CIVIL HIGHLY ENRICHED URANIUM: WHO HAS WHAT?

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The information presented below was compiled by researchers at the James Martin Center for Nonproliferation Studies (CNS) for the Nuclear Threat Initiative (NTI) as part of a project on Minimization of Highly Enriched Uranium (HEU) in Civilian Use.

For more information, visit NTI's CIVILIAN HEU REDUCTION & ELIMINATION DATABASE.

QUANTITY OF CIVILIAN HEU (IN KILOGRAMS)	COUNTRIES
More than 10,000 kg	United States: 354,000 kg. (excluding stockpile available for weapons), of which 20,000 kg. are civilian material.[1]
	Russia: 154,000 kg. (± 120,000 kg.) (excluding stockpile available for weapons), of which 20,000 kg. are civilian material.[2]
	Kazakhstan: 10,520-10,870 kg., most of which are irradiated.[3]
1,000 - 10,000 kg	France: 4,850 kg., of which 1,584 kg. are irradiated.[4]
	Japan: 1,200-1,400 kg.[5]
	United Kingdom: 1,404 kg., of which 141 kg. are irradiated.[6]
	Canada: less than 1,500 kg.
	China: approximately 1,000 kg.[7]
100-1,000 kg	Germany: 950 kg., of which approximately 730 kg. are irradiated.[8]
	Netherlands: 730-810 kg.
	Belgium: 700-750 kg.
	South Africa: 610-760 kg.
	Italy: 100-200 kg., of which most, if not all, are irradiated fuel.[9]
	Belarus: 87-127 kg., of which 40 kg. are 90% enriched.[10]
	Ukraine: approximately 50-150 kg.[11]
10-100 kg	Uzbekistan: less than 56 kg., all of which are irradiated fuel.
	DPRK: 42 kg.[12]
	Israel: 34 kg.[13]
	Pakistan: 17kg.[14]
	Czech Republic: 0-40 kg., all of which are irradiated fuel.
	Mexico: 12 kg.[15]
1-10 kg	Argentina: less than 8 kg.[16]
	Iran: 7 kg.[17]
	Switzerland: 5-10 kg.

	India: 4.5 kg.[18]
	Austria: 1-10 kg.
	Hungary: 1-10 kg.[19]
	Poland: 1-10 kg.[20]
	Vietnam: 1-10 kg.[21]
	Norway: 1-9 kg.[22]
	Australia: 2 kg.[23]
	Ghana: 1 kg.[24]
	Nigeria: 1 kg.[25]
	Syria: 1 kg.[26]
	Jamaica: 1 kg.[27]
Cleared of HEU (less than 1 kg)[28]	Brazil, Bulgaria, Chile,[29] Colombia, Denmark, Georgia, Greece, Indonesia, Iraq, Latvia, Libya, Philippines, Portugal, Romania, Serbia, Slovenia, South Korea, Spain, Sweden, Taiwan**,** Thailand, Turkey.

Sources:

[1] Out of the 354,000 kg., approximately 104,000 kg. remain to be blended down to LEU and 100,000 kg. are irradiated. See: International Panel on Fissile Materials, *Global Fissile Material Report 2010*, December 2010, p. 12, fissilematerials.org.

[2] Out of the total, 104,000 kg. are slated to be blended down and 10,000 kg. are irradiated. See: International Panel on Fissile Materials, *Global Fissile Material Report 2010*, December 2010, p. 12, fissilematerials.org. Note that Russia's civilian materials do not include military materials declared excess. Russia declared 500 tons excess in 1993, which it promised to blend down to LEU. Moscow does not consider this civilian material, unlike Washington's designation of excess material as civilian. For more information, see the USEC Website, "History," Accessed May 16, 2008.

[3] In May 2009, the NNSA announced the removal of 73.7 kg. of Russian-origin HEU spent fuel from Kazakhstan. "NNSA announces removal of more than 73 kilograms of Highly Enriched Uranium from Kazakhstan," NNSA press release, 19 May 2009,nnsa.energy.gov.

[4] Data as of 31 December 2009, as reported in "Communication Received from France Concerning Its Policies Regarding the Management of Plutonium," INFCIRC/549/Add.5/14, 8 September 2010.

[5] See: International Panel on Fissile Materials, *Global Fissile Material Report 2010*, December 2010, fn. 764, p. 203, fissilematerials.org.

[6] Data as of 31 December 2009, as reported in "Communication Received from the United Kingdom of Great Britain and Northern Ireland Concerning Its Policies Regarding the Management of Plutonium," INFCIRC/549/Add.8/13, 16 August 2010.

