X. Global stocks and production of fissile materials, 2021

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Materials that can sustain an explosive fission chain reaction are essential for all types of nuclear explosive, from first-generation fission weapons to advanced thermonuclear weapons. The most common of these fissile materials are highly enriched uranium (HEU) and plutonium. This section gives details of military and civilian stocks, as of the beginning of 2021, of HEU (table 10.11) and separated plutonium (table 10.12), including in weapons, and details of the current capacity to produce these materials (tables 10.13 and 10.14, respectively). The timeliness of the information here is constrained by the most recent annual declarations on civilian plutonium and HEU stocks to the International Atomic Energy Agency (IAEA; INFCIRC/549), which give data for 31 December 2020. The information in the tables is based on estimates prepared for the International Panel on Fissile Materials (IPFM).[1]

The production of both HEU and plutonium starts with natural uranium. Natural uranium consists almost entirely of the non-chain-reacting isotope uranium-238 (U-238) and is only about 0.7 per cent uranium-235 (U-235). Following mining, which produces a large amount of hazardous mining waste, conversion facilities turn uranium into gaseous uranium-hexafluoride. Using the gas, the concentration of U-235 in the uranium can be increased through isotopic separation (enrichment)—now carried out typically by using gas centrifuges and previously by gaseous diffusion technology.

Uranium that has been enriched to less than 20 per cent U-235 (typically, 3–5 per cent), known as low-enriched uranium, is suitable for use in power reactors. Uranium that has been enriched to contain at least 20 per cent U-235, known as HEU, is generally taken to be the lowest concentration practicable for use in weapons. However, to minimize the mass of the nuclear explosive, weapon-grade uranium is usually enriched to over 90 per cent U-235.

Plutonium is produced in nuclear reactors when U-238 in the fuel is exposed to neutrons. The plutonium is subsequently chemically separated from spent fuel in a hazardous reprocessing operation that generates large amounts of long-lived radioactive waste and can expose workers to high radiation doses.

[1] For further information see International Panel on Fissile Materials, 'Fissile material stocks', 4 Sep. 2021. For further information on the history, production and use of fissile materials and options for addressing the risks these materials pose see Feiveson, H. A. et al., *Unmaking the Bomb: A Fissile Material Approach to Nuclear Disarmament and Nonproliferation* (MIT Press: Cambridge, MA, 2014).

Plutonium comes in a variety of isotopic mixtures, most of which are weapon-usable. Weapon designers prefer to work with a mixture that predominantly consists of plutonium-239 (Pu-239) because of its relatively low rate of spontaneous emission of neutrons and gamma rays and the low level of heat generation from alpha decay. Weapon-grade plutonium typically contains more than 90 per cent Pu-239. The plutonium in typical spent fuel from power reactors (reactor-grade plutonium) contains 50–60 per cent Pu-239 but is weapon-usable, even in a first-generation weapon design.

The categories for fissile materials used in this section reflect the availability of these materials for weapon purposes. Material described as 'not directly available for weapons' is either material produced outside of weapon programmes or weapon-related material that states pledged not to use in weapons. This material, however, is not placed under international safeguards (such as through the IAEA or Euratom) or under bilateral monitoring. Safeguarded or monitored material is listed in a separate category. Starting this year, the data accounts only for unirradiated fissile material, a category that corresponds to the IAEA definition of 'unirradiated direct use material'.

All states that have a civil nuclear industry (i.e. that operate a nuclear reactor or a uranium enrichment plant) have some capability to produce fissile materials that could be used for weapons.

Table 10.11. Global stocks of highly enriched uranium, 2021

State	Total stock (tonnes)[a]	In weapons/ available for weapons (tonnes)	Not directly available for weapons, unsafeguarded (tonnes)	Not available for weapons, monitored/ under safeguards (tonnes)	Production status
China	14	14 ± 3	–	–	Stopped 1987–89
France[b]	29	25 ± 6	–	3.8	Stopped 1996
India[c]	4.5	–	4.5 ± 1.9	–	Continuing
Iran[d]	0.02	–	0.02	–	Continuing
Israel[e]	0.3	0.3	–	–	Unknown
Korea, North[f]	Uncertain	–	–	–	Uncertain
Pakistan[g]	4	4 ± 1.2	–	–	Continuing
Russia[h]	678	672 ± 120	6[i]	–	Continuing[j]
UK[k]	23	22	0.6[l]	–	Stopped 1962
USA[m]	495	361	134	–	Stopped 1992
Other states[n]	~4	–	–	~4	. .
Total[o]	**1 250**	**1 100**	**145**	**10**	

. . = not available or not applicable; – = nil or a negligible value.

