

Increasing the transparency of nuclear-warhead and fissile-material stocks as a step toward nuclear disarmament

Zia Mian and Frank von Hippel

UN First Committee, New York, 22 October 2013

About the IPFM

MISSION

To provide the technical basis for policy initiatives to reduce global stocks of military and civilian fissile materials

Established in 2006, IPFM has 28 members from 18 states

Publications: annual *Global Fissile Material Reports*, research reports, and country studies

www.fissilematerials.org and www.fissilematerials.org/blog

Outline

• Nuclear baseline declarations by 2015: Zia Mian

• Preparing for future declarations and cooperative transparency projects: Frank von Hippel

Nuclear Baseline Declarations That Could Be Made by 2015

Zia Mian

2010 NPT Review Conference

The "Action Plan on Nuclear Disarmament" affirmed:

"the importance of supporting cooperation among governments, the UN, other international and regional organizations and civil society aimed at increasing confidence, improving transparency and developing efficient verification capabilities related to nuclear disarmament..."

"...nuclear-weapon States are encouraged to agree as soon as possible on a standard reporting form and to determine appropriate reporting intervals for the purpose of voluntarily providing standard information."

NPDI has proposed a reporting form Progress report from weapon states expected at 2014 NPT PrepCom

Nuclear Disarmament and Transparency: nuclear weapons and fissile materials



A modern thermonuclear warhead contains on average 3–4 kg of plutonium and 15-25 kg highly enriched uranium

Adapted from Final Report of the Select Committee on U.S. National Security and Military/Commercial Concerns with the Peoples Republic of China ("Cox Report"), U.S. House of Representatives, 3 January 1999

Declaring Warheads and Fissile Materials

By 2015 Review Conference, NPT nuclear-weapon states could:

- 1. Make initial baseline declarations about total stockpiles of nuclear warheads and fissile materials
- 2. Agree to begin preparations to make more detailed declarations of historical warhead and fissile material stocks
- 3. Agree to launch cooperative pilot verification projects

Warhead Declarations To Date

US declared history of size of its stock of operational warheads (2010)

UK (2009, 2010, 2011) and France (2008) declared planned upper limits on total and operational warhead stockpiles

China indicated (2004) that its warhead stockpile was smaller than those of the other NPT weapon states, but has not updated

Under START (1994) and New-START (2011) Agreements, US and Russia twice each year share information on the numbers of their deployed strategic warheads on ICBMs and SLBMs and count bombers and declare number of deployed and non-deployed launchers

By 2015: Baseline Warhead Declarations

- Nuclear weapon states could join Russia and the US in declaring their strategic nuclear forces in the categories used in New-START
- Declare total number of nuclear warheads with subsequent annual updates

Some weapon states could be ready to offer a breakdown by status

Warheads by status	Example: U.S. Government information
Strategic operationally deployed	1543 on ICBMs/SLBMs (March 2013)
Other active and inactive	\approx 3450 (based on 1 Sept. 2009 total)
Retired but not yet dismantled	"several thousand" (1. Sept. 2009)
Stored plutonium "pits"	\approx 14,000 at Pantex facility (June 2010)
Stored HEU "secondaries"	\approx 5000 reserve + "thousands" awaiting dismantlement at Y-12 facility

Fissile Material Declarations To Date

Country	HEU production	Plutonium production for weapons	
China	stopped 1987 (unofficial)	stopped 1991 (unofficial)	
France	stopped 1996	stopped 1992	
Russia	stopped 1987–1988	stopped 1994	
United Kingdom	stopped 1962 (but imports from US)	stopped 1995	
United States	stopped 1992	stopped 1988	

Some countries have provided more detailed information

By 2015: Baseline Fissile Material Declarations

• Declare total stocks of HEU and separated plutonium with subsequent annual updates

EXAMPLE

UK declared in 1998:

- 22 tons military HEU (updated in 2006)
- 3.2 tons of weapons plutonium

UK declared for end 2012 (annual INFCIRC/549 report):

