

Appendix 8A. Global stocks of fissile materials, 2008

ALEXANDER GLASER AND ZIA MIAN*

Table 8A.1. Global stocks of highly enriched uranium (HEU), 2008

Country	Stockpile (tonnes) ^a	Production status	Comments
China	20 ± 4	Stopped 1987–89	
France ^b	35 ± 6	Stopped early 1996	
India ^c	0.6 ± 0.3	Continuing	Includes 5.1 tonnes declared civilian
Israel ^d	0.1		
Pakistan	2.0 ± 0.4	Continuing	
Russia ^e	770 ± 300	Stopped 1987 or 1988	Includes 100 tonnes assumed to be reserved for naval and other reactor fuel; does not include 160 tonnes to be blended down
United Kingdom ^f	23.3 (declared)	Stopped 1963	Includes 1.4 tonnes declared civilian
United States ^g	508 (declared)	Stopped 1992	Includes 128 tonnes reserved for naval reactor fuel and 20 tonnes for other HEU reactor fuel; does not include 137 tonnes to be blended down or for disposition as waste
Non-nuclear weapon states ^h	-10		
Total	-1370ⁱ		Not including 297 tonnes to be blended down

^a Most of this material is 90–93% enriched in uranium-235, which is typically considered as weapon grade. Important exceptions are noted where required. Blending down (i.e. reducing the concentration of uranium-235) of excess Russian and US weapon-grade HEU up to early and mid-2008, respectively, has been taken into account. A 20% uncertainty is assumed in the figures for total stocks in China and Pakistan and for the military stockpile in France, and 50% for India. The uncertainty of 300 tonnes for Russia reflects a 20% uncertainty about total Russian HEU production, which may have been up to 1500 tonnes.

* International Panel on Fissile Materials, Princeton University.

^b France declared 5.1 tonnes of civilian HEU to the International Atomic Energy Agency (IAEA) as of the end of 2007, a 20% reduction compared to the previous year; it is assumed here to be weapon-grade, 93% enriched HEU, even though some of the material is in irradiated form. The 20% uncertainty in the estimate applies only to the military stockpile of 30 tonnes and does not apply to the declared stock of 5.1 tonnes.

^d It is believed that India is producing HEU (93% enriched equivalent) at a rate of less than 0.1 tonnes/year for use as naval reactor fuel.

^e Israel may have acquired c. 100 kg of weapon-grade HEU covertly in or before 1965 from the USA.

^f As of June 2008, 337 tonnes of Russia's weapon-grade HEU had been blended down. The estimate shown for the Russian reserve for naval reactors is the authors' estimate based on the size of the Russian fleet.

^g This figure includes 22.9 tonnes of HEU as of 31 Mar. 2002, the average enrichments of which were not given. The UK declared a stock of 1.4 tonnes of civilian HEU to the IAEA as of the end of 2007. About 1 tonne of uranium-235 from the 22.9 tonnes may have been fissioned since 1998 in British naval fuel.

^h The amount of US HEU is given in actual tonnes, not 93% enriched equivalent. As of 30 Sep. 1996 the USA had an inventory of 741 tonnes of HEU containing 620 tonnes of uranium-235. To date, the USA has earmarked 233 tonnes of HEU for blending down. As of mid-2008 it had blended down 96 tonnes of this material; however, little if any of this HEU was weapon-grade.

^j The 2007 IAEA Annual Report lists 270 significant quantities of HEU under comprehensive safeguards. This corresponds to 6.75 tonnes of uranium-235 in uranium. To reflect the uncertainty in the enrichment levels of this material, mostly in research reactor fuel, a total of 10 tonnes of HEU is assumed.

ⁱ This total is rounded to the nearest 5 tonnes.

Sources: International Panel on Fissile Materials (IPFM), *Global Fissile Material Report 2008* (IPFM: Princeton, NJ, Oct. 2008), figure 1.3, p. 11; Institute for Science and International Security (ISIS), *Global Stocks of Nuclear Explosive Materials* (ISIS: Washington, DC, Dec. 2003); Albright, D., Berkhout, F. and Walker, W., SIPRI, *Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities and Policies* (Oxford University Press: Oxford, 1997), p. 80, table 4.1; Israel: Myers, H., 'The real source of Israel's first fissile material', *Arms Control Today*, vol. 37, no. 8 (Oct. 2007), p. 56; Gilinsky, V., 'Israel's bomb', *New York Review of Books*, 13 May 2004; see also Gilinsky, V., 'Time for more NUMEC information', *Arms Control Today*, vol. 38, no. 5 (June 2008); *Pakistan: Hibbs, M.*, 'Pakistan developed more powerful centrifuges', *NuclearFuel*, vol. 32, no. 3 (29 Jan. 2007); Hibbs, M., 'P-4 centrifuge raised intelligence concerns about post-1975 data theft', *Nucleonics Week*, 15 Feb. 2007; *Russia: United States Enrichment Corporation*, 'Megaton to megawatts', <<http://www.usec.com/>>; *UK: British Ministry of Defence*, 'Historical accounting for UK defence highly enriched uranium', London, Mar. 2006, <<http://www.mod.uk/DefenceInternet/AboutDefence/CorporatePublications/HealthandSafetyPublications/DepletedUranium/>>; International Atomic Energy Agency (IAEA), Communication received from the United Kingdom of Great Britain and Northern Ireland concerning its policies regarding the management of plutonium, INF/CIRC/549/Add.8/9, 15 Sep. 2006; USA: US Department of Energy (DOE), *Highly Enriched Uranium, Striking a Balance: A Historical Report on the United States Highly Enriched Uranium Production, Acquisition, and Utilization Activities from 1945 through September 30, 1996* (DOE: Washington, DC, 2001); George, R. and Tousley, D., DOE, 'US highly enriched uranium disposition', Presentation to the Nuclear Energy Institute Nuclear Fuel Supply Forum, Washington, DC, 24 Jan. 2006; George, R., 'U.S. HEU disposition program', Institute of Nuclear Materials Management 49th Annual Meeting, Nashville, TN, 13-17 July 2008; *Non-nuclear weapon states: IAEA, Annual Report 2007* (IAEA: Vienna, 2008), table A4.

