site is the 55-gal steel drum. U. S. Department of Transportation (DOT) 17C or 17H drums with minimum wall thicknesses of .135 cm (.053 in.) and .109 cm (.043 in.), respectively, were both used. Before 1982, most of the drums were painted, so there is approximately .005 in. of paint on both the exterior and interior of the drums. In 1982, galvanized drums replaced the painted drums. Recycled 55-gal drums also were permitted for the storage of TRU waste from 1973 to 1978.

PLUTONIUM FACILITY

MATERIALS CONTROL & ACCOUNTABILITY BURIAL SHIPMENT CHECK LIST

CONDITION	REQUIREMENT	TECHNICIAN		
		YES	NO	N/A
1. Boxes or drums have been approved by Quality Assurance	10 CFR 71.51(A)	✓	—	—
2. Each item has been visually inspected and determined to be free of liquid	10 CFR 71.51(A)	✓	—	—
3. Accountability values for each item(s) does not exceed the range of the NDA Standard	Plutonium Decommissioning FMCP	✓	—	—
4. The Pu value does not exceed 15 gms Pu per drum. Isotopic values have been assigned via traceability to the contract.	Rockwell Conditions and Site Criteria 10 CFR 70.58(e)	✓	—	—
5. Burial drum lids have been fastened down with a closure ring and bolt. Burial boxes were foamed and nailed according to approved Procedures.	Internal Requirements/NECO and/or Rockwell Conditions and Site Criteria 10 CFR 70.51(e)(1)(i)	✓	—	—
6. Appropriate tamper indicating devices have been applied to each box or drum.	Internal Requirement and 10 CFR 70.51(e)(1)(i)	✓	—	—
7. Approved TWX received from HEDL or Rockwell with appropriate shipment numbers. Approved TWX received from NECO for LSA Waste.	Contractual Provisions or NECO and/or Rockwell Site Criteria	✓	—	—
8. Applicable Internal drum or box number, Customer Shipment Number, gross weight and Non-Combustible(if applicable) printed on the boxes or drums.	10 CFR 70.51(e)(1)(i) and (1)(iv) NECO and/or Rockwell Site Criteria	✓	—	—
9. Boxes or Drums measured for Ft ³ determination	NECO and/or Rockwell Site Criteria	✓	—	—
10. Appropriate B&W Data Sheets, Shipper's Check List and Customer Data Forms completed.	Internal Requirements and 10 CFR 70.51(e)(1)(iv)	✓	—	—
11. Health & Safety has smeared the shipment no more than (24) hours prior to the shipment.	Health & Safety Manual and Site Criteria	✓	—	—
12. Copies of all Internal and Customer Data Sheets have been forwarded to the Accountability Representative.	10 CFR 70.54	✓	—	—
13. NRC/DOE-741 prepared, signed and forwarded to the appropriate Plutonium Facility personnel.	10 CFR 70.54	✓	—	—

Figure 4-1. Plutonium Facility Materials Control and Accountability Burial Shipment Checklist.

WHC-EP-0719

David C. Schreengost 3/8/82
 Materials Control Technician and/or Manufacturing Technician (Items 1 thru 12) Date:
Mark Mado 3-8-82
 NDA Specialist and/or Manufacturing Technician (Items 1 thru 12) Date:
Patricia Murdock 3-10-82
 Accountability Representative (Item 13) Date:

Shipment Number: RRM-3536-12
 NRC/DOE 741 No.: HAX-VRA #12

241-603A Rev. 1
3/20/81

PLUTONIUM FACILITY

MATERIALS CONTROL - BOX OR DRUM CHECK LIST

BOX or DRUM NO. B-335

	<u>CONDITION</u>	<u>REQUIREMENT</u>	<u>TECHNICIAN</u>		
			<u>YES</u>	<u>NO</u>	<u>N/A</u>
4-7	1. The box or Drum has been approved by Quality Assurance	10 CFR 7.51 (A)	☒	☐	☐
	2. Assigned Internal and Customer Box, Drum, and Shipment Number	10 CFR 71.51(A)	☒	☐	☐
	3. The items placed in the box or drum have been visually inspected and determined to be free of liquid	49 CFR 173.392	☒	☐	☐
	4. Accountability values for each item(s) does not exceed the range of NDA Standards	Plutonium Decommissioning FNMCP	☒	☐	☐
	5. Nuclear Safety Sheet (if applicable) has been completed and agrees with the NDMC Card.	Internal Requirements 10 CFR 70.51(E)(1)(i)	☐	☐	☒
	6. The Pu Value does not exceed 15 Gms Pu per drum. Isotopic values have been assigned via traceability to the Contract.	Rockwell Conditions and Site Criteria 10 CFR 70.58(E)	☒	☐	☐
	7. The burial drum lids have been fastened down with a closure ring and belt, and the appropriate tamper indicating device has been applied to each drum.	10 CFR 70.51(e)(1)(i), NECO and/or Rockwell Conditions and Site Criteria	☐	☐	☒
	8. The burial box lid has been caulked prior to nailing the box closed, and the appropriate tamper indicating device has been applied to the box. (If applicable)	10 CFR 70.51 (e)(1)(i) NECO and/or Rockwell Conditions and Site Criteria	☒	☐	☐

D. D. D. D.
Materials Control Technician and/or Manufacturing Technician

4/23/81
Date

K. H. H. H.
NDA Specialist and/or Manufacturing Foreman

4-23-81
Date

81-5 YKH-VAN # 38
Shipment No. NRC/DOE-741 No.

Figure 4-2. Plutonium Facility Materials Control
Box or Drum Checklist.

WHC-EP-0719

Figure 4-3. Burial Shipment Checklist.

342-7028
Rev. 4.22/81SHIPMENT TO: Rockwell Hanford, Richland, WA.TRUCK/TRAILER: 840507DATE: 9-12-82TRUCK/TRAILER SMEARED
BEFORE LOADING: DPPACKING SLIP NO.: 22198

CONDITION	REQUIREMENT	VERIFIED BY
1. <u>BOXES</u>		
A. Metal Banded	CNSI Site Criteria 2.1.3.C	NA
B. Stenciled Radioactive - LSA	49.CFR.173.392(c) 8	NA
C. Gross Weight Affixed	49.CFR.172.310 (2)	NA
2. <u>DRUMS</u>		
A. Stenciled Radioactive - LSA	49.CFR.173.392 (c) 8	NA
B. Gross Weight Affixed	49.CFR.172.310 (a)	DP
C. Palletized (if over 600 lbs.)	CNSI Site Criteria 2.1.1	NA
3. <u>LOAD</u>		
A. Properly braced and chained	49.CFR.173.392 (c) 6	DP
B. Drums on front of trailer (If mixed drum/box shipment)	CNSI Site Criteria 2.1.4 A and B	NA
C. Box clearance in van acceptable	CNSI Site Criteria 2.1.3 A and B	NA
D. Tarped or in van trailer		NA
E. Placarded	49.CFR.173.392 (c) 7	DP
4. <u>SHIPPING PAPERS</u>		
A. Shipper's checklist		DP
B. Packing slip		DP
C. Bill of Lading	49.CFR.172.204	DP
D. Certificate of Compliance "Radiation Monitoring Report"		DP
E. CNSI-201 (4/80) Burial Form	CNSI Site Criteria 9.0	NA
F. Radioactive Waste Shipment & Disposal Form - NECO		NA
G. Exclusive Use Instructions for Driver	49.CFR.173.392 (c) 9	DP
H. Certification of Understanding - Beatty, NV. (NECO) - License #13-11-0043-02		NA
I. State Compliance Certification, Beatty, NV. (NECO)	Executive Order Dated 7/24/79	NA
J. Material Acknowledgment Receipt Card		DP
K. NRC Notification		DP

Approval of Shipment DP, Supervisor, Transportation

Document numbers				
ARH-3032 4/74 - 4/77	ARH-3032, Rev. 1 4/77 - 7/78	ARH-3032 Rev. 1 Sup 1 8/78 - 12/78	ARH-3032 Rev. 1 Supp. 2 12/78 - 5/80	RHO- 5/80
TRU defined				
Waste containing Pu and/or other transuranium nuclides in concentrations greater than 10 nCi/g.	Waste containing or suspect of containing Pu and/or other transuranium nuclides in concentrations greater than 10 nCi/g.			Waste containing radionuclides with concentrations greater than 10 nCi/g.
Prohibited wastes types and packaging				
Liquid wastes must be packaged with sufficient inert absorbent so that liquid will not flow if container is breached		No free liquids	No free liquids - except as follows:	
	Liquid organic waste-free or absorbed is prohibited (includes animal carcasses).	Liquid organic waste-free or absorbed is prohibited (includes all oils and animal carcasses).	Animal carcasses, waste with flesh packaged. Liquid special approval.	
	Flammable absorbed liquids prohibited from disposal in caskets.	Damp or wet wastes with highly combustible or explosive liquids prohibited.	Flammable liquids prohibited	
Unreacted alkali metals prohibited.				
			Explosive	
			Pyrophoric	
		TRU waste packages shall be of a nature that no radioactive material escapes as a result of a breach of the container; pressurization of the container shall not occur and the container shall maintain its integrity for a period of 20 years. If a container is vented to prevent pressurization the vent shall equal or exceed a HEPA filter with regard to minimizing passage of radiation.		Materials that generate amounts of gas as follows:
	Hazardous and toxic materials must be treated before burial.			Hazardous and toxic materials
	Exterior surfaces must be free from smearable contamination-fixation allowed.			Exterior surface must be free from smearable contamination

Table 4-1. Transuranic Storage Requirements
for the Hanford Site. (3 sheets)

Title: date:				
AA-222 - 6/82	RHO-MA-222 6/82 Revision 6/82 - 6/83	RHO-MA-222 Rev 1 6/83 - 3/84	RHO-MA-222 Rev. 1 3/84 - 7/84	RHO-MA-222, Rev. 2 7/84 - 8/85*
or suspect of containing transuranium alpha-emitting half-lives greater than 100 years or ²³⁸ U in water than 10 nCi/g.				
Document Unavailable		Waste containing alpha-emitting radionuclides with atomic numbers greater than 82 and half-lives greater than 20 years or ²²⁶ Ra or ²³⁸ U in concentrations greater than 100 nCi/g.		
loading requirements				
except liquid organic wastes.		No free liquids - except liquid organic wastes	No free liquids	
accepted if packaged per requirements. Liquid organic waste > 150 °F accepted if properly labeled and organic waste with flashpoint < 150 °F accepted with		Animal carcasses accepted if packaged per requirements.		
free or absorbed with flashpoints below 150 °F		Sludges cannot contain free liquids.		
		Unreacted Alkali metals prohibited with exceptions.		
Prohibited		Pyrophorics and explosives prohibited except metal fines.	Explosives prohibited.	
is prohibited			Pyrophorics prohibited.	
		Gas cylinders containing radioactive gases prohibited. Empty cylinders accepted if permanently vented.	Compressed gases prohibited.	
rate significant is prohibited.	Waste materials that generate H ₂ , O ₂ or NO _x are prohibited unless permanently vented or catalyst package in container.	Waste materials that generate H ₂ , O ₂ or NO _x are prohibited unless permanently vented or catalyst package in container.	Waste containers that could repressurize to greater than 7 psi within 25 years require venting through HEPA filters.	
Hazardous materials accepted on case by case basis.		Hazardous and Toxic materials must be treated to meet the waste acceptance criteria for disposal.		
must be free from contamination.	Exterior surfaces free from smearable contamination—fixation allowed.		Exterior surfaces free from smearable contamination fixation allowed.	Removable surface contamination limits fixation is not acceptable.
				Flammable solids (metal fines) must be mixed with chemically stable material to produce a solidified waste matrix (glass, concrete, etc.)

