



Facilitating Nuclear Disarmament

Verified Declarations of Fissile Material Stocks and Production

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Washington, DC, 2012

A New Era of Transparency?

United States

May 2010 Declaration of U.S. Nuclear Weapon Stockpile

“As of September 30, 2009, the U.S. stockpile of nuclear weapons consisted of 5,113 [active and inactive] warheads. This number represents an 84 percent reduction from the stockpile’s maximum (31,255) at the end of fiscal year 1967, and over a 75 percent reduction from its level (22,217) when the Berlin Wall fell in late 1989.”

Increasing Transparency in the U.S. Nuclear Weapons Stockpile, U.S. Department of Defense, Fact Sheet, May 3, 2010
available at www.defense.gov/npr, mirrored at www.ipfmlibrary.org/gov10.pdf

United Kingdom

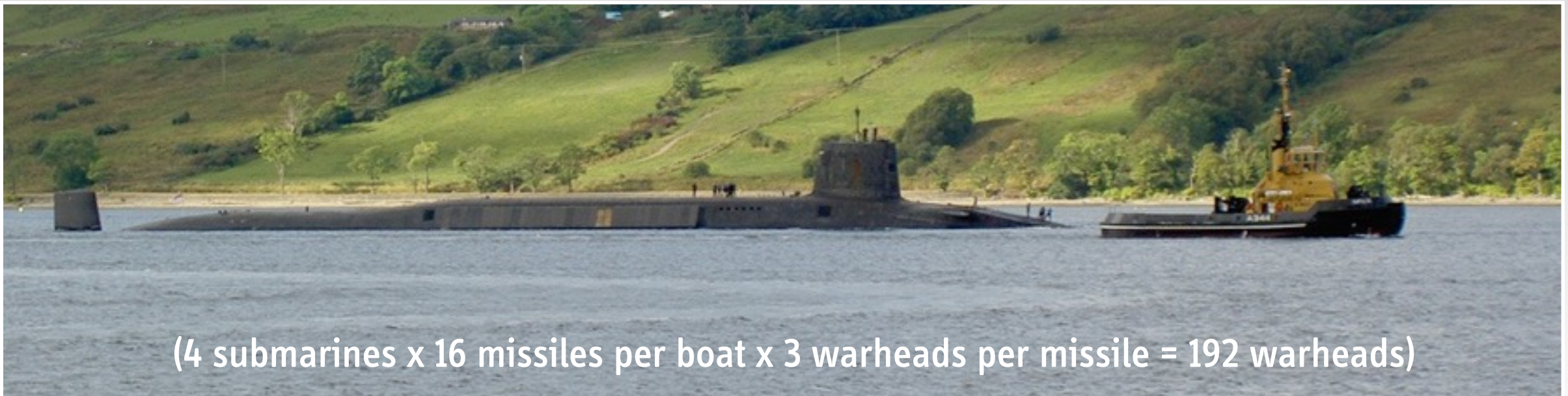
March 2009 and May 2010 Declarations

“Our operationally available warheads now number fewer than 160”

UK Prime Minister Gordon Brown, March 2009

Total number of nuclear weapons in the UK stockpile does not exceed 225

UK Foreign Secretary William Hague, May 2010, www.twitter.com/WilliamJHague



(4 submarines x 16 missiles per boat x 3 warheads per missile = 192 warheads)

France

March 2008 Announcement by French President N. Sarkozy

“I can tell you that our arsenal will include fewer than 300 nuclear warheads. [...]

I have decided to invite international experts to observe the dismantlement of our Pierrelatte and Marcoule military fissile material production facilities.”

Nicholas Sarkozy, President of the French Republic
Presentation of *“Le Terrible”* in Cherbourg
21 March 2008



Picture galleries available at
www.francetnp2010.fr

Why Do Declarations Matter?

Some Weapon States Have Recognized the Value of Declarations

“The data will ... have valuable nonproliferation benefits by making potential International Atomic Energy Agency safeguards easier to implement.”

Declassification of Today's Highly Enriched Uranium Inventories at Department of Energy Laboratories
U.S. Department of Energy, 27 June 1994, www.ipfmlibrary.org/doe06a.pdf

“The U.K. believes that transparency about fissile material acquisition for defence purposes will be necessary if nuclear disarmament is to be achieved.”

Historical Accounting for U.K. Defence Highly Enriched Uranium,
U.K. Ministry of Defence, March 2006, www.ipfmlibrary.org/mod06.pdf

Fissile Material Declarations (and Their Verification) May Help Address the “Baseline Problem”

How do we know that no covert warheads exist outside a verification regime?



Warheads Fabricated, 1945–2010	
United States	70,000
Russia	55,000
United Kingdom	1,200
France	1,260
China	600
TOTAL	128,000

Left: Dismantlement of the last 10-Megaton B53 bomb, October 25, 2011, www.energy.gov/articles/dismantling-final-b53-bomb

Right: Estimates from R. S. Norris and H. M. Kristensen, “Global nuclear weapons inventories, 1945–2010”
Bulletin of the Atomic Scientists, July/August 2010, bos.sagepub.com/content/66/4/77

The US and UK Declarations Have Also Emphasized the Challenges of Preparing Them

“A major problem encountered in examining the records was that a considerable number had been destroyed from the early years of the programme. [...] Even where records have survived, other problems have been encountered, including: ... [list follows]”

Historical Accounting for UK Defence Highly Enriched Uranium
UK Ministry of Defence, March 2006, www.ipfmlibrary.org/mod06.pdf