[7] This is an IPFM 2010 Report number that estimates that as of 2003, China had 1,000kg. China's naval reactors are LEU-powered. See: International Panel on Fissile Materials, *Global Fissile Material Report 2010*, December 2010, p. 100, fissilematerials.org.

[8] "Communication Received from Germany Concerning Its Policies Regarding the Management of Plutonium," INFCIRC/549/Add.2/13, 5 November 2010. It should be noted that the quantity reported is the amount of HEU held on German soil; Euratom also holds HEU materials in France for fabrication into nuclear fuel rods for Germany's FRM-II research reactor. NNSA announced in October 2008 that 20 pounds of HEU were removed from Germany. See "NNSA Completes Successful Year of U.S.-origin Nuclear Fuel Returns," NNSA Press Release, 7 October 2008,

nnsa.energy.gov. However, due to the continuing operation of the FRM-II reactor, Germany is expected to move into the category of countries with holdings of more than 1,000 kg HEU fairly soon. See: International Panel on Fissile Materials, *Global Fissile Material Report 2010*, December 2010, p. 138, fissilematerials.org.

[9] According to 2005 data from Albright, et al, Italy holds 100 kg. irradiated US-origin HEU that are not eligible for return to the United States and cannot be recovered by Italy. NNSA, however, declared in October 2008 that all eligible U.S.-origin HEU has been removed. See "NNSA Completes Successful Year of U.S.-origin Nuclear Fuel Returns," NNSA Press Release, October 7, 2008, nnsa.energy.gov.

[10] In 2010, approximately 43kg of fresh HEU fuel and 41kg of spent HEU fuel from the PAMIR facility were repatriated to Russia. Belarus has agreed to return all of its remaining HEU at Sosny to Russia before the 2012 Nuclear Security Summit. William Potter, "Belarus Agrees to Remove All HEU," CNS Feature Story, 1 December 2010, cns.miis.edu.

[11] NNSA announced the removal of 50 kg. of fresh HEU fuel from three sites in December 2010. In addition, 56 kg. of Russian-origin spent HEU fuel were removed in May 2010. Ukraine has committed to eliminating all of its HEU prior to the 2012 Nuclear Security Summit. "NNSA Achieves Milestone in Removal of HEU from Ukraine," NNSA Press Release, 31 December 2010, nnsa.energy.gov.

[12] This is an estimate by Kramer and Albright from 2005. The material in question is Russian-origin HEU provided for the IRT reactor at Yongbyon. David Albright and Kimberly Kramer, "ISIS Civil HEU Watch: Tracking Inventories of Civil Highly Enriched Uranium," August 2005, isis-online.org.

[13] Note that the estimate for Israel's total HEU stockpile carries great uncertainty. This estimate is from David Albright and Kimberly Kramer, "ISIS Civil HEU Watch: Tracking Inventories of Civil Highly Enriched Uranium," August 2005, isis-online.org. In January 2010, Israel reportedly returned some 5.4 kg of HEU spent fuel, presumably from the IRR-1, to the United States. World Nuclear News, "Final HEU Return from Turkey," 14 January 2010, www.world-nuclear-news.org.

[14] Note that the estimate for Pakistan's total HEU stockpile carries great uncertainty. Pakistan's PARR-2 research reactor operates with HEU. The country, however, does not utilize HEU for naval propulsion. IPFM estimates Pakistan's total HEU stocks at 1,500-3,600 kg. total, all of which are enriched to 90%. See: International Panel on Fissile Materials, *Global Fissile Material Report 2010*, December 2010, pp. 126-130, fissilematerials.org.

[15] Mexico's HEU stocks are set to be eliminated. See: White House, "Trilateral Announcement Between Mexico, the United States, and Canada on Nuclear Security," 13 April 2010.

[16] While all fuel elements have been removed from the RA-6 reactor, Argentina still has 8 kg. of HEU in filters, old fuel plates, and scraps. (CNS communication with official from National Atomic Energy Commission (CNEA), July 17, 2008.) The 2010 IPFM report states that between 1996 and 2010, Argentina shipped back to the United States irradiated HEU containing 40 kg. of U-235 and unirradiated fuel containing 4 kg. of HEU. International Panel on Fissile Materials, *Global Fissile Material Report 2010*, December 2010, fissilematerials.org.

[17] David Albright and Kimberly Kramer, "ISIS Civil HEU Watch: Tracking Inventories of Civil Highly Enriched Uranium," August 2005, isis-online.org.

