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ENVIRONMENTAL MANAGEMENT
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RECYCLED URANIUM MASS BALANCE PROJECT PORTSMOUTH, OHIO SITE REPORT

MANAGED BY
BECHTEL JACOBS COMPANY LLC
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TetraTech NUS.

Contributed to the preparation of this document and should not be considered an eligible contractor for its review.

BJC/PORTS-139/R1

RECYCLED URANIUM MASS BALANCE PROJECT PORTSMOUTH, OHIO SITE REPORT

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BECHTEL JACOBS COMPANY LLC
managing the
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Portsmouth Gaseous Diffusion Plant
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ACRONYMS

^{237}Np, Np	Neptunium-237
^{239}Pu, Pu	Plutonium-239
^{99}Tc	Technetium-99
AEC	Atomic Energy Commission
ASTM	American Society for Testing and Materials
B&W	Babcock and Wilcox
Ci	Curies
CIP	Cascade Improvement Program
CUP	Cascade Uprating Program
DAC	Derived Air Concentration
D&D	Decontamination and Decommissioning
DIA	Division of International Affairs
DOE	Department of Energy
dpm	Disintegrations per Minute
DU	Depleted Uranium
EH	DOE Office of Environmental Safety and Health
EH-3	DOE Office of Nuclear Safety
ERP	Extended Range Product
ES&H	Environmental, Safety, and Health
F_2	Fluorine
FP	Fission Product
FY	Fiscal Year
GAT	Goodyear Atomic Corporation
GCEP	Gas Centrifuge Enrichment Plant
GDP	Gaseous Diffusion Plant
gU	Grams of Uranium
HEU	Highly Enriched Uranium
HF	Hydrogen Fluoride
HRT	Hanford Reactor Tails
HT_CO_4	Pertechnetic Acid
ICP	Inductively Coupled Plasma Spectroscopy
ICPP	Idaho Chemical Processing Plant
kg	Kilogram
kgU	Kilograms of Uranium
LAW	Low Assay Withdrawal
LEU	Low Enriched Uranium
LLW	Low Level Waste
M&O	Maintenance and Operating
MDL	Minimum Detectable Limit
MgF_2	Magnesium Fluoride
MPC	Maximum Permissible Concentration
MTU	Metric Tons Uranium
NaF	Sodium Fluoride
NFS	Nuclear Fuel Services, Inc.
NLO	National Lead of Ohio (Fernald Plant)
NMMSS	Nuclear Materials Management and Safeguards System
NRC	Nuclear Regulatory Commission
ORGDP	Oak Ridge Gaseous Diffusion Plant
PGDP	Paducah Gaseous Diffusion Plant
PPF	Paducah Product Feed
PORTS	Portsmouth Gaseous Diffusion Plant

ACRONYMS (CONT'D)

PUREX	Plutonium – Uranium Extraction
RSD	Relative Standard Deviation
RU	Recycled Uranium
SNM	Special Nuclear Materials
SRT	Savannah Reactor Tails (Savannah Recycle Tails)
SS	Source and Special
S&S	Safeguards and Security
TRU	Transuranic
U	Uranium
UO_2	Uranium Dioxide
UO_3	Uranium Trioxide
U_3O_8	Triuranium Octoxide
UF_4	Uranium Tetrafluoride; Green Salt
UF_6	Uranium Hexafluoride
UNH	Uranyl Nitrate Hexahydrate
USEC	United States Enrichment Corporation
VHE	Very Highly Enriched

Executive Summary

This report has been prepared as the Portsmouth Gaseous Diffusion Plant (PORTS) response to Deputy Secretary of Energy, T.J. Glauthier's memorandum of September 15, 1999. It is presented to address:

1. Shipments and receipts of recycled uranium (RU);

2. Levels of transuranic (TRU) and fission product (FP) contaminants in the PORTS flows and processes that had the potential to expose workers; and

3. Information on mass balances for the RU, TRU, and FP to identify potential Environmental, Safety and Health (ES&H) concerns.