Fissile Material Stocks



Global Fissile Material Report 2008

Scope and Verification of a Fissile

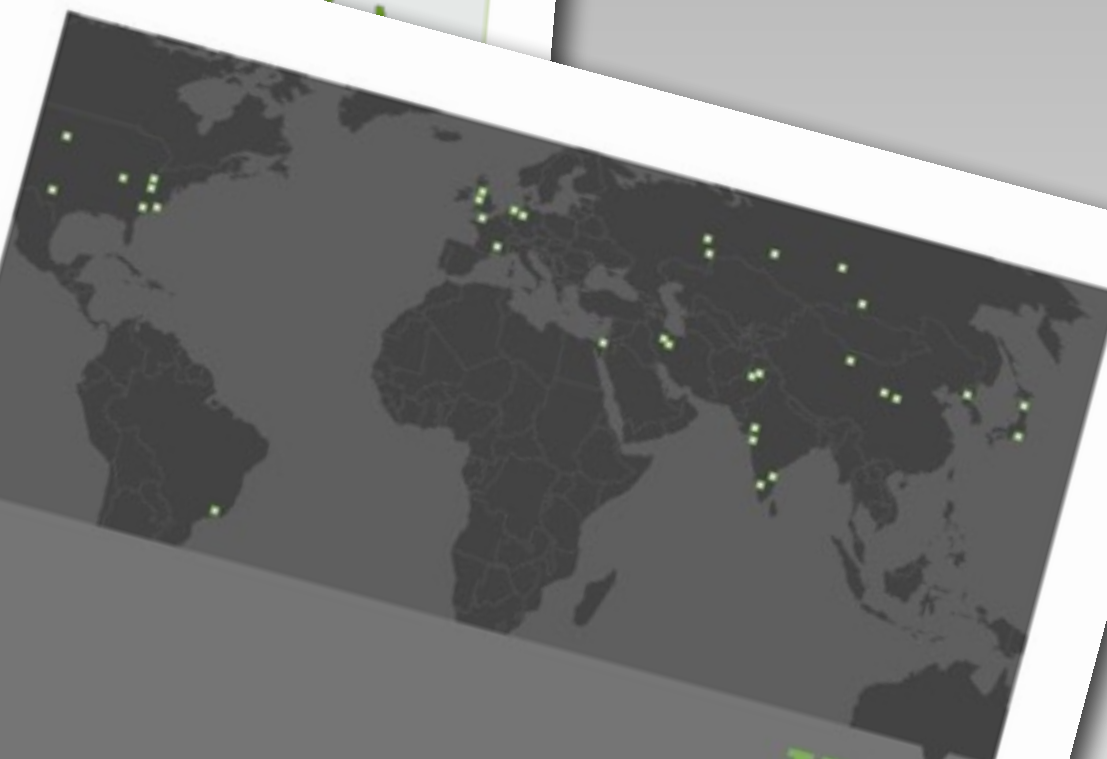
Third annual report of the International Panel on Fissile Materials



