Disposition of Certain U.S. Exports of High Enriched Uranium

Santiago Aguilar, Danielle Emche, Brian Horn,

U.S. Nuclear Regulatory Commission
Washington, D.C.
Santiago.Aguilar@nrc.gov, Danielle.Emche@nrc.gov, Brian.Horn@nrc.gov,

Abstract:

In 2012, the United States (U.S.) Congress, under provisions of the American Medical Isotopes Production Act, required the Chairman of the U.S. Nuclear Regulatory Commission (U.S. NRC) to submit a report detailing the current disposition of previous U.S. exports of highly enriched uranium (HEU) used as fuel or targets in a nuclear research or test reactor (RTR). In January 2014, the U.S. NRC submitted the requested report to Congress. In the preparation of the report, U.S. NRC staff reviewed nearly 1,700 HEU export transactions, 1,400 HEU import transactions, and compared the information to nearly 800 export licenses and license amendments. The report found that the bulk of the U.S. HEU exports and imports, approximately 95 and 80 percent respectively, occurred prior to 1990. The U.S. HEU exports peaked in the late 1960s and have since declined dramatically due to the shutdown of many foreign HEU-fueled RTR facilities and programs. The U.S. exported approximately 22,600 kilograms (kg) of HEU, of which 7,700 kg was imported back to the United States.

The United States continues the effort to reduce and eliminate the use of HEU for use in RTRs and medical isotope production. Although the U.S. exported HEU to 35 countries, 20 countries still possess some U.S. HEU as RTR fuel or target material. Some of the outcomes from the 2010, 2012, and 2014 Nuclear Security Summits were statements on behalf of various countries, endorsing or committing to the minimization of HEU and potential replacement of HEU use in the future production of medical isotopes.

Keywords: Highly Enriched Uranium; Export; Minimization; Safeguards; Security

Introduction

Acknowledging the comprehensive international framework and global partnerships that ensure nuclear material safeguards and security, there is likewise a high degree of United States (U.S.) domestic interest to identify and minimize risks associated with highly enriched uranium (HEU). In accordance with U.S. domestic legislation requirements,[1] the U.S. Nuclear Regulatory Commission (U.S. NRC) developed a report that assessed the current disposition of U.S. exported HEU, defined as uranium enriched to 20 percent or more in the isotope uranium-235. In January 2014, the Chairman of the U.S. NRC submitted the, "Report to Congress on the Current Disposition of Highly Enriched Uranium Exports Used as Fuel or Targets in Nuclear Research or Test Reactors." For all previous U.S. exports of HEU used as fuel or targets in a research or test reactor (RTR), the U.S. NRC reported to Congress on:

- the current location of the HEU;
- whether the HEU has been irradiated;
- whether the HEU has been used for the purpose stated in their export license;
- whether they have been used for an alternative purpose and, if so, whether such alternative purpose has been explicitly approved by the Commission;
- the year of export, and re-importation, if applicable;
- the current physical and chemical forms of the HEU; and
- whether the HEU has been stored in a manner which adequately protects against theft and unauthorized access.

The U.S. NRC developed the report by examining information dating from 1950 through 2012. Data sources analyzed included export license records (over 800); reports by and technical discussions with staff from the National Nuclear Security Administration's (NNSA's) Global Threat Reduction Initiative (GTRI); records for tracking movements of nuclear materials from and to facilities within the United States known as the Nuclear Materials Management and Safeguards System (NMMSS) database (over 1,700 export transactions and 1,400 transactions involving imports and receipts); and U.S. interagency bilateral physical protection visit report information. The report also built upon information that the U.S. NRC presented to Congress in a January 1993 report on the disposition of previous HEU exports.[2] Additionally, the U.S. NRC staff consulted with the U.S. Department of Energy (DOE), U.S. Department of State (DOS), and other relevant agencies.

The report recognizes the significant duration of U.S. experience with exporting HEU and the changes that have occurred over the last 60 years. In order to accurately capture the complexity associated with the current disposition of U.S. exported HEU, the report provides an overview of the historical and legislative evolution of the U.S. experience with exporting HEU, and distinguishes particular policy and technological developments that have contributed to the current disposition of U.S. exported HEU.

