



# **Increasing the Transparency of Nuclear-warhead and Fissile-material Stocks as a Step Toward Nuclear Disarmament**



**Zia Mian, Pavel Podvig and Frank von Hippel**

NPT Prepcom, Geneva, 24 April 2013

# About the IPFM

## MISSION

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

Established in 2006, IPFM has 28 members from 17 states

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

[www.fissilematerials.org](http://www.fissilematerials.org) and [www.fissilematerials.org/blog](http://www.fissilematerials.org/blog)

# Outline

- Building on New-START: Pavel Podvig
- Nuclear Baseline Declarations by 2015: Zia Mian
- Preparing for future declarations and cooperative transparency projects: Frank von Hippel

**Increasing Transparency of Nuclear-warhead and Fissile-material Stocks as a Step toward Disarmament – [ipfmlibrary.org/ipfm13.pdf](http://ipfmlibrary.org/ipfm13.pdf)**



# **Building on New-START**

**Pavel Podvig**

# 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

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

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

# Warhead Declarations: Definitions?

## United States:

“[active and inactive] warheads”

New-START “deployed warheads”

## Russia:

New-START “deployed warheads”

## United Kingdom:

no more than 120 “operationally available warheads” and  
no more than 180 in the “overall nuclear weapon stockpile”

## France:

“no more than 300 nuclear warheads ... in operational stockpile”

## China:

“[a]mong the nuclear-weapon states, China ... possesses the  
smallest nuclear arsenal”

# Building on New-START

New-START provides a time-tested framework for nuclear disarmament

Nuclear weapon states could join Russia and the United States in disclosing information about their strategic nuclear forces in the categories used in the New-START agreement:

- Deployed strategic warheads
- Deployed strategic delivery systems (ICBMs, SLBMs, heavy bombers)
- Deployed and non-deployed launchers  
(silos, road-mobile launchers, submarine launch tubes, heavy bombers)

Disclosure of these numbers would provide a basic level of transparency of the strategic nuclear arsenals



# New-START Advantage: Agreed Definitions

37. (25.) The term "intercontinental ballistic missile" or "ICBM" means a land-based ballistic missile with a range in excess of 5500 kilometers.

6. (5.) The term "ballistic missile" means a missile that is a weapon-delivery vehicle that has a ballistic trajectory over most of its flight path.

13. (63.) The term "deployed ICBM" means an ICBM that is contained in or on a deployed launcher of ICBMs.

14. (66.) The term "deployed launcher of ICBMs" means an ICBM launcher that contains an ICBM and is not an ICBM test launcher, an ICBM training launcher, or an ICBM launcher located at a space launch facility.

# By 2015: New-START Aggregate Declarations

	China	France	Russia	UK	US
Deployed ICBMs, deployed SLBMs, and deployed heavy bombers	60	48	491	24	806
Warheads on deployed ICBMs, on deployed SLBMs, and nuclear warheads counted for deployed heavy bombers	0	288	1,499	88	1,722
Deployed and non-deployed launchers of ICBMs, deployed and non-deployed launchers of SLBMs, and deployed and non-deployed heavy bombers	109	64	884	64	1,034

As of 1 September 2012

# What is Not Included in New-START?

New-START limits strategic delivery systems and deployed warheads.

Not included are:

- Short- and intermediate-range ballistic missiles
- Submarine- and ground-launched cruise missiles
- Short- and intermediate-range bombers and their weapons

However, New-START accounts for almost all the **deployed** nuclear warheads (strategic or non-strategic)

# Beyond 2015: Detailed Data Exchanges

All NPT weapon-states could exchange biannually detailed reports in the New-START format.

At first, include data released by the US in its unclassified report:

- list of operational bases and other facilities
- information on non-deployed delivery systems
- technical characteristics of ICBMs and SLBMs

At the next step, include other New-START data:

- locations of operational bases and other facilities
- unique identifiers assigned to all delivery systems and launchers

# Bases and Facilities in New START-type Reports



All model reports and maps are available at [NuclearForces.org](http://NuclearForces.org)

# **After 2015: Voluntary and Reciprocal Verification Patterned after New-START**

Extending New-START verification activities to all of the NPT nuclear-weapon states would be an important confidence-building measure and create institutional arrangements to support the disarmament process.