Global Fissile Material Report 2009

A Path to Nuclear Disarmament

Fourth annual report of the International Panel on Fissile Materials



IPFM
INTERNATIONAL PANEL
ON FISSILE MATERIALS

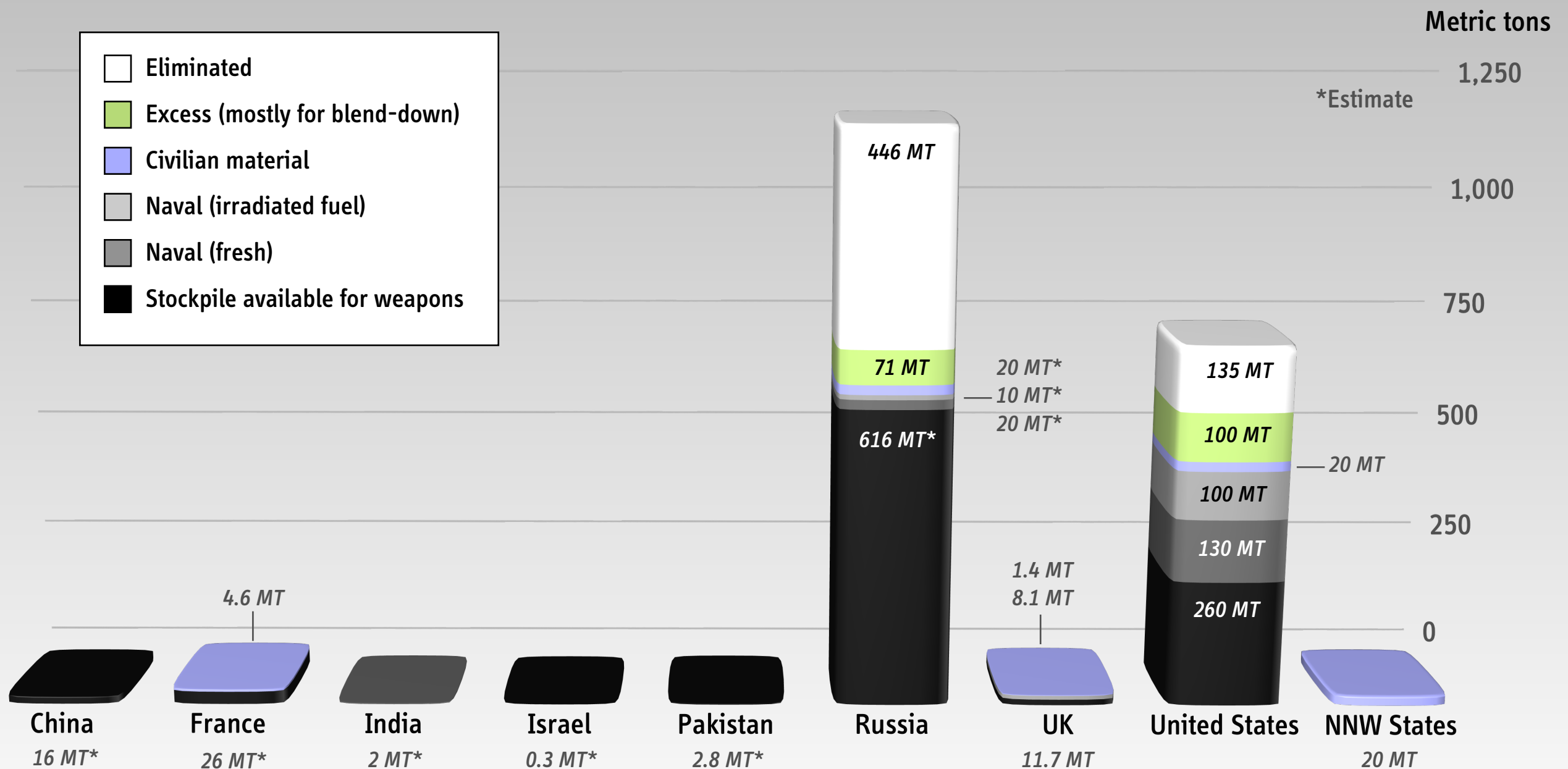
Global Fissile Material Report 2010

Balancing the Books: Production and Stocks

Fifth annual report of the International Panel on Fissile Materials

Highly Enriched Uranium, 2011

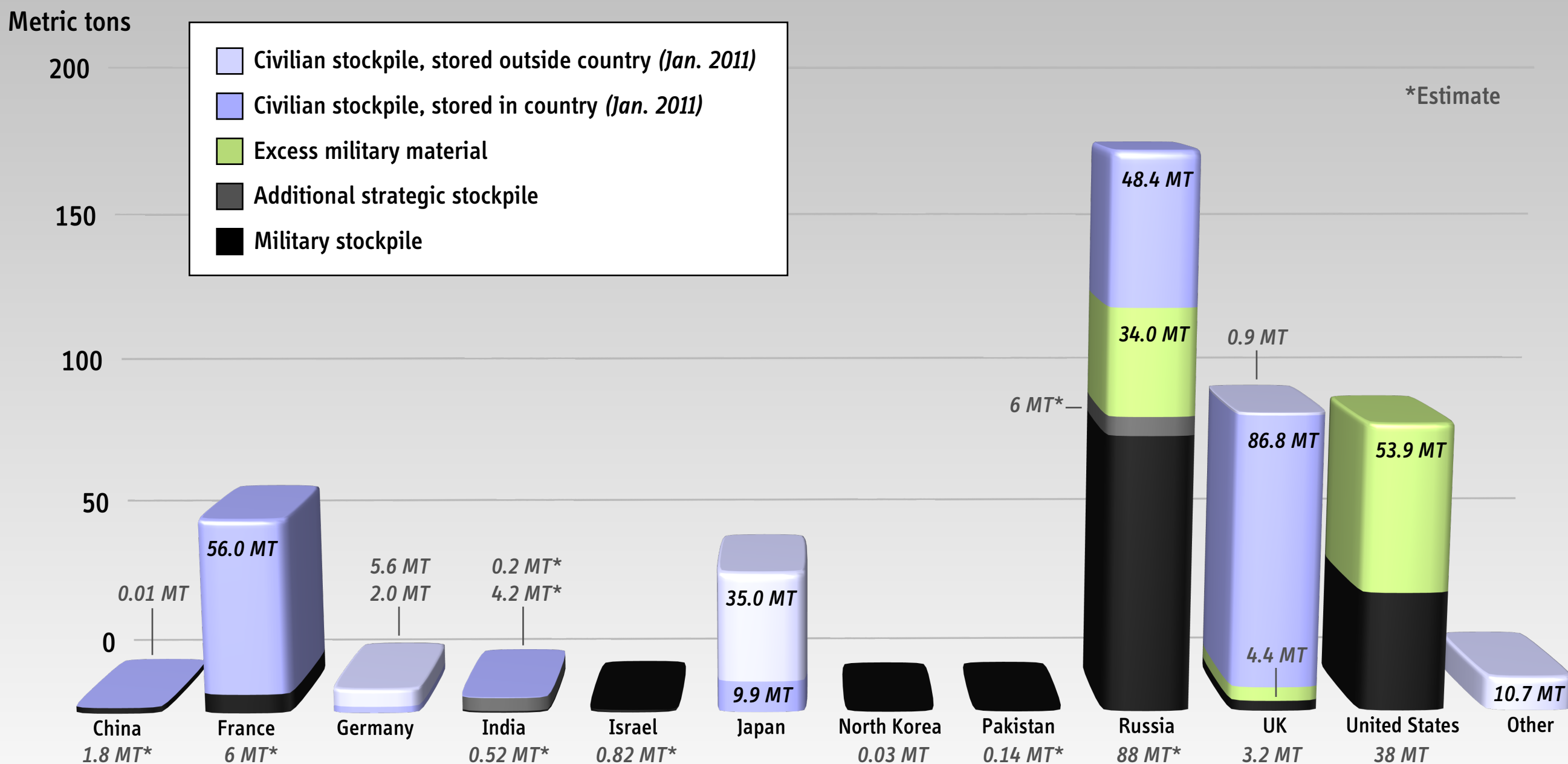
Global stockpile is about 1440 tons, almost 99% is in weapon states



(25 MT of HEU are equivalent to 1,000–2,000 nuclear weapons)

Separated Plutonium, 2011

Global stockpile is about 495 tons, more than half is civilian and this stock is growing