[18] Note that the estimate for India's total HEU stockpile carries great uncertainty. The number above is largely for naval propulsion, though India does have one research reactor and another in the works. IPFM estimates India's total HEU stockpile at 200-500 kg. of U-235, all of which are 30-45 % enriched. See: International Panel on Fissile Materials, *Global Fissile Material Report 2010*, December 2010, pp. 122-125, fissilematerials.org.

[19] According to the NNSA, a shipment of 154.5 kg. of Soviet-era HEU was removed from Hungary and secured at a facility in Russia in October 2008. A further 18 kg. of HEU were removed in July 2009 from the Budapest Research Reactor before it was converted to LEU-fuel in September 2009. See NNSA press releases "Highly Enriched Uranium. Removed from Hungary," 23 October 2008, and "NNSA Completes Conversion of the Budapest Research Reactor and Removal of All Fresh HEU from Hungary," 15 September 2009, nnsa.energy.gov.

[20] Five shipments of HEU spent fuel were made from Poland to Russia from October 2009 to October 2010. Poland, however, still retains some HEU, probably at the Maria research reactor site. For more information see, "NNSA Completes Largest Highly Enriched Uranium (HEU) Fuel Return Campaign in Program's History," NNSA Press Release, 12 October 2010, nnsa.energy.gov.

[21] In 2007, approximately 4.5 kg. of fresh HEU fuel were removed from Vietnam. The country, however, has not yet been labeled as "cleaned out." See NNSA, "Reactor Converted and Nuclear Material Removed in Vietnam," 17 September 2007, nnsa.energy.gov; International Panel on Fissile Materials, *Global Fissile Material Report 2010*, December 2010, p. 138, fissilematerials.org;

[22] Norway imported a total of 9 kg. of HEU in the 1990s, and the bulk of it was blended down. However, the size of the stock is unclear. See discussion of Norway in: International Panel on Fissile Materials, *Global Fissile Material Report 2010*, December 2010, fn. 772, p. 204, fissilematerials.org.

[23] International Panel on Fissile Materials, *Global Fissile Material Report 2010*, December 2010, p. 142, fissilematerials.org. According to the NNSA, 14.5 kg. of U.S.-origin HEU in spent nuclear fuel were removed in May 2009. "Final U.S.-Origin HEU Shipment from Australia Completed," NNSA Press Release, 21 May 2009, nnsa.energy.gov. In addition, approximately 190 kg. of Australian HEU were sent to La Hague, France, for blending down to LEU. As of May 2008, a little over half of the latter material had been reprocessed (Cristina Hansell e-mail communication with Ann MacLachlan, *Platts Nuclear Publications*, May 15, 2008).

[24] The Miniature Neutron Source Reactors (MNSRs) supplied by China to Syria, Nigeria, Ghana, Iran, and Pakistan are all involved in an IAEA Coordinated Research Project looking at conversion to LEU. These reactors each have approximately 1 kg. of HEU in their cores. Pablo Adelfang, Ira Goldman, Adalberto Soares and E. Bradley, "Status and Progress of IAEA Activities on Research Reactor Conversion and Spent Fuel Return Programmes in the Years 2005-2006," paper presented at RERTR-2006, October 29 - November 2, 2006. Also see: International Panel on Fissile Materials, *Global Fissile Material Report 2010*, December 2010, p. 141, fissilematerials.org.

[25] International Panel on Fissile Materials, *Global Fissile Material Report 2010*, December 2010, p. 141, fissilematerials.org.

[26] International Panel on Fissile Materials, *Global Fissile Material Report 2010*, December 2010, p. 141, fissilematerials.org.

[27] In October 2006, the IAEA received an official request from Jamaica, to assist in the conversion of its Slowpoke reactor and the return of its HEU to the United States. The core contains approximately 0.82 kg. of U-235 enriched to 93%. As of 2010, however, there is no "firm timetable for the conversion" because of the need to re-qualify the fabrication process of the LEU fuel by Canada's AECL. Charles Grant, "The Jamaican Slowpoke Utilization and Core Conversion Plans," paper presented at the 32nd RERTR International Meeting, 10-14 October 2010, Lisbon, Portugal.

[28] For countries NNSA considers cleared of HEU, see Parrish Staples, "The NNSA Global Threat Reduction Initiative's Efforts to Minimize the Use of Highly Enriched Uranium for Medical Isotope Production," RRFM 2010 Conference, Marrakech, Morocco, 21-15 March 2010. Also see: International Panel on Fissile Materials, *Global Fissile Material Report 2010*, December 2010, p. 138, fissilematerials.org.

[29] NNSA, "Ahead of Nuclear Security Summit, NNSA Announces Removal of All Highly Enriched Uranium from Chile," 8 April 2010, nnsa.energy.gov.