Table 8A.2. Global stocks of separated plutonium, 2008

Country	Military stocks as of December 2007 (tonnes) ^a	Military production status	Civilian stocks as of December 2007, unless indicated (tonnes)
Belgium	0		0 (does not include 1.4 foreign owned)
China	4 ± 0.8	Stopped in 1991	0
France	5 ± 1.0	Stopped in 1994	54.9 (does not include 27.3 foreign owned)
Germany	0		15 in France, Germany and the UK
India ^b	0.68 ± 0.14	Continuing	6.4
Israel ^c	0.6 ± 0.12	Continuing	0
Japan	0		46.7 (8.7 in Japan and a total of 38 in France and the UK)
North Korea ^d	0.03	Stopped in 2007	0
Pakistan ^e	0.09 ± 0.018	Continuing	0
Russia ^f	145 ± 25 (34–50 declared excess)	Effectively stopped in 1997	44.9
Switzerland	0		<0.05
UK ^g	7.9 (4.4 declared excess)	Stopped in 1989	77.7 (includes 0.9 abroad, but not 26.8 foreign owned)
USA ^h	92 (53.9 declared excess)	Stopped in 1988	0
Totals	~255 (up to 108 declared excess)		~246

^a An uncertainty of 20% is assumed for military plutonium stocks in China, France, India, Israel and Pakistan.

^b India is estimated to be producing c. 30 kg a year of weapon-grade plutonium from the CIRUS and Dhruva reactors. As part of the Indian-US Civil Nuclear Cooperation Initiative, India has included in the military sector much of the plutonium separated from India's spent power-reactor fuel that is labelled civilian here. The 6.4 tonnes of civilian plutonium were not placed under safeguards in the 'India-specific' safeguards agreement signed by the Indian Government and the IAEA on 2 Feb. 2009.

^c Israel is believed to still be operating the Dimona plutonium production reactor but may be using it primarily for tritium production.

^d North Korea is reported to have declared a plutonium inventory of 31 kg in June 2008.

^e Pakistan is estimated to be producing c. 10 kg a year of weapon-grade plutonium from its Khushab-1 reactor. Two additional plutonium production reactors are under construction at the same site.

^f Russia is producing c. 0.5 tonnes of weapon-grade plutonium annually in its 1 remaining production reactor that continues to operate because it also produces heat and electricity for nearby communities. It is scheduled to be shut down in 2010. Russia has committed itself not to use this material for weapons.

^g The United Kingdom declared 82.1 tonnes of civilian plutonium (not including 26.8 tonnes of foreign owned plutonium in the UK). This includes 4.4 tonnes of military plutonium declared excess. However, since this 4.4 tonnes is not designated for IAEA safeguarding, in this estimate it continues to be assigned to the military stocks.

^h In its IAEA INF/CIRC/549 statement, the USA declared 53.9 tonnes of plutonium as excess for military purposes. Russia does not include its plutonium declared as excess in its INF/CIRC/549 statement.

Sources: International Panel on Fissile Materials (IPFM), *Global Fissile Material Report 2008* (IPFM: Princeton, NJ, Oct. 2008), figure 1.8, p. 16; Institute for Science and International Security (ISIS), *Global Stocks of Nuclear Explosive Materials* (ISIS: Washington, DC, Dec. 2003); *Military production status:* Albright, D., Berkhout, F. and Walker, W., SIPRI, *Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities and Policies* (Oxford University Press: Oxford, 1997); US Department of Energy (DOE), 'U.S. removes nine metric tons of plutonium from nuclear weapons stockpile', Press release, 17 Sep. 2007, <<http://www.energy.gov/nationalsecurity/5500.htm>>; *Civilian stocks (except for India):* declarations by country to the International Atomic Energy Agency (IAEA) under INF/CIRC/549, <<http://www.iaea.org/Publications/Documents/>>; *India:* Estimate based on assuming 50% of India's accumulated heavy-water reactor spent fuel has been reprocessed; Mian, Z. et al., *Fissile Materials in South Asia and the Implications of the U.S.-India Nuclear Deal*, International Panel on Fissile Materials (IPFM) Research Report no. 1 (IPFM: Princeton, NJ, Sep. 2006); *North Korea:* Kessler, G., 'Message to U.S. preceded nuclear declaration by North Korea', *Washington Post*, 2 July 2008; *Russia:* Agreement between the Government of the United States of America and the Government of the Russian Federation concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation (Russian-US Plutonium Management and Disposition Agreement), signed on 1 Sep. 2000.