(5 MT of plutonium are equivalent to 1,000–1,500 nuclear weapons)

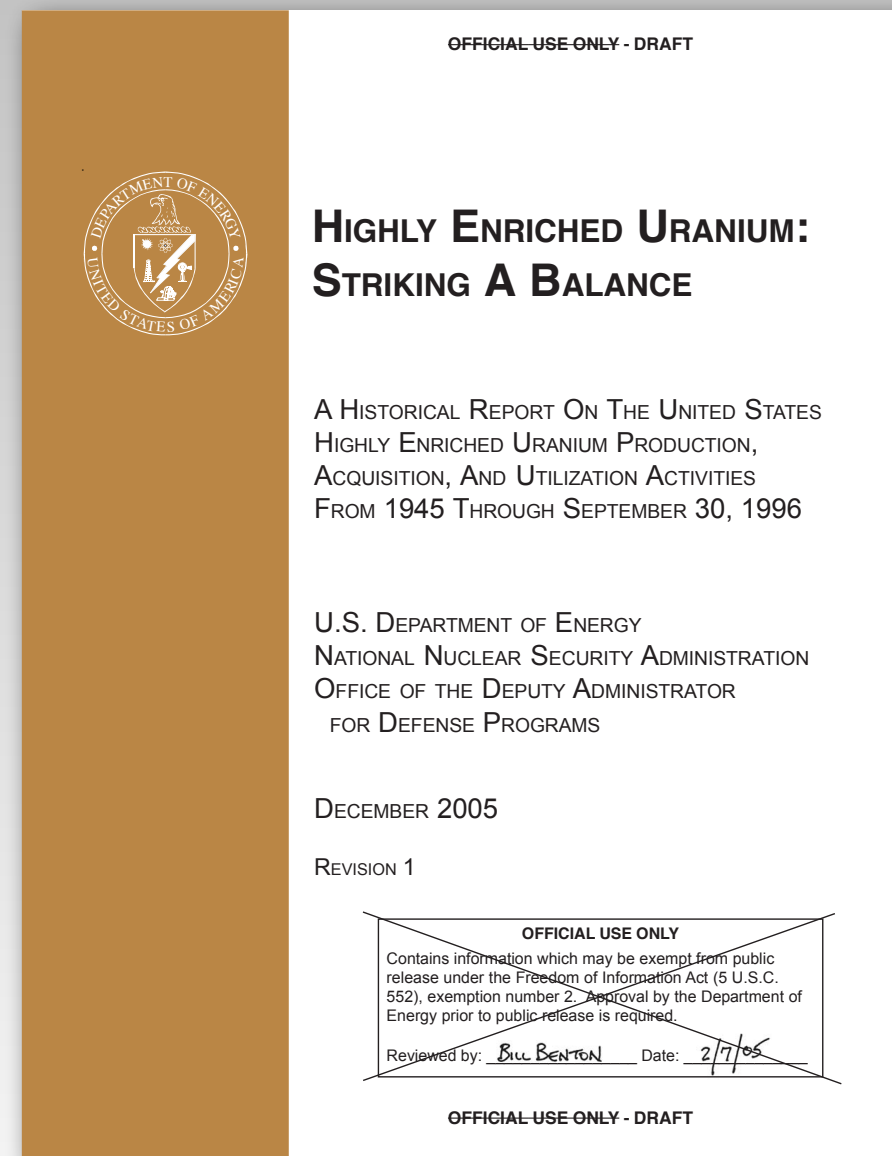
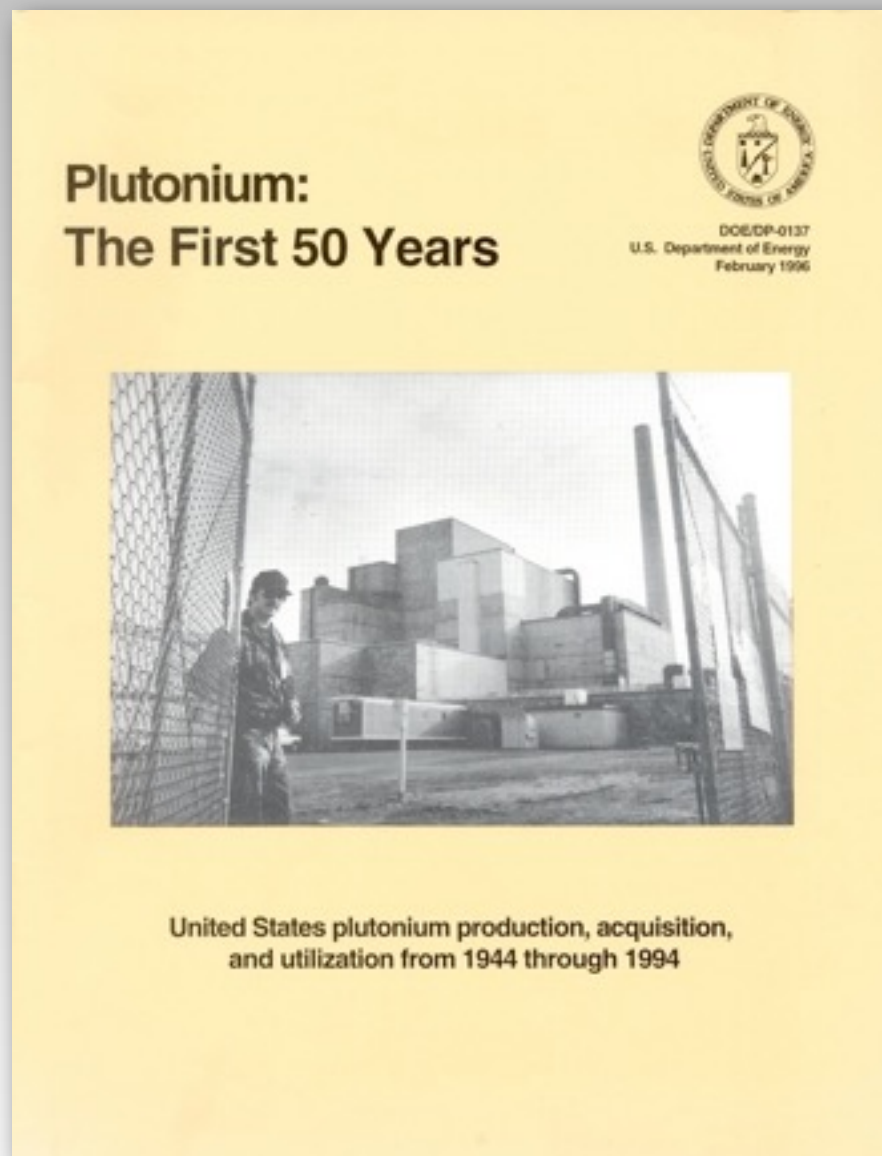
Fissile Material Declarations

