Highly Enriched Uranium Inventory

Amounts of Highly Enriched Uranium in the United States

U.S. Department of Energy
Office of Security and
Safety Performance Assurance

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SECTION 1 INTRODUCTION

PURPOSE

The Department of Energy (DOE) prepared this report, *Highly Enriched Uranium Inventory*, to serve as the authoritative source of information regarding the current amounts of highly enriched uranium (HEU) in the United States. It updates information previously developed in the mid-1990s, and analyzes the major changes in HEU[1] inventories since 1996 in terms of Government and commercial activities that affect HEU inventories.

The information in this report should provide the public with relevant information to understand the current status of HEU inventories in the U.S. without threatening national security or undermining our nation's nuclear deterrence activities. It should also aid DOE in discussions with stakeholders related to uranium storage, safety, and security and assist those with responsibility for formulating policies with respect to identification and disposition of excess nuclear materials. In addition, the publication of this data should encourage other nations to declassify and release similar data.

BACKGROUND

As part of an openness initiative announced in 1993, the United States began a process of declassifying and releasing certain information about nuclear material inventories and identifying excess nuclear materials for disposition. During a June 1994 press conference, the U.S. released information about HEU production and inventories. At a February 1996 press conference, the U.S. provided information about quantities of HEU that had been declared surplus to the nation's needs.

During the mid-1990s, DOE undertook an extensive effort to develop a more accurate history of the production and inventory of HEU from 1945 through 1996. A DOE team examined facility production records, material control and accountability (MC&A) records, historical MC&A summary reports, individual site inventory and transaction data, and historical reports and memoranda. There are typically hundreds of thousands of transactions per year (such as movement of material, enrichment changes, or a process, such as dissolution, that alters material form). In some cases, records of these transactions were maintained in summary form, particularly for the period prior to 1969 when the U.S. first implemented an automated nuclear material accounting system to track the numerous HEU transactions. Although there were some limitations (e.g., some site reports did not distinguish between low enriched uranium and HEU), the effort in the mid-1990s resulted in a more accurate and definitive source of information

[1] HEU is uranium that has been enriched in the uranium-235 isotope and contains 20 percent or more uranium-235. Natural uranium contains 0.711 percent uranium-235.

about the history of HEU production and inventories than had previously been available. The effort culminated in a draft 1996 DOE report that covered the time period from 1945 to the end of Government fiscal year 1996. In addition to providing the HEU inventory information for that time period, the 1996 draft report discussed the history of the U.S. government organizations that controlled HEU usage, the safeguards mechanisms in place at various times, and various aspects of HEU production and usage.

METHODOLOGY

Using the 1996 draft report as a baseline, this 2006 report updates information from the 1996 document and presents the material balance for HEU for the period October 1, 1996, through September 30, 2004. This report was prepared from data contained in facility MC&A records and individual site inventory and transaction data as reported to the Nuclear Materials Management and Safeguards System (NMMSS).

The analysis of the current inventory began with confirmation of the total HEU inventory as of September 30, 1996, that was given in the 1996 document. The previously-reported inventory figures were confirmed using data provided to the NMMSS by facility operators. The total inventory of HEU for September 30, 2004, was then obtained in the same manner. The distribution of the final inventory by location was determined by means of the reporting identification symbols that uniquely identify facilities in the NMMSS, using the same reporting identification symbol groupings that were used in the 1996 document.

The analysis of the current material balance was based on the total September 30, 1996, inventory and transaction records from the NMMSS. All transaction records for the eight-year period of October 1, 1996, through September 30, 2004, were obtained and grouped according to the use code[2] designation. The transaction amounts were then summed to determine the net change in inventory by use code, utilizing the same use code groupings as in the earlier status report. These net changes were applied to the September 30, 1996, inventory to arrive at the calculated September 30, 2004, inventory.

ORGANIZATION OF THIS REPORT

Section 2 of this report states the U.S. HEU inventory as of September 30, 1996, which was confirmed from records as part of the current effort, and updates those values to September 30, 2004. It also briefly discusses some of the sites with the largest HEU inventories. Section 3 reports the material balance for the confirmed inventory as of September 30, 1996, and updates those values to September 30, 2004.

[2] Use codes identify the type of inventory change that a transaction affects.

SECTION 2 U.S. HEU INVENTORY

As of September 30, 2004, the total U.S. HEU inventory was 686.6 metric tons of uranium (MTU) containing 590.5 metric tons of uranium-235 (MTU-235). Uranium-235 is the only naturally occurring fissile isotope of uranium; it makes up only about 0.7 percent by weight of all uranium found in nature. HEU is uranium that has been enriched to a concentration of 20 or more percent uranium-235, and is considered weapons-usable.

Table 1 presents the information on the total quantity and location of HEU in the U.S. inventory as of September 30, 2004. (The site names used in the table are those that are current as of December 2005.) For comparison, the 1996 HEU inventory values, with locations identified by their present names, are also included in Table 1.