Document number				
ARH-3032 4/74 - 4/77	ARH-3032, Rev. 1 4/77 - 7/78	ARH-3032 Rev. 1 Sup 1 8/78 - 12/78	ARH-3032 Rev. 1 Supp. 2 12/78 - 5/80	RH 5/
Prohibited wastes types and pack				
	Contamination that is easily airborne must be in an inner liner.			Loose contain of the container
Be requires double containment.				Double contain TRU waste and accepted from Be and Hg requ. containment.
				"Liquid Organic packaged in a s container (5-10 overpackaged in rigid polyethylene the top with at absorbent requir volume of liquid
				Animal waste m 55-gal drum wi plastic liner, the generation, and sufficient absor liquids two time absorbent requir liquid present or from the decay
Labeling requir				
Waste packages must be suitably labeled so that containers can be identified by cross-reference to permanent records.				Waste packages labeled so that identified by cr permanent reco packages contain labeled 'transur waste'
Be must be labeled.	Be must be labeled.	Be must be labeled.	Be must be labeled.	DOT Class "B" labeled (Be & Hg

Table 4-1. Transuranic Storage Requirements
for the Hanford Site. (3 sheets)

Revision and dates				
RHO-MA-222 3 - 6/82	RHO-MA-222 6/82 Revision 6/82 - 6/83	RHO-MA-222 Rev 1 6/83 - 3/84	RHO-MA-222 Rev. 1 3/84 - 7/84	RHO-MA-222, Rev. 2 7/84 - 8/85*
Packaging requirements (cont.)				
Waste must be stabilized or contained so that the surface remains free of detectable loose contamination.			Loose contamination must be stabilized or contained so that the surface of the container remains free of detectable loose contamination.	Powders, ashes and similar particulates must be immobilized in concrete, glass or similar solidified matrix if > 1 weight % of the matrix weight is particulates < 10 microns in diameter or if > 15 weight % is < 200 microns in diameter.
Double containment required for all TRU waste generators. Must be double	Double containment required for all TRU waste. Double containment is required for Be, Cd, and Hg. Be, Cd, and Hg must be packaged with at least 6" of concrete on all sides.		Double containment required for all TRU waste. Double containment is required for Be, Cd, and Hg. Be, Cd, and Hg must be packaged with at least 6" of concrete on all sides.	Double containment required for all TRU waste. Be, Cd, Hg and other class B poisons must be immobilized in concrete for burial.
Liquid organic waste must be packaged in a sealed liquid-tight container (5-10 gallon), overpackaged in 55-gal drum with a rigid polyethylene liner and filled to the top with at least two times the absorbent required to absorb the volume of liquid in the containers.	"Liquid Organic waste must be packaged unabsorbed in a sealed liquid-tight container (5-10 gallon), overpackaged in 55-gal drum with a rigid polyethylene liner and filled to the top with at least two times the absorbent required to absorb the volume of liquid in the containers.		"Liquid Organic waste must be packaged unabsorbed in a sealed liquid-tight container (5-10 gallon), overpackaged in 55-gal drum with a rigid polyethylene liner and filled to the top with at least two times the absorbent required to absorb the volume of liquid in the containers.	Liquid organic waste must be solidified for storage or disposal. Exceptions are considered on a case by case basis.
Animal waste must be packaged in a 55-gal drum with a minimum 4-mil plastic liner, treated to suppress gas generation, and surrounded by two times the amount of absorbent required to absorb any liquid present or that may result from the decay process.	Animal waste must be packaged in a 55-gal drum with a minimum 4-mil plastic liner, treated to suppress gas generation, and surrounded by two times the amount of absorbent required to absorb any liquid present or that may result from the decay process.		Animal waste must be packaged in a 55-gal drum with a minimum 4-mil plastic liner, treated to suppress gas generation, and surrounded by two times amount of absorbent required to absorb any liquid present or that may result from the decay process.	
Labeling requirements				
Waste packages must be suitably labeled so that containers can be identified by cross-reference to permanent records.	Waste packages must be suitably labeled so that containers can be identified by cross-reference to permanent records.		Waste packages must be suitably labeled so that containers can be identified by cross-reference to permanent records.	
Be, Cd and Hg must be labeled.	Be, Cd and Hg must be labeled.		Be, Cd and Hg must be labeled.	

Document numbers				
ARH-3032 4/74 - 4/77	ARH-3032, Rev. 1 4/77 - 7/78	ARH-3032 Rev. 1 Sup 1 8/78 - 12/78	ARH-3032 Rev. 1 Supp. 2 12/78 - 5/80	RHO-M 5/80
Labeling requirements				
	Hazardous and toxic waste must be labeled.			
				'Liquid Organics' r
				'Animal Waste' m
				'Flammable Material' is tamper indicating contents include 1 Drums containing quantity in grams and lid.

NOTE: For the period of 1970 through April 1974, document numbers are unknown.

*Includes RHO-MA-222, Rev. 3, 3A and 4. The changes made in these revisions are general and do not affect the packaging, storage or disposal requirements.
WHC-EP-0082, Rev. 0 (Willis and Triner 1991).

DOT = U.S. Department of Transportation.

HEPA = High Efficiency Particulate Air.

TRU = Transuranic

Table 4-1. Transuranic Storage Requirements
for the Hanford Site. (3 sheets)

Effective Date				
A-222 6/82	RHO-MA-222 6/82 Revision 6/82 - 6/83	RHO-MA-222 Rev 1 6/83 - 3/84	RHO-MA-222 Rev. 1 3/84 - 7/84	RHO-MA-222, Rev. 2 7/84 - 8/85*
(cont.)				
	DOT labels required for all classes of waste that apply to the package.		DOT labels and color coding required on all waste packages.	
Must be labeled.	'Liquid Organics' must be labeled and must have flashpoint range listed on label.		'Liquid Organics' must be labeled and must have flashpoint range listed on label.	
Must be labeled	'Animal Waste' must be labeled.		'Animal Waste' must be labeled.	
Class and Type "E" label required if 1 or more grams. Pu must have Pu listed on the side	'Fissile Material' label required if contents include 1 or more grams. Pu quantity must be labeled if 1 or more grams of Pu is in the container.		'Fissile Material' label required if contents include 1 or more grams. Pu quantity must be labeled if 1 or more grams of Pu is in the container.	

of TRU unstable or reactive wastes specifically. The requirements listed under Rev. 2 of RHO-MA-222 are effective up to the effective date of

5.0 CHARACTERIZATION OF RETRIEVABLY STORED SOLID WASTE GENERATED BY BABCOCK AND WILCOX

The TRU waste sent from Babcock and Wilcox's Plutonium Facility to retrievable storage at the Hanford Site was generated as the result of fuel pin fabrication for FFTF cores 1, 2, 3, and 4 and the subsequent decontamination and cleanout of the Facility. Fuel pin fabrication for cores 1 and 2 took place roughly from 1972 through 1975 while fuel pin fabrication for cores 3 and 4 took place from 1975 through 1979. Decontamination and cleanout of the Plutonium Facility spanned the years from 1980 through 1983.

The information in this section is based on data available at the Hanford Site about the TRU wastes shipped from Babcock and Wilcox. This information is based primarily on data from the SWITS database. This database, which incorporated the older R-SWIMS database, is used to track information on radioactive and other wastes stored or disposed at the Hanford Site. Radioactive solid waste packages have been tracked since 1970. In the intervening years, changes in the requirements and regulations governing radioactive wastes have left their mark in the quantity and quality of the data tracked in this database. Caveats are included in the text to alert the reader to changes that may affect the interpretation of the data provided. The original SWITS data that form the basis for most of the tables and figures in this section are in Appendix A. Each computer run is preceded by the query used to generate the data.

Unfortunately, before 1981, waste from Babcock and Wilcox was attributed to other buildings (i.e., 234-5Z, 325, 340) in the SWITS database. It is likely that this is because of custody changes from Babcock and Wilcox to HEDL before onsite assay and retrievable storage of the waste. A thorough search of burial records, shipping and receiving logs, nuclear accountability forms, and other pertinent documentation was conducted in an attempt to locate Babcock and Wilcox containers that had been attributed to Hanford Site facilities. Appendix B contains a summary table of the data taken from SWBRs for the Babcock and Wilcox containers that were located. This summary table is not complete as records for the containers believed to have been shipped to the Hanford Site before 1978 have yet to be located. The data for Babcock and Wilcox containers that were redesignated as coming from an onsite facility have been added to the tables and figures in this section to make them as complete as possible. Because not all the records for containers shipped from Babcock and Wilcox have been located, the data in this search represent the minimum numbers of Babcock and Wilcox containers that are present in the solid waste burial grounds.

5.1 SUMMARY OF BABCOCK AND WILCOX WASTE GENERATION

Table 5-1 presents TRU waste generation summaries by container type and year. Waste containers listed for the years 1977 through 1979 resulted from fuel pin fabrication for FFTF cores 3 and 4. Containers listed from 1981 through 1983 were generated as a result of decontamination and cleanout of the Plutonium Facility. Since the initial retrieval efforts and WRAP 1 will focus on 55-gal drums, these containers are considered

separately from all other container types. Therefore, the term 'other containers' in this report will refer to all container types, except 55-gal drums, combined. The term 'drum' refers to 55-gal drums only.

5.1.1 Waste Stored in 55-Gallon Steel Drums

The most common waste container for TRU waste stored at the Hanford Site is the 55-gal steel drum. The drums used are either DOT 17C or 17H produced from carbon sheet steel with minimum wall thicknesses of .135 cm (.053 in.) and .109 cm (.043 in.), respectively. Before 1982, many of the drums used were painted, so these drums have approximately .013 cm (.005 in.) of paint on both the exterior and interior of the drums. In 1982, galvanized drums replaced painted drums. Recycled 55-gal drums also were permitted for the storage of TRU waste between 1973 and 1978.

The 1970 Immediate Action Directive (AEC 1970) stipulated that TRU wastes be packaged and stored as contamination-free packages for at least 20 years. The 20-year interim period was to allow time to study permanent disposal options for TRU contaminated wastes. As more of the 55-gal drums reach and exceed the 20-year storage mark, more attention has been given to ascertaining the condition of these drums. A discussion of the previous studies of steel drum corrosion and degradation can be found in WHC-0225, Rev. 1 (Anderson et al. 1991) and WHC-SA-1450-FP (Duncan et al. 1992).

Table 5-2 contains waste summary data for 55-gal drums of radioactive waste generated at Babcock and Wilcox and sent to retrievable storage at the Hanford Site between 1977 and 1983. This table indicates the number, total weight, and total volume of TRU and TRU-mixed-waste drums. Figures 5-1 through 5-3 present this information graphically.

5.1.1.1 Number of Drums. Between 1977 and 1983, 1451 55-gal drums of radioactive waste were generated at Babcock and Wilcox and sent to retrievable storage at the Hanford Site. This includes one radioactive-mixed-waste drum. Figure 5-1 provides a graph of the number of 55-gal drums of TRU generated at Babcock and Wilcox by year. The peak in 1981 is the result of the repackaging of existing wastes during the early cleanout activities.

5.1.1.2 Weight. Between 1977 and 1983, approximately 104,242 kg (229,810 lb) of TRU waste was generated at Babcock and Wilcox and stored in 55-gal drums. The lightest mean weight per drum was found in 1979 with a mean weight/drum of 46 kg (101 lb). The heaviest mean weight per drum, 89 kg (196 lb), was found in 1982. Figure 5-2 presents a graph depicting the total weight of TRU radioactive wastes stored annually in 55-gal drums.

5.1.1.3 Volume. The total volume of TRU waste generated at Babcock and Wilcox and stored in 55-gal drums is 303.2 m³ (10,707.3 ft³). The volume of TRU waste generated between 1977 and 1983 at Babcock and Wilcox and stored in 55-gal drums is shown graphically in Figure 5-3. All 55-gallon drums have a volume of .21 m³ (X ft³).