“Snapshot Declarations”

	HEU	Plutonium
<i>Inventory as of [DATE]</i>	00,000 kg	00,000 kg
<i>Civilian, available for IAEA safeguards</i>	0,000 kg	0,000 kg
<i>Excess military, available for IAEA safeguards</i>	0,000 kg	0,000 kg
<i>Civilian, not available for IAEA safeguards</i>	0,000 kg	0,000 kg
<i>Excess military, not available for IAEA safeguards</i>	0,000 kg	0,000 kg
<i>Military, in irradiated fuel</i>	0,000 kg	0,000 kg
<i>Military, reserved for non-weapons purposes</i>	0,000 kg	0,000 kg
<i>Military, available for weapons</i>	0,000 kg	0,000 kg

Supporting Declarations Put Data in Context

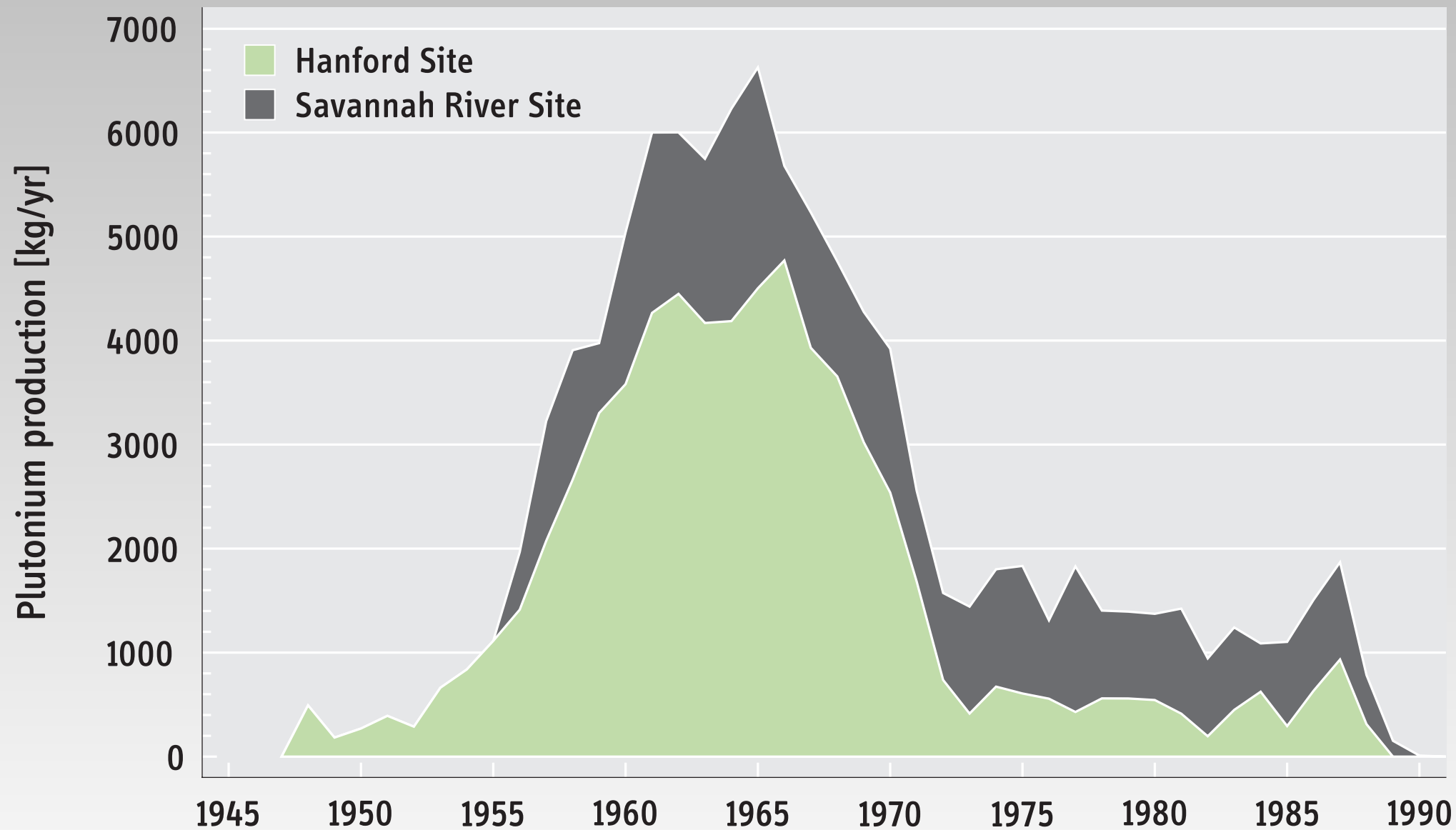
and can help lay the basis for verification of fissile material production and stocks