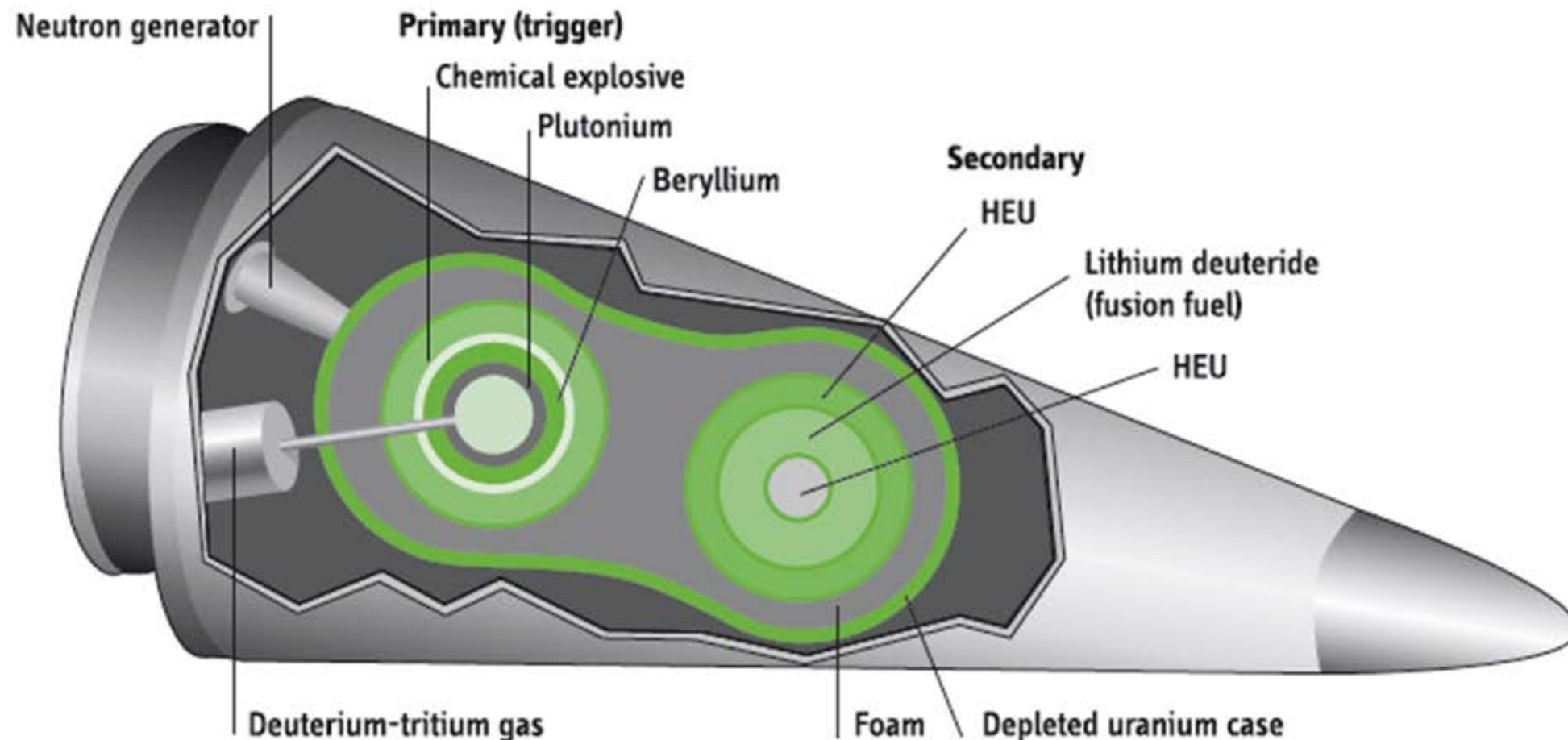
To begin, Russia and the United States could invite other states to conduct demonstration New-START inspections at their facilities in order to share the experience of carrying out inspections activity.



# **Nuclear Baseline Declarations That Could Be Made by 2015**

**Zia Mian**

# Nuclear Disarmament and Transparency: nuclear weapons and fissile materials



A modern thermonuclear warhead contains on average 3–4 kg of plutonium and 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

# By 2015: Baseline Warhead Declarations

Declare total number of nuclear warheads with subsequent annual updates

Some countries could be ready to offer a breakdown by status

Warheads by status	Example: U.S. Government information
Strategic operationally deployed	1604 on ICBMs and SLBMs (Sept. 2012)
Other active and inactive	≈ 3450 (based on 1 Sept. 2009 total)
Retired but not yet dismantled	“several thousand” (1. Sept. 2009)
Stored plutonium “pits”	≈ 14,000 at Pantex facility (June 2010)
Stored HEU “secondaries”	≈ 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) and
- 3.2 tons of weapons plutonium

UK declared for end 2011 (annual INFCIRC/549 report):

- 90 tons of domestic civilian separated plutonium
- 28 tons of foreign-owned civilian separated plutonium
- 1.4 tons of civilian HEU