[a] The numbers in the table are for unirradiated highly enriched uranium (HEU). Most of this material is 90–93% enriched uranium-235 (U-235), which is typically considered weapon-grade. The estimates are for the start of 2021. Important exceptions are noted.

[b] A 2014 analysis offers grounds for a significantly lower estimate of the stockpile of weapon-grade HEU (between 6 ± 2 tonnes and 10 ± 2 tonnes), based on evidence that the Pierrelatte enrichment plant may have had both a much shorter effective period of operation and a smaller weapon-grade HEU production capacity than previously assumed.

[c] It is believed that India is producing HEU (enriched to 30–45%) for use as naval reactor fuel. The estimate is for HEU enriched to 30%.

[d] The data for Iran is the International Atomic Energy Agency's (IAEA) estimate as of 5 Nov. 2021. Iran started enriching uranium up to 20% on 4 Jan. 2021 and started enriching HEU up to 60% enrichment level on 17 Apr. 2021.

[e] Israel may have acquired illicitly *c.* 300 kilograms of weapon-grade HEU from the USA in or before 1965. Some of this material may have been consumed in the process of producing tritium.

[f] North Korea (the Democratic People's Republic of Korea, DPRK) is known to have a uranium enrichment plant at Yongbyon and possibly others elsewhere. Independent estimates of uranium enrichment capability and possible HEU production extrapolated to the beginning of 2021 suggest a potential accumulated HEU stockpile in the range 230–1180 kg.

[g] This estimate for Pakistan assumes total HEU production of 4.1 tonnes, of which *c.* 100 kg was used in nuclear weapon tests.

[h] This estimate assumes that the Soviet Union stopped all HEU production in 1988. It may therefore understate the amount of HEU in Russia (see also note j).

[i] This material is believed to be in use in various civilian as well as military-related research facilities.

[j] The Soviet Union stopped production of HEU for weapons in 1988 but kept producing HEU for civilian and non-weapon military uses. Russia continues this practice.

[k] The estimate for the United Kingdom reflects a declaration of 21.9 tonnes of military HEU as of 31 Mar. 2002, the average enrichment of which was not given.

[l] This figure is from the UK's INFCIRC/549 declaration to the IAEA for the start of 2021. As the UK has left the European Union, the material is no longer under Euratom safeguards.

[m] The amount of HEU held by the United States is given in actual tonnes, not 93%-enriched equivalent. In 2016 the USA declared that, as of 30 Sep. 2013, its HEU inventory was 585.6 tonnes,

of which 499.4 tonnes was declared to be for 'national security or non-national security programs including nuclear weapons, naval propulsion, nuclear energy, and science'. This material was estimated to include about 360.9 tonnes of HEU in weapons and available for weapons, 121.1 tonnes of HEU reserved for naval fuel and 17.3 tonnes of HEU reserved for research reactors. The remaining 86.2 tonnes of the 2013 declaration was composed of 41.6 tonnes 'available for potential down-blend to low enriched uranium or, if not possible, disposal as low-level waste', and 44.6 tonnes in spent reactor fuel. As of the end of 2020, the amount available for use had been reduced to *c*. 472.1 tonnes, which is estimated to include 96 tonnes of HEU in naval reserve and 15.2 tonnes reserved for research reactors. Between the end of the US financial year (FY) 2013 (30 Sep. 2013) and the end of FY 2020 (30 Sep. 2020), the amount of material to be downblended was reduced from 41.6 tonnes to 23 tonnes.

[n] The IAEA's 2020 annual report lists 156 significant quantities of HEU under comprehensive safeguards in non-nuclear weapon states as of the end of 2020. Assuming a significant quantity to be 25 kg of HEU, the total mass is estimated to be 4 tonnes. In INFCIRC/912 (from 2017) more than 20 states committed to reducing civilian HEU stocks and providing regular reports. So far, only 2 states have reported under this scheme. At the end of 2018 (time of last declaration), Norway held less than 4 kg of HEU for civilian purposes. As of 30 June 2019, Australia held 2.7 kg of HEU for civilian purposes.

[o] Totals are rounded to the nearest 5 tonnes.