The PORTS site has received and dealt with RU and its legacy from startup through current modern day operations. Sources and amounts of RU received were:

1. Uranium hexafluoride (UF_6) feed manufactured at the Paducah Gaseous Diffusion Plant (PGDP) or the Oak Ridge Gaseous Diffusion Plant (ORGDP) from recycled uranium trioxide (UO_3) – 1,095.1 metric tons uranium (MTU);

2. UF_6 feed supplied from other miscellaneous foreign and domestic sources – 5.0 MTU; and

3. Oxides and other non-UF_6 forms of uranium containing TRU/FP from miscellaneous foreign and domestic sources for conversion to UF_6 at the PORTS Oxide Conversion Facility – 19.0 MTU.

4. A total of 4.6 MTU of non-UF_6 may have been utilized for development activities.

Additionally, an estimated 60 to 90 kilograms (kg) of the fission product technetium-99 (^{99}Tc) were received through FY 1997 in some 121,485 MTU of enriched UF_6 withdrawn from the PGDP cascade and supplied to PORTS as feed.

Most of the RU-UF_6 was used as gaseous diffusion (cascade) feed with the last sizeable amount (400 MTU) fed in January 1974. Subsequently, a smaller amount, 1.4 MTU of highly enriched uranium (HEU) RU-UF_6 was fed to the X-326 Process Building cascade as late as FY 1997 - FY 1998. Of the total 23.6 MTU received as non-UF_6, 5.6 MTU was converted to UF_6 in the Oxide Conversion Facility. Approximately 1.9 MTU of the 5.6 MTU of UF_6 this was used as cascade feed. The disposition of the 4.6 MTU of non-UF_6 that was potentially used for development activities is uncertain.

Shipments of RU materials from PORTS were limited to those fractions of receipts not processed (cylinder heels, rejected materials, unconverted oxides, etc.) and through March 1999 totaled 15.6 MTU. There was 8.3 MTU of RU materials remaining on site March 31, 1999 (not including wastes, sludges, etc.).

Enriched UF_6 from the PORTS site was, and continues to be, essentially free of TRU contamination. Low but detectable levels of ^{99}Tc were, and continue to be, present in the product. At times, high levels of this contaminant have required additional processing in order to produce product within specifications.

UF_6 tails from the gaseous diffusion cascade are and have been essentially free of TRU/FP.

Locations where worker exposure to TRU was most likely to occur:

1. Cascade cells near RU feed points;

2. Equipment removed from these cells during maintenance and change-out evolutions; and

3. Oxide conversion operations – especially during evolutions involving the handling of filter ash while in operation on RU feed.

Locations where worker exposure to ^{99}Tc was most likely to occur are:

