

Plutonium and Highly-Enriched Uranium: Stopping the fissile materials that make nuclear weapons

The control and elimination of fissile materials, the key ingredients in nuclear weapons, has been recognized as central to the goal of nuclear disarmament from the beginning of the nuclear age.

In November 1957, the United Nations General Assembly proposed a treaty on the reduction of armaments and the prohibition of atomic, hydrogen and other weapons of mass destruction. To achieve its goal, the intended treaty would provide for:

- a) the cessation of the production of fissionable materials for weapons purposes,
- b) the complete devotion of future production of fissionable materials to non-weapons purposes under effective international control, and,
- c) the reduction of stocks of nuclear weapons through a program of transfer, on an equitable and reciprocal basis and under international supervision, of stocks of fissionable materials from weapons uses to non-weapons uses.

While progress on such a nuclear disarmament treaty was prevented by Cold War politics, the Nonproliferation Treaty (NPT) was enacted in 1968 to prevent the further spread of nuclear weapons. This recognised the necessity of disarmament (Preamble and Article VI), while explicitly prohibiting all non-nuclear-weapon states from producing fissile materials for weapons purposes (Article II). This obligation was verified through International Atomic Energy Agency (IAEA) safeguards on fissile material production facilities and stocks (Article III). The important fissile materials are uranium enriched above 20 percent in the isotope uranium-235 (known as highly-enriched uranium or HEU) and separated plutonium. The key facilities are uranium enrichment plants, nuclear reactors, spent nuclear fuel and plutonium separation (reprocessing) plants.

Halting fissile materials proliferation

In December 1993, the General Assembly adopted a resolution calling for negotiation of a non-discriminatory, multilateral, and internationally and effectively verifiable treaty banning the production of fissile material for nuclear weapons or other nuclear explosive devices. The UN asked the Geneva-based Conference on Disarmament (CD) to consider and recommend how best to accomplish this. One month before NPT parties convened in New York for the 1995 NPT Review and Extension Conference, the CD adopted the Shannon Mandate (CD/1299, 24 March 1995), giving itself the responsibility to negotiate what became variously called a Fissban, a Fissile Material Cut-off Treaty (FMCT), or a Fissile Materials Treaty (FMT).

After finalising the Comprehensive Test Ban Treaty (CTBT), the Conference on Disarmament became deadlocked over its programme of work, particularly with regard to the relative priorities of fissile materials, nuclear disarmament and preventing the weaponisation of space. Divisions also surfaced over whether the Fissban should solely prohibit future production or also address past production (i.e. existing stockpiles) of fissile materials. The Shannon Mandate had sought to resolve this question by not explicitly referring to stocks in the three operative paragraphs, while allowing for delegations to raise any such issues during the negotiations.

The 1995 and 2000 NPT Review Conferences reaffirmed the Shannon Mandate. As one of the Thirteen Steps, a target date was recommended for the CD, urging the immediate commencement of negotiations on such a treaty with a view to their conclusion within five years. As of April 2010 talks still have not started.

Military and civil stocks of weapon-usable Plutonium and HEU

As recognized in the 1957 UNGA resolution, to achieve disarmament rather than just cap nuclear arsenals, ending fissile material production must be accompanied by the reduction and elimination of existing stocks.

Another of the Thirteen Steps agreed at the 2000 NPT Review Conference calls for Arrangements by all nuclear-weapon States to place, as soon as practicable, fissile material designated by each of them as no longer required for military purposes under IAEA or other relevant international verification and arrangements for the disposition of such material for peaceful purposes, to ensure that such material remains permanently outside of military programmes. Only the United States, Russia, and Britain have declared any material excess. Despite some of them undertaking such voluntary measures in this direction, the nuclear-weapon states have refused to consider any binding legal commitments to designate as excess the fissile material from warheads withdrawn from service.