5.1.2 Waste Stored in Containers Other Than 55-Gallon Steel Drums

Radioactive solid wastes have been stored or disposed of in a wide variety of containers other than 55-gal steel drums. In this discussion these containers will be referred to as 'other containers.' Container types used for solid waste generated at Babcock and Wilcox and stored at the Hanford Site include portable tanks and metal boxes, cartons, and cases.

Table 5-3 summarizes the waste data for containers of radioactive waste other than 55-gal drums that were generated at Babcock and Wilcox and sent to retrievable storage at the Hanford Site between 1977 and 1983. This table indicates the number, total weight, and total volume of TRU waste stored in other containers.

5.1.2.1 Number of Other Containers. Between 1981 and 1983, 26 other containers of radioactive TRU waste were generated at Babcock and Wilcox for storage at the Hanford Site. Figure 5-4 is a graph of the number of other containers of TRU generated at Babcock and Wilcox for storage at the Hanford Site by year.

The largest number of other containers containing TRU waste was generated in 1982 with 23 containers. Note that 55-gal drums were the only waste containers found from before 1982.

5.1.2.2 Weight. In 1982 and 1983, approximately 72,351 kg (159,504 lb) of radioactive solid TRU waste was generated at Babcock and Wilcox and placed in containers other than 55-gal drums for storage at the Hanford Site. In 1982 other waste containers averaged 2,768 kg (6,102 lb) each; in 1983 they averaged 2,897 kg (6,387 lb) each. Figure 5-5 depicts the weight of TRU waste stored in containers other than 55-gal drums on an annual basis.

5.1.2.3 Volume. The volume of TRU waste generated at Babcock and Wilcox and packaged in containers other than 55-gal drums for storage at the Hanford Site in 1982 and 1983 is 140.4 m³ (x4,958 ft³). Figure 5-6 shows annual volumes of TRU waste generated and packaged in containers other than 55-gal drums.

5.1.3 Summary of Waste Generation Rates at Babcock and Wilcox Between 1977 and 1983

5.1.3.1 Number of Waste Containers. Between 1977 and 1983, there were 1,477 containers of radioactive solid waste generated at Babcock and Wilcox. Fifty-five-gallon drums account for 98 percent of this total; other containers account for the remaining 2 percent. Section 5.2, describes the container types used in greater detail. Figure 5-7 is a graph of the total number of TRU waste containers generated at Babcock and Wilcox on an annual basis during this period.

5.1.3.2 Total Weight. Over 176,593 kg (389,314 lb) of the radioactive solid waste stored at the Hanford Site was generated at Babcock and Wilcox between 1977 and 1983. Waste packaged in 55-gal drums accounts for about 59 percent of the total weight of waste from Babcock and Wilcox; 41 percent of the total weight comprised waste

packaged in some other type of waste container. Figure 5-8 provides a graph of the total weight of TRU waste generated at Babcock and Wilcox yearly between 1977 and 1983.

5.1.3.3 Total Volume. Between 1977 and 1983, 443.6 m³ (15,665 ft³) of the radioactive solid wastes stored at the Hanford Site were generated at Babcock and Wilcox. Sixty-eight percent of this volume comprised 55-gal drums; the remaining 32 percent of the volume is made up of other container types. Figure 5-9 shows the total volume of TRU generated at Babcock and Wilcox for 1977 through 1983.

5.2 WASTE CONTAINERS

Table 5-1 provides a summary of the TRU waste generated annually at Babcock and Wilcox from 1977 to 1983, sorted by container type. Fifty-five gallon metal drums, barrels, and kegs were the only container type used for the TRU waste before 1982.

In 1982 and 1983, other container types in addition to 55-gal drums also were used. Metal boxes, cartons, and cases were the most common containers used, accounting for more than 96 percent of the total TRU waste containers not packaged in 55-gal drums. The other storage container used for TRU waste was a portable tank. Figure 5-10 shows the tanks from Babcock and Wilcox emplaced on the asphalt pad in burial ground 4C on the right side of the photograph.

5.3 TRANSURANIC WASTE STORAGE LOCATIONS

Table 5-4 provides the storage location for TRU waste packaged in 55-gal drums by year. In 1978, drums from Babcock and Wilcox were stored in 218-W-4B. All the drums sent to the Hanford Site after 1978 were stored in a single location, 218-W-4C. The storage location for TRU waste packaged in other containers is also 218-W-4C, as shown in Table 5-5.

5.4 PHYSICAL CONTENTS OF TRANSURANIC WASTE CONTAINERS

The physical contents for 55-gal drums of TRU waste stored in 218-W-4C are shown in Table 5-6. The top portion of the table indicates the number of drums for which a given component is listed; the bottom portion of the table indicates the percentage of the total drums that number represents. It should be noted that before 1978, physical contents were not required to be listed on the burial records, so a great many of the contents on early records are listed only as 'miscellaneous.'

The most commonly listed waste constituents for the drums generated by cores 3 and 4 work were filters. In 1979, filters were packaged in 66 percent of the drums generated. In at least one-third of the drums generated in 1979, the following wastes were found:

- Cloth/rags/nylon
- Paper/cardboard

- Plastic/polyurethane
- Wood/lumber/plywood.

During the decontamination and cleanout of the Plutonium Facility the main items on the drum physical contents lists included the following:

- Cement
- Metal/iron/galvanized/sheet
- Paper/cardboard
- Plastic/polyurethane
- Plexiglass
- Rubber
- Wood/lumber/plywood.

The physical contents for TRU waste containers other than 55-gal drums can be found in Table 5-7. All containers other than 55-gal drums contain metal/iron/galvanized/sheet. Glass and cement also are common waste constituents in these containers.

5.5 RADIOLOGICAL DESCRIPTION OF BABCOCK AND WILCOX SOLID WASTE

Table 5-8 shows the number of TRU grams stored in 55-gal drums each year by storage location; Table 5-9 provides the same information for TRU containers other than 55-gal drums. Figure 5-11 combines the information on these tables in a graph that shows the total grams of TRU present in waste packages shipped to the Hanford Site from Babcock and Wilcox by year.

Burial records from Babcock and Wilcox were searched for containers with greater than 175 g of TRU. Table 5-10 summarizes the data for the 55-gal drums with high gram loading, and Table 5-11 provides the same information for containers other than 55-gal drums. Three of the five heavily gram-loaded containers are spread over a period of several years, and, therefore, probably represent routinely generated containers with abnormally high gram loading. However, two containers were recorded on the same date in 1982. These heavily gram-loaded containers probably represent an anomaly, such as a spill or other random occurrence.

5.6 RADIOACTIVE ISOTOPES PRESENT IN BABCOCK AND WILCOX SOLID WASTE

Information on radioactive isotopes was obtained primarily from the SWITS database and the summary table in Appendix B. Listed below are isotopes known to be in the Babcock and Wilcox solid wastestream:

5.6.1 Plutonium

The SWITS database shows Pu was contained in 773 burial containers in 1981; 246 containers in 1982; and 153 containers in 1983. The summary table lists 9 containers in 1977; 168 containers in 1978; and 127 containers in 1979.

5.6.2 Uranium

The SWITS database indicates the burial of 708 containers with natural uranium in 1981; 209 containers with depleted uranium in 1982; and 9 containers with depleted uranium in 1983.

5.6.3 Americium

The SWITS database has record of 21 containers with ²⁴¹Am being buried in 1981; 136 containers in 1982; and 8 containers in 1983.

5.7 HAZARDOUS CONSTITUENTS OF SOLID WASTE GENERATED BY BABCOCK AND WILCOX

This section provides a review of the data on the hazardous components found in the SWITS database and on the original burial records. Because information on the nonradioactive, hazardous chemicals in waste containers was not required on burial records before 1987, information before that date could be incomplete.

5.7.1 Solid Waste Information and Tracking System

Information about hazardous constituents of the solid waste from Babcock and Wilcox could be incomplete because of the recording and tracking practices in the years before 1987. According to the SWITS database, only one drum from 1981 is designated as mixed waste accounting for < 1 percent of the total drum count. This drum is stored in 218-W-4C and is listed as containing beryllium.

5.7.2 Burial Records

The SWBR or SWSDR for a given container is the source of waste container information abstracted from the SWITS database. Often these records will have more detailed information on the hazardous components of a waste container than is found in SWITS. Additional data also can be found on the supplementary forms often attached to the SWBR or SWSDR. These supplementary documents include Uniform Hazardous Waste Manifests, Contents Inventory Sheets, NRC 741 Forms, and Storage/Disposal Approval Records (SDAR).

A search of the microfilmed burial records indicated that beryllium was the only hazardous constituent listed among the solid waste sent from Babcock and Wilcox for storage at the Hanford Site. Table 5-12 contains a summary of the information obtained from the burial records.

5.7.3 Interviews with Babcock and Wilcox Facility Personnel

Personnel from Babcock and Wilcox indicated that the following hazardous constituents were used at the facility and are suspected in the waste sent for solid waste retrievable storage:

Mercury--Solidified with Fisher Scientific's Mercury Absorbent Powder

Resin--Dried, then solidified in concrete

Beryllium--If any beryllium is present it is probably left over from the source manufacturing days.

No organic solvents are likely to be found in waste packages because the presintering step in the process volatilized these compounds.

5.7.4 Hazardous Constituent Used in Babcock and Wilcox Facility Process

The following constituents were used in the fuel fabrication process for FFTF cores 1 and 2 and may or may not be present in the solid waste stream (Bradley and Clark 1978).

- **Scrap Recovery Process**
 - Resins
 - Nitric acid
 - Hydrofluoric acid
 - Sodium nitrite
 - Other metal nitrites
- **Analytical Chemistry Process**
 - Fuming sulfuric acid
 - Phosphoric acid.

This page intentionally left blank.

Figure 5-1. Number of Transuranic Fifty-Five-Gallon Drums Shipped to the Hanford Site by Babcock and Wilcox by Year.

BAW-9-91

Figure 5-2. Weight of Transuranic Fifty-Five-Gallon Drums Shipped to the Hanford Site by Babcock and Wilcox by Year.

BAW-3-02

Figure 5-3. Volume of Transuranic Fifty-Five-Gallon Drums Shipped to the Hanford Site by Babcock and Wilcox by Year.

5-11

Figure 5-4. Number of Transuranic Other Containers Shipped to the Hanford Site by Babcock and Wilcox by Year.

BAW-0-04

Figure 5-5. Weight of Transuranic Other Containers Shipped to the Hanford Site by Babcock and Wilcox by Year.

WHC-EP-0719

Figure 5-6. Volume of Transuranic Other Containers Shipped to the Hanford Site by Babcock and Wilcox by Year.

5-14

Figure 5-7. Total Number of Transuranic Waste Containers Shipped to the Hanford Site by Babcock and Wilcox by Year.

WHC-EP-07

Figure 5-8. Total Weight of Transuranic Waste Containers Shipped to the Hanford Site by Babcock and Wilcox by Year.

5-16

Figure 5-9. Total Volume of Transuranic Waste Containers Shipped to the Hanford Site by Babcock and Wilcox by Year.

BAW-5-89

Figure 5-10. Metal Box Storage on Asphalt Pad Transuranic Retrievable Storage Burial Ground 4C 200 West Area.

Note Babcock and Wilcox tanks on the right side of the photograph.

Figure 5-11. Grams of Transuranic Shipped to the Hanford Site by Babcock and Wilcox by Year.