Summary of Report Findings

The U.S. Government reviewed all of the available data and contacted the foreign governments relevant to the U.S. HEU that was exported since 1957, which totaled 22,600 kilograms (kg). This equates to approximately 896 significant quantities, as defined by the International Atomic Energy Agency (IAEA). The U.S. NRC was able to identify the disposition or location of 93 percent of this previously exported HEU. This was a major accomplishment, considering the challenges that many historical records predate electronic recordkeeping (increasing the likelihood that records were incomplete); the agreements under which the United States exports HEU do not require the receiving country to report to the United States on the ultimate disposition of the HEU; and, there are inherent accounting uncertainties associated with HEU RTR fuel cycle and medical isotope processing operations.

Of the 22,600 kg of previously exported HEU, the U.S. NRC determined that 7,700 kg was imported back to the United States, and 6,100 kg currently resides in 20 countries. Of the remaining 8,800 kg, information indicates that more than 4,300 kg of the U.S. HEU was eliminated by down-blending to LEU; approximately 500 kg of HEU was eliminated in highly-dilute processing waste; and at least 2,400 kg of HEU was burned up through irradiation in RTRs. There is a remaining seven percent, or 1,600 kg, of HEU that was not precisely reconciled by existing records. This percentage will continue to decrease as the United States continues to work with foreign governments to reconcile information and import material back to the United States.

U.S. History of Exports of Highly Enriched Uranium

The United States has always recognized and continues to recognize the importance for preserving the security interests associated with nuclear materials in order to ensure the peaceful uses of nuclear energy. During the U.S. NRC's work developing the report, it was useful to examine and assess the policy and historical factors that contributed to the creation of the U.S. and international nuclear materials export regime. Through a review of the U.S. history and experience with exporting HEU, the U.S. NRC was able to further contextualize its data findings, and identify enhancements that have developed over the years related to the U.S. and international nuclear export regime, and which contribute to the current disposition of U.S. exported HEU.

The origin of the U.S. experience with exporting HEU began with President Dwight D. Eisenhower's "Atoms for Peace" speech, given to the United Nations General Assembly on December 8, 1953. Following this speech, Congress amended the Atomic Energy Act of 1946 by replacing it with the Atomic Energy Act of 1954 (AEA) to establish the legal framework for developing the U.S. civilian nuclear industry, promoting cooperation with other countries in the peaceful uses of nuclear energy, and ensuring appropriate controls to protect public health, safety, and U.S. common defense and security. In tandem with the "Atoms for Peace" speech, the U.S. Government recognized the need for establishing an effective, independent safeguards verification system administered by an autonomous international organization of broad membership and strong collective purpose. The

U.S. Government strongly promoted the development and implementation of IAEA's safeguards verification.

U.S. Agreements and Requirements for Exports

Starting in the 1950s, the United States established peaceful nuclear cooperation agreements, under Section 123 of the AEA, which became known as "123 Agreements," with countries and organizations. These Agreements are a cornerstone of and precondition for U.S. export of nuclear materials. Presently, the United States maintains bilateral 123 Agreements with 20 individual countries, the European Atomic Energy Community (EURATOM),[3] the IAEA,[4] and Taiwan.[5] The scope and content of 123 Agreements have evolved significantly since the 1950s, reflecting the progression of the international nuclear nonproliferation regime and its key policy instruments – IAEA safeguards agreements and the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). Additionally, 123 Agreements evolved to reflect technological advancements in the nuclear field, and U.S. statutory requirements, such as the Nuclear Non-Proliferation Act of 1978 (NNPA).

Certain fundamental U.S. principles set forth in the 123 Agreements have not changed over the last 60 years. The United States continues to obtain guarantees from the governing bodies of the cooperating nations and organizations stipulating that safeguards will be maintained, no material or equipment supplied by the United States under the agreements will be used for nuclear weapons or for research on or development of nuclear weapons or for any other military purpose, the appropriate physical protection measures will be maintained, and the United States will have certain prior consent rights (for example if the material or equipment supplied under an agreement may be transferred to a third party that had not been provided for in the agreement).

Up until the 1970s, most of the 123 Agreements in force with countries interested in building and operating RTRs provided for the lease of HEU with explicit provisions for the return of the spent nuclear fuel to the United States. Following ratification of the NPT, the United States began relying on the IAEA to implement safeguards, and the United States stopped applying bilateral safeguards. From 1964 – 1988, the United States also began to operate under a policy known as the "Off-Site Fuels Policy," and no longer required returns of spent fuel but continued to accept, store and process it for certain countries and in certain cases. During the 1990s, the Off-Site Fuels Policy and associated programs evolved into the present-day NNSA/GTRI managed Foreign Research Reactor Spent Nuclear Fuel Acceptance Program, which is discussed further in this paper.