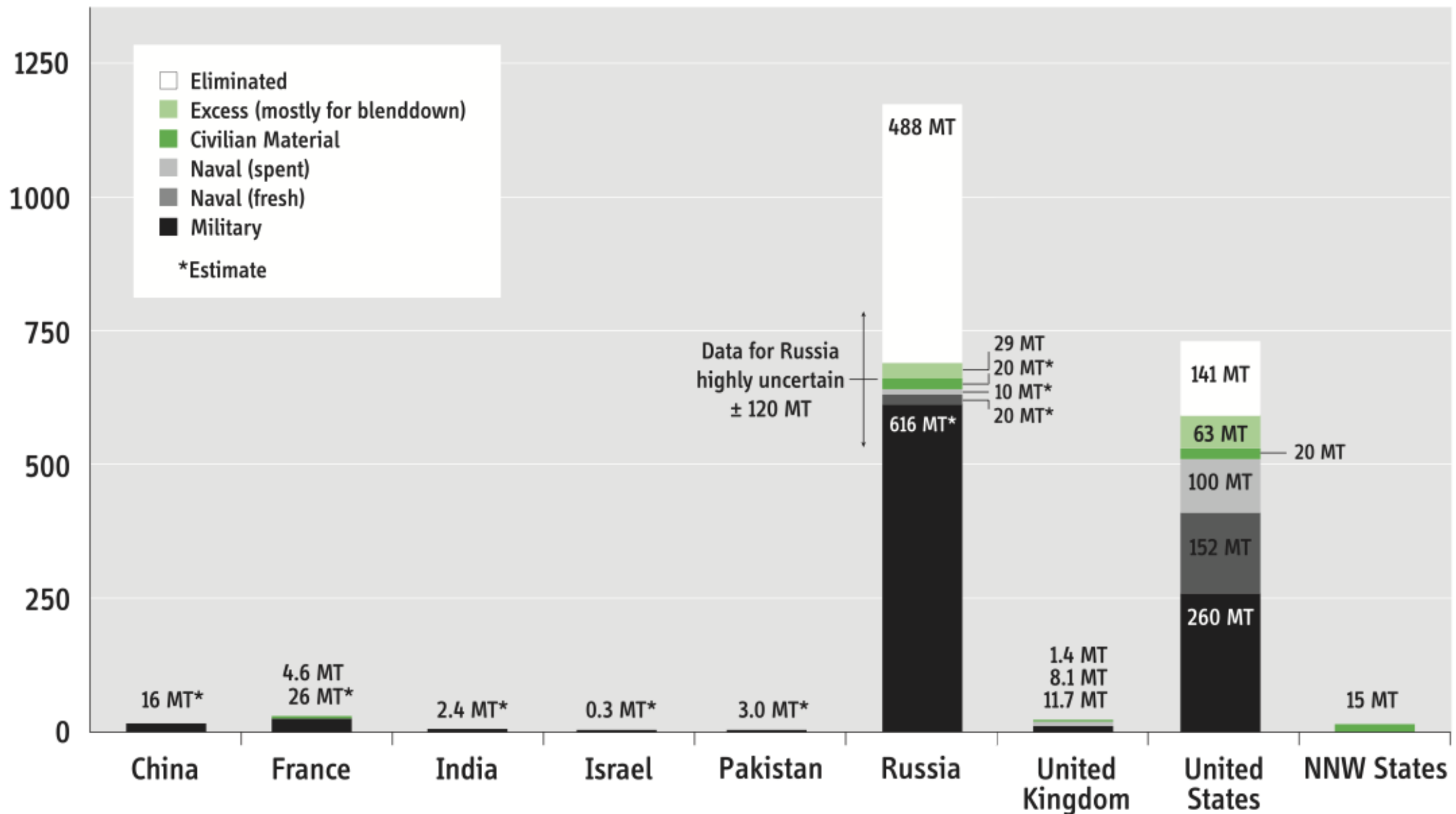
# Some countries could be ready to offer more detail about fissile material stocks

## U.S. Example

	HEU	Plutonium
In and available for weapons	≈ 260 tons	34 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
<b>TOTALS</b>	<b>595 tons</b>	<b>88 tons</b>