1996 and 2001 U.S. Declarations on Plutonium and HEU

Example from the U.S. Declarations

(Plutonium Production by Year and Site)



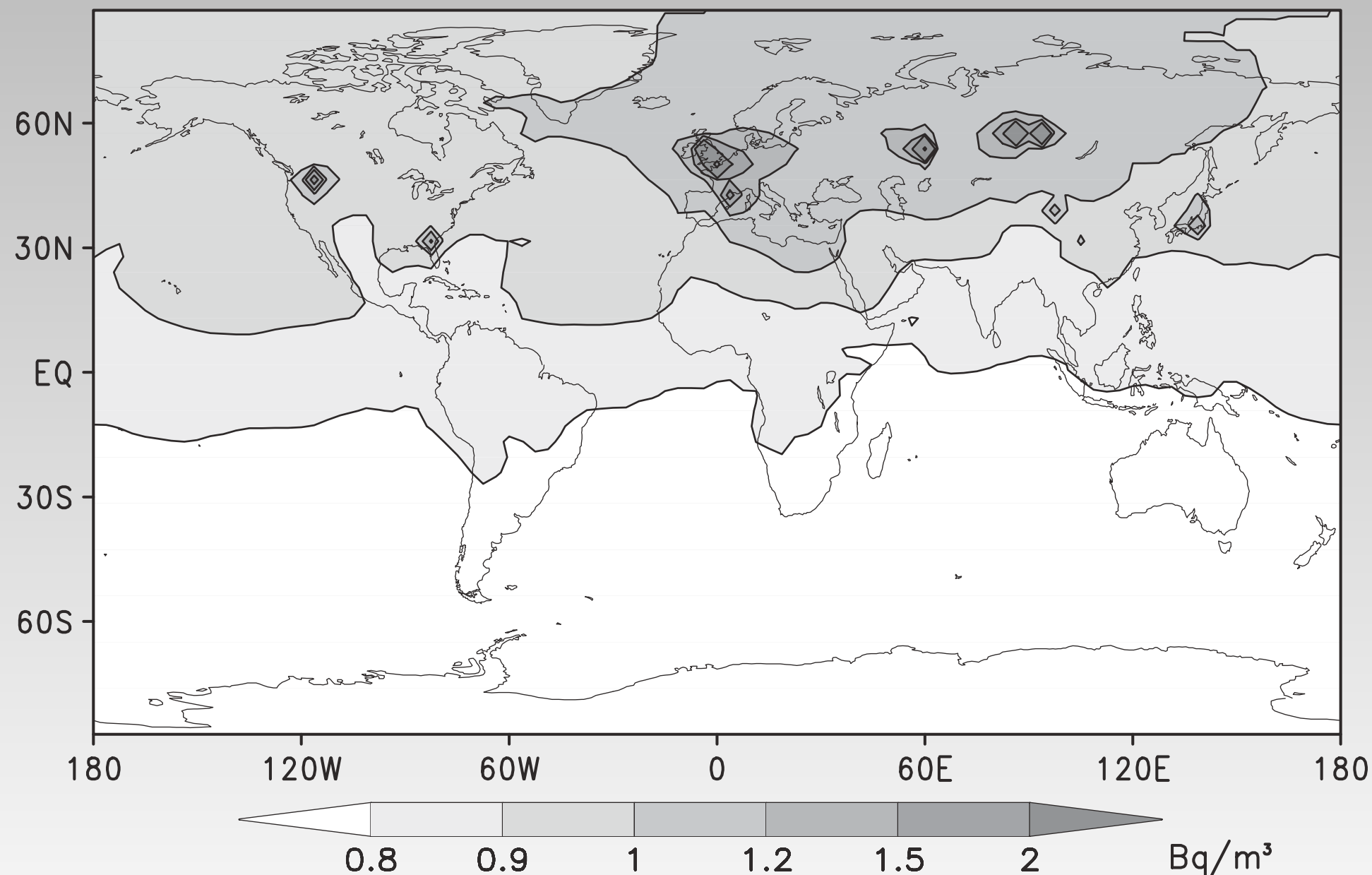
Plutonium: The First 50 Years: United States Plutonium Production, Acquisition and Utilization from 1944 Through 1994
U.S. Department of Energy, DOE/DP-0137, 1996, www.ipfmlibrary.org/doe96.pdf

Verifying Declarations

Independent Assessments

Atmospheric Krypton-85 Levels

July 1987



K. Winger, J. Feichter, M. B. Kalinowski, H. Sartorius and C. Schlosser, "A New Compilation of the Atmospheric Krypton-85 Inventories from 1945 to 2000 and its Evaluation in a Global Transport Model," *Journal of Environmental Radioactivity*, Vol. 80, 2005, pp. 183–215

Public Historic Documents Can Often Help Reconstruct Production Histories

La Hague et de la Cogema a été de minimiser les faits et leurs conséquences possibles, afin de rassurer l'opinion publique française et la clientèle étrangère, faisant prendre ainsi

chaque année en séparant le combustible venant de G2 et G3 (taux de combustion compris entre 700 et 1200 MWJ/t) et le combustible EDF (taux de combustion atteignant 5000 MWJ/t.)