The U.S. requirements and process for the licensing of HEU exports have evolved significantly since the 1950s. Initially, all aspects of the U.S. reactor research, development, and demonstration programs, and associated international cooperation agreements were promoted, executed, and administered by the U.S. Atomic Energy Commission (AEC). In 1975, the responsibility for nuclear material export licensing was transferred to the U.S. NRC, as a result of the Energy Reorganization Act of 1974. The U.S. NRC licenses exports of nuclear material and equipment pursuant to the criteria set forth in the 1954 AEA, as amended. The existing U.S. NRC regulations in Title 10 of the Code of Federal Regulations, Part 110, set forth the criteria for licensing exports of nuclear materials and equipment as prescribed by the AEA.

U.S. NRC licensing criteria address the issues of nuclear non-proliferation, physical protection, and HEU minimization. Overall, it must be determined on a case-by-case basis that an approval of proposed exports of nuclear material or equipment will not be adverse to the common defense and security of the United States. In conducting nuclear material export licensing reviews, the U.S. NRC must seek the judgment of interested U.S. Government executive branch agencies (i.e., the U.S. Departments of Commerce, Energy, and Defense, as coordinated by DOS) as to whether approving a proposed export would be consistent with U.S. statutory and foreign policy requirements. The U.S. NRC cannot issue an export license if the Executive Branch recommends denying the license; however, if the Executive Branch recommends approval and the U.S. NRC disagrees, the license application must be referred to the President of the United States for action, which is subject to Congressional review. To date, every HEU export license issued by the AEC and the U.S. NRC has satisfied U.S. domestic law, internal AEC/NRC export licensing regulations, 123 Agreements, Project and Supply Agreements, the NPT as applicable, and IAEA agreements and protocols.

Significant Recent Policy Developments

In recent years, the global community, including the U.S. Government, led by the National Security staff, DOE, and DOS, has intensified efforts and achieved significant successes to minimize the use of HEU for fuel or targets in RTRs. In this context and consistent with the provisions of U.S. domestic law concerning medical isotopes production,[6] the U.S. Government continues to engage with foreign governments through DOE's GTRI Reduced Enrichment for Research and Test Reactors (RERTR) and associated programs to convert existing facilities to LEU fuel and targets, prioritize returns of HEU to the United States, and reconcile record discrepancies. Concurrently, the GTRI/RERTR program is involved in converting existing U.S. research reactors to LEU fuel and targets to minimize all HEU in civilian use. The U.S. NRC strongly supports and recognizes the sensitive nature of these ongoing efforts.

The importance of continuing these efforts is highlighted by the international commitments that have been made as a result of the Nuclear Security Summits (NSS). In April 2010, President Obama hosted the first NSS in Washington, D.C. and met with 47 heads of state to discuss actions to increase security for nuclear materials and prevent acts of nuclear terrorism and trafficking. The summit reinforced the principle that all states are responsible for ensuring the best security of their materials, for seeking assistance if necessary, and for providing assistance if asked. It promoted the international treaties that address nuclear security and nuclear terrorism and led countries to commit to specific national actions to advance global security. One of the key items included in the Joint Communique issued by the Summit is that world leaders, "Recognize that highly enriched uranium and separated plutonium require special precautions and agree to promote measures to secure, account for, and consolidate these materials, as appropriate; and encourage the conversion of reactors from highly enriched to low enriched uranium fuel and minimization of use of highly enriched uranium, where technically and economically feasible."[7]

At the 2012 Seoul NSS, Belgium, France, the Netherlands, and the United States issued a, "Joint Statement on Minimization of HEU and the Reliable Supply of Medical Radioisotopes." That statement reaffirmed commitments on the part of those four countries to support conversion of European production industries to non-HEU based processes by 2015, subject to the regulatory approvals to reach a sustainable medical isotope production for the benefit of patients in need of vital medical isotope diagnostic treatments in Europe, the United States, and elsewhere. It was also agreed at the 2012 Summit that in the longer term, the use of HEU will be completely eliminated for production of medical isotopes.