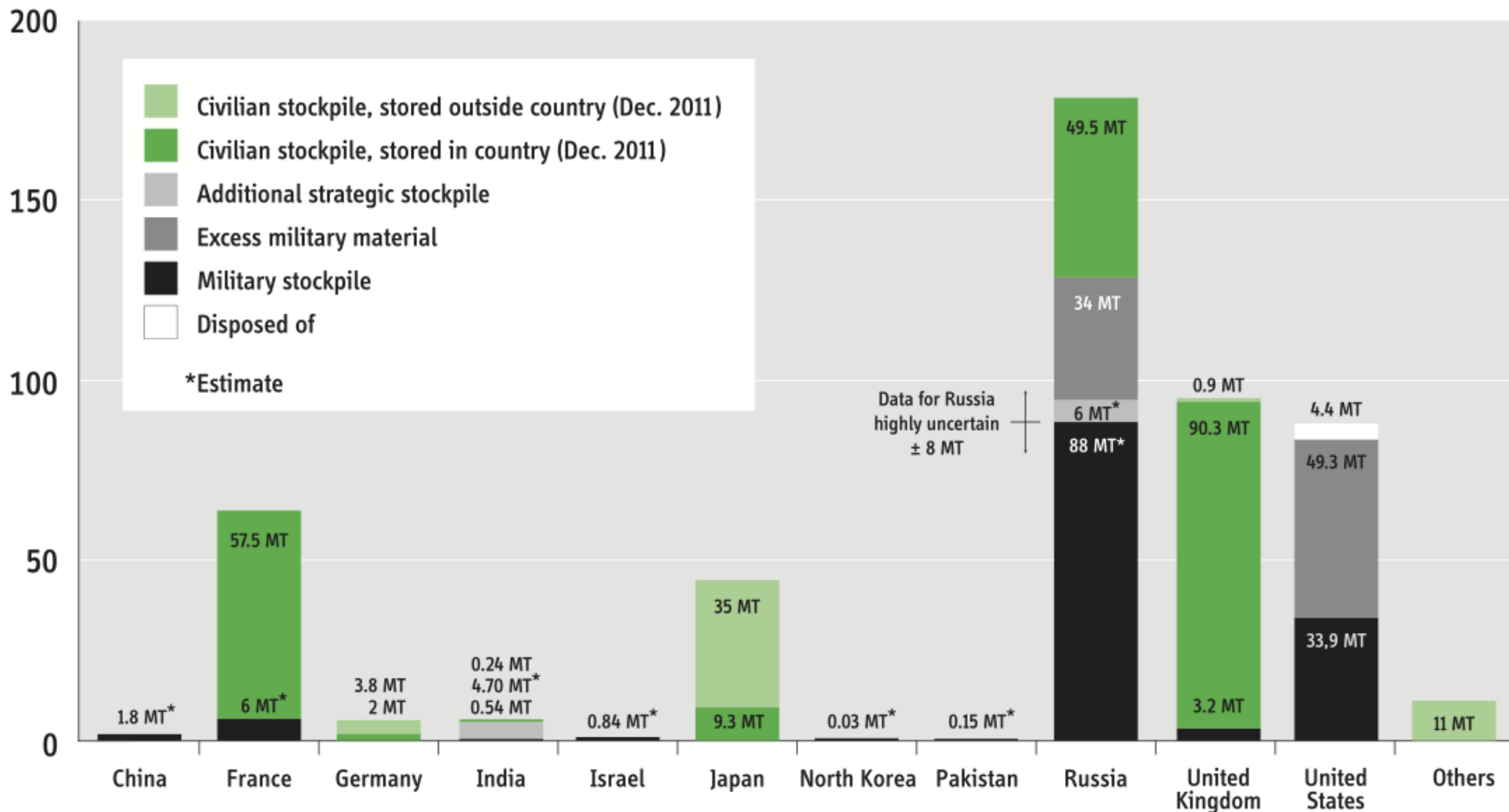
# HEU Stockpile 2012

Metric tons [MT]



# Plutonium Stockpile 2012

Metric tons [MT]



# 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





- 1) Preparing for Future Declarations and**
- 2) Cooperative Transparency Projects**