- 97 tons of domestic civilian separated plutonium
- 24 tons of foreign-owned civilian separated plutonium
- 1.4 tons of civilian HEU

Some countries could be ready to offer more detail about fissile material stocks

U.S. Example

	HEU	Plutonium
In and available for weapons	≈ 260 tons	38 tons
Reserved for naval fuel	152 tons	_
In irradiated naval fuel	≈ 100 tons	
Excess (mostly for disposal)	63 tons	49 tons
Reserved for research reactors	20 tons	_
Disposed		5 tons
TOTALS	595 tons	92 tons

HEU Stockpiles 2012

Metric tons [MT]



IPFM

Plutonium Stockpiles 2012



IPFM

Irreversibility and Verification Through IAEA Monitoring

NPT nuclear-weapon states could place under IAEA monitoring

- All plutonium and HEU in civilian use
- All plutonium and HEU recovered from excess weapons or its nuclear weapons complex and declared excess for weapon purposes
- All plutonium and HEU going to waste disposal sites

Preparing for Future Declarations and Cooperative Transparency Projects

Frank von Hippel

Deep Reductions Will Require Further Transparency

To prepare for verification of future agreements on deeper reductions, nuclear weapon states should:

1. Prepare detailed histories of their nuclear warhead and fissile material stocks even if not yet ready to share them.

- accurate histories will become more difficult to prepare with time.

2. Launch cooperative projects to demonstrate technical approaches to verifying the completeness of warhead and fissile material declarations.

Detailed Histories of Warhead Stocks

Total nuclear-warhead stockpiles and number of warheads built, retired, and dismantled each year



Increasing Transparency in the U.S. Nuclear Weapons Stockpile, U.S. DoD, 3 May 2010

Total Production, Use and Disposition of HEU and Plutonium

Example: US has declared 95.4 tons of separated plutonium as of 2009 111.7 tons acquired, 14.0 tons disposed, consumed, transferred and decayed, 2.4 tons "inventory difference" (measure of uncertainties)



The United States Plutonium Balance, 1944–2009, U.S. DoE, June 2012

Example: Detailed U.S. Plutonium Production History



Plutonium production [kg/yr]

Nuclear Archaeology

- Shutdown HEU enrichment plants, plutonium production reactors and reprocessing plants are being decommissioned.
- States should agree on the operating records and materials to be preserved



U.S. K-25 uranium enrichment plant in Oak Ridge is being demolished, 2008-2014

Nuclear Archaeology for Plutonium Production Reactors

	Graphite reactors		Heavy-water reactors	
United States	Hanford	9	Savannah River	5
Russia	Mayak, Seversk & Zheleznogorsk	13	Mayak	4
United Kingdom	Windscale, Calder Hall, & Chapelcross	10	n/a	
France	Marcoule	3	Marcoule	2
China	Jiuquan and Guangyuan	<u>2</u>	n/a	
TOTAL		37		11

An accurate isotope ratio method for estimating cumulative plutonium production has been demonstrated for graphite-moderated production reactors



Jungmin Kang: "Using the Graphite Isotope Ratio Method to Verify the DPRK's Plutonium-Production Declaration" *Science & Global Security*, 2011

Nuclear Archaeology for HEU Production

Signatures in enrichment equipment and waste materials are less obvious



Equipment in storage from the Pierrelatte gaseous diffusion plant France, June 2009 Stored cylinders of depleted uranium at the K-25 Site, Oak Ridge, TN United States, 2001

Cooperative Demonstration Projects

Countries with similar production facilities could engage in "site-to-site" joint demonstrations of verification approaches **Windscale graphite reactors Sellafield, UK**



Candidate Facilities for Nuclear Archaeology Projects Exist in Non-weapon States

Example: heavy-water research reactors



MZFR, Karlsruhe, Germany

NRX reactor, Canada

Summary

By 2015, the NPT weapon states could:

- 1. Report aggregate strategic arsenals using New-START rules
- 2. Make baseline warhead and fissile material declarations
- 3. Prepare for later declarations of historical production and elimination of fissile materials and warheads
- 4. Launch cooperative verification demonstration projects