BAW-6-10

Table 5-1. Transuranic Waste Generated at Babcock and Wilcox
by Container Type and Year. (2 sheets)

Container type	Container size	Number of containers	Percent of total	Weight (kg)	Percent weight (%)	Volume (m ³)	Percent Volume (%)
1977							
Metal drums, barrels, or kegs	*55-gal	9	100	612	100	1.9	100
Total		9		612		1.9	100
1978							
Metal drums, barrels, or kegs	*55-gal	168	100	13,388	100	32.2	100
Total		168		13,388	100	32.2	100
1979							
Metal drums, barrels, or kegs	*55-gal	127	100	5,791	100	26.2	100
Total		127		5,791		26.2	
1980							
1981							
Metal drums, barrels, or kegs	*55-gal	1	0.1	85	0.2	.2	0.1
	55-gal	772	99.9	52,575	99.8	163.4	99.9
Total		773		52,660		163.6	
1982							
Metal boxes, cartons, and cases	4 by 5 by 6 ft	1	0.4	3,175	3.8	3.4	2.0
	5 by 5 by 7 ft	7	2.9	20,400	24.4	34.3	20.2
	5 by 5 by 9 ft	1	0.4	2,737	3.3	6.2	3.6
	5.4 by 5.6 by 6.8 ft	11	4.5	29,463	35.3	64.0	37.6
	6 by 6 by 7 ft	2	0.8	6,350	7.6	12.9	7.6
Metal drums, barrels, or kegs	55-gal	223	91.4	19,852	23.8	47.3	27.8
Portable tanks	4 by 4 ft	1	0.4	1,533	1.8	2.0	1.2
Total		246		83,510		170.1	

**Table 5-1. Transuranic Waste Generated at Babcock and Wilcox
by Container Type and Year. (2 sheets)**

Container type	Container size	Number of containers	Percent of total	Weight (kg)	Percent weight (%)	Volume (m ³)	Percent Volume (%)
1983							
Metal boxes, cartons, and cases	5.4 by 5.6 by 6.8 ft	3	1.9	8,692	42.1	17.6	35.5
Metal drums, barrels, or kegs	55-gal	151	98.1	11,939	57.9	32.0	64.5
Total		154		20,631		49.6	

^aWaste attributed to another building in SWITS database.

^bThese containers hold mixed waste.

Table 5-2. Babcock and Wilcox Waste Summary Data for Fifty-Five-Gallon Drums.

55-gallon drums	1977	1978	1979	1980	1981	1982	1983
Distribution							
TRU count	9	168	127		773	223	151
TRU wt (kg)	612	13,388	5,791		52,660	19,852	11,939
TRU vol (m ³)	1.9	32.2	26.2		163.6	47.3	32.0
TRU MW count	0	0	0		1	0	0
Non-TRU count	0	0	0		0	0	0
Non-TRU wt (kg)	0	0	0		0	0	0
Non-TRU vol (m ³)	0	0	0		0	0	0
Non-TRU MW count	0	0	0		0	0	0
Percentage							
% TRU by count	100	100	100		100	100	100
% non-TRU by count	0	0	0		0	0	0
Wt% TRU	100	100	100		100	100	100
Wt% non-TRU	0	0	0		0	0	0
Vol% TRU	100	100	100		100	100	100
Vol% non-TRU	0	0	0		0	0	0
% of TRU drums that are TRU MW by count	0	0	0		0.1	0	0
% of non-TRU drums that are MW by count	N/A	N/A	N/A		N/A	N/A	N/A

MW = mixed waste.

TRU = transuranic.

**Table 5-3. Babcock and Wilcox Waste Summary Data for
Containers Other Than 55-Gallon Drums.**

Other containers	1977	1978	1979	1980	1981	1982	1983
Distribution							
TRU count					0	23	3
TRU wt (kg)					0	63,659	8,692
TRU vol (m ³)					0	122.8	17.6
TRU MW count					0	0	0
Non-TRU count					0	0	0
Non-TRU wt (kg)					0	0	0
Non-TRU vol (m ³)					0	0	0
Non-TRU MW count					0	0	0
Percentage							
% TRU by count					N/A	100	100
% non-TRU by count					N/A	0	0
Wt% TRU					N/A	100	100
Wt% non-TRU					N/A	0	0
Vol% TRU					N/A	100	100
Vol% non-TRU					N/A	0	0
% of TRU drums that are TRU MW by count					N/A	0	0
% of non-TRU drums that are MW by count					N/A	N/A	N/A

MW = Mixed waste.

TRU = Transuranic.

**Table 5-4. Babcock and Wilcox Transuranic Waste in
Fifty-Five-Gallon Drums--Drum Count
by Storage Location.**

	1977	1978	1979	1980	1981	1982	1983
218-W-4C		168	127		773	223	151
218-W-4B	9						

**Table 5-5. Babcock and Wilcox Transuranic Waste in
Containers Other Than Fifty-Five-Gallon Drums--
Container Count by Storage Location.**

	1977	1978	1979	1980	1981	1982	1983
218-W-4C					0	23	3

Table 5-6. Distribution and Percentage of Transuranic Fifty-Five-Gallon Drum Physical Contents by Storage Location--218-W-4C.

	1977	1978	1979	1980	1981	1982	1983
Distribution							
Cement					190	162	87
Ceramics						52	
Cloth/rags/nylon			42			15	
Filters			84		258	49	64
Glass					304	62	
Metal/iron/galvanized/sheet					304	166	87
Misc/unknown/other	9	168	43		66		
Paper/cardboard			42		403	57	64
Plastic/polyurethane			42		403	57	64
Plexiglass						104	87
Rubber					403	42	64
Wood/lumber/plywood			42		377	57	64
Percentage							
Cement					25	73	58
Ceramics						23	
Cloth/rags/nylon			33			7	
Filters			66		33	22	42
Glass					39	28	
Metal/iron/galvanized/sheet					39	74	58
Misc/unknown/other	100	100	34		9		
Paper/cardboard			33		52	26	42
Plastic/polyurethane			33		52	26	42
Plexiglass						47	58
Rubber					52	19	42
Wood/lumber/plywood			33		49	26	42

Table 5-7. Distribution and Percentage of Transuranic Containers Other Than Fifty-Five-Gallon Drum Physical Contents by Storage Location--218-W-4C.

	1977	1978	1979	1980	1981	1982	1983
Distribution							
Brick/firebrick						3	
Cement						7	1
Concrete						2	
Filters							1
Glass						23	1
Metal/iron/galvanized/sheet						23	3
Stainless steel						2	
Percentage							
Brick/firebrick						13	
Cement						30	33
Concrete						9	
Filters							33
Glass						100	33
Metal/iron/galvanized/sheet						100	100
Stainless steel						9	

Table 5-8. Babcock and Wilcox Transuranic Waste in Fifty-Five-Gallon Drums--Total Grams Transuranic by Storage Location.

Location	1977	1978	1979	1980	1981	1982	1983
218-W-4B	574.0						
218-W-4C		4,198.0	369.0		11,033.8	1,818.9	47.2

Table 5-9. Babcock and Wilcox Transuranic Waste in Containers Other Than Fifty-Five-Gallon Drums--Total Grams Transuranic by Storage Location.

Location	1977	1978	1979	1980	1981	1982	1983
218-W-4C						1,478.2	221.4

Table 5-10. Fifty-Five-Gallon Drum Waste from Babcock and Wilcox Containing Greater than 175 Grams Transuranic.

Disposal date	Container identification	Storage location	Weight (kg)	TRU (g)	Physical contents	Hazard comp
04/26/77	234-5-ARCHO-77-407 (BW: H-77-4-11)	218-W-4B	* 68	194	Misc/unknown/other	
11/21/78	325-WHC-78-172 (BW: WH-101-W)	218-W-4C	* 68	179	Misc/unknown/other	

*Average weight.

TRU = transuranic waste.

**Table 5-11. Other Container Waste from Babcock and Wilcox
Containing Greater than 175 Grams Transuranic.**

Disposal date	Container identification	Storage location	Weight (kg)	TRU (g)	Physical contents		Hazard comp
					Contents	Percent	
09/17/82	353618-2 (BW: MK-1-67)	218-W-4C	2980	196	Metal Glass Cement	89.5 10.3 0.2	
09/17/82	353619-2 (BW: MK-57)	218-W-4C	2791	185	Metal Glass Cement	95.3 4.5 0.3	
02/07/83	353617-1 (BW: MK-1-3)	218-W-4C	2619	191	Metal Glass Cement	87.5 11.5 1.0	

TRU = Transuranic.

**Table 5-12. Summary of Information from Solid Waste Storage Disposal Records
for TRU Wastes with Hazardous Contents from Babcock and Wilcox.**

Date Accepted	Pin Number	Burial Record Number	Hazardous Constituents	Waste Codes	Weight (kg)	Volume (%)
11/12/81	3536-10-A (B&W S-713)	BABCX-APA-81-7	Beryllium			

6.0 REFERENCES

- AEC, 1970, *Immediate Action Directive*, IAD-0511-21, U.S. Atomic Energy Commission, Washington, D.C.
- AEC, 1973, *Atomic Energy Commission Manual*, Chapter 0511, "Radioactive Waste Management," U.S. Atomic Energy Commission, Washington, D.C.
- Anderson, B. C., J. D. Anderson, J. A. Demiter, D. R. Duncan, L. A. Fort, D. C. McCann, and S. J. Stone, 1991, *Contact-Handled Transuranic Waste Characterization Based on Existing Records*, WHC-EP-0225, Revision 1, Westinghouse Hanford Company, Richland, Washington.
- Babcock and Wilcox, 1983, *Technical Data Summary Report on Decontamination and Removal of Equipment in the Parks Township Site Plutonium Facility - May 1983*, Babcock and Wilcox Company, Apollo, Pennsylvania.
- Bradley, J. G., and D. E. Clark, 1978, *Waste Generated During Fabrication of Mixed Oxide Nuclear Fuels*, HEDL-TME-78-71, Hanford Engineering Development Laboratory, Richland, Washington.
- DOE, 1982, *Management of Transuranic Material*, DOE Order 5820.1, U.S. Department of Energy, Washington, D.C.
- Duncan, D. R., 1991, *Solid Waste Program Plan (Appendix A)*, WHC-EP-0363, Rev. 1, Westinghouse Hanford Company, Richland, Washington.
- Duncan, D. R., D. A. Burbank, B. C. Anderson, and J. A. Demiter, 1992, *Application of Service Examinations to Transuranic Waste Container Integrity at the Hanford Site*, WHC-SA-1450-FP, Rev. 1, Westinghouse Hanford Company, Richland, Washington.
- 40 CFR 265, 1991, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*, as amended.
- 52 FR 1987, "Radioactive Waste: Byproducts Material Final Rule," *Federal Register*, Vol. 52 (84), pp 15937-15941.
- Reddinger, R. W., 1992, *Unstable and Reactive Chemicals in Transuranic Retrievable Waste at the Hanford Site - A Review of Available Data*, WHC-EP-0603, Westinghouse Hanford Company, Richland, Washington.
- Resource Conservation and Recovery Act of 1976*, 42 USC 6901 et seq.
- Willis, N. P., and G. C. Triner, 1991, *Hanford Site Radioactive Solid Waste Acceptance Criteria*, WHC-EP-0063-3, Westinghouse Hanford Company, Richland, Washington.

This page intentionally left blank.

APPENDIX A

**DATA ON BABCOCK AND WILCOX WASTE GENERATION FROM THE
SOLID WASTE INFORMATION TRACKING SYSTEM**

This page intentionally left blank.

**DATA ON BABCOCK AND WILCOX WASTE GENERATION FROM THE
SOLID WASTE INFORMATION TRACKING SYSTEM**

The information found in this appendix is from the Solid Waste Information and Tracking System (SWITS) database. This database incorporates the older R-SWIMS database and is used to track information on radioactive and other wastes stored or disposed at the Hanford Site.

Each SWITS data run in this appendix is preceded by the query used to generate the data. A brief explanation of the run and any additional information needed to understand the data presented also is included.

The bulk of the data provided is limited to information about TRU waste generated at Babcock and Wilcox; however, some general information on the non-TRU waste is included for completeness. The term non-TRU is used, instead of LLW, because a small percentage of the waste has been designated only as not TRU. It is believed that most, if not all, of the non-TRU waste is LLW.