Sources: International Panel on Fissile Materials (IPFM), *Global Fissile Material Report 2015: Nuclear Weapon and Fissile Material Stockpiles and Production* (IPFM: Princeton, NJ, 2015). *China*: Zhang, H., *China's Fissile Material Production and Stockpile* (IPFM: Princeton, NJ, 2017). *France*: International Atomic Energy Agency (IAEA), 'Communication received from France concerning its policies regarding the management of plutonium', INFCIRC/549/Add.5/25, 21 Sep. 2021; and Philippe, S. and Glaser, A., 'Nuclear archaeology for gaseous diffusion enrichment plants', *Science & Global Security*, vol. 22, no. 1 (2014), pp. 27–49. *Iran*: IAEA, Board of Governors, 'Verification and monitoring in the Islamic Republic of Iran in light of United Nations Security Council Resolution 2231 (2015)', Report by the Director General, GOV/2021/51, 17 Nov. 2021. *Israel*: Myers, H., 'The real source of Israel's first fissile material', *Arms Control Today*, vol. 37, no. 8 (Oct. 2007), p. 56; and Gilinsky, V. and Mattson, R. J., 'Revisiting the NUMEC affair', *Bulletin of the Atomic Scientists*, vol. 66, no. 2 (Mar./Apr. 2010). *North Korea*: Hecker, S. S., Braun, C. and Lawrence, C., 'North Korea's stockpiles of fissile material', *Korea Observer*, vol. 47, no. 4 (winter 2016), pp. 721–49. *Russia*: Podvig, P. (ed.), *The Use of Highly-Enriched Uranium as Fuel in Russia* (IPFM: Washington, DC, 2017). *UK*: British Ministry of Defence, 'Historical accounting for UK defence highly enriched uranium', Mar. 2006; and IAEA, 'Communications received from the United Kingdom of Great Britain and Northern Ireland concerning its policies regarding the management of plutonium', INFCIRC/549/Add.8/25, 13 Oct. 2021. *USA*: US Department of Energy (DOE), National Nuclear Security Administration, *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, Jan. 2001); White House, 'Transparency in the US highly enriched uranium inventory', Fact sheet, 31 Mar. 2016; US DOE, *FY 2021 Congressional Budget Request*, vol. 1, *National Nuclear Security Administration* (DOE: Washington, DC, Feb. 2020), p. 593; and US DOE, *Tritium and Enriched Uranium Management Plan through 2060*, Report to Congress (DOE: Washington, DC, Oct. 2015). *Non-nuclear weapon states*: IAEA, *IAEA Annual Report 2020* (IAEA: Vienna, 2020), Annex, Table A4, p. 139; IAEA, 'Communication dated 19 July 2019 received from the Permanent Mission of Norway concerning a joint statement on minimising and eliminating the use of highly enriched uranium in civilian applications', INFCIRC/912/Add.3, 15 Aug. 2019; and IAEA, 'Communication dated 23 January 2020 received from the Permanent Mission of Australia concerning the joint statement on minimising and eliminating the use of highly enriched uranium in civilian applications', INFCIRC/912/Add.4, 5 Mar. 2020.

Table 10.12. Global stocks of separated plutonium, 2021

State	Total stock (tonnes)[a]	In weapons/ available for weapons (tonnes)	Not directly available for weapons, unsafeguarded (tonnes)	Not available for weapons, monitored/ under safeguards (tonnes)	Military production status
China	2.9	2.9 ± 0.6	0.04[b]	–	Stopped in 1991
France	85.4	6 ± 1.0	–	79.4[c]	Stopped in 1992
India	9.2	0.71 ± 0.14	8.1 ± 4.3[d]	0.4	Continuing
Israel[e]	0.8	0.83 ± 0.1	–	–	Continuing
Japan	46.1	–	–	46.1[c]	–
Korea, North[f]	0.04	0.04	–	–	Continuing
Pakistan[g]	0.5	0.46 ± 0.16	–	–	Continuing
Russia	191	88 ± 8	88.3[h]	15[i]	Stopped in 2010
UK	119.3	3.2	116.1[c]	–	Stopped in 1995
USA[j]	87.8	38.4	46.4	3[k]	Stopped in 1988
Total[l]	**545**	**140**	**260**	**145**	

– = nil or a negligible value.

[a] Estimates are for the start of 2021. Important exceptions are noted.

[b] These numbers are based on China's INFCIRC/549 declaration to the International Atomic Energy Agency (IAEA) for the end of 2016. As of May 2022, this is the most recent declaration.