**Frank von Hippel**

# Deep Reductions Will Require Further Transparency

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

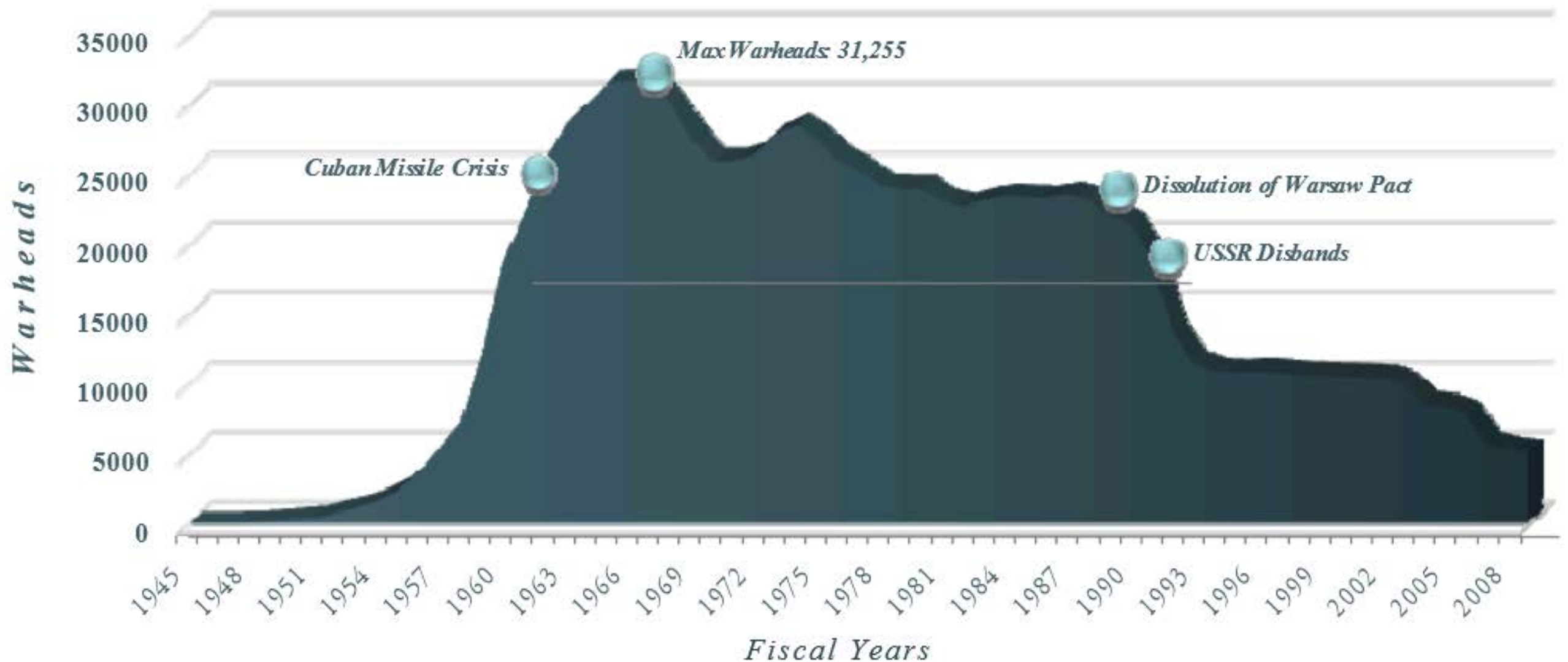
1. *Prepare detailed histories of their nuclear warheads and fissile material stocks.*

- These histories should be prepared even if governments are not ready to share them.
- Preparing accurate histories will become more difficult with time.

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

# Detailed Warhead Histories

Histories of total nuclear-warhead stockpiles by year including numbers of warheads built, retired, and dismantled each year