The most recent Nuclear Security Summit was held in 2014 at The Hague. In the significant final joint communique that was issued, participants affirmed the shared goal to, " encourage States to minimize their stocks of HEU (…). Similarly, we will continue to encourage and support efforts to use non-HEU technologies for the production of radioisotopes (…)."[8] Commitments resulting from the 2010, 2012, and 2014 NSS underscore the importance for ensuring safety and security of HEU, with the goal of minimizing or eliminating its use.

Detailed Analysis of the Disposition of U.S. Exported HEU

Since 1957, the United States exported HEU for use as fuel or targets in RTRs to a total of 35 countries either directly (to 32 countries) or indirectly (to an additional three countries) as a result of re-transfers between those countries in Table 1, on the following page. Approximately 6,100 kg of U.S. supplied HEU presently remains in 20 countries, with 95 percent of that material located in Europe and Canada. Many of the 20 countries have converted their RTRs from HEU to low enriched uranium (LEU) fuel or have committed to doing so in the future. The remaining 15 countries no longer possess any U.S. supplied HEU for these purposes and have either converted facilities to LEU or have shut down the facilities that required HEU. Approximately 7,700 kg of HEU has been returned to the United States primarily as irradiated fuel.

Table 1: Disposition of U.S. HEU Used as Fuel or Targets in a Nuclear Research or Test Reactor

Countries that received HEU (Direct exports from the U.S.)		Countries that no longer possess U.S. HEU for these purposes[9]	Countries with less than 1 kg of U.S. HEU for these purposes[10]	Countries with 1 kg or more of U.S. HEU for these purposes[10]
Argentina	Netherlands	Austria	Australia	Argentina
Australia	Pakistan	Chile	Brazil	Belgium
Austria	Philippines	Colombia	Jamaica	Canada
Belgium	Portugal	Denmark	South Africa	France
Brazil	Republic of Korea	Greece	Turkey	Germany
Canada	Romania	Mexico		Indonesia
Colombia	Slovenia	Philippines		Iran
Denmark	South Africa	Portugal		Israel
France	Spain	Republic of Korea		Italy
Germany	Sweden	Romania		Japan
Greece	Switzerland	Slovenia		Netherlands
Indonesia	Taiwan	Spain		Norway
Iran	Thailand	Sweden		Pakistan
Israel	Turkey	Taiwan		Switzerland
Italy	United Kingdom	Thailand		United Kingdom
Japan				
Mexico				

As shown in Figures 1 and 2 below, the bulk of U.S. HEU exports occurred in the 1960s and 70s, with the peak occurring in the late 1960s. The dramatic decline of U.S. HEU exports is attributed to the shutdown of many foreign HEU-fueled RTR facilities and programs, additional export controls imposed under the NNPA in 1978, and the establishment of DOE's GTRI/RERTR program to convert such facilities to LEU. Overall, the bulk of the U.S. HEU exports and imports (approximately 95 and 80 percent respectively) occurring prior to 1990, as displayed in Figures 1 and 2. Although there is no current requirement for U.S.-origin HEU to be returned to the United States, in August 1982, the U.S. NRC issued a "Statement of Policy on the Use of HEU in Research Reactors" (47 Fed. Reg. 37,007), expressing support for the RERTR program to convert facilities to LEU. The U.S. NRC also stated that it would perform more rigorous reviews related to U.S. supplied material used in foreign RTRs, with the intent of eliminating inventories of U.S. supplied HEU to the maximum degree possible. Furthermore, AEA Section 134 was amended in 1992 to add more stringent criteria for licensing U.S. exports of HEU to be used as fuel or targets in RTRs. In addition, NNSA/GTRI continues to work with foreign governments to return additional amounts of fresh and irradiated U.S. HEU to the United States.