[c] The data for France, Japan and the United Kingdom is for the end of 2020, reflecting their most recent respective INFCIRC/549 declarations to the IAEA. Some states with civilian plutonium stocks do not submit an INFCIRC/549 declaration. Of these states, the Netherlands, Spain and Sweden store their plutonium abroad, but the total amounts are too small to be noted in the table.

[d] This material is the plutonium separated from spent power-reactor fuel. While such reactor-grade plutonium can, in principle, be used in weapons, it is labelled as 'not directly available for weapons' here since it is intended for breeder reactor fuel. It was not placed under safeguards in the 'India-specific' safeguards agreement signed by the Indian government and the IAEA on 2 Feb. 2009. India does not submit an INFCIRC/549 declaration to the IAEA.

[e] Israel is believed to be operating the Dimona plutonium production reactor. The estimate assumes partial use of the reactor for tritium production from 1997 onwards. The estimate is for the end of 2020. Without tritium production, the stockpile could be as high as 1070 kg.

[f] North Korea (the Democratic People's Republic of Korea, DPRK) reportedly declared a plutonium stock of 37 kg in June 2008. It is believed that it subsequently unloaded its 5 megawatt electric reactor three additional times, in 2009, 2016 and 2018. The stockpile estimate has been reduced to account for North Korea's six nuclear tests. North Korea's reprocessing facility operated again in 2021 for five months.

[g] As of the end of 2020, Pakistan was operating four plutonium production reactors at its Khushab site. This estimate assumes that Pakistan is separating plutonium from all four reactors.

[h] This material includes 63.3 tonnes of separated plutonium declared in Russia's 2021 INFCIRC/549 declaration as civilian. Russia does not make the plutonium it reports as civilian available to IAEA safeguards. This amount also includes 25 tonnes of weapon-origin plutonium stored at the Mayak Fissile Material Storage Facility, which Russia pledged not to use for military purposes.

[i] This material is weapon-grade plutonium produced between 1 Jan. 1995 and 15 Apr. 2010, when the last plutonium production reactor was shut down. It cannot be used for weapon purposes under the terms of a 1997 Russian–United States agreement on plutonium production reactors. The material is currently stored at Zheleznogorsk and is subject to monitoring by US inspectors.

[j] In 2012 the USA declared a government-owned plutonium inventory of 95.4 tonnes as of 30 Sep. 2009. In its 2021 INFCIRC/549 declaration, the most recent submitted, the USA declared 49.4 tonnes of unirradiated plutonium (both separated and in mixed oxide, MOX) as part of the stock identified as excess for military purposes (declaration for 31 Dec. 2020).

[k] The USA has placed about 3 tonnes of its excess plutonium, stored at the K-Area Material Storage Facility at the Savannah River Plant, under IAEA safeguards.

[l] Totals are rounded to the nearest 5 tonnes.

Sources: International Panel on Fissile Materials (IPFM), *Global Fissile Material Report 2015: Nuclear Weapon and Fissile Material Stockpiles and Production* (IPFM: Princeton, NJ, 2015). *Civilian stocks (except for India)*: declarations by countries to the International Atomic Energy Agency (IAEA) under INFCIRC/549. *China*: Zhang, H., *China's Fissile Material Production and Stockpile* (IPFM: Princeton, NJ, 2017). *Israel*: Glaser, A. and de Troullioud de Lanversin, J., 'Plutonium and tritium production in Israel's Dimona reactor, 1964–2020', *Science & Global Security*, vol. 29, no. 2 (2021). *North Korea*: Kessler, G., 'Message to US preceded nuclear declaration by North Korea', *Washington Post*, 2 July 2008; Hecker, S. S., Braun, C. and Lawrence, C., 'North Korea's stockpiles of fissile material', *Korea Observer*, vol 47, no. 4 (winter 2016), pp. 721–49; and IAEA, Board of Governors and General Conference, 'Application of safeguards in the Democratic People's Republic of Korea', Report by the acting director general, GOV/2019/33-GC(63)/20, 19 Aug. 2019. *Russia*: Russian–United States Agreement Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation (Plutonium Management and Disposition Agreement), signed 29 Aug. and 1 Sep. 2000, amendment signed 5 Sep. 2006, entered into force 13 July 2011. *USA*: National Nuclear Security Administration (NNSA), *The United States Plutonium Balance, 1944–2009* (NNSA: Washington, DC, June 2012); and Gunter, A., 'K-Area overview/update', US Department of Energy, Savanah River Site, 28 July 2015.