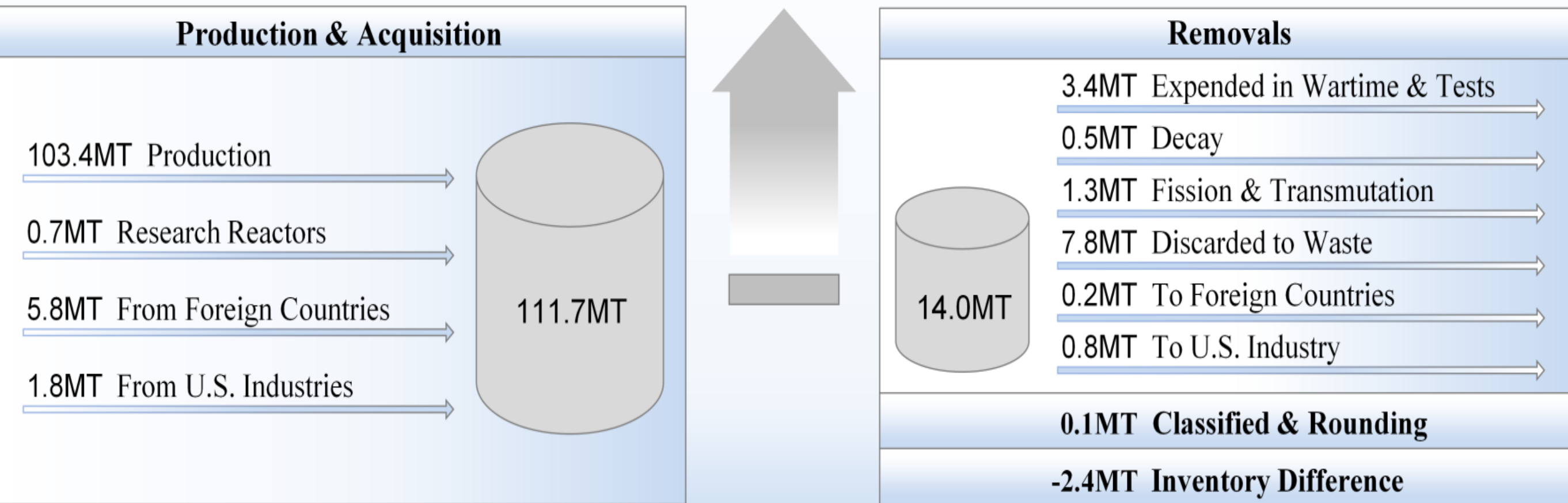


*Increasing Transparency in the U.S. Nuclear Weapons Stockpile, U.S. DoD, 3 May 2010*

# Detailed Fissile Material Production Histories

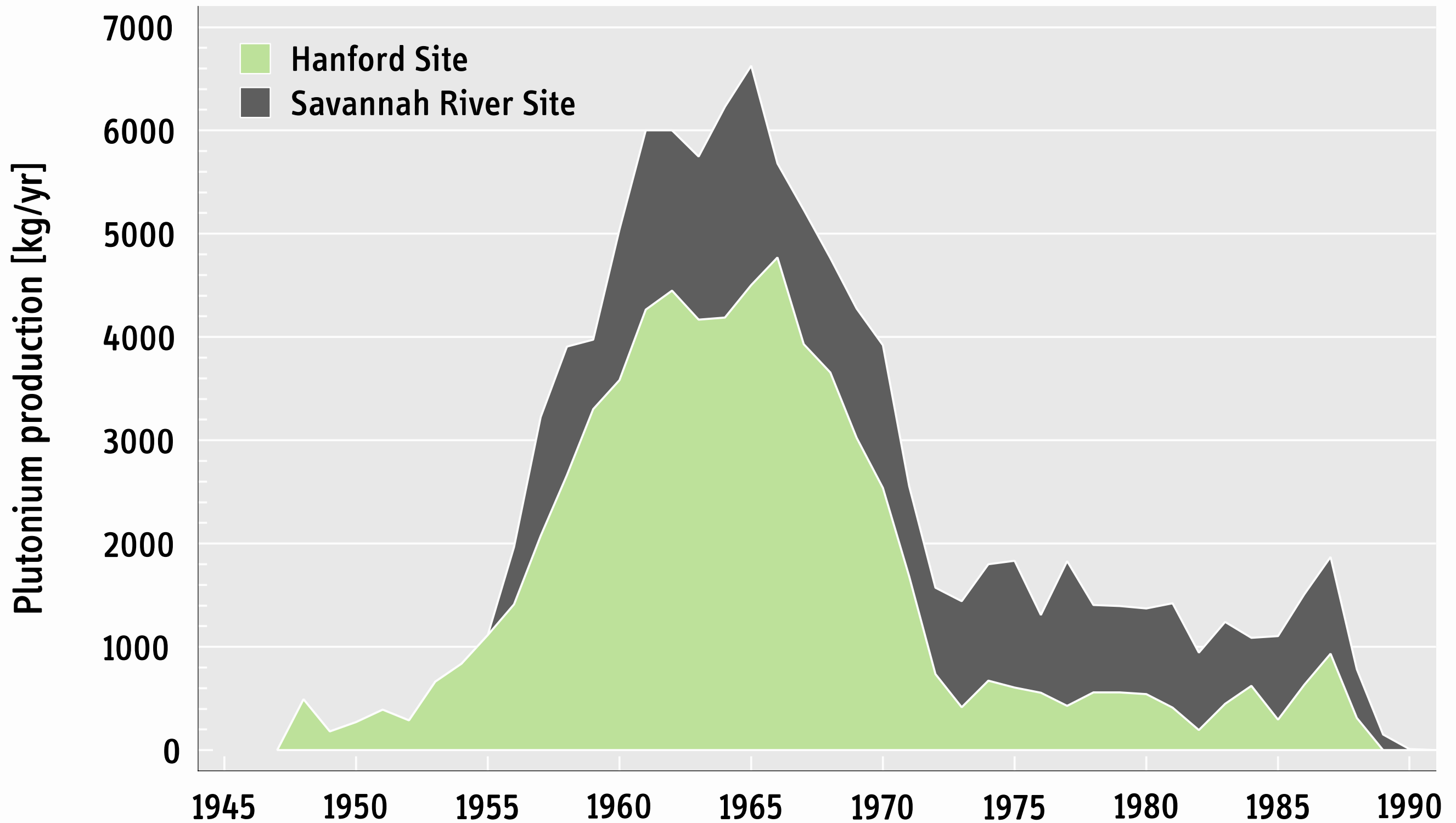
Total HEU and plutonium production, use, and disposition