In addition to fissile materials produced specifically for weapons purposes, it must be recognised that as a consequence of commercial reprocessing and enrichment activities over many decades there are also large stocks of weapon-usable material in civil as well as military use. To achieve and secure nuclear disarmament today will require addressing these materials and uses.

Table 1: Global stocks of highly enriched uranium and plutonium, 2009

Country	HEU (tons)	Plutonium (tons)
Britain	23.3	86.5
China	20	4
France	35	88.8
India	0.6	7.5
Israel	0.1	0.6
North Korea	-	0.035
Pakistan	2	0.1
Russia	888	191.5
United States	617	92
Non-weapon states	~10	~10

Table 1 gives the most recent estimate of plutonium and HEU stockpiles by the International Panel on Fissile Materials (IPFM). There are large uncertainties, of the order of 20%, associated with some of these estimates, and a very large uncertainty, of the order of +/- 300 tons in figures for Russia's stockpile of HEU. These estimates include material that has been declared excess by the United States and Russia and is to be blended down or disposed. It also includes foreign plutonium held in France and the UK. Most of the plutonium in non-weapon states is in Japan, which is the only non-weapon state with an active reprocessing programme. The IAEA adopts as its standard significant quantity that 25 kg of HEU or 8 kg plutonium are sufficient to make a simple, first-generation nuclear weapon, such as those used by the United States on Hiroshima and Nagasaki. More advanced fission weapons could be made with smaller quantities.

Paving the way for nuclear disarmament

The NPT nuclear weapon states – China, France, Russia, the United Kingdom and the United States – have large stockpiles of HEU and plutonium and have ended production for weapons, in some cases decades ago. Only China has not declared that it is abiding by a moratorium and so has not formalised its production halt. Israel, India, North Korea and Pakistan continue to produce fissile materials for weapons. Britain and the United States have declared the size of their total fissile material holdings. France has been willing at least to declare its civilian plutonium stockpiles, while China has refused to provide any figures for its fissile material holdings.

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French Foreign Ministry invites international experts to inspect the decommissioned Marcoule plutonium production facility, 2008.

Today, along with about ten thousand warheads that are deployed or in reserve, there are a similar number awaiting dismantlement, and materials and components from tens of thousands more in storage. There are also stocks of these materials assigned to fuel military and research nuclear reactors, but which could be used to make nuclear weapons. Most of these stocks are a legacy of the Cold War arms race. Table 2 shows the IPFM breakdown of the global fissile material stockpile by its uses.

Table 2: Estimated aggregate fissile material stockpiles by function, 2009

	HEU (tons)	Plutonium (tons)
In weapons programs	900	150
Declared excess	250	90
Naval programs	380	
Civilian programs	70	240

To assist the process of verifying a Fissban and to lay a basis for the future verification of nuclear disarmament, states should make complete and comprehensive public declarations of their HEU and plutonium stockpiles and production histories.

Nuclear disarmament would release about 900 tons of HEU and 150 tons of plutonium currently in nuclear warheads and the associated production complexes. About 500 tons of HEU from weapons was previously declared excess by the US and Russia and has been blended down to make low-enriched uranium (LEU) for power reactor fuel. France and the UK have reduced their arsenals from their Cold War highs but have not declared all the material in the surplus weapons as excess.

The global HEU stockpile is now shrinking as Russia and the US downblend excess HEU at a rate faster than HEU is being produced by Pakistan for weapons and by India for naval propulsion reactor fuel.

The global civilian plutonium stockpile is growing faster than the military stockpile. The rate of plutonium separation will increase dramatically if Japan's much-delayed Rokkasho reprocessing plant begins full-scale operation, if Britain ever resumes activity at its THORP facility, and if India goes ahead with building several large new reprocessing plants that it wants to reprocess spent fuel from the imported reactors that have been made possible by the US-India nuclear deal brokered by the Bush administration. China, which is about to begin operating a pilot-scale reprocessing plant, also has ambitions for large reprocessing facilities, which would add to global plutonium stocks.