1. Top cascade cells (purge cascade);

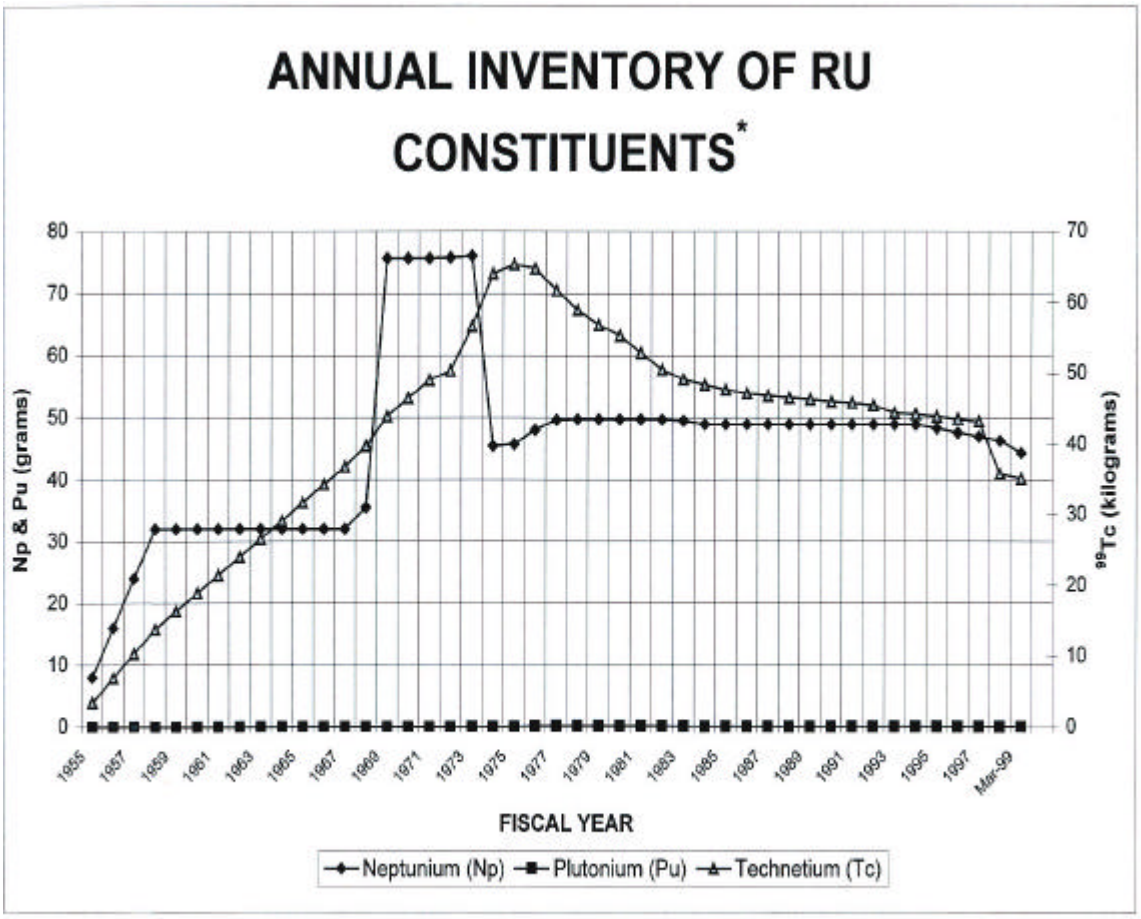
2. Cascade vent alumina traps;

3. Magnesium fluoride (MgF_2) traps for ^{99}Tc reduction; and

4. Decontamination and Uranium Recovery Building (X-705) solution recovery raffinates and their treatment sludges.

Figure ES-1 depicts the PORTS annual inventory of TRU/FP constituents of RU.

Figure ES-1



* Does not include 4.6 MTU that was potentially utilized for development activities

Ongoing ES&H concerns from past operations dealing with TRU/FP are primarily those associated with trace quantities of TRU and ^{99}Tc. Technetium continues to be detected throughout much of the cascade (albeit at low levels) in plant process vents, effluents, and enriched product streams.

The majority of TRU constituents have been removed from the cascade with two equipment change-out programs. These constituents would also be in Low Enriched Uranium (LEU) oxides produced from the solutions used to decontaminate and clean this change-out equipment. These oxides were containerized or shipped and no longer present a significant concern at PORTS. A small fraction of these constituents remains in the process equipment that was not changed-out.

Activities during the 1990's associated with suspension of HEU production introduced 1.4 MTU of RU containing low levels of TRU into the X-326 cascade under the HEU refeed program. Constituents introduced during this program will remain until the process equipment is removed.

Since plant startup, many cases of worker exposure to and uptake of uranium are known and documented to have occurred. While no internal dose has been assigned to workers from TRU constituents of RU, it is likely that an uptake of these constituents has occurred at very low levels in the range of the limits of detection. Workers are known to have been exposed to ^{99}Tc.