The US declared a stock of 95.4 tons of plutonium (as of 2009)



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

# Detailed Fissile Material Production Histories



*Plutonium: The First 50 Years*: U.S. DoE, 1996

# Nuclear Archeology and Cooperative Verification Projects

Shutdown production reactors and enrichment plants being decommissioned

States could agree on the most important types of operating records and waste materials to be preserved



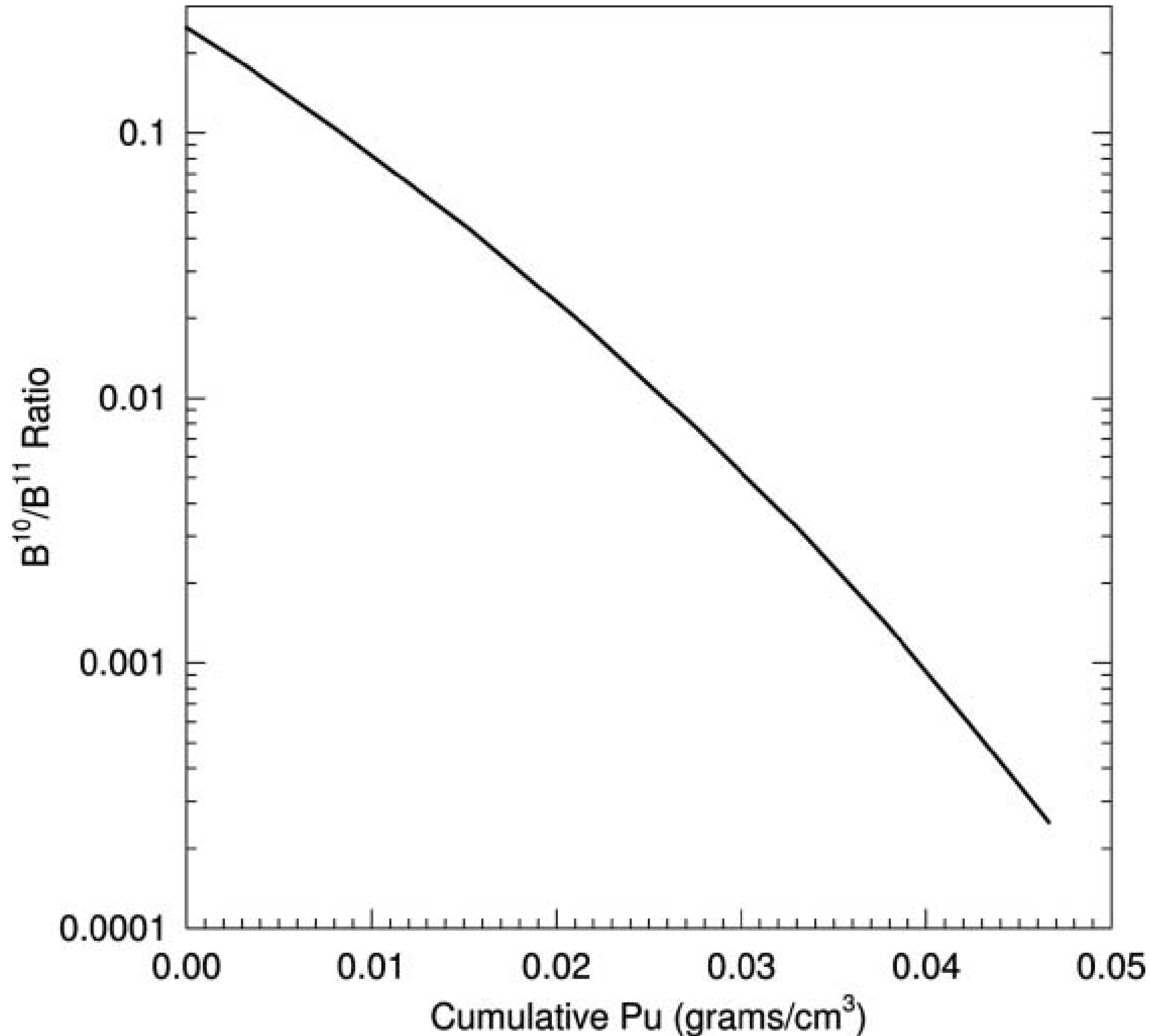
Demolition of first U.S. uranium enrichment plant in Oak Ridge, Tennessee