Table 1 U.S. HEU Inventory as of September 30, 1996 and September 30, 2004

Location	9-30-96 MTU	9-30-96 MTU-235	9-30-04 MTU	9-30-04 MTU-235
Y-12 Plant, Pantex Plant, and Defense Department	651.6	557.4	621.2	546.6
Idaho National Laboratory	27.4	19.3	26.8	18.6
Savannah River Site	22.2	14.6	18.7	12.8
Portsmouth Gaseous Diffusion Plant	21.7	14.1	0.9	0.5
Rocky Flats Environmental Technology Site	6.0	5.6	0.1	0.1
Los Alamos National Laboratory	3.5	3.2	2.4	2.2
Oak Ridge National Laboratory	1.6	1.3	1.6	1.3
K-25 Site	1.5	0.8	1.5	0.8
Sandia National Laboratories	0.7	0.6	0.7	0.5
Hanford Site	0.5	0.2	0.5	0.2
Brookhaven National Laboratory	0.3	0.2	0.0	0.0
Miscellaneous	3.7	3.0	12.2	6.9
Total	**740.6**	**620.3**	**686.6**	**590.5**

On November 7, 2005, Secretary of Energy Samuel W. Bodman announced that in the coming decades, the National Nuclear Security Administration (NNSA) will remove up to 200 metric tons of HEU from further use as fissile material in U.S. nuclear weapons and prepare this material for other uses. DOE will dispose of the additional HEU the following ways:

- About 160 metric tons will be provided for use in naval ship power propulsion, postponing the need for construction of a new uranium high-enrichment facility for at least 50 years.
- About 20 metric tons will be down-blended to low enriched uranium for eventual use in civilian nuclear power reactors, research reactors or related research. Down-blending this material will eliminate its potential usefulness to terrorists.

- Approximately 20 metric tons will be reserved for space and research reactors that currently use HEU, pending development of fuels that would enable the conversion to low enriched uranium fuel cores.

The following sections provide additional information on the current locations of the U.S. HEU inventory reported in Table 1.

Y-12, Pantex, and Defense Department

More than 90 percent of the U.S. HEU inventory is located at the Y-12 Plant in Oak Ridge, Tennessee; at the Pantex Plant near Amarillo, Texas; and in the custody of the Department of Defense (DoD). These facilities have 621.2 MTU as HEU. For purposes of national security, the HEU inventory for the Y-12 Plant, the Pantex Plant, and DoD is reported as a total quantity rather than separate amounts.

The Y-12 National Security Complex was constructed as part of the World War II Manhattan Project. Its first mission was to separate uranium-235 from natural uranium using the electromagnetic separation process. Today, it processes HEU for use in weapon activities and the Naval Nuclear Propulsion Program. Y-12 is the repository of U.S. weapons-grade materials, and it has been the destination of fissile materials removed from foreign nuclear facilities.

Pantex is a nuclear weapons assembly and disassembly facility that was originally constructed as a conventional bomb plant for the U.S. Army during World War II. Since deactivation of the Rocky Flats Plant, the Pantex Plant has also been used for the interim storage of plutonium.

Idaho National Laboratory

Recently renamed from the Idaho National Engineering and Environmental Laboratory (INEEL), the Idaho National Laboratory (INL) is located near Idaho Falls, Idaho. Its missions include interim storage of HEU, facility decontamination and decommissioning, and environmental restoration. The Energy Policy Act of 2005 authorized INL to explore the production of hydrogen fuel using nuclear power. INL had 26.8 MTU as HEU as of September 30, 2004.

Savannah River Site

The Savannah River Site (SRS), located near Aiken, South Carolina, has been one of the primary producers and processors of nuclear materials in the United States. The site is mainly engaged in cleanup activities related to past work on nuclear weapons. As of September 30, 2004, it had 18.7 MTU as HEU.

Portsmouth Gaseous Diffusion Plant

The Portsmouth Gaseous Diffusion Plant, located at Piketon, Ohio, was originally used for the production of HEU for nuclear weapons. Later, it was used for the production of HEU for military reactors and in the production of low enriched uranium for commercial reactors along with its sister plant in Paducah, Kentucky. Owned by the DOE and leased by the United States Enrichment Corporation (USEC), the Portsmouth plant was shut down in May 2001 when USEC consolidated its uranium enrichment operations in Paducah. The Portsmouth plant had 0.9 MTU as HEU as of September 30, 2004.

Rocky Flats Environmental Technology Site

The Rocky Flats Plant, located near Denver, Colorado, was a nuclear weapons production facility that started operation in 1952. It produced weapon components, including plutonium triggers, which were used at the Pantex Plant to assemble nuclear weapons. In 1994, it was renamed the Rocky Flats Environmental Technology Site, reflecting its earlier mission change from weapon production to environmental cleanup and restoration. As of September 30, 2004, the site had 0.1 MTU as HEU. Cleanup was declared complete in October 2005, and all remaining HEU had been transferred to other sites.

Los Alamos National Laboratory

Los Alamos National Laboratory is one of two laboratories in the United States where classified work on the design of nuclear weapons is undertaken. (The other is Lawrence Livermore National Laboratory). Managed by the University of California and located at Los Alamos, New Mexico, the laboratory is one of the largest multidisciplinary institutions in the world. It had 2.4 MTU as HEU as of September 30, 2004.