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Tonnage G2, G3	190	130	320	620	640	760	850	820	960	730	890
Tx de combustion	100	100	100	200	200	300	300	300	400	400	450
Tonnage EDF	—	—	—	—	—	—	—	—	—	—	—
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Tonnage G2 G3	530	570	460	480	240	280	260	170	non connu	non connu	190
Tx de combustion	450	450	500	600	700	800	1000	1200			1200
Tonnage EDF					113	8	25	120	245	280	310

Si jusqu'aux années 1972-73 les tonnages retraités sont très élevés, une des raisons essentielles en est le faible taux de combustion des combustibles.

Le tonnage retraité diminue ensuite sensiblement en

ne. Il est également inférieur aux prévisions faites par la Cogéma au début de l'année 1980 puisque 310 tonnes ont été retraitées alors que les prévisions étaient 365 tonnes.

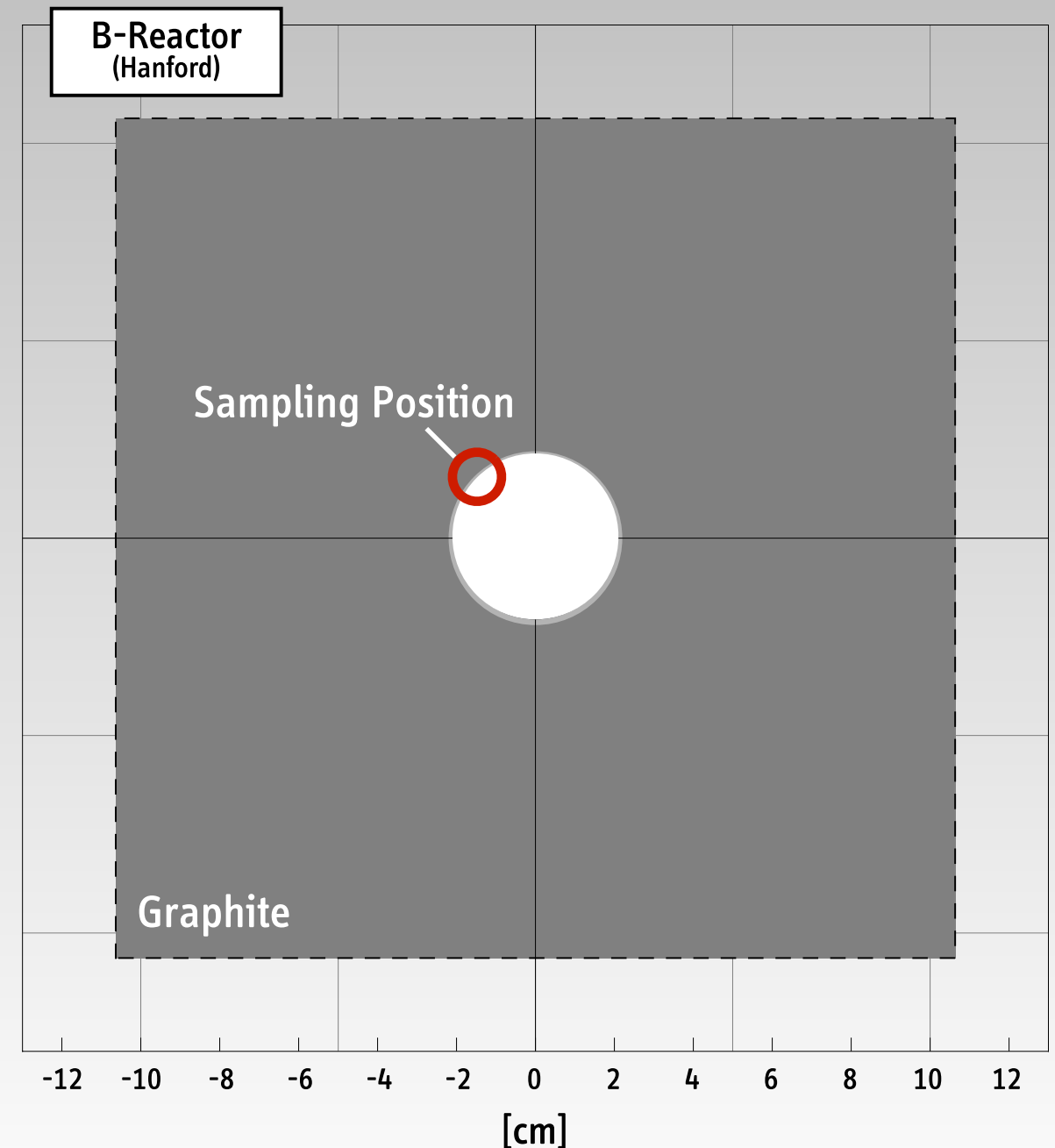
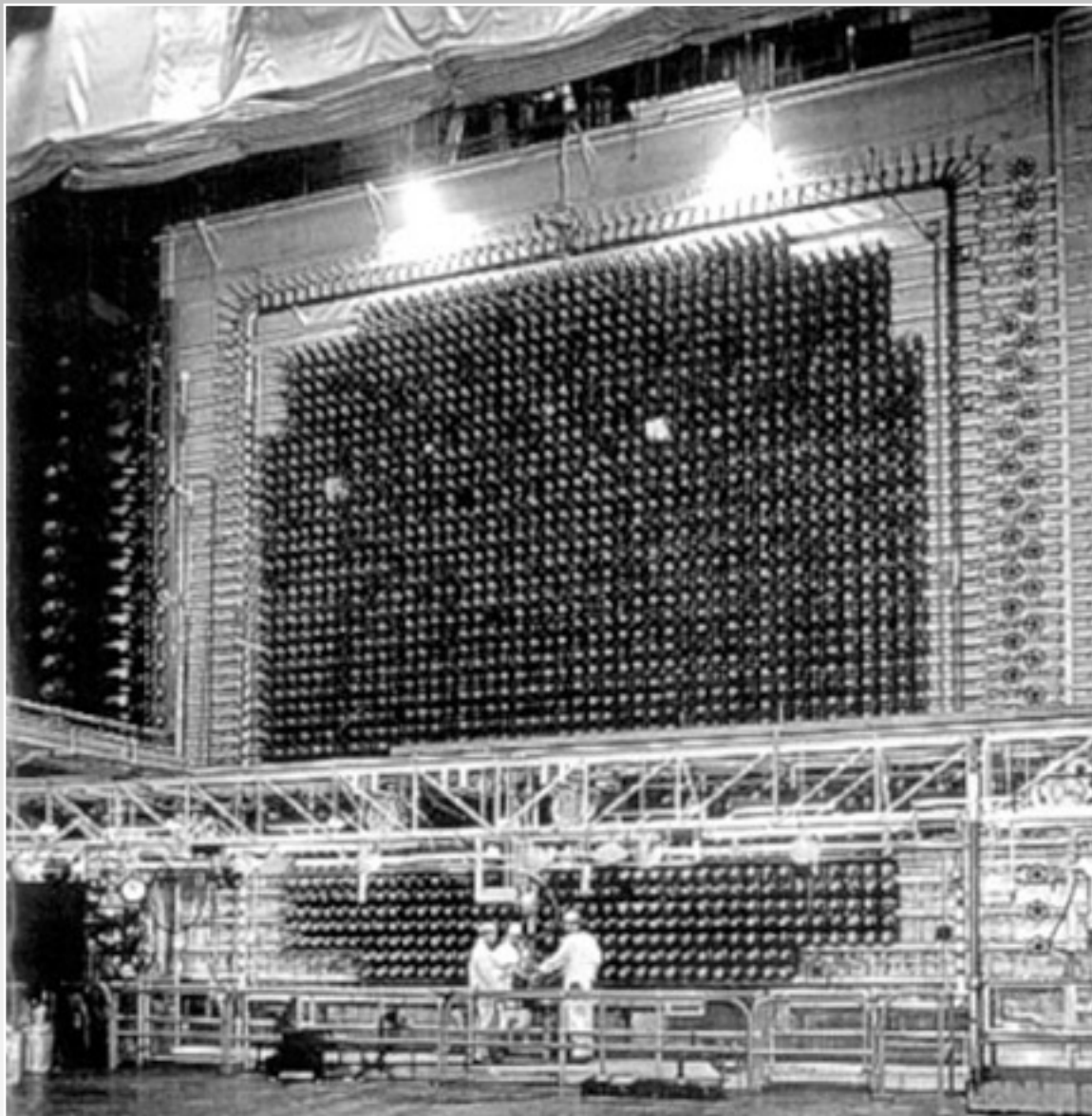
LES CONDITIONS DE