# Nuclear Archaeology and Plutonium Production Reactors

	Graphite reactors	Heavy-water reactors
United States	Hanford: 9 reactors	Savannah River 5 reactors
Russia	Mayak, Seversk, Zheleznogorsk 13 reactors (total)	Mayak 4 reactors
United Kingdom	Windscale, Calder Hall, Chapelcross 10 reactors (total)	n/a
France	Marcoule 3 reactors	Marcoule 2 Célestin reactors
China	Jiuquan and Guangyuan 2 reactors	n/a

method already demonstrated for graphite-moderated reactors

# Example: North Korea's Yongbyon Reactor



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 equipment and waste materials less obvious



Equipment in storage from the Pierrelatte gaseous diffusion plant France, June 2009



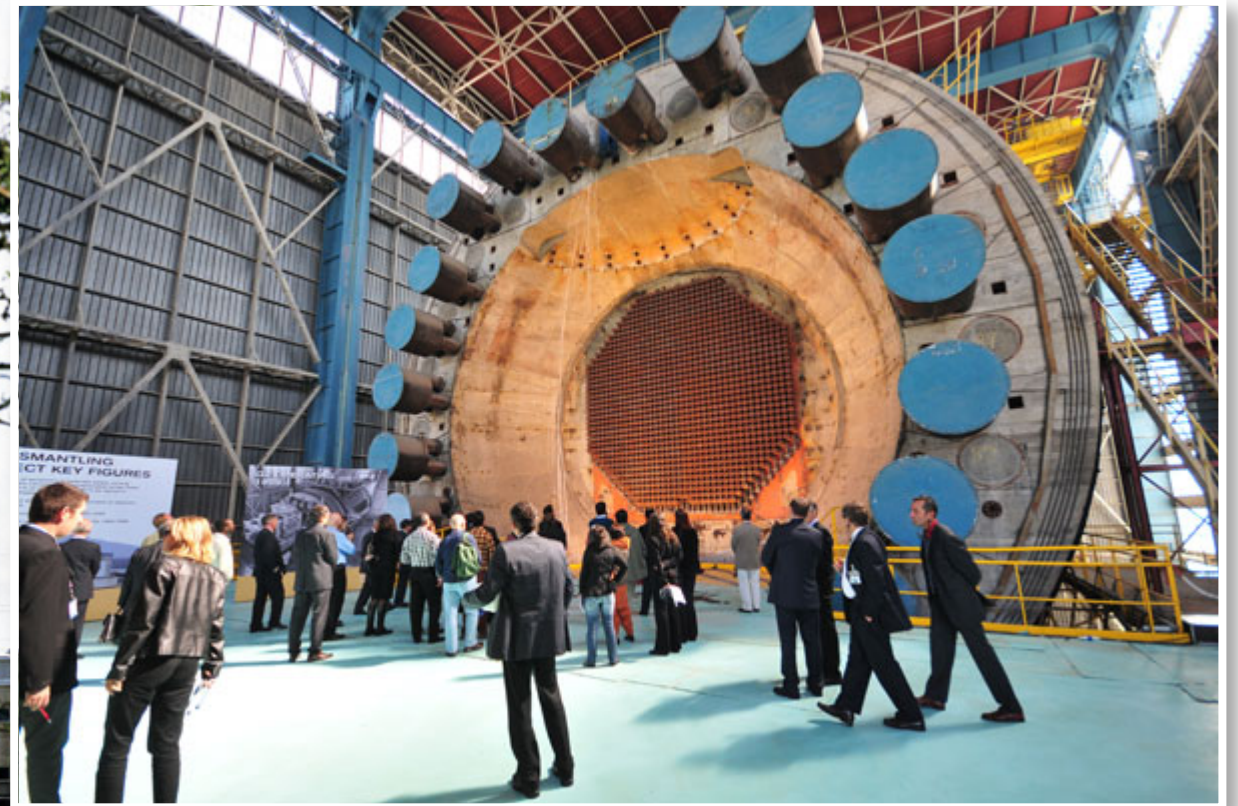
Stored cylinders of depleted uranium at the K-25 Site, Oak Ridge, TN United States, 2001



# Cooperative Demonstration Projects

Countries with similar production facilities could engage in “site-to-site” joint demonstrations of verification approaches

## Windscale Piles, Sellafield, UK



## G2 Reactor, Marcoule, France



# Neutral Candidate Facilities for Nuclear Archaeology Demonstrations are Available in Non-weapon States

Example: two heavy-water research reactors



**NRX, Canada**



**MZFR, Karlsruhe, Germany**

# Summary

By 2015, NPT weapon states could:

- Report strategic arsenals using New-START rules
- Make baseline warhead and fissile material declarations
- Place under IAEA safeguards civilian, excess military, and waste fissile material
- Prepare for later declarations of historical production and elimination of fissile materials and warheads
- Launch cooperative verification demonstration projects