Other Sites with Small HEU Holdings

Several other sites had small holdings totaling 16.5 MTU as HEU. These include Oak Ridge National Laboratory, K-25 Site, Sandia National Laboratories, Lawrence Livermore National Laboratory, Hanford Site, Brookhaven National Laboratory, and various miscellaneous sites.

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SECTION 3
MATERIAL BALANCE

The material balance for uranium-235, the fissile isotope of uranium used in nuclear weapons, began with the previously-determined values for the period 1945 through September 30, 1996, and was then modified based on values for the period October 1, 1996, through September 30, 2004. The previous and current material balances are presented in Table 2.

Table 2 Material Balance for Uranium-235 in HEU

Material Balance Element	Material Balance Category	MTU-235 for the period of 1945 - 9/30/1996	MTU-235 for the period of 10/1/1996 - 9/30/2004
Acquisitions	Production from Uranium Enrichment Processes	859.2	0.0
	Production from Blending	0.3	0.0
	Miscellaneous Receipts	0.0	0.8
	Receipts from Foreign Countries	4.9	0.4
	Total Acquisitions	**864.4**	**1.2**
Removals	Refeed at Enrichment Plants	114.2	0.0
	Nuclear Tests, Wartime Detonations and Naval Reactor Use	31.9	0.0
	Fission and Transmutation	56.2	0.6
	Normal Operating Losses	4.9	0.5
	Transfers to Foreign Countries	34.6	0.3
	Down Blending	1.5	29.8
	Inventory Differences	3.2	0.0
	Total Removals	**246.5**	**31.2**
Totals	Beginning Inventory	0.0	620.3
	Total Acquisitions (+)	864.4	1.2
	Uranium Enrichment Process Holdup (+)	1.7	0.0
	Classified Transactions (+)	0.3	0.2
	Total Removals (-)	246.5	31.2
	Equals Calculated U.S. Inventory[1]	619.9	590.5
	Actual U.S. Inventory	**620.3**	**590.5**

[1] The difference between the September 30, 1996 calculated inventory and actual inventory can be explained by several factors. The calculated inventory covers over 50 years whereas the actual inventory is from the NMMSS for that date. Also, the calculated inventory is based on available official Department historical information and records, the interpretation of these records, and the potential recording and reporting discrepancies prior to the beginning of the NMMSS in 1965.

The material balance comprises six primary elements: acquisitions, removals, classified transactions, uranium enrichment process holdup, calculated inventory, and actual inventory. Acquisitions and removals are broken down further into material balance categories. The methodology used to determine the 9/30/2004 calculated HEU inventory is to add the total quantity of acquisitions and classified transactions for the eight-year time period covered in this report to the actual September 30, 1996, inventory (Beginning Inventory) and subtract the total quantity of removals for the eight-year period. The calculated inventory is then compared to the actual inventory at the end of the period. As shown in Table 2, the September 30, 2004, calculated inventory equals the actual inventory.

ACQUISITIONS

From October 1, 1996, through September 30, 2004, the U.S. acquired only 1.2 MTU-235 in HEU. No HEU was produced from uranium enrichment processes or blending, in keeping with the government's self-imposed moratorium on the production of fissile materials for use in nuclear weapons or other nuclear explosive devices. The 1.2 MTU-235 was acquired primarily from receipts from foreign countries and miscellaneous returns from waste operations. The acquisitions were an increase to the U.S. HEU inventory.

REMOVALS

In the eight-year period covered by this report, 31.2 MTU-235 contained in HEU was removed from the U.S. inventory. More than 95 percent of this, 29.8 MTU-235, resulted from the down-blending of HEU to low enriched uranium (see Table 3 for down-blending activities). The remaining 1.4 MTU-235 was removed from the U.S. inventory by fission and transmutation, normal operating losses, and transfers to foreign countries. It should be noted that no nuclear tests or wartime detonations were conducted during the period, and removal attributed to naval reactor use is not shown in the table for national security reasons. The removals were a decrease to the U.S. HEU inventory.

Table 3 HEU Disposition Activities

Disposition Activities	MTU-235 As of 9/30/04
USEC Transfer Program	13.8
Tennessee Valley Authority Off-Spec Program	3.8
Research Reactor Supply Program	0.4
Miscellaneous Dispositions	11.2
Total, Disposition Program	**29.2**
Other Down-Blending	0.6
Total, Down-Blending	**29.8**

Classified Transactions

0.2 MTU-235 is added to the calculated inventory to account for classified transactions, which cannot be detailed in this report.

Calculated Inventory

The calculated inventory of U-235 in HEU as of September 30, 2004 is 590.5 MTU-235. This is a decrease of 29.8 MTU-235 compared to the actual September 30, 1996 inventory. HEU acquisitions during the eight-year period covered by this report amounted to 1.2 MTU-235. Of the inventory removals during the period, HEU down-blending activities accounted for 29.8 MTU-235, while fission and transmutation, normal operating losses, and transfers to foreign countries accounted for an additional 1.4 MTU-235. Classified transactions accounted for the remaining 0.2 MTU-235.

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