Figures comparing U.S. HEU Used as Fuel or Targets in a Nuclear Research or Test Reactor

Figure 1: Exports 1957 - 2012

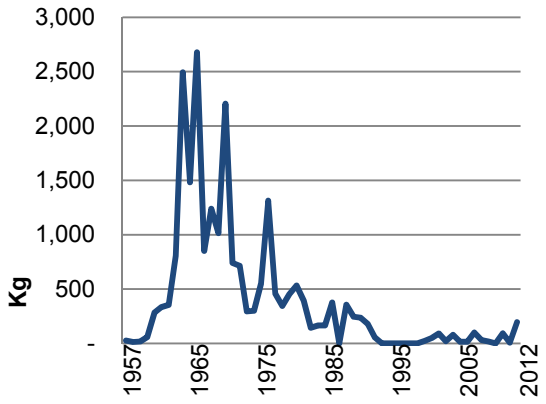
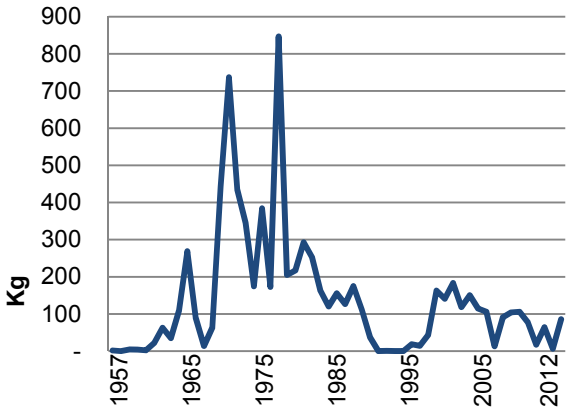


Figure 2: Imports 1957 - 2012



In 2005, additional criteria were added to AEA Section 134 for licensing exports of HEU to certain countries[10] for medical isotope production. Under these provisions, the U.S. NRC is required to review the adequacy of physical protection requirements that are applicable to the transportation and storage of the HEU for medical isotope production or control of residual material after irradiation and extraction of medical isotopes. If the U.S. NRC determines that additional physical protection requirements are necessary (including a limit on the quantity of HEU that may be contained in a single shipment), the U.S. NRC shall impose such requirements as licensing conditions or through other appropriate means. Presently, the United States continues to export HEU for use as RTR fuel or targets to a limited number of facilities in Canada and Europe.[11] The primary purpose of these HEU exports is to support medical isotope production.

Reconciling the Current Disposition of U.S. Exports of HEU

The U.S. Government continues to work with certain partners to reconcile inventory records. These reconciliations are not facility specific, but at a State level. The U.S. NRC does not believe that adding new inventory reconciliation or other requirements to U.S. 123 Agreements or other international instruments would be an acceptable change to the status quo in the national interests of other countries.

U.S. law has instead required the U.S. Government to obtain nonproliferation, peaceful use, and safeguards assurances from foreign government authorities on a case-by-case basis as a pre-condition for authorizing the export of any special nuclear materials, including HEU to foreign RTRs for use as fuel or targets. The U.S. Government has relied on these assurances among other factors in determining that the foreign recipient and the responsible government oversight authority will implement and maintain the controls to ensure that the nuclear materials are appropriately used, controlled and safeguarded. Additionally, the U.S. Government and the global community rely on the IAEA to conduct independent safeguards audits and inspections to verify that the records for and physical inventories of nuclear materials, whether supplied by the United States or another country, are consistent and provide no evidence of diversion.

HEU Irradiation Status and Current Physical and Chemical Forms

Approximately 60 percent of the U.S.-origin HEU remaining in foreign countries is irradiated and 40 percent is un-irradiated. Most of the irradiated material is in the form of irradiated RTR fuel, targets, and medical isotope production residues. The un-irradiated U.S. HEU at foreign facilities exists primarily in the form of fabricated RTR fuel and medical targets, but some of the un-irradiated HEU is in the form of metal, compounds, scrap, and waste.

Uses Stated in Export License, Alternative Uses, U.S. NRC-Approved Alternative Uses

In most cases, U.S. supplied HEU was used for its stated uses as described in relevant U.S. export licenses. For the most part, U.S. export licenses have anticipated the need for transfers among certain countries and typically identified approved intermediate facilities (fuel and/or target fabrication facilities) and ultimate foreign consignees (RTRs and target processing facilities). In a number of instances, and to the extent that some countries subsequently transferred and/or received U.S. supplied HEU between themselves and other countries, they were required to obtain additional approval (prior consent) from the U.S. Government to do so. Requests for prior consent are processed as “subsequent arrangements” by NNSA in accordance with Section 131 of the AEA as amended. In a limited number of cases, based on international agreements and requirements for HEU exports in effect at that time, no additional U.S. approval was required. The U.S. NRC identified 13 requests to use U.S. supplied HEU for purposes other than what was originally authorized, as noted in Table 2 on the following page.