The data runs in this appendix are further segregated by waste container type. Since initial retrieval efforts and WRAP 1 will focus on 55-gal drums, these container types are considered separately.

Some general information about SWITS database and the codes used follows. Please note the disclaimer found on the next page.

DON'T SAY IT --- Write It !

Date:

To: *Judy Pattmeyer*

From: Solid Waste Engineering Data Management Group
N3-11 6-4394/6-4020

Re: SWITS DATA REQUEST

Attached for your information and use is the data which you requested. This data represents best available information regarding wastes currently in storage at the Hanford Site. I trust the information will be suitable to your needs.

Requests for information from the Solid Waste Information and Tracking System (SWITS) are normally relatively limited in scope, requesting specific data fields or summary data. The responses to these requests undergo review during data collection, summary and response preparation.

The response to this request represents a simple reproduction of the SWITS Database. Transmittal of this information is made with the following disclaimers:

- 1) The information contained in this transmittal is raw data, and represents information provided to Solid Waste Engineering (SWE) on burial records or other documents. This data has not been validated.
- 2) The information contained in this transmittal is subject to change without notice. Continual update of SWITS information and improvement of the software system make it impossible to ensure consistency of this data with the database after transmittal.
- 3) This information is current as of 12/11/92.

If I can be of further assistance to you, do not hesitate to call me.

APPENDIX A.1

**CONTAINER NUMBER AND WEIGHT OF TRANSURANIC WASTE IN
FIFTY-FIVE-GALLON DRUMS BY WASTE TYPE**

This page intentionally left blank.

**CONTAINER NUMBER AND WEIGHT OF TRANSURANIC WASTE IN
FIFTY-FIVE-GALLON DRUMS BY WASTE TYPE**

This data run gives an overall look at the waste types, container numbers, and total weight (in kilograms) of the radioactive wastes generated yearly at Babcock and Wilcox. These data are for wastes stored in 55-gal drums only. The introduction to Appendix A contains a table of primary and secondary waste codes and their meanings.

From 1970 until 1978 individual container weights were not required for TRU drums. During the data reentry program in the mid-1980's, standard weights were assigned for all container types; 55-gal drums were given a standard weight of 68 kg. This is why the average weight/drum for TRU is so consistent during this period.

```

set linesize 170
set pagesize 45
set newpage 0
spool pot2a.srep
title center 'BABCX' -
right 'Page:' format 999 sql.pno skip 1
break on dt skip 1
compute sum of sum(con_gross_wgt) on dt
compute sum of sum(rdet_rswims_count) on dt
compute sum of sum(con_cntr_vol) on dt
col dt                                format a4          heading "Date"
col con_pwtyp_cd                      format a4          heading "Pri|Wast|Type"
col rdet_swtyp_cd                     format a4          heading "Sec|Wast|Type"
col sum(rdet_rswims_count)            format 999999      heading "Count"
col avg(con_gross_wgt)                format 99999.99    heading "Avg|Weight"
col sum(con_gross_wgt)                format 999999.99    heading "Sum|Weight"
col sum(con_cntr_vol)                 format 99999.99    heading "Sum|Vol"
col avg(con_cntr_vol)                 format 99999.99    heading "Avg|Vol"
col cntyp_descr                       format a30        heading "Container Description"
col con_size_descr                    format a25        heading "Container Size"
select cntyp_descr,
       con_size_descr,
       substr (to_char(con_tsd_accept_dt, 'YYYY'),1, 4) dt,
       con_pwtyp_cd,
       rdet_swtyp_cd,
       sum(rdet_rswims_count),
       sum(con_gross_wgt),
       avg(con_gross_wgt),
       sum(con_cntr_vol),
       avg(con_cntr_vol)
from radwaste, cntype
where con_tsd_accept_dt between '01-jan-69' and '31-dec-92' and
con_srce_facil_id = 'BABCX'
and con_size_descr = '55 GALLON' and con_cntyp_cd = cntyp_cd
group by cntyp_descr,
       con_size_descr,
       con_pwtyp_cd,
       substr (to_char(con_tsd_accept_dt, 'YYYY'),1, 4),
       rdet_swtyp_cd
;
spool off

```


A.1-5

		BABCX							
Container Description	Container Size	Date	Pri	Sec	Count	Sum Weight	Avg Weight	Sum Vol	Avg Vol
			Wast	Wast					
			Type	Type					
METAL DRUMS, BARRELS, KEGS	55 GALLON	1981	M	1A	1	85.27	85.27	.21	.21
METAL DRUMS, BARRELS, KEGS	55 GALLON		R	1A	772	52574.75	68.10	163.38	.21

		sum			773	52660.02		163.59	
METAL DRUMS, BARRELS, KEGS	55 GALLON	1982	R	1A	223	19851.78	89.02	47.28	.21

		sum			223	19851.78		47.28	
METAL DRUMS, BARRELS, KEGS	55 GALLON	1983	R	1A	151	11938.78	79.06	32.01	.21

		sum			151	11938.78		32.01	

Page: 1

WHC-EP-0719

This page intentionally left blank.

APPENDIX A.2

**BABCOCK AND WILCOX TRANSURANIC WASTE CONTAINERS
SORTED BY CONTAINER DESCRIPTION, SIZE, YEAR,
AND PRIMARY WASTE TYPE**

This page intentionally left blank.

**BABCOCK AND WILCOX TRANSURANIC WASTE CONTAINERS
SORTED BY CONTAINER DESCRIPTION, SIZE, YEAR,
AND PRIMARY WASTE TYPE**

This subappendix provides information on Babcock and Wilcox TRU waste containers, weight, volume, and primary waste type stored at various TRU waste storage facilities on the Hanford Site. The data provides the TRU waste generation from the Babcock and Wilcox facility by year.

```

set linesize 170
set pagesize 44
set newpage 0
spool pot3.srep
title center 'TRU WASTE- BABCOX APA' -
right 'Page:' format 999 sql.pno skip 1
break on dt skip 1
compute sum of sum(con_gross_wgt) on dt
compute sum of sum(rdet_rswims_count) on dt
col dt                                format a4          heading "Date"
col con_pwtyp_cd                      format a4          heading "Pri|Wast|Type"
col rdet_swtyp_de                     format a4          heading "Sec|Wast|Type"
col sum(con_gross_wgt)                format 999999.99      heading "Weight"
col sum(rdet_rswims_count)            format 99999          heading "Count"
col avg(con_gross_wgt)                format 999999.99      heading "Avg|Weight"
col sum(con_cntr_vol)                 format 99999.99       heading "Volume"
col avg(con_cntr_vol)                 format 99999.99       heading "Avg|Volume"
col cntyp_descr                       format a55          heading "Container Discription"
col con_size_descr                    format a45          heading "Container Size"
col con_locn_facil_id                 format a8          heading "Facility"
select
    cntyp_descr,
    con_size_descr,
    substr (to_char(con_tsd_accept_dt, 'YYYY'),1, 4) dt,
    con_pwtyp_cd,
    con_locn_facil_id,
    sum(rdet_rswims_count),
    sum(con_gross_wgt),
    avg(con_gross_wgt),
    sum(con_cntr_vol),
    avg(con_cntr_vol)
from radwaste, contype
where con_tsd_accept_dt between '01-jan-69' and '31-dec-92' and
con_srce_cmpny_id = 'APA' and
con_srce_facil_id = 'BABCOX'
and rdet_swtyp_cd in ('1A','1B','1C','1D','1E','1F','UG','UF','UJ') and
con_cntyp_cd = cntyp_cd
group by cntyp_descr,
    con_size_descr,
    substr (to_char(con_tsd_accept_dt, 'YYYY'),1, 4) ,
    con_pwtyp_cd,
    con_locn_facil_id
;
spool off

```

TRU WASTE- BABCOX APA

Page: 1

Container Discription	Container Size	Pri Wast Date Type Facility	Count	Weight	Avg Weight	Volume	Avg Volume
METAL BOXES, CARTONS, CASES	4*5*6	1982 R 218W4C	1	3175.13	3175.13	3.40	3.40
METAL BOXES, CARTONS, CASES	5*5*7	R 218W4C	7	20400.21	2914.32	34.29	4.90
METAL BOXES, CARTONS, CASES	5*5*9	R 218W4C	1	2736.96	2736.96	6.23	6.23
METAL BOXES, CARTONS, CASES	5.4*5.6*6.8	R 218W4C	11	29463.40	2678.49	63.97	5.82

		sum	20	55775.70			
METAL BOXES, CARTONS, CASES	5.4*5.6*6.8	1983 R 218W4C	3	8692.15	2897.38	17.64	5.88

		sum	3	8692.15			
METAL BOXES, CARTONS, CASES	6*6*7	1982 R 218W4C	2	6350.26	3175.13	12.91	6.46

		sum	2	6350.26			
METAL DRUMS, BARRELS, KEGS	55 GALLON	1981 M 218W4C	1	85.27	85.27	.21	.21
METAL DRUMS, BARRELS, KEGS	55 GALLON	R 218W4C	772	52574.75	68.10	163.38	.21

		sum	773	52660.02			
METAL DRUMS, BARRELS, KEGS	55 GALLON	1982 R 218W4C	223	19851.78	89.02	47.28	.21

		sum	223	19851.78			
METAL DRUMS, BARRELS, KEGS	55 GALLON	1983 R 218W4C	151	11938.78	79.06	32.01	.21

		sum	151	11938.78			
TANKS, PORTABLE	4*4	1982 R 218W4C	1	1533.13	1533.13	2.04	2.04

		sum	1	1533.13			

11 rows selected.

A.2-5

WHC-EP-0719

This page intentionally left blank.

APPENDIX A.3

**RADIOLOGICAL DATA FOR TRANSURANIC WASTE CONTAINERS
SORTED BY DATE, PRIMARY WASTE TYPE, AND
STORAGE FACILITY**

This page intentionally left blank.

**RADIOLOGICAL DATA FOR TRANSURANIC WASTE CONTAINERS
SORTED BY DATE, PRIMARY WASTE TYPE, AND
STORAGE FACILITY**

This subappendix summarizes the radiological data for all TRU waste containers generated at Babcock and Wilcox. Specifically, this computer run provides the total grams of TRU elements in a given container type in a given year. Additionally, the average gram loading for a given container type in a given year has been calculated.

In 1991 and 1992 the number of curies (Ci) of alpha radiation was included on the SWBRs. Since the Babcock and Wilcox waste generation data is all from 1970 to 1988, these columns contain blank entries. The "Max Dose" column contains the highest value recorded for a given container in a given year, in millirems per hour.