Table 10.13. Significant uranium enrichment facilities and capacity worldwide, 2021

State	Facility name or location	Type	Status	Enrichment process[a]	Capacity (thousands SWU/yr)[b]
Argentina[c]	Pilcaniyeu	Civilian	Uncertain	GD	20
Brazil	Resende	Civilian	Expanding capacity	GC	45
China[d]	Lanzhou	Civilian	Operational	GC	2 600
	Hanzhong (Shaanxi)	Civilian	Operational	GC	2 000
	Emeishan	Civilian	Operational	GC	1 050
	Heping	Dual-use	Operational	GD	230
France	Georges Besse II	Civilian	Operational	GC	7 500
Germany	Urenco Gronau	Civilian	Operational	GC	3 800
India	Rattehalli	Military	Operational	GC	15–30
Iran[e]	Natanz	Civilian	Limited operation	GC	3.5–10
	Qom (Fordow)	Civilian	Limited operation	GC	0.7–2
Japan	Rokkasho[f]	Civilian	Resuming operation	GC	75
Korea, North	Yongbyon[g]	Uncertain	Operational	GC	8
Netherlands	Urenco Almelo	Civilian	Operational	GC	5 200
Pakistan	Gadwal	Military	Operational	GC	. .
	Kahuta	Military	Operational	GC	15–45
Russia	Angarsk	Civilian	Operational	GC	4 000
	Novouralsk	Civilian	Operational	GC	13 300
	Seversk	Civilian	Operational	GC	3 800
	Zelenogorsk[h]	Civilian	Operational	GC	7 900
UK	Urenco Capenhurst	Civilian	Operational	GC	4 500
USA	Urenco Eunice	Civilian	Operational	GC	4 900

. . = not available or not applicable.

[a] The gas centrifuge (GC) is the main isotope-separation technology used to enrich uranium in uranium-235 (U-235), but a few facilities continue to use gaseous diffusion (GD).

[b] Separative work units per year (SWU/yr) is a measure of the effort required in an enrichment facility to separate uranium of a given content of U-235 into two components, one with a higher and one with a lower percentage of U-235. Where a range of capacities is shown, the capacity is uncertain or the facility is expanding its capacity.

[c] In Dec. 2015 Argentina announced the reopening of its Pilcaniyeu GD uranium enrichment plant, which was shut down in the 1990s. There is no evidence of actual production.

[d] Assessments of China's enrichment capacity in 2015 and 2017 identified new enrichment sites and suggested a much larger total capacity than had previously been estimated.

[e] In July 2015 Iran agreed the Joint Comprehensive Plan of Action (JCPOA), which ended uranium enrichment at Fordow but kept centrifuges operating and limited the enrichment capacity at Natanz to 5060 IR-1 centrifuges (equivalent to 3500–5000 SWU/yr) for 10 years. Since the withdrawal of the United States from the JCPOA in 2018, Iran has increased enrichment capacities at its facilities. As of 17 Nov. 2021, the International Atomic Energy Agency (IAEA) had verified 5229 IR-1 centrifuges (31 cascades), 1044 IR-2m centrifuges (6 cascades) and 348 IR-4 centrifuges (2 cascades) installed at the Natanz Fuel Enrichment Plant. Highly enriched uranium (HEU) production takes place at the Pilot Fuel Enrichment Plant at Natanz, with a capacity of up to 2000 SWU. At the Fordow Fuel Enrichment Plant, there were 1044 IR-1 and 189 IR-6 centrifuges as of Nov. 2021.

[f] The Rokkasho centrifuge plant has been in the process of being refitted with new centrifuge technology since 2011. Production since the start of retrofitting has been negligible.

[g] North Korea (the Democratic People's Republic of Korea, DPRK) revealed its Yongbyon enrichment facility in 2010. It appeared to be operational in 2021. It is believed that North Korea is operating at least one other enrichment facility.

[h] Zelenogorsk operates a centrifuge cascade for HEU production for fast reactor and research reactor fuel.