Table 2: Requests to Use U.S.-Supplied HEU for Purposes Other than Originally Authorized[12]

Country	Original use	New use
Japan	KUHFR	KUR
	KUHFR	KUR
	KUHFR	KUR
	JMTR	JRR-4
	KUHFR	KUR
	KUHFR	KUR
	KUHFR	KUR
	KUHFR	samples
	YAYOI	Down blend
Argentina	RA-3 &RA-6	Down blend
South Africa	SAFARI	Storage
Canada	Chalk River	Dounreay

Total U.S. HEU 112.5 kg

KUHFR - Kyoto University high Flux research Reactor; KUR - Kyoto University Reactor;
JMTR - Japan Material Test Reactor; JRR-4 - Japan Research Reactor #4;
YAYOI - Research Reactor located in Japan; RA-3 - Argentina Research Reactor #3;
RA-6 = Argentina Research Reactor #6; SAFARI - South African Research Reactor;
Chalk River - Canadian nuclear site; Dounreay - United Kingdom nuclear site; Down blend - HEU into LEU

Adequate Protection against Theft and Unauthorized Access

Consistent with the current U.S. NRC export licensing criteria, physical protection measures at foreign facilities are assessed against recommendations in IAEA publication Information Circular (INFCIRC/225).[13] To determine the adequacy of physical protection measures for high-risk nuclear materials at foreign facilities, the U.S. NRC primarily relies upon bilateral physical protection information exchange and assessment visits to the foreign country.[14] These visits are conducted by a U.S. interagency team and involve exchanges of technical physical protection information as well as site-level security assessments. When appropriate, a determination is made on a country-wide basis as to whether the measures employed at a facility provide protection comparable to the INFCIRC/225 guidelines.[15]

Returned U.S.-origin HEU is stored and processed at a small number of DOE facilities as well as at U.S. NRC licensed facilities. Most of the material returned to the U.S. has been irradiated HEU fuel, but has also included un-irradiated HEU – in addition to HEU that was down-blended to LEU. The physical protection measures at these U.S. facilities are maintained, as appropriate, in accordance with either DOE or NRC requirements and they provide adequate protection of the HEU against unauthorized access and theft.

U.S. NRC has neither any evidence to suggest nor any reason to believe that any U.S. exported HEU has been stolen or diverted from a foreign facility. The U.S. NRC is confident of this assessment, based on the effectiveness of the aforementioned physical protection measures at foreign facilities to which U.S. materials have been licensed and exported. International safeguards containment, surveillance, and verification measures, and IAEA inspections provide further confidence that no U.S. HEU has been stolen or diverted. All recipient countries have provided nonproliferation and physical protection assurances and peaceful use guarantees as a precondition of supply, as required by U.S. law. Furthermore, HEU that has been transferred and/or retransferred to foreign countries has not been reported as missing or unaccounted for, nor has any country has

ever notified the U.S. Government that they lost or did not receive U.S. supplied HEU or that they relinquished control over the material.

As reaffirmed by heads of state participating in the 2010 and 2012 NSS, recipient countries are responsible for maintaining safety and ensuring the adequacy of physical protection measures for nuclear materials they receive from the United States and other countries. As part of the U.S. export licensing process, the responsible foreign government authority in the recipient country must confirm on a case-by-case basis that a facility is authorized to receive and possess the material and agree to maintain protection at least comparable to the recommendations in the current version of INFCIRC/225. The U.S. Government must receive these and other written assurances, including commitments to convert to LEU fuel or targets from the receiving country as part of the U.S. NRC export licensing process.

Documentation and Data Gaps

There are gaps and uncertainties in the historical records available to the U.S. NRC staff. The following reasons explain why the U.S. NRC was unable to fully document the status and location of all HEU exported by the United States:

- HEU transfers between countries.
- Material losses and waste
- HEU consumption in reactors
- HEU down-blending
- Co-mingling of U.S. and non-U.S. HEU
- Co-mingling of RTR and non-RTR HEU
- National classification information laws

Observations and Conclusions

The U.S. Government continues to work with its foreign partners to reconcile historical records for the disposition of the past U.S. HEU exports and to maintain an appropriate level of awareness regarding the disposition of the current and future U.S. HEU exports.