Additional information about the isotopes present in Babcock and Wilcox waste containers can be found in subappendices A.9 and A.10.

```

set linesize 170
set pagesize 44
set newpage 0
spool pot4.srep
tttitle center 'TRU Waste BABCX' -
right 'Page:' format 999 sql.pno skip 1
break on dt skip 1
compute sum of sum(rdet_rswims_count) on dt
compute sum of sum(rdet_rswims_count) on report
compute sum of sum(rad_qty) on dt
compute sum of avg(rad_qty) on dt
compute sum of sum(rad_alpha_ci) on dt
compute sum of avg(rad_alpha_ci) on dt
compute sum of max(rdet_bg_dose_rate) on dt
col dt                format a4                heading "Date"
col cntyp_descr       format a45                heading "Container Description"
col con_size_descr    format a20                heading "Container Size"
col con_pwtyp_cd      format a4                heading "Pri|Wast|Type"
col con_locn_facil_id format a8                heading "Location"
col sum(rdet_rswims_count) format 999999        heading "Count"
col sum(rad_qty)      format 999999.99          heading "Total|TRU (g)"
col avg(rad_qty)      format 99999.99           heading "Avg|TRU (g)"
col sum(rad_alpha_ci) format 999999.99          heading "Total|Alpha (ci)"
col avg(rad_alpha_ci) format 999999.99          heading "Avg|Alpha (ci)"
col max(rdet_bg_dose_rate) format 999999.99     heading "Max|Alpha (ci)"
select cntyp_descr,
       con_size_descr,
       substr(to_char(con_tsd_accept_dt, 'YYYY'), 1, 4) dt,
       con_pwtyp_cd,
       con_locn_facil_id,
       sum(rdet_rswims_count),
       sum(rad_qty),
       avg(rad_qty),
       sum(rad_alpha_ci),
       avg(rad_alpha_ci),
       max(rdet_bg_dose_rate)
from radwaste, cntype, isoqty
where con_tsd_accept_dt between '01-jan-69' and '31-dec-92' and
con_srce_facil_id = 'BABCX' and
rad_iso_num in (1,21,22,26,41,52,87,97,98,100,104,105,111,146,147) and
rdet_swtyp_cd in ('1A','1B','1C','1D','1E','1F','UF','UG','UJ') and
con_cntyp_cd = cntyp_cd(+) and con_pkg_id = rad_pkg_id(+)
group by cntyp_descr,
       con_size_descr,
       con_pwtyp_cd,
       substr(to_char(con_tsd_accept_dt, 'YYYY'), 1, 4),
       con_locn_facil_id
;
spool off
tttitle off

```

TRU Waste BABCX

Page: 1

Container Description	Container Size	Pri		Count	Total TRU (g)	Avg TRU (g)	Total Alpha (ci)	Avg Alpha (ci)	Max Alpha (ci)
		Date	Waste Type Location						
METAL BOXES, CARTONS, CASES	4*5*6	1982	R 218W4C	2	10.47	5.24			1.00
METAL BOXES, CARTONS, CASES	5*5*7		R 218W4C	14	750.42	53.60			6.00
METAL BOXES, CARTONS, CASES	5*5*9		R 218W4C	2	48.78	24.39			1.00
METAL BOXES, CARTONS, CASES	5.4*5.6*6.8		R 218W4C	15	658.28	43.89			2.50

		sum		33	1467.95	127.11	.00	.00	10.50
METAL BOXES, CARTONS, CASES	5.4*5.6*6.8	1983	R 218W4C	4	221.40	55.35			160.00

		sum		4	221.40	55.35	.00	.00	160.00
METAL BOXES, CARTONS, CASES	6*6*7	1982	R 218W4C	4	10.23	2.56			1.00

		sum		4	10.23	2.56	.00	.00	1.00
METAL DRUMS, BARRELS, KEGS	55 GALLON	1981	M 218W4C	1	32.00	32.00			1.00
METAL DRUMS, BARRELS, KEGS	55 GALLON		R 218W4C	793	11001.83	13.87			1.00

		sum		794	11033.83	45.87	.00	.00	2.00
METAL DRUMS, BARRELS, KEGS	55 GALLON	1982	R 218W4C	344	1818.94	5.29			42.00

		sum		344	1818.94	5.29	.00	.00	42.00
METAL DRUMS, BARRELS, KEGS	55 GALLON	1983	R 218W4C	157	47.17	.30			200.00

		sum		157	47.17	.30	.00	.00	200.00
TANKS, PORTABLE	4*4	1982	R 218W4C	1	.02	.02			.04

		sum		1	.02	.02	.00	.00	.04

11 rows selected.

This page intentionally left blank.

APPENDIX A.4

**PHYSICAL CONTENTS DESCRIPTION FOR BABCOCK AND WILCOX FIFTY-FIVE-GALLON
DRUMS CONTAINING TRANSURANIC WASTE SORTED BY DATE, PRIMARY
WASTE TYPE, AND STORAGE FACILITY**

This page intentionally left blank.

**PHYSICAL CONTENTS DESCRIPTION FOR BABCOCK AND WILCOX FIFTY-FIVE-GALLON
DRUMS CONTAINING TRANSURANIC WASTE SORTED BY DATE, PRIMARY
WASTE TYPE, AND STORAGE FACILITY**

This subappendix describes the physical contents of the 55-gal drums of TRU waste generated by Babcock and Wilcox. Because physical contents were not required on the burial records before 1978, a great many of the early records list the contents of the drum as "Miscellaneous."

The printout for this computer run sorts the contents data by storage facility, date, and primary waste type. The introduction to Appendix A contains a table of waste codes and their meanings.

```

set linesize 170
set pagesize 45
set newpage 0
spool pot5.srep
tttitle center 'TRU WASTE- BABCOX APA ' -
right 'Page:' format 999 sql.pno skip 1
break on con_locn_facil_id skip 1
col phys_comp_descr          format a40          heading "Physical Description"
col cntyp_descr              format a55          heading "Container Discription"
col con_size_descr           format a45          heading "Container Size"
col dt                       format a4          heading "Date"
col con_pwtyp_cd             format a4          heading "Pri|Wast|Type"
col con_locn_facil_id        format a8          heading "Facility"
col sum(rdet_rswims_count)    format 999999      heading "Count"
compute sum of sum(rdet_rswims_count) on con_locn_facil_id
select phys_comp_descr,
       cntyp_descr,
       con_size_descr,
       substr (to_char(con_tsd_accept_dt, 'YYYY'),1, 4) dt,
       con_pwtyp_cd,
       con_locn_facil_id,
       sum(rdet_rswims_count)
from radwaste, contype, physcomp
where con_tsd_accept_dt between '01-jan-69' and '31-dec-92' and
con_srce_cmpny_id = 'APA' and
con_srce_facil_id = 'BABCOX'
and con_size_descr = '55 GALLON'
and rdet_swtyp_cd in ('1A','1B','1C','1D','1E','1F','UG','UF','UJ') and
con_cntyp_cd = cntyp_cd and con_pkg_id = phys_pkg_id(+)
group by con_locn_facil_id,
phys_comp_descr,
con_pwtyp_cd,
substr (to_char(con_tsd_accept_dt, 'YYYY'),1, 4),
cntyp_descr,
con_size_descr
;
spool off

```

Physical Description	Container Discription	Container Size	Pri Wast		Count
			Date	Type Facility	
CEMENT	METAL DRUMS, BARRELS, KEGS	55 GALLON	1981 M	218W4C	1
CEMENT	METAL DRUMS, BARRELS, KEGS	55 GALLON	1981 R		129
CEMENT	METAL DRUMS, BARRELS, KEGS	55 GALLON	1982 R		162
CEMENT	METAL DRUMS, BARRELS, KEGS	55 GALLON	1983 R		87
CERAMICS	METAL DRUMS, BARRELS, KEGS	55 GALLON	1982 R		52
CLOTH/RAGS/NYLON	METAL DRUMS, BARRELS, KEGS	55 GALLON	1982 R		15
FILTERS	METAL DRUMS, BARRELS, KEGS	55 GALLON	1981 R		258
FILTERS	METAL DRUMS, BARRELS, KEGS	55 GALLON	1982 R		49
FILTERS	METAL DRUMS, BARRELS, KEGS	55 GALLON	1983 R		64
GLASS	METAL DRUMS, BARRELS, KEGS	55 GALLON	1981 M		1
GLASS	METAL DRUMS, BARRELS, KEGS	55 GALLON	1981 R		303
GLASS	METAL DRUMS, BARRELS, KEGS	55 GALLON	1982 R		62
METAL/IRON/GALVANIZED/SHEET	METAL DRUMS, BARRELS, KEGS	55 GALLON	1981 M		1
METAL/IRON/GALVANIZED/SHEET	METAL DRUMS, BARRELS, KEGS	55 GALLON	1981 R		303
METAL/IRON/GALVANIZED/SHEET	METAL DRUMS, BARRELS, KEGS	55 GALLON	1982 R		166
METAL/IRON/GALVANIZED/SHEET	METAL DRUMS, BARRELS, KEGS	55 GALLON	1983 R		87
MISCELLANEOUS/UNKNOWN/OTHER	METAL DRUMS, BARRELS, KEGS	55 GALLON	1981 R		66
PAPER/CARDBOARD	METAL DRUMS, BARRELS, KEGS	55 GALLON	1981 R		403
PAPER/CARDBOARD	METAL DRUMS, BARRELS, KEGS	55 GALLON	1982 R		57
PAPER/CARDBOARD	METAL DRUMS, BARRELS, KEGS	55 GALLON	1983 R		64
PLASTIC/POLYURATHANE	METAL DRUMS, BARRELS, KEGS	55 GALLON	1981 R		403
PLASTIC/POLYURATHANE	METAL DRUMS, BARRELS, KEGS	55 GALLON	1982 R		57
PLASTIC/POLYURATHANE	METAL DRUMS, BARRELS, KEGS	55 GALLON	1983 R		64
PLEXIGLASS	METAL DRUMS, BARRELS, KEGS	55 GALLON	1982 R		104
PLEXIGLASS	METAL DRUMS, BARRELS, KEGS	55 GALLON	1983 R		87
RUBBER	METAL DRUMS, BARRELS, KEGS	55 GALLON	1981 R		403
RUBBER	METAL DRUMS, BARRELS, KEGS	55 GALLON	1982 R		42
RUBBER	METAL DRUMS, BARRELS, KEGS	55 GALLON	1983 R		64
WOOD/LUMBER/PLYWOOD	METAL DRUMS, BARRELS, KEGS	55 GALLON	1981 R		377
WOOD/LUMBER/PLYWOOD	METAL DRUMS, BARRELS, KEGS	55 GALLON	1982 R		57
WOOD/LUMBER/PLYWOOD	METAL DRUMS, BARRELS, KEGS	55 GALLON	1983 R		64

SUM					4112

31 rows selected.

A.4-5

WHC-EP-0719

This page intentionally left blank.

APPENDIX A.5

**PHYSICAL CONTENTS DESCRIPTION FOR BABCOCK AND WILCOX TRANSURANIC
WASTE CONTAINERS OTHER THAN FIFTY-FIVE-GALLON DRUMS SORTED
BY DATE, PRIMARY WASTE TYPE, AND STORAGE FACILITY**

This page intentionally left blank.

**PHYSICAL CONTENTS DESCRIPTION FOR BABCOCK AND WILCOX TRANSURANIC
WASTE CONTAINERS OTHER THAN FIFTY-FIVE-GALLON DRUMS SORTED
BY DATE, PRIMARY WASTE TYPE, AND STORAGE FACILITY**

This subappendix describes the physical contents of the TRU waste containers other than 55-gal drums generated at Babcock and Wilcox. Because physical contents were not required on the burial records before 1978, a great many of the early records list the contents of the drum as "Miscellaneous."

The printout for this computer run sorts the contents data by storage facility, date, and primary waste type. The introduction to Appendix A contains a table of waste codes and their meanings.

```

set linesize 170
set pagesize 45
set newpage 0
spool pot6.srep
tttitle center 'TRU WASTE - BABCOX APA' -
right 'Page:' format 999 sql.pno skip 1
break on con_locn_facil_id skip 1
col phys_comp_descr          format a40      heading "Physical Description"
col con_size_descr          format a47      heading "Container Description"
col cntyp_descr             format a45      heading "Container Size"
col dt                      format a4       heading "Date"
col con_pwtyp_cd            format a4       heading "Pri|Wast|Type"
col con_locn_facil_id       format a8       heading "Facility"
col sum(rdet_rswims_count)   format 999999  heading "Count"
col rdet_swtyp_cd           format a4       heading "Sec|Wast|Type"
compute sum of sum(rdet_rswims_count) on con_locn_facil_id
select phys_comp_descr,
       cntyp_descr,
       con_size_descr,
       substr (to_char(con_tsd_accept_dt, 'YYYY'),1, 4) dt,
       con_pwtyp_cd,
       rdet_swtyp_cd,
       con_locn_facil_id,
       sum(rdet_rswims_count)
from radwaste, contype, physcomp
where con_tsd_accept_dt between '01-jan-69' and '31-dec-92' and
con_srce_cmpny_id = 'APA' and
con_srce_facil_id = 'BABCX'
and con_size_descr <> '55 GALLON'
and rdet_swtyp_cd in ('1A','1B','1C','1D','1E','1F','UG','UF','UJ') and
con_cntyp_cd = cntyp_cd and con_pkg_id = phys_pkg_id(+)
group by con_locn_facil_id,
phys_comp_descr,
con_pwtyp_cd,
rdet_swtyp_cd,
substr (to_char(con_tsd_accept_dt, 'YYYY'),1, 4),
cntyp_descr,
con_size_descr
;
spool off

```


WHC-EP-0719

A.5-5

This page intentionally left blank.