For nuclear disarmament to be pursued effectively, it will be necessary to prevent states creating new stockpiles of civilian separated plutonium and to eliminate existing stocks to ensure they are not available as a reserve of weapon-usable material should states seek to violate a future nuclear abolition regime by building new nuclear weapons or reconstituting their nuclear arsenals.

If the Conference on Disarmament were able to overcome its structural weaknesses and begin negotiations in the next year, then a multilateral treaty may still be possible. But this will require among other things that CD governments make a fissile material treaty a priority. It will also require the United States and others to focus on more than the war against the Taliban and Al-Qaeda in their relations with Pakistan, which has been obstructing the start of talks in recent years.

As momentum grows for a comprehensive approach to nonproliferation, disarmament and preventing nuclear dangers, multilateral negotiations on some form of Nuclear Weapons Convention could bypass the current deadlock over negotiating a separate FMCT and ensure that banning the production of weapon-usable fissile materials is negotiated as a priority measure to be implemented early in the process, with provision made for reducing and eliminating existing stocks.



Acronym Institute for Disarmament Diplomacy

What needs to be done?

At the 2010 NPT Review Conference, states should reaffirm their commitment to a ban on the production of fissile materials for weapons purposes, as adopted by the 1995 and 2000 NPT Review Conferences, and consider ways and means to make progress on such a ban in the Conference on Disarmament or as part of broader negotiations on a Nuclear Weapons Convention.

In conjunction with negotiations on an instrument banning the future production of fissile materials for weapons, states should undertake to phase out reprocessing and end programmes for separating plutonium and producing HEU for civilian use. This will prevent the stockpiling of weapon-usable fissile material as part of naval propulsion and civilian nuclear energy programmes after a Fissban comes into force. It will be necessary to explore practical initiatives to provide safe and secure multinational or international alternatives to national fuel cycle facilities and to eliminate stockpiles of high-enriched uranium and plutonium.

States should reaffirm their commitment to the principle of irreversibility and undertake to dismantle nuclear weapons that are taken out of deployment through unilateral, bilateral or multilateral steps as they fulfil disarmament commitments. Fissile materials from dismantled warheads should be declared excess and their safe and secure disposition arranged under IAEA safeguards.

To assist the process of verifying a Fissban and to lay a basis for the future verification of nuclear disarmament, states should make complete and comprehensive public declarations of their HEU and plutonium stockpiles and production histories.

Further reading

Global Fissile Material Report 2009: A Path to Nuclear Disarmament, International Panel on Fissile Materials, October 2009.
http://www.fissilematerials.org/ipfm/site_down/gfmr09.pdf

Global Fissile Material Report 2008: Scope and Verification of a Fissile Material (Cutoff) Treaty, International Panel on Fissile Materials, October 2008.
http://www.fissilematerials.org/ipfm/site_down/gfmr08.pdf

Banning the Production of Fissile Materials for Nuclear Weapons: Country Perspectives on the Challenges to a Fissile Material (Cutoff) Treaty, International Panel on Fissile Materials, September 2008.
http://www.fissilematerials.org/ipfm/site_down/gfmr08cv.pdf

A Fissile Material (Cut-Off) Treaty: A Treaty Banning the Production of Fissile Materials for Nuclear Weapons or Other Nuclear Explosive Devices with article-by-article explanation, IPFM, September 2009,
http://www.fissilematerials.org/ipfm/site_down/fmct-ipfm-sep2009.pdf

This briefing is the copyright of the Acronym Institute for Disarmament Diplomacy with acknowledgement and thanks to the lead author Dr Zia Mian, Princeton University. It is part of an Acronym Institute series originally produced for the 2010 NPT Review Conference. Drawing on the knowledge and experience of key thinkers, analysts and experts in the field of multilateral arms control and international security, we address some of the core issues relating to the NPT, non-proliferation and disarmament with the aim of enhancing the conference outcome and developing collective strategies to move towards security in a world free of nuclear weapons.

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