Sources: Indo-Asian News Service (IANS), 'Argentina president inaugurates enriched uranium plant', *Business Standard*, 1 Dec. 2015; 'Brazil's INB launches new centrifuge cascade', *Nuclear Engineering International*, 25 Nov. 2021; Zhang, H., 'China's uranium enrichment complex', *Science & Global Security*, vol. 23, no. 3 (2015), pp. 171–90; Zhang, H., *China's Fissile Material Production and Stockpile* (International Panel on Fissile Materials, IPFM: Princeton, NJ, 2017); Hecker, S. S., Carlin, R. L. and Serbin, E. A., 'A comprehensive history of North Korea's nuclear program', Stanford University, Center for International Security and Cooperation (CISAC), 2018 update; International Atomic Energy Agency (IAEA), Board of Governors, 'Verification and monitoring in the Islamic Republic of Iran in light of United Nations Security Council Resolution 2231 (2015)', Report by the Director General, GOV/2021/51, 17 Nov. 2021; and IAEA, Board of Governors, 'Verification and monitoring in the Islamic Republic of Iran in light of United Nations Security Council resolution 2231 (2015)', Report by the Director General, GOV/2022/4, 3 Mar. 2022. Enrichment capacity data is based on IAEA, Integrated Nuclear Fuel Cycle Information Systems (iNFCIS); Urenco, 'Global operations', [n.d.]; and IPFM, *Global Fissile Material Report 2015: Nuclear Weapon and Fissile Material Stockpiles and Production* (IPFM: Princeton, NJ, 2015).

Table 10.14. Significant reprocessing facilities worldwide, 2021

All facilities process light water reactor (LWR) fuel, except where indicated.

State	Facility name or location	Type	Status	Design capacity (tHM/yr)[a]
China[b]	Jiuquan pilot plant	Civilian	Operational	50
France	La Hague UP2	Civilian	Operational	1 000
	La Hague UP3	Civilian	Operational	1 000
India[c]	Kalpakkam (HWR fuel)	Dual-use	Operational	100
	Tarapur (HWR fuel)	Dual-use	Operational	100
	Tarapur-II (HWR fuel)	Dual-use	Operational	100
	Trombay (HWR fuel)	Military	Operational	50
Israel	Dimona (HWR fuel)	Military	Operational	40–100
Japan	JNC Tokai	Civilian	Reprocessing shut down[d]	(was 200)
	Rokkasho	Civilian	Start planned for 2022	800
Korea, North	Yongbyon (GCR fuel)	Military	Operational	100–150
Pakistan	Chashma (HWR fuel)	Military	Starting up	50–100
	Nilore (HWR fuel)	Military	Operational	20–40
Russia[e]	Mayak RT-1, Ozersk	Civilian	Operational	400
	EDC, Zheleznogorsk	Civilian	Starting up	250
UK	Sellafield B205 (Magnox fuel)	Civilian	To be shut down in 2022	1 500
	Sellafield Thorp	Civilian	Shut down in 2018	(was 1 200)
USA	H-canyon, Savannah River Site	Civilian	Operational	15

HWR = heavy water reactor; GCR = gas cooled reactor.

[a] Design capacity refers to the highest amount of spent fuel the plant is designed to process and is measured in tonnes of heavy metal per year (tHM/yr), tHM being a measure of the amount of heavy metal—uranium in these cases—that is in the spent fuel. Actual throughput is often a small fraction of the design capacity. LWR spent fuel contains *c*. 1% plutonium, and heavy water- and graphite-moderated reactor fuels contain *c*. 0.4% plutonium.

[b] China is building a pilot reprocessing facility near Jinta, Gansu province, with a capacity of 200 tHM/yr, to be commissioned in 2025. A second reprocessing plant of the same capacity is planned for the same site.

[c] As part of the 2005 Indian–United States Civil Nuclear Cooperation Initiative, India has decided that none of its reprocessing plants will be opened for International Atomic Energy Agency safeguards inspections.

[d] In 2014 the Japan Atomic Energy Agency announced the planned closure of the head-end of its Tokai reprocessing plant, effectively ending further plutonium separation activity. In 2018 the Japanese Nuclear Regulation Authority approved a plan to decommission the plant.

[e] Russia continues to construct a 250 tHM/yr pilot experimental centre at Zheleznogorsk. A pilot reprocessing line with a capacity of 5 tHM/yr was launched in June 2018.

Sources: Kyodo News, 'Japan approves 70-year plan to scrap nuclear reprocessing plant', 13 June 2018; and RIA Novosti, [Rosatom is ready to start 'green' processing of spent nuclear fuel], 29 May 2018 (in Russian). Data on design capacity is based on International Atomic Energy Agency, Integrated Nuclear Fuel Cycle Information Systems (iNFCIS); and International Panel on Fissile Materials (IPFM), *Global Fissile Material Report 2015: Nuclear Weapon and Fissile Material Stockpiles and Production* (IPFM: Princeton, NJ, 2015).