APPENDIX A.6

**HAZARDOUS CONSTITUENTS OF FIFTY-FIVE-GALLON
DRUMS CONTAINING TRANSURANIC WASTE**

This page intentionally left blank.

**HAZARDOUS CONSTITUENTS OF FIFTY-FIVE-GALLON
DRUMS CONTAINING TRANSURANIC WASTE**

The presence of hazardous constituents in a radioactive waste drum designates the waste as "Mixed" (primary waste code "M"). In this subappendix the hazardous contents of 55-gal drums generated at Babcock and Wilcox are sorted by storage facility.

Information concerning the hazardous constituents of waste containers was not required before 1986. During the R-SWIMS data reentry program in the mid-1980's, an attempt was made to add any available information on the hazardous materials present; however, this information was limited.

```

set linesize 170
set pagesize 45
set newpage 0
spool pot7.srep
title center 'TRU Waste - BABCOX APA ' -
right 'Page:' format 999 sql.pno skip 1
break on con_locn_facil_id skip 1
col haz_comp_text          format a40          heading "Hazardous"
col con_size_descr        format a45          heading "Container Description"
col cntyp_descr           format a40          heading "Container Size"
col dt                    format a4           heading "Date"
col con_pwtyp_cd          format a4           heading "Pri|Wast|Type"
col con_locn_facil_id     format a8           heading "Facility"
col sum(rdet_rswims_count) format 9999999    heading "Count"
compute sum of sum(rdet_rswims_count) on con_locn_facil_id
select haz_comp_text,
       substr (to_char(con_tsd_accept_dt, 'YYYY'),1, 4) dt,
       cntyp_descr,
       con_size_descr,
       con_pwtyp_cd,
       con_locn_facil_id,
       sum(rdet_rswims_count)
from radwaste, contype, chemcomp
where con_tsd_accept_dt between '01-jan-69' and '31-dec-92' and
con_srce_cmpny_id = 'APA' and
con_srce_facil_id = 'BABCOX'
and con_size_descr = '55 GALLON'
and rdet_swtyp_cd in ('1A','1B','1C','1D','1E','1F','UG','UF','UJ') and
con_cntyp_cd = cntyp_cd and con_pkg_id = haz_pkg_id
group by con_locn_facil_id,
haz_comp_text,
con_pwtyp_cd,
substr (to_char(con_tsd_accept_dt, 'YYYY'),1, 4),
cntyp_descr,
con_size_descr
;
spool off

```

A.6-5

TRU Waste - BABCOX APA

Page: 1

Hazardous	Date	Container Size	Container Description	Pri Wast Type	Facility	Count
BERYLLIUM		1981 METAL DRUMS, BARRELS, KEGS	55 GALLON	M	218W4C	1
				*****	-----	
				sum		1

WHC-EP-0719

This page intentionally left blank.

APPENDIX A.7

**HAZARDOUS CONSTITUENTS OF TRANSURANIC WASTE CONTAINERS
OTHER THAN FIFTY-FIVE-GALLON DRUMS**

This page intentionally left blank.

**HAZARDOUS CONSTITUENTS OF TRANSURANIC WASTE CONTAINERS
OTHER THAN FIFTY-FIVE-GALLON DRUMS**

The presence of hazardous constituents in a radioactive waste drum designates the waste as "Mixed" (primary waste code "M"). No hazardous constituents are listed in containers other than 55-gal drums generated at Babcock and Wilcox; therefore, this run did not reveal any hazardous information.

```

set linesize 170
set pagesize 45
set newpage 0
spool pot8.srep
title center 'TRU Waste - BABCOX APA' -
right 'Page:' format 999 sql.pno skip 1
break on con_locn_facil_id skip 1
col haz_comp_text          format a40          heading "Hazardous"
col con_size_descr        format a45          heading "Container Description"
col cntyp_descr           format a40          heading "Container Size"
col dt                    format a4           heading "Date"
col con_pwtyp_cd          format a4           heading "Pri|Wast|Type"
col con_locn_facil_id     format a8           heading "Facility"
col sum(rdet_rswims_count) format 999999     heading "Count"
select haz_comp_text,
       substr (to_char(con_tsd_accept_dt, 'YYYY'),1, 4) dt,
       cntyp_descr,
       con_size_descr,
       con_pwtyp_cd,
       con_locn_facil_id,
       rdet_rswims_count
from radwaste, contype, chemcomp
where con_tsd_accept_dt between '01-jan-69' and '31-dec-92' and
con_srce_cmpny_id = 'APA' and
con_srce_facil_id = 'BABCOX'
and con_size_descr <> '55 GALLON'
and rdet_swtyp_cd in ('1A','1B','1C','1D','1E','1F','UG','UF','UJ') and
con_cntyp_cd = cntyp_cd and con_pkg_id = haz_pkg_id
group by con_locn_facil_id,
haz_comp_text,
con_pwtyp_cd,
       cntyp_descr,
       substr (to_char(con_tsd_accept_dt, 'YYYY'),1, 4),
       con_size_descr,
       rdet_rswims_count
;
spool off

```

```

col con_pwtyp_cd          format a4      heading "Pri|Wast|Type"
col con_locn_facil_id     format a8      heading "Facility"
col sum(rdet_rswims_count) format 999999 heading "Count"
select haz_comp_text,
       substr (to_char(con_tsd_accept_dt, 'YYYY'),1, 4) dt,
       cntyp_descr,
       con_size_descr,
       con_pwtyp_cd,
       con_locn_facil_id,
       rdet_rswims_count
from radwaste, contype, chemcomp
where con_tsd_accept_dt between '01-jan-69' and '31-dec-92' and
con_srce_empny_id = 'APA' and
con_srce_facil_id = 'BABCX'
and con_size_descr <> '55 GALLON'
and rdet_swtyp_cd in ('1A','1B','1C','1D','1E','1F','UG','UF','UJ') and
con_cntyp_cd = cntyp_cd and con_pkg_id = haz_pkg_id
"pot8.sql" 37 lines, 1187 characters

```

SQL> @pot8

no rows selected

SQL>

• • • •

•VT100• 80 COL• •7 BIT MODE•

This page intentionally left blank.

APPENDIX A.8

**ISOTOPES LISTED IN FIFTY-FIVE-GALLON DRUMS
CONTAINING TRANSURANIC WASTES**

This page intentionally left blank.

ISOTOPES LISTED IN FIFTY-FIVE-GALLON DRUMS CONTAINING TRANSURANIC WASTES

This subappendix contains a listing of the SWITS isotope information for TRU waste from Babcock and Wilcox stored in 55-gal drums. The isotope field in SWITS contains several types of information as follows:

- Specific isotope (e.g., ^{241}Am , ^{237}Np , ^{233}U , ^{238}Pu)
- Generic isotope listings (e.g., Pu, uranium-enriched, uranium-depleted)
- ^{239}Pu Fissile Gram Equivalents (^{239}Pu FSL GR equiv)
- Total alpha
- Total beta/gamma.

This computer run contains the isotope field listing along with the number of TRU waste drums with that listing. The run is sorted by storage facility and year.

```

set linesize 170
set pagesize 45
set newpage 0
spool pot9.srep
title center 'TRU Waste - BABCOX APA' -
right 'Page:' format 999 sql.pno skip 1
break on dt skip 1
compute sum of sum(rad_qty) on con_locn_facil_id
compute sum of sum(rdet_rswims_count) on con_locn_facil_id
col iso_name          format a30          heading "Isotope"
col sum(rad_qty)      format 999999.999999 heading "Rad Qty"
col iso_unit          heading a4          heading "Unit"
col dt                format a4          heading "Date"
col cntyp_descr        format a40         heading "Container Size"
col con_size_descr     format a45         heading "Container Description"
col con_pwtyp_cd       format a4         heading "Pri|Wast|Type"
col con_locn_facil_id  format a8         heading "Facility"
col sum(rdet_rswims_count) format 999999 heading "Count"
select iso_name,
       sum(rad_qty),
       iso_unit,
       substr (to_char(con_tsd_accept_dt, 'YYYY'),1, 4) dt,
       cntyp_descr,
       con_size_descr,
       con_pwtyp_cd,
       rdet_swtyp_cd,
       con_locn_facil_id,
       sum(rdet_rswims_count)
from radwaste, contype, isotope, isoqty
where con_tsd_accept_dt between '01-jan-69' and '31-dec-92' and
con_srce_cmpny_id = 'APA' and
con_srce_facil_id = 'BABCOX'
and con_size_descr = '55 GALLON'
and rdet_swtyp_cd in ('1A','1B','1C','1D','1E','1F','UG','UF','UJ') and
con_cntyp_cd = cntyp_cd and con_pkg_id = rad_pkg_id and rad_iso_num = iso_num
group by iso_name,
       iso_unit,
       substr (to_char(con_tsd_accept_dt, 'YYYY'),1, 4),
       con_pwtyp_cd,
       rdet_swtyp_cd,
con_locn_facil_id,
       cntyp_descr,
       con_size_descr,
       rdet_rswims_count
;
spool off

```

Isotope	Rad Qty	Un Date	Container Size	Container Description	Pri Waste Type	Sec Waste Type	Facility	Count
AM-241	41.820000	GM 1981	METAL DRUMS, BARRELS, KEGS	55 GALLON	R	1A	218WAC	21
	****							-----
	SUM							21
AM-241	34.226200	GM 1982	METAL DRUMS, BARRELS, KEGS	55 GALLON	R	1A	218WAC	121
	****							-----
	SUM							121
AM-241	.155600	GM 1983	METAL DRUMS, BARRELS, KEGS	55 GALLON	R	1A	218WAC	7
	****							-----
	SUM							7
PU	32.000000	GM 1981	METAL DRUMS, BARRELS, KEGS	55 GALLON	M	1A	218WAC	1
PU	10960.010000	GM	METAL DRUMS, BARRELS, KEGS	55 GALLON	R	1A	218WAC	772
	****							-----
	SUM							773
PU	1784.713600	GM 1982	METAL DRUMS, BARRELS, KEGS	55 GALLON	R	1A	218WAC	223
	****							-----
	SUM							223
PU	47.014300	GM 1983	METAL DRUMS, BARRELS, KEGS	55 GALLON	R	1A	218WAC	150
	****							-----
	SUM							150
TOTAL BETA/GAMMA	.010000	CI 1981	METAL DRUMS, BARRELS, KEGS	55 GALLON	M	1A	218WAC	1
TOTAL BETA/GAMMA	7.604000	CI	METAL DRUMS, BARRELS, KEGS	55 GALLON	R	1A	218WAC	764
	****							-----
	SUM							765
TOTAL BETA/GAMMA	1.416110	CI 1982	METAL DRUMS, BARRELS, KEGS	55 GALLON	R	1A	218WAC	223
	****							-----
	SUM							223
TOTAL BETA/GAMMA	4.654960	CI 1983	METAL DRUMS, BARRELS, KEGS	55 GALLON	R	1A	218WAC	151
	****							-----
	SUM							151
URANIUM-DEPLETED	38.920000	GM 1981	METAL DRUMS, BARRELS, KEGS	55 GALLON	M	1A	218WAC	1
URANIUM-DEPLETED	30923.508000	GM	METAL DRUMS, BARRELS, KEGS	55 GALLON	R	1A	218WAC	707

A.8-5

WHC-EP-0719

Isotope	Rad Qty	Un Date	Container Size	Container Description	Pri Waste Type	Sec Waste Type	Facility	Count
			****					-----
			SUM					708
URANIUM-DEPLETED	5352.270000	GM 1982	METAL DRUMS, BARRELS, KEGS	55 GALLON	R	1A	218W4C	187
			****					-----
			SUM					187
URANIUM-DEPLETED	141.000000	GM 1983	METAL DRUMS, BARRELS, KEGS	55 GALLON	R	1A	218W4C	7
			****					-----
			SUM					7
URANIUM-NATURAL	2945.970000	GM 1981	METAL DRUMS, BARRELS, KEGS	55 GALLON	R	1A	218W4C	66
			****					-----
			SUM					66

16 rows selected.