The United States continues to be a leader in the effort to reduce and eliminate the use of HEU for use in RTRs and medical isotope production. Some of the outcomes of the 2010, 2012, and 2014 Nuclear Security Summits were statements endorsing the minimization of HEU and possible replacement of HEU use in future production of medical isotopes. The United States recognizes that the peaceful use of nuclear technology can only occur when it is pursued and fostered in a way that does not compromise global security.

Acknowledgements

This paper reflects contents of the “Report to Congress on the Current Disposition of Highly Enriched Uranium Exports Used as Fuel or Targets in Nuclear Research or Test Reactors,” (January, 2014).

The authors of this paper would like to acknowledge additional individuals who reviewed and contributed to the information discussed in this paper:

Janice Owens, Janice.Owens@nrc.gov
Gary Langlie, Gary.Langlie@nrc.gov
Jenny Weil, Jenny.Weil@nrc.gov
Oleg Bukharin, Oleg.Bukharin@nrc.gov
Maureen Conley, Maureen.Conley@nrc.gov
Michelle Albert, Michelle.Albert@nrc.gov

Legal matters

Privacy regulations and protection of personal data

I agree that ESARDA may print my name/contact data/photograph/article in the ESARDA Bulletin/Symposium proceedings or any other ESARDA publications and when necessary for any other purposes connected with ESARDA activities.

Copyright

The author agrees that submission of an article automatically authorizes ESARDA to publish the work/article in whole or in part in all ESARDA publications – the bulletin, meeting proceedings, and on the website.

The author declares that their work/article is original and not a violation or infringement of any existing copyright.

Endnotes and References

[1] The National Defense Authorization Act for Fiscal Year 2013 (NDAA 2013), Title XXXI, Subtitle F, American Medical Isotopes Production Act of 2012, Section 3175, required the "Report on Disposition of Exports," by the Chairman of the NRC, to be delivered to the U.S. Congress within one year after President Obama signed the NDAA 2013 into law on January 2, 2013.
[2] The NRC 1993 report was pursuant to section 903(b) of the Energy Policy Act of 1992.
[3] The current U.S.-EURATOM 123 Agreement entered into force in March 1996 and meets the Nuclear Non-Proliferation Act of 1978. The agreement encompasses U.S. peaceful nuclear cooperation with all 28 EURATOM members. It is in force through April 2026, with an option for rolling five-year extensions.
[4] The current U.S.-IAEA 123 Agreement entered into force June 2014 and meets the Nuclear Non-Proliferation Act of 1978. It enables the U.S to supply power reactor fuel through the IAEA to Member States, under long-term Project and Supply Agreements, and remains in force until June 2054.
[5] This agreement is administered on a non-government basis by the American Institute in Taiwan.
[6] NDAA 2013, Title XXXI, Subtitle F, American Medical Isotopes Production Act of 2012, Section 3175.
[7] "Communiqué of the Washington Nuclear Security Summit," (The White House, Office of the Press Secretary, Washington, DC, April 13, 2010).
[8] "The Hague Nuclear Security Summit Communiqué," (The Hague, March 25, 2014).
[9] Three countries – Chile, Jamaica, and Norway – received U.S. HEU from other countries, not directly exported from the United States.
[10] Those countries include Belgium, Canada, France, Germany, and the Netherlands.
[11] In 2013, the appropriate HEU export licenses were amended to add RTRs in Poland and the Czech Republic as temporary intermediate consignees to receive and irradiate medical isotope targets. These reactors may receive HEU targets, containing gram-quantities of HEU each, for irradiation. Following irradiation, the targets are promptly shipped away to isotope production facilities in other countries.
[12] The NRC did not locate records indicating whether these 13 requests for alternative uses were approved by the U.S. Government or whether the HEU was used for the requested alternative use.
[13] Revision 4, June 1999, ''The Physical Protection of Nuclear Material and Nuclear Facilities''
[14] High-risk materials include Category II and Category I quantities of nuclear materials. For HEU, these correspond to the material quantities containing greater than or equal to 1 kg but less than 5 kg uranium-235 (Category II HEU), and greater than or equal to 5 kg uranium-235 (Category I HEU). For material irradiated to greater than 100 r/h at 1 m, the material category is reduced by one.
[15] Country-wide determinations are usually made for lower risk, Category III or less materials (less than 1 kg uranium-235); and for nuclear sites, which have not received a U.S. Government assessment team visit, but which are located in countries where such visits have occurred. In all cases, a country-wide determination involves consideration of available public and non-public sources.