Le retraitement des combustibles irradiés: La situation de la Hague et Marcoule, Analyses et positions de la CFDT
Rayonnement, Syndicat National du Personnel de l'Energie Atomique, No. 92, Février 1981

***Cooperative Approaches
and Nuclear Archaeology***

Nuclear Archaeology for Plutonium

(U.S. Hanford B Reactor, 1944–1968)



North Korea's Yongbyon Reactor, 2008



Credit: CNN/Brian Rokus

Similar Methods Need to be Demonstrated for Other Types of Production Reactors

	Graphite moderated		Heavy-water moderated	
	H ₂ O cooled	CO ₂ cooled	H ₂ O cooled	D ₂ O cooled
United States	Hanford			Savannah River
Russia	"Tomsk-7"			
U.K.		Calder Hall		
France		G-Series		Célestin
China	"Jiuquan"			
Israel				Dimona
India			Cirus/NRX	Dhruva
Pakistan			Khushab	
DPRK		Yongbyon		

A. Glaser, Isotopic Signatures of Weapon-grade Plutonium from Dedicated Natural-uranium-fueled Production Reactors and Their Relevance for Nuclear Forensic Analysis, *Nuclear Science & Engineering*, September 2009

Nuclear Archaeology for Uranium Enrichment

(Former Storage area for cylinders of depleted uranium in 2001 at K-25 Site, Oak Ridge, TN)



Challenges and Opportunities

for Fissile Material Declarations – and the Way Forward

“The Hard Cases”

Russia

Secretive policy shaped during Cold War, presumably (very) large uncertainties

China

Security concerns about increased transparency remain relevant today

India and Pakistan

Ongoing production; interim agreements limiting fissile material production?

Israel

Declarations of fissile material stocks that are not under IAEA safeguards?

Non-weapon States Could Play Critical Roles in Demonstrating Verification Approaches

Many Candidate Reactors Would Be Available to Demonstrate the Methods of Nuclear Archaeology



NRX, Canada



MZFR, Germany

The Way Forward

Verified Declarations of Fissile-Material Stocks and Production

Fissile material declarations can offer a basic (first) step towards increased transparency for a nuclear weapon program

Information release can be sequenced

Declarations would initially be unverified (and unverifiable)

Needed: common categories and criteria (and regular updates)

2010 NPT Review Final Document has many Action Items to that effect
Important milestones could be achieved by the time of the 2015 NPT Review Conference

The Way Forward

Verified Declarations of Fissile-Material Stocks and Production

Most former production facilities are already shut-down or in various stages of decommissioning

To retain the option of verifying declarations:
Need to preserve production reactors (and depleted uranium tails)
in a condition that will permit nuclear archaeology

Some precedents and many opportunities for cooperative initiatives

Start with joint (bilateral) demonstration exercises
to establish the methods and tools for all types of relevant plants



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