A.8-6

WHC-EP-0719

APPENDIX A.9

**ISOTOPES LISTED IN TRANSURANIC CONTAINERS
OTHER THAN FIFTY-FIVE-GALLON DRUMS**

This page intentionally left blank.

ISOTOPES LISTED IN TRANSURANIC CONTAINERS OTHER THAN FIFTY-FIVE-GALLON DRUMS

This subappendix contains a listing of the SWITS isotope information for TRU waste from Babcock and Wilcox stored in containers other than 55-gal drums. The isotope field in SWITS contains several types of information as follows:

- Specific isotope (e.g., ^{241}Am , ^{237}Np , ^{233}U , ^{238}Pu)
- Generic isotope listings (e.g., Pu, uranium-enriched, uranium-depleted)
- ^{239}Pu Equivalent Curies (PE-Ci)
- Total alpha
- Total beta/gamma
- PE-Ci (Pu equivalent curies).

This computer run contains the isotope field listing along with the number of TRU waste containers with that listing. The run is sorted by storage facility and year.

```

set linesize 170
set pagesize 45
set newpage 0
spool pot10.srep
tttitle center 'TRU Waste - BABCOX APA' -
right 'Page:' format 999 sql.pno skip 1
break on dt skip 1
compute sum of sum(rad_qty) on con_locn_facil_id
compute sum of sum(rdet_rswims_count) on con_locn_facil_id
col iso_name          format a30          heading "Isotope"
col sum(rad_qty)      format 9999999.999999 heading "Rad Qty"
col iso_unit          heading a4          heading "Unit"
col dt                format a4          heading "Date"
col cntyp_descr       format a45          heading "Container Size"
col con_size_descr    format a45          heading "Container Description"
col con_pwtyp_cd      format a4          heading "Pri|Wast|Type"
col con_locn_facil_id format a8          heading "Facility"
col sum(rdet_rswims_count) format 999999 heading "Count"
select iso_name,
       sum(rad_qty),
       iso_unit,
       substr (to_char(con_tsd_accept_dt, 'YYYY'),1, 4) dt,
       cntyp_descr,
       con_size_descr,
       con_pwtyp_cd,
       con_locn_facil_id,
       sum(rdet_rswims_count)
from radwaste, contype, isotope, isoqty
where con_tsd_accept_dt between '01-jan-69' and '31-dec-92' and
con_srce_cmpny_id = 'APA' and
con_srce_facil_id = 'BABCX'
and con_size_descr <> '55 GALLON'
and rdet_swtyp_cd in ('1A','1B','1C','1D','1E','1F','UG','UF','UJ') and
con_cntyp_cd = cntyp_cd and con_pkg_id = rad_pkg_id and rad_iso_num = iso_num
group by iso_name,
       iso_unit,
       con_pwtyp_cd,
       con_locn_facil_id,
       substr (to_char(con_tsd_accept_dt, 'YYYY'),1, 4),
       cntyp_descr,
       con_size_descr
;
spool off

```


Isotope	Rad Qty	Un Date	Container Size	Container Description	Pri Wast Type Facility	Count
AM-241	.030000	GM 1982	METAL BOXES, CARTONS, CASES	4*5*6	R 218W4C	1
AM-241	3.270000	GM	METAL BOXES, CARTONS, CASES	5*5*7	R 218W4C	7
AM-241	.160000	GM	METAL BOXES, CARTONS, CASES	5*5*9	R 218W4C	1
AM-241	1.082000	GM	METAL BOXES, CARTONS, CASES	5.4*5.6*6.8	R 218W4C	4
AM-241	.030000	GM	METAL BOXES, CARTONS, CASES	6*6*7	R 218W4C	2
	****					-----
	SUM					15
AM-241	.102300	GM 1983	METAL BOXES, CARTONS, CASES	5.4*5.6*6.8	R 218W4C	1
	****					-----
	SUM					1
PU	10.440000	GM 1982	METAL BOXES, CARTONS, CASES	4*5*6	R 218W4C	1
PU	747.150000	GM	METAL BOXES, CARTONS, CASES	5*5*7	R 218W4C	7
PU	48.620000	GM	METAL BOXES, CARTONS, CASES	5*5*9	R 218W4C	1
PU	657.200000	GM	METAL BOXES, CARTONS, CASES	5.4*5.6*6.8	R 218W4C	11
PU	10.200000	GM	METAL BOXES, CARTONS, CASES	6*6*7	R 218W4C	2
PU	.016000	GM	TANKS, PORTABLE	4*4	R 218W4C	1
	****					-----
	SUM					23
PU	221.300100	GM 1983	METAL BOXES, CARTONS, CASES	5.4*5.6*6.8	R 218W4C	3
	****					-----
	SUM					3
TOTAL BETA/GAMMA	.001000	CI 1982	METAL BOXES, CARTONS, CASES	4*5*6	R 218W4C	1
TOTAL BETA/GAMMA	.211000	CI	METAL BOXES, CARTONS, CASES	5*5*7	R 218W4C	7
TOTAL BETA/GAMMA	.001000	CI	METAL BOXES, CARTONS, CASES	5*5*9	R 218W4C	1
TOTAL BETA/GAMMA	.022000	CI	METAL BOXES, CARTONS, CASES	5.4*5.6*6.8	R 218W4C	11
TOTAL BETA/GAMMA	.001100	CI	METAL BOXES, CARTONS, CASES	6*6*7	R 218W4C	2
TOTAL BETA/GAMMA	.001000	CI	TANKS, PORTABLE	4*4	R 218W4C	1
	****					-----
	SUM					23
TOTAL BETA/GAMMA	40.676000	CI 1983	METAL BOXES, CARTONS, CASES	5.4*5.6*6.8	R 218W4C	3
	****					-----
	SUM					3
URANIUM-DEPLETED	31.320000	GM 1982	METAL BOXES, CARTONS, CASES	4*5*6	R 218W4C	1
URANIUM-DEPLETED	2240.000000	GM	METAL BOXES, CARTONS, CASES	5*5*7	R 218W4C	7

A.9-5

WHC-EP-0719

A.9-6

TRU Waste - BABCOX APA

Page: 2

Isotope	Rad Qty	Un Date	Container Size	Container Description	Pri Waste Type	Facility	Count
URANIUM-DEPLETED	145.800000	GM	1982	METAL BOXES, CARTONS, CASES	5*5*9	R 218W4C	1
URANIUM-DEPLETED	1972.550000	GM		METAL BOXES, CARTONS, CASES	5.4*5.6*6.8	R 218W4C	11
URANIUM-DEPLETED	30.600000	GM		METAL BOXES, CARTONS, CASES	6*6*7	R 218W4C	2
	****						-----
	SUM						22
URANIUM-DEPLETED	665.800000	GM	1983	METAL BOXES, CARTONS, CASES	5.4*5.6*6.8	R 218W4C	2
	****						-----
	SUM						2

26 rows selected.

WHC-EP-0719

APPENDIX B

BABCOCK AND WILCOX WASTE SUMMARY TABLE

This page intentionally left blank.

BABCOCK AND WILCOX WASTE SUMMARY TABLE

Table B-1 is a summary of Babcock and Wilcox attributed in SWITS database to building and generators other than Babcock and Wilcox (i.e., 234-5Z, 325, 340). The data that comprise this table was taken from the SWBRs that denote the waste as originating from Babcock and Wilcox, but having undergone some form of custody change, and therefore being buried as waste attributed to a generator other than Babcock and Wilcox on the SWITS database.

Table B-1. Transuranic Waste Shipments to the Hanford Site from Babcock and Wilcox Listed Under 234-5Z, HEDL-325, and 340 Buildings.

SWBR number	Number of containers	Date received	Date accepted	Isotopes (g/Pu)	Physical contents
WH-1496 ^a	8 drums	06-27-77	06-27-77	536	Combustible misc. room and hood waste
WH-1496 ^a	1 drum	06-27-77	06-27-77	38	Combustible misc. room and hood waste
WH-744	1 drum	05-17-78	05-22-78	47	Combustible analytical waste
WH-744A	27 drums	05-17-78	05-16-79	907	Noncombustible analytical waste
WH-752	1 drum	05-24-78	10-29-78	8	Combustible analytical waste
WH-752A	10 drums	05-24-78	05-18-79	344	Noncombustible analytical waste
WH-752B ^b	1 drum	05-24-78	11-04-80	60	Noncombustible analytical waste
WH-753	13 drums	06-07-78	10-29-78	115.4	Combustible analytical waste
WH-753A	22 drums	06-07-78	05-18-79	857	Noncombustible analytical waste
WH-754	35 drums	07-26-78	10-29-78	251.9	Combustible analytical waste
WH-754A	5 drums	07-26-78	05-18-79	208	Noncombustible analytical waste
WH-782	12 drums	08-16-78	11-21-78	865	Combustible analytical waste
WH-783	36 drums	09-27-78	05-01-79	319.3	Combustible analytical waste
WH-783A	5 drums	09-27-78	05-18-79	215.4	Noncombustible analytical waste
WH-784	1 drum	02-14-79	05-03-79	127	Combustible analytical waste
WH-785	31 drums	07-25-79	08-11-79	100.5	Combustible analytical waste
WH-785A	11 drums	07-25-79	05-16-80	21	Noncombustible analytical waste
WH-786	42 drums	08-22-79	09-15-79	7	Combustible analytical waste: 50% plastic, 50% filter media
WH-1027	42 drums	09-19-79	10-15-79	113.5	Combustible analytical waste: 50% filter media, 20% wood, 20% cloth, 10% paper

^a234-5Z Building.

^b340 Building.

g = grams

misc. = miscellaneous

SWBR = Solid Waste Burial Record.

DISTRIBUTION

Number of copiesOFFSITE

6 Los Alamos Technical Associates
 8633 Gage Boulevard
 Kennewick, Washington 99336

J. A. Pottmeyer (3)
 M. I. Weyus-Rollosson
 K. D. Dicenso
 D. S. Delorenzo

1 Babcock and Wilcox
 Nuclear Environmental Services, Inc.
 Route #1, Box 355
 Vandergrift, Pennsylvania 15690

M. J. Straub

ONSITE

4 U.S. Department of Energy-
Richland Field Office

R. M. Gordon R3-80
 R. F. Guercia (2) A5-21
 Public Reading Room A1-65

27 Westinghouse Hanford Company

J. D. Anderson N3-13
 C. L. Bergeson H1-60
 B. J. Broomfield T3-04
 D. M. Caum H5-33
 J. A. Demiter L5-31
 D. R. Duncan (10) H5-33
 W. O. Greenhalgh L5-31
 K. L. Hladek N3-13
 D. M. Johnson H5-33
 B. A. Mayancsik H5-33
 M. M. McCarthy G1-19
 W. W. Olson H4-70
 J. G. Riddelle H5-33
 R. J. Roberts N3-13

DISTRIBUTION (cont)

Number of copies

ONSITE

J. A. Swenson (2)	G6-45
Central Files	L8-04
Document Processing and	
Distribution (2)	L8-04
Information Release	
Administration	L8-07

**DATE
FILMED**

5/12/94

END